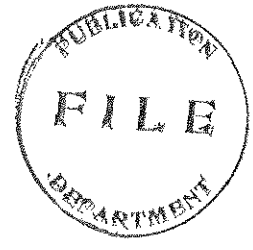
OPERATION AND MAINTENANCE MANUAL
FOR
LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
EMERGENCY DIESEL GENERATORS
COLT/FMED ORDER NO. 11-700000

VOLUME II



Data and Specifications Subject To Change Without Notice.

Colt Industries

Fairbanks Morse
Engine Division

REVISED 5/8/81

LIMERICK GENERATING STATIONS UNITS 1 AND 2
PHILADELPHIA ELECTRIC COMPANY

OPERATION AND MAINTENANCE MANUAL

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Chapter 6
Static Exciter-Voltage Regulator

11908310

LIMERICK GENERATING STATION UNITS 1 AND 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
PURCHASE ORDER NO. LX 239585
FAIRBANKS MORSE ORDER NO. 11-700000

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APPROVED
Rev. 3 [illegible]
CHIEF ENGINEER CONTROL
APPR'D
Rev. 2 [illegible]
QUALITY CONTROL

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	/ /
DR. BY R. Keyes	8/24/72
CHK'D. BY RCallo D	8/24/72
MAT'L	
CAST.	MAT'L
APPV. MACH.	ENGR.
WELD.	
SHEET SIZE B	DWG. NO. 11 908 310
	SHEET 1 OF 1

TITLE: EXCITER REGULATOR

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .060 0.0 ± .030 0.00 ± .010

REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	10703	3-1-77	DWG 11870828 AS REVD.	RE RTC
3	10242	3-25-77	ETE 2ND SENTENCE	RK RTC
2	10204	2-18-77	ETE MAN. VOLTS (2) ACR AUTO VOLTS	RK RTC
1	PC1598	11-19-76	RELEASE	
1			TO SHOW GEN. CAPACITOR & CONTROL SYSTEMS TEST	YHW RTC
1			NOT TO BE PLOTTED ON 2 MIL MYLAR	RTC
5	11014	8-7-78	ADD REV. STATE TO SUBTITLE SPEC (2)	RK

STATIC EXCITER VOLTAGE REGULATOR IN ACCORDANCE WITH BECHTEL SPECIFICATION 8031-M-71, REV. 3, PARA. 4.7, AND OTHER SECTIONS OF SPEC. 8031 MENTIONED BELOW. THE EXCITER REGULATOR WILL CONTROL A 3562 KVA, 4160V, 3 PHASE WYE CONNECTED GENERATOR WITH A 125V NOM. FIELD. GENERATOR CHARACTERISTICS, SATURATION CURVES AND FIELD EXCITATION REQUIREMENTS WILL BE SUPPLIED BY COLT.

EXCITER REGULATOR EQUIPMENT WILL BE MOUNTED BY OTHERS; HEAT REJECTION DATA AND APPROXIMATE WEIGHT SHOULD BE GIVEN ON OUTLINE DRAWINGS OF MAJOR COMPONENTS. CONTROL SWITCHES WILL BE FURNISHED BY OTHERS, TO AGREE WITH SWITCH CONTACT ARRANGEMENT SPECIFIED BY THE EXCITER REGULATOR MANUFACTURER.

CONTROL REQUIREMENTS:

1. AUTOMATIC FIELD FLASHING. SIGNAL TO FLASH FIELD WILL BE SUPPLIED BY OTHERS; ONE N.O. CONTACT WILL CLOSE AT AND REMAIN CLOSED ABOVE 75% OF SYNCHRONOUS SPEED. TERMINATION OF FLASHING SHALL BE CAUSED BY EQUIPMENT IN THE EXCITER REGULATOR.

2. THERE WILL BE NO GENERATOR FIELD CONTACTOR. EXCITATION SYSTEM IS TO COAST DOWN WITH SPEED; 60 HZ TO 0 HZ ABOUT 2 MINUTES, STRAIGHT LINE.

3. MOMENTARY OPERATION OF AN N.O. SWITCH CONTACT FURNISHED BY OTHERS SHALL STOP EXCITATION. THE EXCITATION MUST CEASE EVEN WITH AN INTERNAL FAILURE WITHIN THE EXCITATION CONTROL SYSTEM. EXCITATION MUST NOT BE POSSIBLE UNTIL AN N.O. CONTACT, FURNISHED BY OTHERS, IS OPERATED MOMENTARILY. THERE SHALL BE ONE FORM C CONTACT, WIRED TO TERMINALS, FOR EXTERNAL INDICATION WHEN THE EXCITER IS SHUT DOWN BY THIS DEVICE.

4. AUTOMATIC VOLTAGE ADJUSTMENT SHALL BE A MOTOR (125 VDC) OPERATED RHEOSTAT. ~~LIMIT SWITCHES WIRED TO TERMINALS SHALL INDICATE THE LIMITS OF RHEOSTAT TRAVEL.~~ LIMIT SWITCHES SHALL BE PROVIDED ALSO FOR AUTOMATIC RUN-BACK OF THE RHEOSTAT TO A PRE-SELECTED POSITION BY CONTROL CONTACTS FURNISHED BY OTHERS.

(2) ~~MANUAL VOLTAGE CONTROL SHALL TRACK THE AUTOMATIC CONTROL FOR "BUMPLESS" TRANSFER UNDER LOAD.~~

PERFORMANCE SHALL MEET THE REQUIREMENTS OF PARAS. 3.2e, 3.3 & 3.4.

EQUIPMENT MUST WITHSTAND SEISMIC DISTURBANCES AS DESCRIBED IN SPEC. 8031-G-14, REV. 4. COLT ~~WILL HAVE ANALYTICAL ANALYSIS OF THE EXCITER REGULATOR COMPONENTS MOUNTED IN THE CONTROL PANEL BY OTHERS~~ WILL HAVE A SHAKER TABLE TEST PERFORMED BY A QUALIFIED LABORATORY, WITH THE EXCITER REGULATOR MOUNTED IN THE GENERATOR CONTROL PANEL (FURNISHED ~~BY OTHERS~~) ~~FOR THIS PURPOSE~~. SEE SPEC. 8031-G-4 REV. 6 SHOP PAINTING, (PANEL COLOR WHITE); 8031-G-5 REV. 2 DOCUMENTATION, AND 8031-G12, REV. 9, FOR TERMINAL BOARDS, NAMEPLATES, EQUIPMENT, ETC. (NOTE: INTERNAL WIRING OF ELECTRONIC COMPONENTS MAY BE MANUFACTURER'S STANDARD; WIRING BETWEEN MAJOR COMPONENTS AND TO TERMINAL BOARDS SHALL BE AS SPECIFIED).

QUALITY ASSURANCE DOCUMENTATION IS TO BE FOLLOWED ACCORDING TO COLT DRAWING 11870828 REV. 2. (9)

Coltec Internal Memo

Date: 1-31-96

To: Ted Stevenson

From: Steve Gebhardt

Subject: Order 11735214, P/N 9119808100

9119808100

We recently returned three pieces of printed circuit board 9119808100. The reason for the return was because of the part number difference. The part number which they sent in was 9119808102. I have been advised by Terry Gaines that this is the replacement (commercial grade) part number for 9119808100. Form, fit and function is not affected.

Please change your paperwork accordingly to reflect this part number change by Basler. I have instructed Basler to return these 3 circuit boards.

Steve

CC: G. Ferriter

BASLER ELECTRIC

FAX

Date: 01/31/96

Number of pages including cover sheet: 1

Terry Gaines

To: Steve Gebhardt

Phone:

Fax phone: 608-364-8463

CC:

From: Terry Gaines

Phone: 618-654-2341 ext 778

Fax phone: 618-654-2351

REMARKS: ☐ Urgent ☒ For your review ☐ Reply ASAP ☐ Please comment

Steve,

Thanks for your reply, to my fax of 1/29/96. On P.O. # 450589 I will enter the order today with a standard part number for the MOC. It should be 90 723 00 100.

On P.O # 442927 concerning the returned circuit boards we changed the part number to allow us to use standard commercial parts in our manufacturing of these boards. As you may recall, I sent you correspondence on this P. O. back in May of 1995 on this order as well as P.O. numbers 444045-A and 654233-A. I've attached a copy for your reference. Please advise me as to what we need to do to ship these boards back t o Coltec.

I have made the internal change to reflect your part number change. Return parts to Coltec.

Steve G

1-31-96

Coltec Industries
701 Lawton Ave
Beloit WI 53511

May,31, 1995

Attn : Steve Gebhardt

Sub: Coltec P.O.Numbers 442927-A, 444045-A and 654233-A

Re : My correspondence of May 5, 1995.

Steve,

In my referenced letter, I informed Coltec of the situation concerning the subject purchase orders. In order for us to process these orders we will need you to change the wording on the purchase orders. As they are now written, the orders include our part numbers that were originally supplied. These numbers are parts of static exciters we helped qualify to some nuclear standards.

We will need to change the part numbers to reflect the fact that we will be supplying commercial grade parts. Unfortunately, we can no longer supply these part numbers with their original parts. Since these assemblies will be new part numbers we need the following changes to your P.O.'s:

1) Some means to allow us to change the part number of each assembly. The part should be ordered as " provide a new circuit board that is equivalent to the existing part number". Basler Electric could supply a certificate of form ,fit and function. for this new part number and reference the old part number.
2) On repair orders, the clause for any replacements being manufactured as identical to the original equipment must be removed.

With the above changes we can accept the purchase orders and manufacture a commercial grade part.

INSTRUCTION MANUAL

FOR

STATIC EXCITER-REGULATOR

Model: SER-CB

Part Number: 9 1198 00 100

Basler Electric
Highland, Illinois

Publication Number: 9 1198 00 990
Date: April, 1977
Revision B: May, 1988

WARNING

To prevent personal injury or equipment damage, only qualified technicians/operators should install, operate, or service this device.

CAUTION

Meggers and high potential test equipment should be used with extreme care. Incorrect use of such equipment could damage components contained in the device.

CONFIDENTIAL INFORMATION

OF BASLER ELECTRIC COMPANY, HIGHLAND, IL. IT IS LOANED FOR CONFIDENTIAL USE. SUBJECT TO RETURN ON REQUEST, AND WITH THE MUTUAL UNDERSTANDING THAT IT WILL NOT BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF BASLER ELECTRIC COMPANY.

It is not the intention of this manual to cover all details and variations in equipment, nor does it provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, call Basler Electric Company, Highland, Illinois.

REV	ECA
A	9751
B	10103

SECTION 1

INTRODUCTION

1.1 GENERAL

The Model SER-CB family of static exciter-regulators are of the high performance type featuring extremely fast response to changes in generator loading and high forcing capabilities that are required when large inductive motor loads are applied to the generator. This exciter-regulator system senses any change in the generator output voltage and supplies dc current to the revolving field of the generator as required to maintain the generator terminal voltage. Provisions are included for underfrequency or volts/hertz operation, manual control of the exciter output, automatic flashing of the generator field, reactive droop compensation for parallel operation, three phase voltage sensing, and exciter shutdown (ac Contactor).

1.2 SPECIFICATIONS

Generator Rating	3562 kVA
Generator Voltage	4160 Volts
Generator Frequency	60 Hertz
Power Factor (rated)	0.8
Generator Field Current:	
Rated Load	124 A
No Load	74 A
Forcing	300 A
Generator Field Resistance	0.829 ohms (100°)
Generator Field Voltage:	
Rated Load	105 V.
No Load	49 V.
Forcing	251 V.
Exciter Power Potential Transformer:	
Rating	39 kVA
Primary Voltage	4160 V (Wye)
Secondary Voltage	160 V (Delta)
Exciter Power Current Transformer:	
Primary Current	494 A
Secondary Current	60 A
Secondary Voltage	200 V Max.
Sensing Voltage	120/208/240/416/ 480 V. (3 phase)
Burden	10 VA per phase
Voltage Regulation	±1/2%
Voltage Adjust Range	±10%
Underfrequency Protection Pickup	50 Hertz See Figure 2-2
Ambient Temperature	-40°C to +50°C

1.3 EQUIPMENT CONFIGURATION

a. Power Potential Transformer (PPT) - Three phase voltage transformer with primary rated at generator voltage and secondary voltage matched to exciter power bridge requirements. Primary winding wye connected during manufacture and the secondary is arranged for delta connection with the power current transformer.

b. Power Current Transformer (PCT) - Current transformer with integral primary winding matched to generator voltage and current rating. Secondary winding is arranged to be compatible with the secondary of the PPT.

c. Power Bridge - Module consisting of 3 power thyristors (SCR's) and 3 diodes where the ac supply from the PPT and the PCT is rectified to dc for supply to the generator field. Surge Suppression and a free-wheeling (or flyback) diode are also part of the power bridge. This 3 phase, full-wave bridge utilizing an SCR-Diode combination per phase and is called a semi-converter.

d. Voltage Regulator and Firing Circuits - Module accepts generator terminal voltage sensed value and controls the firing pulse to the SCR gating circuit. The timing of the firing circuit pulse to the SCR gate controls the dc voltage output level to the exciter. Generator field current is determined by the exciter output voltage and controls the generator terminal voltage.

e. Automatic Flashing Contactor - External dc battery voltage is applied through the flashing contactor to the generator field to provide approximately 50% of the generator terminal voltage to the exciter during start-up.

f. Exciter Shutdown Contactor - A method of immediate removal of ac supply voltage is provided by this contactor inserted between the PPT and the PCT secondary windings and the power bridge.

SECTION 2

PRINCIPLES OF OPERATION
(Refer to Figure 2-1)

2.1 OPERATING POWER

Generator terminal voltage and current is applied to terminals P1, P2, and P3 of the power chassis and the exciter-regulator internal power supply. Secondary windings of the PPT and the PCTs are arranged so that the voltage across the voltage and current transformer winding are additive to provide a net voltage to the power supply and power bridge circuits. This method of connection ensures an ac voltage to the power bridge and power supply even during extreme load transient changes. The internal power supply provides operating power for the voltage regulator, firing circuits, manual control, start circuits, and flashing power control circuit.

2.2 FLASHING AND SHUTDOWN CONTACTOR

With the system at rest, there is no ac supply voltage to the power bridge or power supply and thus, there can be no output. During the starting cycle of the engine-generator-exciter system, a control relay contact closure in the engine control signals the proper time for the external battery power to be applied, through the flashing contactor, to the generator field. This external battery power actuates relay K1 on the power chassis and connects the PPT and PCTs to the power bridge. Relay K2 actuates and supplies battery power to the generator field which causes generator terminal ac voltage to appear. When the terminal ac voltage reaches a proper value, the flashing is removed and the exciter assumes command.

2.3 SEMI-CONVERTER POWER BRIDGE

Ac supply voltage from the PPT and PCTs secondary windings is converted to dc voltage in the power bridge. The level of the dc voltage is determined by the conduction time of the SCR's. The greater the conduction time, the higher the dc voltage applied to the generator field. Gating pulses from the firing circuits determine when and how long the SCR's in the power bridge will conduct. In Manual Control mode, the firing circuit controls the gating pulse to the SCR's.

2.4 VOLTAGE SENSING

a. Sensing voltage signals representative of the generator terminal voltage are applied to terminals E1, E2, and E3 of the control chassis TS2 terminal strip. This signal voltage is normalized and rectified to a dc signal level. A reactive droop signal

from the paralleling transformer may also be included in this processing.

b. This normalized and rectified dc signal is compared with an internal reference voltage in the regulator and an error signal is developed. This error signal in the reference determines whether more or less field voltage output from the power bridge is required. An appropriate adjustment in the control signal from the regulator to the firing circuits results in a change in the timing of the SCR gating pulses.

2.5 AUTOMATIC VOLTAGE REGULATOR

The automatic voltage regulator senses any change in generator output voltage and converts these changes to a dc error voltage. In the AUTO mode position, the dc error voltage is connected to the base control firing circuit where it modifies the gating pulse output originally set by the manual control MOC2. When the automatic voltage regulator determines that the generator output voltage is low, the in-crease in error voltage causes the firing circuit to fire earlier. The firing time of the gating pulse output increases and the power bridge SCR's pass more voltage to the exciter field circuit. When the generator output voltage is too high, the decrease in error voltage causes the firing circuit to fire later in the cycle, and the SCR's in the power bridge conduct less. The current supplied to the generator field is reduced and the generator output voltage is reduced. In the automatic mode, the regulated generator output voltage level is determined by the setting of the rheostat in MOC-1.

2.6 BASE CONTROL FIRING CIRCUIT (MANUAL CONTROL)

a. The base control firing circuit accepts inputs from the exciter-regulator power supply which are representative of the generator field voltage. After normalizing, these signals are compared with a reference signal determined by the setting of the manual control rheostat (MOC-2). The base control firing circuit determines when the gating pulses to the power bridge SCR's should be applied. A change in the MOC-2 setting to increase terminal voltage causes these gating pulses to move forward in the cycle resulting in increased output dc voltage. This increased dc output voltage causes an increase in generator field current and a corresponding increase in generator terminal voltage. In the Manual mode, the base control firing circuits operate independently of the automatic voltage regulator and the sensing voltage signals and the exciter system does not regulate the ac system voltage.

b. In the Automatic mode, the base control firing circuit pulses are modified by the regulator action to provide automatic regulation of the generator terminal ac voltage. Regulated voltage level may be adjusted by changing the setting of the automatic voltage adjust rheostat (MOC-1).

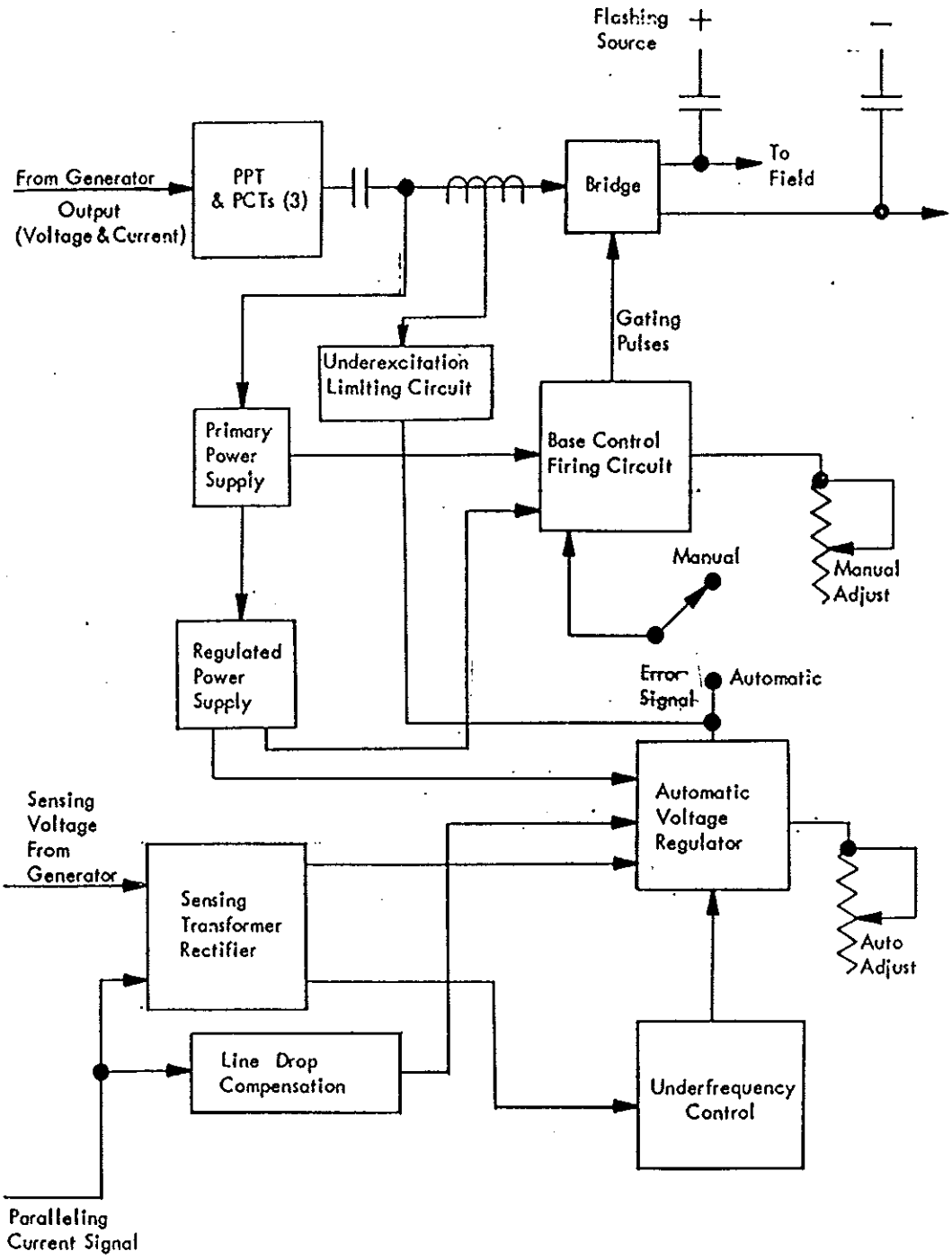
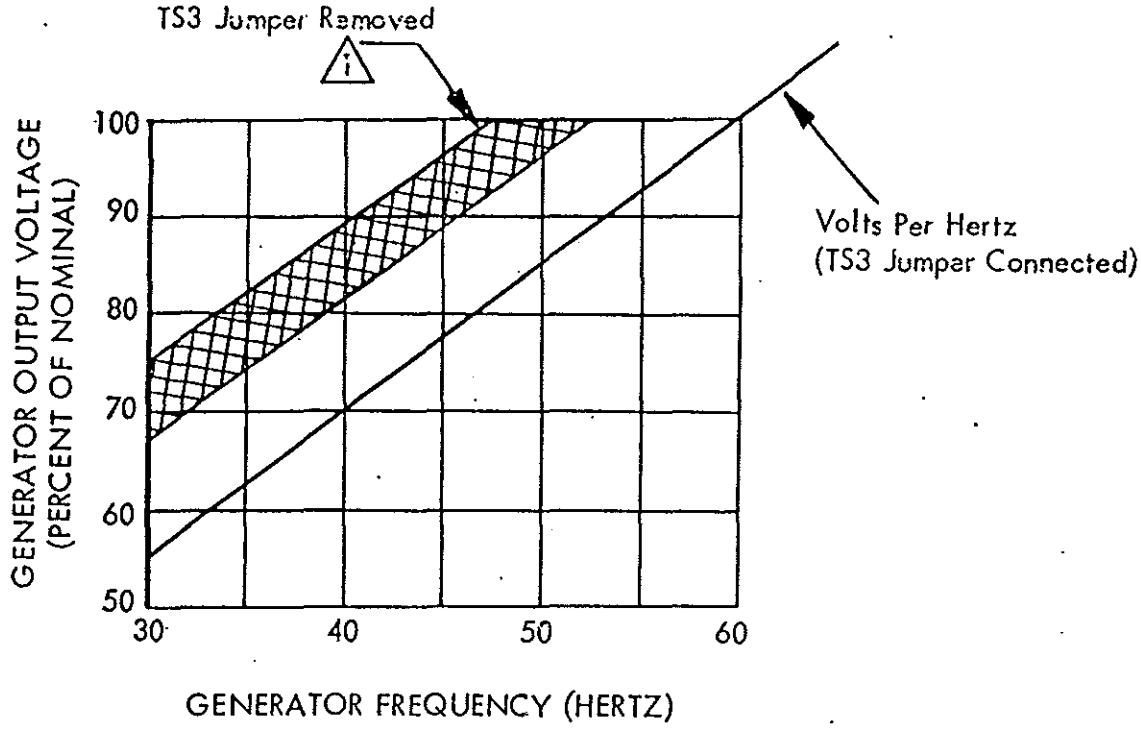


Figure 2-1. Functional Block Diagram



1 The spread in the envelope (crosshatched area) is a function of operational temperature and normal tolerance of components.

Figure 2-2. Voltage-Frequency Characteristic Curve

2.7 UNDERFREQUENCY CONTROL

The underfrequency control circuit reduces the generator output voltage in proportion to speed. The percentage of generator output voltage that will be obtained for specified generator speeds is shown in Figure 2-2. The vertical axis of the graph represents generator output voltage. The underfrequency pickup point is factory set at 50 Hertz. Volts per hertz operation is also possible (see paragraph 3.3b).

2.8 UNDEREXCITATION LIMITING CIRCUIT

a. This feature prevents generator field excitation from becoming excessively low. If underexcitation becomes excessive, the generator can slip poles and pull out of synchronization.

b. The circuit uses three inputs to produce an output which overrides the voltage regulator (VR) output if the excitation is not sufficient. These inputs are as follows:

(1) A reference signal from R31 which establishes the desired per cent of no load field current (threshold) below which underexcitation limiting will begin. To express it in another way, R31 establishes minimum no-load field current (refer to Figure 5-1).

(2) A feedback voltage from R21 representing actual field current.

(3) A signal from R25 that is representative of the system kW load. This signal establishes the minimum field current under various conditions of kW load. The slope of the curve in Figure 5-1 is determined by the setting of R25.

c. When the actual field current (input 2, above) becomes less than the desired field current for a specific kW load (inputs 1 and 3, above), the output from the limiting circuit overrides the VR output which results in increased excitation that is sufficient to overcome the established threshold value.

d. Adjustment of the underexcitation limiting circuit (R31, R25, R21, R20, R4) is explained in paragraph 5.5.

2.9. LINE DROP COMPENSATION

CAUTION

This circuit is intended for use only in Unit (Single-Generator/Non-Parallel) Operation. If Parallel Operation is used, R44 must be set to the fully CCW position position (zero voltage rise).

This circuit compensates for decreases in line voltage due to long transmission distances. This is accomplished by raising generator voltage as output current increases. The amount of voltage rise at full rated line current is adjustable between 0 and +10% of nominal line voltage using R44. When in the fully counter-clockwise (CCW) position, the circuit provides no voltage rise. The exciter-regulator is shipped with R44 set fully CCW. When set fully clockwise (CW), a 10% rise of voltage is obtained when 5 A of current flows in the external paralleling current transformer.

SECTION 3

CONTROLS, INDICATORS, AND JUMPERS
(Refer to Figure 3-1)

3.1 CONTROLS

a. MANUAL Adjust Control (MOC-2)

This motor operated rheostat control establishes the generator output voltage level when the Exciter Mode switch is in the MANUAL position. The control is positioned by operating the external Manual RAISE - OFF - LOWER - TRACK switch (refer to paragraph 2.6).

b. AUTO Adjust Control (MOC-1)

This motor operated rheostat control provides adjustment of the generator output voltage level when the Exciter Mode switch is in the AUTO position. The control is positioned by operating the external Auto RAISE - OFF - LOWER switch.

c. Voltage Range Adjust (R16)

This adjustment is provided to vary the limits of the Auto Adjust Control (MOC-1). Normally R16 is set to provide the Auto Adjust Control (MOC-1) with an adjustment range of ±10% of rated generator output.

d. Stability Circuit Adjustment, STAB. ADJ. (R20)

This potentiometer adjustment provides stable operation by controlling the amount of feedback that is applied to the automatic voltage regulator. Normally, it is factory set at mid-range. The extreme clockwise (CW) position generally assures good stability, but tends to slow the response time of the generator. If rotated counterclockwise (CCW), the exciter-regulator response time becomes faster. If the control is rotated too far CCW, the generator voltage may oscillate (hunt). The control should then be rotated CW to well above the point where oscillating occurred. The system voltage stability is most critical at no load. When setting the control for the fastest possible voltage response having good generator stability, an oscilloscope or a voltage recorder may be used to observe the generator output voltage.

e. Exciter Mode MANUAL/AUTO Switch (Externally mounted)

When this switch is in the MANUAL position, the potentiometer in MOC-2 controls the output to the exciter field by controlling the firing circuit. Generator output is not automatically regulated and will vary with generator loading. When the switch is in the AUTO position, the rheostat in MOC-1 sets the generator output voltage level and precise regulation is provided.

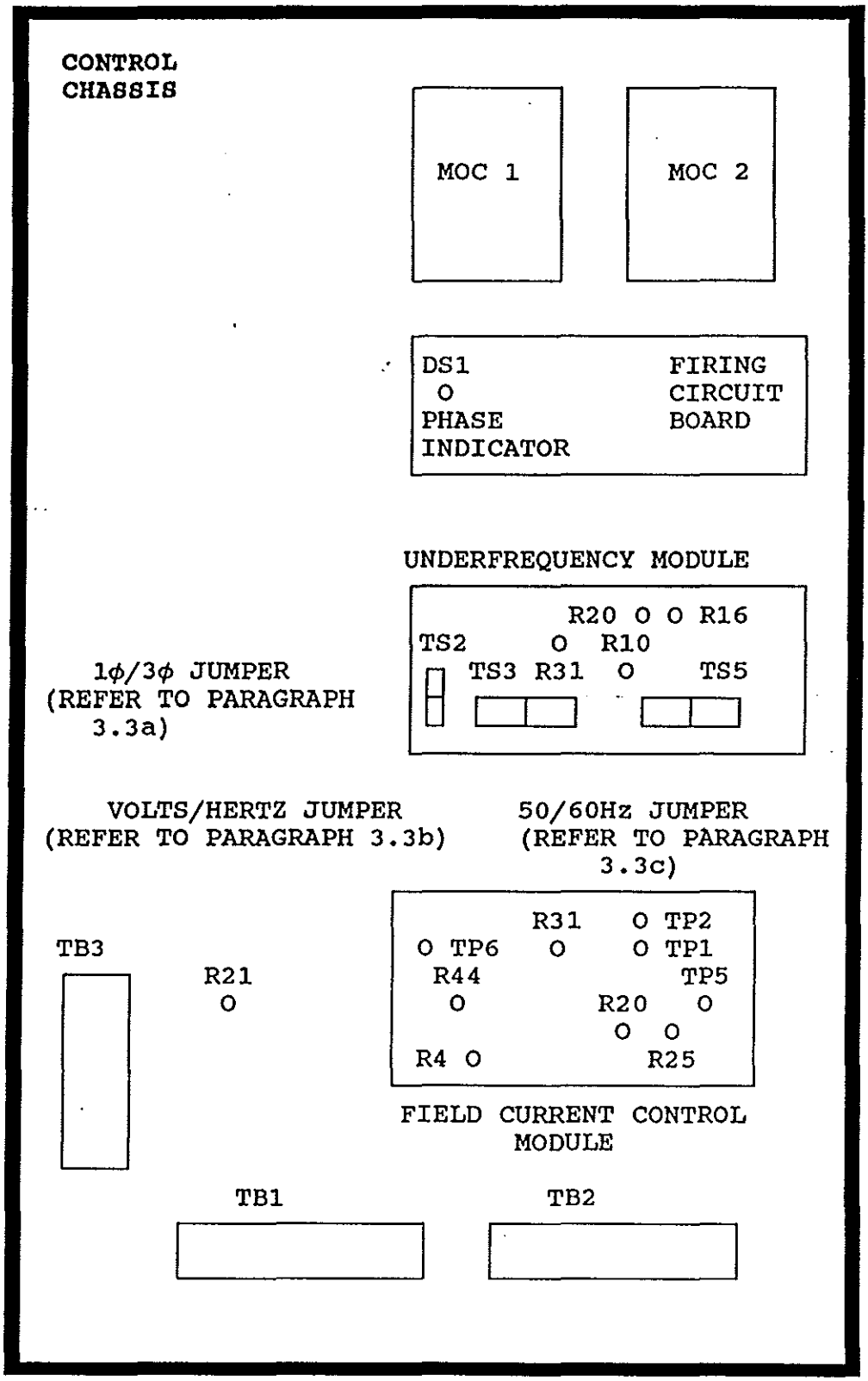


Figure 3-1. Component Location

f. Reset/Stop Contact

An external contact closure from the customer's control system is required to initiate starting up of the exciter-regulator system. This contact causes K1 to actuate and connect the PPT and PCTs to the power bridge. Relay K2 also actuates and provides flashing power to the generator field when a contact is closed between terminals 10 and FL.

g. Rectifier Assembly Transfer Switch

This switch is located on the lower left portion of the power chassis. It permits selection of either Rectifier "A" or Rectifier "B". A center OFF position disables both rectifiers.

CAUTION

Do not operate the Rectifier Assembly Transfer Switch with power applied to the system.

3.2 INDICATORS

a. Reverse Phase Indicator DS1

Reverse phase indicator DS1 is located on the firing circuit printed circuit board. It illuminates if power applied to terminals P1, P2, and P3 is other than A, B, and C phase rotation. IF IT ILLUMINATES, REMOVE POWER AND REVERSE ANY TWO OF THE POWER LEADS. The light does not respond to incorrect phasing between the sensing voltage and the CT input connections.

b. Diode Failure Indicator

A 125 Vdc bulb should be connected across terminals 53 and 54 on TB21. This light will illuminate upon failure of a diode or SCR in any phase of the in-service rectifier assembly.

c. Nullmeter

This meter is used to ensure a smooth transition between modes of operation, particularly when changing from Automatic to Manual and is used as follows:

(1) When changing from Manual to Automatic mode, adjust the AUTO Adjust Control (MOC-1) until the Nullmeter reads zero. At that time, the transfer from MANUAL to AUTO mode can be made with minimum disturbance to the system.

(2) When changing from Automatic to Manual mode, adjust the MANUAL Adjust Control (MOC-2) until the Nullmeter reads zero. At that time, the transfer from AUTO to MANUAL mode can be made with minimum disturbance to the system.

3.3 JUMPER CONNECTIONS

a. Single Phase/Three Phase Jumper

If single phase sensing is used, install a jumper between terminals 1 and 2 of TS2 on the 9 1120 07 102 PC board. When three phase sensing is used, a jumper is not installed between terminals 1 and 2; this is the normal operating configuration.

b. Volts/Hertz Jumper

(1) When no jumper is installed between TS3-1 and TS3-2 on the 9 1120 07 102 PC Board, the underfrequency circuits will assume control when the generator frequency is approximately 50 hertz; this is the normal operating configuration. See Figure 2-2.

(2) If a direct volts/hertz generator output is desired, install a jumper between TS3-1 and TS3-2 on the 9 1120 07 102 PC Board. If the generator voltage range observed when adjusting MOC-1 is higher than desired, reduce it by readjusting R10 (on 60 Hz systems). With 50 Hz systems, readjust R31 on the underfrequency module if necessary.

c. 50 Hz/60 Hz Jumper

When the system is operated at 50 Hz, connect the jumper to TS5, terminal 1 (50 Hz). If operating at 60 Hz, connect it to TS5, terminal 2 (60 Hz).

SECTION 4

INSTALLATION

4.1 MOUNTING

The exciter MUST be vertically mounted to obtain maximum convection cooling. The unit must be located in an area where the ambient temperature does not exceed the environmental specifications provided in Section 1.

4.2 INTERCONNECTION

CAUTION

Meggers and high potential test equipment must not be used. Incorrect use of such equipment can destroy the semiconductor devices in the Exciter-Regulator.

a. Power Connection Phasing

Phase rotation must be A, B, C at terminals P1, P2, and P3, respectively.

b. Sensing Input

This system employs three-phase sensing. Connection between the generator output and the control chassis is made via a transformer which steps the voltage down to 120 volts. For precise regulation, the sensing leads should be connected as close as possible to the point where regulation is desired. The regulator cannot correct for cable or bus voltage drops that may occur at points other than where the sensing leads are connected. Sensing leads should not be used to provide power to any equipment other than low burden metering devices.

c. Field Power (Terminal F+, F-, P, PC, N and NC)

Polarities must be observed when making connections to the generator field flashing source and the flashing control circuit source. The F+ terminal must be connected to the positive generator field terminal and the F- must be connected to the negative generator field terminal. The positive lead from the flashing battery must be connected to terminal P on the Power chassis; the negative battery lead must be connected to the terminal N. The positive battery lead for

the flashing control circuit must be connected to terminal PC on the Power Chassis; the battery negative must be connected to terminal NC.

CAUTION

The exciter dc output (terminals F+ and F-) must never be opened during operation. To do so will produce inductive arcing that might destroy the generator field and/or the bridge rectifiers. Never place a voltage shutdown switch in series or in parallel with the generator field.

SECTION 5

OPERATION

5.1 GENERAL

Before placing the system into operation, check that all interconnections have been made in accordance with interconnection diagram, Figure 8-1.

5.2 FIELD FLASHING

Make certain that the flashing voltage battery can deliver 125 Vdc to the P and N terminals on the Power Chassis. During the starting sequence, relays on the Power Chassis apply flashing power to the generator field. A diode in the circuit prevents inductive arcing when the flashing power circuit is opened and also prevents feedback into the power source during flashing.

5.3 SINGLE GENERATOR/NON-PARALLEL OPERATION

a. AUTO Mode

(1) With the generator off, operate the external MOC-1 and MOC-2 control handles to LOWER until the lower limit is reached.

(2) Set MODE Selector Switch to AUTO.

(3) Position the Rectifier Transfer Switch to either "Rectifier A" or "Rectifier B".

(4) Ensure jumper connections (paragraph 3.3) are correctly made.

(5) Ensure that the UNIT/PARALLEL switch is in UNIT.

(6) Ensure that R44 (Line Drop Compensation Adjust) is set fully CCW.

(7) Close the "Center" contacts for about 60 seconds with the OPERATE/CENTER switch or relay. This causes the automatic voltage adjust MOC-1 to return to the center of its range.

(8) Start generator prime mover. When the generator attains normal speed, a speed switch closes the RESET contact. The generator output voltage should be between 80 and 100%. If not, operate the STOP contact, and consult Table 6-1. Since resistor R2 is rated for intermittent operation, flashing intervals should not exceed 10 seconds to avoid

overheating. If generator fails to build up to 80 to 100% of nominal in 10 seconds, energize the STOP contact and determine the cause of the failure.

(9) While monitoring the generator output voltage, operate the MOC-1 control until the correct output voltage is reached.

(10) Apply the load to the generator and verify that voltage regulation is within ±1/2%. If it is not within these limits, refer to Section 6.

(9) Alternately remove and apply the load to determine if the generator voltage is stable. If it is not stable, adjust the STAB. ADJ. Control (R20) on the underfrequency module for maximum generator voltage stability.

> **NOTE**
>
> Unstable governors may contribute to generator voltage instability.

b. MANUAL Mode

(1) Remove the load from the generator.

(2) Operate the MANUAL MOC-2 until the Nullmeter reads zero.

(3) Place the MODE switch to MANUAL.

5.4 LINE DROP COMPENSATION CALIBRATION

(1) Bring generator up to rated speed and nominal terminal voltage.

(2) Apply full kW load at rated power factor.

(3) Slowly adjust LD COMP potentiometer R44 clockwise (CW) until the generator terminal voltage is back to nominal.

> **CAUTION**
>
> This circuit is intended for use only in Unit (Single-Generator/Non-Parallel) Operation. If Parallel Operation is used, R44 must be set to the fully CCW position position (zero voltage rise).

5.5 UNDER EXCITATION CIRCUITS

a. Initial Adjustments.

(1) With the prime mover at rest and no power applied to the system, locate the Minimum Excitation Adjust Potentiometer (R31) and adjust fully counter-clockwise (CCW)

(2) Adjust the kW Taper Potentiometer (R25) fully counter-clockwise (CCW).

(3) Start the prime mover and bring the generator up to rated speed and nominal generator terminal voltage. Calibration is performed with an unloaded generator.

> **CAUTION**
>
> Do not close the generator breaker.

(4) Connect a dc voltmeter to test points TP6 (positive lead) and TP1 (negative lead). The voltmeter should indicate approximately 5 Vdc. If the voltage is not 5 Vdc, adjust the Field Signal Calibrate Resistor (R21).

b. Calibration.

(1) Connect a dc voltmeter to test points TP2 (positive lead) and TP1 (negative lead).

(2) While observing the generator voltmeter, slowly adjust the Minimum Excitation Adjust Potentiometer (R31) clockwise (CW) to a point where the generator voltage just starts to increase.

(3) Record the voltage at TP2. This dc voltage corresponds to the no load excitation current.

EXAMPLE: Voltmeter indicates -2 Vdc.

(4) Determine what minimum excitation current is required and express it as a percentage of no load excitation current.

EXAMPLE: Assume for a particular generator, no load current is 100 A. Determine that 50 A is to be the minimum excitation, therefore:

$$\frac{\text{Minimum}}{\text{Maximum}} \text{ or } \frac{50\text{ A}}{100\text{ A}} = 50\%$$

(5) Calculate the dc voltage required at TP2 as follows: Multiply the dc voltage recorded in step (3) above, by the percentage determined in step (4) above.

EXAMPLE: -2 Vdc X 50% = -1 Vdc

(6) Slowly adjust the Minimum Excitation Adjust Potentiometer (R31) counter-clockwise (CCW) until the dc voltage at TP2 equals the voltage determined in step (5) above.

EXAMPLE: Set R31 so that the voltage at TP2 measures -1 Vdc.

c. kW Sensing (for kW Load Taper of Minimum Excitation Limit).

(1) Connect a dc voltmeter to test point TP5 (positive lead) and TP1 (negative lead).

(2) Adjust R20, kW BAL potentiometer, until TP5 measures 0 Vdc.

(3) Apply full kW load to the generator.

(4) Adjust R4, kW CAL potentiometer, until TP5 measures -5 Vdc.

(5) Remove all load from the generator.

(6) Connect a dc voltmeter to test point TP4 (positive lead) and TP1 (negative lead).

(7) Adjust R25, kW TAPER potentiometer, clockwise (CW) until TP4 measures the dc voltage corresponding to the desired percentage increase of no-load field current (minimum excitation limit). See chart and graph in Figure 5-1.

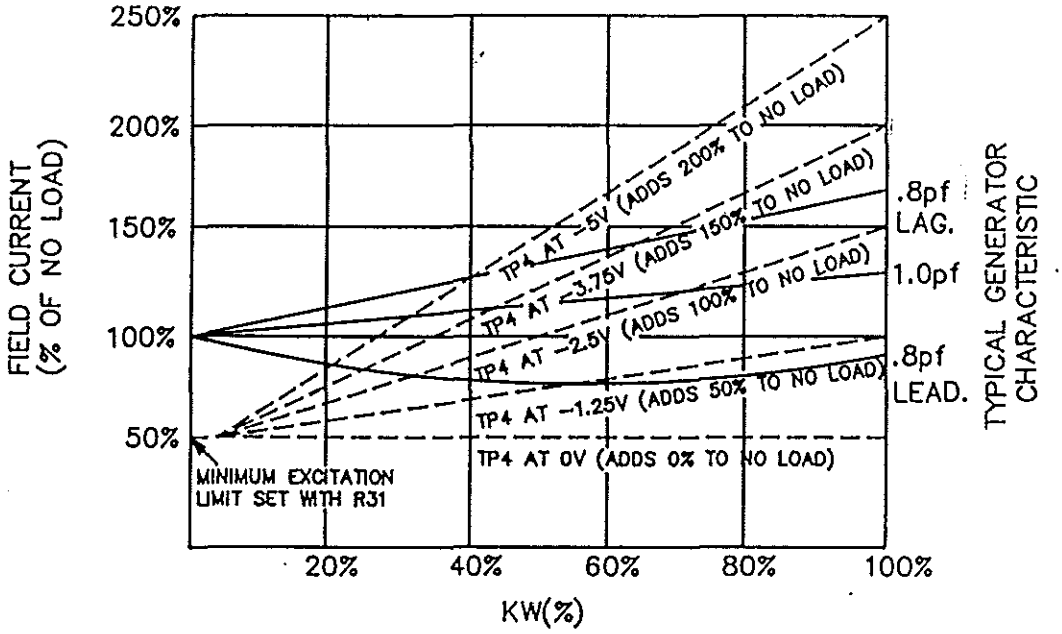
5.6 PARALLEL OPERATION

(1) Place the UNIT/PARALLEL switch to PARALLEL position.

(2) Position R44 to the fully CCW position.

(3) Parallel operation should only be accomplished after satisfactory operation in the UNIT (single generator/non-parallel) mode has been demonstrated. Paralleling should be accomplished using standard techniques.

TP4 Voltage	Results in the following percentage addition of no load field current at full load
0 V	0
-1.25V	+50%
-2.50V	+100%
-3.75V	+150%
-5.00V	+200%



D119-011

NOTE:
Typical generator characteristic curves are not drawn to scale. They do illustrate the importance of setting the KW TAPER, R25, potentiometer low enough to achieve a desired operating power factor. Conversely, it can be used to restrict leading power factor operation.

The kW Sensing circuitry only functions with the minimum excitation circuit. It does not affect the maximum excitation limit.

If kW Sensing (taper) is not a desirable feature, simply adjust R25 to the full counterclockwise (CCW) position or TP4 at 0 Vdc.

Figure 5-1. Field Current vs. TP4 Voltage.

SECTION 6

MAINTENANCE INSTRUCTIONS

6.1 PREVENTIVE MAINTENANCE

Accumulated dust should be periodically removed from the heat sinks and transformers using a compressed air source equipped with a moisture trap.

6.2 CORRECTIVE MAINTENANCE

Due to a protective transparent conformal coating, repair on the printed circuit board is difficult and should be attempted only by qualified personnel. The printed circuit board is easily removed, and replacing the whole board is recommended. Replacement printed circuit boards are available from Basler Electric.

6.3 WARRANTY AND REPAIR SERVICE

The shunt exciter is warranted against defective material and workmanship for 18 months from the date of initial shipment. A complete service center at the Basler Electric factory in Highland, Illinois is geared to provide prompt turn around on parts, warranty, and non-warranty repairs.

6.4 TROUBLESHOOTING

The more common generator system malfunctions and the appropriate repair procedures are listed in Table 6-1.

Table 6-1. Troubleshooting Chart
(Refer to Figure 3-1)

SYMPTOM	PROBABLE CAUSE	SOLUTION
Voltage does not build up to rated value.	Reversed flashing voltage. No flashing voltage.	Check dc Power Source.
	Improper Phase rotation of A, B, & C or no voltage to input power terminals P1, P2, & P3.	Verify wiring.
	No connection F+,F-	Verify wiring.

Table 6-1. Troubleshooting Chart - Continued

SYMPTOM	PROBABLE CAUSE	SOLUTION
Voltage does not build up to rated value (continued).	Generator output shorted or heavily loaded.	Remove load or short.
	Defective exciter-regulator.	Check SCR-Diode Bridge, fuses, faulty PC Board, flashing diode, relay, or replace regulator.
	Generator speed to low.	Bring up to rated speed.
Voltage builds up until relay actuates, then decays.	Rheostat in MOC-1 open.	Repair open connections or replace rheostat.
	In Manual, MOC-2 set too low.	Raise setting.
	No firing pulse applied to SCR gates.	Replace PC Board.
	No power to bridge.	Check power fuses.
Voltage high uncontrollable with voltage adjust rheostat.	No sensing voltage, terminal E1, E2, and E3.	Verify wiring.
		Verify sensing PT fuses.
	Faulty PC Board.	Replace.
	SCR's or diodes faulty.	Replace SCR's or diodes.
Poor regulation.	Single unit operation with UNIT/PARALLEL switch in PARALLEL position.	Place switch into UNIT position.
	Output voltmeter at different location than regulator sensing (voltage drop in leads or wrong phase.	Reconnect voltmeter to same point as regulator sensing.

Table 6-1. Troubleshooting Chart - Continued

SYMPTOM	PROBABLE CAUSE	SOLUTION
Poor regulation - continued	Waveform distortion due to harmonic content in generator voltage. Regulator senses average voltage; meter may be indicating RMS values.	(1) Check for saturated load. (2) Consult generator manufacturer.
	Unbalanced load with three phase sensing.	(Unit averages all three phase voltages.
	Generator not up to rated speed.	Bring up to rated speed.
	Mode Switch set to MANUAL.	Set switch to AUTO.
	Faulty PC Board.	Replace.
	Faulty SCR's, diodes, or fuse.	Replace.
Poor voltage stability.	Frequency unstable.	Consult governor manual.
	R20 (Stab. Adj.) improperly adjusted.	Adjust to proper setting.
	Faulty PC Board.	Replace.
Voltage high, controllable with AUTO voltage adjust rheostat.	Open fuse in one of the sensing phases.	Replace fuse.
	Improper connection of sensing leads to generator.	Verify wiring.
	Voltmeter inaccurate.	Verify operation or replace.
	Faulty PC Board.	Replace.
	Range Adj. R16 misadjusted.	Adjust R16

Table 6-1. Troubleshooting Chart - Continued

SYMPTOM	PROBABLE CAUSE	SOLUTION
Voltage low, controllable with AUTO voltage adjust rheostat.	Generator not up to rated speed.	Increase speed.
	Improper connections of sensing leads to generator.	Verify wiring.
	Voltmeter inaccurate.	Verify operation or replace.
	TS2 jumper installed with three phase sensing.	Remove jumper.
	Range Adj. R16 misadjusted.	Adjust R16
Voltage recovery slow with load change.	R20 adjusted improperly.	Adjust STAB. ADJ. R20.
	Slow prime mover response.	Consult generator manufacturer.
No Reactive Droop during paralleling.	UNIT/PARALLEL Switch (or contact) in UNIT position.	Verify wiring and /or switch position.
	Tap on R3 set to minimum droop position.	Adjust R3 to obtain required droop.
	CT does not supply the required 3 to 5A secondary current.	Check wiring.
	Improper CT phasing.	Correct wiring.

SECTION 7

REPLACEMENT PARTS

7.1 GENERAL

Table 7-1 lists components of the SER-CB shunt exciter that have maintenance significance. Indented items are component parts of the previous item. In addition to indicating part numbers and descriptions, include the basic assembly part number.

Table 7-1. Replacement Parts

DESCRIPTION	REFERENCE DESIGNATOR	BASLER PART NUMBER
Transformer	CT1,CT2,CT3	BE 15488 001
Transformer	PT4	BE 15487 001
Power Chassis Assembly	-----	9 1198 01 100
Surge Suppressor	VR1,VR2	10741B
Contactor, ac, Shutdown	K1	10742B
Transformer	T11,T12	BE 15827 001
Transformer	T13,T14,T15, T17	BE 14174 001
Contactor, Field Flashing	K2	10309B
Relay, Voltage, 28V, 4PDT	K3	06112B
Fuse, 10A, 250V	F1	04599A
Resistor, 2.5 ohms, 810 W	R2	10311B
Resistor, 10 ohms, 5%, 100 W	R3,R4,R5,R6	08487B
Resistor, 50 ohms, 5%, 100 W	R7,R8,R9	08682B
Resistor, 50 ohms, 5%, 100 W, variable	R1,R16,R17	03146B
Diode Bridge Assembly	CR19-CR24	9 1121 15 100
Capacitor, 1.0µf, 2000 Vdc	C1	10298B

Table 7-1. Replacement Parts - Continued

DESCRIPTION	REFERENCE DESIGNATOR	BASLER PART NUMBER
Capacitor, 2.0µf, 2000 Vdc	C2,C3,C4	10300B
Capacitor, 0.5µf, 2000 Vdc	C5,C6,C7	10299B
Control Chassis Assembly	------	9 1198 02 100
P.C. Board, Firing Circuit	FCB	9 1120 06 100
P.C. Board, Auto Volt. Reg. & Underfrequency	UFB	9 1120 07 102
Control, Motor Operated, (MOC 2505), 500 ohms	MOC1	9 0723 00 121
Control, Motor Operated, (MOC 2107, 5000 ohms	MOC2	9 0723 00 112
P.C. Board, Field Current Control Module	FCCM	9 1198 08 100
Capacitor, 25 µf, 370 Vac	C1,C2,C3	04875B
Capacitor, 10 µf, 370 Vac	C4,C5,C6	07759B
Resistor, 1 ohm, 100 W	R1	02662B
Resistor, 200 ohm, 25 W	R21	03132B
Choke	L1,L2,L3	BE 13033 001
Choke	L4	BE 08794 001
Transformer	T5	BE 13034 001
Transformer	T3,T4	BE 15349 001
Transformer	T7,T8	BE 11686 001
Transformer	T2	BE 15062 001
Transformer	T6	BE 15492 001

9119808100 3

Table 7-1. Replacement Parts - Continued

DESCRIPTION	REFERENCE DESIGNATOR	BASLER PART NUMBER
Rectifier Chassis Assembly	-----	9 1198 03 100
Fuse, 400 A, 700 Vac	F2-F4	10310A
Diode Heat Sink Assembly	CR1-CR4	9 1157 04 100
Surge Suppressor	VR3,VR4	10741B
SCR Heat Sink Assembly	SCR1-SCR3	9 1120 03 101
Transformer	T5-T7	BE 15362 002
Diode Heat Sink Assembly	CR5-CR7	9 1121 10 100

SECTION 8

DRAWINGS

8.1 GENERAL

The following drawings are included to facilitate installation, operation, and maintenance of the SER-CB exciter-regulator.

Figure 8-1 Interconnection Diagram (D9 1198 00 960)
Figure 8-2 Power Chassis Schematic (C9 1198 01 910)
Figure 8-3 Control Chassis Schematic (D9 1198 02 910)
Figure 8-4 Rectifier Chassis "A" & "B" Schematics (C9 1198 03 910)

Additional manuals included:

Motor Operated Control (A9 0723 00 99X)
Motor Operated Control (A9 0723 00 99Y)

INSTRUCTION MANUAL

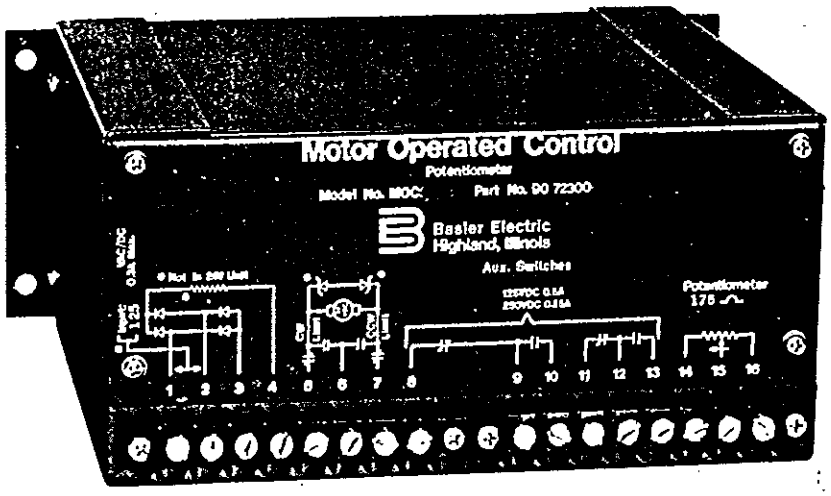
FOR

MOTOR OPERATED POTENTIOMETER

(RETURN-TO-CENTER)

MODELS: MOC25XX through MOC28XX

Part Number: 9 0723 00 XXX



Basler Electric
Highland, Illinois

Publication Number: 9 0723 00 99Y
Date: February, 1971
Revision C: November, 1986

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WARNING

To prevent personal injury or equipment damage, only qualified technicians/operators should install, operate or service this device.

CAUTION

Meggers and high potential test equipment must not be used. Incorrect use of such equipment could damage components contained in the device.

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REV	ECA
A	7257
B	7517
C	8382

SECTION 1.0

GENERAL INFORMATION

1.1 GENERAL

The Basler MOC2XXX Motor Operated Controls are electromechanical assemblies containing a motor-driven potentiometer and the necessary limit switches required to assure that the control will return to its center position, regardless of the start position. MOC2XXX are available for AC or DC operation at 24, 32, 48, or 120 volts (see Table 1-1).

1.2 SPECIFICATIONS

MOTOR DRIVE POWER:

Voltage (±10%)	24, 32, 48, or 120 volts
Current	0.3 Amperes, Maximum
Frequency	DC to 450 Hz
Phase	Single

OUTPUT FUNCTIONS: Linear wire wound potentiometers are available in two basic types: Normal resolution rated at 10 watts and precise resolution rated at two watts. (See Table 1-1).

OVERVOLTAGE: Withstands 135%, maximum, for five minutes.

LIMIT SWITCHES: Motor drive and auxiliary NC-NO limit switches are factory set within 2% ±0.5% of element electrical rotational limit. Auxiliary switches can be readjusted by user.

AUXILIARY LIMIT SWITCH RATINGS: 5 A at 250 Vdc, 0.5 A at 125 Vdc, and 0.25 A at 250 Vdc, resistive.

DYNAMIC BRAKING: Motor shaft stops within 10 msec after shorting of motor terminals.

OPERATING TEMPERATURE RANGE: -40°F (-40°C) to +158°F (+70°C)

SHOCK: Withstands 15G's in all planes.

MAXIMUM WEIGHT: 9 pounds, net; 10.5 pounds, shipping.

1.3 MOC CHARACTERISTICS

Model numbers for this series of MOC consist of prefix MOC2 followed by three additional digits. The first of these digits establishes input operating voltage. The second and third digits establish characteristics of the output control element. Table 1-1 presents the characteristics of available motor operated controls. MOC2503, for example, has a 120 volt input and a 175 ohm, 10 watt potentiometer.

Table 1-1. MOC Characteristics

MODEL PREFIX	MOTOR DRIVE VOLTAGE(1)	CONTROL ELEMENT OUTPUT CHARACTERISTICS				
Sample Model Number MOC2	5	03				
		Control Element	Resistance (Ohms)	Maximum Power (watts)	Adjustment Rate (ohms/sec)	Traverse Time (Sec)
MOC2	5 - 120V	02 - Potentiometer(2)	175 ± 10%	10	8.15	21.5 (Normal)
	6 - 48V	03 - Potentiometer(2)	250 ± 5%	2	3.13	80 (Precise)
	7 - 32V	04 - Potentiometer(2)	250 ± 10%	10	11.7	21.5
	8 - 24V	05 - Potentiometer(2)	500 ± 5%	2	6.26	80
		07 - Potentiometer(2)	5000 ± 10%	10	232	21.5
		08 - Potentiometer(2)	50 ± 5%	2	0.63	80
		99 - Special(3) (Specify resistance and power rating)				

(1) Input Operating Voltage, ±10% , DC or 9C (to 450 Hz)
(2) Potentiometers have linear taper
(3) Special linear wire wound controls are available in the normal resolution, 10 watt rating from 1 to 25,000 ohms and in the precise resolution, 2 watt rating from 10 to 10,000 ohms.

SECTION 2.0

OPERATION

2.1 GENERAL

a. The operation of the Motor Operated Control is as follows: AC or DC drive motor voltage is applied between terminals 1 and 2. It is rectified (if AC) and decreased by use of series resistors to 24 Vdc, at terminals 3 (negative) and 4 (positive). This 24 Vdc is applied to the motor through a network of external switches which allow the 24 Vdc to be applied to the motor in either polarity. The polarity will be determined remotely by the need to raise or lower the voltage, frequency, or some other function.

b. When the "RAISE" or "LOWER" switch is closed (and the external DPDT switch is in "OPERATE", the voltage is applied to the motor, causing it to turn. If the "RAISE" switch is closed, the 24 Vdc is applied in such a polarity to cause the motor to turn in the clockwise direction, moving the sliding contact towards terminal 14, to increase the voltage, frequency, or other function in the application. The motor will continue to turn in the CW direction until the "RAISE" switch is released or until the CW limit switch is activated thereby causing the 24 Vdc to be removed from the motor.

c. If the "LOWER" switch is closed, the 24 Vdc is applied in the opposite polarity to cause the motor to turn in the counterclockwise direction. This will move the sliding contact towards terminal 16 to decrease the voltage, frequency, or other function. The motor will continue to turn in the CCW direction until either the "LOWER" switch is opened or the CCW limit switch is activated. This will remove the 24 Vdc from the motor.

d. Dynamic braking is obtained by shorting terminals 5 and 7. The switch (available as an accessory item) provides this shorting action and the dynamic braking feature.

e. Terminals 8 through 13 are connected to internal switches to provide the centering feature.

2.2 ACCESSORY ITEMS

The following items are available from Basler Electric Company as an accessory for the MOC2 Motor Operated Controls:

Switch and dial plate sets:

P/N 9 1748 05 106	Switch, Rotary, 3-position, momentary action, with pistol grip handle; with black dial plate.
P/N 9 1748 05 107	Switch, Rotary, 3-position, momentary action, with pistol grip handle; with "LOWER-OFF-RAISE", "FREQUENCY CONTROL" dial plate.
P/N 9 1748 05 108	Switch, Rotary, 3-position, momentary action, with pistol grip handle; with "LOWER-OFF-RAISE", "VOLTAGE CONTROL" dial plate.

2.3 DRAWINGS/DIAGRAMS

Figure 2-1 - Outline Drawing

Figure 2-2 - Schematic and Interconnection Diagram

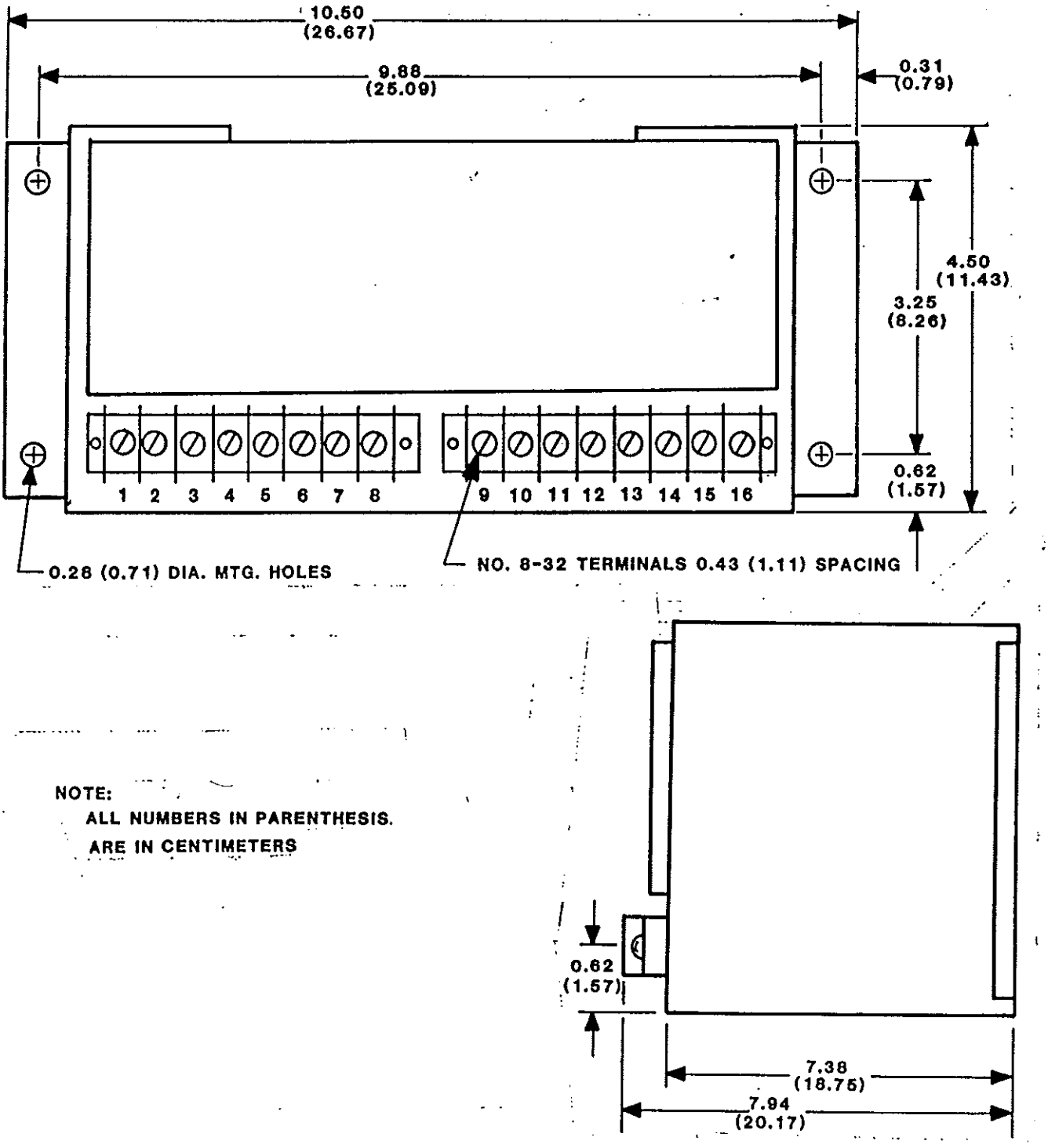


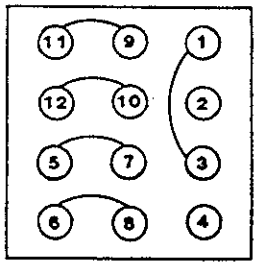
Figure 2-1. Outline Drawing

THE RETURN CENTER CONTACTS (1A, 1B, 2A, 2B) ARE SHOWN AS THEY WOULD APPEAR WHEN THE MOC IS IN THE CENTER POSITION.
WHEN THE MOC IS BELOW THE CENTER POSITION, CONTACTS 1A AND 1B WILL CHANGE STATE. IF THE OPERATE/RESET SWITCH IS SET TO RESET, THE MOC MOTOR WILL RUN CLOCKWISE (CW) RETURNING THE MOC TO CENTER POSITION.
WHEN THE MOC IS ABOVE THE CENTER POSITION, CONTACTS 2A AND 2B WILL CHANGE STATE. IF THE OPERATE/RESET SWITCH IS SET TO RESET, THE MOC MOTOR WILL RUN COUNTERCLOCKWISE (CCW) RETURNING THE MOC TO CENTER POSITION.

SWITCH
(SEE ACCESSORY DEVICES)

CONTACTS	LOWER	OFF	RAISE
1&2 / 5&6	X		
3&4/11&12			X
7&8 /9&10		X	

INTERNAL JUMPER DIAGRAM



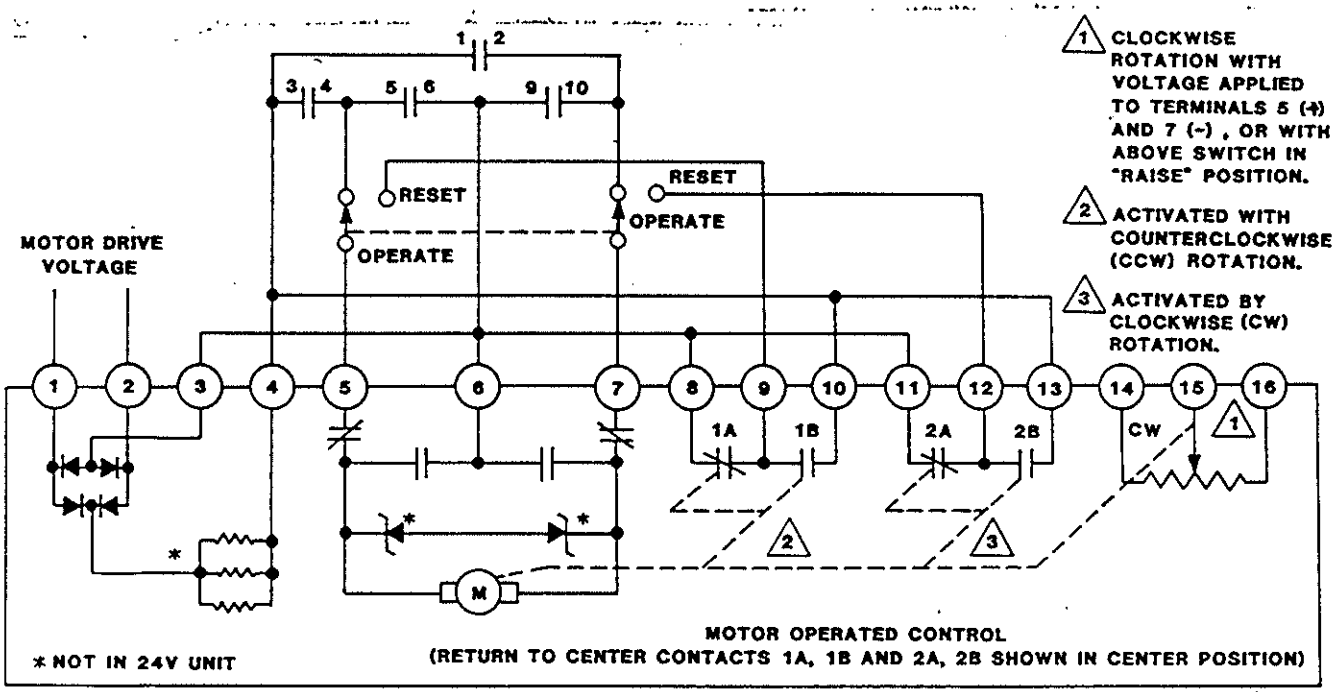
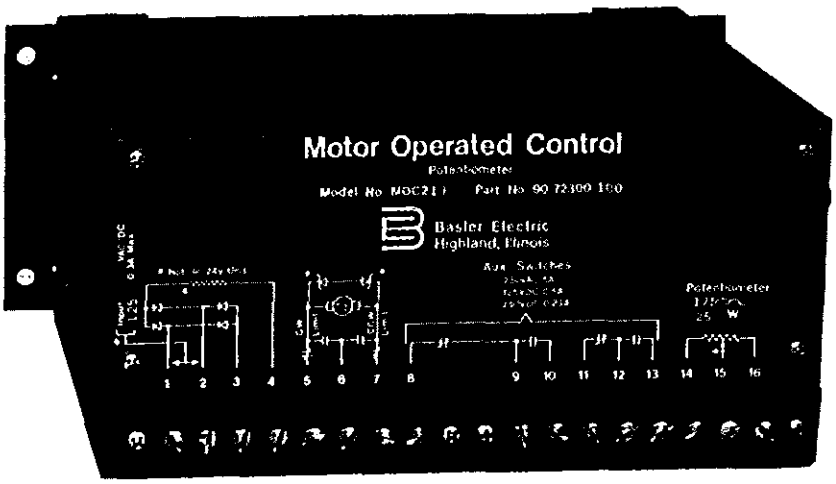


Figure 2-2. Schematic and Interconnection Diagram

INSTRUCTION MANUAL
FOR
MOTOR OPERATED POTENTIOMETER
Models: MOC21XX through MOC24XX and MOC29XX

Part Number: 9 0723 00 XXX



Basler Electric
Highland, Illinois

Publication Number: 9 0723 00 99X
Date: February, 1976
Revision B: November, 1986

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WARNING

To prevent personal injury or equipment damage, only qualified technicians/operators should install, operate or service this device.

CAUTION

Meggers and high potential test equipment should not be used. Incorrect use of such equipment could damage components contained in the regulator.

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REV	ECA
A	7261
B	8383

SECTION 1.0

GENERAL INFORMATION

1.1 GENERAL

The Basler MOC2XXX Motor Operated Control is an electro-mechanical assembly containing a motor-driven variable potentiometer and the limit switches required to provide remote adjustment of resistance or voltage. MOC2XXX Controls are available for AC or DC operation at 24, 32, 48 or 120 volts (see Table 1-1).

1.2 SPECIFICATIONS

MOTOR DRIVE POWER:

Voltage (±10%)	24, 32, 48 or 120 Volts
Current	0.3 Amperes, Maximum
Frequency	DC to 450 Hz
Phase	Single

OUTPUT FUNCTIONS: Linear wire wound potentiometers are available in two basic types: Normal resolution rated at ten watts and Precise resolution rated at two watts (see Table 1).

OVERVOLTAGE: Withstands 135%, maximum, for five minutes.

LIMIT SWITCHES: Motor driven and auxiliary NC-NO limit switches are factory set 2% ±0.5% of element electrical rotational limit. Auxiliary switches can be readjusted by user.

AUXILIARY LIMIT SWITCH RATINGS: 5A at 250 VAC, 0.5A at 125 VDC, and 0.25A at 250 VDC, Resistive.

DYNAMIC BRAKING: Motor shaft stops within 10 msec. after shorting of motor terminals.

OPERATING TEMPERATURE RANGE: -40°F (-40°C) to +158°F (+70°C).

SHOCK: Withstands 15 G's in all planes.

MAXIMUM WEIGHT: 9 pounds, net; 10.5 pounds, shipping.

Model number for this series of MOC consist of prefix MOC2 followed by three additional digits. The first of these digits establishes input operating voltage. The second and third digits establish characteristics of the output control element, Table 1 presents the characteristics of available motor operated controls. MOC2305, for example, has a 32 volt input and a 500 ohm, two watt variable potentiometer.

TABLE 1.1. MOC Characteristics

Model Prefix	Motor Drive Voltage*	CONTROL ELEMENT OUTPUT CHARACTERISTICS				
Sample Model Number						
MOC2	1	03				
		Control Element	Resistance (Ohms)	Maximum Power (watts)	Adjustment Rate (ohms/sec)	Traverse Time (Sec)
MOC2	1 – 120V	02 – Potentiometer**	175 ± 10%	10	8.15	21.5 (Normal)
	2 – 48V	03 – Potentiometer**	250 ± 5%	2	3.13	80 (Precise)
	3 – 32V	04 – Potentiometer**	250 ± 10%	10	11.7	21.5
	4 – 24V	05 – Potentiometer**	500 ± 5%	2	6.26	80
	9 – Special (Specify Voltage)	99 – Special*** (Specify resistance and power rating)				

* Motor Drive Voltage, ± 10%, DC or AC (to 450 Hz)
** Potentiometers have linear taper
*** Special linear wire wound controls are available in the normal resolution, 10 watt rating from 1 to 25,000 ohms and in the precise resolution, 2 watt rating from 10 to 100,000 ohms

SECTION 2.0

OPERATION

2.1 GENERAL

The operation of the Motor Operated Potentiometer is as follows: The input voltage of 24, 32, 48 or 120 volts AC or DC is applied between terminals 1 and 2. It is rectified and decreased, if necessary, by use of series resistors to 24 volts DC, at terminals 3 (negative) and 4 (positive). This 24 volt DC is applied to the motor through network of external switches. This network of switches allows the 24 volts DC to be applied to the motor in either polarity. The polarity is determined by the need to raise or lower the voltage, frequency, or some other function.

When the remote "RAISE" or "LOWER" switch is closed, the voltage is applied to the motor, causing it to turn, thus moving the slider on the variable potentiometer. If the "RAISE" switch is closed, the 24 volts DC is applied in such a polarity to cause the motor and variable Potentiometer to turn in the clockwise direction. The motor will continue to turn in the CW direction until the "RAISE" switch is released or until the CW limit switch is activated causing the 24 volts DC to be removed form the motor.

If the "LOWER" switch is closed, the 24 volts DC is applied in the opposite polarity to cause the motor and variable potentiometer to turn in the counterclockwise direction. The motor will continue to turn in the CW direction until the "LOWER" switch is released or until the CCW limit switch is activated causing the 24 volts DC to be removed from the motor.

Dynamic braking obtained by shorting terminals 5 and 7. A switch is available as an Accessory Device which provides the necessary contact arrangement for the Raise/Lower function and the dynamic breaking feature. Terminals 8, 9 and 10 are connected to internal auxiliary switches for remote use. These switches are set to operate so that when the motor reaches the extreme clockwise limit, contact between terminal 9 and 10 closes and contact between terminal 8 and 9 opens. They can be reset to any position. Terminals 11, 12 and 13 are also connected to an internal auxiliary switch for remote use. These switches are set to operate so that when the motor reaches the extreme counterclockwise limit, contact between terminal 12 and 13 closes and contact between terminal 11 and 12 opens. They can be reset to any position. Terminals 14, 15 and 16 are the connections for the variable potentiometer to be used as the adjusting component. The slider of the potentiometer moves toward terminal 14 when the "RAISE" switch is closed, and toward terminal 16 when the "LOWER" switch is closed.

2.2 ACCESSORY ITEMS

The following items are available from Basler Electric Company as an accessory for the MOC2 Motor Operated Controls:

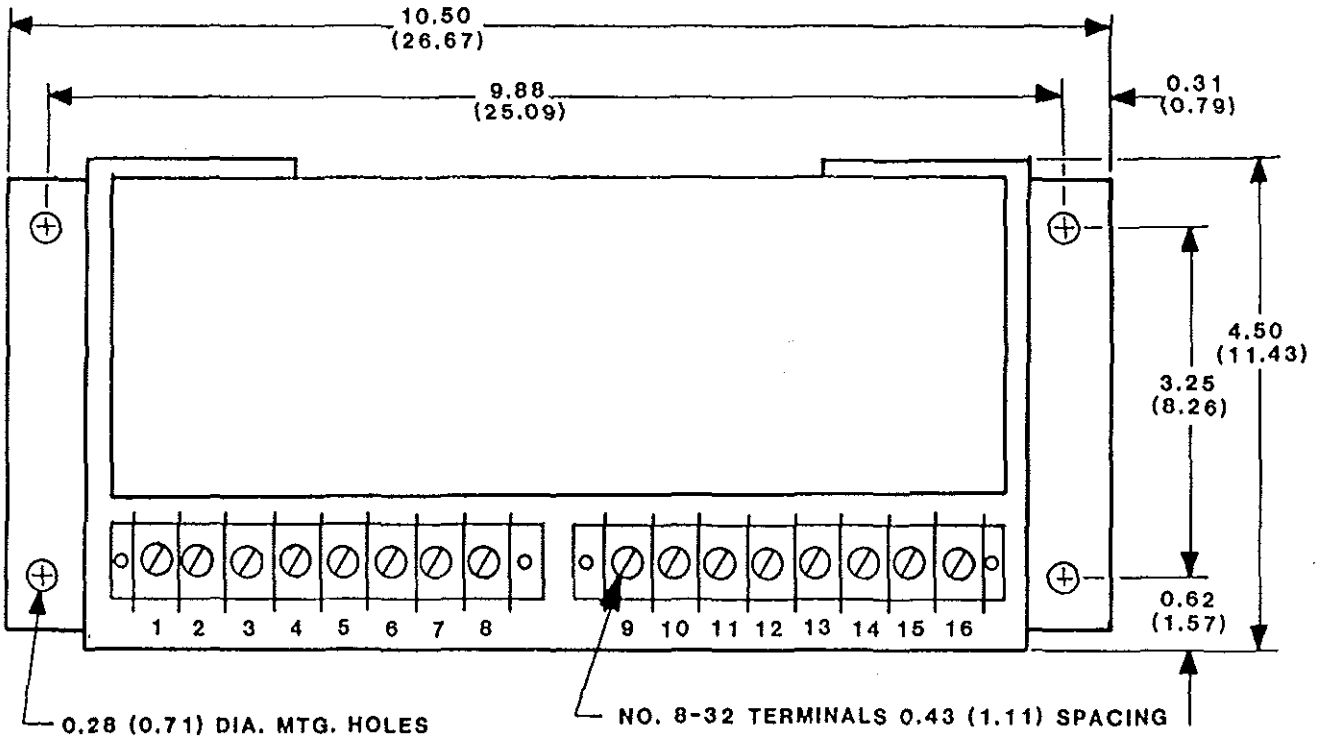
SWITCH AND DIAL PLATE SETS:

P/N 9 1748 05 106	Switch, Rotary, 3-position, momentary action, with pistol grip handle, with blank dial plate.
P/N 9 1748 05 107	Switch, Rotary, 3-position, momentary action, with pistol grip handle; with "LOWER-OFF-RAISE" "FREQUENCY CONTROL" dial plate.
P/N 9 1748 05 108	Switch, Rotary, 3-position, momentary action, with pistol grip handle; with "LOWER-OFF-RAISE" "VOLTAGE CONTROL" dial plate.

2.3 DRAWINGS/DIAGRAMS

Figure 2-1 - Outline Drawing

Figure 2-2 - Schematic and Internconnection Diagram



NOTE:
ALL NUMBERS IN PARENTHESIS ARE IN CENTIMETERS

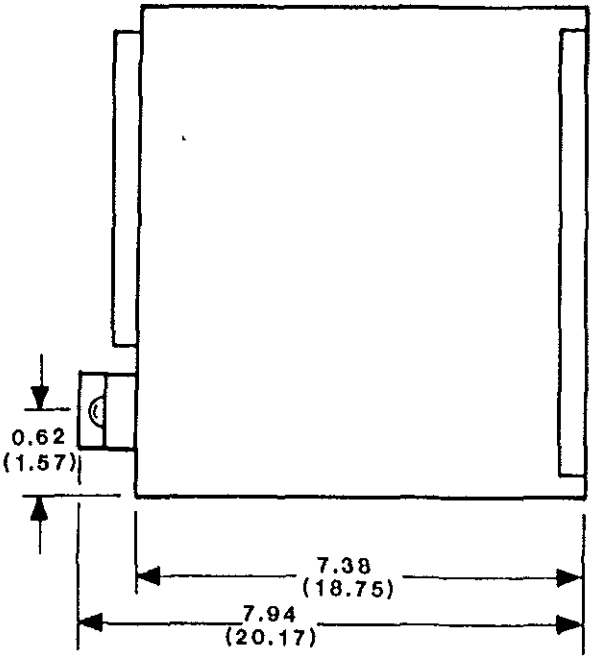


Figure 2-1. Outline Drawing

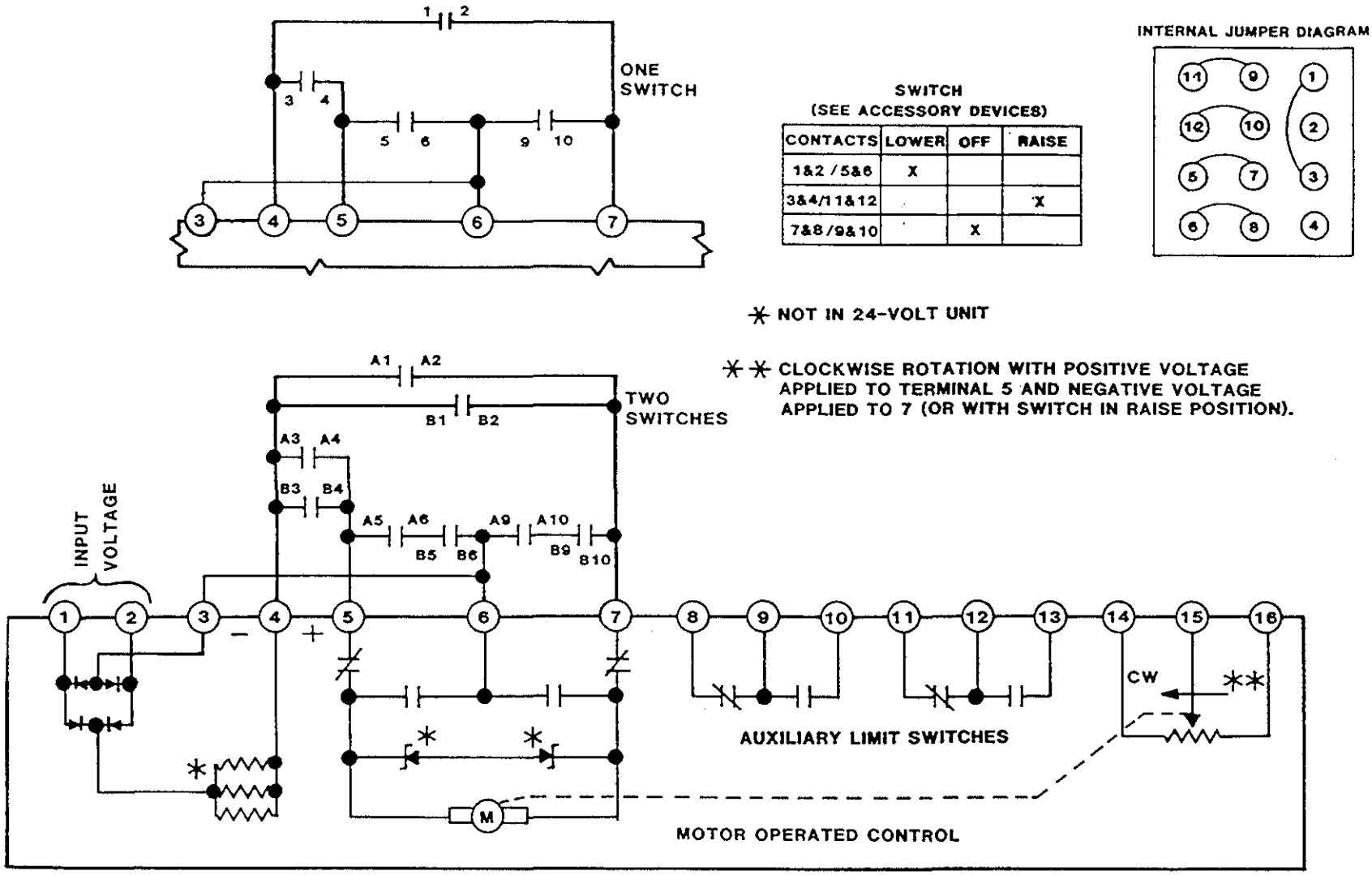


Figure 2-2. Schematic and Interconnection Diagram

Basler Electric
Highland, Illinois

INSTRUCTION MANUAL

Obsolete
6/27/85

Basler Electric
Highland, Illinois

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STATIC EXCITER REGULATOR
MODEL SER-CB
Part Number: 9 1198 00 100

Publication
Number: 9 1198 00 990
Date: April 11, 1977
Change 1: February 16, 1978

SECTION 1.0

INTRODUCTION

1.1 The Model SER-CB family of static exciter regulators are of the high performance type featuring extremely fast response to changes in generator loading and high forcing capabilities that are required when large inductive motor loads are applied to the generator. This exciter regulator system senses any change in the generator output voltage and supplies DC current to the revolving field of the generator as required to maintain the generator terminal voltage. Provisions are included for underfrequency or volts/hertz operation, manual control of the exciter output, automatic flashing of the generator field, reactive droop compensation for parallel operation, three phase voltage sensing, and exciter shutdown (AC Contactor).

1.2 Specifications

Generator Rating	3562 KVA
Generator Voltage	4160 Volts
Generator Frequency	60 Hertz
Power Factor (rated)	0.8
Generator Field Current - rated load	124 amps
no load	74 amps
forcing	300 amps
Generator Field Resistance	0.829 ohms (100°)
Generator Field Voltage - rated load	105 volts
no load	49 volts
forcing	251 volts
Exciter Power Potential Transformer	
Rating	39 KVA
Primary Voltage	4160V (Wye)
Secondary Voltage	160V (Delta)
Exciter Power Current Transformer	
Rating	
Primary Current	494 Amps
Secondary Current	60 Amps
Secondary Voltage	200 Max.
Sensing Voltage	120/208/240/416/480V (3 ph)
Burden	10 Va per phase
Voltage Regulation	±1/2%
Voltage Adjust Range	±10%
Underfrequency Protection Pickup	50 Hertz
	See Figure 2-2
Ambient Temperature	-40°C to +50°C

1.3 Equipment Configuration

Power Potential Transformer (PPT) - Three phase voltage transformer with primary rated at generator voltage and secondary voltage matched to exciter power bridge requirements. Primary winding wye connected during manufacture and the secondary is arranged for delta connection with the power current transformer.

Power Current Transformer (PCT) - Current Transformer with integral primary winding matched to generator voltage and current rating. Secondary winding is arranged to be compatible with the secondary of the PPT.

Power Bridge - Module consisting of 3 power thyristors (SCRs) and 3 diodes where the AC supply from the PPT and PCT is rectified to DC for supply to generator field. Surge Suppression and free wheeling (or flyback) diode are also part of the power bridge. This 3 phase full wave bridge utilizing an SCR-Diode combination per phase is called a semi-converter.

Voltage Regulator and Firing Circuits - Module accepts generator terminal voltage sensed value and controls the firing circuit pulse to the SCR gating circuit. The timing of the firing circuit pulse to the SCR gate controls the DC voltage output level of the exciter. Generator field current is determined by exciter output voltage and controls generator terminal voltage.

Automatic Flashing Contactor - External DC battery voltage is applied through the flashing contactor to the generator field to provide approximately 50% of generator terminal voltage to the exciter during startup.

Exciter Shutdown Contactor - A method of immediate removal of AC supply voltage is provided by this contactor inserted between the PPT and PCT secondary windings and the power bridge.

SECTION 2.0

PRINCIPLES OF OPERATION
(Refer to Figure 2-1)

2.1 Operating Power

Generator Terminal voltage and current is applied to terminals P1, P2 and P3 of the power chassis and the exciter-regulator internal power supply. Secondary windings of the PPT and PCT's are arranged so that the voltage across the voltage and current transformer windings adds to provide a net voltage to the power supply and power bridge circuits. This method of connection insures an AC voltage to the power bridge and power supply even during extreme load transient changes. The internal power supply provides operating power for the voltage regulator, firing circuits, manual control, start circuits, and flashing power control circuit.

2.2 Flashing & Shutdown Contactor

With the system at rest there is no AC supply voltage to the power bridge or power supply and there can be no output. During the starting cycle of the engine-generator-exciter system a control relay contact closure in the engine control signals the proper time for external battery power to be applied, thru the flashing contactor, to the generator field. This external battery power actuates K1 relay on the power chassis and connects the PPT and PCTs to the power bridge. K2 relay actuates and supplies battery power to the generator field which causes generator terminal AC voltage to appear. When the terminal AC voltage reaches a proper value the flashing is removed and the exciter assumes command.

2.3 Semi-Converter Power Bridge

AC supply voltage from the PPT and PCTs secondary windings is converted to DC voltage in the power bridge. The level of DC voltage is determined by the conduction time of the SCRs. The

greater the conduction time the higher the DC voltage applied to the generator field. Gating pulses from the firing circuits determine when and for how long the SCR's in the power bridge will conduct. In the Manual Control mode the base control firing circuit controls the gating pulse to the SCR's.

2.4 Voltage Sensing

Sensing voltage signals representative of generator terminal voltage are applied to terminals E1, E2, E3, of the control module TB2 terminal strip. This signal voltage is normalized and rectified to a DC signal level. A reactive droop signal from the paralleling transformer may also be included in this processing.

This normalized and rectified DC signal is compared with an internal reference voltage in the regulator and an error signal is developed. This error signal in the regulator determines whether more or less field voltage output from the power bridge is required. An appropriate adjustment in the control signal from the regulator to the firing circuits results in a change in the timing of the SCR gating pulses.

2.5 Automatic Voltage Regulator

The automatic voltage regulator senses any change in generator output voltage and converts these changes into a D.C. error voltage. In the AUTO Mode position, the D.C. error voltage is connected to the base control firing circuit where it modifies the gating pulse output originally set by the manual control MOC-2. When the automatic voltage regulator determines that the generator output voltage is low, the increase in error voltage causes the base firing circuit to fire earlier. The firing time of the gating pulse output increases and the power bridge SCR's pass more voltage to the exciter field circuit. When the generator output voltage is too high, the error voltage changes the base firing circuit to fire later in the cycle, and the SCR's in the power bridge conduct less. The current supplied to the generator field is reduced and the generator ouput voltage is reduced. In the automatic mode, the regulated generator output voltage level is determined by the setting of the rheostat in MOC-1.

2.6 Base Control Firing Circuit (Manual Control)

The base control firing circuit accepts inputs from the exciter regulator power supply which are representative of the generator field voltage. After normalizing, these signals are compared with a reference signal determined by the setting of the manual control rheostat (MOC-2). The base control firing circuits determine when the gating pulses to the power bridge SCRs should be applied. A change in MOC-2 setting to increase terminal voltage causes these gating pulses to move forward in the cycle resulting in increased output DC voltage. This increased DC output voltage causes an increase in generator field current and a corresponding increase in generator terminal voltage. In the Manual mode the base control firing circuits operate independently of the regulator and the sensing voltage signals and the exciter system does not regulate the AC system voltage.

In the Automatic mode the base control firing circuit pulses are modified by the regulator action to provide automatic regulation of the generator terminal AC voltage. Regulated voltage level may be adjusted by changing the setting of the automatic voltage adjust rheostat (MOC-1).

2.7 Underfrequency Control

The underfrequency control circuit reduces the generator output voltage in proportion to speed. The percentage of generator output voltage that will be obtained for specified generator speeds is shown in Figure 2-2. The horizontal axis of the graph represents generator output voltage. The underfrequency pickup point is factory set at 50 hertz. Volts per hertz operation is possible (see paragraph 3.3.2).

2.8 Underexcitation Limiting Circuit

This feature, used during the parallel operation of generators, prevents generator field excitation from becoming excessively low. If underexcitation becomes excessive the generator can slip poles and get out of synchronization.

The circuit utilizes three inputs to produce an output which overrides the voltage regulator (VR) output if the excitation is not sufficient. The inputs are:

(1) A reference signal from R31 which establishes the desired per cent of no load field current (threshold) below which underexcitation limiting will begin. To express it in another way, R31 establishes minimum no-load field current (See Figure 2-3).

(2) A feedback voltage from R26 representing actual field current.

(3) A signal from R25, representative of system KW load. This signal establishes the minimum field current under various conditions of KW load. The slope of the curve in Figure 2-3 is determined by the setting of R25.

When the actual field current (input 2 above) becomes less than the desired field current for a specific KW load (inputs 1 and 3), the output from the limiting circuit overrides the VR output, resulting in increased excitation sufficient to overcome the established threshold value.

Adjustment of underexcitation limiting circuit (R31, R25, R21, R20, R4) is explained in paragraph 5.3.1.

2.9 Line Drop Compensation

This circuit compensates for decreases in line voltage due to long transmission distances. This is accomplished by raising generator voltage as output current increases. The amount of voltage rise at full rated line current is adjustable between 0 and +10% of nominal line voltage using R44. When in the fully counter clockwise (CCW) position, the circuit provides no voltage rise. The exciter-regulator is shipped with R44 set fully CCW. When set fully clockwise (CW) a 10% rise of voltage is obtained when 5 amps of current flow in the external paralleling current transformers.

CAUTION

THIS CIRCUIT IS INTENDED FOR USE ONLY IN UNIT (SINGLE GENERATOR/NON-PARALLEL) OPERATION. IF PARALLEL OPERATION IS USED, R44 MUST BE SET TO THE FULLY CCW POSITION (ZERO VOLTAGE RISE).

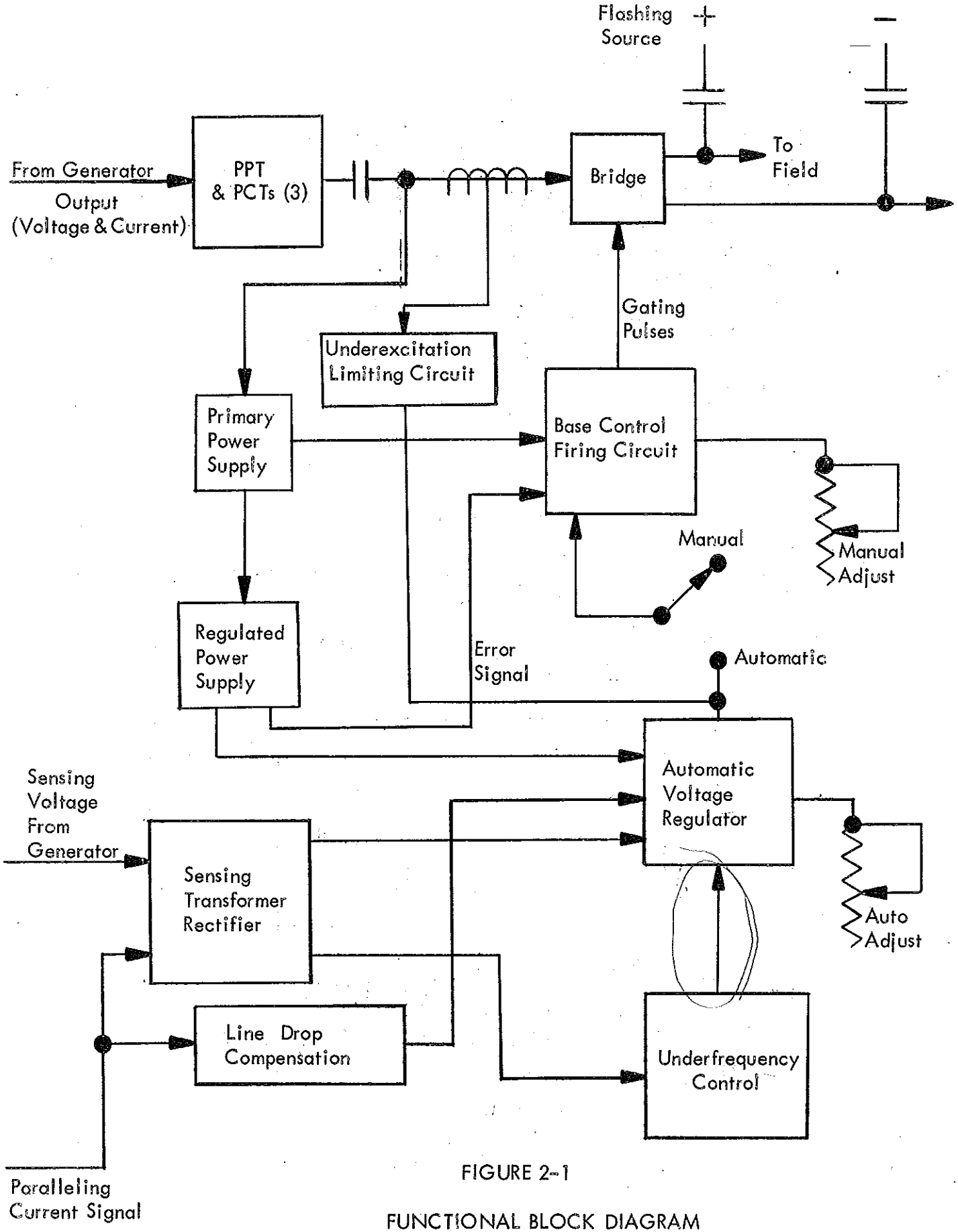
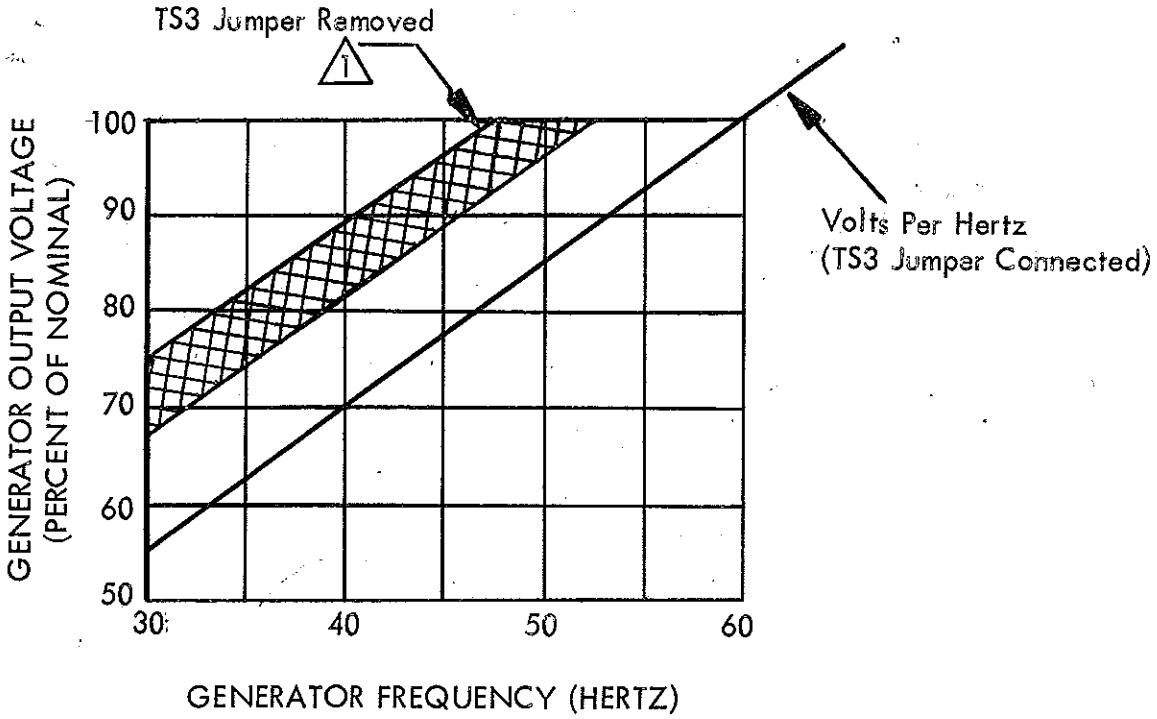


FIGURE 2-1

FUNCTIONAL BLOCK DIAGRAM



1 The spread in the envelope (crosshatched area) is a function of operational temperature and normal tolerance in components.

FIGURE 2-2 VOLTAGE-FREQUENCY CHARACTERISTIC CURVE

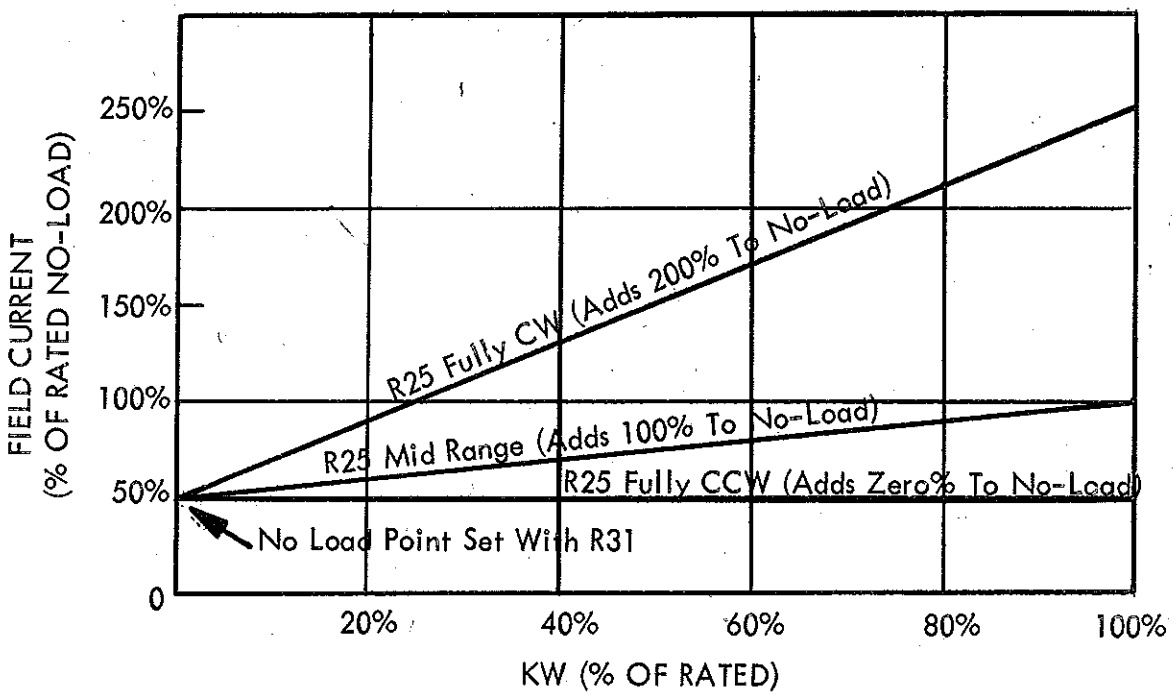


FIGURE 2-3

SECTION 3.0

CONTROLS, INDICATORS AND JUMPER CONNECTIONS
(Refer to Figure 3-1)

3.1 Controls

3.1.1 MANUAL Adjust Control (MOC-2)

This motor operated rheostat control establishes the generator output voltage level when the Exciter Mode switch is in the MANUAL position. The control is positioned operating the external MAN-RAISE-LOWER Control.

3.1.2 AUTO Adjust Control (MOC-1)

This motor operated rheostat control provides adjustment of the generator output voltage level when the Exciter Mode switch is in the AUTO position. The control is positioned by operating the external AUTO-RAISE-LOWER Control.

3.1.3 Stability Circuit Adjustment, STAB ADJ (R20)

This potentiometer adjustment provides stable operation by controlling the amount of feedback that is applied to the automatic voltage regulator. Normally, it is factory set at midrange. The extreme clockwise (CW) position generally assures good stability, but tends to slow the response time of the generator. If rotated counterclockwise (CCW), the exciter regulator response time becomes faster. If the control is rotated too far CCW, the generator voltage may oscillate (hunt). The control should then be rotated CW to well above the point where oscillating occurred. The system voltage stability is most critical at no load. When setting the control for the fastest possible voltage response having good generator stability, an oscilloscope or a voltage recorder may be used to observe the generator output voltage.

3.1.4 Exciter Mode MANUAL/AUTO Switch (Externally mounted)

When this switch is in the MANUAL position, the potentiometer in MOC-2 controls the output to the exciter field controlling the base firing circuit. Generator output is not automatically regulated and will vary with generator loading. When the switch is in the AUTO position the rheostat in MOC-1 sets the generator output voltage level and precise regulation is provided.

3.1.5 Reset - Stop Contact

An external contact closure from the customer's control system is required to initiate starting up of the exciter-regulator system. This contact causes K1 to actuate and connect the PPT and PCTs to the power bridge. Relay K2 also actuates and provides flashing power to the generator field when a contact is closed between terminals 10 and FL.

3.1.6 Rectifier Assembly Transfer Switch

This switch is located on the lower left portion of the power chassis. It permits selection of either Rectifier "A" or Rectifier "B". A center OFF position disables both rectifiers.

WARNING: DO NOT OPERATE THIS SWITCH WITH POWER APPLIED TO THE SYSTEM.

3.2 Indicators

3.2.1 Reverse Phase Indicator DS1

Reverse phase indicator DS1 is located on the firing circuit printed circuit board. It illuminates if power applied to terminals P1, P2 and P3 is other than L1, L2 and L3 phase rotation. IF IT ILLUMINATES, REMOVE POWER AND REVERSE ANY TWO OF THE POWER LEADS. The light does not respond to incorrect phasing between the sensing voltage and CT input connections.

3.2.2 Diode Failure Indicator

A 125 Vdc bulb should be connected across terminals 53 and 54 on TB21. This light will illuminate upon failure of a diode or SCR in any phase of the in-service rectifier assembly.

3.2.3 Null Meter

This meter is used to provide a smooth transition between modes of operation, particularly when changing from AUTOMATIC to MANUAL. The meter is used as follows:

1) When changing from AUTOMATIC to MANUAL mode, adjust the MANUAL Adjust Control (MOC-2) until the NULL meter reads zero. At that time the transfer from AUTO to MANUAL mode can be made with minimum disturbance to the system.

2) When changing from MANUAL to AUTOMATIC mode, adjust the AUTO Adjust Control (MOC-1) until the NULL meter reads zero. At that time the transfer from MANUAL to AUTO mode can be made with minimum disturbance to the system.

3.3 Jumper Connections

3.3.1 Single Phase/Three Phase Jumper

If single phase sensing is used, install a jumper between terminal 1 and 2 of TS2 on the 9 1120 07 101 PC Board. When three phase sensing is used, a jumper is not installed between terminals 1 and 2 of TS2; this is the normal operating configuration.

3.3.2 Volts/Hertz Jumper

When no jumper is installed between TS3-1 and TS3-2 on the 9 1120 07 100 PC Board, the underfrequency circuits will assume control when the generator frequency is approximately 50 hertz; this is the normal operating configuration. See Figure 2-2.

If a direct volts/hertz generator output is desired, install a jumper between TS3-1 on the 9 1120 07 101 PC Board and TS3-2. If the Generator Voltage range observed when adjusting MOC-1 is higher than desired, reduce it by readjusting R10 (on 60 Hz systems). With 50 Hz systems readjust R31 on the underfrequency module if necessary.

3.3.3 50 Hz/60 Hz Jumper

When the system is operated at 50 Hz, connect the jumper to TS5, terminal 1. If operating at 60 Hz, connect it to TS5, terminal 2.

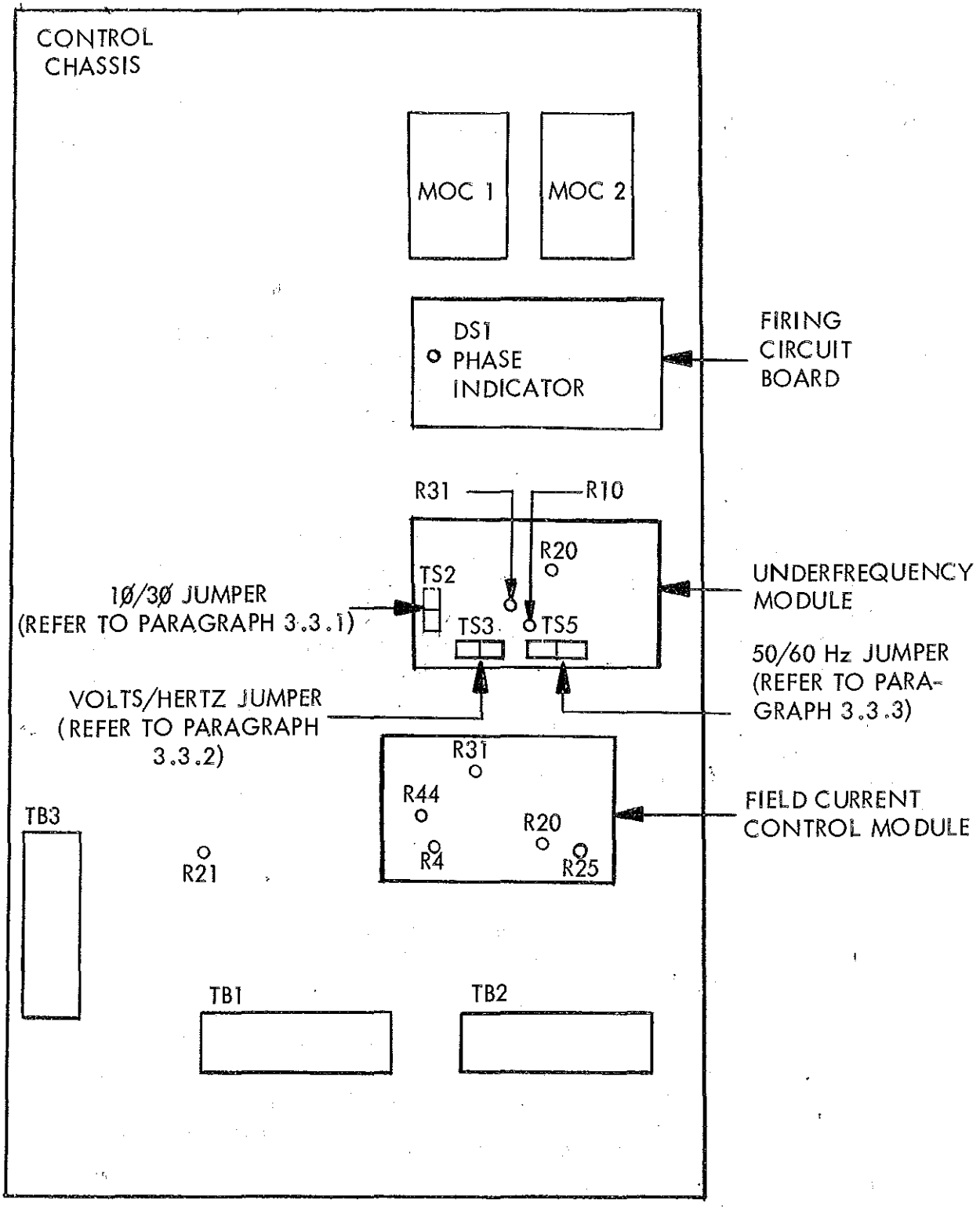


FIGURE 3-1 COMPONENT LOCATIONS

SECTION 4.0

INSTALLATION

4.1 Mounting

The exciter MUST be vertically mounted to obtain maximum convection cooling. The unit must be located in areas where the ambient temperature does not exceed the environmental specifications provided in Section 1.

4.2 Interconnection

CAUTION

MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT MUST NOT BE USED. INCORRECT USE OF SUCH EQUIPMENT CAN DESTROY THE SEMI-CONDUCTOR DEVICES IN THE EXCITER REGULATOR.

4.2.1 General

The exciter must be connected as shown in the interconnection diagram, Figure 8-1. Connections between terminal P1, P2 and P3 and the power transformers shall be made using 0 gauge wire. Connections between F+ and F- terminals and the exciter field shall be made using 00 gauge wire. Connections to the P and N terminals shall be made using 6 gauge wire. All other connections between the control, power and rectifier units use 16 gauge or larger wire. The "G" and "K" series of terminals should be connected with twisted pair less than 10 feet long.

NOTE: The wire sizes are intended only as a guide and do not eliminate consideration of other operational requirements that relate to wire and cable selection. The sizes recommended assume the use of 90°C wire in 60°C ambient environment with no more than 3 conductors in a bundle or raceway.

4.2.2 Power Connection Phasing

Phase rotation must be L1, L2, L3 at terminals P1, P2, P3, respectively.

4.2.3 Sensing Input

This system employs three-phase sensing. Connection between the generator output and the control chassis is made via transformer which steps the voltage down to 120 volts. For precise regulation, the sensing leads should be connected as close as possible to the point where regulation is desired. The regulator cannot correct for cable or bus voltage drops that may occur at points other than where the sensing leads are connected. Sensing leads should not be used to provide power to any equipment other than low burden metering devices.

4.2.4 Field Power (Terminal F+, F- and P and N)

Polarities must be observed when making connection to the generator field flashing source and the flashing control circuit source. The F+ terminal must be connected to the positive generator field terminal; the F- must be connected to the negative generator field terminal. The positive lead from the flashing battery must be connected to terminal P on the power rectifier chassis; the negative

battery lead must be connected to terminal N. The positive lead from the flashing control circuit must be connected to terminal PC on the Power Rectifier chassis; the battery negative must be connected to terminal NC.

CAUTION

THE EXCITER D.C. OUTPUT (TERMINALS F+ AND F-) MUST NEVER BE OPENED DURING OPERATION. TO DO SO WILL PRODUCE INDUCTIVE ARCING THAT MIGHT DESTROY THE GENERATOR FIELD AND/OR THE BRIDGE RECTIFIERS. NEVER PLACE A VOLTAGE SHUT-DOWN SWITCH IN SERIES OR IN PARALLEL WITH THE GENERATOR FIELD.

SECTION 5.0

OPERATION

5.1 General

Before placing the system into operation, check that all interconnections have been made in accordance with interconnection diagram, Figure 8-1.

5.2 Field Flashing

Make certain that the flashing voltage battery can deliver 125 Vdc to the P and N terminals on the power chassis. During the starting sequence, relays in the power chassis apply flashing power to the generator field. A diode in the circuit prevents inductive arcing when the flashing power circuit is opened and also prevents feed back into the power source during flashing.

5.3 Unit (Single Generator/Non-parallel) Operation

5.3.1 AUTO Mode

A. With the generator off, operate the external MOC-1 and MOC-2 control levers to LOWER until the lower limit is reached.

B. Set MODE switch to AUTO.

C. Position Rectifier Transfer Switch to either "Rectifier A" or Rectifier B".

D. Insure jumper connections (paragraph 3.3) are correctly made.

E. Insure that the UNIT/PARALLEL switch is in UNIT.

F. Insure that R44 (line drop compensation adjust) is set fully CCW.

G. Close the "Center" contacts for about 60 seconds of the OPERATE/CENTER switch or relay. This causes automatic voltage adjust MOC-1 to return to center of its range.

H. Start generator prime mover. When the generator attains normal speed, a speed switch closes the RESET relay. The generator output voltage should be between 90 and 110%. If not, operate STOP switch, and consult Table 6-1. Since resistor R2 is rated for intermittent operation, flashing intervals should not exceed 10 seconds to avoid overheating. If generator voltage fails to build up to 90-110% of nominal in 10 seconds, energize the STOP switch and determine the cause of failure.

I. Monitoring the generator output voltage, operate the MOC-1 control to RAISE until the correct output voltage is reached.

J. Apply the load to the generator and verify that voltage regulation is within ±1/2%. If it is not within these limits, refer to Section 6.

K. Alternately remove and apply load to determine if generator voltage is stable. If it is not stable adjust STAB ADJ Control R20 on the underfrequency module for maximum generator voltage stability.

NOTE: Unstable governors may contribute to generator voltage instability.

L. Apply 1/2 rated load or more and adjust R44 to obtain the desired line drop compensating voltage increase (if any) up to +10%.

M. Adjustment of underexcitation limiting circuit.

(1) With a no load condition accomplish the following:

(a) Adjust R21 to obtain +5 Vdc between TP6 and TP1
(b) Adjust R20 on the field current module to obtain 0 Vdc between TP5 and TP1
(c) Adjust R31 on the field current control module, measuring between TP2 and TP1, establish the desired minimum excitation threshold:

-15V = 150% of no load field current
-10V = 100% of no load field current
-5V = 50% of no load field current

(2) Under full KW load, adjust R4 to obtain -5Vdc between TP5 and TP1.
(3) Under full load, adjust R25, as follows, to establish the desired slope (see Figure 2-3):

This R25 dial setting	Results in the following per centage addition of no load to field current at full load.
0	0%
25	+50%
50	+100%
75	+150%
100	+200%

5.3.2 MANUAL Mode

A. Remove the load from the generator.

B. Operate the MANUAL MOC-2 control until the null meter reads zero.

C. Place the MODE switch to MANUAL.

5.4 Parallel Operation

A. Place the UNIT/PARALLEL switch to the PARALLEL position.

B. Position R44 to the fully CCW position.

C. Parallel operation should only be accomplished after satisfactory operation in the UNIT (single generator/non-parallel) mode has been demonstrated. Paralleling should be accomplished using standard techniques.

SECTION 6.0

MAINTENANCE AND TROUBLESHOOTING

6.1 Preventive Maintenance

Accumulated dust should be periodically removed from the heat sinks and transformers using a compressed air source equipped with a moisture trap.

6.2 Corrective Maintenance

Due to a protective transparent conformal coating, repair on the printed circuit board is difficult and should be attempted only by qualified personnel. The printed circuit board is easily removed, and replacing the whole board is recommended. Replacement printed circuit boards are available from Basler Electric.

6.3 Warranty and Repair Service

The shunt exciter is warranted against defective material and workmanship for 18 months from the date of initial shipment. A complete service center at the Basler Electric factory in Highland, Illinois, is geared to provide prompt turn around on parts, warranty and nonwarranty repairs.

6.4 Troubleshooting

The more common generator system malfunctions and the appropriate repair procedures are listed in Table 6-1.

TABLE 6-1 TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
Voltage does not build up to rated value.	Reversed flashing voltage. No flashing voltage.	Check DC Power Source.
	Improper Phase rotation of P1, P2 & P3 or no voltage to input power terminals P1, P2 and P3.	Verify wiring.
	No connection F+, F-	Verify wiring.
	Generator output shorted or heavily loaded.	Remove load or short.
	Defective exciter-regulator.	Check SCR-diode bridge, fuses, faulty PC board, flashing diode, relay or replace regulator.
	Generator speed too low.	Bring up to rated speed.
Voltage builds up until relay actuated, then decays.	Rheostat in MOC-1 open.	Repair open connections or replace rheostat.
	In Manual mode MOC-2 set too low.	Raise setting.
	No firing pulse applied to SCR gates.	Replace PC board.
	No power to bridge.	Check power fuses.
Voltage high uncontrollable with voltage adjust rheostat.	No sensing voltage, terminal E1, E2 and E3.	Verify wiring. Verify sensing PT fuses.
	Faulty PC Board.	Replace.
	SCR's or diodes faulty.	Replace SCR's.
Poor regulation.	Output voltmeter at different location than regulator sensing (Voltage drop in leads or wrong phase).	Connect voltmeter at same point as regulator sensing.
	Waveform distortion due to harmonic content in generator voltage. (Regulator senses average voltage; meter may be indicating RMS values).	(1) Check for saturated load (2) Consult generator manufacturer.
	Unbalanced load with three phase sensing.	(Unit averages all three phase voltages).
	Generator not up to rated speed.	Bring up to rated speed.
	Mode Switch in Manual.	Switch to AUTO position.
	Faulty PC Board.	Replace.
	Faulty SCR's or diodes or fuse.	Replace.
Poor voltage stability	Frequency unstable.	Consult governor manual.
	R20 (Stab adjust) improperly adjusted.	Adjust to proper setting.
	Faulty PC Board.	Replace.

SYMPTOM	PROBABLE CAUSE	REMEDY
Voltage high, controllable with voltage adjust rheostat	Blown fuse in one of sensing phases.	Replace fuse.
	Improper connection of sensing leads to generator.	Verify wiring.
	Voltmeter inaccurate.	Verify operation or replace.
	Faulty PC board.	Replace.
	Range Adj., R16 misadjusted.	Adjust R16
Voltage low, controllable with voltage adjust rheostat.	Generator not up to rated speed.	Increase speed.
	Improper connections of sensing leads to generator.	Verify wiring.
	Voltmeter inaccurate.	Verify operation or replace
	TS2 jumper installed with 3Ø sensing.	Remove jumper.
	Range Adj., R16 misadjusted.	Adjust R16
Voltage recovery slow with load change.	R20 adjusted improperly.	Adjust STAB ADJ R20.
	Slow prime mover response.	Consult governor manufacturer.
No Reactive Droop during paralleling	UNIT - Parallel Switch (or contact) in unit position.	Verify wiring.
	Tap on R3 set to minimum droop position.	Adjust R3 to obtain required droop.
	CT does not supply the required 3 to 5 amp secondary current.	Check wiring
	Improper CT phasing	Correct

SECTION 7.0

REPLACEMENT PARTS

7.1 General

Table 7-1 lists components of the SER-CB shunt exciter that have maintenance significance. Indented items are component parts of the previous item. When ordering parts, in addition to indicating part numbers and description, include the basic assembly part number, 9 1198 00 100.

TABLE 7-1

DESCRIPTION	REFERENCE DESIGNATOR	BASLER PART NUMBER
Transformer	T1, T2, T3	BE 15488 001
Transformer	T4	BE 15487 001
Power Chassis		9 1198 01 100
Surge Suppressor	VR1, VR2	10741
Contactor, A.C.	K1	10742
Transformer	T11, T12	BE 15363 001
Transformer	T13, T14, T15, T16	BE 14174 001
Contactor, Field Flashing	K2	10309
Relay, Voltage, 28V, 4 PDT	K3	06112
Fuse	F1	04599
Resistor, 2.5 ohms, 810 W	R2	10311
Resistor, 10 ohms, 5%, 100W	R3, R4, R5, R6	08487
Resistor, 50 ohms, 5%, 100W	R7,R8,R9,R16,R17,R1	08682
Diode Bridge Assembly	CR19-CR24	9 1121 15 100
Capacitor Assembly	C1,C2,C3,C4,C5, C6,C7	9 1156 12 100
Chassis, Control Assembly		9 1198 02 100
P.C. Board, Firing Circuit	---	9 1120 06 100
P.C. Board, Auto Volt Reg. & Underfrequency	---	9 1120 07 101
Control, Motor Operated (MOC 2505) 500 ohms	---	90 72300 121
Control, Motor Operated (MOC 2107) 5000 ohms	---	90 72300 112
P.C. Board, Under Excitation Limiter	---	9 1198 08 100
Capacitor, 25 uf, 370 V	C1,C2,C3	04875
Capacitor, 10 uf, 370 V	C4,C5,C6	07759
Resistor, 1 ohm, 100 W	R3	02662

Resistor, 200 ohm, 25 W	R21	03132
Choke	L1, L2, L3	BE 13033 001
Choke	L4	BE 8794 001
Transformer	T5	BE 13034 001
Transformer	T7, T8	BE 11686 001
Transformer	T3, T4	BE 15349 001
Transformer	T2	BE 15062 001
Transformer	T6	BE 15492 001
Rectifier Chassis	----	9 1198 03 100
Fuse, 400 amp	F2, F3, F4, F5, F6, F7	10310
Diode Heat Sink Assy.	CR1-CR4, CR11-CR14	9 1157 04 100
Surge Suppressor	VR3, VR4, VR5, VR6	10741
SCR Heat Sink Assy.	SCR1, SCR2, SCR3, SCR4, SCR5, SCR6	9 1120 03 100
Transformer	T5, T6, T7, T8, T9, T10	BE 15362 002
Diode Heat Sink Assy.	CR5-CR7, CR15, CR17	9 1121 10 100

SECTION 8

8.1 General

The following drawings are included to facilitate installation, operation and maintenance of the SER-CB exciter regulator.

Figure 8-1	Interconnection Diagram (D9 1198 00 960)
Figure 8-2	Power Chassis Schematic (C9 1198 01 910)
Figure 8-3	Control Chassis Schematic (D9 1198 02 910)
Figure 8-4	Rectifier Chassis "A" and "B" Schematics (C9 1198 03 910)

Additional manual included.

Motor Operated Potentiometer:
Publication No. 90 72300 99X and 90 72300 99Y

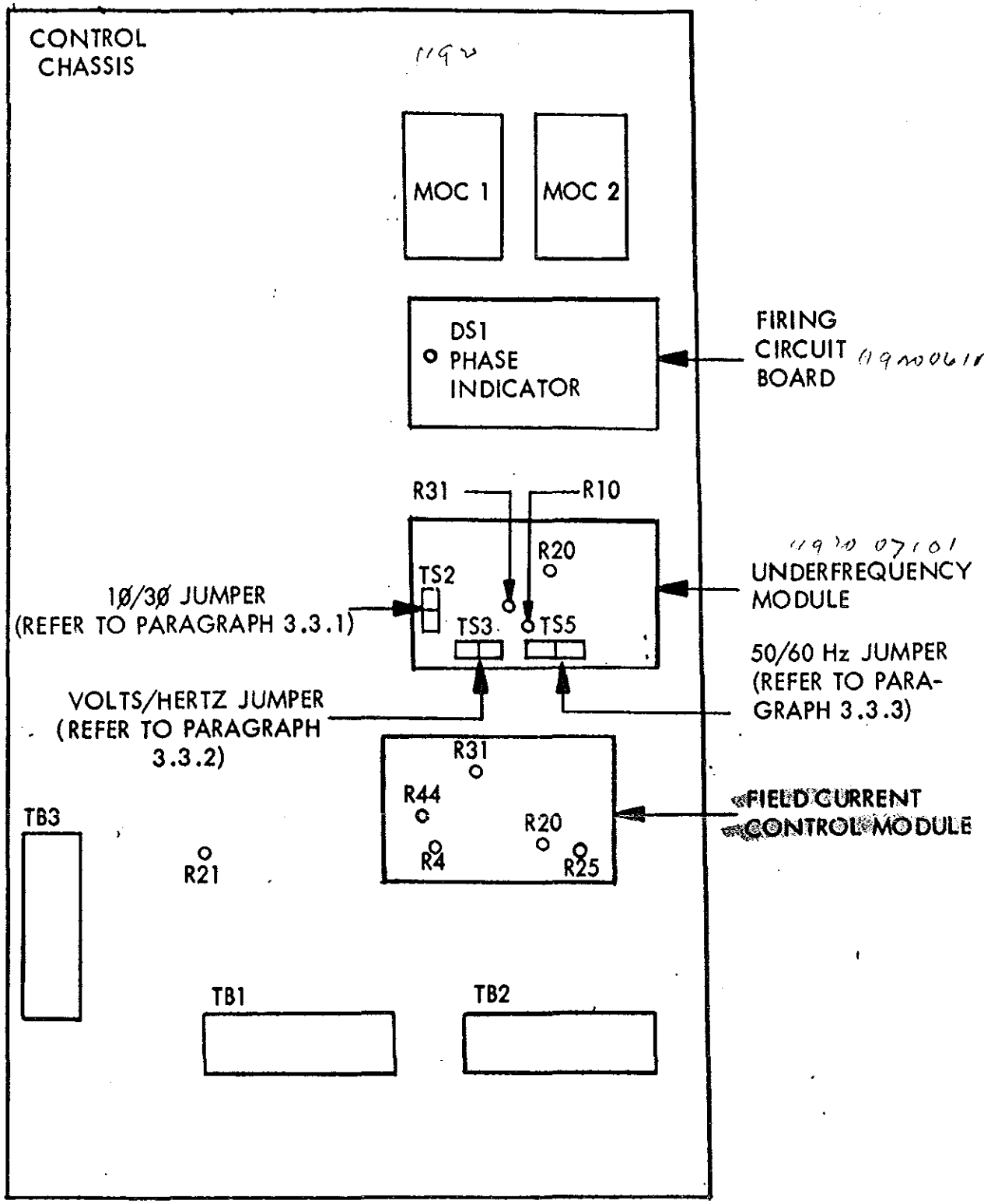


FIGURE 3-1 COMPONENT LOCATIONS

180 VAC

TB3 A B C CHASSIS

L1 25mf T5A BE13033001 C4 10mf
L2 25mf T5B BE13033001 C5 10mf
L3 25mf T5C BE13033001 C6 10mf

REV. PHASE INDICATOR DS1

CR3 CR4 CR5 CR6 C1 .27
CR7 CR8 CR9 CR10 C2 .27
CR11 CR12 CR13 CR14 CR15 C3 .27

R1 27K R2 33K 1W R3 27K R4 270K C9 .15
CR16 R3 5K CR17 R6 5K R7 5K

CR19 CR20 CR18 VR1 15V TP1
R8 400 C17 10mF C18 C5 .68
R10 120 R11 1.8K C6 .2 R12 27K C7 2
R9, 3K, 12W CR21 100V CR22 CR23 Q1 +10
BASE ADJ R13 22K Q3 R14 18K Q4 R16 820K R15 10K R17 560 R18 4.7K
C8 .1mf CR24

ØB BAL
C19 .22mf R24 10K CR25 C9 .22 TS2-8 K1 SCR1 R22 1K R23 39 Q6
R19 3.9K Q5 R20 4.7K R25 10K R28 5K CW R29 1.8K Q7 R30 4.7K Q8 C10 .1mf R34 39 R35 1K C11 10 C15 C16 10 R31 22K R32 22K R33 470

ØC BAL
C20 .22mf R37 10K CR28 C12 .22 TS2-3 K2 SCR2 R38 10K C13 .1mf R39 22K R40 22K
R41 5K CW R42 1.8K Q9 R43 47K Q10 R44 39 R46 1K
C21 .22mf R47 10K CR31 C14 .22 TS1-3 K3 SCR3 R48 10K R49 22K R50 22K

CHASSIS TB3 K1 G1 K2 G2 K3 G3 PCB TS2 PCB TS3

9 1120 06 100 FIRING CIRCUIT

CERTIFIED DRAWING
APPROVED Michael B McCabe
DATE 9/15/20
Basler Electric Highland, Illinois

TB1 R1 R2 125 VDC + - PP NN CHASSIS TB3
EXT RAISE LOWER SWITCH AUTO MOC — MOC-1
EXT. RAISE LOWER SWITCH MAN MOC — MOC-2
500Ω CW 5KΩ CW

CH TB3 CHASSIS
1 1A 2 E1 E5 TB2 TB3
T2 BE15062001 R1 1Ω Com 120 240 480
T3 BE15349001 115 230 460 600 48V
BE T4 15349 001 60V
E2 E7 E3 TB2 TB3 CHASSIS

TS1 9 Com TS1 8 +10 TS1 5 TS1 7

JUMPER CLOSE FOR 1Ø
L1 BE7196 R3 4K R4 6K TP2 CR11 R11 -100 = 68K -101 = 93K R12 22K
CR1 CR2 CR3 CR4 CR5 CR6 CLOSE V/HZ SW1 R28 22K R5 3.9K R6 1K C1 2 C6 6 TP3 CR12 R13 80K R14 30.1K CR13 R15 820
U1 VR2 R21 18K CW R20 10K STAB ADJ VR1 C11 3.0 K1 COM
R18 220K C9 .1 R19 47K R27 C10 1.0 R22 10K R23 390Ω 1W K1 10V R23 2.2K
C8 6 2N3053 Q1 2N3053 Q2 R23 390K 1/2W R26 10K 1/2W CR14 -15V
R30 CW 10K R31 10K V/HZ CAL. R9 15K CW R10 10K T35 60 HZ 50 HZ J1 0.1uf C7
R7 42.2K R1 5.6K R2 5.6K CR7 CR8 C5 1.0 C2 C3 .047 C4 .047 CR9 CR10 R8 33K U2
R16 CW 500 RANGE ADJUST R17 680

CHASSIS M1 M2 TB2 19 20 TB3 FIELD CURRENT SENSOR

BE15492001 T6 TO E2 TO E3 TO E1 T4 BE11686001 T5 BE 8794 001 L4 BE 11686001 2 TB 5
R1 2.2K R2 1K R3 1K TP7 TP8 R5 3.3K R6 3.3K C2 1UF C13 .1UF R4 200 CW KW CAL VR1
MC1595L U8 COM +10V R7 10K R8 10K R9 1.8K R10 1.5K R11 1.5K C5 1UF R12 R13 4.99K R14 33K R15 33K C1 .002UF C3 .002UF C4 .002UF R16 15K R17 15K R18 21K R19 22.1K R20 2K R43 332K C6 .1UF R41 787K U4 U5
R44 200Ω PSO LD COMP R47 1K R52 3.9K R49 2TK CR2 CR3 CR4 CR9 CR14 CR15 TP5
CW KW TAPER R25 10K CR10 U7 TP6 TP4 CR11 CR9 CR13 C11 10UF
R21 200 CR5 CR6 CR7 CR8 C7 .1UF R22 1K R24 5.4K C8 4UF R27 249K R28 5.4K C9 2UF R32 100K R33 5.6K C10 4UF R45 2.2M C14 .1UF R39 120K
U2 U3 U4 U5 U6 R23 49.1K R29 100K R34 49.9K R37 33K R38 33K R51 560K R42 1K VR2 U7 24
TP2 TP3 TP1 MAX EXC. ADJ. 10K R31 CW MAX EXC. ADJ. 10K R36 CW R46 33K COMMON -15V
FIELD CURRENT CONTROL D9-1198-08-100

9 1120 07 UNDER/FREQ

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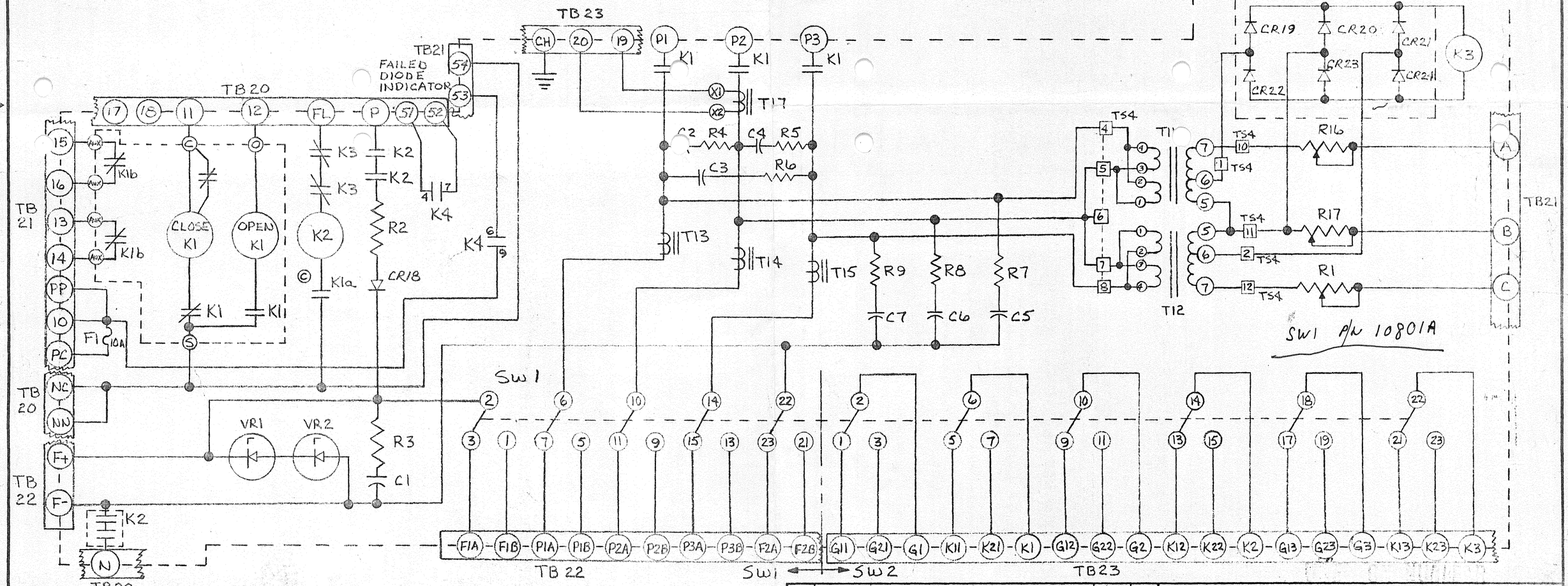
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D	REVISED PER ECA# 3440 & 3441 3-21-80	3/21/80	JK
C	REVISED PER ECA# 3440 & 3441 3-21-80	3/1/80	JK
B	REV. PER ECA# 3133 S.V.LEAK 5-26-77	WJF	10-17-77
A	ADDED TP6 TO 9198 01 > PCB Scale 3-15-77		

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SCHEMATIC - CONTROL CHASSIS
MATERIAL NUCLEAR EXCITER/REGULATOR
DRAWN BY TEA 3-1-77 CHKD J.C. 3-2-77 APPD WJF 3-3-77 SCALE NONE
BASLER ELECTRIC CO. HIGHLAND, ILLINOIS
SIZE D DRAWING NO. 9 1198 02 910 REV E

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NUCLEAR CONTROLLED



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APPROVED
DATE
Basler Electric
Highland, Illinois

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2	PER ECA#10102 L.R. 5-5-88	5/5/88	DEL
1	REV. PER ECA#9853 MCW 2-4-88	2/4/88	DLP
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E	CERT. PER ECA# 4550 BRJ 9-15-80	9/15/80	MSM
D	Rev. Per. ECA # 3930	1/3/79	M.S.
—	REDRAWN WITHOUT REVISION S. ULASAR 6-30-77	6-77	M.S.
C	REV. PER ECA # 3633 D. SCHMITT 6/6/77	6-30-77	WJF
B	REV. PER ECA # 3641 AL	4/4/77	GVF
A	UPDATED DWG.	3-77	M.S.

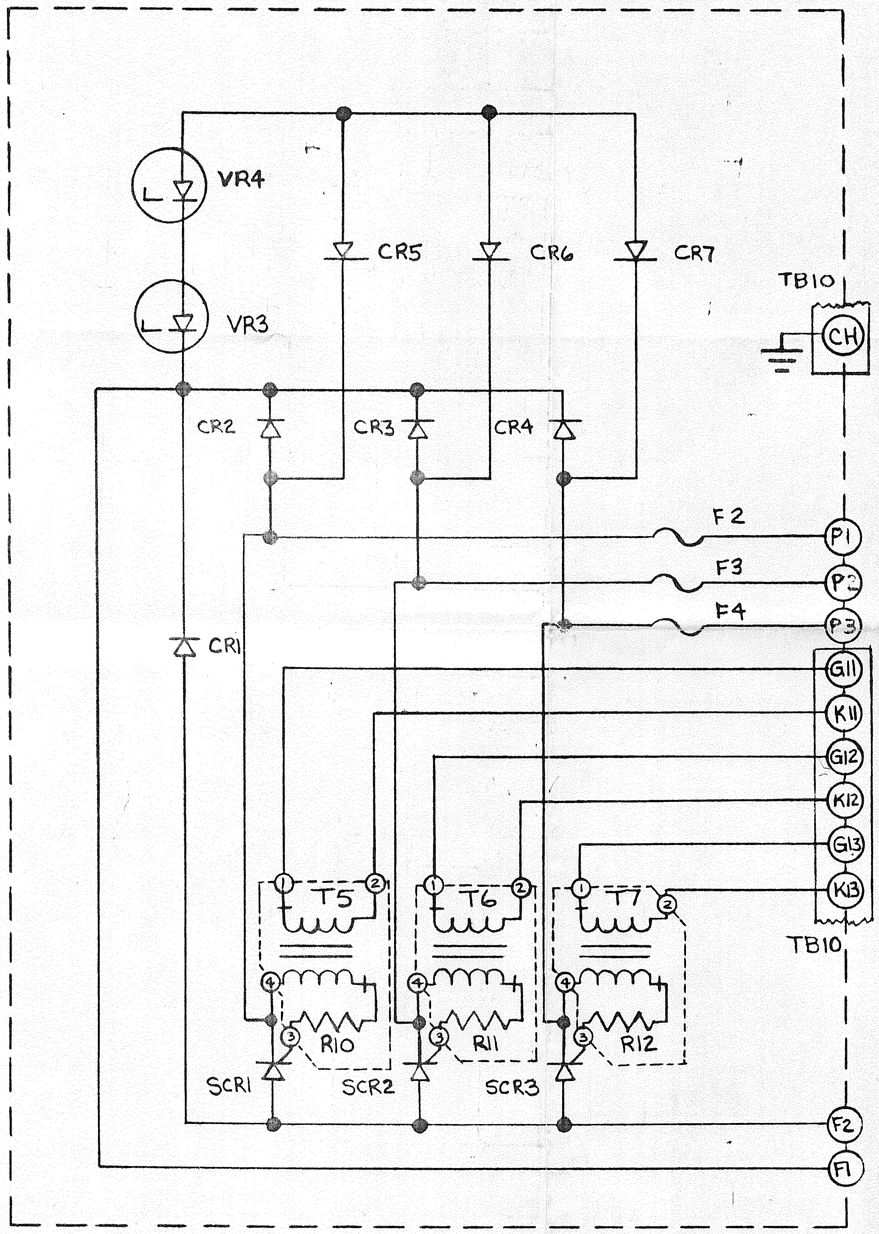
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MATERIAL: NUCLEAR EXCITER/REGULATOR

DRAWN BY	DATE	CHKD BY	DATE	APPR. BY	DATE	SCALE
TEA	3-4-77			CJH	3-11-77	

BASLER ELECTRIC CO.
HIGHLAND, ILLINOIS

DWG SIZE: C
DRAWING NO.: 9 11980 1 910
REV: G



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APPROVED [signature]
DATE 9/15/80
Basler Electric
Highland, Illinois

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—	STAMPED "USED ON NUCLEAR"	10/27/77	
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A	REVISED PER ECA #3641 AL	4/4/77	M.S.

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TITLE RECTIFIER CHASSIS SCHEMATIC
MATERIAL NUCLEAR EXCITER/REGULATOR

DRAWN BY	DATE	CHKD BY	DATE	APPR BY	DATE	SCALE
D.S.	2-17-77			CJH	2-21-77	

BASLER ELECTRIC CO.
HIGHLAND, ILLINOIS

DWG SIZE C | DRAWING NO 91198 03 910 | REV B

PARALELLING CT.

SENSING PT.

120V

120V

UNIT

PAR

UNIT PARALLEL SWITCH (2)

MODE SELECTOR SWITCH IS CLOSED FOR MANUAL, OPEN FOR AUTOMATIC MODE. (2)

(2) NULL METER

USE TWISTED PAIRS LESS THAN 10 FT. LONG

E1 E2 E3 1 2 1A MI M2 N1 N2

TB2

TB1

TB3

CONTROL CHASSIS

P/N 9119802100

(6) AUTOMATIC VOLT ADJUST (2)

CENTER

OPERATE

OPERATE

CENTER

MANUAL VOLT ADJUST (2)

CONTROL SWITCH CONTACT ARRANGEMENT

CONTACTS	RAISE	OFF	LOWER
A11-B11	X		
A1-B1		X	X
A5-B5	X	X	
A7-B7			X

E5 E7 CH 19 20 G1 K1 G2 K2 G3 K3 NN PP A B C

TB23 TB20 TB21

P1A P2A P3A F1A F2A G11 K11 G12 K12 G13 K13

TB22 TB23

P1B P2B P3B F1B F2B G21 K21 G22 K22 G23 K23

P1 P2 P3 F1 F2 G11 K11 G12 K12 G13 K13

TB10

CH

RECTIFIER CHASSIS

P/N 9119803100

RECTIFIER CHASSIS

P/N 9119803100

24 25 26 27 34 35 36 37 R2 R1

H3 X3 X6 H2 X2 X5 H X1 X4

BE 5467 001

BE 5488 001 CT4

BE 5488 001 CT3

BE 5488 001 CT2

BE 5488 001 CT1

160A

500V

P3 P2 P1

POWER CHASSIS

P/N 9119801100

15 16 PC NC 17 18 51 52

K1b (5)

TB21

(+) 125VDC/OA (-) CONTROL POWER

(B)

DIODE FAILURE CONTACT

TB20

K2 (5)

TB22 TB21 TB20

F- F+ 53 54 13 14 10 11 12 FL P N

250V 187A

DIODE FAILURE

TRIP CIRCUIT GEN. BKR.

RESET

STOP

FLASH

FIELD FLASHING (+) 125VDC 50A (-) POWER

2 3 2 4

416OV 3562 KVA GEN.

FIELD

NOTES:

1. A, B, C ROTATION.
2. NOT SUPPLIED BY BASLER.
3. RESET & STOP CONTACTS MUST BE INTERLOCKED AND NOT CLOSED AT THE SAME TIME. CONTACTS MAY BE CLOSED CONTINUOUSLY OR MOMENTARILY.
4. CLOSE CONTINUOUSLY OR FOR DURATION OF FLASHING.
5. K1 AUXILIARY CONTACTS SHOWN IN SHUTDOWN CONDITION.
6. RETURN TO CENTER MOMENTARY CONTACTS.

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—	RECATALOG WITHOUT REVISION S.V. CHANGE 6-30-77	6-77	MS
B	REVISED PER ECA # 3823 DESIGNATED 6/14/77	6-77	MS
A	REVISED & RECATALOGED SUPERSEDES 4-25-77	6-77	MS

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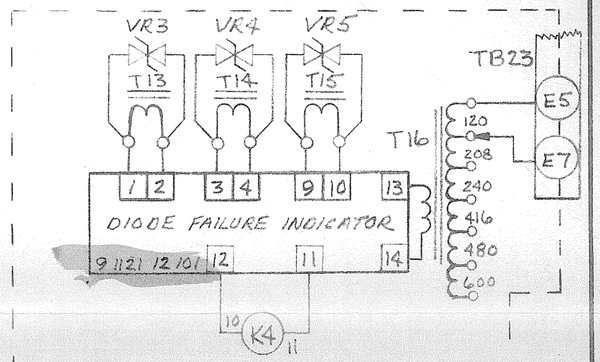
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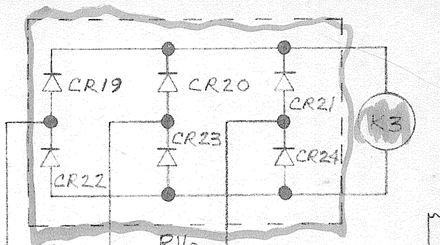
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TEA	3-8-77				5-11-77	

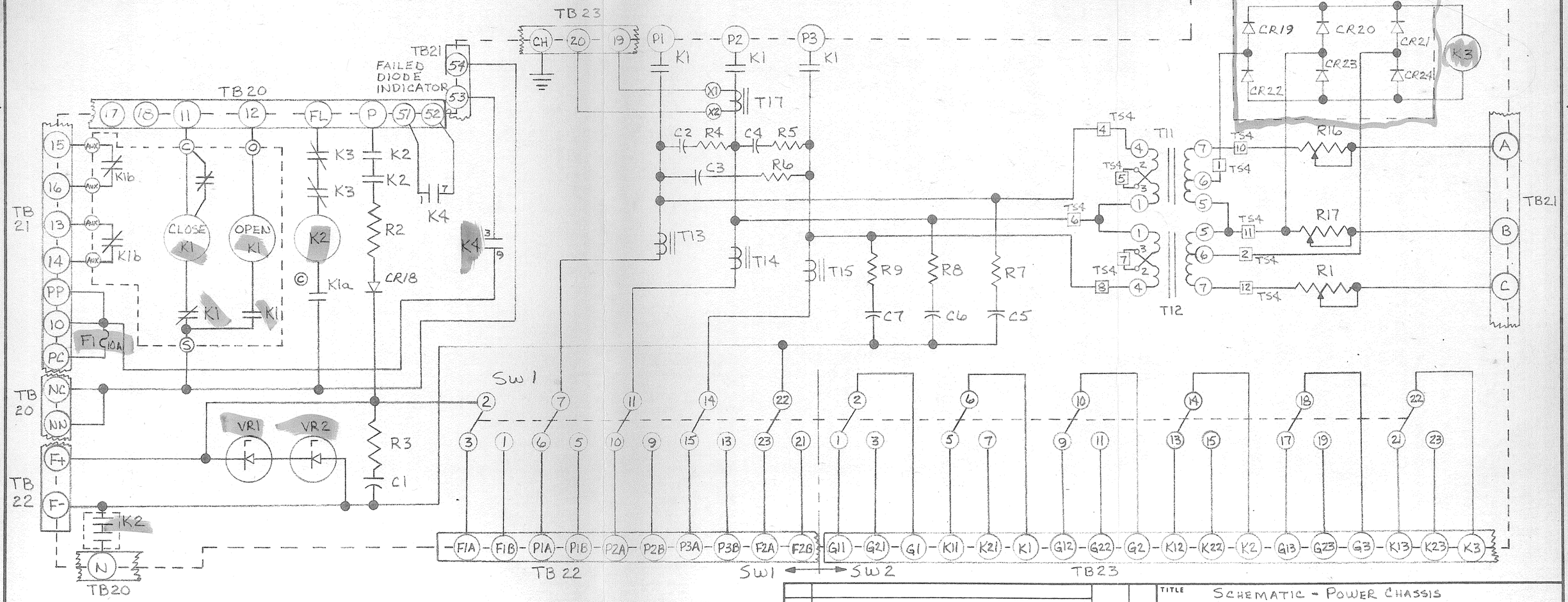
BASLER ELECTRIC CO. HIGHLAND, ILLINOIS

DWG SIZE D

DRAWING NO 9119800960 REV B







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LETTER	REVISION	DATE	BY
—	REDRAWN WITHOUT REVISION S.ULASAK 6-30-77	6-77	M.S.
C	REV. PER ECA # 3633 D. Schmitt 6/16/77	6-30-77	M.S.
B	REV. PER ECA # 3641 AL	4/4/77	M.S.
A	UPDATED DWG.	3-77	M.S.

DO NOT SCALE. ALL DIMENSIONS ARE IN INCHES. TOLERANCE UNLESS OTHERWISE SPECIFIED: DECIMALS ± X FRACTIONS ± X ANGLES ± X

TITLE: SCHEMATIC - POWER CHASSIS

MATERIAL: NUCLEAR EXCITER/REGULATOR

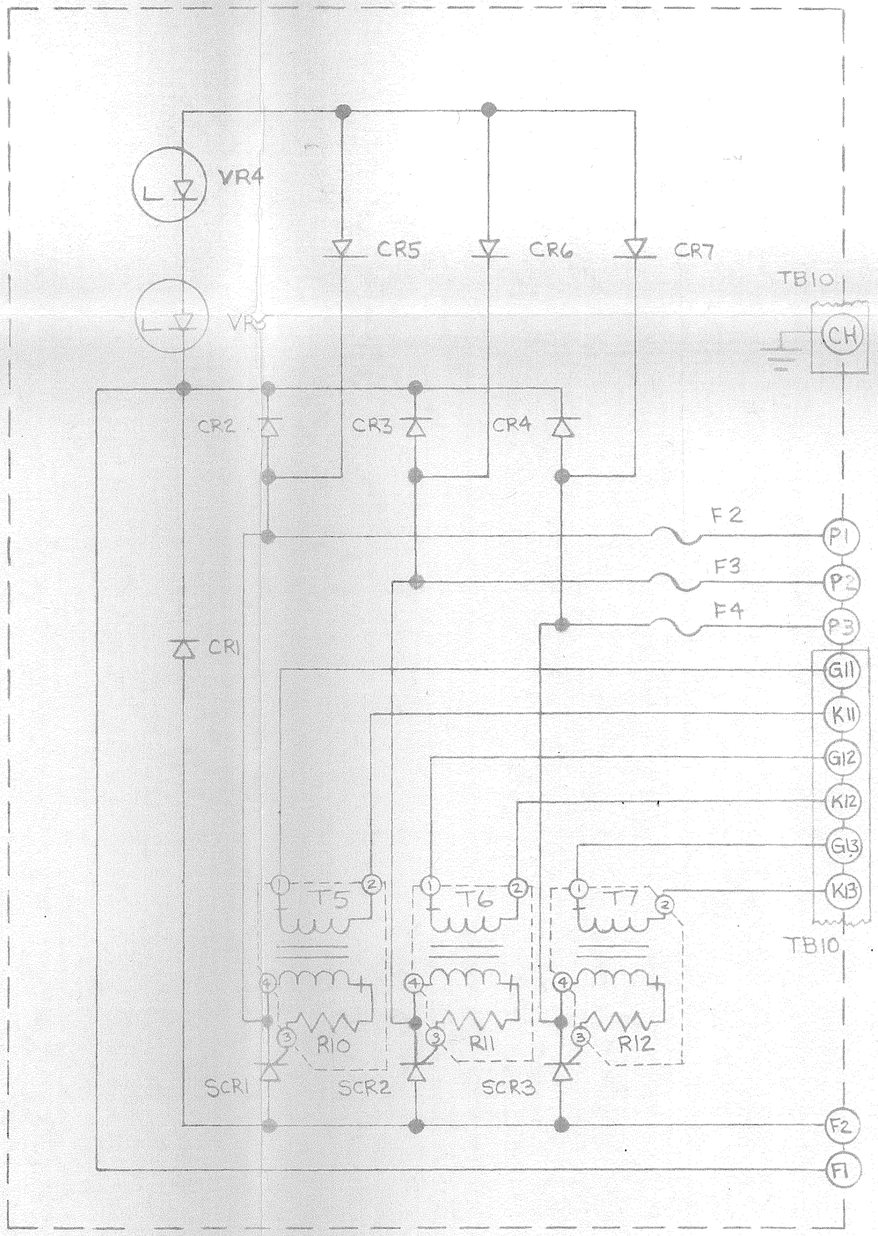
DRAWN BY	DATE	CHKD BY	DATE	APPR. BY	DATE	SCALE
TEA	3-4-77			GJH	3-11-77	X

BASLER ELECTRIC CO.
HIGHLAND, ILLINOIS

DWG SIZE: C

DRAWING NO. 9 119801 910

REV. C



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LETTER	REVISION	DATE	BY
A	REVISED PER ECA #3641	4/4/77	M.S.

DO NOT SCALE ALL DIMENSIONS ARE IN INCHES TOLERANCE UNLESS OTHERWISE SPECIFIED DECIMALS ± FRACTIONS ± ANGLES ±

TITLE RECTIFIER CHASSIS SCHEMATIC

MATERIAL NUCLEAR EXCITER/REGULATOR

DRAWN BY	DATE	CHKD BY	DATE	APPR BY	DATE	SCALE
D.S.	2-17-77			CJH	2-21-77	

BASLER ELECTRIC CO. HIGHLAND, ILLINOIS

DWG SIZE C | DRAWING NO. 91193 03 910 | REV A

180 VAC

TB3 A B C

CHASSIS

L1 25 µf C1 BE13033 001 — T5A BE13034 001 — C4 10µf

L2 25 µf C2 BE13033 001 — T5B — C5 10µf

L3 25 µf C3 BE13033 001 — T5C — C6 10µf

160V

CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10 CR11 CR12 CR13 CR14 CR15

C1 .27 C2 .27 C3 .27

R1 27K R2 33K 1W R7 5K

REV. PHASE INDICATOR DS1 R3 27K R4 270K C4 .15

CR16 R5 5K CR17 R6 5K

CR19 CR20 CR18 VR1 15V TP1

R8 400 C17 10µf C18

CR21 100V CR22 CR23 R9, 3K, 12W Q1

R10 120 R11 1.8K C6 .2 C5 .68 Q2 R12 27K C7 .2

+10 BASE ADJ R13 22K Q4 R16 820K R15 10K R17 560 R18 4.7K Q3 R14 18K

R19 3.9K Q5 R20 4.7K Q6 CR24 C8 .1µf

ØB BAL R28 5K CW R29 1.8K Q7 R30 4.7K Q8 C10 .1µf C11 10 C15 10 C16 10 R31 22K R32 22K R33 470

ØC BAL R41 5K CW R42 1.8K Q9 R43 47K Q10 C13 .1µf R44 39 R38 10K R39 22K R40 22K

C19 .22 µf R24 10K CR25 CR26 C9 .22 K1 TS2-8 SCR1 R22 1K R23 39 R25 10K

C20 .22 µf R37 10K CR28 CR29 C12 .22 K2 TS2-3 SCR2 R34 39 R35 1K R36 10K

C21 .22 µf R47 10K CR31 CR32 C14 .22 K3 TS1-3 SCR3 R46 1K R48 10K R49 22K R50 22K

CHASSIS TB3 8 K1 7 G1 3 K2 2 G2 — Pulse TS2 — 3 K3 2 G3 — Pulse TS1

TS1-2 G3 TS2-7 G1 TS2-2 G2

9 1120 06 100 FIRING CIRCUIT

CH TB3 CHASSIS

125 VDC + − PP NN TB3 CHASSIS

MOC-1 EXT RAISE LOWER SWITCH AUTO MOC

TB1 CHASSIS 24 25 26 27 — CW 500Ω 14 15 16

MOC-2 EXT RAISE LOWER SWITCH MAN MOC

TB1 CHASSIS 34 35 36 37 — CW 5KΩ 14 15 16

1A 2 TB2 E1 E5 TB3 E2 TB2 E7 TB3 E3 TB2 CHASSIS

K1 1Ω

BE 15068 001 — 120 240 480 COM 120 240 480

T3 BE 15349 001 — 115 230 460 600 — 48V

BE T4 15349 001 — 115 230 460 600 — 48V 60V

TS1 14 13 12 10 6 11 9 8 5 7 — TS2 10 8

TB3 CHASSIS 1 9 12 1 2 3 4 5 6 7

TB2 1A 2 E1 E5 E2 E7 E3

TB1 CHASSIS 1 2 3 4 5 6 7

TB1 CHASSIS 1 2 3 4 5 6 7

TB2 115 230 460 600

TB3 1 2 3 4 5 6 7

TS1 9 COM — TS1 8 +10 — TS1 5 — TS1 7

CHASSIS M1 M2 TB2

TO E3 TO E1

BE 11686 001 T6 — BE 11686 001 T7 — BE 8794 001 L4

2 T7 3 — 2 T8 5

TP7 TP8 R1 R2 R3 C12 R5 R4 KW CAL CW VR1 C13 R14 R15 MC1595L U8 R16 R17 C1 C2 C3 C4 R18 R12 R43 R13 R15 R20 R41 C6 CR12 R44 LD COMP CW R47 R50 R52 CR14 CR15 R49 CR2 CR4 CR1 CR3 TP5

CW KW. TARE R25 CR10 U7 TP4 CR9 R45 CR13 C14 C11 R39 TP6 CR11 C7 R22 C8 R24 R27 R28 C9 R32 C10 R33 R35 R38 R37 R51 R42 VR2 U7 Z

R21 200Ω CR5 CR6 R48 R26 R30 U2 U3 U4 U5 U6 R29 R34 CR7 CR8 TP2 TP3 TP1 MIN EXC. ADJ. R31 KW MAX EXC. ADJ. R36 CW R46 COMMON

TS1 5 JUMPER CLOSE FOR 1Ø

L1 BE7196 — TS2 1 TS2 2 — TP2 CR11 R11 −100 = 68K −101 = 33K R12 22K

CR1 CR2 CR3 CR4 CR5 CR6 C1 .2 R3 4K R4 6K CLOSE V/HZ SW1 TS8 1 TS8 2 R28 22K R5 3.9K R6 1K C6 .2 TP3 CR12 R13 80K R14 30.1K CR13 R15 820

U1 VR2 R21 18K CW R20 10K STAB ADJ

R18 220K C9 .1 R19 47K R27 C10 1.0 R22 10K R23 390Ω 1W

K1 5 K1 4 +10V TS4 TS5 K1 3 R23 2.2K K1 (K1) C11 9.0 K1 8 COM TS1 4

C8 .6 2N3053 Q1 2N3053 Q2 R28 390K 1/2W R26 10K 1/2W CR14 R17 680 −15V TS1 10

VR1 R16 500 RANGE ADJUST

R30 10K CW R31 10K V/HZ CAL. R9 15K CW R10 10K T35 60 HZ 50 HZ J1 0.1uf C7

R1 5.6K R2 5.6K CR7 CR8 R7 422K C5 1.0 R8 33K U2 CR9 CR10 C2 .2 C3 .047 C4 .047

9 1120 07 — UNDER/FREQ

CONFIDENTIAL INFORMATION OF BASLER ELECTRIC COMPANY, HIGHLAND, ILL. IT IS LOANED FOR CONFIDENTIAL USE, SUBJECT TO RETURN ON REQUEST, AND WITH THE MUTUAL UNDERSTANDING THAT IT WILL NOT BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF BASLER ELECTRIC COMPANY.

REV	REVISION	DATE	BY
B	REV. PER ECA # 3633 S. VLCEAK 5-26-77	10-17-77	WJF
A	ADDED TP6 TO 9 1198 08 100 P.C.B. J. Smith 3-15-77		

DO NOT SCALE ALL DIMENSIONS ARE IN INCHES TOLERANCE UNLESS OTHERWISE SPECIFIED: DECIMALS ± FRACTIONS ± ANGLES ±

FIELD CURRENT SENSOR 19 20 TB3

FIELD CURRENT CONTROL D9-1198-08-100

SCHEMATIC - CONTROL CHASSIS

NUCLEAR EXCITER/REGULATOR

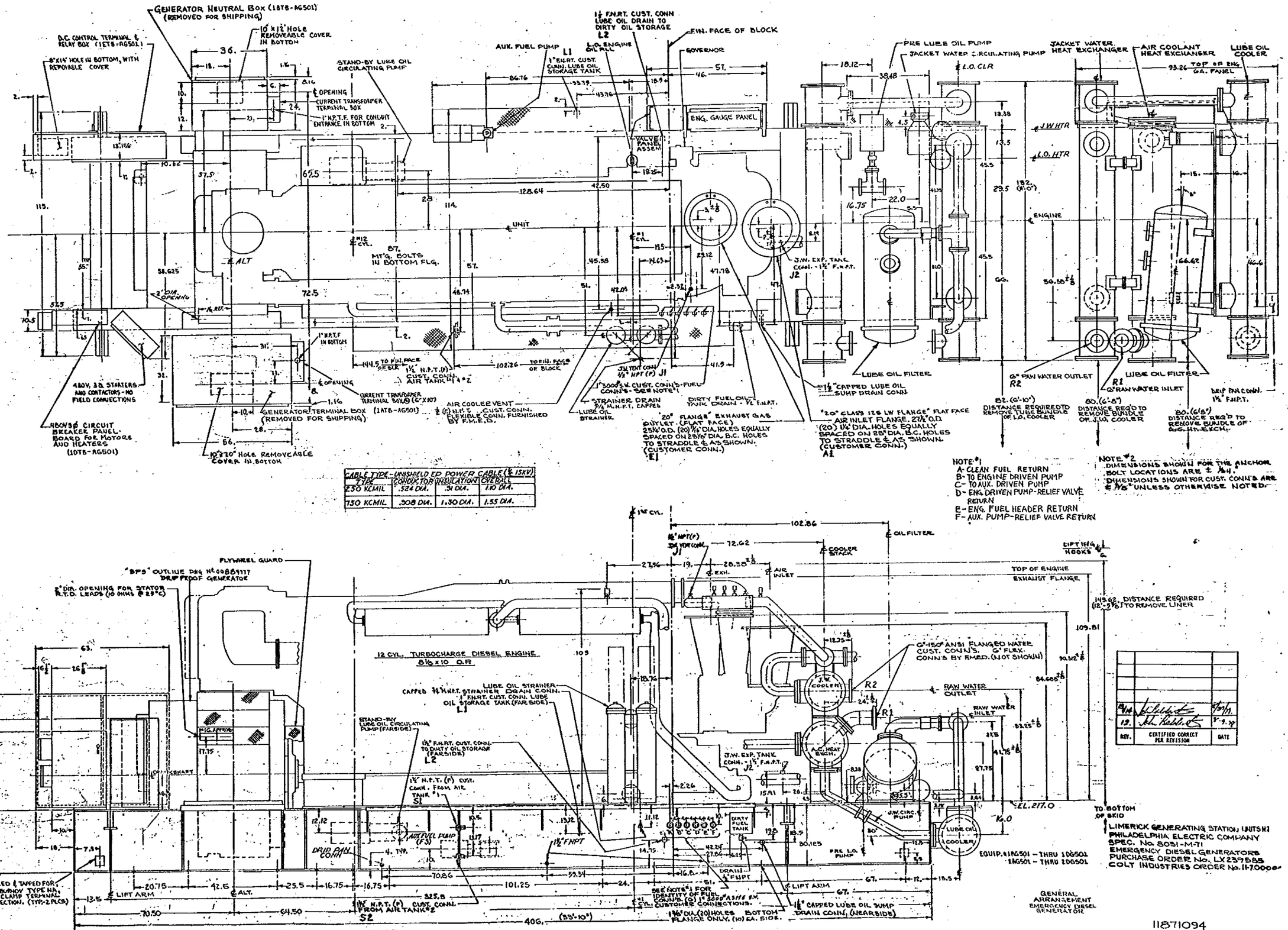
DRAWN BY	DATE	APPD BY	DATE	SCALE
TEA	3-1-77	J. Smith 3-2-77	WJF	3-3-77	NONE

BASLER ELECTRIC CO. HIGHLAND, ILLINOIS

SIZE D — CAGE NO. — 9 1198 02 910 — REV B

LIMERICK

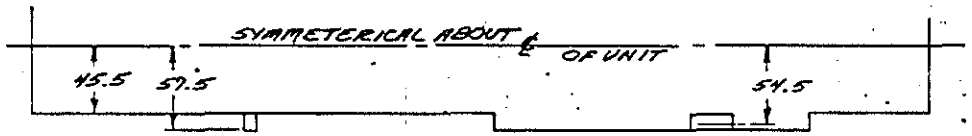
Chapter 7
Installation

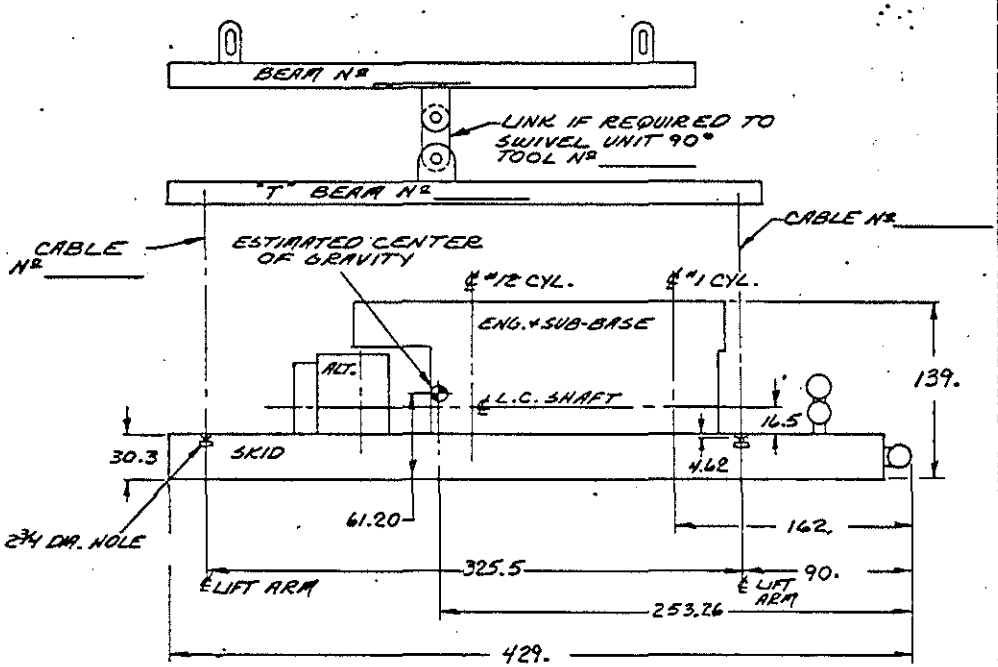

GENERATOR NEUTRAL BOX (18TB-AG501) (REMOVED FOR SHIPPING)
10" x 12" HOLE REMOVEABLE COVER IN BOTTOM
D.C. CONTROL TERMINAL & RELAY BOX (1ETB-AG501)
8"x14" HOLE IN BOTTOM, WITH REMOVABLE COVER
STAND-BY LUBE OIL CIRCULATING PUMP
AUX. FUEL PUMP
1" F.N.P.T. CUST. CONN. LUBE OIL STORAGE TANK
L1
1½ F.N.P.T. CUST. CONN LUBE OIL DRAIN TO DIRTY OIL STORAGE
L2
L.O. ENGINE OIL FILL
F.IN. FACE OF BLOCK
GOVERNOR
ENG. GAUGE PANEL
VALVE PANEL ASSEM.
PRE LUBE OIL PUMP
JACKET WATER CIRCULATING PUMP
JACKET WATER HEAT EXCHANGER
AIR COOLANT HEAT EXCHANGER
LUBE OIL COOLER
TOP OF ENG. GA. PANEL
L.O. CLR
J.W. HTR
L.O. HTR
ENGINE
UNIT
ALT.
MTG. BOLTS IN BOTTOM FLG.
J.W. EXP. TANK CONN. - 1½" F.N.P.T.
J2
LUBE OIL FILTER
1½" CAPPED LUBE OIL SUMP DRAIN CONN
R1
R2
6" RAW WATER OUTLET
6" RAW WATER INLET
DRIP PAN CONN. 1½" F.N.P.T.
480V, 3Ø STARTERS AND CONTACTORS - NO FIELD CONNECTIONS
480V, 3Ø CIRCUIT BREAKER PANEL BOARD FOR MOTORS AND HEATERS (10TB-AG501)
GENERATOR TERMINAL BOX (1ATB-AG501)
CURRENT TRANSFORMER TERMINAL BOX
AIR COOLER VENT
1½" (F) N.P.T. CUST. CONN. FLEXIBLE CONN. FURNISHED BY F.M.E.I.O.
1½ N.P.T.(F) CUST. CONN. AIR TANK #1 & #2
J1
3000 S.W. CUST. CONN'S - FUEL
STRAINER DRAIN ¾" N.P.T. CAPPED
LUBE OIL STRAINER
DIRTY FUEL OIL TANK DRAIN - ½" F.N.P.T.
"20" CLASS 125 LW FLANGE" FLAT FACE AIR INLET FLANGE. 27¼" O.D. (20) 1¼" DIA. HOLES EQUALLY SPACED ON 25" DIA. B.C. HOLES TO STRADDLE ℄ AS SHOWN. (CUSTOMER CONN.)
A1
"20" FLANGE" EXHAUST GAS OUTLET (FLAT FACE) 25¼" O.D. (20) 1¼" DIA. HOLES EQUALLY SPACED ON 23½" DIA. B.C. HOLES TO STRADDLE ℄ AS SHOWN. (CUSTOMER CONN.)
E1
NOTE #1
A- CLEAN FUEL RETURN
B- TO ENGINE DRIVEN PUMP
C- TO AUX. DRIVEN PUMP
D- ENG. DRIVEN PUMP-RELIEF VALVE RETURN
E- ENG. FUEL HEADER RETURN
F- AUX. PUMP-RELIEF VALVE RETURN
NOTE #2
DIMENSIONS SHOWN FOR THE ANCHOR BOLT LOCATIONS ARE ± 1/64".
DIMENSIONS SHOWN FOR CUST. CONN'S ARE ± 1/16" UNLESS OTHERWISE NOTED.
82. (6'-10") DISTANCE REQUIRED TO REMOVE TUBE BUNDLE OF L.O. COOLER
80. (6'-8") DISTANCE REQ'D TO REMOVE BUNDLE OF J.W. COOLER
80. (6'8") DISTANCE REQ'D TO REMOVE BUNDLE OF AUS. HT. EXCH.
CABLE TYPE - UNSHIELDED POWER CABLE (¼ 15KV)
TYPE | CONDUCTOR | INSULATION | OVERALL
250 KCMIL | .524 DIA. | .31 DIA. | 1.10 DIA.
750 KCMIL | .908 DIA. | 1.30 DIA. | 1.55 DIA.
FLYWHEEL GUARD
"BPS" OUTLINE DWG Nº 00885117 DRIP PROOF GENERATOR
2" DIA. OPENING FOR STATOR R.T.D. LEADS (10 OHMS @ 25°C)
12 CYL. TURBOCHARGE DIESEL ENGINE 8½ x 10 O.P.
LUBE OIL STRAINER CAPPED ¾" N.P.T. STRAINER DRAIN CONN. 1" F.N.P.T. CUST. CONN. LUBE OIL STORAGE TANK (FAR SIDE) L1
STAND-BY LUBE OIL CIRCULATING PUMP (FAR SIDE)
1½" F.N.P.T. CUST. CONN. TO DIRTY OIL STORAGE (FAR SIDE) L2
1½" N.P.T. (F) CUST. CONN. FROM AIR TANK #1 S1
1½" N.P.T. (F) CUST. CONN. FROM AIR TANK #2 S2
AUX. FUEL PUMP (FS)
DRIP PAN CONN.
1½" F.N.P.T.
DIRTY FUEL TANK
J.W. EXP. TANK CONN. - 1½" F.N.P.T. J2
J.W. COOLER
A.C. HEAT EXCH.
J.W. CIRC. PUMP
PRE L.O. PUMP
LUBE OIL COOLER
R1
R2
RAW WATER OUTLET
RAW WATER INLET
TOP OF ENGINE EXHAUST FLANGE
6"-150 ANSI FLANGED WATER CUST. CONN'S. 6" FLEX. CONN'S BY RMED. (NOT SHOWN)
149.62 DISTANCE REQUIRED (12'-5⅝") TO REMOVE LINER
EL. 217.0
TO BOTTOM OF SKID
LIFT ING HOOKS
COOLER STACK
AIR INLET
EXH.
OIL FILTER
DRAIN 1" F.N.P.T.
1½" DIA. (20) HOLES BOTTOM FLANGE ONLY. (10) EA. SIDE.
1½" CAPPED LUBE OIL SUMP DRAIN CONN. (NEAR SIDE)
SEE NOTE #1 FOR IDENTITY OF FUEL CONNS. (2) 1" 3000# A.S.M.E. S.W. CUSTOMER CONNECTIONS.
GROUNDING CONNECTION DRILLED & TAPPED FOR ℄ FURNISHED COMPLETE WITH BURNDY TYPE NA, CATALOG NUMBER NA39-411, CLAMP TERMINAL FOR 1/0 MCM COPPER GROUND CONNECTION. (TYP. 2 PLCS)
LIFT ARM
℄ ALT.
406. (33'-10")
EQUIP. #1AG501 - THRU 10AG501
2AG501 - THRU 20AG501
LIMERICK GENERATING STATION, UNITS #1
PHILADELPHIA ELECTRIC COMPANY
SPEC. No. 8031-M-71
EMERGENCY DIESEL GENERATORS
PURCHASE ORDER No. LX239585
COLT INDUSTRIES ORDER No. 11-70000
GENERAL ARRANGEMENT EMERGENCY DIESEL GENERATOR
11871094

D.R. 118698

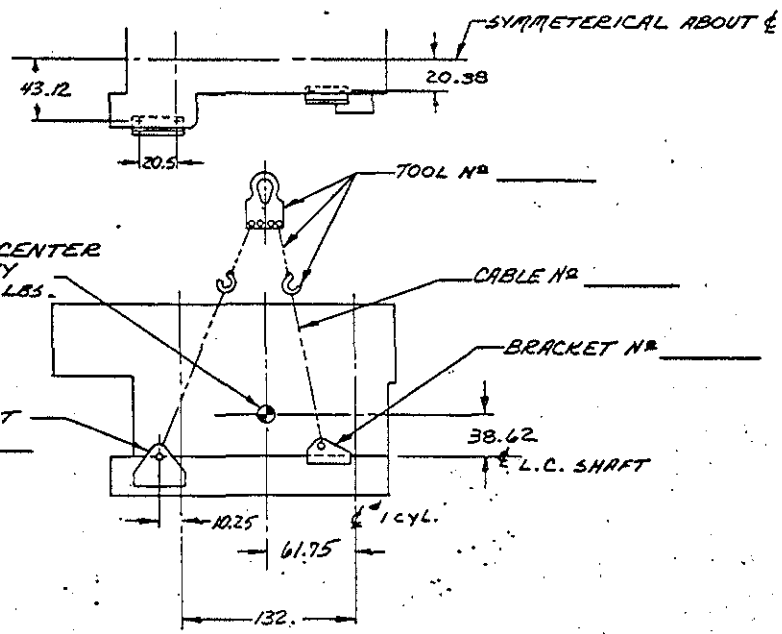
STIMATED WEIGHTS

ENGINE & SUB-BASE	49,000
SKID WELDMENT	13,000
ALTERNATOR	33,600
MISC. EQUIPMENT	26,400 ①
TOTAL	122,000 ②



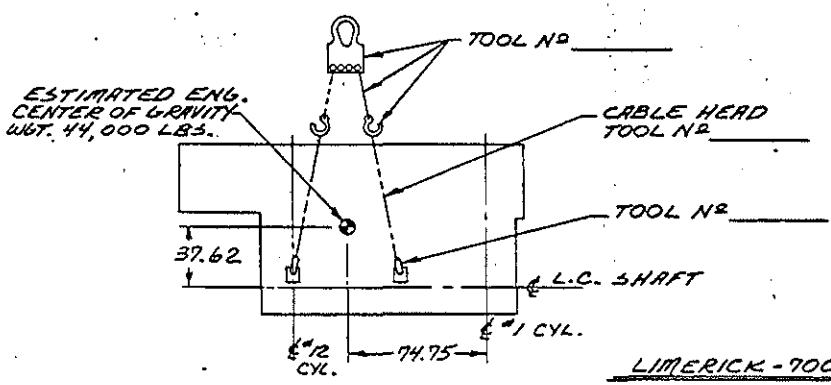


COMPLETE SKID UNIT LIFT



ENGINE & SUB-BASE LIFT

11872212



ENGINE LIFT

LIMERICK - 700000

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	11604	9-27-79	Q63 WAS 103,600 Q65 WAS 8,000	

TITLE: LIFTING DATA

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, BENDING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .060 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Power Systems Division

DES. No. PC1902	7/27 77	ASSY. OR LO.
DR. BY HERTENSTEIN	9/1 / 77	SCALE
CHK'D K.O.	7/21/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
MACH.		ENG'R
WELD.		

SHEET SIZE C — DWG. NO. 11872212 — SHEET 1 OF 1 — A

PACKAGING, SHIPPING, HANDLING, AND STORAGE INSTRUCTIONS

ORDER 700000 LIMERICK

I. GENERAL

A. THIS INSTRUCTION DEFINES THE PACKAGING, SHIPPING, HANDLING AND STORAGE REQUIREMENTS FOR THE ENGINE-GENERATOR SKID UNITS.

B. THIS INSTRUCTION IS INTENDED TO COMPLY WITH THE REQUIREMENTS OF BECHTEL SPECIFICATION 8031-M-71, PARAGRAPH 6.3.a, REVISION 3 DATED MAY 13, 1976 AS APPLICABLE TO THE ENGINE GENERATOR SKID UNITS.

II. PACKAGING

A. VISUAL INSPECTION OF THE UNIT IS MADE FOR CLEANLINESS AND EXPOSED PRESERVED MACHINE SURFACES AND PAINTED AREAS ARE TOUCHED UP AS REQUIRED. ANY DIRT, OIL RESIDUE, METAL CHIPS, OR OTHER FORMS OF CONTAMINATION SHALL BE REMOVED BY WIPING WITH A CLEAN RAG USING A LAUNDRY DETERGENT IF NECESSARY.

B. AIR START DISTRIBUTOR IS COVERED WITH PRESSURE SENSITIVE TAPE.

C. ALL PIPE OPENINGS WITH FLANGES ARE COVERED WITH 3/4" PLYWOOD AND SECURED WITH BOLTS, WASHERS ON THE WOOD SIDE, AND NUTS AS FOLLOWS:

COLT QA JAN 30 1979 RCP

DWG. NO. 11 873 300

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	11297	2-8 79	ADDED DRAWING NO 11873 312 TO PARA. V	J.H.

SHEET 1 OF 2

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REL. NO. PC2304 1/4 78

DR. BY [illegible] 1/4/78

CHK'D. BY [illegible] 1/4/78

APPV. [illegible]

Colt Industries

Fairbanks Morse Engine Division

1. USE TWO BOLTS, WASHERS, AND NUTS ON TWO THROUGH FOUR HOLE FLANGES.

2. USE FOUR BOLTS, WASHERS, AND NUTS ON FIVE THROUGH TEN HOLE FLANGES.

3. USE SIX BOLTS, WASHERS, AND NUTS ON TWELVE AND UP HOLE FLANGES.

D. ALL PIPE OPENINGS WITHOUT FLANGES ARE COVERED WITH PLASTIC CLOSURES.

E. FUEL RACKS ARE WRAPPED WITH GRADE "C" NON-OXIDE CLOTH.

F. GOVERNOR (WOODWARD) IS COVERED WITH A PIECE OF PLASTIC AND A PIECE OF FIRE RETARDANT CANVAS AND TIED WITH ROPE TO SECURE IN PLACE.

G. FLYWHEEL IS PROTECTED WITH GRADE "C" NON-OXIDE CLOTH AND 1/2" PLY-WOOD AND SECURED WITH 3/4" BANDING.

H. GENERATOR IS COVERED WITH 3 MIL POLYETHELENE AND VENTED FOR BREATHING.

I. ALL ELECTRICAL CABINETS, ELECTRICAL PANELS, GAUGE BOARDS, AND MISCELL-ANEOUS SMALL ELETRICAL DEVICES SUCH AS PRESSURE SWITCHES AND TEMEPRATURE SWITCHES ARE COVERED WITH 3 MIL POLYETHELENE AND VENTED FOR BREATHING.

J. SECURE UNIT TO RAILROAD CAR WITH ADEQUATE BLOCKING, BRACING, BOLTING, NAILING, AND WELDING (NOT TO THE UNIT) TO FACILITATE SHIPPING DEPENDING ON THE TYPE OF CAR TO MEET OR EXCEED UNIFORM FREIGHT CLASSIFICATION RE-QUIREMENTS. ANCHOR BOLTING HOLES SHALL PROVIDE A SNUG FIT, WASHERS SHALL BE USED UNDER NUTS, AND AFTER TORQUED THE NUTS STAKED.

K. SUITABLE PADDING (CARDBOARD, FIBRE BOARD, AIR CAP POLYETHELENE, WOOD FRAMES) WILL BE APPLIED TO SHARP OR PROTRUDING CORNERS TO ELIMINATE TEARING OF EXTERIOR CANVAS.

L. COVER ENTIRE UNIT WITH FIRE RETARDANT CANVAS TO PROVIDE ADDITIONAL PADDING.

M. COVER ENTIRE UNIT WITH 28 FOOT WIDE, 3 MIL POLYETHELENE SHEET. THIS COVER IS POSITIONED TO INSURE AIR CIRCULATION THROUGHOUT THE PACKAGE.

N. COVER ENTIRE UNIT WITH A FORM FITTING FIRE RETARDANT CANVAS TO PRO-VIDE DRAINAGE AND AIR CIRCULATION AND SECURE THE CANVAS TO RAILROAD CAR.

O. A 1/4" DIAMETER ROPE IS THREADED AROUND AND OVER THE PACKAGE TO PRE-VENT BILLOWING IN TRANSIT.

III. SHIPPING

A. SHIPMENT BY RAIL.

B. NO HUMPING SIGNS SHALL BE PROMINENTLY DISPLAYED ON THE RAILROAD CAR.

COLT JAN 30 1979

DWG. NO. 11 873 300

SHEET 2 of 3

C. AN IMPACT RECORDING METER INSTRUMENT SHALL BE INSTALLED ON THE RAILROAD CAR. IF TRANSIT TIME EXCEEDS FIFTEEN DAYS PROVISIONS SHALL BE MADE WITH THE CARRIER TO SERVICE THE RECORDER IN TRANSIT.

IV. MARKING

A. THE FOLLOWING INFORMATION IS STENCILED BY PAINTING ON TWO PIECES OF 3/4" PLYWOOD AND ONE PIECE IS SECURED TO THE UNIT AND THE OTHER PIECE TO THE BLOCKING. CHARACTERS OF THE STENCIL SHALL BE NO LESS THAN 3/4" HIGH.

1. DESTINATION
2. RETURN ADDRESS
3. PURCHASE ORDER NUMBER FOLLOWED BY THE PACKAGE NUMBER, FOLLOWED BY THE NUMBER OF PACKAGES.
4. WEIGHT
5. MATERIAL NUMBERS AS FOLLOWS:

5.1 ENGINE-GENERATOR SKID #1 - 1AG501
5.2 ENGINE-GENERATOR SKID #2 - 1BG501
5.3 ENGINE-GENERATOR SKID #3 - 1CG501
5.4 ENGINE-GENERATOR SKID #4 - 1DG501
5.5 ENGINE-GENERATOR SKID #5 - 2AG501
5.6 ENGINE-GENERATOR SKID #6 - 2BG501
5.7 ENGINE-GENERATOR SKID #7 - 2CG501
5.8 ENGINE-GENERATOR SKID #8 - 2DG501

B. VISUALLY INSPECT THAT ALL WARNING TAGS AS REQUIRED PER DRAWING 11871322, PARAGRAPH IX ARE INSTALLED.
REV Z

V. HANDLING

A. REFER TO DRAWING 11872212 FOR SITE UNLOADING/LIFTING OF THE ENGINE-GENERATOR SKID.

VI. STORAGE, SITE

A. STORAGE WILL BE INDOORS OR EQUIVALENT.

B. PACKAGING STEPS TAKEN IN II.A THRU I ARE TO BE INSPECTED AND MAINTAINED.

C. COVER ENTIRE UNIT WITH FORM FITTING FIRE RETARDANT CANVAS DRAPED OVER UNIT AND TIED IN PLACE TO INSURE AIR CIRCULATION THROUGHOUT.

COLT QA JAN 30 1979

DWG. NO. 11 873 300

SHEET 3 OF 3

11 873 300

SETTING AND ALIGNMENT INSTRUCTIONS
ORDER NO. 700000 - LIMERICK
SKIDDED 12 CYL 38TD8 1/8 DIESEL GENERATOR SET

I. LIFTING

A. THESE INSTRUCTIONS ARE PROVIDED TO ASSIST IN THE SAFE LIFTING OF THE UNIT. THEY DO NOT RELIEVE THE MOVER OF FULL RESPONSIBILITY FOR ANY DAMAGES INCURRED IN HANDLING THIS EQUIPMENT.

1. USE SPREADERS TO PREVENT DAMAGE TO EQUIPMENT AND PIPING MOUNTED ON THE SKID.

2. USE RIGGING WITH A LARGE FACTOR OF SAFETY. SLIGHT TIPPING, ACCELERATIONS AND DECELERATIONS GREATLY INCREASE THE LIFTING LUG LOADS ABOVE THE APPROXIMATE STATIC WEIGHTS STENCILED ON THE UNIT.

3. RIG TO LIFT OVER THE CENTER OF GRAVITY (APPROXIMATE LOCATION SHOWN ON LIFTING DATA DWG. 11872212) SO UNIT DOES NOT TIP.

4. EQUALIZING SLINGS MUST BE LOCKED BEFORE LIFTING. DUE TO THE HIGH CENTER OF GRAVITY, AVOID USE OF PIVOTED BEAM RIGGING WHICH COULD ALLOW THE LOAD TO TIP.

CAUTION: THE CENTER OF GRAVITY IS ABOVE THE LIFTING LUGS.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SETTING AND ALIGNMENT INSTRUCTIONS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC2819	3/14/79	ASSY. OR LO.
DR. BY R. HUMKE	2/16/79	SCALE
CHK'D. BY T.M.	2/26/79	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 875 044 | SHEET 1 OF 5

II. LEVELING

A. TO INSURE PROPER ALIGNMENT IN THE FIELD, THREE SCRIBED STEEL BLOCKS ARE INSTALLED ON THE UPPER OUTSIDE SURFACE OF THE BOTTOM FLANGE OF EACH MAIN SKID "I" BEAM. ONE IS UNDER EACH LIFTING LUG AND THE THIRD IS ABOUT HALF WAY BETWEEN. THE UNIT SHOULD BE LEVEL IN ALL DIRECTIONS AND THE SCRIBE MARKS SHOULD BE LINED UP WHEN THE UNIT HAS BEEN PROPERLY SET.

1. PLACE THE UNIT ON THE FOUNDATION WITH SIX BLOCKS OF REQUIRED THICKNESS UNDER THE "I" BEAMS; ONE BELOW EACH OF THE SCRIBED STEEL BLOCKS ON THE "I" BEAMS.

2. STRETCH A WIRE TIGHT BETWEEN THE SCRIBE MARKS BELOW THE LIFTING LUGS ON EACH SIDE. USE A TRANSIT TO CHECK ELEVATION OF IDENTICAL POINTS ON THE FOUR CORNERS OF THE DIESEL GENERATOR UNIT.

3. JACK AND SHIM AS NECESSARY TO BOTH:

   a. LEVEL THE FOUR CORNERS WITHIN ± 1/8".

   b. LINE UP THE CENTER SCRIBE MARK ON EACH "I" BEAM WITH THE WIRE STRETCHED BETWEEN THE OUTER SCRIBE MARKS WITHIN ± 1/16".

III. GROUTING

A. THE MOUNTING RAIL SURFACES WHICH COME IN CONTACT WITH THE GROUT SHALL BE CLEANED TO REMOVE DIRT, PAINT, RUST AND GREASE. ALSO, CLEAN AND ROUGHEN SURFACES OF CONCRETE GROUT AREA TO REMOVE DIRT, GREASE AND LOOSE CONCRETE. CLEANING OF THE MOUNTING RAIL AND THE GROUT AREA SHOULD BE DONE PRIOR TO LOWERING THE SKID ONTO THE FOUNDATION. GROUT SHALL BE MADE AND APPLIED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SETTING AND ALIGNMENT INSTRUCTIONS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC2819	3/14/79	ASSY. OR LO.	
DR. BY R. HUMKE	2/16/79	SCALE	
CHK'D. BY T.M.	2/26/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 875 044 | SHEET 2 OF 5

BF3009-2

COLT MAR 9 1979

IV. ALIGNMENT

A. REMOVE ALTERNATOR OUTER BEARING CLOSURE AND MEASURE THE "C" DIMENSION (DISTANCE BETWEEN OUTER BEARING CLOSURE MOUNTING SURFACE AND OUTER FACE OF OUTER BEARING RACE). REFER TO ALTERNATOR INSTRUCTIONS 117. THIS MEASUREMENT SHOULD BE .577" - .620". IF THE "C" DIMENSION IS NOT WITHIN THIS TOLERANCE LOOSEN THE ALTERNATOR HOLD DOWN BOLTS AND MOVE THE STATOR TOWARDS OR AWAY FROM THE ENGINE TO OBTAIN CORRECT BEARING CLEARANCE. IF IT IS NECESSARY TO MOVE THE STATOR TOWARDS OR AWAY FROM THE ENGINE, TAKE SPECIAL PRECAUTIONS TO ASSURE THAT THE STATOR IS NOT MOVED SIDEWAYS i.e. MAINTAIN GENERATOR SHAFT TO STATOR BORE AND PARALLEL TO AND CONCENTRIC WITH ENGINE CRANKSHAFT.

B. BEFORE REINSTALLING THE OUTER BEARING CLOSURE USE A STRAIGHT EDGE AND SCRIBE THE LOCATION OF THE CENTERLINE OF THE ALTERNATOR SHAFT ON THE BEARING ARM FOR REFERENCE FOR MARKING THE OIL LEVEL GAGE. DETERMINE THAT THE LEVEL MARKS ON THE ALTERNATOR BEARING OIL SIGHT GAGE ARE AT THE EXACT ORIGINAL SETTING. THE SIGHT GAGE MARKS ARE DIMENSIONED FROM THE CENTERLINE OF THE ALTERNATOR SHAFT. THE LOWER MARK ON THE GAGE IS THE MINIMUM OPERATING OIL LEVEL AND IS 6.06" BELOW THE CENTERLINE AND THE UPPER MARK IS THE STANDING OIL LEVEL AND IS 5.67" BELOW THE CENTERLINE. USING SAE40 TURBINE QUALITY MINERAL OIL (DO NOT USE ENGINE OIL) FILL THE BEARING TO THE UPPER MARK (STANDING OIL LEVEL). REFER TO ALTERNATOR INSTRUCTIONS 117.

C. FILL THE ENGINE TO THE PROPER LEVEL WITH SAE40 LUBE OIL. OPEN ALL VENTS IN THE LUBRICATING OIL SYSTEM. USE THE PRE-LUBE PUMP TO CIRCULATE LUBRICATING OIL THROUGH THE ENTIRE SYSTEM UNTIL THERE IS OIL TO THE END OF THE UPPER HEADER.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SETTING AND ALIGNMENT INSTRUCTIONS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL NO. PC2819	3/14/79	ASSY. OR LO.
DR. BY R. HUMKE	2/16/79	SCALE
CHK'D. BY T.M.	2/26/79	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 875 044 | SHEET 3 OF 5

CULT MAR 1979 QA

BF3009-2

IV. (CONTINUED)

D. PRIOR TO ROTATING THE ALTERNATOR AND ENGINE, REMOVE THE COUPLING GUARD AND REMOVE SUBBASE TO GENERATOR COUPLING STUDS AND NUTS FROM BOTH SIDES OF COUPLING. AFTER REMOVING STUDS INSTALL PIPE PLUGS IN SUBBASE.

E. NO. 14 BEARING CLEARANCE

1. PRIOR TO TAKING CRANK STRAIN READINGS, CHECK NO. 14 BEARING CLEARANCE. WHEN THE UNIT WAS ALIGNED AT THE FACTORY, THE NO. 14 BEARING CLEARANCES WERE AS GIVEN BELOW AND SHOULD NOT CHANGE PROVIDED THE STATOR IS NOT SHIFTED LATERALLY OR VERTICALLY DURING SHIPMENT OR SETTING OF THE "C" DIMENSION. THERE SHOULD BE NO CLEARANCE AT THE BOTTOM (CANNOT INSERT .0015" FEELER GAGE). THERE SHOULD BE EVEN SIDE CLEARANCE. THE DIFFERENCE BETWEEN THE TWO SIDES SHOULD NOT EXCEED .002". RECORD FEELER GAGE READINGS. MEASURE AND RECORD THE TOP CLEARANCE.

F. ALTERNATOR SHAFT RUN OUT

1. THE RUN OUT OF THE ALTERNATOR SHAFT SHALL BE MEASURED PERPENDICULAR TO THE CENTERLINE OF THE SHAFT AND ON THE ALTERNATOR SHAFT FLANGE. THE RUN OUT SHOULD NOT EXCEED .003" T.I.R.

G. AIR GAP

1. THE AIR GAP SHOULD ALWAYS BE MEASURED BETWEEN THE CENTER OF THE SOLE FACE AND THE FACE OF A STATOR TOOTH.

2. THE BEARING ARM AND BEARING ESTABLISH THE CORRECT AIR GAPS AT THE FREE END. THE CORRECT AIR GAP AT THE ENGINE END IS OBTAINED BY SHIFTING AND/OR SHIMMING THE ALTERNATOR FEET.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SETTING AND ALIGNMENT INSTRUCTIONS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC2819	3/14/79	ASSY. OR LO.
DR. BY R. HUMKE	2/16/79	SCALE
CHK'D. BY T.M.	2/26/79	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 875 044 | SHEET 4 OF 5

BF3009-2

QA MAR 1979

G. (CONTINUED)

3. MEASURE THE TOP AIR GAP AT THE FREE END AND AT THE ENGINE END. THE AIR GAP AT THE ENGINE END SHOULD BE WITHIN ± 5% OF THE FREE END. IF THE AIR GAP IS NOT WITHIN THE TOLERANCE SHIM THE ALTERNATOR FEET TO OBTAIN THE CORRECT AIR GAP.

4. THE HORIZONTAL AIR GAP IS CHECKED ON THE ENGINE END AND THE DIFFERENCE BETWEEN THE TWO SIDES SHOULD NOT EXCEED .040". IF THE HORIZONTAL GAPS DIFFER BY MORE THAN .040" SHIFT THE STATOR FEET TO OBTAIN THE CORRECT AIR GAP. REFERENCE MARK THE FEET BEFORE SHIFTING THE STATOR TO MAKE SURE THAT THE "C" DIMENSION IS MAINTAINED AS PREVIOUSLY SET.

H. CRANKSHAFT STRAIN

1. PLACE THE STRAIN GAGE BETWEEN #12 CYL CRANK WEBS AT 180° FROM CRANKPIN (AS NEAR AS POSSIBLE WITH ROD IN PLACE) AND IN LINE WITH OUTER SURFACE OF MAIN JOURNAL. SET STRAIN GAGE AT ZERO WHEN CRANK PIN IS ON BOTTOM CENTER. ROTATE CRANK UNTIL CRANK THROW IS AT TOP DEAD CENTER. THE STRAIN GAGE SHOULD READ BETWEEN 0 AND -.0015" AT THIS POSITION. THE (-) SIGN INDICATES THE WEBS OF THE CRANK ARE CLOSER TOGETHER. IF THE CRANK STRAIN READING IS NOT WITHIN THE LIMITS OF 0 AND -.0015 ADJUST ALTERNATOR HEIGHT BY ADDING OR REMOVING SHIMS TO OBTAIN THE CORRECT STRAIN. ~~TAKE THE CRANK STRAIN OF ALL OTHER CYLINDERS AND RECORD ON FORM S-1005.~~

2. RECHECK ALIGNMENT AND AIR GAP AFTER THE UNIT HAS BEEN RUN UP TO OPERATING TEMPERATURES AND DOWEL THE ALTERNATOR TO THE SKID.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SETTING AND ALIGNMENT INSTRUCTIONS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	PC2819	3/14/79	ASSY. OR LO.
DR. BY	R. HUMKE	2/16/79	SCALE
CHK'D. BY	T.M.	2/26/79	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 875 044 | SHEET 5 OF 5

8F3009-2

VO

Chapter 8
Support Systems & Equipment Components

1. FUEL OIL SYSTEM

Part No.	Description
11 903 403	Drain Valve
11 906 076	Pressure Switch
11 906 081	Level Alarm Switch
11 907 024	Isolation Valve
11 908 171	Duplex Filter
11 908 190	Check Valve
11 908 193	Relief Valve
11 908 194	Fuel Oil Pump
11 908 198	Fuel Oil Pump Motor
11 908 523	Fuel Oil Meter
11 908 528	Normal Vent
11 908 529	Emergency Vent
11 908 549	Level Switch
11 908 550	Level Switch
11 908 553	Differential Pressure Switch
11 908 554	Temperature Switch
11 908 650	Isolation Valve
11 908 677	Duplex Strainer
11 908 695	Differential Pressure Switch
11 908 813	Differential Pressure Switch
16 100 079	Duplex Filter
16 102 300	Orifice, Check Valve Combination
16 104 402	Check Valve

11903 403

Description: 1/2" Gem Ball valve with screwed ends.

Vendor: Crane Co.
Industrial Products Div.
4100 South Kedzie Avenue
Chicago, Ill.

Piece/Part No.: Cat. No. 2180

Drawing No.:

NOTE: "Substitutes Not Permitted."

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: VALVE, GEM BALL

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries — Fairbanks Morse Power Systems Division — C

REL. NO AT559567(Q)	12/11/64	ASSY. OR LO.
DR. BY T. Moseley	/ /	SCALE
CHK'D. BY [illegible]	12/14/64	APPV. LWC FDS 12/14/64
MAT'L		HEAT TR.

SHEET SIZE A | DWG. NO. 11 903 403 | SHEET OF

11906076

DESCRIPTION: ALLEN BRADLEY BULETIN 836 OPEN TYPE PRESSURE SWITCH WITH FOLLOWING FEATURES:

1. Adjustable range -- 0-30 psi.
2. Adjustable differential 0.4 to 4 psi
3. Max. allowable press -80 psi

VENDOR'S PART NO: 836-C3

VENDOR: ALLEN-BRADLEY

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH, PRESS. 0-30 psi

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205713	1/21/72	ASSY. OR LO.	
DR. BY	/ /	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11906076	SHEET OF	

BF3009-2

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts

DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC [5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

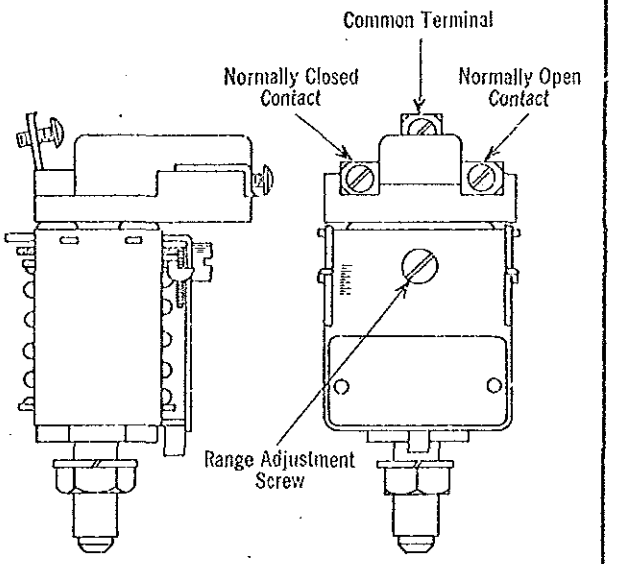
To adjust the controls to suit particular requirements, the following adjustments are to be made; these will apply to both the pressure and temperature controls.

FIXED DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount. It is not possible to change the differential between the cut-in and cut-out settings.

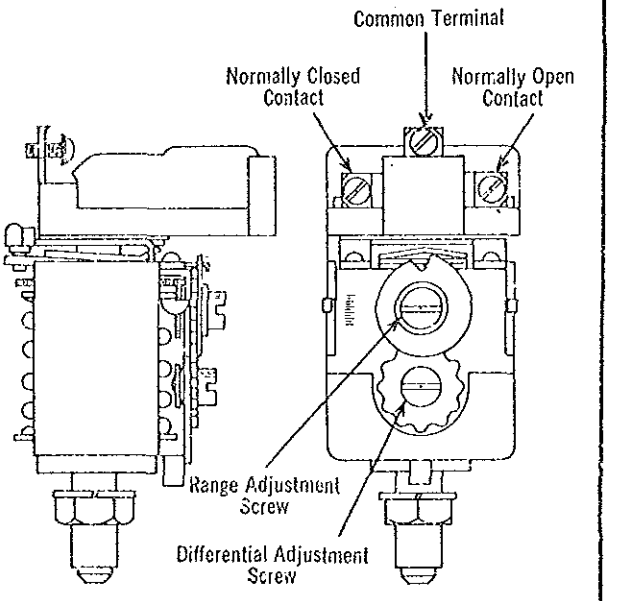
ADJUSTABLE DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount.

When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



Instructions 836-800—November, 1969
Supersedes Instructions 836-800 Dated August 16, 1960

DESCRIPTION: Gorn Type GHF 5400 liquid level switch suitable for use with diesel engine jacket water (containing up to 50% ethylene glycol and corrosion inhibitors), fuel oil or lube oil at temperatures up to 250°F. and pressures up to 30 PSI. Operates on magnetic proximity principle. Suitable for use under conditions of continuous vibration of approximately 5 mils amplitude at 5 to 15 CPS. Furnish with the following features:

1. Brass switch cartridge with sil-brazed or integral 2-1/2" square flange 1/4" thick, 4 holes 0.31" dia. on 1.62" centers. Electrical lead end of cartridge to be 1/2" male NPT. Pressure test (cartridge only) at 60 PSI.
2. Buna "N" unicellular hard rubber sponge float.
3. SPDT switch rated at 0.25 amps, 125 volts D.C. or 5 amps at 115 volts A.C. for relay service. Furnish 18" leads potted in cortridge and color coded(with float in the down position):

   Common - Black
   N.O. - Blue
   N.C. - Red

VENDOR PC. NO.:

VENDOR DWG. NO.: GHF-5400-G13, Rev. ① B

VENDOR: Gorn Division
GAP Instrument Corp.
110 Marcus Blvd.
Hauppauge, New York 11787

NOTE: Switch actuates at approx 1/16" above center line for water and 1/8" above center line for diesel fuel on increasing fluid level. Reaction on decreasing fluid level occurs approx. 5/16" below actuation point of increasing level.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	8469	4-2-73	① WAS REV. A	EL

TITLE: LIQUID LEVEL SWITCH, FLANGE MOUNTED

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205713	1/21/71	ASSY. OR LO.	
DR. BY L.W.Cooper	1/18/71	SCALE	
CHK'D. BY L.W.C	1/18/71	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 906 081 | SHEET 1 OF 1

BF3009-2

DESCRIPTION: Whitey Forged Body Angle Valve, with the Following Features:

1. With 3/8" Male Pipe Connections
2. .250" Orifice
3. Vee Tip
4. Brass Body

VENDOR'S PART NO: 1VM6-A

VENDOR: WHITEY COMPANY
5679 LANDREGAN STREET
OAKLAND, CALIFORNIA

Repr.: Badger Valve & Tube Fitting
1504 Underwood Avenue
Wauwatosa, Wisconsin

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: VALVE, ANGLE .250 ORIFICE 3/8" MPT CONNECTIONS

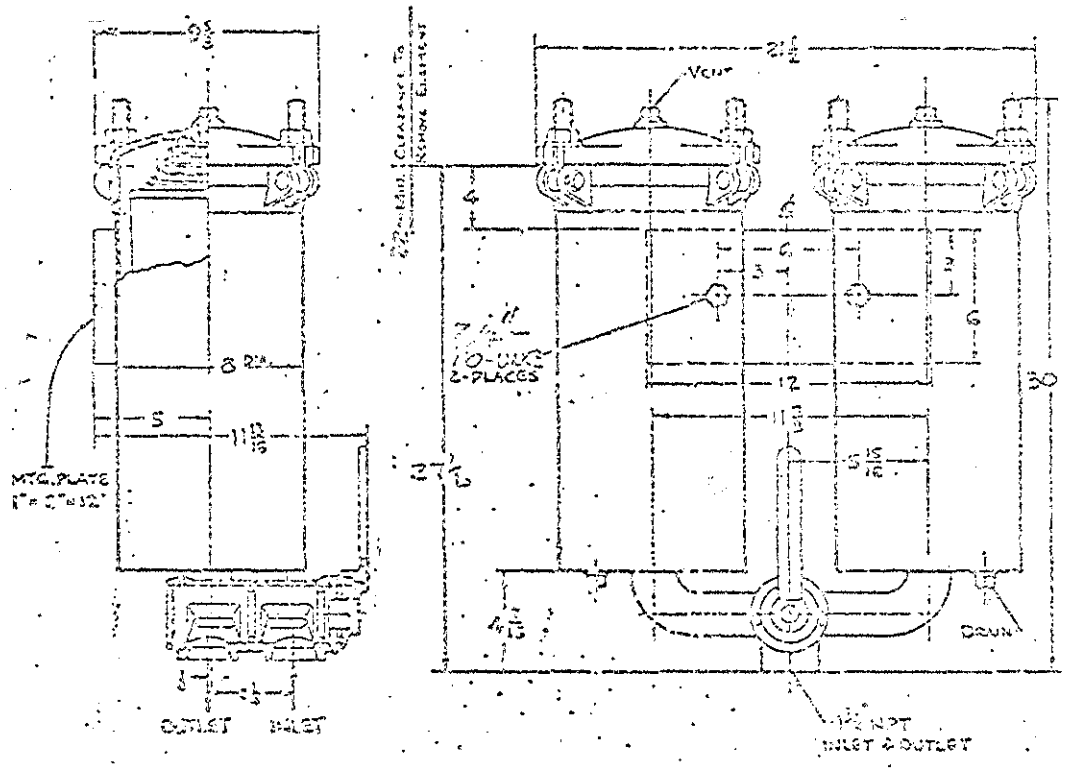
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .040 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC502	1/2 74	ASSY. OR LO.	
DR. BY L.W. Cooper	12/26/73	SCALE	
CHK'D. BY LWC	12/26/73	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 907 024 | SHEET 1 OF 1

11 908 171



VENDOR PART NO: 11-422-201

VENDOR: WM. W. NUGENT CO.
SKOKIE, ILLINOIS

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

(2)

APPROVED
Rev. 2
MAR 10 1977
QUALITY CONTROL

APPROVED
DEC 22 1976
QUALITY CONTROL

SEE 11 908 456 FOR COLT FMED
Q.A. REQUIREMENTS ON VENDOR
(1)

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REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D. BY
2	10236	3-16-77	SEE SHEET 2, 3 & 4	RNH
2	"	"	VIEW ADDED (2)	RNH
1	10102	10-29-76	(1) ADDED "SEE 11908456 Rev. 1" NOTE	JJS

TITLE: FILTER F.O. DUPLEX

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .020 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL NO. PC1503	9/3/76	ASSY. OR I.O.
DR. BY P. ESTRADA	8/30/76	SCALE
CHK'D. BY R. HUNKE	9/3/76	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A — DWG. NO. 11 908 171 — SHEET 1 OF

1190171

INSTRUCTIONS FOR INSTALLING AND OPERATING NUGENT ~~STRAINERS AND~~ FILTERS

GENERAL DATA

Filters may be furnished ~~with or~~ without internal bypass relief valves. ~~If so equipped, they are preset at the factory to open at the maximum recommended element differential pressure. The valve(s) IS (ARE) NOT~~ field adjustable.

~~Strainers cannot be equipped with internal bypass relief valves.~~

For lubricating oil filters not equipped with internal bypass relief valves, Nugent recommends the installation of a Model 1591 Dumping Valve to protect the element(s) from abnormal differential pressure.

If filter ~~or strainer~~ is not equipped with a gauge for determining differential pressure, it is recommended that gauges be installed in the inlet and outlet piping.

INSTALLATION INSTRUCTIONS

1. Locate unit so that there is adequate space for element removal. Refer to outline drawing for height needed.
2. Inspect piping leading to and from unit for scale, dirt, etc. and, if necessary, clean piping.
3. Remove protective covers from inlet and outlet piping and connect the filter or strainer. (Connections are clearly marked with pressure sensitive decals indicating the inlet and outlet connections, or refer to the outline drawing.)

CAUTION

DURING INSTALLATION, USE CARE SO AS NOT TO INTRODUCE DIRT INTO THE SYSTEM.

4. Remove cover and clean inside thoroughly. Inspect the element(s) for damage that may have occurred during shipment. Inspect cover gasket and gasket surface on cover. Replace cover. Torque head bolts to 70-80 lb.-ft. on sizes 1, 4L, and larger. ~~On the smaller sizes 0, HR, 1S, torque to 15-20 lb-ft.~~

~~CAUTION~~

~~ON 1116, 1576 AND 1554 SERIES, THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL SINCE FLOW IS FROM THE INSIDE OUT. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.~~

OPERATING INSTRUCTIONS

1. After filter ~~or strainer~~ has attained operating temperature, check the differential pressure across it. ~~On filters or strainers so equipped, this may be done with the three way valve located underneath the pressure gauge. Turn the valve handle to upstream (inlet) side and read the pressure; turn the valve handle to downstream (outlet) side and read the pressure. The difference in pressure readings is the differential pressure across the element(s). Always return the valve to the "off" (center) position.~~
2. It is recommended that the differential pressure be checked daily, as it indicates the amount of contaminant build-up within the element(s). When this differential pressure reaches approximately 20 psi at normal operating temperature, the element(s) shall be removed and replaced with genuine Nugent element(s) for series ~~1553~~, 1555 ~~and 1576~~ filters. Element(s) should be removed and replaced only after first referring to Nugent Co. element replacement instructions. ~~The strainer screen cylinder shall be cleaned for series 1554 and 1700 strainers or clean bags installed in series 1116 filters. Strainer cylinders should be cleaned and new filter bags should be installed only after first referring to Nugent Co. cylinder cleaning and bag installation procedures.~~

WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, IL. 60076, U.S.A.
Telephone: 312/674 7737 TELEX: 724-312
EST. 1877 WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

1190171

ELEMENT REPLACEMENT

SERIES 1555, ~~1577 AND 1578~~

When the differential pressure reaches 20 psi, the element(s) shall be removed and replaced with genuine Nugent element(s). Refer to parts list or name plate for part number of element(s) to be used in this filter.

1. Drain completely by removing the ¾" NPT plug(s) (1) located on the side and/or bottom of the filter shell. During draining, open vent, loosen nuts (3), and swing bolts (4) clear of cover lugs. Remove cover (2) by lifting to clear positioning tabs located on shell ring. DO NOT LAY COVER ON THE "O" RING SEALING SURFACE.
2. On single stack filters, remove spring plate assembly (7) and strainer tube (10). ~~On multiple stack filters, remove bolt(s) (3), pressure plate (5), spring plate assemblies (7), and strainer tubes (10).~~

CAUTION

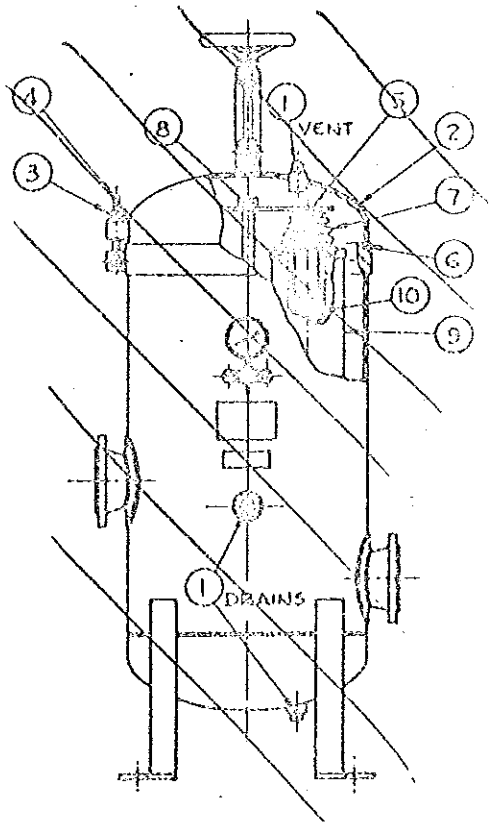
BEFORE REMOVING ELEMENT(S), CHECK TO MAKE SURE THAT THE LIQUID HAS BEEN DRAINED COMPLETELY.

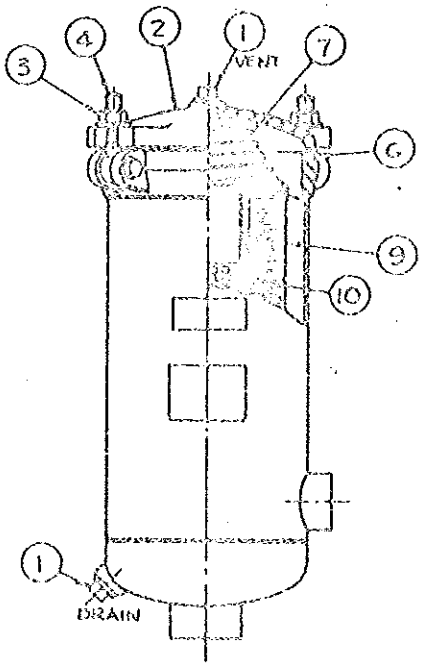
3. Remove and discard the element(s) (9). Inspect interior of vessel for loose or broken parts and excessive accumulation of dirt.

~~CAUTION~~

~~INSPECTION OF THE VESSEL INTERIOR IS PARTICULARLY IMPORTANT ON THE SERIES 1576 FILTERS, SINCE THE INTERIOR IS THE CLEAN SIDE OF THE FILTER. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.~~

4. Remove new element(s) from shipping container and inspect for damage that may have occurred during shipment. Place element(s) over seat(s) protruding from bottom of vessel. Make sure that each element seats securely and insert strainer tube (10).
5. Replace spring plate assembly(ies) ~~after checking condition of bypass valve(s) if filter is so equipped.~~
6. ~~On multiple filters, replace pressure plate (5) and bolts (3). Tighten bolts until pressure plate makes contact with top of tie rod. When pressure plate is properly installed, there should be approximately 3½ inches between the top of the elements and the bottom of the pressure plate.~~
7. Inspect "O" ring (6) and replace cover by lowering it onto the "O" ring. Align lugs before cover contacts "O" ring. DO NOT ROTATE COVER TO OBTAIN ALIGNMENT AFTER IT HAS CONTACTED "O" RING. Torque nuts (3) to 70-80 lb.-ft. on sizes 1, ~~4 and larger~~.
8. Close drain(s) and fill vessel with fluid. In order to assure complete filling of vessel, release trapped air through vent located on cover. Check for leaks. After filter has attained operating temperature, check the differential pressure. It should be less than 5 psi.





WM. W. NUGENT & CO. (INC.) 3460 CLEVELAND ST. SKOKIE, ILL. 60076, U.S.A.
Telephone: 312/674-7702 TELEX: 724-312
EST. 1897 WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

P/N 11-425-201
LIST OF MATERIAL

3-28-77

ASSEMBLY 11-425-201 DUPLEX FILTER 1555-1B-DN-W ISO 4

ITEM NO.	DESCRIPTION	ROUGH NUMBER	FINISH NUMBER	QUAN.	MATERIAL	COST OR PRODUCTION
1.	SHELL ASSEMBLY.		21-175-202	1		
2.	COVER		35-001-001	2		
3.	EYE BOLT		30-023-003	8		
4.	NUT, HVY. HEX.		01-043-003	8		
5.	WASHER		01-040-012	8		
6.	RIVET		01-060-004	8		
7.	RETAINING RING		01-058-001	8		
8.	PLUG, SQ. HD. 3/4" NPT		01-021-018	4		
9.	NAME PLATE		01-100-001	1		
10.	DECAL		01-091-002	1		
11.	O-RING		01-061-026	2		
12.	SPRING PLATE ASSY.		30-227-206	2		
13.	ELEMENT		30-400-201	2		x
14.	DISTRIBUTOR PLUG		35-008-001	1		x
15.	HANDLE		35-010-001	1		x
16.	BALL		01-109-001	1		
17.	SPRING		35-011-001	1		
18.	ROLL PIN		01-065-005	1		
19.	ROLL PIN		01-065-002	2		
20.	O-RING		01-061-004	1		
21.	O-RING		01-061-008	2		
22.	RETAINING RING		01-057-004	2		
23.	STRAINER TUBE		30-285-208	2		

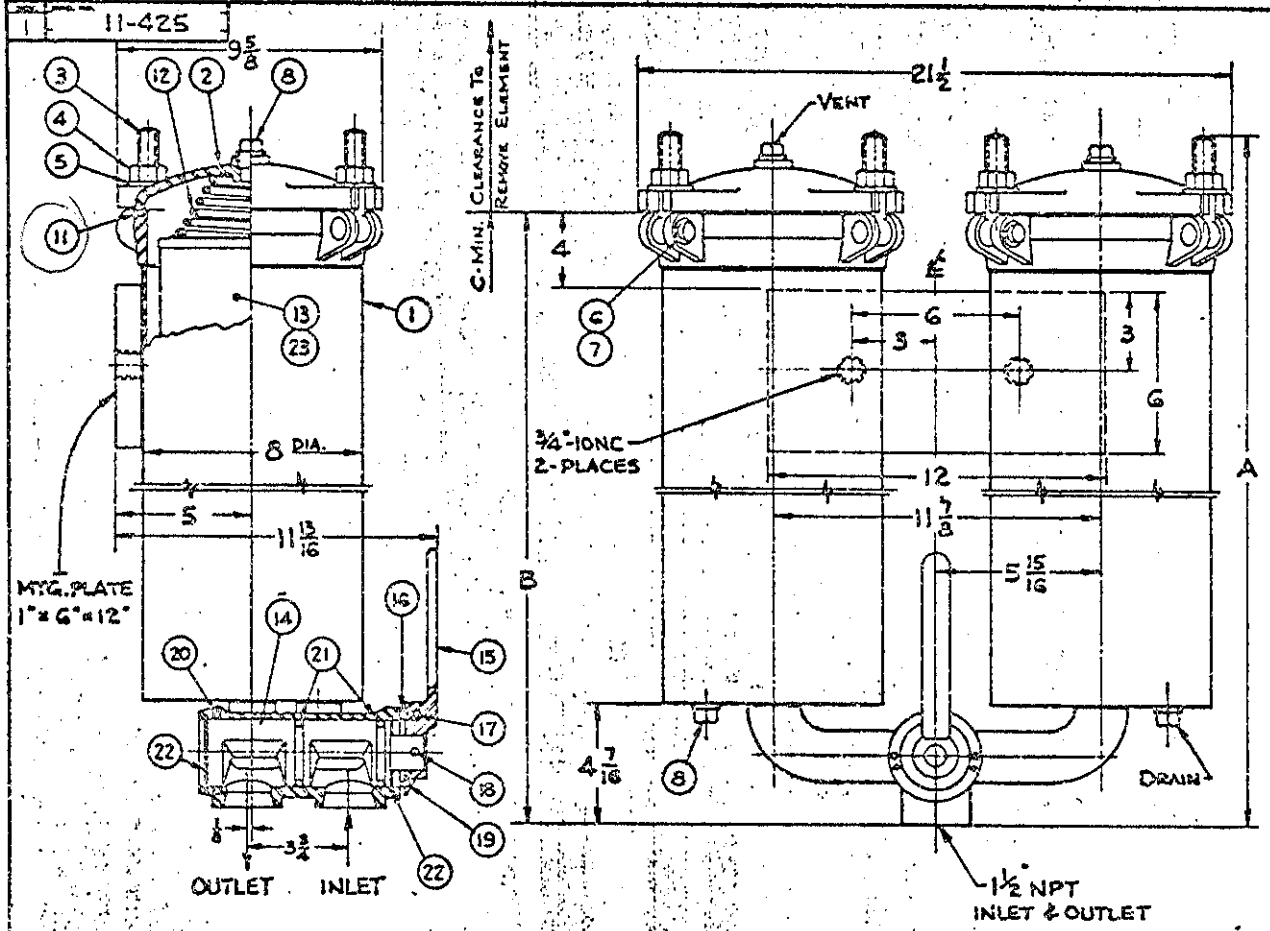
11-425-201

Engr. 3

List No.

Page No.

11-425



1. DESIGN PRESSURE 150 PSI.
TEST PRESSURE 225 PSI.
DESIGN TEMPERATURE 250°F
2. FABRICATED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASME CODE FOR PRESSURE VESSELS.

PART No	MODEL No	A	B	C	EMPTY WEIGHT	FULL WEIGHT
11-425-201	1555-18-DN-W	30	27 1/2	22	180	225

ALTERATIONS						
NO.	NAME	DATE	APP'D			
1	CHANGED					

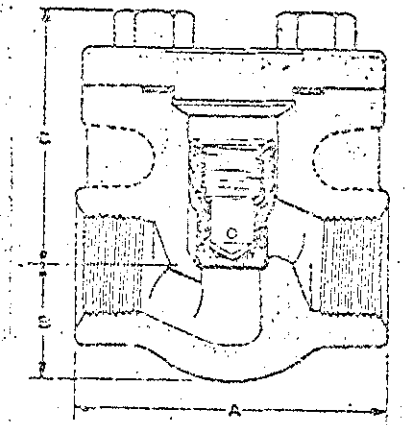
PART No. SEE TAB. | DUPLEX FILTER ASSEMBLY
MATERIAL SEE DET. B/M
TYPE | DRAWN BY | CHECKED BY | TOLERANCES 1/8
WM. W. NUGENT & CO. (INC.)
SKOKIE, ILL. U.S.A.
DATE | SCALE | DRAWING No. 11-425

VENDOR NO:

VENDOR: HENRY VOGT MACHINE CO.
P.O. BOX 1918
LOUISVILLE, KENTUCKY 40201

(1) SEE 11908456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



SIZE (Inches)	¼"	⅜"	½"	¾"	1"	1¼"	1½"	2"
Weight, Pounds, Approximate	2.6	2.5	2.7	3.5	6.5	11.7	16.5	25.0
A—Length, End to End, Inches	3¼	3¼	3¼	3½	4⅝	6⅛	6⅛	7½
B—Center to Bottom, Inches	1	1	1	1⅛	1 9/16	2⅛	2¼	2 13/16
C—Center to Top, Inches	2 5/16	2 5/16	2 5/16	2 5/16	3½	4½	4½	4 11/16

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED
NOV 18 1976
QUALITY CONTROL

APPROVED
OCT 24 1976
QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10123	11-10-76	See Sht. 3	
1	10097	10-29-76	Added "See 11908456.." Note (1)	
1	"	"	See Sheets 1, 2&3	

TITLE
VALVE, CHECK
3/4 (NPT (F)
ASME SECT. III. CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0x ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

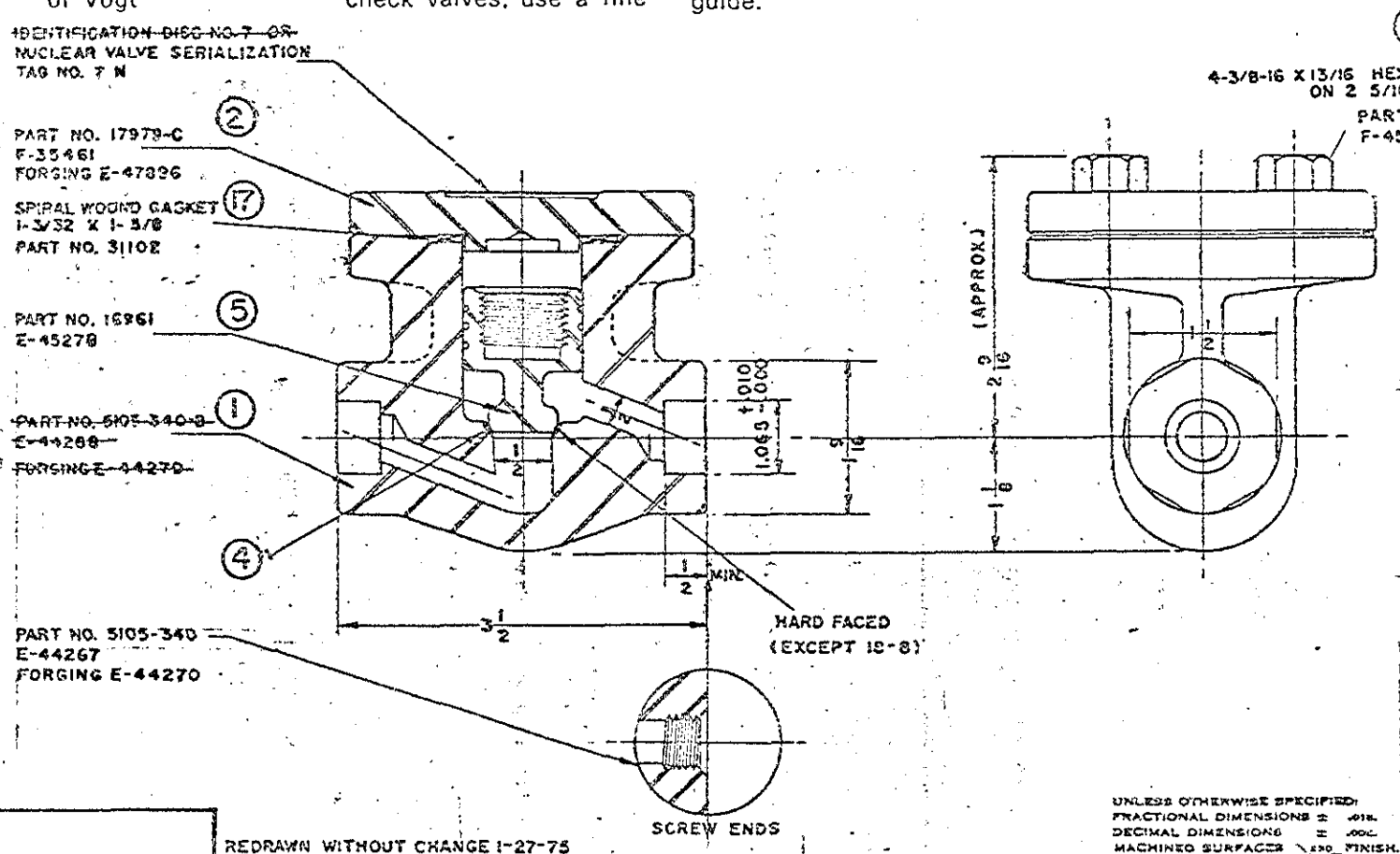
REL NO. PC1503	9/3/76	ASSY. OR LO	
DR. BY P. ESTRADA	8/30/76	SCALE	
CHK'D. BY L. Wilson	9/2/76	HEAT TR.	
MAT'L PURCHASE			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11 908 190	SHEET 1 OF	

REPAIRING CHECK VALVES

Leakage through seat and disc is not always easy to detect, but when definitely known to exist, immediate repair is recommended since delay may permanently injure the disc or seat, or both. If seating surfaces show galling, slight pittings, grooving or indentations not deeper than 0.010", lapping will usually restore to tight closure. Defects beyond 0.010" cannot be corrected by lapping but seating surfaces can be remachined or new parts installed. For relapping the seat and disc of Vogt check valves, use a fine and a coarse grade emery-base compound, such as Clover Compound A and D. Apply a light coat of the fine, or A, compound to the seating surface of disc or stem, insert disc or stem into seat, and lap using an oscillating motion. Lap a few minutes and then wipe seating surfaces clean; this will clearly show extent of damage. If bad, use the coarse, or D, compound and lap until all defects are removed; then finish with a fine, or A, compound. It is recommended.

Vogt piston check valves do not require lapping fixtures as the bore of the valve body serves as a guide.

REVISION RECORD					
No.		DATE	FROM	TO	BY
1		2-1-77	ADDED	INSERT	R.E.K.



CONTRACT NO. LIMERICK 700000
LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

E.M. PART NO. 11908190
COLT INDUSTRIES
P.O.# B-45208-N
VOGT INVOICE NO. 214677-NUC

MATERIAL:
A.S.M.E. SECTION III
NUCLEAR, CLASS 3
"N" STAMP VALVES

R.E.K.
2-1-77

WEIGHT = 3.5 LBS. (APPROX.)

HENRY VOGT MACHINE CO.
LOUISVILLE, KY.

3/4 COMPACT DESIGN CHECK VALVE HORIZONTAL TYPE - FORGED STEEL BOLTED BONNET-GASKET JOINT (SPIRAL WOUND) - 70° INTEGRAL SEAT - BODY GUIDED DISC CHECK - ~~SOCKET WELD ENDS~~ & THREADED ENDS.
150# 300# 600# ANSI

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL DIMENSIONS ± .015
DECIMAL DIMENSIONS ± .005
MACHINED SURFACES 250 FINISH

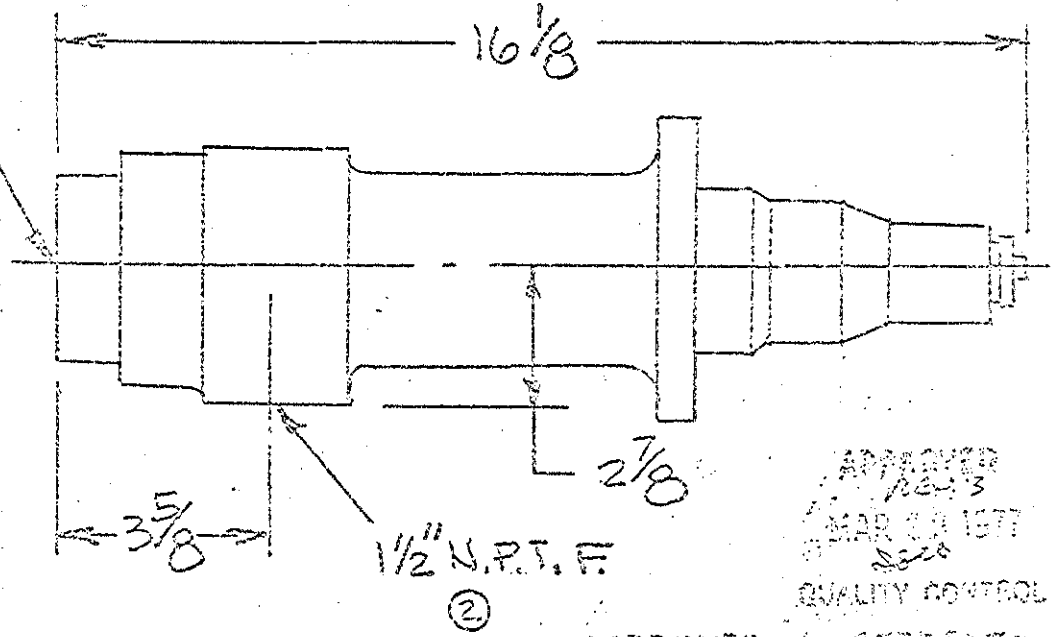
DRAWN BY R.E.K. ORIG. DATE 3-12-75
CHECKED BY
CHIEF ENG.
SCALE: NONE

REDRAWN WITHOUT CHANGE 1-27-75

E-48563 | REV. NO. 1 | 2-1-77 | E-48563

11908190

11 908 193



VENDOR PART NO:

VENDOR: J. E. LONERGAN
PHILADELPHIA, PA

REPR: GEORGE H. FREDRICK & CO.
MILWAUKEE, WI

(1) SEE 11908456 FOR COLT FMED Q.A. REQUIREMENTS FOR VENDOR

LCT-20

APPROVED Rev 3 MAR 08 1977 QUALITY CONTROL

APPROVED Rev. 2 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	10261	9-1-77	CHANGED VALVE SIZE (2)	
3	"	"	SEE SHEET 2	
2	10128	11-10-76	See Shts 3 & 4	
1	10097	10-29-76	Added "See 11908456... ..." Note (1)	
1	"	"	See Sheets 1 & 4	

TITLE
VALVE, RELIEF
25 TO 30 PSI
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .040
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1503	9/3/76	ASSY. OR LO.	
DR. BY P. ESTRADA	8/30/76	SCALE	
CHK'D. BY L.W.	9/2/76	HEAT TR.	
MAT'L PURCHASE			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 193 | SHEET 1 OF 4

11008193

MANUAL #69-A

J. E. LONERGAN COMPANY
Red Lion Road, West of Verree Road
Philadelphia, Pennsylvania

INSTRUCTIONS FOR INSTALLING, ADJUSTING AND DISMANTLING

"LCT" SERIES RELIEF VALVES

INSTALLATION

1) Always install relief valves in a vertical position - either directly connected to the equipment or to equal size fittings no longer than the end-to-end dimensions of an American Standard extra heavy TEE.

2) Thoroughly clean the inlet connections to valve before installation.

3) When flanged end valves are required, use proper gaskets and flange facings to match those of the valve. Tighten flange bolts evenly to exert uniform pressure.

4) Connect discharge piping carefully as above, and be certain that the piping is as large as the valve outlet, never less.

5) Provide rigid support for the discharge piping, taking special care to see that the valve does not support the weight of the discharge piping.

6) Where long piping is necessary on the discharge end of the valve, step up the size of the piping to minimize back pressure.

MAINTENANCE

Periodic, planned maintenance will insure longer and better performance from any product. Always be careful during any phase of maintenance since carelessness can be very destructive and costly.

TO REMOVE CAP

A. SCREWED CAP - Turn Cap counter-clockwise to remove. Be careful not to lose sealing gasket.

B. PLAIN LIFT CAP - Break seal and remove Yoke Pin and Yoke. Loosen set screw (or set screws) and lift cap from bonnet. No gasket is used with this type of Cap.

C. PACKED LIFT CAP -
(LCT-11 TYPE) - Unscrew packing gland housing (Part #21) counter-clockwise, shaft and gland assembly (Parts #22 and 24). Unscrew Cap (Part #1) counter-clockwise to remove. Be careful not to lose sealing gasket (Part #4).

(LCT-20 TYPE) - Remove Bonnet cap screws (Part #20). Lift Cap (Part #16) up allowing Lever (Part #26) to rotate so that Yoke (Part #22) will come clear of Lifting Disc (Part #17). Remove Cotter Pin (Part #18) and remove Lifting Disc (Part #17) by unscrewing off Stem (Part #10) in a counterclockwise direction.

ADJUSTING "SET" PRESSURE

The set pressure of a relief valve should not be adjusted over a range greater than plus-or-minus 10% of the original set pressure of the valve. However, it is not always good practice to take advantage of the full latitude of this adjusting range. Therefore, it is advisable to check with the manufacturer when set pressure change can be made using the existing springs, or whether new spring should be used. When a new spring is furnished, matched sets of spring steps are included for each spring to avoid fitting on the job.

When ordering parts for a set pressure change for any "LCT" valve, always specify the following:

Valve Model - Inlet Size - Original Set Pressure
Proposed Revised Pressure

When the proposed set pressure is within the range of the original spring, proceed as follows:

1. Turn the Locknut counter-clockwise, releasing the compression screw so that the spring load can be adjusted freely.

2. To increase the relieving pressure, turn the compression screw clockwise, and to decrease the pressure turn it counter-clockwise.

3. When the desired setting is reached, turn the Locknut clockwise, locking the Adjusting Screw.

4. Replace the Cap, by reversing procedure above.

   NOTE: It is always advisable to disconnect the outlet piping when testing or resetting relief valve to observe the exact opening point.

When proposed new set pressure requires replacement of Spring, proceed with dismantling as follows:

1. Loosen Locknut (Part #3), turning counter-clockwise.

2. Back-off Compression Screw (Part #2) by turning counter-clockwise until there is no load on Spring (Part #7).

3. Un-screw Base (Part #12) and Bonnet (Part #6).

4. Lift Bonnet (Part #6) off stem and Spring Assembly (Parts #7 and 8) being careful not to drop any of the parts that are now exposed.

5. Lift Spring and Stem Assembly out of Disc. Replace Spring and Spring Steps Assembly (Parts #5 and 7) with new Assembly.

   NOTE: While valve is this far apart, it is wise to check condition of seating surfaces of Disc and Base and re-condition if necessary.

6. Shake Disc (Part #9) out of Guide (Part #10) and remove Guide (Part #10) from Base (Part #12). Both seating surfaces are now exposed and can be examined. If re-conditioning is necessary, proceed as follows:

LAPPING SEATS

When the seating surfaces are lightly scratched, they can be completely reconditioned by using a cast iron lapping plate or a ring lap which is clean and flat. The actual lapping is accomplished by first applying a thin coating of compound to the lap or block. Keep the piece flat on the lapping plate and use a figure eight (8) motion. When using a ring lap an oscillating motion should be used. When lapping, apply uniform but light pressure being careful not to rock the piece. The disc should never be lapped to the base.

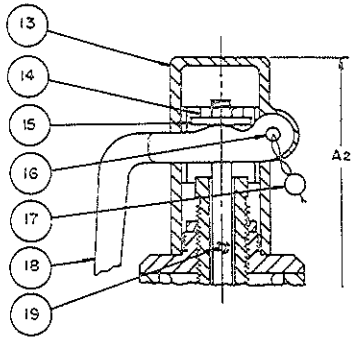
The base seat is on a slight angle. Therefore, only the inner surface is lapped. Too much lapping will make the seating larger than desirable. Where the seating surfaces have deep nicks, re-machining, followed by lapping is required. The base seat should be machined on a 2½ degree angle and then lapped lightly so that only a small inner surface will be flat.

Lapping compounds vary from coarse to fine. Generally a medium compound is used first, then a very fine compound to finish the piece. Clean the plate thoroughly after each different compound is used. Coarse compounds are to be used only when removing deep scratches and must always be followed by finer grades. It is advisable to have different plates for different compounds.

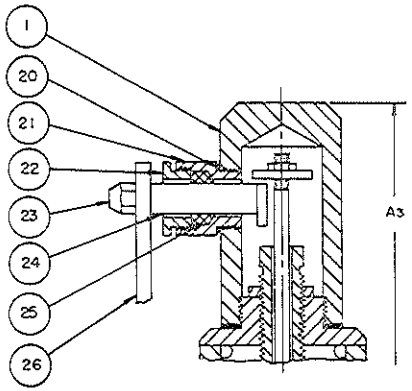
#1800	Medium	Crane Packing Co.
#1000	Fine	U.S. Products Co.
Levigated Alumina	Polishing	U.S. Products Co.

After lapping, be sure all grinding compound is removed from parts. To reassemble, reverse steps listed above.

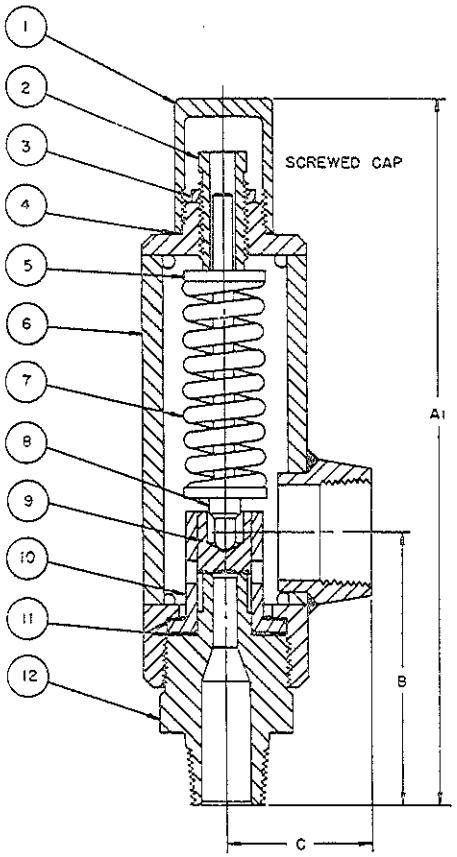
DWG. A-2176



PLAIN LIFT CAP



PACKED LIFT CAP



VALVE DATA

SIZE	MODEL	ORIFICE DISCHARGE AREA SQ. IN.	SERV. LIMITS PRESS P.S.I.	SERV. LIMITS TEMP °F	STD. CONN. INLET	STD. CONN. OUTLET	VALVE DIMENSIONS A1	A2	A3	B	C
1/2 X 1	LCT-11	.06	2000	400	MALE	FEMALE	8 1/2	9 15/16	9 3/4	3 1/4	1 3/4
	LCT-11T		2000	750							
3/4 X 1	LCT-11	.06	2000	400			8 1/2	9 15/16	9 3/4	3 1/4	1 3/4
	LCT-11T		2000	750							
1 X 1	LCT-11	.06	2000	400			8 3/4	10 3/16	10	3 1/2	1 3/4
	LCT-11T		2000	750							

LIST OF MATERIAL

PC. NO.	NAME OF PIECE		MATERIAL
1	CAP (SCREWED, PACKED)		COLD ROLLED STEEL
2	COMPRESSION SCREW		STAINLESS STEEL TYPE-303
3	LOCKNUT		STAINLESS STEEL TYPE-303
4	GASKET, CAP		SOFT IRON
5	SPRING STEP		COLLED ROLLED STEEL
6	BONNET		(SEE NOTE-1)
7	SPRING	LCT-11	CARBON STEEL (CADMIUM PLATED)
		LCT-11T	TUNGSTEN STEEL (NICKEL PLATED)
8	STEM		STAINLESS STEEL TYPE-416
9	DISC		STAINLESS STEEL TYPE-304
10	GUIDE		STAINLESS STEEL TYPE-416
11	GASKETS, GUIDE		SOFT IRON
12	BASE		STAINLESS STEEL TYPE-304
13	CAP (PLAIN LIFT)		DIE CAST BRASS
14	CASTLE NUT		STAINLESS STEEL TYPE-303
15	LIFTING DISC		STAINLESS STEEL TYPE-303
16	LEVER PIN		COLLED ROLLED STEEL
17	SEAL		LEAD
18	LEVER (PLAIN LIFT CAP)		STEEL
19	CAP SCREW		STEEL
20	GASKET		SOFT IRON
21	PACKING GLAND HOUSING		STAINLESS STEEL TYPE-303
22	PACKING GLAND		STAINLESS STEEL TYPE-416
23	LEVER NUT		COLLED ROLLED STEEL
24	SHAFT		STAINLESS STEEL TYPE-303
25	PACKING		ASBESTOS
26	LEVER (PACKED LIFT CAP)		COLD ROLLED STEEL

NOTES:

1. BONNET FABRICATED FROM CARBON STEEL ASTM A-106 AND AISI 1018.

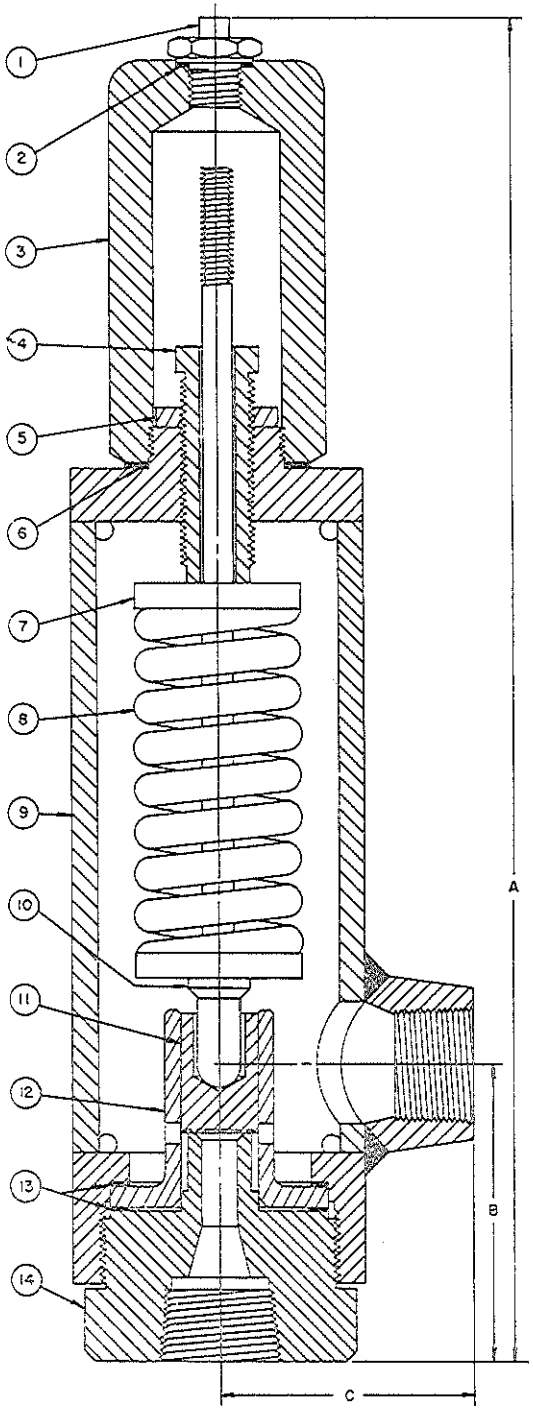
CERTIFIED PRINT
ALL DIMENSIONS GIVEN ARE TRUE AND CORRECT
J. E. LONERGAN COMPANY
ENGINEERING DEPT.
PER J. F. Sweet

COMPOSITE DRAWING OF MODEL LCT-11 RELIEF VALVE
J.E. LONERGAN COMPANY
PHILADELPHIA, PA.
DATE 7-22-70
DRAWN D.D. TRACED
CHECKED JFS APPROVED
DWG. NO. A-2176

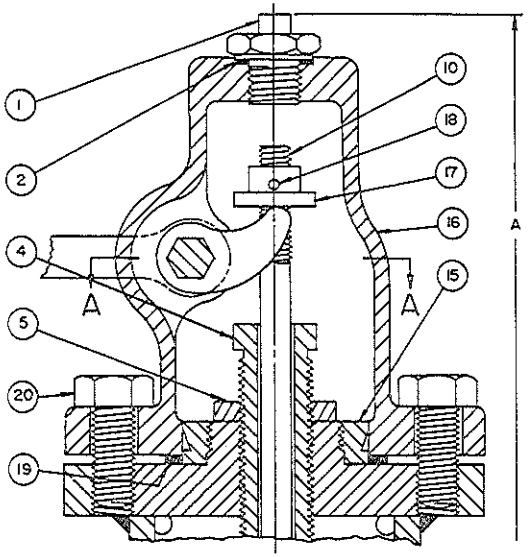


DWG. A-2177

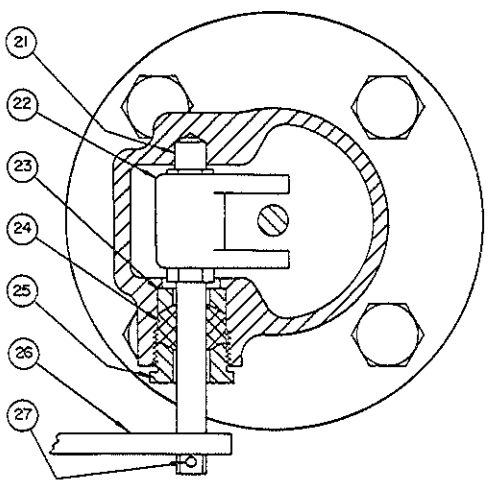
SCREWED CAP



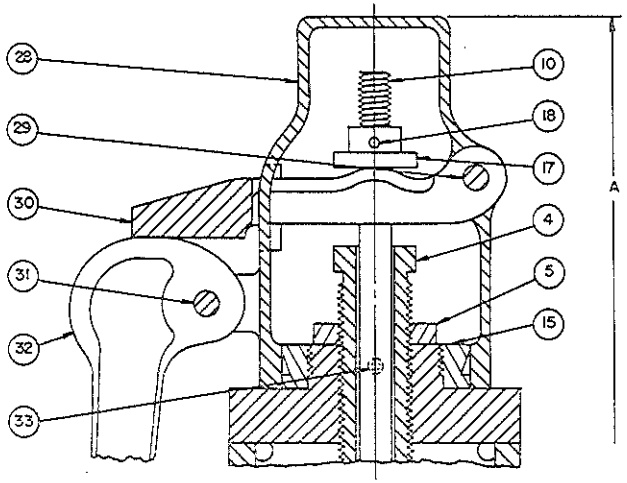
PACKED LIFT CAP



SECTION A-A



PLAIN LIFT CAP



LIST OF MATERIAL

FIG NO.	NAME OF PIECE	MATERIAL
1	GAG SCREW	STAINLESS STEEL-416
2	GASKET-GAG SCREW	SOFT IRON
3	CAP-PLAIN SCREWED	STEEL
4	COMPRESSION SCREW	STAINLESS STEEL-416
5	LOCKNUT	STAINLESS STEEL-416
6	GASKET-SCREWED CAP	SOFT IRON
7	SPRING STEP	COLD ROLLED STEEL
8	SPRING LCT-20	CARBON STEEL (NOTE 2)
	SPRING LCT-20T	TUNGSTEN STEEL (NOTE 2)
9	BONNET	(NOTE 3)
10	STEM	STAINLESS STEEL-416
11	DISC	STAINLESS STEEL-304
12	GUIDE	STAINLESS STEEL-416
13	GASKETS-GUIDE	SOFT IRON
14	BASE	STAINLESS STEEL-304
15	ADAPTER	COLD ROLLED STEEL
16	CAP-PACKED	CAST STEEL (NOTE 1)
17	LIFTING DISC	STAINLESS STEEL-303
18	COTTER PIN	STEEL
19	GASKET-PACKED CAP	SOFT IRON
20	CAP BOLT	STEEL (ASTM A-325)
21	SHAFT	STAINLESS STEEL-303
22	YOKE-PACKED CAP	COLD ROLLED STEEL
23	COLLAR	COLD ROLLED STEEL
24	PACKING	GRAPHITED ASBESTOS
25	PACKING GLAND	STAINLESS STEEL-303
26	LEVER-PACKED CAP	COLD ROLLED STEEL
27	COTTER PIN	STEEL
28	CAP-PLAIN LIFT	MALLEABLE IRON
29	YOKE PIN	STEEL
30	YOKE-PLAIN LIFT CAP	MALLEABLE IRON
31	LEVER PIN	STEEL
32	LEVER-PLAIN LIFT CAP	MALLEABLE IRON
33	CAP SCREWS	STEEL

NOTES:
1. CAST STEEL (ASTM A-216 GR. WCB)
2. CARBON STEEL (CADMIUM PLATED)
   TUNGSTEN STEEL (NICKEL PLATED)
3. BONNET FABRICATED FROM CARBON STEEL ASTM A-106 AND ASTM A-515 EQUIVALENT TO ASTM A-216 GRADE WCB.

VALVE DATA

SIZE	MODEL	ORIFICE DISCHARGE AREA SQ.IN.	SERV. LIMITS PRESS PSI	SERV. LIMITS TEMP °F	CONNECTIONS INLET	CONNECTIONS OUTLET	DIMENSIONS A	DIMENSIONS B	DIMENSIONS C
$\frac{3}{4}$ X 1	LCT-20	.110	5000	400	FEMALE	FEMALE	$16\frac{1}{8}$	$3\frac{5}{8}$	$3\frac{1}{8}$
	LCT-20T		5000	750					
1 X $1\frac{1}{2}$	LCT-20	.196	3000	400			$16\frac{1}{8}$	$3\frac{5}{8}$	$3\frac{3}{16}$
	LCT-20T		3000	750					
$1\frac{1}{2}$ X 2	LCT-20	.442	1500	400			$17\frac{5}{8}$	4	$3\frac{9}{16}$
	LCT-20T		1500	750					
2 X 2	LCT-20	.442	1500	400			$17\frac{5}{8}$	4	$3\frac{9}{16}$
	LCT-20T		1500	750					

11908193

CERTIFIED PRINT
ALL DIMENSIONS GIVEN ARE TRUE AND CORRECT
J. E. LONERGAN COMPANY
ENGINEERING DEPT.
PER J. F. Sweet

COMPOSITE DRAWING OF MODEL LCT-20 RELIEF VALVE

J. E. LONERGAN COMPANY
PHILADELPHIA, PA.

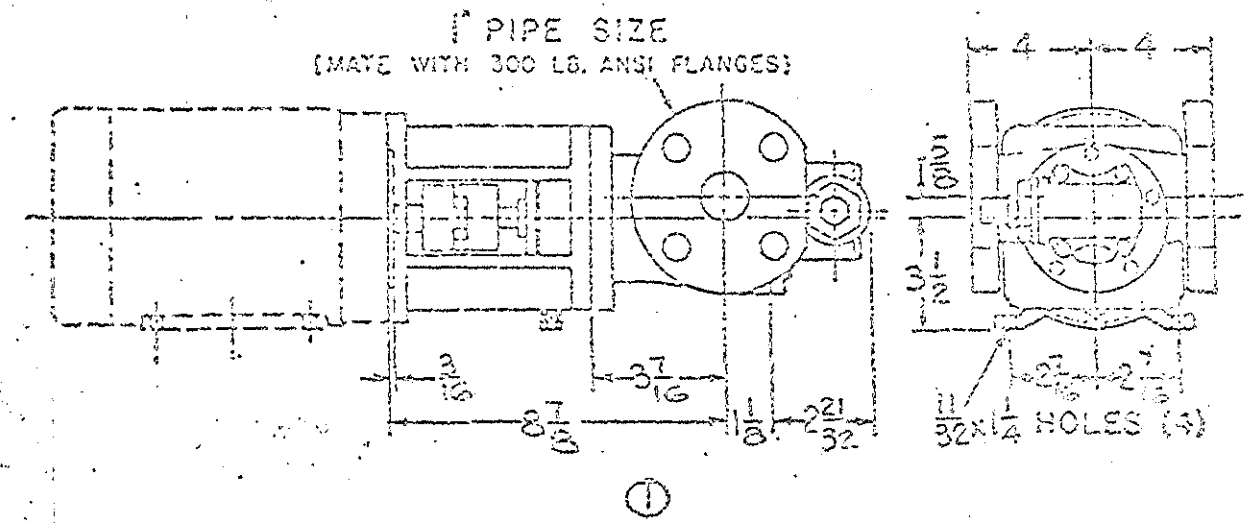
DATE 7-27-70

DRAWN D.D.	TRACED
CHECKED JES	APPROVED

DWG. NO. A-2177

11 908 194

DESCRIPTION: VIKING GG-93M FLANGE
BRACKET MOUNT PUMP
WITH STEEL EXTERNALS



①

VENDOR: VIKING PUMP DIV.
HOUDAILLE INDUSTRIES, INC.
CEDAR FALLS, IOWA

REPR: WALTER B. ROM & SON, INC.
1050 N. 115TH ST.
WAUWATOSA, WI

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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FOR DRIVE MOTOR, SEE 11 908 198

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11-77	See Shts 2,3,&4	
2	"	"	Sketch Redrawn - ① Brkt & coil added	
1	10098	11-22-76	SEE SHEET 3	

TITLE
PUMP, FUEL OIL
10 GPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES.
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1503	9/3/76	ASSY. OR LO.
DR. BY L.W. COOPER	8/30/76	SCALE
CHK'D. BY E. HUMKE	9/1/76	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 194 | SHEET 1 OF 4

INTRODUCTION

The illustrations used in this article are for identification purposes only and *should not be used for ordering parts.* Secure a parts list from the factory or a Viking representative. Always give complete name of part, part number and material with the model and serial number of the pump when ordering repair parts. The unmounted pump or unit model and serial number can be found on a nameplate attached to the pump or base.

In the Viking model number system, the basic size letters are combined with the series number (93) indicating both the unmounted or mounted pump units.

UNMOUNTED PUMP	UNIT
FLANGE MOUNTED FLANGED PORTS	Units are designated by the unmounted pump model numbers followed by a letter indicating drive style. M — Horizontal Direct Drive IM — Vertical In-line Direct Drive
GG93 HJ93 HL93 AS93 AK93 AL93	

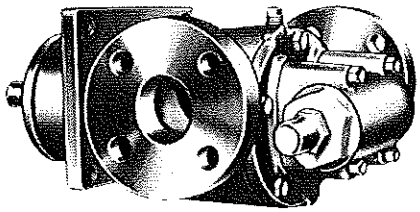


FIGURE 1
GG, HJ and HL SIZE 93 SERIES
Unmounted Pump with Flanged Ports

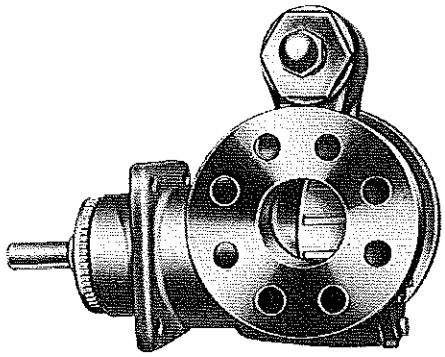


FIGURE 2
AS, AK and AL SIZE 93 SERIES
Unmounted Pump with Flanged Ports

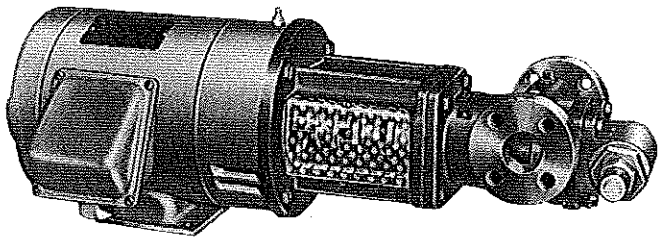


FIGURE 3
SERIES 93M
Horizontal Mounted Unit
With Tapped Ports

Maintenance

Series 93 pumps are designed for long, trouble free life under a wide variety of application conditions with a minimum of maintenance, however the following should be considered:

1. END CLEARANCE ADJUSTMENT—After long term operation it is sometimes possible to improve the performance of the pump, without major repair, thru adjustment of end clearance of the pump. Refer to instructions under Reassembly of the pump for information regarding this procedure.
2. CLEANING THE PUMP—It is good practice to keep the pump as clean as possible. This will facilitate inspection, adjustment and repair work and help prevent omission of lubrication to fittings covered or hidden with dirt.
3. STORAGE—If the pump is to be stored or not used for any appreciable length of time it should be drained and a light coat of lubricating and preservative oil should be applied to the internal parts. Lubricate all fittings.

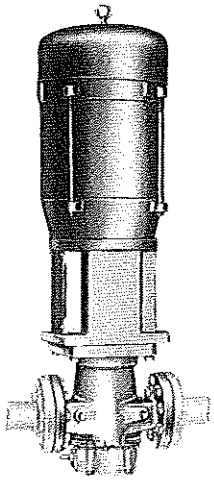


FIGURE 4
SERIES 93IM
Vertical Mounted Unit
With Flanged Ports

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

Disassembly

1. Remove the head capscrews.
2. Remove the head and O-Ring gasket.

CAUTION: AVOID TILTING THE HEAD DOWN, AS THE IDLER MAY SLIDE OFF.

3. Remove the idler from the idler pin. If the idler pin is worn, the head, idler pin and the idler bushing should be replaced.
   If the idler bushing is worn, it is strongly recommended that the idler and bushing be replaced. This bushing can be replaced in the field, but is very difficult. It is a brittle material, and extreme care should be taken to prevent breaking when it is being installed in the idler. If it is cracked in the idler, this bushing will quickly disintegrate. A hydraulic press should be used to install carbon graphite bushings. Be sure the bushing is started straight. DO NOT STOP the pressing operation until the bushing is in the proper position.
4. Remove the locknut from the shaft. A piece of brass rod or hardwood inserted in the port opening will hold the shaft from turning.
5. The rotor and shaft can now be removed from the casing. The spring and rotary member of the mechanical seal will come out with the shaft.

NOTE: On the HJ and HL size pumps the bearing housing and double row ball bearing must be removed before the snap ring in the shaft can be removed. The rotor and shaft cannot be removed until the snap ring is removed from the shaft.

6. Loosen the two (2) setscrews in the end of the bearing housing, turn the bearing housing counterclockwise and remove from the casing. Remove the snap ring from the bearing housing on GG, HJ and HL size pumps and the double row ball bearing can be removed. On the AS, AK, and AL size pumps you must loosen the setscrews in the outer ring of the bearing housing and remove bearing housing end cap, closure and bearing collar. Use a spanner wrench to remove the end cap.

Wash the bearing thoroughly and examine. If there is any evidence of wear or damage, a new bearing should be used.

7. Remove the snap ring and casing ball bearing in the GG, HJ and HL size pumps. Remove the bearing spacer in the AS, AK and AL size pumps. The bearing retainer washer, located between the casing bearing and seal seat, can now be removed if it did not stay on the rotor shaft when the shaft was removed.
8. The seal seat or stationary part of the seal can now be removed from the casing.
9. The casing should be examined for wear, particularly at the seal area between the port openings.

All parts should be checked for wear before the pump is put together. When making major repairs, such as replacing a rotor and shaft, it is usually advisable to also install a new head and idler.

Reassembly

1. Installing New Seal: See Figure 5. The seal is simple to install and good performance will result if care is taken in its installation.

NOTE: Never touch the sealing faces with anything except the fingers or a clean cloth. Clean the rotor hub, shaft and seal seat housing in the casing, making sure they are clean and free from dirt and grit.

Coat the outside diameter of the seal seat and the inside diameter of the seal housing bore with light oil. With thumb and forefinger, push the seal seat into place in the casing.

Place the tapered sleeve (furnished with replacement seals) on the shaft as far as it will go. Thin end must be toward end of shaft. See Figure 5. Coat the inside of the rotary member and the outside of the tapered sleeve with light oil. Be sure the shaft is free of nicks and burrs. Place the spring and rotary member on the shaft, spring first, over the sleeve and against the hub of the rotor. *Remove the tapered sleeve.*

2. Flush the sealing faces of both the rotary member and seal seat with light oil and install rotor and shaft. Push the rotor and shaft into the casing slowly until the ends of the rotor teeth are just beyond the face of the casing.

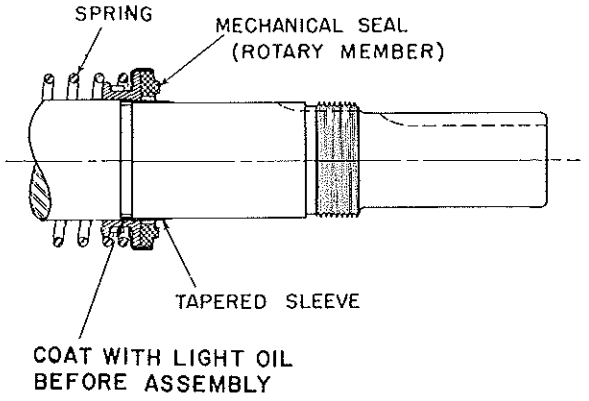


FIGURE 5

3. Place the idler on the idler pin and the O-ring head gasket on the head. Place the head assembly on the pump and tighten the capscrews evenly and securely. The seal is now automatically compressed to its proper working length.
4. Pack the single row ball bearing with grease and install in the casing. Install the snap ring in GG, HJ and HL pumps.

NOTE: The AS, AK and AL pumps do not have a snap ring, but the bearing retainer washer must be

assembled over the end of the shaft before the bearing is assembled.

5. Place the bearing spacer over the shaft and against the single row ball bearing in the casing. (AS, AK, & AL size pumps).
6. Install the snap ring in the groove in the shaft on the HJ or HL size pumps.
7. Pack the lubrication chamber between the casing ball bearing and the double row ball bearing in the bearing housing approximately half full with *lithium base ball bearing grease.*
8. Pack the double row ball bearing with *lithium base ball bearing grease* and press into the bearing housing. Install the snap ring to hold the bearing in place.

NOTE: On AS, AK and AL pumps, install the closure in the bearing housing end cap. Put the bearing spacer sleeve in the closure and install this in the bearing housing and tighten securely.

9. Start the bearing housing into the casing. Turn by hand until tight. This forces the rotor against the head. Replace and tighten the locknut on the shaft. Insert a piece of brass or hardwood through the port opening between the rotor teeth to keep the shaft from turning.
10. Adjust the pump end clearance as follows:

Thrust Bearing Adjustment

Loosen the two setscrews in the bearing housing and turn counterclockwise ½" measured on the outside of the bearing housing of GG, HJ and HL size pumps. This represents approximately .003" end clearance. On the AS, AK and AL size pumps, turn the thrust bearing assembly counterclockwise two notches which represents approximately .003" end clearance.

NOTE: Be sure the shaft can be rotated freely. If not, turn the bearing housing counterclockwise until the shaft can be turned. Be sure set screws are tightened securely after adjustment is made. High viscosity liquids require additional end clearance. The amount of end clearance depends on the viscosity of the liquid being pumped.

Valve Instructions

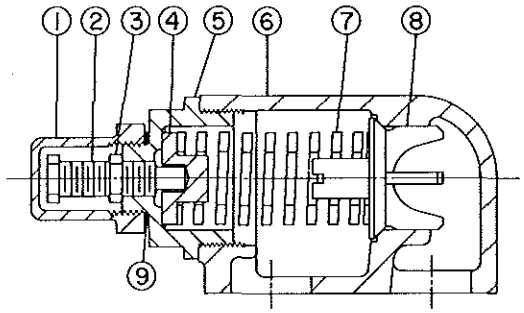


FIGURE 6 GG, HJ, HL SIZE VALVE

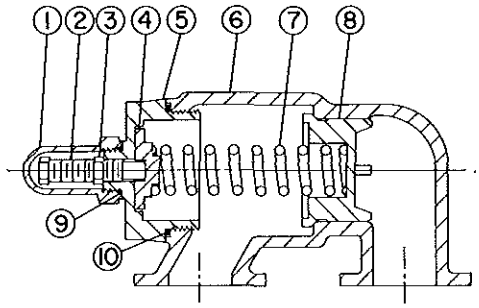


FIGURE 7 AS, AK, AL SIZE VALVE

LIST OF PARTS

1. Valve Cap	6. Valve Body
2. Adjusting Screw	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	10. Bonnet Gasket

Disassembly

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and repair or replace as necessary.

Reassembly

Follow the procedure outlined under disassembly.

If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

Pressure Adjustment

If the pressure setting of the valve is to be changed from that which the factory has set, the following instructions should be carefully followed: Remove the valve cap which covers the adjusting screw, and loosen the lock nut which locks the adjusting screw so pressure setting will not change during operation of pump. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the relief valve will allow while pump is in operation.

Important

In ordering parts for relief valve on head, always be sure to give Model and Serial Number of pump as it appears on name plate and the name of the part wanted. When ordering springs, be sure to give the pressure setting desired.

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

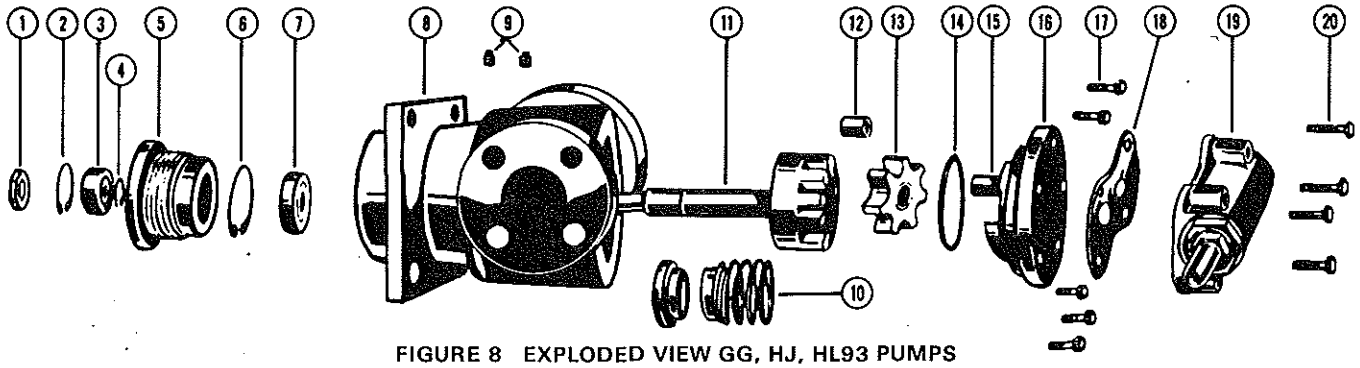


FIGURE 8 EXPLODED VIEW GG, HJ, HL93 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	11	Rotor and Shaft	Not Illus.	Mounting Bracket (For 56C, 143TC & 145TC Frame Motors)
2	Snap Ring, Outer	12	Idler Bushing		
3	Ball Bearing, Outer	13	Idler and Bushing	Not Illus.	Mounting Bracket (For 182TC & 184TC Frame Motors)
4	*Snap Ring for Shaft	14	O-Ring Gasket for Head		
5	Bearing Housing with Setscrews	15	Idler Pin	Not Illus.	Capscrew for Pump to Bracket (4-Req'd)
6	Snap Ring, Inner	16	Head (Valve Type) and Idler Pin		
7	Ball Bearing, Inner	17	Capscrew for Head (5-Req'd)	Not Illus.	Capscrew For Motor to Bracket (4-Req'd) (For 56C, 143TC & 145TC Frame Motors)
8	Casing	18	Gasket for Relief Valve		
9	Pipe Plug — 1/4" (2-Req'd)	19	Internal Relief Valve (Complete)	Not Illus.	Capscrew For Motor to Bracket (4-Req'd) (For 182TC & 184TC Frame Motors)
10	Mechanical Seal (Complete)	20	Capscrew for Valve (4-Req'd)		

*NOT USED ON GG SIZE PUMPS

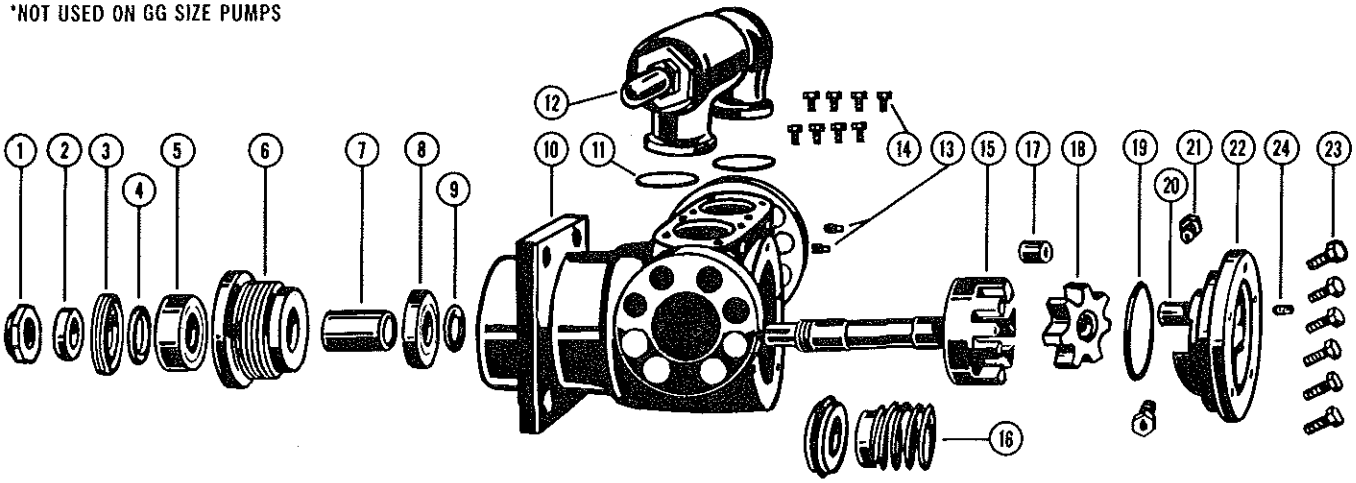


FIGURE 9 EXPLODED VIEW AS, AK, AL93 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	11	O-Ring Valve Gasket (2-Req'd)	21	Check Valve (2-Req'd)
2	Bearing Spacer Collar	12	Internal Relief Valve (Complete)	22	Head (Plain) and Idler Pin
3	End Cap for Bearing Housing	13	Pipe Plug — 1/4" (2-Req'd)	23	Capscrews for Head (6-Req'd)
4	Closure for Bearing Housing	14	Capscrews for Valve (8-Req'd)	24	Pipe Plug — 1/8"
5	Ball Bearing (2-Row)	15	Rotor and Shaft	Not Illus.	Mounting Bracket (For 182TC, 184TC, 213TC, 215TC, 254TC & 256TC Frame Motors)
6	Bearing Housing with Setscrews	16	Mechanical Seal (Complete)		
7	Bearing Spacer	17	Idler Bushing	Not Illus.	Capscrew for Pump & Motor to Bracket (4-Req'd) (For 182TC thru 256TC Frame Motors)
8	Ball Bearing (1-Row)	18	Idler and Bushing		
9	Bearing Retainer Washer	19	O-Ring Head Gasket		
10	Casing, Opposite Ports	20	Idler Pin		

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INSTALLATION

General

Before installation is started a few items of a general nature should be considered.

1. *Location* — always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.
2. *Accessibility* — the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.
3. *Port Arrangement* — since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see Figure 1. The right angle ports are normally right-hand, see Figure 2; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.

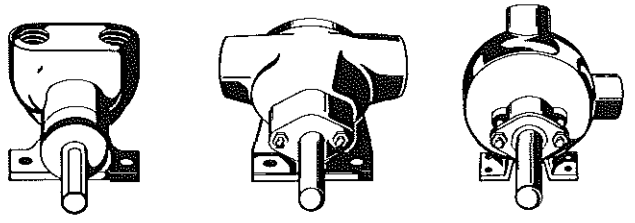


FIGURE 1

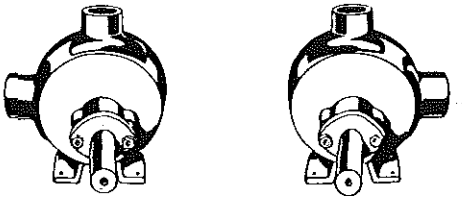


FIGURE 2

4. *Suction/Discharge* — shaft rotation will determine which port is suction and which discharge. A look at Figure 3 will show how rotation determines which port is which; as the pumping elements (gears) come out of mesh, point "A" on Figure 3, liquid is drawn into the suction port; as the gears come into mesh, point "B", the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump.

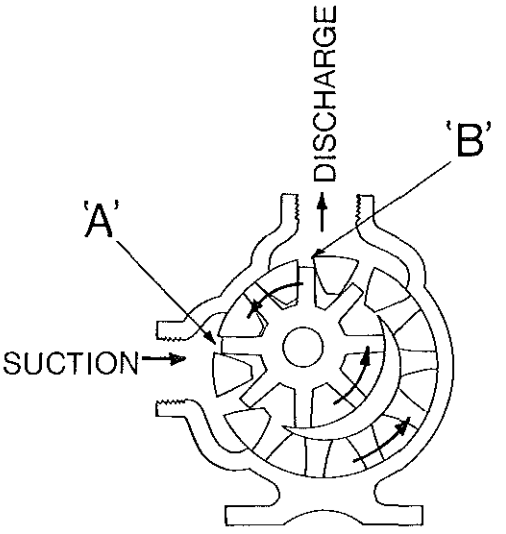
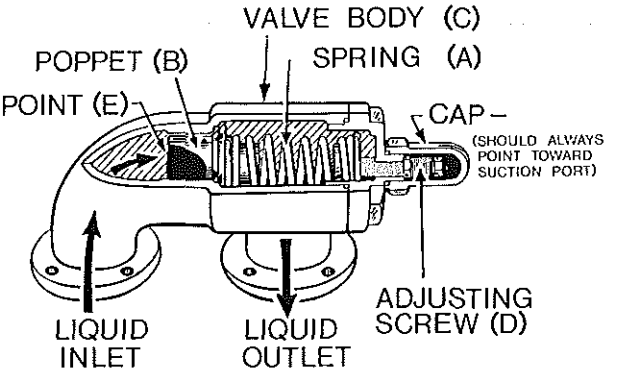


FIGURE 3

5. *Safety Relief Valve* — the Viking pump is a positive displacement pump. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for this liquid to go — discharge line is blocked or closed — the pressure will build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. To prevent the possibility of any one or more of these things happening in case of unintentional closing of the discharge line, the use of a safety relief valve is recommended. A safety relief valve will relieve the pressure at a predetermined value, thus protecting the entire system.



CUT-AWAY OF VIKING INTERNAL SAFETY RELIEF VALVE

FIGURE 4

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

The safety relief valve mounted on Viking pumps (optional on many models) and most in-line valves are of the spring loaded poppet design. See Figure 4. The spring (A) holds poppet (B) against the seat in the valve body (C) with a given force determined by the spring size and by how tightly it is compressed by the adjusting screw (D). The pump discharge pressure pushes against the under side of the poppet at point (E). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve. As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This pressure is the relief valve setting.

Viking pumps can be furnished with either an internal safety relief valve — one which directs the flow from the valve back to the suction side of the pump — or a return-to-tank valve which directs the flow through piping back to the supply tank. See Figure 5. An inline safety relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank should also be as short and large as possible.

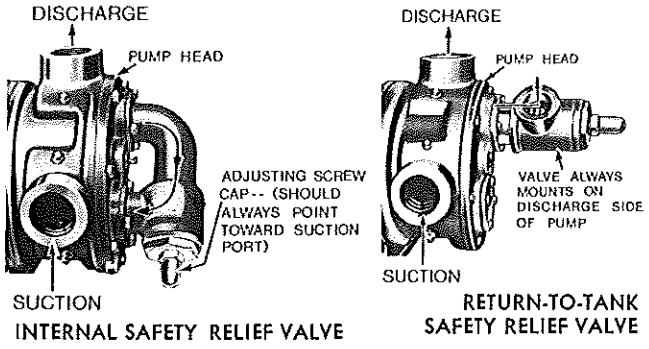


FIGURE 5

NOTE: on some models the safety relief valve is mounted on the pump casing instead of the pump head.

The spring loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should **not** be used as a pressure or flow control device. **It is intended strictly as a safety relief valve.**

CAUTION: THE INTERNAL TYPE SAFETY RELIEF VALVE MOUNTED ON THE VIKING PUMP SHOULD ALWAYS HAVE THE CAP OR BONNET POINTED TOWARD THE SUCTION SIDE OF THE PUMP. THE RETURN-TO-TANK TYPE SAFETY RELIEF VALVE SHOULD ALWAYS BE MOUNTED ON THE DISCHARGE SIDE OF THE PUMP. IF PUMP ROTATION IS REVERSED CHANGE THE RELIEF VALVE. TURN THE INTERNAL TYPE END FOR END; MOVE THE RETURN-TO-TANK TYPE TO THE OTHER PORT.

The pressure at which either type valve by-passes can be changed by turning the adjusting screw.

For details on maintenance of the relief valve see Technical Service Sheet covering your model series.

Foundation

Every pump should have a good foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

A certified print of the pumping unit should be used in preparing the foundation. Ask for one. If a separate foundation is provided, make it at least two inches wider and longer than the base of the unit.

When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

Alignment

CHECK ALIGNMENT AFTER MOUNTING

The pump, drive, and motor were properly aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **CHECK IT!**

1. Check pump ports to be sure they are square and in proper position; shim or move pump as required.
2. If the pump is driven by a flexible coupling(s), either direct connected to the motor or through a reducer, remove any coupling guards or covers and check alignment of the coupling halves. A straightedge (a piece of key stock works nicely) across the coupling must rest evenly on both rims at the top, bottom, and sides. See Figure 6.

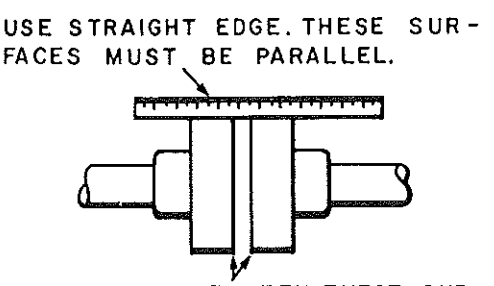


FIGURE 6

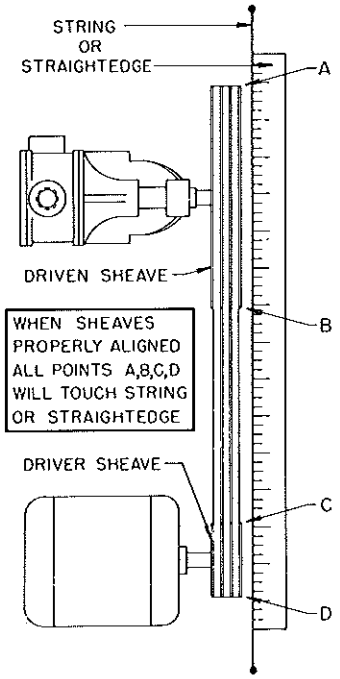


FIGURE 6A

3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See Figure 6A.
4. Make a final check on alignment after piping is hooked up. See item 13 under "Installation — Piping".

Figures 7, 8, and 9 show typical units — direct, gear reducer and V-belt drive.

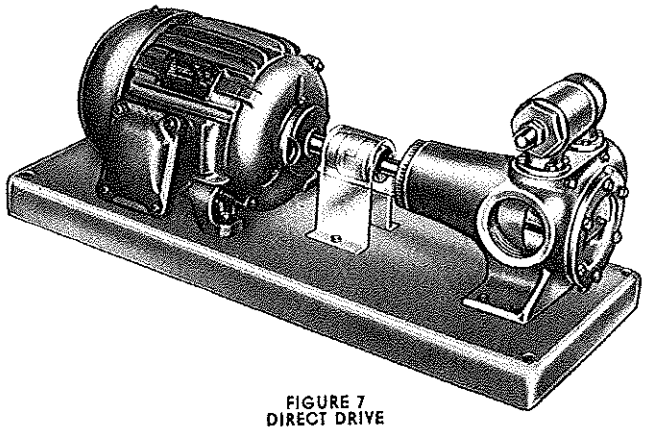


FIGURE 7
DIRECT DRIVE

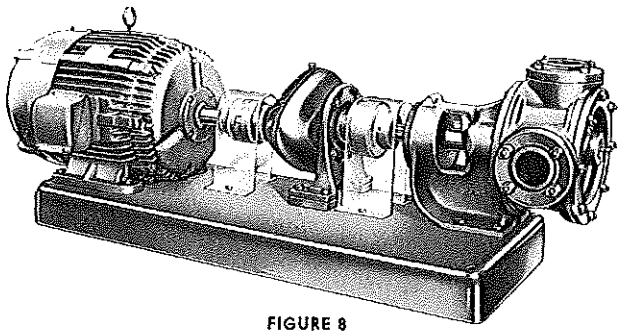


FIGURE 8
GEAR REDUCER DRIVE

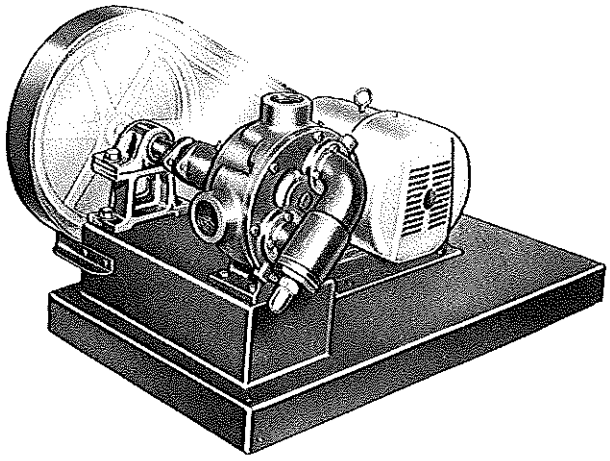


FIGURE 9
V-BELT DRIVE

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

Piping

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size piping, both suction and discharge, refer to Viking General Catalog Section 510.

Before starting layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.
2. Be sure the inside of the pipe is clean before hooking it up.
3. *Foot valve* — When pumping a light liquid with a suction lift, a foot valve at the end of the suction piping will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot valve is big enough so that it doesn't cause excessive line loss.
4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See Figure 10.

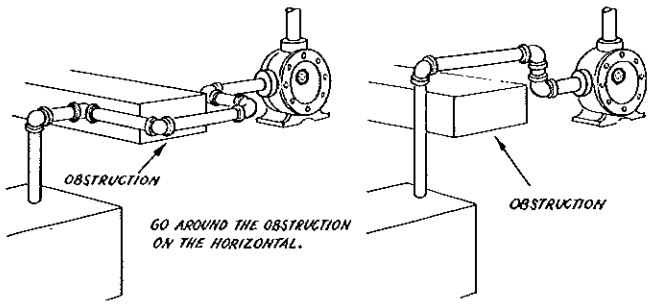


FIGURE 10

5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
6. For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no foot valve. See Figure 11.
7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted or put into a bind.

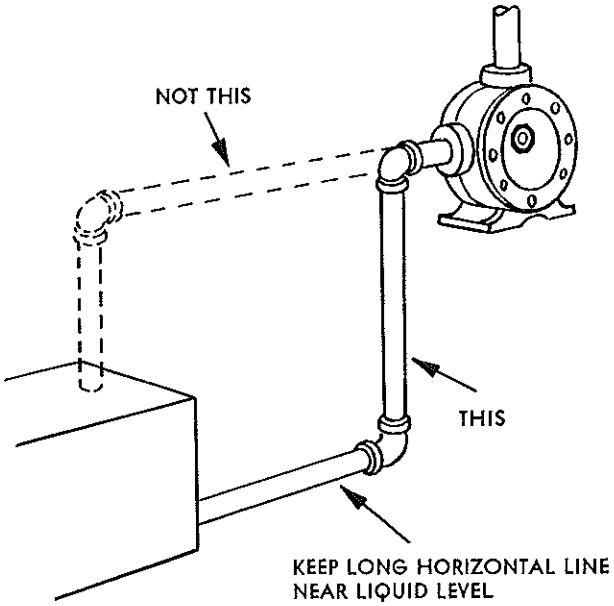


FIGURE 11

8. *Strainer* — It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be fine enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving him pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects.
9. If the pump is not equipped with a safety relief valve, consideration should be given to mounting one in the discharge line. See discussion on safety relief valves under START UP.
10. The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.

11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.
12. All joints of the piping system should be tight; pipe dope or teflon tape will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.
13. *Alignment* — Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size standard duty pumps.
14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the liquid pumped.

START UP

Before pushing the "start" button, check the following:

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. Check alignment — See suggestions under "Installation — Alignment" in this manual.
3. Check piping to be sure there is no strain on the pump casing.
4. Rotate the pump shaft by hand to be sure it turns freely.
5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under "Installation — General" item 4 in this manual.
6. Check any safety relief valve to be sure it is installed correctly. See discussion on safety relief valve under "Installation — General".
7. Check suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below liquid level.
8. Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the liquid to go.
9. Lubricate any grease fitting on the pump using a good, general purpose #2 ball bearing grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended.
10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.
11. Do **not** use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.
12. Check to be sure all guards are in place.
13. Now you are ready to push the "start" button — gently.

If the pump begins to deliver liquid within 60 seconds, you're in business. If it does not, push the "stop" button. Do **not** run the pump longer than one minute without liquid in it; you will ruin it. Review the steps just outlined, consider what the suction and discharge gauges indicate, see page 6 ; if everything appears to be in order, put some liquid in the pump, a lubricating liquid is best. This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver, the cause may be one or more of the following:

1. Suction line air leaks; vacuum gauge reading should help determine if this is the problem.
2. End of suction pipe not submerged deep enough in liquid.
3. Suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, suggest you review again all points given under START UP; read through Trouble-Shooting in this manual and try again. If it still does not pump, contact your Viking representative.

TROUBLE-SHOOTING

A Viking pump which is properly installed and maintained will give long and satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to *install a vacuum*

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gauge in the suction port and a pressure gauge in the discharge port. Readings on these gauges often will give a clue as to where to start looking for the trouble.

Vacuum Gauge — Suction Port

1. High reading would indicate —
   a. Suction line blocked — foot valve stuck, gate valve closed, strainer plugged.
   b. Liquid too viscous to flow through the piping.
   c. Lift too high.
   d. Line too small.
2. Low reading would indicate —
   a. Air leak in suction line.
   b. End of pipe not in liquid.
   c. Pump is worn.
   d. Pump is dry — should be primed.
3. Fluttering, jumping, or erratic reading —
   a. Liquid vaporizing.
   b. Liquid coming to pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
   c. Vibrating from cavitation, misalignment, or damaged parts.

Pressure Gauge — Discharge Port

1. High reading would indicate —
   a. High viscosity and small and/or long discharge line.
   b. Gate valve partially closed.
   c. Filter plugged.
   d. Vertical head did not consider a high specific gravity liquid.
   e. Line partially plugged from build up on inside of pipe.
   f. Liquid in pipe not up to temperature.
   g. Liquid in pipe has undergone a chemical reaction and has solidified.
   h. Relief valve set too high.
2. Low reading would indicate —
   a. Relief valve set too low.
   b. Relief valve poppet not seating properly.
   c. Bypass around the pump partially open.
   d. Too much extra clearance.
   e. Pump worn.
3. Fluttering, jumping, or erratic reading —
   a. Cavitation.
   b. Liquid coming to pump in slugs.
   c. Air leak in suction line.
   d. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A. Pump does not pump.
   1. Lost its prime — air leak, low level in tank, foot valve stuck.
   2. Suction lift too high.
   3. Rotating in wrong direction.
   4. Motor does not come up to speed.
   5. Suction and discharge valves not open.
   6. Strainer clogged.
   7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
   8. Pump worn out.
   9. Any changes in the liquid system, or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.

B. Pump starts, then loses its prime.
   1. Supply tank empty.
   2. Liquid vaporizing in the suction line.
   3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
   4. Worn out.

C. Pump is noisy.
   1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
   2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the liquid, raise the liquid level closer to the pump; if the liquid is above the pump, increase the head of liquid.
   3. Check alignment.
   4. May have a bent shaft or rotor tooth. Straighten or replace.
   5. Relief valve chatter; increase pressure setting.
   6. May have to anchor base or piping to eliminate or reduce vibration.
   7. May be a foreign object trying to get into the pump through the suction port.

D. Pump not up to capacity.
   1. Starving or cavitating — increase suction pipe size or reduce length.
   2. Strainer partially clogged.
   3. Air leak in suction piping or along pump shaft.
   4. Running too slowly; is motor the correct speed and is it wired up correctly.
   5. Bypass line around pump partially open.
   6. Relief valve set too low or stuck open.
   7. Pump worn out.

E. Pump takes too much power.
   1. Running too fast — Is correct motor speed, reducer ratio, sheave size, etc. being used.
   2. Is liquid more viscous than unit sized to handle; heat the liquid, increase the pipe size, slow the pump down, or get a bigger motor.
   3. Discharge pressure higher than calculated, check with pressure gauge. Increase size or

reduce length of pipe, reduce speed (capacity), or get bigger motor.

4. Packing gland drawn down too tight.
5. Pump misaligned.
6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

F. Rapid Wear.

On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. **Rapid wear,** occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. Some of the causes, evidence and cures are listed here.

CAUSE	EVIDENCE	CURE
1. Abrasives	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
2. Corrosion	Rust, general overall aggressive attack or sloughing off of metal.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3. Exceeding operating limits	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat.	Review General Catalog for operating limits on particular model involved.
4. Insufficient extra clearance	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your distributor or the factory with details of the application so that information regarding proper extra clearance may be provided.
5. Lack of lubrication	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all zerks are greased before starting and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6. Misalignment	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7. Run dry	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing color because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the cost per gallon pumped.

A. Lubrication — Grease all zerks after every 500 hours of operation or after 60 days, whichever occurs first. If service is severe, grease more often. Do it gently with a hand gun. Use a #2 ball bearing grease. If it is hot, use a heavier grease; if cold, use a lighter one.

B. Packing Adjustment — Occasional packing adjustment may be required to keep leakage to a slight weep; if impossible to reduce leakage by gentle tightening, replace packing or use different type. See Technical Service (TS) Manual on particular model series for details on repacking.

C. End Clearance Adjustment — After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See TS manual on particular model series for procedure on adjusting end clearance for pump involved.

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D. Examine Internal Parts — Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. See TS manual on particular model series for procedure in removing head of the pump. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.

E. Cleaning the Pump — A clean pump is easier to inspect, lubricate, adjust, and runs cooler; plus, it looks better.

F. Storage — If a pump is to be out of service or stored for a long time, drain it and protect it from rusting inside and out.

DO'S AND DON'TS

Do's and don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

Installation —

1. Do install pump as close to supply tank as possible.
2. Do leave working space around the pumping unit.
3. Do use large, short, and straight suction piping.
4. Do install a strainer in the suction line.
5. Do double-check alignment after the unit is mounted and piping is hooked up.
6. Do provide a safety relief valve for the discharge side of the pump.
7. Do cut out the center of gaskets used as port covers on flanged port pumps.
8. Do record pump model number and serial number and file for future reference.

Operation —

1. Don't run pump at speeds faster than shown in the catalog for your model.
2. Don't require pump to develop pressures higher than those shown in the catalog for your model.
3. Don't operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. Don't operate pumps without all guards being in place.
5. Don't operate pump without a safety relief valve on the pump or in the discharge piping; be sure valve is mounted and set correctly.
6. Don't exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.
7. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

Maintenance —

1. Do make sure any pump that has handled high vapor pressure liquids (LP-Gas, ammonia, Freons, etc.) has been vented before it is disassembled.
2. Do make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
3. Don't drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump; it may drop on your foot, plus, it may get nicked or gouged.
4. Don't stick fingers in the ports of a pump! The close running parts may trim more than your fingernails if the pump is rotated.
5. Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
6. Do remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
7. Do **obtain,** read and keep maintenance instructions furnished with your pump.

WARRANTY

Viking warrants (unless otherwise specified) all pumps and pump parts manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any pump or pump parts sold by Viking prove to be defective in workmanship or material under normal use and service, and if such pump or pump parts are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the pump or pump parts are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, F.O.B. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking pump or pump part are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of Houdaille Industries, Inc. or Viking Pump Division is authorized to alter this warranty.

VIKING HEAVY-DUTY STEEL VERTICAL INLINE UNMOUNTED PUMP

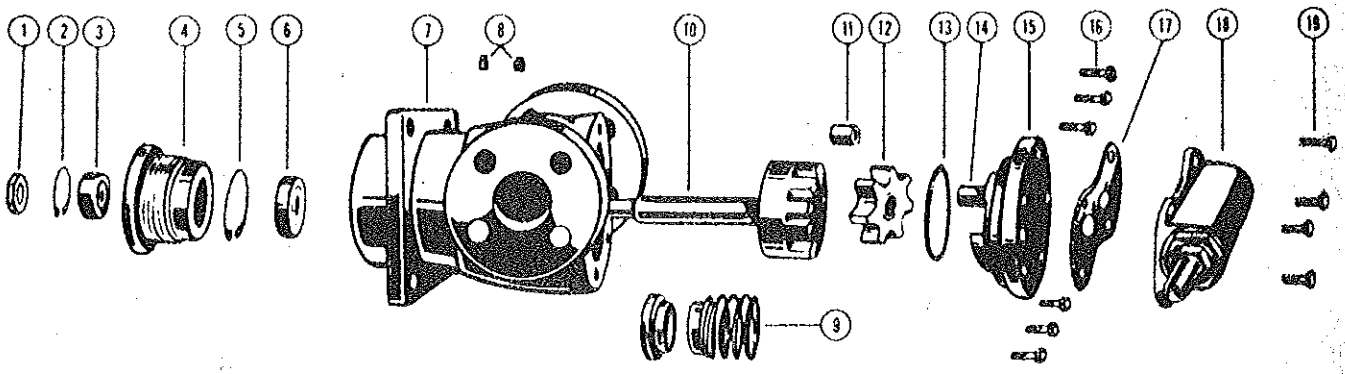
MODEL GG93 for Units GG93IM

PARTS LIST

SECTION	R120
PAGE	R120.19
EFFECTIVE	6-28-76
SUPERSEDING	4-18-75

SUBJECT TO CHANGE WITHOUT NOTICE
F.O.B. CEDAR FALLS, IOWA

SUPERSEDES ALL PREVIOUS LISTS



ITEM	PART NO.	DESCRIPTION	MATERIAL	PRICE EA.
1	2-505-002-376	Locknut	Steel	$ 1.10
2	2-555-005-375 *	Snap Ring,Outer	Steel	.65
3	2-055-005-375 *	Ball Bearing, Outer (New Dep.#5503)	Steel	15.00
4	3-060-037-956	Bearing Housing with Setscrews	Aluminum	15.00
5	2-555-006-375 *	Snap Ring,Inner	Steel	.65
6	2-055-006-375 *	Ball Bearing, Inner (Schatz #BR938T-1XB-00)	Steel	11.00
7	2-183-210-271	Casing	Steel	217.00
8	2-542-004-376	Pipe Plug-1/4" (2-Req'd)	Steel	.40 ea.
9	2-473-003-999 *	Mechanical Seal (Complete) √	Standard	18.00
10	3-564-200-012 *	Rotor and Shaft √	Iron & Steel	38.00
	3-564-207-420-23		Steel & Steel	99.00
11	2-091-004-880	Idler Bushing	Carbon Graphite	11.00
12	3-417-200-401 *	Idler and Bushing √	Steel P.M. & Carbon Graphite	25.00
	3-417-203-402-42		Steel & Carbon Graphite	51.00
13	2-511-001-860 *	O-Ring Gasket for Head √	Standard	1.10
14	2-431-001-281	Idler Pin	Hardened Steel	1.30
15	3-365-208-416	Head (Plain) and Idler Pin	Steel & Hardened Steel	83.00
	3-366-201-416 *	Head (Valve Type) and Idler Pin √	Steel & Hardened Steel	91.00
16	2-150-001-255	Capscrew for Plain Head (6 Req'd)	Steel	.05 ea.
	2-153-002-255	Capscrew for Valve Type Head (6-Req'd)	Steel	.05 ea.
17	2-316-003-806-30 *	Relief Valve Gasket √	Standard	.20
18	3-795-228	Internal Relief Value (Complete)	Steel External	66.00
19	2-150-004-255	Capscrew for Valve (4-Req'd)	Steel	.05 ea.
2, 3, 4	3-060-010-999	Bearing Housing Assembly (Complete)	Standard	30.00
not illus.	2-308-017-806-62	Pipe Flange Gasket (2-Req'd) √	Standard	1.30 ea.

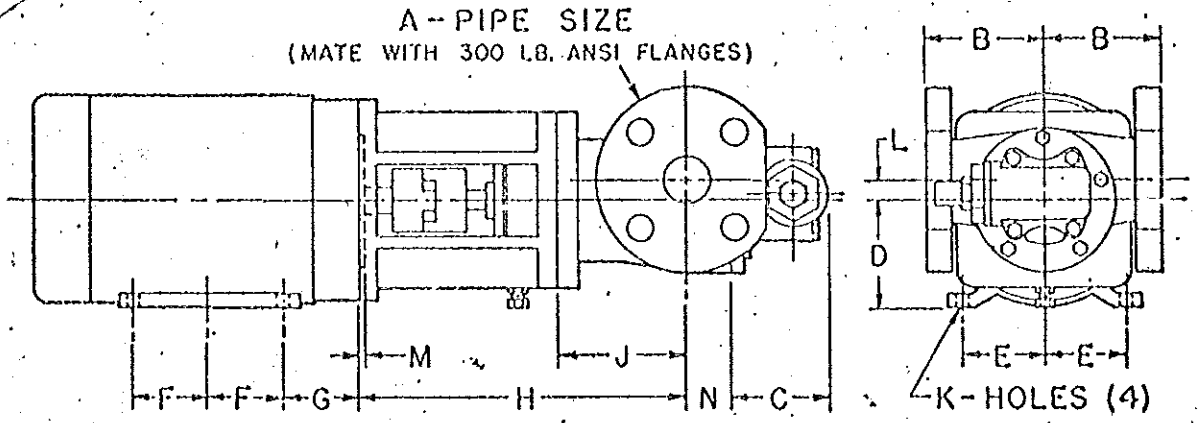
Minimum Billing $15.00

PURCHASE ORDER NO. B-451444-0
CONTRACT NO. 700000

* RECOMMENDED SPARES

When ordering parts, be sure to give PART NO., NAME OF PART, MATERIAL, MODEL & SERIAL NO. of pump as it appears on nameplate.

120.20



MODEL NO.	A	B	C	J	L	M	N	MOTOR FRAME	D	E	F	G	H	K
GG93M	1	4	$2\frac{21}{32}$	$3\frac{7}{16}$	$\frac{5}{8}$	$\frac{3}{16}$	$1\frac{1}{8}$	56C	$3\frac{1}{2}$	$2\frac{7}{16}$	$1\frac{1}{2}$	$2\frac{9}{16}$	$8\frac{7}{8}$	$\frac{11}{32}$ x $1\frac{1}{4}$
										62	38	65		9x32
								143TC		$2\frac{3}{4}$	2	$2\frac{7}{8}$		$\frac{11}{32}$
											51			
								145TC			$2\frac{1}{2}$			
										70	64	73	225	9
								182TC	$4\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{7}{16}$	$9\frac{9}{16}$	$\frac{13}{32}$
											57			
								184TC			$2\frac{3}{4}$			
		102	67	87	16	5	29		114	95	70	87	243	10
HJ93M	$1\frac{1}{2}$	4	$3\frac{9}{32}$	$4\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{16}$	$1\frac{1}{2}$	56C	$3\frac{1}{2}$	$2\frac{7}{16}$	$1\frac{1}{2}$	$2\frac{9}{16}$	$11\frac{1}{8}$	$\frac{11}{32}$ x $1\frac{1}{4}$
										62	38	65		9x32
								143TC		$2\frac{3}{4}$	2	$2\frac{7}{8}$		$\frac{11}{32}$
											51			
								145TC			$2\frac{1}{2}$			
										70	64	73	283	9
HL93M								182TC	$4\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{7}{16}$	$11\frac{13}{16}$	$\frac{13}{32}$
											57			
								184TC			$2\frac{3}{4}$			
		102	83	114	16	5	38		114	95	70	87	300	10

MODELS

NOTE: Dimensions shown in shaded area are millimeters, others are in inches.

FOR Walter B. Rom & Son, Inc.
Wauwatosa, Wisconsin 53226
ORDER NO. F-21501-JR
REQ. NO. Colt Industries, Inc.
Beloit, Wisconsin 53511

REFERENCE Milwaukee
INVOICE NO. E-43772
ORDER NO. B-451444-0
MODEL NO. GG-93M, Opposite Ports, 1" 300# Flg.
RELIEF VALVE With Stl. Internal SET AT 50 PSI
CONSTRUCTION Steel Head & Casing - Iron Fitted -
Carbon Graphite Idler Bushing - 2-473-003 Standard
Seal - Buna N O-Ring Head Gasket - Steel Internal
Valve with Cast Iron Poppet

MISCELLANEOUS MOTOR: 3/4 HP, 1800 RPM, 56C Frame

SERVICE: Liquid #2 Diesel Fuel, 10 GPM, 38-55 SSU Viscosity, 35 Discharge Head

TAG: Colt Part # 11-908-194 FUEL OIL PUMP, Colt P.O.# B-451444-0

DRAWING NO. GV-934

0124F129 1/24/77

CERTIFICATION NUMBER DATE

BY Ed. Reichenberger ENGR. DEPT.

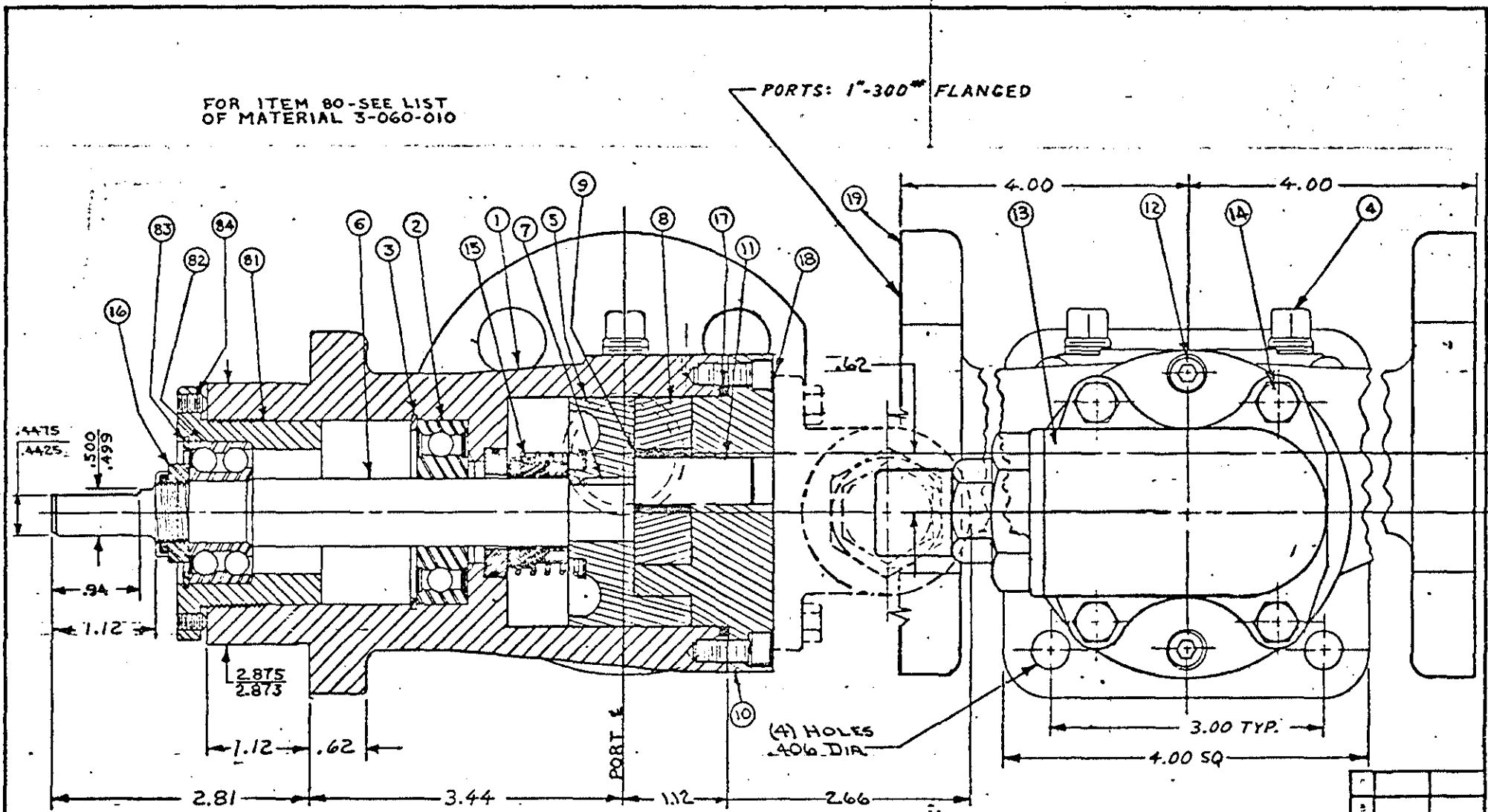
DRAWN BY BLASBERG DATE 6-2-75
CHECKED BY E.R. DATE "

THIS PRINT IS CERTIFIED

VIKING PUMP | HOUDAILLE
Viking Pump Division, Houdaille Industries, Inc.
Cedar Falls, Iowa 50613 U.S.A.

JAN 25 1977

JAN 24 1977



REV	CHANGE	DATE
C		
B		
A		

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PATTERN NO.	SCALE FULL	DATE 12-13-76
DRAWN B.Y. — CHECKED E.R.	APPROVED	

MODEL GG93 CONSTRUCTION PER LIST OF MATERIAL LM 4-1062-2942-501

VIKING PUMP CO., CEDAR FALLS, IOWA, U. S. A.

REF 4-1062-2942-[illegible]

DRAWING NO. 4-1062-2942-501 | SHEET 8

JAN 24 1977

STEEL EXTERIOR

MODEL GG93

LM- 4-1062-2942 Flange Mounted Pump With Steel Int. Relief Valve - 1" Opp. Flanged Ports 300#
Steel Head & Casing - Iron Fitted - Carbon Graphite Idler Bushing -
2-473-003 Standard Seal - Buna N O-Ring Head Gasket -
Steel Internal Valve With Cast Iron Poppet Dwg. No. 4-1062-2942-501

Walter B. Rom & Son, Inc. # F-21501-JR Viking Invoice # E-43772 Colt Industries

TAG: Colt Part # 11-908-194 FUEL OIL PUMP, Colt P.O.# B-451444-0

Item	SUB-ASSEMBLY NO.	PART NO.		MATERIAL	Qty.	DESCRIPTION
1		2-183-210-271		Steel	1	CASING, 1" Opp. Flanged Ports 300#
2		2-055-006-375		Steel	1	BEARING, Ball (1-Row, 1-Seal)
3		2-555-006-375	C	Steel	1	SNAP RING, Internal
4		2-542-004-376	C	Steel	2	PIPE PLUG 1/4
5	3-564-200-012-24	2-564-200-100-24		C.I.	1	ROTOR
* 6		2-617-001-260		Steel	1	SHAFT, Rotor
7		2-596-003-375	C	Steel	1	KEY, Rotor
8	3-417-200-40L-42	2-417-201-353-40		Steel P.M.	1	IDLER
* * 9		2-091-004-880-02		C.G.	1	BUSHING, Idler
10	3-366-201-416	2-366-201-271		Stl.	1	HEAD (Valve Type)
* * 11		2-431-001-281		Stl. Carb.	1	IDLER PIN
12		2-153-002-255	C	Steel	6	CAPSCREW (1/4 NF x 1/2) Head
13	3-795-228-000 -03			Steel	1	RELIEF VALVE, Set 50 #.
14		2-150-004-255	C	Steel	4	CAPSCREW (5/16 NC 3/4) Valve
* 15		2-473-003-999			1	MECHANICAL SEAL
80	3-060-010-999			Aluminum	1	BEARING HOUSING ASSEMBLY
16		2-505-002-376	C	Steel	1	NUT, Self Lock Hex 5/8 NF
* 17		2-511-001-860	C	Buna N	1	O-RING, Head Gasket
* 18		2-316-003-806-30	C	Comp. Asb.	1	GASKET, Relief Valve
* 19		2-308-017-806-62	C	Comp. Asb.	2	GASKET, Pipe Flange 1" 300#

NOTE: (1) Put Titeseal on Relief Valve Gasket.

THIS LIST OF MATERIAL
FOR REPLACEMENT PARTS
NOT FOR PRODUCTION DEPT.

* RECOMMENDED SPARE PARTS

*RECOMMENDED SPARE ASSEMBLIES

NOTE
ALWAYS GIVE
MODEL & SERIAL
NO. WHEN ORDERING
PARTS

JAN 24 1977

4-1062-2942-501

#10 Assm. 2937 | #30 Test 2563

SHEET NO. 1 OF 1 | MADE A.R. 6-21-73 | 3735 2-74

CHECK 1 | 4072 11-75

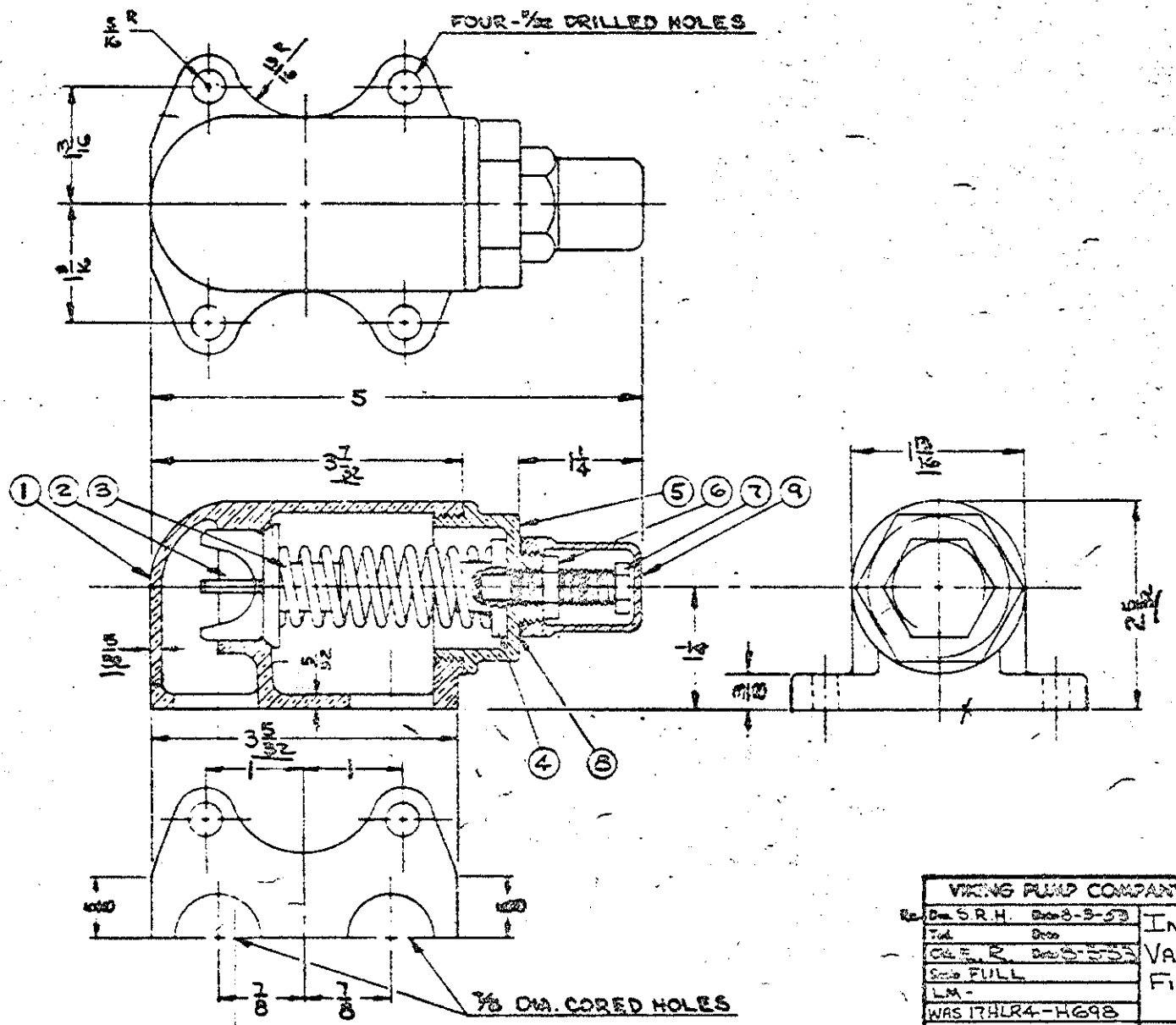
ENGR

LM 4-1062-2942-501 | Was 4-1062-2941-502

EX. END CL. .002

Form No. 211 F VIKING PUMP DIVISION, HOUDAILLE INDUSTRIES, INC. mf

JAN 24 1977



VIKING PUMP COMPANY, CEDAR FALLS, IOWA	
Dwn S.R.H. Date 8-9-57	INTERNAL RELIEF VALVE, STEEL-IRON FITTED for G, H, HL PUMPS
Trd. Date	
Ck'd E.R. Date 8-555	
Scale FULL	
L.M. -	
WAS 17HLR4-H698	
	3-795-228 DWG A SIZE

LM- 3-795-228 Relief Valve for G- H- HL Pump — MODEL 17-HLR-4

Steel Exterior - Iron Fitted — Drawing No. 3-795-228

Item	SUB-ASSEMBLY NO.	PART NO.	MATERIAL	Qty.	DESCRIPTION
1		2-795-001-271	Steel	1	BODY
2		2-796-004-100	C.I.	1	POPPET
					PRESSURE RANGE
					G ~~& H & HL~~
3		2-761-003-371 C	St.Cad.Plt.		SPRING ~~30-75~~ 50**
		~~2-761-004-371~~	~~St.Cad.Plt.~~		~~SPRING 76-125~~
		~~2-761-008-371~~	~~St.Cad.Plt.~~		~~SPRING 126-200~~
4		2-799-007-375 C	Steel	1	SPRING GUIDE
5		2-797-002-271	Steel	1	BONNET
6		2-503-004-376 C	St.Cad.Plt.	1	LOCKNUT
7		2-595-004-376 C	St.Cad.Plt.	1	ADJUSTING SCREW
8		2-305-009-808-40C	Fiber	1	GASKET, Adjusting Screw Cap
9		2-798-004-376 C	St.Cad.Plt.	1	CAP, Adjusting Screw

NOTE

/) SEAL BONNET TO BODY WITH TITESEAL.

JAN 24 1977

3-795-228

SHEET NO. 1 OF 1	MADE AR 5-10-72	3155 5-72	
	CHECK		
LM 3-795-228	ENGR		EX. END CL.
	RETYPED 5-10-72		

LM- 3-060-010 Bearing Housing Assembly

Aluminum For GG-195 DRG. NO. 3-060-010

Item	SUB-ASSEMBLY NO.	PART NO.	MATERIAL	Qty.	DESCRIPTION
81		2-060-001-707	Alum. A-10	1	BEARING HOUSING
82		2-055-005-375	Steel	1	BALL BEARING (2 Row - 1 Shield)
83		2-555-005-375 C	Steel	1	SNAP RING
84		2-596-003-375 C	Steel	2	SET SCREW #10-32 X 3/8

UL

3-060-010

SHEET NO. OF	MADE	1	#1742 4-9-63	
	CHECK	2	#1810 2-4-64	
LM 3-060-010	ENGR G-495			EX. END CL.

JAN 25 1977

JAN 25 1977

SUB-ASSEMBLY 3-060-010 CONSISTS OF THE FOLLOWING:

QUANTITY	PART #	NAME OF PART
(1)	2-060-001-707	BEARING HOUSING
(1)	2-055-005-375	BALL BEARING (2 Row - 1 Shield)
(1)	2-555-005-375	SNAP RING
(2)	2-596-003-375	SET SCREW #10-32 X 3/8"

UL

This drawing is the property of the Viking Pump Division, Houdaille Industries, Inc., Cedar Falls, Iowa and is proprietary in general and in detail. It shall not be copied or its contents revealed to outside parties without the written consent of the Viking Pump Division, Houdaille Industries, Inc., Cedar Falls, Iowa.

REF.	CHANGED	DATE
C		
B		
A		

PATTERN No.	SCALE	DATE 9-11-74	BEARING HOUSING - ALUMINUM For GG-195
DRAWN drd	CHECKED E.R.	VIKING PUMP HOUDAILLE	
APPROVED		Viking Pump Division, Houdaille Industries, Inc. Cedar Falls, Iowa 50613 U.S.A.	DRAWING No. 3-060-010 DRG. A SIZE

Form 455-C

Service	Fuel Oil	Req'n. No.	8031-M-71	Item No	
Plant	Limerick Gen. Sta.	Spec. No.	8031-M-71	No. Req'd.	8 (1 per diesel)
Location	Pottstown	P.O. No.		Cost Code	See M/R
Draw'g. Ref.	(Layout)	(Process)	M-20	Mfr.	Viking GG-93 2

LINE NO.				
1	Liquid Pumped / Newtonian or Non-N.		# 2 DIESEL FUEL OIL	
2	Viscosity (SSU) (CS): Norm. Temp. / Min. Temp. / Max. Temp.		38-55 SSU	
3	Vapor Press. (PSIA): Norm. Temp. / Min. Temp. / Max. Temp.			
4	Temperature (°F): Norm. / Min. / Max.			
5	Specific Gravity / Pour Point / Flash Point @ .....°F			
6	Solids: Type / % by vol. / Abrasive / Shape / Distr. / Density			
7	Gases: Entr. / Dis'd. / Solubility (% by Vol. at 30" Hg. abs.)			
8	Flow: Rating / Min. / Max.	(GPM)	16	12
9	Pressure: Outlet / Inlet / Diff. Max ΔP	(PSIG)	25	0 200
10	NPSH: Available / Req'd. @ ℄ Suction	(PSIG)	—	3.3 PSIA
11	Type of Pump		Rotary	2
12	RPM / Rotation Facing Coupling		1700	CW
13	Efficiency / BHP Rating / BHP Max		30 % 0.5	NA
14	Relief Valve: Internal - Setting / External - Setting	(PSIG)	50	NA
15	Suction Conn.: Size / Rating / Facing / Position		1" 300# FLAT	RIGHT
16	Discharge Conn.: Size / Rating / Facing / Position		1" 300# FLAT	LEFT
17	Mfr. Brg. No.: Radial / Thrust		NEW DEPARTURE #5503	
18	Base Plate: Pump (& Gear) Only / Comb. W. Driver (& Gear)		2-081-014 IRON BY VIKING	
19	Coupling: Mfr. / Model Size / Guard / Dr. Half Mtd.		LOVEJOY L070	
20	Seal: Packing Size, No., Type / Mech. Seal Mfr., No.		CRANE DWG. D-SK-1098 CODE 32P871-2561-B	
21	Lubrication: Main, Type / Secondary, Type / Max. Micron		NLGI #2	
22	Cooling: Water GPM., Pr. / Quench / Steam Jacket		NA	
23	Material: Case		STEEL	
24	Rotors		STEEL	
25	Shaft / Shaft Sleeve		STEEL	
26	Throat Bushing BEARING		STEEL	
27	Lantern Ring / Gland		NA	
28	Relief Valve		STEEL	
29	Base Plate		NA	
30	Cooling Piping / Steam Piping		NA	
31	Seal Piping / Lubrication Piping		NA	
32	Driver: Type (Motor - ~~XXXXXXXX~~) / RPM / HP (D.C.)		MOTOR BY CUSTOMER	
33	Furn. By / Weight / Dwg. / Mfr.		Seller	
34	Bearing Description: Radial, No. / Thrust, No.			
35	Lubrication: Radial / Thrust / Cooling			
36	High Speed Cplg.: Mfr. / Model / Furn. By			
37	Drawings: Outline / Sectional / Perf. Curve		GV-934	4-1062-2942-501 PC# 120-1
38	Net Weight		28 Lbs. Less Power	
39	Inspection: Std. / QA		YES	
40	Testing: Ultrasonic / Eddy Cur. / Mag. Part. / Liq. Pen. / Radiogr.		Manufacturer's Standards	
41	Hydrostatic / Witness // NPSH / Witness		Yes	
42	Performance / Witness / Disassembly		Yes	Yes
43	Quality Assurance: Mfr. Std. / Documented		Per 8031-G-1	
44	Codes		DEMA, ASME, ASTM, API, SNT	
45	Seismic Design Req's		Class I Seismic	
46			1AP538, 1BP538, 1CP538, 1DP538	
47	Equipment No.		2AP538, 2BP538, 2CP538, 2DP538	

FILL IN ALL BLANKS: IF NOT APPLICABLE MARK "NA"

NO.	DATE	REVISIONS	BCW	NOTES
2	7-30-71	Issued for Purchase		
1	3-25-71	Reissued for Bids		
0	8-11-70	Issued for Bids		

ORIGIN

BECHTEL

ROTARY PUMP DATA SHEET

D.C. MOTOR-DRIVEN FUEL PUMP FOR DIESEL GENERATORS
LIMERICK GEN. STA. UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY

JOB NO. 8031

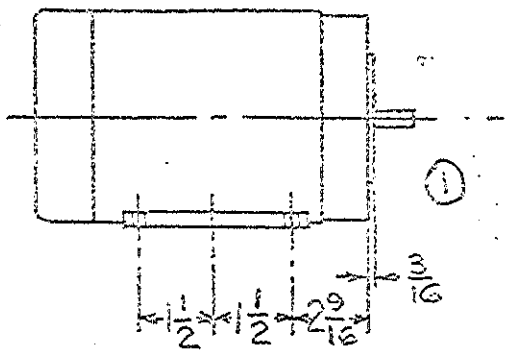
DATA SHEET NUMBER: 8031-M-71-DS-4

REV.: 2

2-2-70 M309E

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JAN 21 1971



VENDOR NO:

VENDOR: BALDOR ELECTRIC CO.

REPR: K. H. BURNER & ASSOC.
10721 W. CAPITOL DRIVE
SUITE 210
MILWAUKEE, WI 53222

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

FOR PUMP SEE 11908194

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11-77	See Sheets 2,3 & 4	
2	"	"	Motor sketch added ①	
1	10098	11-22-76	SEE SHEET 3 (NEW)	

TITLE
MOTOR, D.C.
3/4 HP, 100-140 VOLTS

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .030
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1503	9/3 76	ASSY. OR LO.
DR. BY P. ESTRADA	9/ 1 76	SCALE
CHK'D. BY R. HUMKE	9/ 1 76	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 198 | SHEET 1 OF 4

DIRECT CURRENT MOTORS

INSTALLATION AND MAINTENANCE

INSPECTION: Examine to determine that the motor has not been damaged in shipment and that the shaft turns freely by hand. Check the brush springs to see that they bear properly on the brush pressure plate. Check the nameplate voltage to be sure it agrees with power supply.

INSTALLATION: Motor should be mounted on a firm foundation. If foundation is not flat, shims should be used to prevent misalignment when tightening hold-down bolts. D.C. motors are equipped with ball bearings and may be operated in any position, however, shaft-up mounting should be avoided when possible. Location should be dry, clean and well-ventilated for most satisfactory service. Be sure possibility of oil seepage into the motor is prevented. Commutator end of motor should be available so that brushes can be conveniently inspected.

ALIGNMENT: Shafts should be carefully aligned with a straight edge before tightening any couplings. Remove paint, dirt and burrs with sandpaper. If necessary, use file or reamer for proper fit. Pulley or coupling should be carefully fitted. Do not hammer on shaft, pulley or coupling.

CONNECTIONS: If the motor is part of an SCR drive system, refer to the control manufacturer's diagrams and installation data. If motor is shunt wound and not part of an SCR control system, a proper resistance starter should be used. Use a fuse or circuit breaker rated at 125% of full load amperage on the nameplate. If the motor is series or compound wound, refer to the connection data tag attached to the motor. If the motor is a component part of a piece of equipment, be sure to refer to the Equipment Manufacturer's electrical circuit information for proper connection.

BEARINGS: The ball bearings are prelubricated and permanently sealed. The lubrication is sufficient for the life of the bearing. When bearings become worn, they will produce excessive noise, which is a warning that bearings should be replaced. They should be replaced in the following manner. Pull brushes out of brush holder. Remove pulley end plate , withdrawing rotor. Pull off bearing with a bearing puller, taking care not to mar center in end of shaft. The new bearing is pushed on the shaft gently by pressure on the Inner Race or by tapping gently on the Inner Race. See that no dirt enters the bearing housing. Reassemble motor, taking care that any bearing shims are assembled so that the brushes ride properly on the commutator. While the motor is disassembled, take the opportunity to blow out brush dust residue.

BRUSHES: Periodically, the brushes should be inspected and brush dust blown out of the motor. When brushes are worn down to about 3/4 of the wear length, they should be replaced. If at this time, the commutator is worn or rough, the armature should be removed. The commutator should be turned in a lathe, the mica recut, and commutator polished. Reassemble, and seat the new brushes using a brush seating stone. Be sure the rocker arm is set on the neutral mark.

REPAIRS: Unless maintenance personnel are properly qualified, it is advisable the repair work be done at a qualified service station. When ordering replacement parts, give Complete Nameplate Data.

DATA
SECTION 506

NOV. 27, 1978

REPLACES DATA
SECTION 506 of 4-15-78

BALDOR®

STANDARD MOTOR
RENEWAL PARTS SERVICE

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D. C. MOTOR INSTALLATION & MAINTENANCE	12

For any part not listed please provide complete description and ordering information requested below.

ORDERING INFORMATION

When ordering renewal parts always give complete motor nameplate data — **especially noting the Baldor specification number.**

Minimum charge is $15.00 net per order. All list prices are subject to discounts of product group P-1. F.O.B. factory, no transportation allowance.

BALDOR®

PHONE 501-646-4711
TELEX 53-7425 — TWX 910-723-7650
FORT SMITH, ARKANSAS 72902

CAPACITORS

ELECTROLYTIC

VOLTAGE AC	MED. VALUE MIN./MAX.	CATALOG NUMBER	CASE DIMENSIONS LENGTH*	CASE DIMENSIONS DIAMETER	LIST PRICE EA.
110/125	64- 77	31304	1-7/16	3-3/8	$ 2.50
	88-108	41304	1-7/16	3-3/8	2.80
	130-157	31300	1-7/16	3-3/8	3.25
	145-175	51304	1-7/16	3-3/8	3.35
	161-193	61304	1-7/16	3-3/8	3.70
	189-227	41300	1-7/16	3-3/8	3.90
	216-259	71304	1-7/16	3-3/8	4.25
	270-324	51300	1-13/16	3-3/8	4.80
	340-412	61311	1-13/16	3-3/8	6.00
	430-485	71311	1-13/16	3-3/8	6.55
	485-540	71300	2-1/16	4-3/8	7.35
	540-648	21300	2-1/16	4-3/8	8.00
	650-780	91300	2-1/16	4-3/8	8.80
	815-945	81300	2-1/16	4-3/8	10.60
	860-950	01300	2-1/16	4-3/8	12.45
220/230	72- 88	31302	1-13/16	3-3/8	6.95
	108-130	71302	2-1/16	4-3/8	7.80
	124-149	41302	2-1/16	4-3/8	8.40
	145-170	91302	2-1/16	4-3/8	10.30
	189-227	01302	2-1/16	4-3/8	10.85
	216-240	61302	2-1/16	4-3/8	14..35

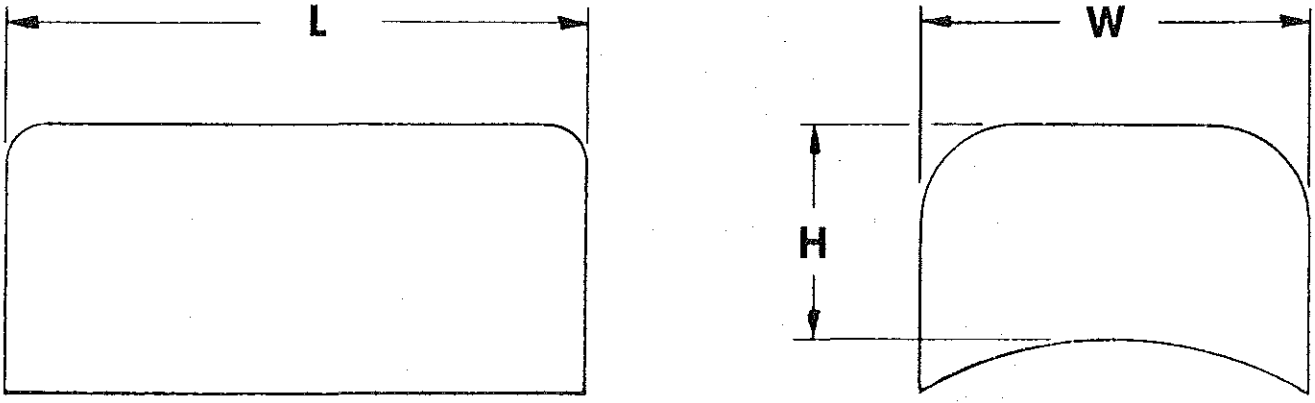
*Terminals Extend 1/32" Above Top Of Case.

OIL

MFD. VALUE	CAT. NO.	V.A.C.	LIST PRICE
5	03705	370	$ 7.30
6	03706	370	7.85
7.5	03707	370	8.95
10	03710	370	11.75
12.5	03712	370	14.00
15	03715	370	14.85
20	03720	370	18.50

NOTE: Order All Capacitors From Stock Motor Department.

CAPACITOR HOUSINGS



PART NO.	USED ON NEMA FRAME	MATERIAL TYPE	DIMENSIONS L	DIMENSIONS H	DIMENSIONS W	LIST PRICE
35-2355-1	48, 56, 143-5, 182-4	STEEL	4	2 3/32	2 1/8	$ 6.00
35-2355-2	48, 56, 143-5, 182-4	STEEL	5	2 3/32	2 1/8	6.00
35-1231	56, 143-5	DIE CAST ALUM.	5 1/8	2 1/4	4 3/4	9.00
36-1621	182-4	CAST	5 5/8	2 1/4	5 1/16	9.00
37-61	213-5	CAST	5 5/8	2 1/4	5 1/16	9.00
7-284	213-5	DIE CAST ALUM.	7 5/8	2 3/4	7 1/16	17.00
309-370**	213-5, 254-6**	CAST	11 1/4	6 3/16	5 5/16	37.00
6-577	182-4 (LC)	DIE CAST ALUM.	6 5/8	2 5/8	6 3/16	9.00

**This is a Combination Capacitor Housing and Conduit Box, Split Diagonally. Price is for Motor Mounted Portion and Lid.

PAINT

BALDOR GRAY LACQUER — 16 oz. AEROSOL CAN — LIST PRICE $5.00

CENTRIFUGAL STARTING SWITCHES

Please state motor speed and if rotating or stationary member required.

NEMA FRAME	BALDOR TYPE	DESCRIPTION	STATIONARY MEMBER PART NO.	STATIONARY MEMBER LIST PRICE	ROTATING ASSEMBLY PART NO.	ROTATING ASSEMBLY LIST PRICE
42	300	SINGLE SPEED	2-3	$6.00	2-63A	$10.00
48	400	TERMINAL PLATE	2-63B	8.00	2-63A	10.00
48*	400	TERMINAL PLATE	2-147	7.00	2-3	10.00
48	400	SINGLE SPEED	2-3	6.00	2-3	10.00
56, 143-5	500	SINGLE SPEED	2-3	6.00	2-3	10.00
56, 143-5	500	TWO SPEED	2-166▲	7.00	2-3	10.00
56, 143-5	500	TERMINAL PLATE	2-3B	7.00	2-3	10.00
56, 143-5*	500	TERMINAL PLATE	2-155	8.00	2-3	10.00
182-184	600	DUAL CONTACT	2-17	10.00	2-17A	10.00
213-215	700	DUAL CONTACT	2-17	10.00	2-17B	12.00

SPRING ONLY FOR ROTATING SWITCH	$1.50
WEIGHT ONLY FOR ROTATING SWITCH	.50*

*Quick Disconnect For Use With New Die Cast E.P.
▲Replaces 2-52 and Is Interchangeable

OVERLOAD PROTECTORS

KLIXON TYPE — Manual and Automatic Styles

Please give complete Klixon number if available or motor specification number.

SINGLE PHASE	
*PART NO.	LIST PRICE
MS	$ 9.00
MR	9.00
LE	16.00
CR	9.00
BR	18.00

THREE PHASE	
*PART NO.	LIST PRICE
MY	$18.00
CY	20.00
BY	23.00
FY	45.00

*Part Numbers Listed Are The First Two Letters Of Klixon Model Number.

CONDUIT BOXES, LIDS AND GASKETS

NEMA FRAME	BALDOR TYPE	BOX NO.	LIST PRICE	LID NO.	LIST PRICE	BOX GASKET NO.	LIST PRICE	LID GASKET NO.	LIST PRICE
42	300	33-31	$3.00	33-33	$3.00	33-32	$1.00	33-34	$1.00
48	400	* 34-1000	3.60	34-11	2.00	34-12	1.00	34-13	1.00
56 & 143-5T	500	* 35-7500	4.00	36-40	2.00	36-48	1.50	36-49	1.50
182-184	600	* 36-3950	5.00	36-40	2.00	36-48	1.50	36-49	1.50
213-215	700	* 37-2675	6.00	37-49	3.00	37-51	1.75	37-50	1.75
254-256	900	*309-1226	6.00	309-1227	6.00	309-46	2.25	309-49	2.25
284-286	1000	310-941	10.00	310-942	10.00	312-48	2.25	310-981	2.25
324-326	1200	310-941	10.00	310-942	10.00	312-48	2.25	310-981	2.25
364-365	1400	314-207	12.00	310-942	12.00	314-9	2.50	310-981	2.50

*New Die Cast No.

FANS — INTERNAL

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)

NEMA FRAME	BALDOR TYPE	PART NO.	BORE	LIST PRICE
48	400	T 34-47C	.937	$5.00
48	400	O 34-16C	.937	5.00
56	500	T 35-233A	.937	5.00
56	500	T 35-233B	1.187	5.00
56	500	O 35-33A	.937	5.00
56	500	O 35-33B	1.187	5.00
182-184	600	T 36-100A	1.187	7.00
182-184	600	T 36-100B	1.437	7.00
182-184	600	O 36-41A	1.187	7.00
182-184	600	O 36-41B	1.437	7.00
213-215	700	T 37-62A	1.437	10.00
213-215	700	T 37-62B	1.625	10.00
213-215	700	O 37-47A	1.437	10.00
213-215	700	O 37-47B	1.625	10.00
254-256 and Larger — Fan Is Cast Integrally With Rotor.				

O-Open Motors
T-Total Enclosed Motors

FANS — EXTERNAL

Please note motor speed on 254 Frame and larger.

NEMA FRAME	BALDOR TYPE	BORE	PART NO.	LIST PRICE	MOTOR SPEED*
42	300	.670	21-9	$ 5.00	ALL
48	400	.625	34-25	6.00	ALL
56	500	.625	35-63	6.00	ALL
182-184	600	.910	36-133	7.00	ALL
213-215	700	1.174	37-56	10.00	ALL
254-256	900**	1.503	309-1284▲	19.00	ALL
284-286	1000**	1.690	310-60	24.00	2 POLE
284-286	1000**	1.690	310-907▲	30.00	4, 6 & 8 POLE
324-326	1200**	2.003	312-85	38.00	2 POLE
324-326	1200**	2.003	312-38	42.00	4, 6 & 8 POLE
364-365	1400**	2.125	314-32	48.00	4, 6 & 8 POLE

*2 Pole = 3450; 4 Pole = 1725; 6 Pole = 1140; 8 Pole = 850 R.P.M.
**These Are Cast Aluminum, Others Are Stamped.
▲Plastic

FAN COVERS FOR T.E.F.C. MOTORS

NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
42	300	33-64	$ 7.00
48	400	34-26	7.00
48C	400	34-87	7.00
56 & 143-5T	500	35-1249	8.00
56C & 143-5TC	500	35-6535	8.00
182-184	600	36-537	10.00
213-215	700	37-59	15.00
254-256	900*	309-43	35.00
284-286	1000*	310-37	48.00
324-326	1200*	312-37	85.00
364-365	1400*	314-33	110.00

*These Are Cast, Others Are Stamped.

ENDPLATES — Standard Horizontal Motors

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)

OPEN MOTORS

OPEN — SHAFT END — RIGID BASE MOUNTED

(Same For Single & Three Phase Motors)

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
48	400	203	* 34-6	34-5	$14.00
56	500	203	* 35-8524	35-8503	19.00
56 & 143-145T	500	205	* 35-8613	35-8610	19.00
182-184	600	205	* 36-4179	36-4147	25.00
182-184	600	206	* 36-4158	36-4157	25.00
213-215	700	206	* 37-3016	37-3010	33.00
213-215	700	307	* 37-3038	37-3013	33.00
254-256	900	308	309-310	309-308	50.00
254-256T	900	309	309-417	309-416	50.00
284-286U	1000	310	310-330	310-737	70.00
324-326U	1200	311	312-256	312-472	100.00

OPEN — OPPOSITE SHAFT END — RIGID BASE MOUNTED

(Same For Single & Three Phase Motors)

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
48	400	203	* 34-7	34-5	$14.00
56 & 143-145T	500	203	* 35-8582	35-8503	19.00
182-184	600	205	* 36-4148	36-4147	25.00
213-215	700	206	* 37-3014	37-3010	33.00
254-256	900	208	309-309	309-308	50.00
284-286	1000	309	310-305	310-737	70.00
324-326	1200	311	312-264	312-472	100.00

*New Die Cast

TOTALLY ENCLOSED MOTORS

ENCLOSED — SHAFT END — RIGID BASE MOUNTED

(Same For Single & Three Phase Motors)

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
42	300	203	33-25	33-23	$14.00
48	400	203	*34-19	34-18	14.00
56	500	203	*35-8915	35-8742	19.00
56 & 143-145T	500	205	*35-8918	35-8743	19.00
182-184	600	205	36-52	36-536	28.00
182-184	600	206	36-962	36-961	28.00
213-215	700	206	37-54	37-52	37.00
213-215	700	307	37-1869	37-1809	37.00
254-256	900	308	309-237	309-38	45.00
254-256T	900	309	309-348	309-347	45.00
284-286T	1000	311	310-189	310-188	65.00
324-326	1200	311	312-44	312-28	85.00
324-326T	1200	312	312-191	312-190	85.00
364-365	1400	313	314-53	606-459	110.00

*Die Cast Alum.

ENDPLATES — Standard Horizontal Motors (Cont'd)

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)

ENCLOSED — OPPOSITE SHAFT END — RIGID BASE MOUNTED

(Single Phase & Three Phase)

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
42	300	203	33-66	33-69	$14.00
48	400	203	*34-20	34-18	14.00
56 , 143-145t	500	203	*35-8766	35-8742	19.00
182-184	600	205	36-65	36-51	25.00
213-215	700	206	37-53	37-52	33.00

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P.NO.	PATT. NO.	LIST PRICE
254-256	900	208	309-236	309-36	45.00
284-286	1000	309	310-32	310-31	65.00
324-326	1200	311	312-43	312-27	85.00
364-365	1400	312	314-30	606-471	110.00

ENDPLATES — NEMA C Face Motors

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)

FRAME	BRG. SIZE	T.E.F.C.	OPEN	E.P. NO.	PATT. NO.	LIST PRICE EACH
42C	203	√		33-506	33-505	$14.00
48C	203		√	34-34	34-33	14.00
48C	203	√		34-32	34-31	14.00
48W/56C	203	√		*34-171	34-1100	14.00
48W/56C	203		√	*34-151	34-1105	14.00
56C	203		√	35-39	35-38	26.00
56C	203	√		35-111	35-110	26.00
56C	205		√	*35-8765	35-8741	26.00
*56C	205	√		*35-8763	35-8740	26.00
~*143-145TC	205		√	*35-8764	35-8741	26.00
~*143-145TC	205	√		*35-8762	35-8740	26.00
*182-184C	205		√	36-66	36-65	38.00
*182-184C	205	√		36-77	36-76	38.00
*182-184C	206	√		36-1037	36-926	38.00
*182-184C	206		√	36-486	36-485	38.00
~*182-184TC	206		√	36-1755	36-1304	38.00
~*182-184TC	206	√		36-1749	36-1342	38.00
▾213-215C	306		√	37-65	37-64	48.00
▾213-215C	306	√		37-71	37-70	48.00
°213-215TC	307		√	37-1881	37-1880	48.00
°213-215TC	307	√		37-1892	37-1891	48.00
▾254-256C	308	√		309-238	309-53	70.00
▾254-256C	308		√	309-312	309-311	70.00
°254-256TC	309	√		309-400	309-399	80.00
°254-256TC	309		√	309-408	309-407	80.00
284-286TC	311	√		310-198	310-197	90.00
284-286TC	310		√	310-331	604-718	110.00
324-326C	311	√		312-61	312-60	110.00
324-326TC	312	√		312-204	312-203	110.00

~ Interchangeable With Horizontal Endplate But Results In Non-Nema "BA" Dimension.
° Not Interchangeable With Horizontal Endplate Without Also Changing Complete Rotor Assembly.
▾ Only Fit Horizontal Motors Built Prior to 1970.
* Die Cast Alum.

ENDPLATES — RESILIENT MOUNTED MOTORS

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)
***With Quick Connect Term Plant (Die Cast Alum.)**

OPEN — OPPOSITE SHAFT END

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
48	400	203	*34-1162	34-1161	$14.00
56	500	203	*35-8978	35-8804	19.00

ENCLOSED — OPPOSITE SHAFT END

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
48	400	203	*34-1193	34-1192	$14.00
56	500	203	*35-8951	35-8950	19.00

OPEN — OPPOSITE SHAFT END — RESILIENT MOUNTED

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
48	400	203	34-50	34-49	$14.00
56	500	203	35-1116	35-47	19.00

OPEN — SHAFT END — RESILIENT MOUNTED

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
48	400	203	*34-1164	34-1163	$14.00
56	500	203	*35-8818	35-8803	19.00

ENCLOSED — OPPOSITE SHAFT END — RESILIENT MOUNTED

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
42	300	203	33-24	33-23	$14.00
48	400	203	34-82	34-44	14.00
56	500	203	35-1112	35-1111	19.00

ENCLOSED — SHAFT END — RESILIENT MOUNTED

NEMA FRAME	BALDOR TYPE	BRG. SIZE	E.P. NO.	PATT. NO.	LIST PRICE
42	300	203	33-25	33-23	$14.00
48	400	203	*34-1173	34-1167	14.00
56	500	203	*35-8949	35-8948	19.00

*Die Cast Alum.

PARTS FOR REPULSION INDUCTION MOTORS

BRUSHES AND BRUSH SPRINGS (Be Sure To Note Motor Specification Number)

BALDOR MOTOR TYPE	BRUSH DIMENSIONS			BRUSH NO.	BRUSH GRADE	LIST PRICE EA. BRUSH	SPRING NO.	LIST PRICE EA. SPRING
	W"	D"	L"					
5300R	1/2	1/4	7/8	2527	E-44	$2.00	DR913	$1.50
6200R	1/2	1/4	7/8	2527	E-44	2.00	DR913	1.50
150R	1/2	1/4	7/8	2527	E-44	2.00	DR913	1.50
180R	1/2	1/4	7/8	2527	E-44	2.00	DR913	1.50
7500R	3/4	1/4	1	2434	E-44	3.50	DR1196	1.50
20R	3/4	1/4	1	2434	E-44	3.50	DR1196	1.50
23R	3/4	1/4	1	2434	E-44	3.50	DR1196	1.50
9100R	7/8	5/16	1-1/8	2601	E-44	4.00	DR46	1.50
27R	7/8	5/16	1-1/8	2601	E-44	4.00	DR46	1.50
33R	1-1/4	5/16	1-3/8	2995	E-44	4.00	DR100	1.50
7500R	1-1/4	5/16	1-3/8	2995	E-44	4.00	DR1196	1.50
7500R	3/4	3/16	1	29-238	E-44	3.50	DR1196	1.50

SHORT CIRCUITING DEVICES (State Speed Required)

NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
56	5300R	DR-2617	$20.00
66	1800R	DR-6802	25.00
182-184	6200R	DR-6802	25.00
213-215	7500R	*DR-2442	45.00
213-215	7500R	29-1066	45.00
254-256	9100R	DR-2593	50.00

COMMUTATORS (State Slot Width or Wire Size)

NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
56	5300R	27-1157	$35.00
56	5300R	*DR-146	35.00
66	1800R	DR-1710	35.00
182-184	6200R	DR-1710	35.00
213-215	7500R	DR-1193	60.00
254-256	9100R	DR-36	80.00

ROCKER ARM ASSEMBLIES (Less Brushes and Brush Springs)

NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
56	5300R	27-98	$35.00
66	1800R	28-67	40.00
182-184	6200R	28-67	40.00
213-215	7500R	* 29-248	50.00
213-215	7500R	29-160	50.00
254-256	9100R	DR-124	58.00

EXTERNAL FANS AND FAN COVERS

NEMA FRAME	BALDOR TYPE	FAN BORE	FAN PART NO.	FAN LIST PRICE	COVER PART NO.	COVER LIST PRICE
56	5300R	.5950	27-153 W/HUB 27-167A	$ 5.00	27-152	$10.00
182-184	6200R	.6734	6-814 W/HUB 28-356	7.00	6-1840	12.00
213-215	7500R	.7924	7-291 W/HUB 29-78	10.00	29-585	15.00
213-215	7500R	1.174	37-56	10.00	29-536	15.00
254-256	9100R	.985	30-32	19.00	22-393	35.00

*Motors With Serial No. 10-72 Or Before.

DIRECT CURRENT

RENEWAL PARTS

(Be Sure to Note Motor Spec. No.)

COMMUTATORS: (Slotted)

(State Slot Width or Wire Size)

NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
42	3800D	38-50	$ 38.00
56	34D	34-1124	38.00
56	500D & 53D-2P	35-3149	38.00
56	X150D-5300D - 4 Pole	DR-7	38.00
66	1800D & X180D	DR-6034	48.00
66	1800DD	DR-8865	60.00
66	5800DD Duplex	DR-8865	60.00
66	5800D Simplex	DR-6034	48.00
182-184	36D	36-4602	55.00
182-184	6200D	28-277	55.00
213-215	7500D Power Mtr	29-21	70.00
213-215	7500D Simplex Mtr	29-1452	70.00
213-215	7500D Traction Mtr	29-784	80.00
254-256U	9100D	30-75	100.00
254-256U	9100D**	30-585	100.00
254-256U	9100D Traction	30-874	100.00
284-286U	1000D	310-209	200.00
324-326U	312D	312-421	325.00
324-326U	312D**	312-571	225.00
203-204	X20D	DR-6495	80.00

**For 500-575 Volts

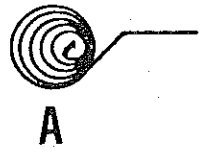
ROCKER ARM ASSEMBLIES:

(Less Brushes & Brush Springs)

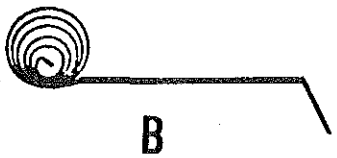
NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
56	500D	35-3158	$35.00
56	5300d - 4P	11856	35.00
56	5300D - 2P	27-1389	35.00
66	1800D	11728	40.00
66	1800DD	11380	45.00
66	5800D	31-11	40.00
66	5800DD	31-60	45.00
182-184	36D	36-4608	42.00
182-184	6200D	28-500	42.00
*213-215	7500D	29-1449	50.00
213-215	7500D Power Mtr	29-568	50.00
213-215	7500D Traction Mtr	29-129	50.00
254-256U	9100D	30-64	60.00
254-256U	9100D***	30-588	60.00
284-286U	1000D	310-212	70.00
324-326U	312D	312-422	85.00

* New Simplex Brush
***For 500-575 Volt

REPLACEMENT BRUSH SPRINGS FOR DIRECT CURRENT MOTORS



A



B



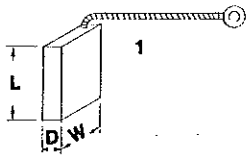
C

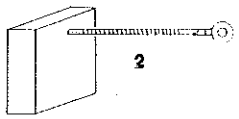
BALDOR MOTOR TYPE	SPRING NUMBER	COLOR	FIGURE	LIST PRICE PER SPRING	
5300D & 6200D & 36D	35-4347A	Orange	B	$1.50	Current Construction
5300D & 6200D & 36D	35-4347B	Red	B	1.50	
5300D & 6200D & 36D	35-4347C	White	B	1.50	
5800D & 1800D	11729	Red	C	1.50	
6200D, 9100D & 310D	11729	Red	C	1.50	
20D & 180D & 150D	11885	Green	C	1.50	
5300D & 7500D	11885	Green	C	1.50	
20D, 180D & 5800DD	12104	Orange	C	1.50	
500D & 5300D	12104	Orange	C	1.50	
6200D & 7500D	12104	Orange	C	1.50	
9100D	12104	Orange	C	1.50	
500D, 53D & 6200D	12105	White	C	1.50	
7500D & 9100D	12105	White	C	1.50	
312D	312-515		A	1.50	
150D & 1500D	DR-913	Bronze	A	$1.50	Prior Construction
5300D	DR-913	Bronze	A	1.50	
1500D, 1800D & 180D	DR-2407	Bronze	A	1.50	
5300D & 6200D	DR-2407	Bronze	A	1.50	
7500D	29-68	Bronze	A	1.50	
6200D & 35D	12104	Orange	C	1.50	
6200D & 35D	11729	Red	C	1.50	
6200D	12105	White	C	1.50	

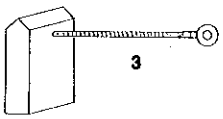
REPLACEMENT BRUSHES FOR DIRECT CURRENT MOTORS

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)

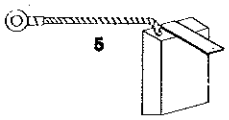
BRUSH STYLES

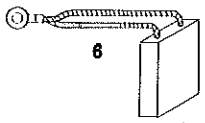


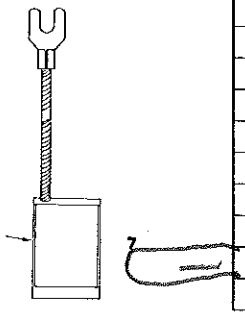












STYLE	W"	D"	L"	BRUSH NO.	BRUSH GRADE	LIST PRICE EA. BRUSH
1	5/8	5/16	1-1/8	7384	E45	$4.00
1	5/8	5/16	1-1/8	7384	673	4.00
2	7/8	3/8	1-1/8	28-279	673	4.00
2	7/8	3/8	1-1/8	28-279	E45	4.00
2	7/8	3/8	1-1/8	28-279	698	5.00
2	3/4	7/16	1-1/4	29-54	E45	5.50
2	3/4	7/16	1-1/4	29-54	661	4.00
2	3/4	7/16	1-1/4	29-54	673	4.50
3	5/8	5/16	1-1/8	999	673	4.00
3	5/8	5/16	1-1/8	999	698	4.00
3	5/8	5/16	1-1/8	1858	E45	4.00
3	5/8	5/16	1-1/8	1858	619	4.00
3	5/8	5/16	1-1/4	10549	673	4.00
3	5/8	5/16	1-1/4	10549	698	4.00
3	7/8	5/16	1-1/8	11136	673	4.00
4	1/2	5/16	3/4	38-89	673	5.00
4	3/8	1/4	3/4	38-42	E45	4.00
4	7/16	5/16	1	34-1127	E45	4.50
5	5/8	5/16	1-1/4	28-71	E3	4.00
5	5/8	5/16	1-1/4	28-71	E45	4.00
5	5/8	5/16	1-1/4	28-71	698	4.50
5	5/8	5/16	1-1/4	28-71	673	4.00
5	5/8	5/16	1-1/4	28-71	619	4.00
5	7/8	3/8	1-1/4	28-503	#247F	4.50
5	7/8	3/8	1-1/4	28-503	E3	4.50
5	7/8	3/8	1-1/4	28-503	673	5.50
5	7/8	3/8	1-1/4	28-503	619	5.00
5	3/4	7/16	1-1/4	29-130	E45	5.00
5	3/4	7/16	1-1/4	29-130	E-3	5.00
5	3/4	7/16	1-1/4	29-130	673	5.50
5	3/4	7/16	1-1/4	29-130	619	5.00
5	3/4	5/16	1-1/4	29-569	E45	4.00
5	3/4	5/16	1-1/4	29-569	673	4.00
5	3/4	5/16	1-1/4	29-569	610	4.00
5	5/8	5/16	1-1/4	31-180	673	5.00
5	5/8	5/16	1-1/4	31-180	698	5.00
5	5/8	5/16	1-1/4	31-180	E3	5.00
5	7/8	5/16	1-1/4	11735	E3	5.00
5	7/8	5/16	1-1/4	11735	673	5.50
5	7/8	5/16	1-1/4	11735	E45	5.00
5	7/8	5/16	1-1/4	11735	698	5.50
5	3/4	7/16	1-1/4	29-816	673	5.50
6	7/8	5/16	1-1/8	5877	673	5.50
6	1 1/32	31/32	1-3/4	312-427	E45	9.00
7	7/8	3/8	1-1/4	*28-1795	673	5.50
7	7/8	3/8	1-1/4	*28-1795	E45	5.50
7	7/8	3/8	1-1/4	*28-1795	698	6.00

*Replaces 35-4348 and is interchangeable.

REPLACEMENT FANS & FAN HOUSINGS
FOR
DIRECT CURRENT MOTORS

(Advise Specification Number From Motor Nameplate For Proper Identification of Part.)

EXTERNAL FANS:

NEMA FRAME	BALDOR TYPE	BORE	PART NO.	LIST PRICE
42	3600D	.670	21-9	$ 5.00
48	34D	.637-.638	34-25B	5.00
56	5300D	.629	27-153 w/Hub 27-167B	5.00
56	500D	.625	35-63	5.00
66	X180D	.625	6-814 w/Hub 28-356A	7.00
66	5800D	.673	6-814 w/Hub 28-356B	7.00
182-184	36D & 6200D	.910	36-133	7.00
213-215	7500D	1.174	37-56	10.00
254-256U	9100D	1.376	22-431	19.00
284-286U	1000D	1.689	310-907*	30.00
324-326U	312D	2.000	312-38	42.00

*Changed as of 12-1-77, Still Interchangeable

INTERNAL FANS:

	OPEN TYPE MOTORS				TENV TYPE MOTORS		
NEMA FRAME	BALDOR TYPE	PART NO.	BORE	LIST PRICE	PART NO.	BORE	LIST PRICE
48	34D	34-16C	.925	$ 5.00	34-47C	.925	$ 5.00
56	500D	35-33A	.925	5.00	35-255A	.925	5.00
56	5300D	27-417A	.809	5.00	None	- -	- -
66	5800D	34-16C	.925	5.00	35-233A	.925	5.00
182-184	6200D	28-342	1.1750	7.00	None	- -	- -
182-184	36D	36-41B	1.4250	7.00	36-100B	1.425	7.00
213-215	7500D	29-50*	1.500	10.00	None	- -	- -
254-256U	9100D	30-67	2.063	19.00	None	- -	- -
284-286U	1000D	None	- -	- -	310-296	2.502	24.00
324-326U	312D	None	- -	- -	312-508	2.691	32.00

*Changed to Fan 29-1157A and is Interchangeable

FAN HOUSINGS:

NEMA FRAME	BALDOR TYPE	PART NO.	LIST PRICE
42	3600D	33-274	$ 7.00
48	34D	34-772	7.00
56	5300D	27-152	8.00
56	500D	35-7666	8.00
66	1800D	32-4	8.00
66	5800D	32-4	8.00
182-184	6200D	28-859	10.00
182-184	36D	36-659	10.00
213-215	7500D	29-536	15.00
254-256U	9100D	30-149	35.00
284-286U	1000D	310-498	48.00
324-326U	312D	312-433	85.00

BALDOR

D. C. MOTOR INSTALLATION AND MAINTENANCE

INSPECTION: Examine the motor for possible damage in shipment. Check the brush springs to see that they bear properly on the brush pressure plate, and be sure the shaft turns freely by hand. Check the nameplate voltage to be sure it agrees with power supply.

INSTALLATION: Motor should be mounted on a firm foundation. If foundation is not flat, shims should be used to prevent strains when tightening hold-down bolts. All Baldor motors are equipped with ball bearings and may be operated in any position, however, shaft-up mounting should be avoided when possible. Location should be dry, clean and well ventilated for most satisfactory service. Be sure possibility of oil seepage into the motor is prevented. Communtator end of motor should be accessible so that brushes can be conveniently inspected.

ALIGNMENT: Shafts should be carefully aligned with a straight edge before tightening any couplings. Remove paint, dirt and burrs from shaft. If necessary use file or reamer for proper fit. Pulley or coupling should be carefully fitted so as to easily slip on shaft. Self-aligning couplings are recommended. Do not hammer on shaft, pulley or coupling.

CONNECTIONS: If the motor is part of an SCR drive system, refer to the control manufacturer's diagrams and installation data. If the motor is shunt wound and not part of an SCR control system, a proper resistance starter should be used. For protection, use a fuse or circuit breaker rated at 125% of full load amperage on the nameplate. If the motor is a series or compound wound motor, refer to the connection data tag attached to the motor. If the motor is a component part of a piece of equipment, be sure to refer to the Original Equipment Manufacturer's electrical circuit information for proper connection.

BEARINGS: Baldor D. C. Motors have prelubricated and permanently sealed ball bearings. The lubrication is sufficient for the life of the bearing. When bearings become worn they will produce excessive noise, which is a warning that bearings should be replaced. They should be replaced in the following manner. Pull brushes out of brush holder. Remove pulley end bell, withdrawing armature. While the motor is disassembled, take the opportunity to blow out brush dust residue. Pull off bearings by means of bearing puller, taking care not to mar center in end of shaft. The new bearing is pushed on the shaft gently by pressure on the Inner Race or by tapping gently on the Inner Race. See that no dirt enters the bearing housing. Reassemble motor, taking care that the bearing shims are properly assembled so that the brushes ride properly on the commutator.

BRUSHES: Periodically, the brushes should be inspected and the brush dust blown out of the motor. If the length has been worn down ½" from the original length shown on Page 10, the brushes should be replaced. If at this time the commutator is worn or rough, the armature should be removed. The commutator should be turned in a lathe, the mica recut, and commutator polished. Reassemble, and seat the new brushes using a brush seating stone. Be sure the rocker arm is set on the neutral mark.

REPAIRS: Unless the maintenance man is properly qualified, it is advisable that the repair work be done at a qualified service station. When ordering replacement parts, give Complete Nameplate Data.

BALDOR

PHONE 501-646-4711
TELEX 53-7425 — TWX 910-723-7650
FORT SMITH, ARKANSAS 72902

BASE =

ASSEMBLY LAYOUT =

FR BRG =

PU BRG =

STORES =

CON DIAG=

F. COV 402 D. COV.

C O N T I N U E D
ON NEXT PAGE

P/N PAGE 2

SPECIAL INSTRUCTIONS FOR SPEC - 27A03W125

REF SPEC - 27A02W63 CATALOG -

MACHINE	SHAFT	= 947	
	PU. E. P.	= 959	27-958
	FR. E. P.	= 1399	27-953
	RET.	= 21-135	
	SLEEVE	= 38-17	
	C. B.	=	
	KEY	=	
ROTOR	ALUM	=	28G2C8T#20SP14
	END	=	
	SKEW	=	
	LAM.	= 35-3106	
	DIA.	= 3.250	
	CONN.	= 1-2	
	SH-ON	= 1/2	
ISH	PAINT	=	
	CON. DIAG=	10670	
	PACK	=	
	LABEL	=	

SPECIFICATION FILE = 27A03W125 REF SPEC = 27A02W63

FLAG = WEIGHT = 0124 PLTS = -S- -

ENCL	= TEFC	H. P.	= 3/4
MTG	= VERT	VOLTS	= 140
CENT. SW. RELAY	=	AMP	= 5. 2
THERMAL	=	R. P. M.	= 1750
BAND	=	HZ	= DC
CAPACITOR/COMM	= 35-3149	PH	=
ROCK ARM	= 1389	CL	= B
BR. HLDR	= 54342	SER. F.	= 1. 0
BR. SPRING	= 4347A	DES	=
BRUSH	= 28-1795E45	CD	= SH
NAME PLATE	= 12176	EFF	=
CAT NO	=	PF	=
FRAME	= 56C 5328D	RATING	= 40C AMB-CONT
POLES	= DC	TYPE	=
CUST PART NUM	=	CUST NO	= - -
TEST INFO:		CUST NAME=	

T. V. C. NLA NLW NLRPM LRV LRP

SPECIAL INSTRUCTIONS

ON NEXT PAGE

CHG DATE = 11-09-78 C CREATE DATE = 01-12-77 P/N PAGE 1

SPECIAL INSTRUCTIONS FOR SPEC - 27A03W125

REF SPEC - 27A02W63 CATALOG -

WINDING LAM = 27-1143

INSUL = B

LEAD = 2#16-2#18

WIR DIAG= 1-202

SHUNT 1500#28

INTERPOLE 109#19&#20

STATOR STAT = 1168

COMMUTATOR MACHINE

WINDING NO. 27W125

APPLICATION 2 Pole Shunt FRAME 56 NEMA DESIGN —

S 5328D H.P. 3/4 SER. FAC. 1.0 VOLTS 140 AMPS 5.2

1750 CYC. DC PH. Sh CODE — RATING 40°C Amb. CLASS INSULATION B

27FL2040 STATOR C 50269 C D 0 219

STACKING 3½ SLOTS DWG. NO. INT. WIRING DIAG. Test CONN. DIAG. Test

SLOT INSUL WEDGES TEST VOLTAGE 1750

S 27828 0 L 2C 1500T 1#28

SHUNT FIELD MOULD NO.

WIND 2 COILS OF 1500 TURNS NO. 28 SPAN Pole TH 2 LEAD 8" LONG NO. 18

CONNECTION

~~SERIES or COMPOUND FIELD~~ MOULD NO.

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

CONNECTION

C 27828 0 1/2 IP C 109T 1#20 S 1#19

COMPENSATING ~~or MAIN~~ FIELD *20 *19 MOULD NO.

WIND 2 COILS OF 109 TURNS NO. SPAN IP TH 2 LEAD 8" LONG NO. 16

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

WIND COILS OF TURNS NO. SPAN TH LEAD LONG NO.

CONNECTION Series

A 35282 1L 28G 2C 3T 1#20

35AL2281 ARMATURE #16 Leads

SLOTS 28 DWG. NO. 35-3106 COMM. BARS 56 SKEW ½ T.P. TURN DIA. 3.250

WIND 28 GROUPS OF 2 COILS OF 8 TURNS NO. #20 COLOR B&W SPAN 14 TH

WIND GROUPS OF COILS OF TURNS NO. COLOR SPAN TH

WINDING TYPE Lap FIRST END COIL NO. 1 CONNECTS TO SEGMENT NO. 1 AND LAST END OF COIL NO. 1 CONNECTS TO SEGMENT NO. 2

MOULD NO. SLOT INSUL WEDGES INSUL. TEST. VOLTAGE 1750

SWITCH ASSEMBLY

BRUSH Speer E45

PACE ¾ X ⅞ LENGTH 1¼

NO. 2 TENSION 500 gm.

TEST DATA USING				PULLEY		HORSE	
LOAD	VOLTS	AMPS	WATTS	PULL	RPM	H.P.	EFF.

#3

BALDOR ELECTRIC COMPANY
FT. SMITH, ARK.

DATE 12-20-76 BY PRM

SCREW & PARTS LIST

DWG. NO. 27A01

53 DC Horiz. TEFC Power Motor (2 Pole) NEMA 56

SHEET 2 OF 2

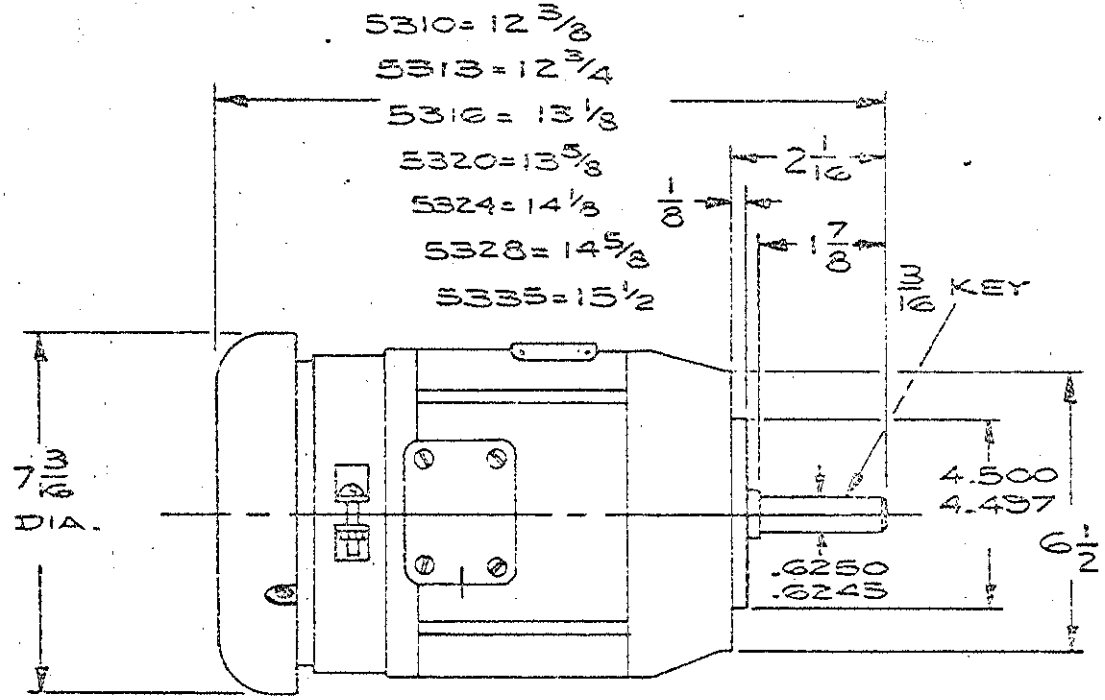
ITEM	DWG. NO.	MATERIAL
SCREWS:		
Base		⅝-20 x 5/8 RHMS W/L.W.- Zinc Plated
Conduit Box		#10-32 X ½ RHMS W/L.W. Zinc Plated
Box Lid		#8-32 X 3/8 Type "F" Pan HD. (SelfTap) Z.P.
Ret. Ring-In.Fr.		#8-32 X7/8 RHMS W/L.W. - Zinc Plated
Fan Cover		#10-32 X 3/8 RHMS W/L.W. Zinc Plated
Inspection Band		⅜-20 x 1¼ RHMS W/Hex Nut, & L.W.-Z.P.
Nameplate		#4 x ⅛ Type"U" Drive Pins-Zinc Plated
Packing		⅜-20 x 3/4 Carriage Bolt W/Flat W, & Hex Nut
FAN CLAMP		#10-32 x 3/16 HEX SOCKET CUP POINT SET
PARTS:		
Shaft	27-947	15/16 Dia. C-1138
Stator	27-1145	
Stator Wedge	27-1144	Coil Retainer
Endplate-Pu.	27-952	C.I. 27-951
Endplate-Fr	27-1399	C.I. 27-953
Thru Bolt	27-1347	
Bearing-Pu. & Fr.		#203 (Double Seal) See Grease
WAVY WASHER-FR. BRG.		W1543-017 (W-B)
Commutator	35-3149	56 Seg.
Rockerarm Assem.	27-1389	See Dwg. For Parts
Brush-Carbon	28-1795	See S.P. #40 For Grade
Ret. Ring-In. Fr.	DR-22	
Lead Bushing	29-1726	
Terminal	29-1079	Stator Leads to Brush Holder
Conduit Box	35-7500	Die Cast
Box Lid	36-40	
Gasket-Box	36-48	
Gasket-Lid	36-49	
Inspection Band	27-1348	
Clip-Insp. Band	DR-2528	
Gasket-Insp. Band	27-1349	
Base	21-259	REF. NO. 35-2630 REV. 1-30-75 PK
Fan Cover	35-1255	REF. NO. 35-62
Fan-Ext.	35-8189	
Fan Clasp	35-8558	
Fan-Internal	35-233A	
Key	6-30	
Key Retainer	21-469	
Nameplate	12176	
Grease		Bearings Pre-Loaded-See S.P. #31
Paint		See S.P. #19
Carton	21-238	
Plywood	21-239	
INSULATOR - ARMATURE	34-1733B	USE ONE ON COMMUTATOR END ONLY
ROTOR END BUSHING	27-1964	1/16 THICK VULCANIZED FIBER

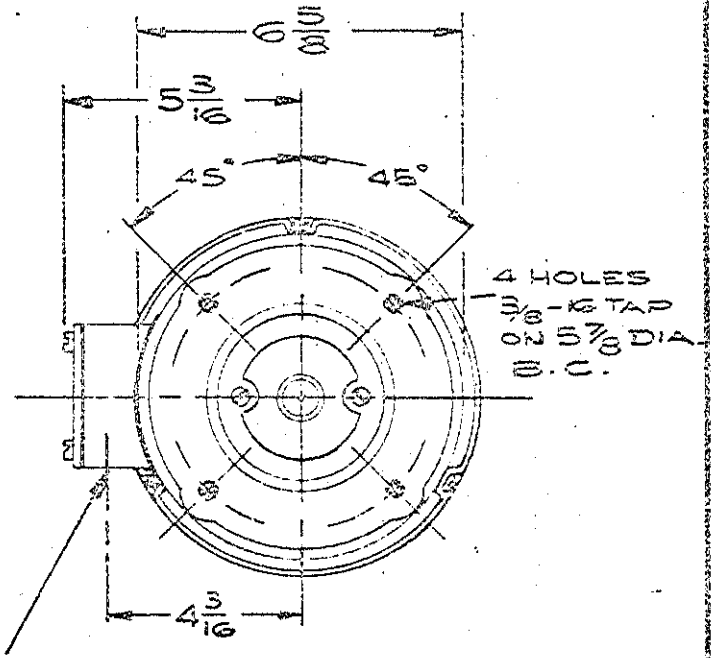
Note:
1. For motors with dual volt fields, use connection label 1-532. Place on stator adjacent to conduit box.
Do not use label 1-532 on single volt fields.

Rev. "B" 6-13-75 P.K. Added note #1
REV. C 9-23-74 PK. BRUSH WAS 35-4348
REV. B 12-2-75 P.K. LEAD BUSHING WAS 31-20

5-13-75-RK. 6-6-75-RK.
3-13-75-RK. 5-27-75 RK
2-28-72
DATE 8-29-73 RK. P.K.

S. NO.
27A03





SPECIALS:

STATOR = 27-1168

END PLATE-PU. = 27-959 (PAT. No. 27-953)

RET. RING-IN PU. = 21-135

SCREW-RET. = #10-32 x 1 1/4 RHMS W/L.W. (2)

TIGHT SLEEVE = 38-17

FAN COVER = 35-402

REV.	DATE	BY	MATERIAL
A	1-25-73	LJ	REDRAWN-REPLACES DWG. OF 11-29-71

BALDOR ELECTRIC CO.

STANDARD VERT. "C" TEFC POWER
MOTOR-53 DC FRAME-NEMA 56C

DWG. NO.	PATT. NO.	TOL. ON FRAC. DIMS. ±	
27A03	REF. NO. 27A01	DATE 1-25-73	BY LJ

(THIS SPACE RESERVED FOR VENDOR DWG. WHEN IT BECOMES AVAILABLE)

11 908 523

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR:

VENDOR DWG. NO.:

TITLE: METER, DIESEL FUEL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL NO. PC 1728	3/11/77	ASSY. OR LO.	
DR. BY J. Dorn	2/18/77	SCALE	
CHK'D. BY G. WEAVER	3/4/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO 11 908 523 | SHEET 1 OF 2

DIESEL FUEL METER FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 41-42, PARA. 6.1a - PAINTING

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

2. TECHNICAL SPECIFICATIONS

2.1 METER FOR TOTAL FLOW MEASUREMENT OF #2 DIESEL OIL AND AS FOLLOWS

2.2 FLOW - 15 GPM AT 150 PSI MAXIMUM

2.3 REGISTER TO BE HORIZONTAL NON-SET BACK STRAIGHT READING TYPE WITH SIX FIGURE TOTALIZER READING U. S. GALLONS AND FITTED WITH PROTECTIVE METAL LID.

2.4 ACCURACY TO BE WITHIN 1%

2.5 THE METER MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.6 ANCHOR BOLT LOADINGS - THE MANUFACTURER'S SETTING PLAN DRAWING OF THE COMPONENT SHALL INDICATE THE ANCHOR BOLT LOADINGS IN THE FORMAT OF A NOTE. "THE SEISMIC AND OPERATING ANCHOR BOLT LOADINGS, EACH BOLT AT THE _____ LOCATIONS, ____ LBS. TENSION AND ____ LBS. SHEAR."

2.7 VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

2.8 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S ARRANGEMENT PLAN FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS, DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE AND ANCHOR BOLT LOADINGS.

11 908 523

11908523

These Instructions Must Be Read Before Installing Meter

KEEP THIS SHEET FOR REFERENCE

Layout of Piping: It is very necessary to set the meter correctly if accurate measurement is to be secured. Note the diagrams of correct installations opposite, and the following principles of installation:

1. Set the meter so air or vapor or other gases do not pass through it. To help keep air out, do not let the meter drain between periods of use; trap the meter in a depression in the pipe line if necessary; keep suction lines and pump stuffing boxes tight. If air cannot be kept out of a line handling light oils or solvents, use an Air Release Valve between the pump and the meter.

2. Protect the meter from sediment, pipe scale, etc., when needed, by the Niagara Trap Strainer, and arrange installation so strainer can be easily cleaned.

3. in gravity - pressure installation, set the meter to take advantage of all possible pressure head; in pump - pressure installations set the meter on the discharge side of the pump if possible.

4. Use the meter only on the liquid for which it was ordered and within the specified limits of pressure, temperature and Flow Rate.

5. If the line must be kept in continuous service, install a by-pass around the meter and strainer, with appropriate valves.

6. Before placing the meter in the pipe line and after the meter couplings are connected into place, flush the line thoroughly with liquid to remove pipe cuttings, chips, etc., then set the meter in position. **When starting up the meter, open the control valve just a little, to fill the line and meter with liquid very slowly. Some meter pistons may be damaged if run rapidly before the line is full.**

Typical installations are shown opposite, to illustrate principles involved. (For installation of auxiliary equipment with Electricontact Meters, see the Electricontact Instruction Sheet shipped with such meters.)

Hersey PRODUCTS INC Industrial Measurement Division
Old Valley Falls Road, Spartanburg, S.C 29303
(803) 578-3800 Telex 80-9430

Please send change gears and instructions for correcting the meter inaccuracy described here.

Serial Number of Meter .....
(STAMPED ON BRONZE TOP LID OR NUMBER PLATE)

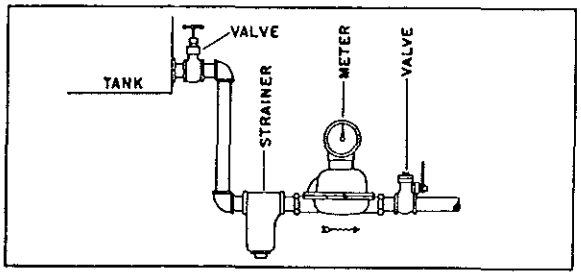
What liquid is being measured? .....

Name .....

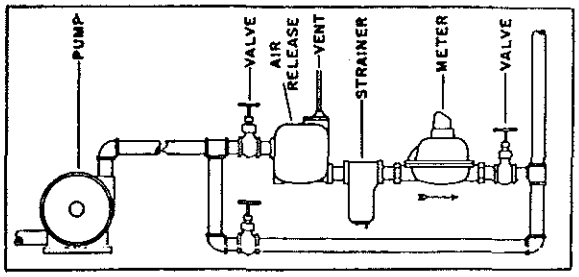
Addres .....

.....

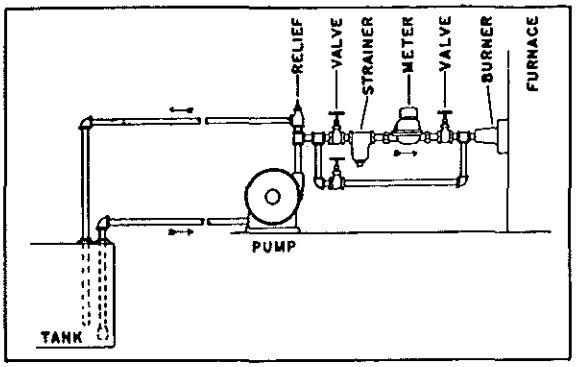
A—Gravity flow from storage tank, with tank valve, strainer, meter and control valve in the order named. The net drop should be at least two feet more if the pipe is long, if there are many elbows or if very fast flow is wanted.



B—Pump pressure flow from storage tank with pump, air release valve, strainer, meter, control valve and riser pipe in the order named. The air release may be omitted if the supply tank will never be emptied. If supply tank is below the pump level, valves on the suction line must be tight. If delivery tank is below meter level, a 1-foot riser pipe on meter outlet should be used, with vacuum breaker or vent at the high point.



C—Installation on pump pressure oil burners having circulating system. Meter should be kept outside the circulating loop if possible. If two meters must be used, on supply and return lines, first pump oil through the system with burner shut off, to check the exact uniformity of registration of the two meters. Be sure that the valve on suction pipe is tight. System must be air free to insure accuracy of the meters.



REPORTS OF TESTS

	GALLONS ACTUALLY PASSED THRU METER	GALLONS REGISTERED BY METER
1		
2		
3		
4		
5		

USE OTHER SIDE OF THIS SHEET FOR SKETCH OF INSTALLATION AND ANY OTHER INFORMATION OF INTEREST.

To Obtain Accurate Measurement:

1. Avoid passing air or vapor through the meter. This registers like liquid and produces inaccurate measurement. Use an Air Release Valve to accomplish this, if necessary. Do not let a pump run after the supply tank is empty. Sometimes small leaks on the suction line of the pump will cause air to be sucked into the pipe line causing inaccurate registration of the meter. These cannot usually be detected by any leakage of oil, so care must be taken to keep the pipe absolutely tight, especially on suction lines.

2. Keep the meter clean as described below.

3. If the meter registers much more than the liquid that actually passes through it, this is due to air passing through the meter with the liquid. The only remedy is to keep air out. If the meter stops, or registers much less than actually passes through it, this is due to dirt (or sometimes to wear) and the meter should be cleaned or repaired as described below.

4. Each meter is individually calibrated the last thing before being shipped from the factory. After the meter is set, the peculiarities of the working conditions may cause a small constant error, or the meter may become slightly inaccurate after long service. If this happens it may easily be corrected, by change gears, as follows:

To correct error by change gears: Test carefully the exact error, fill out the test report below, tear it off and mail to Hersey Products Inc., Ametrol Division. We will then calculate the new gear ratio between meter and register that is needed to correct the reported error, and enter an order for and supply directions for installing them in the meter. The change gears are immediately beneath the register, and are accessible without removing the meter from the pipe or shutting off the flow.

Care of the Meter: If the meter shows evidence of needing repairing or cleaning of the measuring unit, write for the Service Manual, which gives complete repair instructions. For emergency cleaning or inspection, proceed as follows: Unbolt the main flange and lift off the entire top half of the casing. Lift out the measuring chamber in which the nutating piston moves and separate the two halves, removing any screws which hold the two halves together. Lift out the measuring piston and inspect this carefully for wear or for dirt embedded in the metal. Clean off any embedded dirt with fine emery paper but do not attempt to cut away any metal.

Next inspect the measuring chamber for wear in the lower ball seat or for rubbing of the edge of the piston on the vertical chamber wall. If either wear or rubbing is found, the chamber should be replaced, otherwise clean out any dirt and reassemble the piston in the chamber.

Try the register by turning the gearing inside the top casing. If the register hand fails to move or moves irregularly, remove the register of the meter and inspect the calibrating or change gears located just beneath the register base plate. Tighten the set screws of these gears if necessary and see that they mesh squarely with a little play between the teeth.

Replace the measuring chamber and piston into the bottom casing of the meter. Replace the flange gasket or use a new one obtained from the factory, then carefully set the top casing onto the assembled unit. Be careful to obtain a proper mesh of the gearing when replacing the top casing to avoid damage to the internal gears. After reassembly, the meter should operate when held to the mouth and air blown through it.

If leakage occurs at the base of the register mounting, this is due to a leaking stuffing box. Two types of stuffing box packings may be used. If the packing is of high temperature type, the nut should be tightened down snugly by hand. New packing must be procured from the factory if leaking occurs. With all other types of stuffing box packing if a leak occurs, tighten down the nut one-eighth turn at a time, until leakage stops. Meters used at temperature above 180° F. or on corrosive liquids must have suitable type packing.

Clean the strainer ahead of the meter occasionally to prevent clogging and allow full flow through the meter.

Speed of Operation: A meter must be operated within its proper capacity range. For details see the Niagara Meter Selection Guide, issued by Hersey Products, Inc.

For more complete Installation and Maintenance Instructions, send for our Service Manual.

Hersey
PRODUCTS INC. Industrial Measurement Division
Old Valley Falls Road, Spartanburg, S C 29303
(803) 578-3800 Telex 80-9430

Is the meter operating on pump or gravity pressure?

.....

What is the rate of flow?

Maximum ..... Minimum .....

Have you a strainer ahead of the meter?

.....

(THIS SPACE RESERVED FOR VENDOR DWG. WHEN IT BECOMES AVAILABLE)

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX -239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR:

VENDOR DWG. NO:

TITLE: VENT W/FLAME ARRESTOR

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1728	3/11/77	ASSY. OR LO.	
DR. BY J. Dorn	3/ 1/77	SCALE	
CHK'D. BY J. WHALEY	3/4/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 528 | SHEET 1 OF 2

VENT WITH FLAME ARRESTOR FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 41 & 42, PARA. 6.1 a - PAINTING

1.1.2 PAGE 42, PARA. 6.2 a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3 a - SHIPMENT

1.1.4 PAGE 47, PARA. 6.2 f - STATEMENT OF CONFORMANCE

2. TECHNICAL SPECIFICATIONS

2.1 VENT WITH FLAME ARRESTOR FOR NORMAL VENTING OF A DIESEL OIL DAY TANK

2.2 VENT MUST MEET THE REQUIREMENTS OF NFPA NO. 30

2.3 VENT CAPACITY: 120 CFH FREE AIR AT 1" WATER - MINIMUM

2.4 VENT CONNECTION SIZE: 1-1/2" - MINIMUM

2.5 VENT MUST BE FURNISHED WITH WEATHER HOOD

2.6 THE VENT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.7 VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

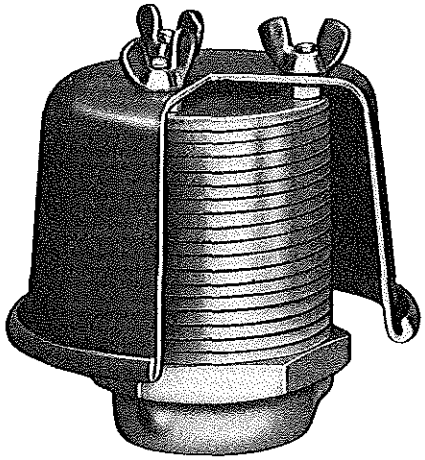
2.8 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DWG. FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

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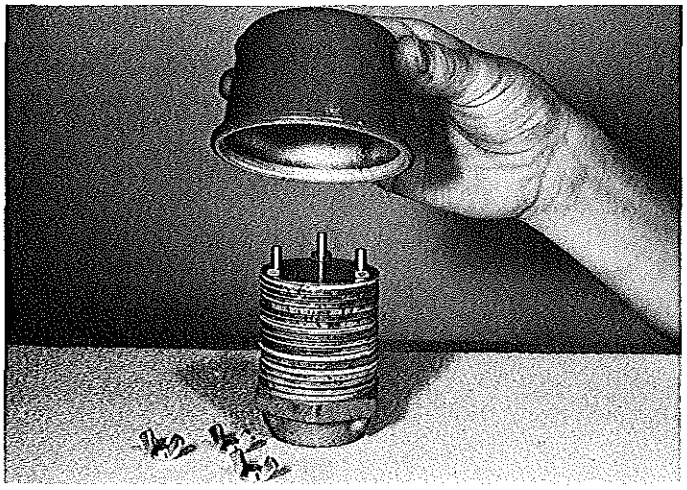
PROTECTOSEAL® • INSTALLATION AND MAINTENANCE INSTRUCTIONS

FLAME ARRESTER



Series 670

Series 6670



IMPORTANT - Before installation or servicing, make sure line is free of flammable or hazardous vapor.

Installation

1. Remove all protective packing.
2. Install unit, using suitable wrench on body flats to tighten.
3. Unit is ready for service.

Maintenance

1. Remove unit from installation.
2. Remove wing nuts on weatherhood. Remove weatherhood.
3. Inspect grid plates, blow out loose dirt and immerse in suitable solvent to dissolve gums and deposits. IMPORTANT: DO NOT DISASSEMBLE GRID ASSEMBLY.
4. Reassemble weatherhood and wing nuts. Tighten wing nuts securely.
5. Reinstall unit, using suitable wrench on body flats to tighten.

(THIS SPACE RESERVED FOR VENDOR DWG. WHEN IT BECOMES AVAILABLE)

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR:

VENDOR DWG. NO.:

TITLE: VENT, PRESSURE RELIEF

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1728	3/11/77	ASSY. OR LO.
DR. BY J. Dorn	3/ 11/77	SCALE
CHK'D. BY J. Wheeler	3/14/77	HEAT TR.
MAT'L		
APPV. CAST.		MATT.
APPV. MACH.		CHGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO 11 908 529 | SHEET 1 OF 2

PRESSURE RELIEF VENT FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 41 & 42, PARA. 6.1 a - PAINTING

1.1.2 PAGE 42, PARA. 6.2 a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3 a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2 f - STATEMENT OF CONFORMANCE

2. TECHNICAL SPECIFICATIONS

2.1 PRESSURE RELIEF VENT FOR EMERGENCY VENTING OF A DIESEL OIL DAY TANK

2.2 VENT MUST MEET THE REQUIREMENTS OF NFPA 30

2.3 VENT CAPACITY - 147,000 CFH FREE AIR AT 10 PSIG

2.4 VENT CONNECTION SIZE - 1-1/2" MINIMUM

2.5 VENT MUST BE FURNISHED WITH WEATHER HOOD

2.6 THE RELIEF VENT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.7 VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

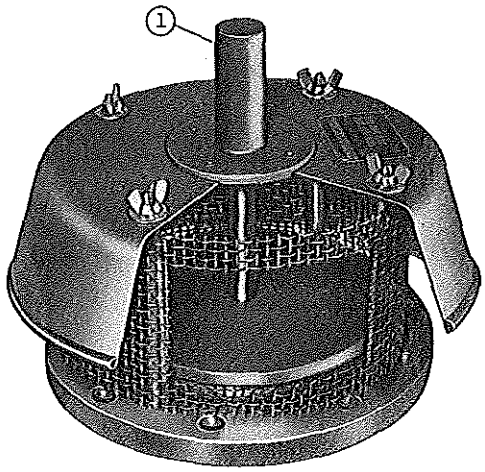
2.8 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DWG. FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

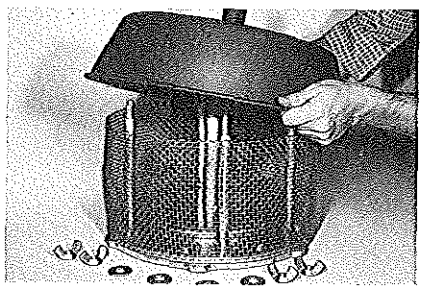
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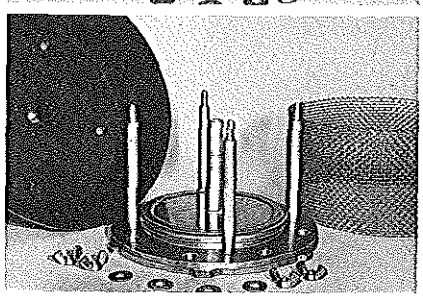
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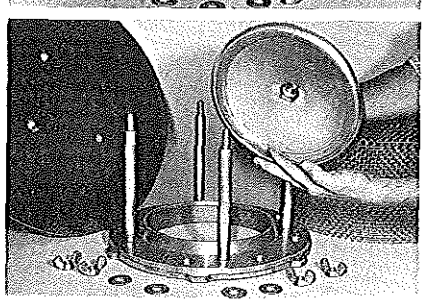
PRESSURE RELIEF VENT



Series 7800







IMPORTANT - Before installation or servicing, make sure line is free of flammable or hazardous vapor.

Installation

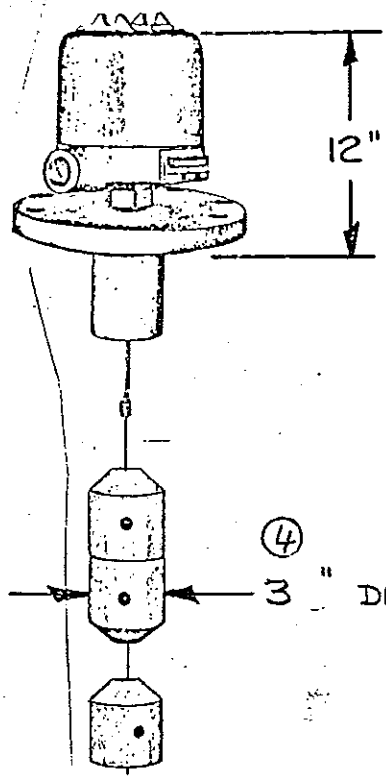
1. To preclude damage in shipment, particularly on the larger sizes, the stem guide of the weatherhood (see 1 in photo) is normally not shipped in place but is taped flat to the top of the weatherhood. Remove all tape and lay stem guide aside for later assembly.
2. Remove wing nuts and washers on weatherhood. Remove weatherhood.
3. Withdraw pressure valve from unit and remove protective cardboard and tape from the valve pallet.
4. When pressure weight (packed separately if heavy) is included with unit, place on valve. Reinsert valve.
5. Replace weatherhood, washers and wing nuts. Tighten securely.
6. Install stem guide in tapped opening in weatherhood, making sure that stem valve pallet is centered in the guide.
7. Install unit, using suitable gasket.

Maintenance

1. Loosen and remove wing nuts and washers.
2. Remove weatherhood and screen.
3. Wipe or wash screen free of dirt or foreign matter. If screen is damaged or corroded, replace.
4. Remove pressure valve (and weight, if used). Inspect and clean valve seat in body with suitable solvent. Seat should be free of nicks, mars or dirt. DO NOT USE FILE OR SHARP TOOLS on valve seating surface.
5. Inspect and clean valve diaphragm surface. Clean with suitable solvent. If damaged, replace valve assembly.
6. Inspect and clean sliding surface of valve stem.
7. Inspect valve stem guide from underside of weatherhood. Remove any deposits or dirt so the valve stem clears easily.
8. Reinstall pressure valve (and weight, if used).
9. Replace screen, weatherhood, washers and wing nuts. Tighten all wing nuts securely.

THE PROTECTOSEAL COMPANY 225 W. FOSTER AVE., BENSENVILLE IL 60106

11 908 549



SK 689564

LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: MAGNETROL

VENDOR DWG. NO: MODEL A-153-F-EP/VP-TDM-Y-S1M3DC-S1M3DC

TITLE: SWITCH, F.O. LEVEL ALARM

See 11 908 552 Sw. Switch

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY
4	12221	3-18 81	⑥ ADDED "Y" IN VENDOR PART NO.	W.R.S.
3	11	11	⑤ ADDED DISPL. MAT ④ 3 DIA WAS 3 1/8 DIA	W.R.S. JWD
2	11137	10-12 78	③ DELETE REF. TO REV. OF SPEC PG. 42-43	JM MSD
1	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS ②	NLS MSD
	10616	1-6-78	① ADDED PICTURE, VENDOR & VENDOR DWG. NO.	SJV

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1742	3/25/77	ASSY. OR LO.	
DR. BY J. Dorn	3/11/77	SCALE	
CHK'D. BY J. WHALEN	3/21/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 549 | 1 SHEET OF 2

ORIGINAL

11 908 549

908 549

FUEL OIL LEVEL ALARM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 41, PARA. 6.1a - PAINTING

1.1.2 PAGE 42*, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43*, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

* 8031-M-71 PAGE 42 REV. 2

2. TECHNICAL SPECIFICATIONS

2.1 DISPLACEMENT TYPE, DUAL SWITCH, LEVEL ALARM FOR HIGH AND LOW LEVEL ALARMS.

2.2 DISPLACERS SHALL BE SUITABLE FOR USE IN #2 DIESEL FUEL AT 115°F MAXIMUM; DISPLACERS SHALL BE ADJUSTABLE ALONG THE LENGTH OF THE STEM. DISPLACER MATERIAL STAINLESS STEEL.

2.3 DISPLACER STEM SHALL BE 4 FT. LONG

2.4 MOUNTING CONNECTION SHALL BE A 4" - 150 LB RAISED FACE STEEL FLANGE, ANSI

2.5 SWITCHES SHALL BE SPDT, NON-MERCURY TYPE, RATED FOR 125 VOLT DC, .2 AMP

2.6 SWITCH HOUSING SHALL BE NEMA TYPE 7

2.7 THE COMPONENT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMUTANEOUSLY

2.8 MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

COLT QA OCT 17 1970

11908549

BULLETIN: 45-607.1
EFFECTIVE: May 1977
SUPERSEDES: April 1976

INSTRUCTION MANUAL and PARTS LIST
MODEL A-103 and A-153 SERIES
LIQUID LEVEL CONTROLS

DESCRIPTION

The Model A-103 series controls are single stage "wide" differential type units designed primarily for pump or valve control applications in liquid make-up service on tanks or vessels.

The Model A-153 series controls are single stage "narrow" differential displacement units designed for high or low level alarm service.

Each standard A-103 and A-153 control utilizes a single switch mechanism and is top mounted to a tank or vessel by means of a threaded or flanged pipe connection.

Optional multistage "tandem" versions of the A-103 and A-153 controls employ multiple switch mechanisms to combine various control and alarm functions into a single instrument.

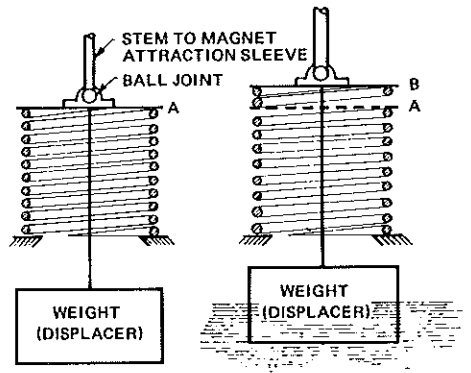
OPERATING PRINCIPLE

Magnetrol® displacer type controls "pick-up" level travel by utilizing Archimedes' principle. "Any body immersed in a liquid is "buoyed up" by a force equal to the weight of the liquid the body displaces."

The illustration at right shows the relationship of all parts at "low liquid level" and "high liquid level." The "body" takes the form of one or more weights called displacers, hung on a stem, and suspended from a support spring. When the liquid level is below the displacer(s), the spring will come to fixed position "A". When the liquid level rises to the center of the displacer(s) the downward load on the spring is lightened allowing it to move to position "B". This happens even though the weights are heavier than the liquid and do not "float". The spring is always partially compressed from the downward load. It is the varying weight of this load by liquid displacement that causes the spring to be compressed MORE or LESS. This movement is transmitted to the switch mechanism. See bulletin on switch mechanism for its operating principle.

Since MOVEMENT OCCURS ONLY WHEN THE LIQUID LEVEL REACHES A DISPLACER, the point at where switch action is desired can be varied anywhere within the displacer stem length. Loosen the set screw clamp at the center of the displacer and slide the displacer to the point where switch action is desired, then retighten clamp.

FIG. 1



INSTALLATION

Adjust the displacers on the displacer cable for the desired switch actuating levels. (Instruction tag attached to cable.) Screw displacer cable fitting to threaded connecting link protruding from underside of control.

Be sure there are no tubes, rods, or other obstacles in the tank or vessel to interfere with the operation of the displacers. No guides into the tank are necessary unless liquid turbulence is excessive, in which case a "guide pipe" or "stilling tube" is recommended. The I.D. of the pipe or tube should be at least 1" larger than the displacer diameter, open at the bottom end and with several vent holes located above the maximum high level of the liquid.

Check installation of pipe or tube to be certain it is plumb.

IMPORTANT: Before attaching Magnetrol control to tank or vessel, check with level to see that tank mounting flange or spud is within 3° of horizontal. Proper operation of the control depends on the switch housing being within 3° of vertical.

WIRING INSTRUCTIONS

NOTE: If control is equipped with pneumatic switch mechanism, disregard these instructions and refer to instruction bulletin on mechanism furnished for air (or gas) connections.

Most Magnetrol control switch housings are designed to provide 360° positioning of conduit outlet by loosening the set screw(s) located under the housing base. Diagrams of the control's internal electrical circuits (switching action between terminals) will be found in the switch mechanism instruction bulletin included, as listed on page 11.

On high temperature applications (above 250°F.) asbestos covered wire should be used between control and first junction box located in a cooler area. Supply wires (conductors) are brought into the switch housing, wrapped around the enclosing tube under the baffle plate and then brought up to the proper terminals. Excess wire should be positioned so as not to interfere with switch mechanism or housing cover.

Some controls are furnished with an explosion proof (cast) switch housing or a vapor tight (gasketed) type. These housings are used in hazardous locations or when liquid temperature is so low that excessive condensation and frosting of switch parts is likely. After wiring connections have been completed, explosion proof housings must be "sealed" at the conduit outlet with suitable compound or "dope" to prevent entrance of air. Check cover to base fit on explosion proof and vapor tight housings to be certain gasketed joint is tight. A positive seal is necessary to prevent infiltration of moisture laden air or corrosive gases into switch housing.

Connect power supply to control and test switch action by varying liquid level. If switch mechanism fails to function, check verticle alignment of control and consult installation bulletin on mechanism furnished.

PREVENTIVE MAINTENANCE

Periodic inspections are a necessary means to keep your Magnetrol level control in good working order. This control is, in reality a safety device to protect the valuable equipment it serves. Should the control fail, the resultant damage to equipment dependent upon its performance could very well cost far in excess of the control itself. Therefore, a systematic program of "Preventive Maintenance" should be implemented when control is placed into service. If the following sections on "What to Do" and "What to Avoid" are observed, your control will provide reliable protection of your capital equipment.

WHAT TO DO

1. KEEP CONTROL CLEAN

— NEVER leave switch housing cover off the control. This cover is designed to keep dust and dirt from interfering with switch mechanism operation. In addition, it protects against damaging moisture and acts as a safety feature by keeping bare wires and terminals from being exposed. Should the housing cover become damaged or misplaced, order a replacement immediately.

2. INSPECT SWITCH MECHANISMS, TERMINALS AND CONNECTIONS MONTHLY

— Mercury switches may be visually inspected for short circuit damage. Check for small cracks in the glass tube containing the mercury. Such cracks can allow entrance of air into the tube causing the mercury to "oxidize". This is noticeable as the mercury will appear dirty and have a tendency to "string out" like water, instead of breaking into clean round pools. If these conditions exist, replace the mercury switch immediately.

— Dry contact switches should be inspected for excessive wear on actuating lever or misalignment of adjustment screw at point of contact between screw and lever. Such conditions can cause false switch actuating levels. Adjust switch mechanism to compensate (if possible) or replace switch.

DO NOT operate your control with defective or maladjusted switch mechanisms (refer to bulletin on switch mechanism furnished for service instructions).

— Magnetrol controls may sometimes be exposed to excessive heat or moisture. Under such conditions, insulation on electrical wires may become brittle, eventually breaking or peeling away. The resulting "bare" wires can cause short circuits. Check wiring carefully and replace at first sign of brittle insulation.

— Vibration may sometimes cause terminal screws to work loose. Check all terminal connections to be certain that screws are tight. Air (or gas) operating medium lines, subjected to vibration, may eventually crack or become loose at connections causing leakage. Check lines and connections carefully and repair or replace, if necessary.

WHAT TO AVOID

1. **NEVER** leave switch housing cover off the control longer than necessary to make routine inspections.
2. **NEVER** use lubricants on pivots of switch mechanisms. A sufficient amount of lubricant has been applied at the factory to insure a lifetime of service. Further oiling is unnecessary and will only tend to attract dust and dirt which can interfere with mechanism operation.
3. **NEVER** place a jumper wire across terminals to "cut-out" the control. If a "jumper" is necessary for test purposes, be certain it is removed before placing control into service.
4. **NEVER** attempt to readjust magnetic attraction sleeves which are factory set. Tampering may cause failure of control while in service even though manual operation actuates switches.
5. **NEVER** attempt to make adjustments or replace switches without reading instructions carefully. Certain adjustments provided for in Magnetrol controls should not be attempted in the field. When in doubt, consult the factory or your local Magnetrol representative.

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TROUBLE SHOOTING

Usually the first indication of improper operation is failure of the controlled equipment to function – pump will not start (or stop), signal lamps fail to light, etc. When these symptoms occur, whether at time of installation or during routine service thereafter, check the following external causes first.

- Fuses may be blown.
- Reset button(s) may need resetting.
- Power switch may be open.
- Controlled equipment may be faulty.
- Wiring (or medium lines) leading to control may be defective.

If a thorough inspection of these possible conditions fails to locate the trouble, proceed next to a check of the control's switch mechanism.

1. Pull disconnect switch or otherwise assure that electrical circuit(s) through the control is deactivated.
2. Remove switch housing cover.
3. Swing magnet assembly in and out by hand, checking carefully for any sign of binding. Assembly should require no force, however slight, to move it through its full swing.
4. If binding exists, magnet may be rubbing enclosing tube or pivot sockets may be overly tight. Readjust pivot sockets as required until a slight amount of side play is evident. If magnet is rubbing, loosen magnet clamp screw and shift magnet position.
5. If switch magnet assembly swings freely and mechanism still fails to actuate, check installation of control to be certain it is within the specified three (3°) degrees of vertical (use spirit level on side of enclosing tube in two places, 90° apart).
6. If mechanism is equipped with a mercury switch, examine glass tube closely, as previously described in preventive maintenance section. If switch is damaged, replace it immediately.

NOTE: As a matter of good practice, spare switches should be kept on hand at all times.

If switch mechanism is operating satisfactorily, a test of the complete control's performance is the next likely step.

1. Reconnect power supply and carefully actuate switch mechanism manually (using a non-conductive tool on electrical switch mechanism) to determine whether controlled equipment will operate.

CAUTION: With electrical power "on" care should be taken to avoid contact with switch leads and connections at terminal block.

2. If controlled equipment responds to manual actuation test, trouble may be located in level sensing portion of the control (displacers, spring, stem and magnetic attracting sleeve).

NOTE: Check first to be certain liquid is entering tank or vessel. A valve may be closed or pipe line plugged.

3. With liquid in tank or vessel, proceed to check level sensing action by removing switch housing assembly.

CAUTION: Be certain to pull disconnect switch or otherwise assure that electrical circuit(s) through control is deactivated. Close operating medium supply valve on controls equipped with pneumatic switch mechanisms.

   A. Disconnect wiring from supply side of switch mechanism(s) and remove electrical conduit or operating medium line connections to switch housing.
   B. Relieve pressure from tank or vessel and allow unit to cool.
   C. Remove switch housing assembly by loosening hex nut located immediately below housing base.

4. With switch housing assembly removed, inspect attracting sleeve and inside of enclosing tube for excessive corrosion or solids build-up which could restrict movement, preventing sleeve from reaching field of switch magnet.
5. If trouble still is not located, proceed to remove the entire sensing unit from the tank or vessel by unbolting head flange or unscrewing mounting bushing. Inspect displacer assembly and all internal parts for any signs of damage. Check assembly for binding by supporting head flange or mounting bushing over the edge of a bench and move displacer assembly by hand.

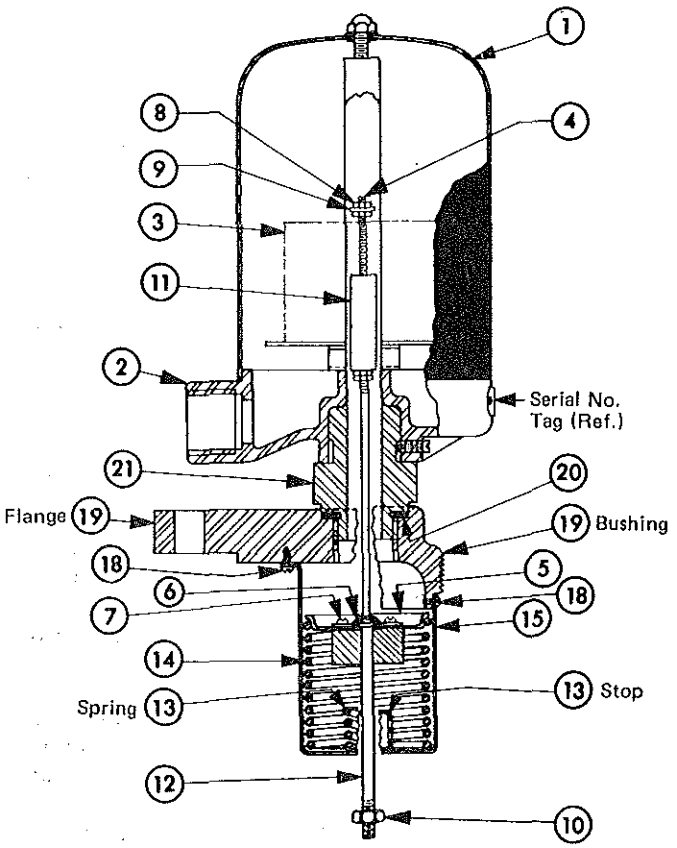
NOTE: When in doubt about the condition or performance of a Magnetrol control, return it to the factory. See "Our Service Policy" on back page.

The instructions contained in this bulletin are general and can be applied to most any Magnetrol displacement type control. If difficulties are encountered which can not be identified, consult with the factory or your local representative for assistance. A complete description of the trouble should be provided along with information concerning your piping and mounting arrangement, and a description of your operation sequence. Sketches or photographs showing the installation are also beneficial.

When communicating about your control, be certain always to specify the complete Model and Serial numbers.

STANDARD MODEL REPLACEMENT PARTS

TYPICAL MODEL A-103 or A-103-F
(Composite Section)



DISPLACER SETS

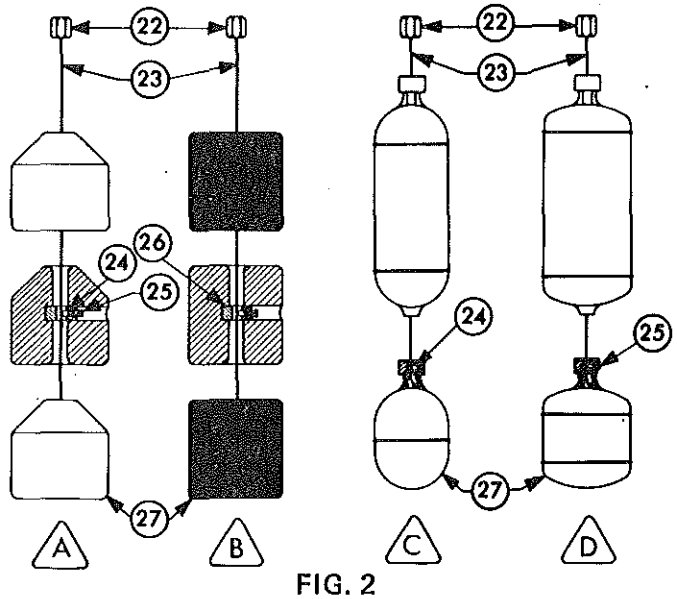
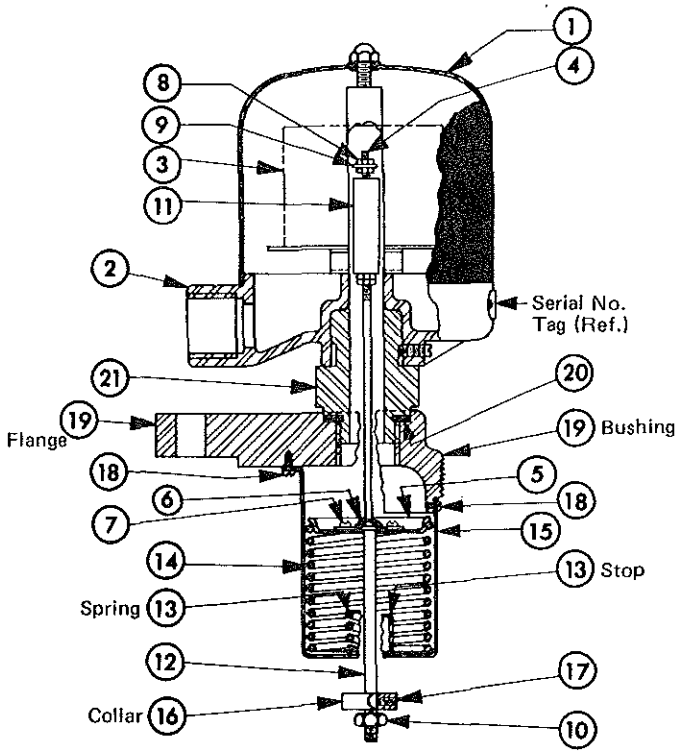


FIG. 2

TYPICAL MODEL A-153 or A-153-F
(Composite Section)



DISPLACER SETS

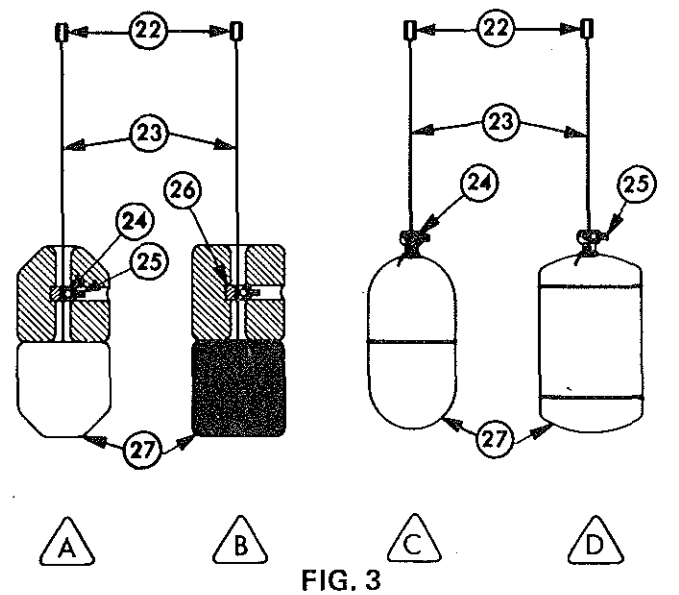


FIG. 3

CAUTION:

Location of jam nuts (item 9) on stem (item 4) must be maintained for proper switch actuation. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

STANDARD MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION		REPLACEMENT ASSEMBLIES ①			
			MODEL			
			A-103	A-103-F	A-153-F	A-153
1	Switch Housing Cover	Housing Kits	See Bulletin 42-680 for Ref. Type S-1 Housing Replacement Assemblies. Consult Local Representative on Types J-1, J-2 and M-1 Housings.			
2	Switch Housing Base					
3	Switch Mechanism	–	See Bulletin on Switch Mechanism Furnished (Listed on Page 11).			
4	Stem ②	Stem Kits ③	89-5523-001 Standard Sleeve 89-5524-001 Sheathed Sleeve			
5	Spring Guide					
6	Retaining Bracket					
7	Bracket Mtg. Screws					
8	Jam Nuts					
9	Guide Washer(s)					
10	Lock Nut					
11	Attraction Sleeve					
12	Connecting Link Ass'y.	Spring Kits ④	89-5303-001 Standard 89-5304-001 W/Karbate Displacers	89-5305-001 Standard 89-5306-001 W/Karbate Displacers	89-5307-001 Standard 89-5308-001 W/Karbate Displacers	89-5309-001 Standard 89-5310-001 W/Karbate Displacers
13	Spacer Spring or Stop					
14	Range Spring					
15	Spring Cup					
16	Stop Collar					
17	Set Screw					
18	Cup Mtg. Screws					
18	Cup Mtg. Screws	Mounting Kits	NOTE: Mounting Components Directly Affect Calibration of Displacement Type Controls. Should Replacement Kit Be Required, Control Should Be Returned to the Factory for Fitting of New Components and Recalibration. See Return Material Procedure on Back Page.			
19	Mounting Bushing					
	Mounting Flange					
20	E-Tube Gasket					
20	E-Tube Gasket	E-Tube Kits	89-5908-001 (Short) 89-5903-001 (Tall)		89-5908-001 (Short)	
21	Enclosing Tube					

ITEM	DESCRIPTION	REPLACEMENT DISPLACER SETS ⑤							
		MODELS A-103 and A-103-F				MODELS A-153 and A-153-F			
		Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)	Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)
22	Connector Nut	89-6110-001	89-6111-001	89-6112-001	89-6113-001	89-6114-001	89-6115-001	89-6116-001	89-6117-001
23	Displacer Cable								
24	Clamp Balls								
25	Set Screws								
26	Displacer Clamps								
27	Displacers								

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard base models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in above listing.

② Stem furnished must be cut to match length of old stem before assembly.

③ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeve is type 400 series stainless steel.

④ All spring Kits listed use standard inconel range springs. Consult local representative on Kits for optional models using stainless steel range springs.

⑤ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers. Displacer sets can not be interchanged without special control modifications and recalibration.

TANDEM STYLE CONTROLS

TWO LEVEL STAGE TANDEM CONTROLS

The Magnetrol two level stage tandem control combines the functions of two separate controls into a single unit – requiring only one opening into the tank or vessel upon which it is to be mounted. Two separate switch mechanisms are employed – each operated independently. There are two general types of controls – those with a "wide" differential at each level stage, and those with a "narrow" differential at each level stage.

A-103 SERIES (Wide Differential)

These controls were designed for a variety of functions, of which five of the most common switch and displacer arrangements are described in Figure 4 below.

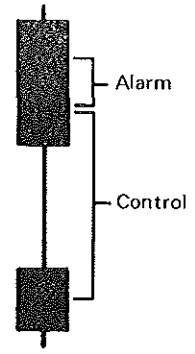
The A-103 Model is mounted by means of a 3" NPT cast iron mounting bushing. The A-103-F Model is furnished with a 4" cast iron mounting flange as standard and is available with larger flanges and/or flanges of other materials.

A-153 SERIES (Narrow Differential)

These units were designed principally for applications requiring both high and low level alarm functions in a single control, as described in Figure 5 below.

The A-153 Model is installed with a mounting bushing while the A-153-F Model is flange mounted version.

TYPICAL A-103 SERIES TANDEM CONTROL ARRANGEMENTS

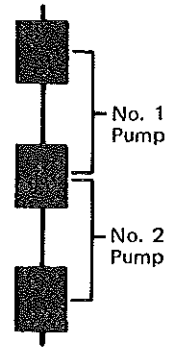


Arrangement No. 1

PUMP CONTROL PLUS ALARM

Arrangement No. 1 (illustrated): At the lowest level the pump starts. When the level rises to the middle displacer, the pump stops. If the level continues to rise, the upper displacer actuates the alarm switch which remains actuated until the level drops to the middle displacer.

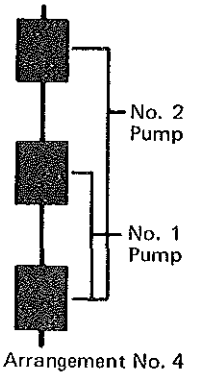
Arrangement No. 2: The sequence of Arrangement No. 1 can be reversed to provide pump start at high level and pump stop at low level followed by low level alarm operation.



Arrangement No. 3

CONTROL OF TWO PUMPS OF DIFFERENT CAPACITY

Arrangement No. 3 (illustrated): Two pumps are used to keep a tank filled. When the level falls to the middle displacer, a small No. 1 pump starts. A second larger pump is started should the level continue to fall to the bottom displacer.



Arrangement No. 4

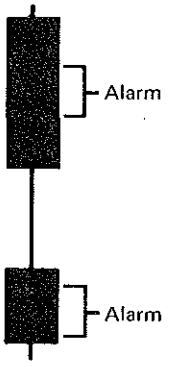
CONTROL OF TWO PUMPS

Arrangement No. 4 (illustrated): In this sequence No. 1 pump starts as the level rises to the middle displacer. Should the level continue to rise to the upper displacer, No. 2 pump is actuated. Both pumps operate until the level is dropped to the lower displacer.

Arrangement No. 5: The pumping sequence of Arrangement No. 4 can be reversed for a pump "fill" application.

FIG. 4

TYPICAL A-153 SERIES TANDEM CONTROL ARRANGEMENT



When properly installed, the normal level would be somewhere between the two displacers. Should the level rise to the upper displacer, the high level alarm switch will actuate and remain actuated until the level recedes. Conversely, should the level drop to the lower displacer, the low level alarm switch actuates and remains actuated until the level rises.

FIG. 5

CAUTION: Tandem style level controls are factory calibrated to function in one arrangement only to meet original customer specifications. Any variation in actual conditions from design conditions usually requires special control modifications. Consult with factory or local representative for assistance.

TANDEM STYLE CONTROLS – continued

THREE LEVEL STAGE TANDEM CONTROLS

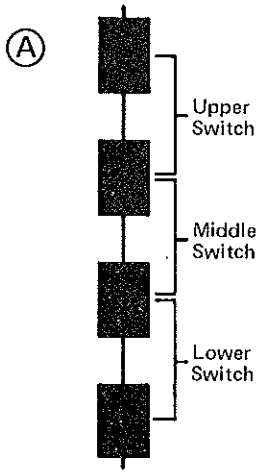
A-103-3X SERIES (Wide Differential)

Magnetrol three level stage tandem controls are designed for applications where a single instrument is required to provide three electrically separate control signals in sequence. Three independent switch mechanisms are employed – operating in a special extended switch housing. Seven factory set switch and displacer arrangements are described in Figure 6 below.

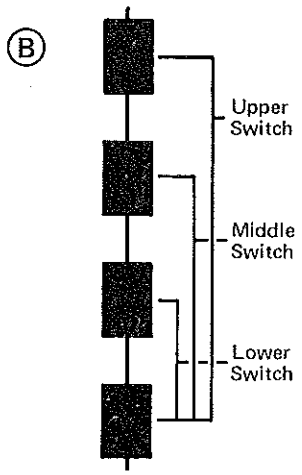
The A-103-3X Model is mounted by means of a 3" NPT cast iron mounting bushing. The A-103-F-3X Model is furnished with a 4" cast iron mounting flange as standard and is available with larger flanges and/or flanges of other materials.

TYPICAL A-103-3X SERIES TANDEM CONTROL ARRANGEMENTS

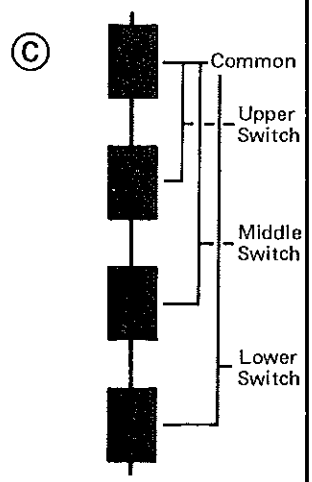
Control of three separate devices employing two common displacers.



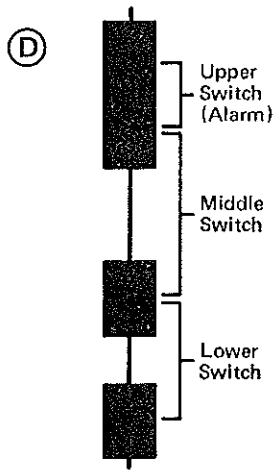
Control of three separate pumps on rising level. Pumps cut-in individually; stop simultaneously at lower displacer.



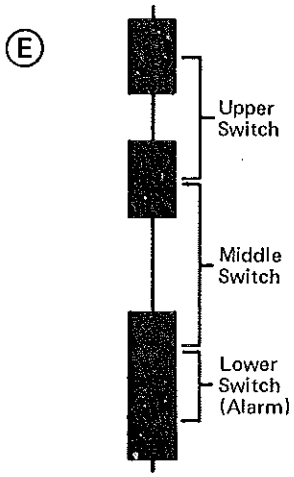
Control of three separate pumps on falling level. Pumps cut-in individually; stop simultaneously at upper displacer.



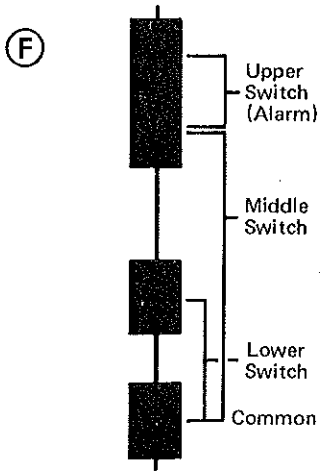
Control of two pumps of different capacity, plus high level alarm.



Control of two pumps of different capacity, plus low level alarm.



Control of two pumps on rising level plus high level alarm. Pumps cut-in individually; stop simultaneously at lower displacer.



Control of two pumps on falling level plus low level alarm. Pumps cut-in individually; stop simultaneously at upper displacer.

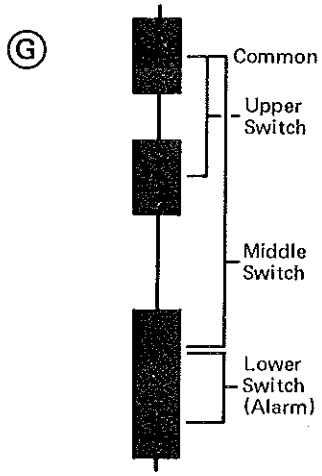
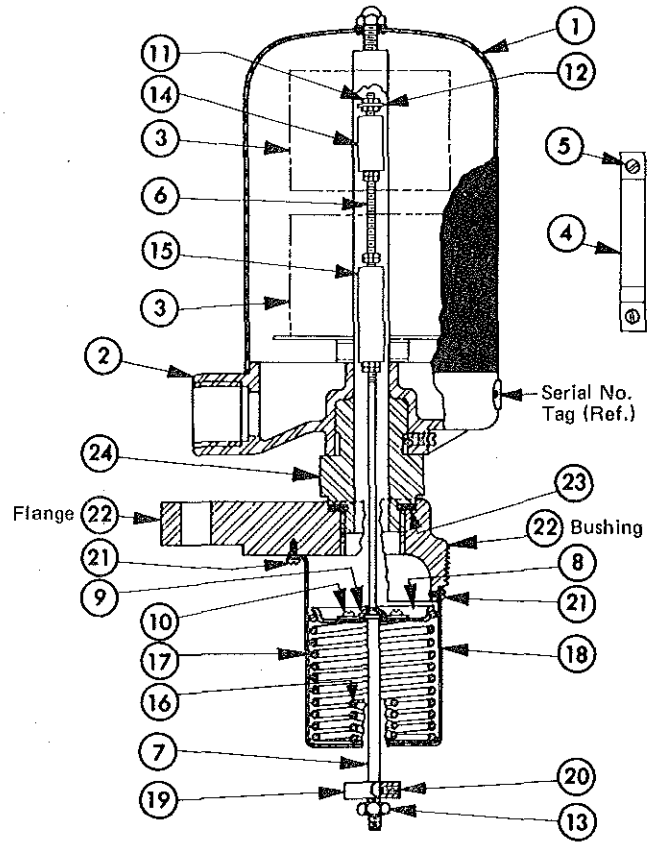


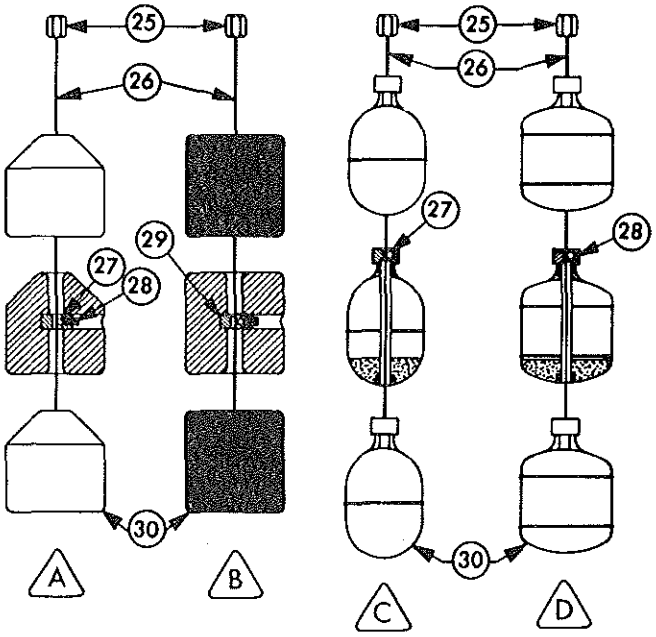
FIG. 6

TANDEM MODEL REPLACEMENT PARTS

TYPICAL A-103-TDM and A-103-F-TDM
A-153-TDM and A-153-F-TDM UNITS
(Composite Section)



A-103-TDM and A-103-F-TDM
DISPLACER SETS



IMPORTANT: Many control models are specially tailored to meet specific customer specifications and therefore may contain special parts. When ordering replacement parts, always give serial number of control.

CAUTION:

Location of jam nuts (item 11) on stem (item 6) must be maintained for proper switch actuations. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

(*) IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

A-153-TDM and A-153-F-TDM
DISPLACER SETS

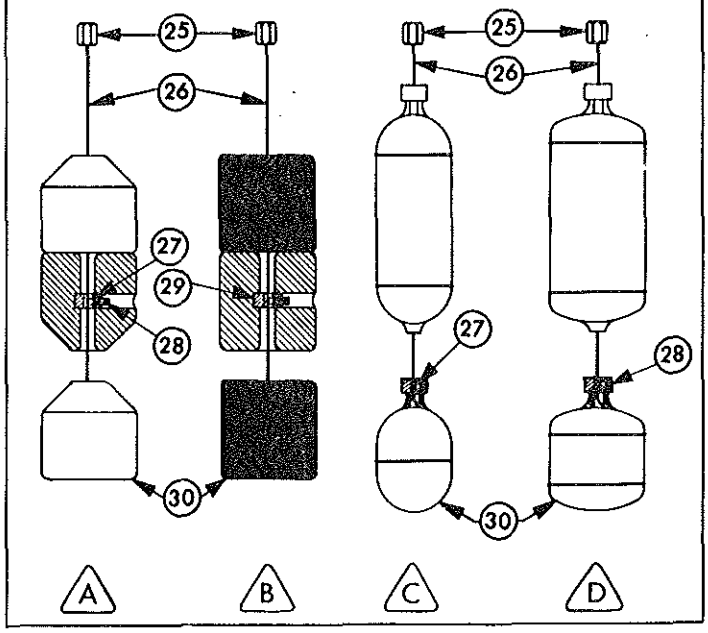


FIG. 7

NOTE:

(1) All replacement assemblies listed are furnished in Kit form for standard tandem models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in listing, page 9.

(2) Stem furnished must be cut to match length of old stem before assembly.

TANDEM MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION		REPLACEMENT ASSEMBLIES ①			
			MODEL			
			A-103-TDM	A-103-F-TDM	A-153-F-TDM	A-153-TDM
1	Switch Housing Cover	Housing Kits	See Bulletin 42-680 For Ref. Type S-1 Switch Housing Replacement Assemblies. Consult Local Representative on Types J-1, J-2 and M-1 Housings.			
2	Switch Housing Base					
3	Switch Mechanisms	–	See Bulletin on Switch Mechanisms Furnished (Listed on Page 11).			
4	Spacer Bracket	Spacer Kit	89-6919-001			
5	Rd. Hd. Screws					
6	Stem ②	Stem Kits ③	89-5525-001 Standard Sleeves 89-5526-001 Sheathed Sleeves	89-5527-001 Standard Sleeves 89-5528-001 Sheathed Sleeves	89-5525-001 Standard Sleeves 89-5526-001 Sheathed Sleeves	
7	Connecting Link					
8	Spring Guide					
9	Retaining Bracket					
10	Bracket Mtg. Screws					
11	Jam Nuts					
12	Guide Washer(s)					
13	Lock Nut					
14	Attraction Sleeve (upper)					
15	Attraction Sleeve (lower)					
16	Spacer Spring	Spring Kits ④	89-5311-001	89-5312-001	89-5311-001	
17	Range Spring					
18	Spring Cup					
19	Stop Collar					
20	Set Screw					
21	Cup Mtg. Screws					
21	Cup Mtg. Screws	Mounting Kits	NOTE: Mounting Components Directly Affect Calibration of Displacement Type Controls. Should Replacement Kit Be Required, Control Should Be Returned to the Factory for Fitting of New Components and Recalibration. See Return Material Procedure on Back Page.			
22	Mounting Bushing					
	Mounting Flange					
23	E-Tube Gasket					
23	E-Tube Gasket	E-Tube Kits	89-5903-001			
24	Enclosing Tube					

ITEM	DESCRIPTION	REPLACEMENT DISPLACER SETS ⑤							
		MODELS A-103-TDM and A-103-F-TDM				MODELS A-153-TDM and A-153-F-TDM			
		Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)	Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)
25	Connector Nut	89-6118-001	89-6119-001	89-6120-001	⊛ Special Order Item. See Important Order Note on Page 8.	89-6118-001	89-6119-001	89-6121-001	⊛ Special Order Item. See Important Order Note on Page 8.
26	Displacer Cable								
27	Clamp Balls								
28	Set Screws								
29	Displacer Clamps								
30	Displacers								

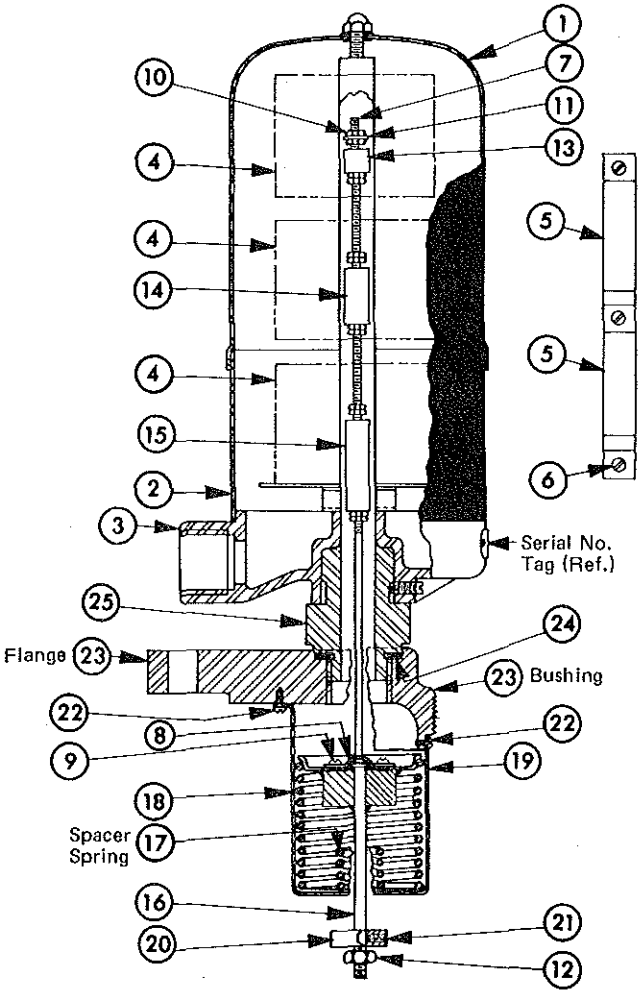
③ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeves are type 400 series stainless steel.

④ Spring kits listed use inconel range springs. Consult local representative on kits for optional models using stainless steel range springs.

⑤ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers. Displacer sets can not be interchanged without special control modifications and recalibration.

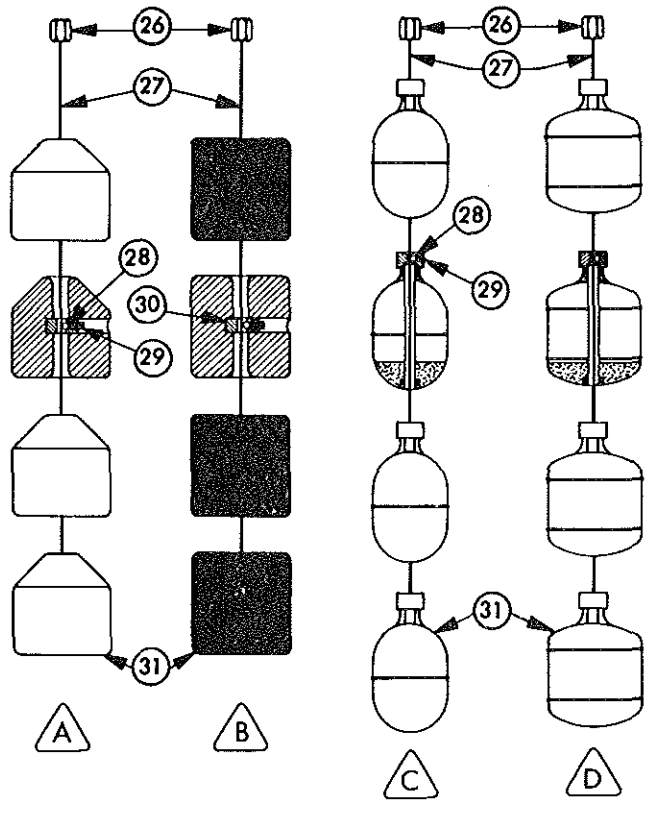
TRIPLEX TANDEM MODEL REPLACEMENT PARTS

TYPICAL A-103-3X-TDM and
A-103-F-3X-TDM UNITS
(Composite Section)



IMPORTANT: Many control models are specially tailored to meet specific customer specifications and therefore may contain special parts. When ordering replacement parts, always give Serial number of control.

A-103-3X-TDM and A-103-F-3X-TDM
DISPLACER SETS



CAUTION:

Location of jam nuts (item 10) on stem (item 7) must be maintained for proper switch actuations. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

⊛ IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

FIG. 8

TRIPLEX TANDEM MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION	REPLACEMENT ASSEMBLIES ① MODEL A-103-3X-TDM	REPLACEMENT ASSEMBLIES ① MODEL A-103-F-3X-TDM
1	Switch Housing Cover	89-6528-001 Standard Housing ② 89-6529-001 Explosion Proof Housing	
2	Cover Extension		
3	Switch Housing Base		
4	Switch Mechanisms	See Bulletin on Mechanism Furnished.	
5	Spacer Brackets	89-6920-001 Spacer Kit	
6	Rd. Hd. Screws		
7	Stem ③	89-5529-001 Stem Kit w/Standard Sleeves 89-5530-001 Stem Kit w/Sheathed Sleeves ④ ⑤	
8	Retaining Bracket		
9	Bracket Mtg. Screws		
10	Jam Nuts		
11	Guide Washer(s)		
12	Lock Nut		
13	Attraction Sleeve (upper)		
14	Attraction Sleeve (middle)		
15	Attraction Sleeve (lower)		

ITEM	DESCRIPTION	REPLACEMENT ASSEMBLIES ① MODEL A-103-3X-TDM	REPLACEMENT ASSEMBLIES ① MODEL A-103-F-3X-TDM
16	Connecting Link Ass'y.	89-5313-001 Spring Kit ⑤ ⑥	89-5314-001 Spring Kit ⑤ ⑥
17	Spacer Spring		
18	Range Spring		
19	Spring Cup		
20	Stop Collar		
21	Set Screw		
22	Cup Mtg. Screws		
22	Cup Mtg. Screws	Mounting Kits (See Note ⑤ Below)	
23	Mounting Bushing		
	Mounting Flange		
24	E-Tube Gasket		
24	E-Tube Gasket	89-5902-001 E-Tube Kit	
25	Enclosing Tube		

ITEM	DESCRIPTION	DISPLACER SETS ⑦ Porcelain (A)	Karbate (B)	SST (C)	SST (D)
26	Connector Nut	89-6122-001	89-6123-001	⊛ Special Order Items. See Important Order Note on Page 10.	
27	Displacer Cable				
28	Clamp Balls				
29	Set Screws				
30	Displacer Clamps				
31	Displacers				

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard triplex tandem models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in above listings.

② Replacement standard housing kits are furnished with moisture proof epoxy coated housing covers only for NEMA classifications 1 through 5 and 12.

③ Stem furnished must be cut to match length of old stem before assembly.

④ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeves are type 400 series stainless steel.

⑤ Stem, spring, and mounting kit components directly affect calibration of triplex tandem model displacement controls. Should any of these replacement kits be required, control should be returned to the factory for fitting of new components and recalibration. See return material procedure on back page.

⑥ Spring kits listed use inconel range springs. Consult local representative on kits for optional models using stainless steel range springs.

⑦ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers.

NOTE: Refer to one of the following bulletins furnished with your control for switch mechanism replacement parts.

SWITCH MECHANISM (Model Suffix Number)	BULLETIN	REF. TYPE
S-1 & DPS-1 Mercury Switches	42-608	S-1
J-1 Bleed Type Pneumatic Valve	42-617	J-1
J-2 Non-Bleed Type Pneumatic Valve	42-621	J-2
S-1M & DPS-1M Dry Contact Switches	42-657	S-1
M-1 & M-4 Anti-Vibration Dry Contact Switches	42-670	M-1
SPS-1 & SPDPS-1 Anti-Vibration Mercury Switches	42-675	S-1

Guarantee

We guarantee to repair or to replace, at our option, any MAGNETROL Level or Flow Control which, within one year from date of shipment, exhibits any defect in material or workmanship, provided that: (1) the unit has been properly installed; and (2) it has been operated with the liquid and within the pressure, temperature, specific gravity and electric current or pneumatic supply limitations specified on the original purchase order or as stamped on the MAGNETROL instrument nameplate.

Important

OUR SERVICE POLICY

Owners of Magnetrol controls may request to return a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. If, once returned, the underlying cause of the trouble is found to be defective material or workmanship (within the guarantee period), the item will be either rebuilt, or replaced completely, without charge on an F.O.B. factory basis. If the trouble is the result of conditions beyond our control or is not covered by the guarantee, there will be a charge for labor and a charge for parts required to rebuild or replace the item.

In some cases it may be expedient to ship new parts or in extreme cases, a complete new control to replace the original before it is returned. If this is desired, inform us as to what parts are needed, the model number and the serial number of the control and repair part number. Credit for materials returned in such cases will be determined on the basis of the applicability of our guarantee.

No claims for labor or consequential damage will be allowed.

RETURN MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" tag be obtained from the factory for attachment to the goods. This is available through Magnetrol's local representative or by writing directly to the factory supplying the following information:

1. Installation Name
2. Description of Material
3. Production Number
4. Serial Number
5. Reason for Return
6. Desired Action

All shipments returned to the factory must be by Prepaid transportation.

All replacements will be shipped F.O.B. factory.

MAGNETROL
INTERNATIONAL, INCORPORATED

5300 Belmont Road • Downers Grove, Illinois 60515 • (312) 969-4000 • Telex 25-3085

In Canada: Magnetrol International Ltd.
6291 Dorman Road
Mississauga, Ontario L4V-1H2
Phone: (416) 678-2720
Telex: 06-968502

In Europe: Magnetrol International N.V.
Industriepark Blok E
9140 Zele, Belgium
Phone: 052-445901
Telex: 846-25944

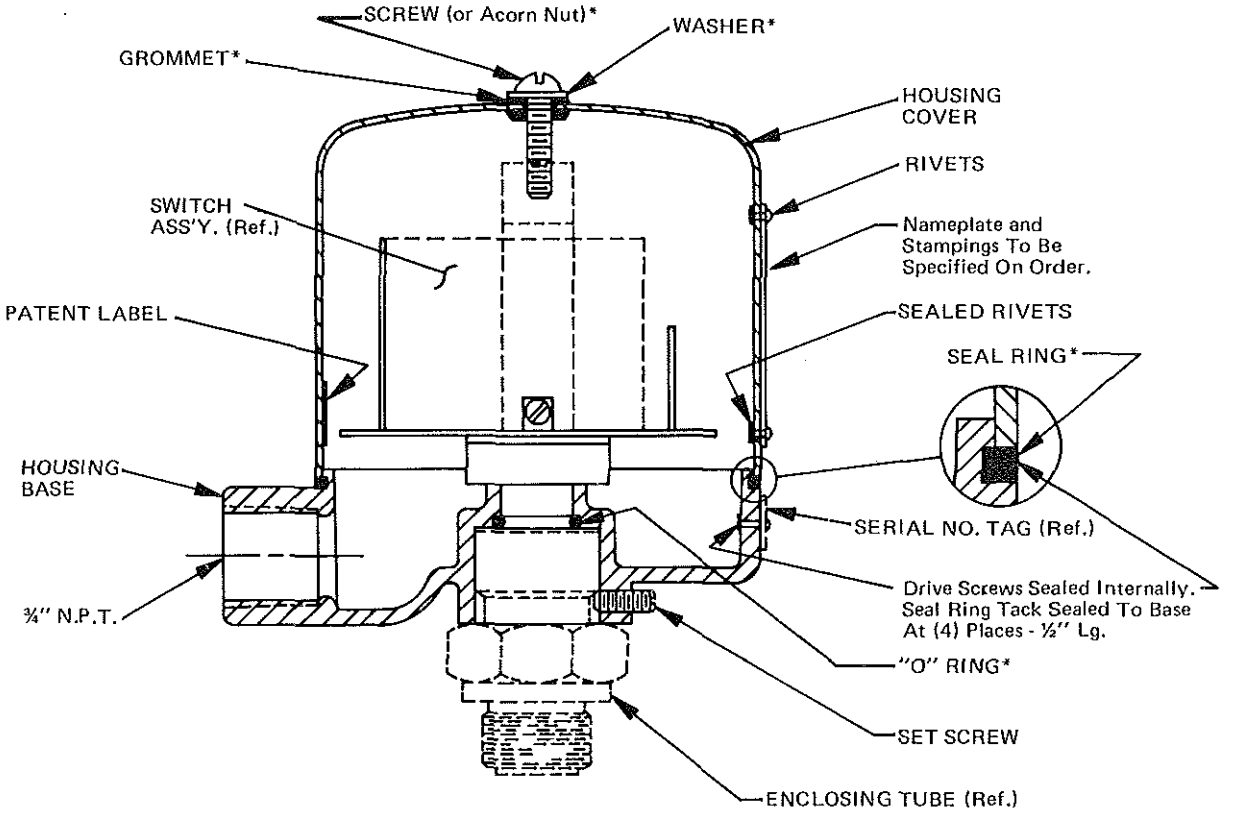
REPRESENTATIVES IN PRINCIPAL CITIES.

Printed in USA

MAGNETROL
INTERNATIONAL, INCORPORATED

BULLETIN: 42-680.4
EFFECTIVE: October 1977
SUPERSEDES: November 1975

MAGNETROL TYPE S-1 SWITCH HOUSING REPLACEMENT ASSEMBLIES



TYPICAL STANDARD HOUSING ASSEMBLY

DESCRIPTION

Standard housing replacement assemblies are designed for applications ranging from general purpose indoor use to non-hazardous installations requiring a dust, water, lint, fiber and oil tight enclosure.

The manual reset (M.R.) assemblies utilize the same basic components as the standard units, but are limited to general purpose indoor applications where unit is not exposed to unusual conditions.

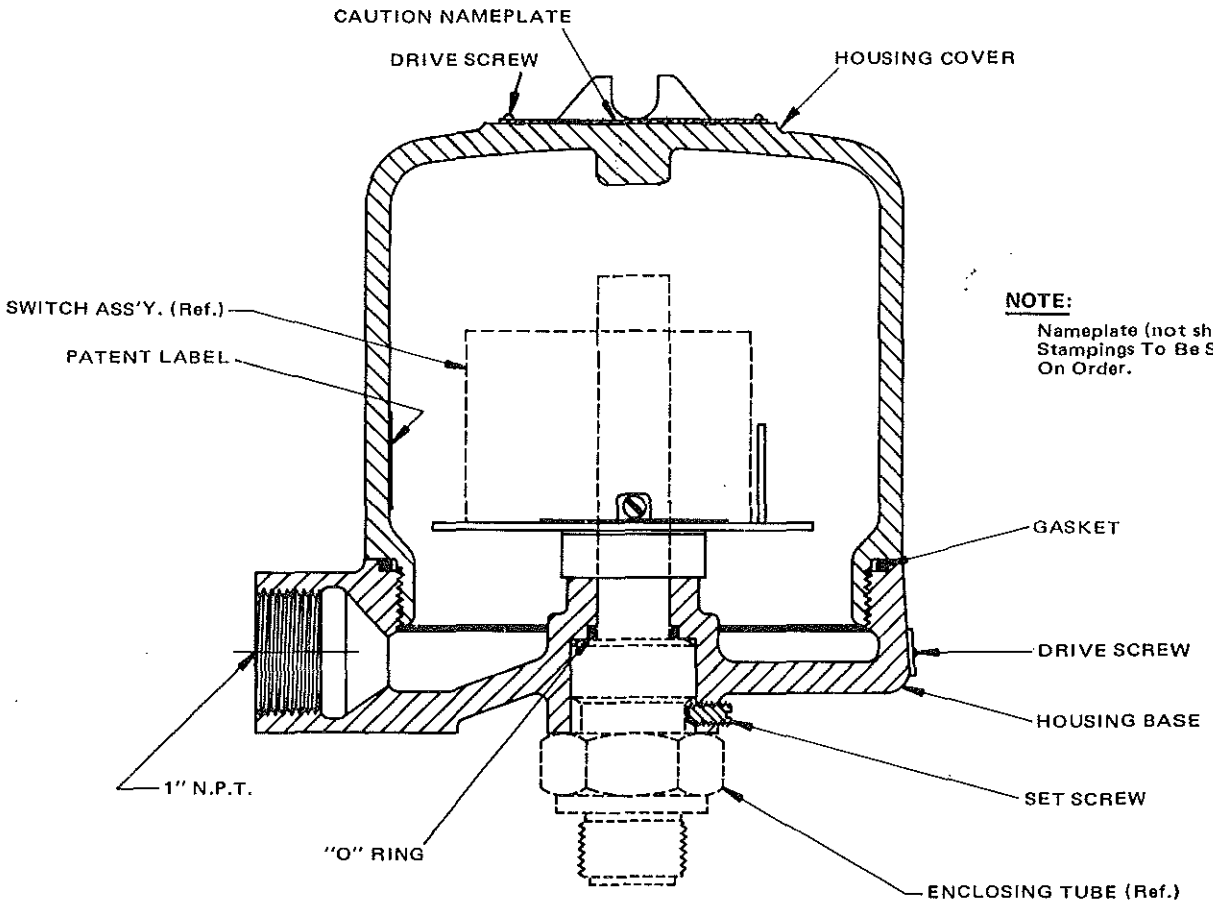
NOTE: Manual reset mechanism requires a hole in the side of the cover to accommodate the reset actuating plunger.

DESCRIPTION		NEMA ① TYPE	REPLACEMENT PART KIT NO.
Standard Housing Cover	Short (4")	NEMA 1 thru 5 & 12	89-6509-001 ②
	Tall (6")		89-6510-001 ②
Manual Reset Housing Cover	Short (4")	NEMA 1 (only)	89-6511-001 ②
	Tall (6")		89-6512-001 ②
Transparent "Lexan" Housing Cover Tall (6") Only		NEMA 1 thru 5 & 12	89-6522-001 ②
Housing Base (Std. & M.R.)		NEMA 1 thru 5 & 12	89-6505-001 ③
Cover Assembly Hardware *		NEMA 1 thru 5 & 12	89-6508-001

① National Electrical Manufacturers Association.
② Includes assembly hardware kit (89-6508-001).
③ Includes base assembly hardware.

(continued)

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TYPICAL EXPLOSION PROOF (E.P.) HOUSING ASSEMBLY

DESCRIPTION

Explosion proof housing replacement assemblies are designed for applications in hazardous atmospheric locations, as classified under types NEMA 7 and 9 of the National Electrical Code.

Housings equipped with submersible base are suitable for submersion under water, as classified under NEMA type 6 of the code.

IMPORTANT:

When ordering, please specify:

1. Model and Serial number of control.
2. Name and Number of replacement kit.

NOTE:

Consult your local representative on applications to meet NEMA and other codes not covered in this bulletin.

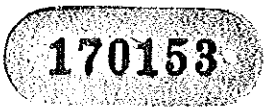
DESCRIPTION	NEMA ① TYPE	REPLACEMENT KIT PART NO.
Explosion Proof Housing Cover (4")	NEMA 6, 7 & 9	89-6513-001 ②
Explosion Proof Housing Cover (6")	NEMA 6, 7 & 9	89-6514-001 ②
Standard Explosion Proof Housing Base	NEMA 7 & 9	89-6515-001 ③
Explosion Proof Housing Base W/Drain	NEMA 7 & 9	89-6516-001 ③
Submersible Explosion Proof Housing Base	NEMA 6, 7 & 9	89-6517-001 ③

① National Electrical Manufacturers Association
② Includes cover assembly hardware.
③ Includes base assembly hardware.

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PRINTED IN U.S.A.

MAGNETROL INTERNATIONAL
5300 BELMONT ROAD / DOWNERS GROVE, IL 60515 / AREA 312/969-4000



THIS IS A MAGNETROL® SERIAL NUMBER TAG

SERIAL NUMBERS — YOUR GUIDE TO PROMPT, ACCURATE SERVICE

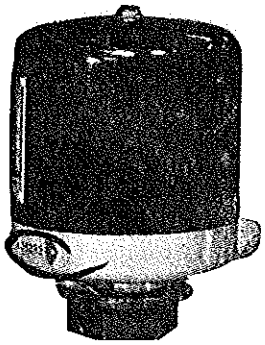
Should an electrical short circuit damage or physical damage make parts replacement necessary, be sure your purchase order includes the SERIAL NUMBER of your Magnetrol control. This will insure prompt delivery of the proper parts.

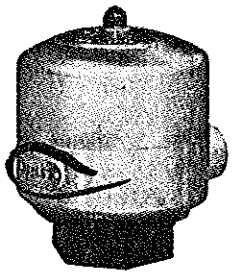
WHY SERIAL NUMBER?

The serial number of each Magnetrol control is recorded and cross-indexed with the production records. These records are then kept on micro film to provide a quick access "key" to the complete engineering of any given control. This file contains full information on the mechanism furnished, exact control action, the liquid or material for which the control was intended, its specific gravity, dielectric constant, pressure and temperature, etc. In addition, all drawings and specifications are included for any special parts used in the construction of non-standard model controls.

On the Type S-1 Moisture Proof Housings . . .

The Serial Number will be located at a point 180° from the conduit opening. This housing is distinguished by the black sheet-steel cover. Whether the cover is the standard "short" (illustrated), standard "tall" or "extended", the Type S-1 standard cover serial number will be in this location.

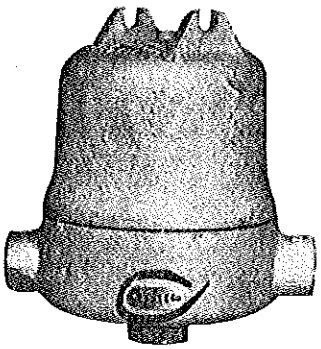




On the Type S-5 Splash-Proof Housings . . .

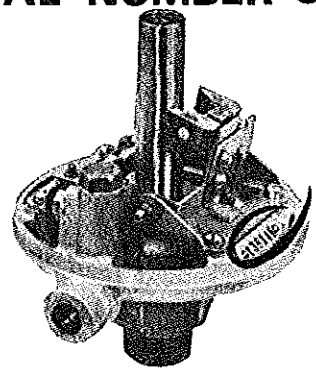
The Serial Number is also located at a point 180° from the conduit opening.

RECORD THE SERIAL NUMBER OF YOUR CONTROL



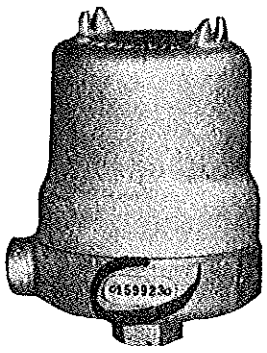
On the Type S-1 Double-tap Explosion- or Vapor-Proof Housing . . .

The Serial Number will be located at a point 90° from either of the conduit openings (one will be "plugged"). Whether the cover is the EP or VP short, tall or "extended", the Serial Number tag will be in this position.



On the Type J-1 Pneumatic Pilot Mechanism . . .

The Serial Number is located *inside* the housing. After the housing is removed, the Serial Number will be found riveted to the housing base.



On the Type S-1 or S-5 Explosion- or Vapor-Proof Housing . . .

The Serial Number will be located at a point 90° from the conduit opening, or 90° from the nameplate.

FORM: 41-310.2
November 1977

PRINTED IN U.S.A.

BULLETIN: 42-657.3
EFFECTIVE: August, 1975
SUPERSEDES: May, 1974

GENERAL INSTRUCTIONS FOR TYPE "S-1M" and TYPE "DPS-1M" SWITCH MECHANISMS

DESCRIPTION

TYPE S-1M SWITCH MECHANISM

The type S-1M switch mechanism uses a single SPDT dry contact switch and is designed to be interchangeable with the type S-1 Mercury switch mechanism used in most Magnetrol® liquid level controls and flow switches. It is completely self contained with numbered terminal strip and removeable dry contact switch. See bulletin 42-110 for further details and rating information.

TYPE DPS-1M SWITCH MECHANISM

The type DPS-1M mechanism uses two SPDT dry contact switches actuated by the same magnet, to obtain double pole action. This arrangement provides the capability to "break" both sides of a control circuit simultaneously or control two circuits of different voltage and current characteristics. A high temperature porcelain terminal block is featured as standard. Also see bulletin 42-110 for complete specifications.

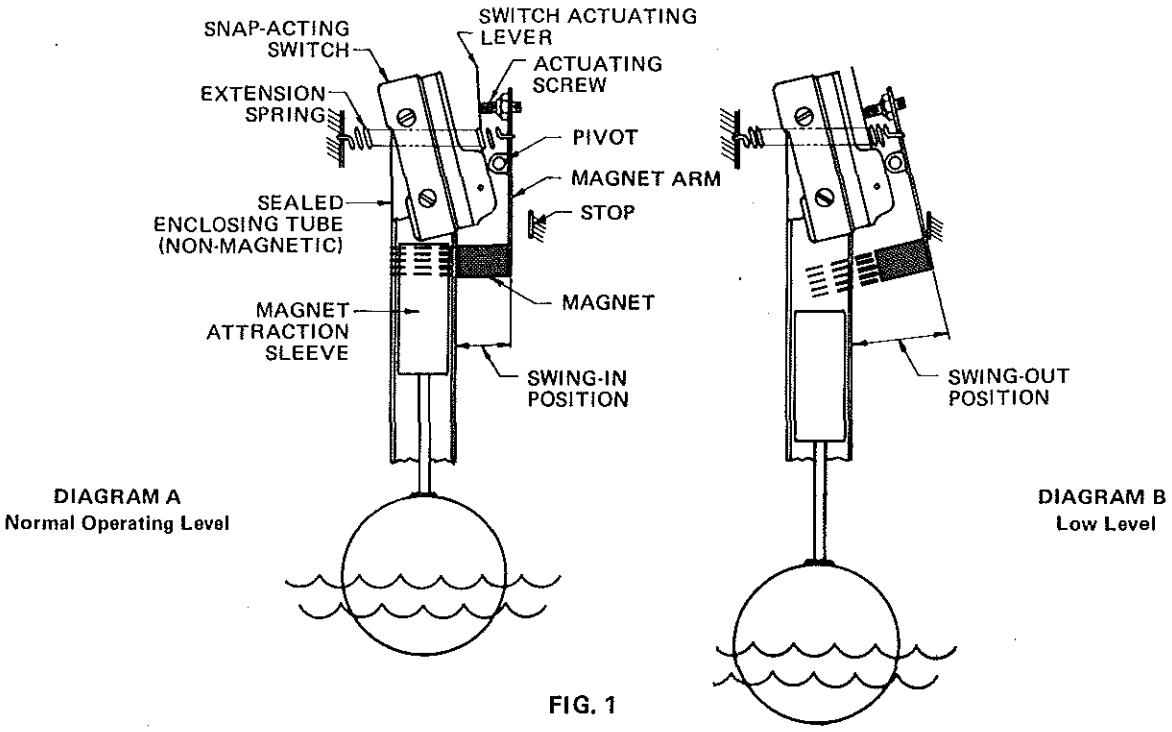


FIG. 1

OPERATING PRINCIPLE

Diagrams A and B illustrate the simple and foolproof Magnetrol operating principle. Switching action is obtained through the use of a magnetic sleeve actuated by a float (or flow sensing device) and a switching mechanism. These two basic component assemblies are separated by a non-magnetic, pressure-tight enclosing tube. A swinging magnet carriage, operating on precision stainless steel pivots, activates the switch.

OPERATING CYCLE

At "Normal Operating Level" of liquid in a storage vessel (diagram "A"), the float moves the magnetic sleeve up within the field of a switch magnet, drawing it in tightly to the enclosing tube. This causes the switch lever to release, "making" or "breaking" an electrical circuit. As liquid level recedes, the float pulls the magnetic sleeve downward until, at a pre-determined "Low Level", the switch magnet releases and swings outward away from the enclosing tube. This in turn re-actuates the switch lever, thus reversing switch action.

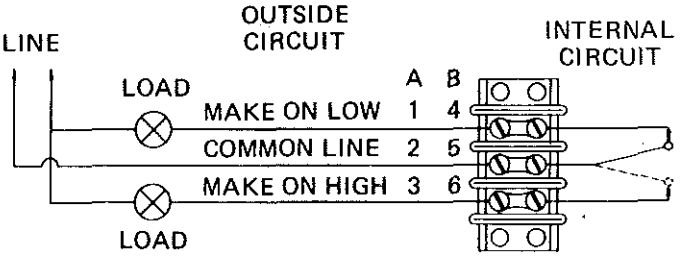
When liquid level returns to normal, the float once again moves the magnetic sleeve up the enclosing tube, causing the switch mechanism to assume its original position.

Switch mechanisms can be used singly or in multiples depending on operational requirements and switching action desired.

WIRING INSTRUCTIONS

S-1M MECHANISM

WIRING DIAGRAM

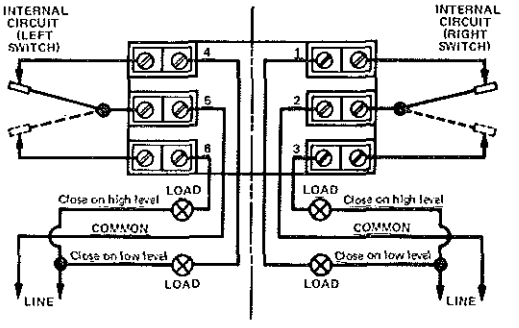


NOTE: When used on side mounted float-in-tank switches, the wiring diagram is reversed. (Make on Low becomes Make on High, etc.)

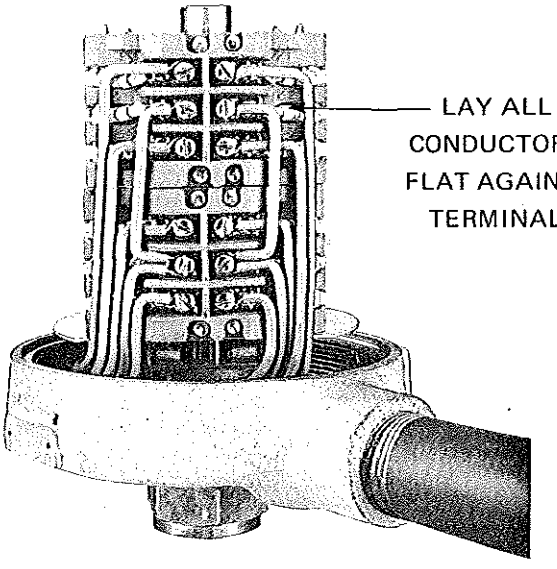
FIG. 2

DPS-1M MECHANISM

WIRING DIAGRAM



NOTE: – Double pole action is obtained by simultaneous operation of R.H. and L.H. single pole switches.
– When used on side mounted float-in-tank switches, the wiring diagram is reversed. (Make on High becomes Make on Low, etc.)



DPS-1M WIRING

Care must be exercised in positioning the incoming conductors to insure clearance between the conductors and the housing cover. Figure at right shows a recommended wiring practice for two DPS-1M mechanisms. All conductors are brought into the housing, wrapped around the enclosing tube under the baffle plate and then brought up to the proper terminal. Excess wire must be cut off before stripping ends. Use asbestos insulated wire suitable for at least 90°C if a high ambient temperature exists at the control or conduit. These wires need not extend beyond the first junction box.

FIG. 3

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REMOVING THE SWITCH MECHANISM

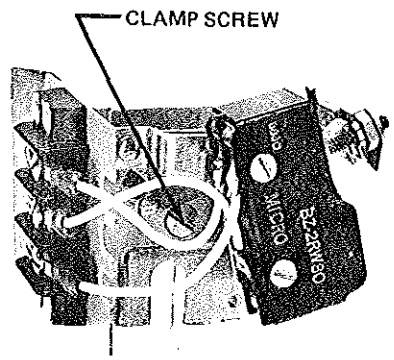


FIG. 4

All type S-1M and DPS-1M switch mechanisms can be easily removed from a Magnetrol control without disturbing piping connections or the rest of the control. Switch mechanisms are secured in the controls by means of a split clamp screw.

CAUTION: Before attempting to remove a switch mechanism, be certain to pull disconnect switch or otherwise assure that electrical circuit through control is deenergized.

1. Disconnect wiring from supply side of terminal block on switch mechanism(s). Note and record lead wire terminal locations.

NOTE: Measure location of switch mechanism(s) on enclosing tube and record for reference use during reassembly. Measure from top of enclosing tube to top of split mounting clamp on switch mechanism.

2. Loosen screw in split mounting clamp until mechanism slides freely on enclosing tube.
3. Remove small round head screw securing lower switch mechanism to baffle plate.
4. Carefully lift off switch mechanism(s) and place on clean surface, free of metal particles which may be attracted to switch magnet(s).
5. Replace switch mechanism(s) in reverse of steps 1 thru 4 above. Be certain, in the case of S-1M mechanisms, that assemblies are stacked in proper order on controls with multiple mechanisms.
   - "B" mechanism must be replaced first and attached to baffle plate, then followed by an "A" mechanism.
   - On controls with three or more mechanisms, an "A" mechanism must be positioned between two "B" mechanisms.

NOTE: All S-1M mechanisms have "A" or "B" identification markings placed next to terminal blocks.

REPLACING THE TYPE S-1M SWITCH

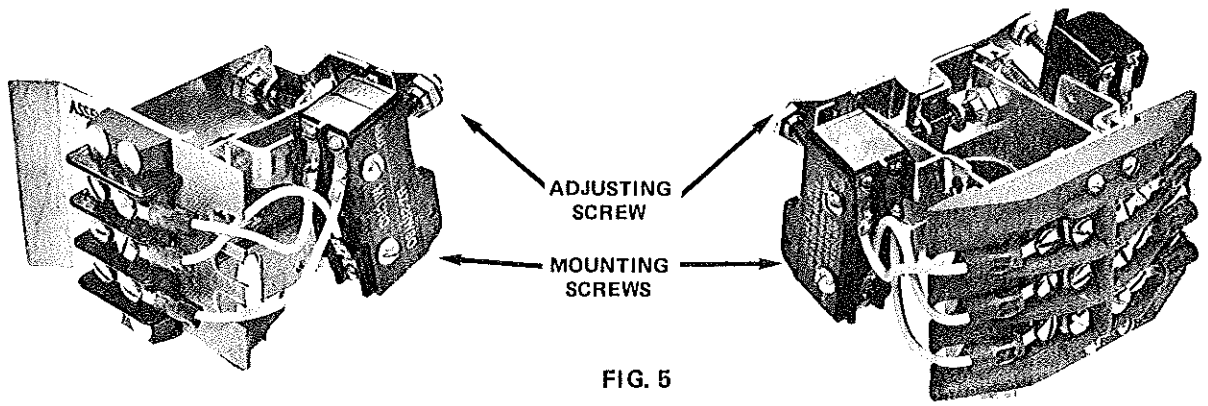


FIG. 5

Dry contact switches used in Magnetrol S-1M and DPS-1M switch mechanisms are easily removed and replaced when damaged or broken.

1. Disconnect Magnetrol control from power supply.
2. Disconnect switch leads from terminal block. Note and record terminal connections of switch to be replaced.
3. Remove two mounting screws holding existing switch.
4. Remove existing switch and install replacement switch in the same position, tightening mounting screws securely.

NOTE: For proper operation of the replacement switch, it must actuate in the middle portion of the pivoted magnet's swing.

5. Check switch action and adjust as follows:
   A. Slowly rotate the pivoted magnet by hand, back and forth through its angle of swing, listening closely for the actuating "click" of the switch in each direction.
   B. Check .to see if there is equal additional over-travel of magnet in its swing after the switch "click" in either direction.
   C. If switch actuation is not correct, change adjustment of actuating screw using a 1/16" hexagon key wrench.

NOTE: If a single switch is being replaced on a DPS-1M mechanism, lever of second switch must be depressed and held to allow for the audible adjustment of new switch, as described above.

   D. With new switch in adjustment, release lever of second switch and perform "fine-tuning" of both switches to provide simultaneous actuation (clicks).
6. Re-connect power supply and test switch action by varying liquid level in the vessel or by "blowing down" float chamber.

REPLACEMENT PARTS

PART NUMBERS FOR TYPE S-1M and DPS-1M SWITCH MECHANISMS (W/SWITCHES)									
DESCRIPTION		MAXIMUM LIQUID TEMPERATURE							
		250°F				450°F			
CONTACTS	Elec. Current	Red Dot Magnet		Yellow Dot Magnet		Red Dot Magnet		Yellow Dot Magnet	
		"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism
SPDT (S-1M)	AC	89-7401-101	89-7401-102	89-7401-103	89-7401-104	89-7401-107	89-7401-108	89-7401-109	89-7401-110
	DC	–	–	89-7401-105	89-7401-106	–	–	–	–
Baffle Plate Ass'y.		36-5303-001 (RP-1011)							
DPDT (DPS-1M)	AC	89-7401-121		89-7401-122		89-7401-124		89-7401-125	
	DC	–		89-7401-123		–		–	
Baffle Plate Ass'y.		36-5305-001 (RP-6206)							

CAUTION: **When ordering replacement switch mechanisms, be certain to determine color dot on magnet. NEVER replace a mechanism having a red dot magnet with one having a yellow dot magnet, and vice versa.**

PART NUMBERS FOR DRY CONTACT SWITCHES ONLY									
For L.H. or "B" Mechanisms ①	MAXIMUM LIQUID TEMPERATURE				MAXIMUM LIQUID TEMPERATURE				For R.H. or "A" Mechanisms ①
	250°F		450°F		250°F		450°F		
	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	
AC CURRENT	89-7101-021		89-7101-023		89-7101-020		89-7101-022		AC CURRENT
DC CURRENT	–	89-7101-025	–	–	–	89-7101-024	–	–	DC CURRENT

NOTE:
1. "LEFT HAND" (L.H.) or "RIGHT HAND" (R.H.) designations, used to identify switches on DPS-1M mechanisms only, determined by viewing switch mechanism facing terminal block.

IMPORTANT:
When ordering, please specify:
1. Model and Serial number of control.
2. Name and Number of part.

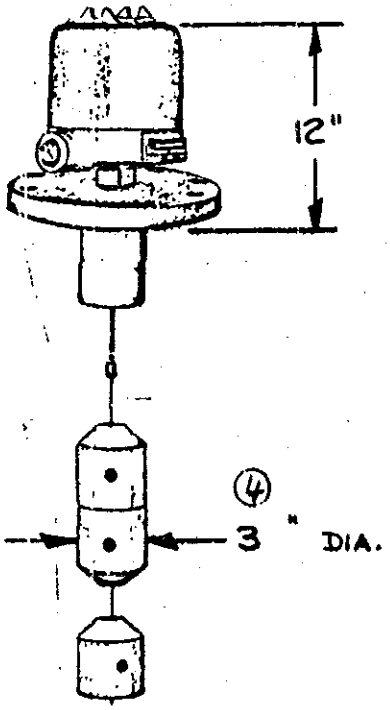
MAGNETROL
INTERNATIONAL, INCORPORATED
5300 Belmont Road • Downers Grove, Illinois 60515 • (312) 969-4000 • Telex 25-3085

PRINTED IN U.S.A.

8.5"

8.5"

11 908 549



LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: MAGNETROL

VENDOR DWG. NO: MODEL A-153-F-EP/VP-TDM-[redacted]DC

TITLE: SWITCH, F.O. LEVEL ALARM

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

				Colt Industries	Fairbanks Morse Engine Division	
	12221	3-18 81	② ADDED 'Y' IN VENDOR PART NO.	H.R.S.	REL. NO. PC 1742	3/25/77 ASSY. OR LO.
	"	"	⑤ ADDED DISPL. HAT ④ 3 DIA WAS 3 1/8 DIA	H.R.S. 7WD	DR. BY J. Dorn	3/11/77 SCALE
3	11137	10-12 MA	③ DELETE REF TO REV. OF SPEC PG 4 & 5	MA mc4	CHK'D. BY J. WHALEN	3/2/77 HEAT TR.
		2-7 MA	ADD REV. STATE TO	ALS mc4	MAT'L	
					CAST.	MAT'L.

11 908 545

FUEL OIL LEVEL ABARM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 41, PARA. 6.1a - PAINTING

1.1.2 PAGE 42*, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43*, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

~~* 8031-M-71 Para 1a 1.2 Rev 2~~

2. TECHNICAL SPECIFICATIONS

2.1 DISPLACEMENT TYPE, DUAL SWITCH, LEVEL ALARM FOR HIGH AND LOW LEVEL ALARMS.

2.2 DISPLACERS SHALL BE SUITABLE FOR USE IN #2 DIESEL FUEL AT 115°F MAXIMUM; DISPLACERS SHALL BE ADJUSTABLE ALONG THE LENGTH OF THE STEM. DISPLACER MATERIAL STAINLESS STEEL.

2.3 DISPLACER STEM SHALL BE 4 FT. LONG

2.4 MOUNTING CONNECTION SHALL BE A 4" - 150 LB RAISED FACE STEEL FLANGE, ANSI

2.5 SWITCHES SHALL BE SPDT, NON-MERCURY TYPE, RATED FOR 125 VOLT DC, .2 AMP

2.6 SWITCH HOUSING SHALL BE NEMA TYPE 7

2.7 THE COMPONENT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMUTANEOUSLY

2.8 MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

11 908 549

BF4858

Jemerich.

Date: 5-19-89

Time:

1 & 2

TELECON RECORD

From: Dave Royce To: Frank G. Chase

Subject:

Discussion: Magnetical Replace Kit

XO 89-6121-001

SN 689564

Buc VS-607.1
89-6117-001

A153F-EP / VP-TDM-SIM 3DC-SIM3DC

EQ LSHL20-122

RECOMMENDED SPARE PARTS FOR 1190854?

(Ben) SINGLE POLE, DOUBLE THROW 89-7101-024

Right Side

Left Side

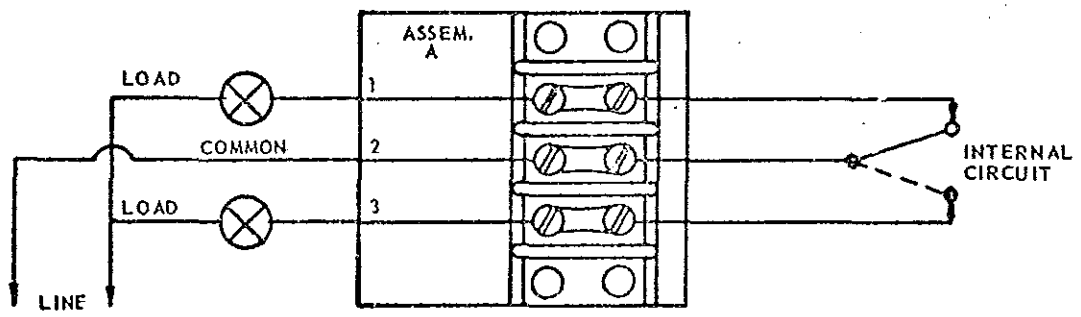
Distribution:

11908549

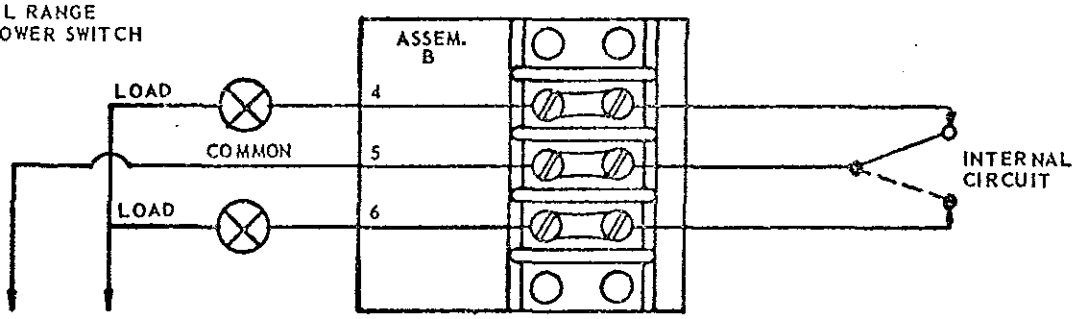
MAGNETROL

TERMINAL CONNECTIONS
TANDEM TYPE DISPLACEMENT MAGNETROLS

UPPER LEVEL RANGE
OPERATES UPPER SWITCH
MECHANISM



LOWER LEVEL RANGE
OPERATES LOWER SWITCH
MECHANISM



LIMERICK GENERATING STATIONS UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
P.O. NO. LX 239585
COLT/FMED ORDER NO. 11-700000

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

FOR Colt Industries/Fairbanks Morse

CUSTOMER ORDER B458958-0 Rev. 1 MAGNETROL ORDER M471494-101

MODEL A153F-EP/VP-TDM-S1M3DC-S1M3DC

SWITCH RATING: 2.2 AMPS 125 VOLTS DC TEMPERATURE OF PROCESS LIQUID 250 °F MAX.

CERTIFIED BY J. F. Byrnes DATE 4-25-78

Tag:
F.M. P/N
11908549

FORM: 42-618
MAY 1970

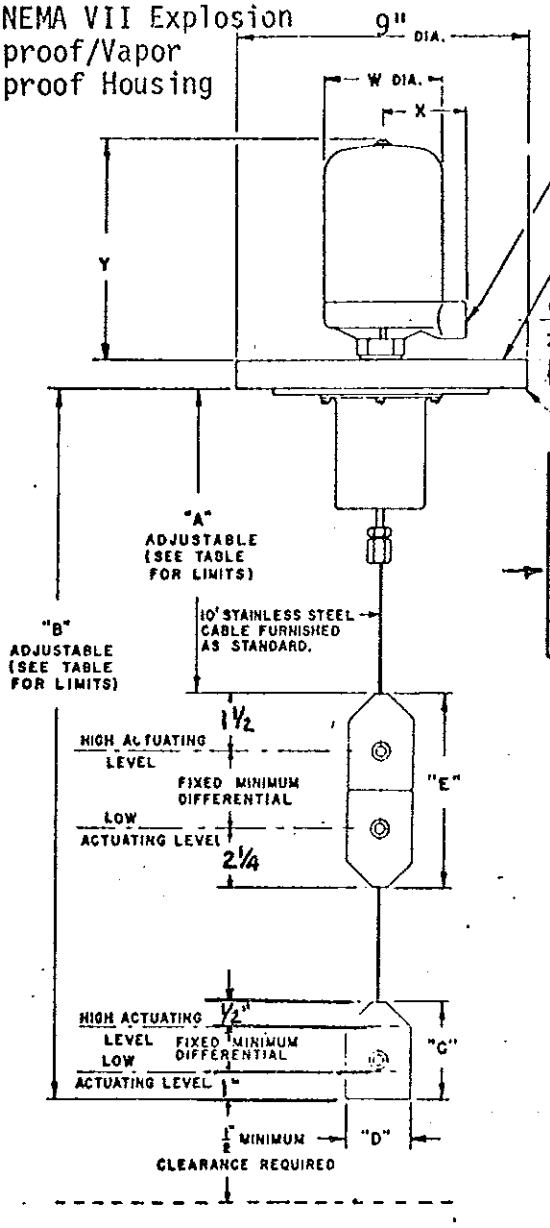
MAGNETROL
division of Schaub Engineering Co.
5300 BELMONT ROAD ★ DOWNERS GROVE, ILLINOIS 60515 ★ 312/969-4000

11908549

INSTALLATION DIMENSIONS

MODEL A-153-F-TDM & A-153-F-E.P.-TDM

NEMA VII Explosion proof/Vapor proof Housing



CONDUIT CONNECTIONS
¾" N.P.T. STANDARD HOUSING 1" N.P.T. EXPLOSION-PROOF HOUSING STD. AND E.P. HOUSINGS MAY BE ROTATED THROUGH 360°.

4"-125 LB. CAST IRON FLANGE FURNISHED AS STANDARD.

ALLOW 16.00" OVERHEAD CLEARANCE FOR INSTALLATION ABOVE THIS POINT.

TYPE OF SWITCH HEAD	W	X	Y	Z
STANDARD & SPLASH-PROOF	4.69	3.25	8.50	1.50
EXPLOSION PROOF & VAPOR-PROOF	5.81	4.00	9.81	1.62

FLANGE SPECIFICATIONS OTHER THAN STANDARD	
4 " 150 LBS. F.S.	FLANGE
8	BOLT HOLES 3/4 " DIA.
7-1/2	" DIAMETER BOLT CIRCLE

TYPE OF DISPLACER	DIAMETER OF DISPLACERS "D"	HEIGHT OF LOWER DISPLACER "C"	HEIGHT OF UPPER DISPLACER(S) "E"	LIMITS OF DISPLACERS ADJUSMENT "A" MINIMUM	LIMITS OF DISPLACERS ADJUSMENT "B" MINIMUM
PORCELAIN	3.12	3.50	7.00	6.00	17.25
KARBATE	3.00	4.75	9.50	5.38	20.88
3" DIA. STAINESS STEEL	3.00	6.00	11.00	5.75	24.25

Levels given are for .95 sp. gr. at 115°F.

LIMERICK GENERATING STATIONS UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
P.O. NO. LX 239585
COLT/FMED ORDER NO. 11-700000

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

FOR Colt Industries/Fairbanks Morse

TAG(S) F.M. P/N 11908549

CUSTOMER ORDER B458958-0 Rev. 1 MAGNETROL ORDER M471494-101

MODEL A153F-EP/VP-TDM-S1M3DC-S1M3DC QUANTITY 8

UPPER SPDT SWITCH MECHANISM ACTUATES ON UPPER DISPLACER(S)

LOWER SPDT SWITCH MECHANISM ACTUATES ON LOWER DISPLACER.

DISPLACER TYPE Porcelain ~~STEEL~~ STAINLESS SWITCH HOUSING Explosion proof/Vapor proof

MIN. SP. GR. .95 MAX. PRESS. 225 P.S.I. MAX. TEMP. 115 °F. SERVICE LIQUID -

CERTIFIED BY [signature] DATE 4-25-78

FORM: 45-505.3
September 1977

MAGNETROL INTERNATIONAL

5300 BELMONT ROAD / DOWNERS GROVE, IL 60515 / AREA 312/969-4000

Printed in U.S.A.

11908549

RECOMMENDED SPARE PARTS

IMPORTANT: When ordering parts, furnish the serial number of the Magnetrol.

CUSTOMER Colt Industries/Fairbanks Morse

CUST. P.O. NO. B458958-0 Rev. 1 PRODUCTION NO. M471494-101

MAGNETROL MODEL(S)

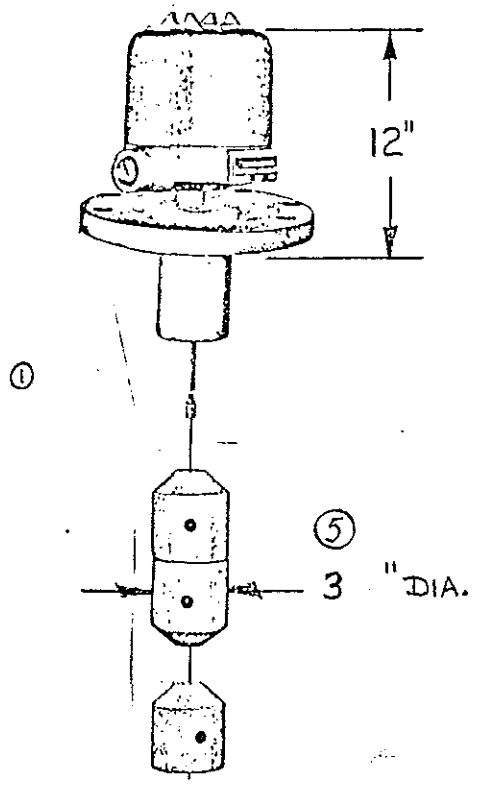
A153F-EP/VP-TDM-S1M3DC-S1M3DC

QUANTITY	PART NO.	DESCRIPTION	PRICE EACH F.O.B. FACTORY
		MERCURY SWITCH	
		SPST - Closes on Falling Level	
		Right Side	
		Left Side	
		MERCURY SWITCH	
		SPST - Closes on Rising Level	
		Right Side	
		Left Side	
		MERCURY SWITCH	
		Single Pole, Double Throw	
		Right Side	
		Left Side	
		MICRO-SWITCH	
8	89-7101-024	Single Pole, Double Throw Right Side Left Side	47.00

MINIMUM INVOICE: A minimum charge will be made on small purchases to cover packing, shipping, order processing, billing and other handling expenses, as follows: $35.00 within the U.S.A. and possessions, $45.00 Canada and Puerto Rico shipments and $50.00 elsewhere.

NOTE: All orders are subject to current prices at time of order placement.

MAGNETROL INTERNATIONAL
5300 BELMONT ROAD/DOWNERS GROVE, ILLINOIS 60515/AREA (312) 969-4000



LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: MAGNETROL

①

⑦

See 11908552 S.W. Switch

VENDOR DWG. NO: MODEL A-103-F-EP/VP- Y-S1MD4DC

TITLE: SWITCH, F.O. TRANSFER PUMP CONTROL

COLT QA Per 3 cuts OCT 17 1978 APP
COLT QA FM

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY
4	12221	3-18 81	⑦ ADDED "Y" IN VEND. PART NO.	H.R.S.
4	"	"	⑥ ADDED DISPL. MAT, ⑤ 3 DIA WAS 3 1/8 DIA	H.R.S. JWB
3	11137	10-12 78	④ DELETE REF. TO REV. OF SPEC. PG 42 & 43	
2	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS ③	NLS
1	10616	1-6 78	② PARA. 2.5 WAS 125VDC 5 AMP	SJV
1	10616	"	① ADDED PICTURE, VENDOR & VENDOR DWG. NO.	SJV

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1742	3/25 77	ASSY. OR LO.	
DR. BY J. Dorn	3/11/77	SCALE	
CHK'D. BY J. WHALEN	3/21/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 550 | SHEET 1 OF 2

11 908 550

ORIGINAL

11 908 550

FUEL OIL TRANSFER PUMP CONTROL FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 41, PARA. 6.1a - PAINTING

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

(4) ~~8031-M-71 PAGES 42 1/2 REV 2~~

2. TECHNICAL SPECIFICATIONS

2.1 DISPLACEMENT TYPE, SINGLE SWITCH, LEVEL CONTROL TO START/STOP F.O. TRANSFER PUMP

2.2 DISPLACERS SHALL BE SUITABLE FOR USE IN #2 DIESEL FUEL AT 115°F MAXIMUM. DISPLACERS SHALL BE ADJUSTABLE ALONG THE LENGTH OF (6) THE STEM. DISPLACER MATERIAL STAINLESS STEEL.

2.3 DISPLACER STEM SHALL BE 4 FT. LONG.

2.4 MOUNTING CONNECTION SHALL BE A 4" - 150 LB RAISED FACE STEEL FLANGE, ANSI

2.5 SWITCH SHALL BE DPDT, NON-MERCURY TYPE, RATED FOR 125 VOLT DC, (2) 0.5 AMP; INDUCTIVE LOAD OR 120 VOLT AC, 5 AMP

2.6 SWITCH HOUSING SHALL BE NEMA TYPE 7

2.7 THE COMPONENT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMUTANEOUSLY.

2.8 MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

Colt Industries / Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 550	REV. 2 REV. 1	SHEET 2 OF 2

ORIGINAL

REV. 3
REV. 4

11908550

BULLETIN: 45-607.1
EFFECTIVE: May 1977
SUPERSEDES: April 1976

INSTRUCTION MANUAL and PARTS LIST
MODEL A-103 and A-153 SERIES
LIQUID LEVEL CONTROLS

DESCRIPTION

The Model A-103 series controls are single stage "wide" differential type units designed primarily for pump or valve control applications in liquid make-up service on tanks or vessels.

The Model A-153 series controls are single stage "narrow" differential displacement units designed for high or low level alarm service.

Each standard A-103 and A-153 control utilizes a single switch mechanism and is top mounted to a tank or vessel by means of a threaded or flanged pipe connection.

Optional multistage "tandem" versions of the A-103 and A-153 controls employ multiple switch mechanisms to combine various control and alarm functions into a single instrument.

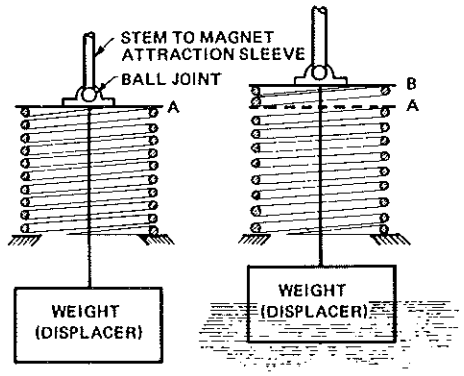
OPERATING PRINCIPLE

Magnetrol® displacer type controls "pick-up" level travel by utilizing Archimedes' principle. "Any body immersed in a liquid is "buoyed up" by a force equal to the weight of the liquid the body displaces."

The illustration at right shows the relationship of all parts at "low liquid level" and "high liquid level." The "body" takes the form of one or more weights called displacers, hung on a stem, and suspended from a support spring. When the liquid level is below the displacer(s), the spring will come to fixed position "A". When the liquid level rises to the center of the displacer(s) the downward load on the spring is lightened allowing it to move to position "B". This happens even though the weights are heavier than the liquid and do not "float". The spring is always partially compressed from the downward load. It is the varying weight of this load by liquid displacement that causes the spring to be compressed MORE or LESS. This movement is transmitted to the switch mechanism. See bulletin on switch mechanism for its operating principle.

Since MOVEMENT OCCURS ONLY WHEN THE LIQUID LEVEL REACHES A DISPLACER, the point at where switch action is desired can be varied anywhere within the displacer stem length. Loosen the set screw clamp at the center of the displacer and slide the displacer to the point where switch action is desired, then retighten clamp.

FIG. 1



INSTALLATION

Adjust the displacers on the displacer cable for the desired switch actuating levels. (Instruction tag attached to cable.) Screw displacer cable fitting to threaded connecting link protruding from underside of control.

Be sure there are no tubes, rods, or other obstacles in the tank or vessel to interfere with the operation of the displacers. No guides into the tank are necessary unless liquid turbulence is excessive, in which case a "guide pipe" or "stilling tube" is recommended. The I.D. of the pipe or tube should be at least 1" larger than the displacer diameter, open at the bottom end and with several vent holes located above the maximum high level of the liquid.

Check installation of pipe or tube to be certain it is plumb.

IMPORTANT: Before attaching Magnetrol control to tank or vessel, check with level to see that tank mounting flange or spud is within 3° of horizontal. Proper operation of the control depends on the switch housing being within 3° of vertical.

WIRING INSTRUCTIONS

NOTE: If control is equipped with pneumatic switch mechanism, disregard these instructions and refer to instruction bulletin on mechanism furnished for air (or gas) connections.

Most Magnetrol control switch housings are designed to provide 360° positioning of conduit outlet by loosening the set screw(s) located under the housing base. Diagrams of the control's internal electrical circuits (switching action between terminals) will be found in the switch mechanism instruction bulletin included, as listed on page 11.

On high temperature applications (above 250°F.) asbestos covered wire should be used between control and first junction box located in a cooler area. Supply wires (conductors) are brought into the switch housing, wrapped around the enclosing tube under the baffle plate and then brought up to the proper terminals. Excess wire should be positioned so as not to interfere with switch mechanism or housing cover.

Some controls are furnished with an explosion proof (cast) switch housing or a vapor tight (gasketed) type. These housings are used in hazardous locations or when liquid temperature is so low that excessive condensation and frosting of switch parts is likely. After wiring connections have been completed, explosion proof housings must be "sealed" at the conduit outlet with suitable compound or "dope" to prevent entrance of air. Check cover to base fit on explosion proof and vapor tight housings to be certain gasketed joint is tight. A positive seal is necessary to prevent infiltration of moisture laden air or corrosive gases into switch housing.

Connect power supply to control and test switch action by varying liquid level. If switch mechanism fails to function, check verticle alignment of control and consult installation bulletin on mechanism furnished.

PREVENTIVE MAINTENANCE

Periodic inspections are a necessary means to keep your Magnetrol level control in good working order. This control is, in reality a safety device to protect the valuable equipment it serves. Should the control fail, the resultant damage to equipment dependent upon its performance could very well cost far in excess of the control itself. Therefore, a systematic program of "Preventive Maintenance" should be implemented when control is placed into service. If the following sections on "What to Do" and "What to Avoid" are observed, your control will provide reliable protection of your capital equipment.

WHAT TO DO

1. KEEP CONTROL CLEAN

— **NEVER** leave switch housing cover off the control. This cover is designed to keep dust and dirt from interfering with switch mechanism operation. In addition, it protects against damaging moisture and acts as a safety feature by keeping bare wires and terminals from being exposed. Should the housing cover become damaged or misplaced, order a replacement immediately.

2. INSPECT SWITCH MECHANISMS, TERMINALS AND CONNECTIONS MONTHLY

— Mercury switches may be visually inspected for short circuit damage. Check for small cracks in the glass tube containing the mercury. Such cracks can allow entrance of air into the tube causing the mercury to "oxidize". This is noticeable as the mercury will appear dirty and have a tendency to "string out" like water, instead of breaking into clean round pools. If these conditions exist, replace the mercury switch immediately.

— Dry contact switches should be inspected for excessive wear on actuating lever or misalignment of adjustment screw at point of contact between screw and lever. Such conditions can cause false switch actuating levels. Adjust switch mechanism to compensate (if possible) or replace switch.

DO NOT operate your control with defective or maladjusted switch mechanisms (refer to bulletin on switch mechanism furnished for service instructions).

— Magnetrol controls may sometimes be exposed to excessive heat or moisture. Under such conditions, insulation on electrical wires may become brittle, eventually breaking or peeling away. The resulting "bare" wires can cause short circuits. Check wiring carefully and replace at first sign of brittle insulation.

— Vibration may sometimes cause terminal screws to work loose. Check all terminal connections to be certain that screws are tight. Air (or gas) operating medium lines, subjected to vibration, may eventually crack or become loose at connections causing leakage. Check lines and connections carefully and repair or replace, if necessary.

WHAT TO AVOID

1. **NEVER** leave switch housing cover off the control longer than necessary to make routine inspections.
2. **NEVER** use lubricants on pivots of switch mechanisms. A sufficient amount of lubricant has been applied at the factory to insure a lifetime of service. Further oiling is unnecessary and will only tend to attract dust and dirt which can interfere with mechanism operation.
3. **NEVER** place a jumper wire across terminals to "cut-out" the control. If a "jumper" is necessary for test purposes, be certain it is removed before placing control into service.
4. **NEVER** attempt to readjust magnetic attraction sleeves which are factory set. Tampering may cause failure of control while in service even though manual operation actuates switches.
5. **NEVER** attempt to make adjustments or replace switches without reading instructions carefully. Certain adjustments provided for in Magnetrol controls should not be attempted in the field. When in doubt, consult the factory or your local Magnetrol representative.

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TROUBLE SHOOTING

Usually the first indication of improper operation is failure of the controlled equipment to function – pump will not start (or stop), signal lamps fail to light, etc. When these symptoms occur, whether at time of installation or during routine service thereafter, check the following external causes first.

- Fuses may be blown.
- Reset button(s) may need resetting.
- Power switch may be open.
- Controlled equipment may be faulty.
- Wiring (or medium lines) leading to control may be defective.

If a thorough inspection of these possible conditions fails to locate the trouble, proceed next to a check of the control's switch mechanism.

1. Pull disconnect switch or otherwise assure that electrical circuit(s) through the control is deactivated.
2. Remove switch housing cover.
3. Swing magnet assembly in and out by hand, checking carefully for any sign of binding. Assembly should require no force, however slight, to move it through its full swing.
4. If binding exists, magnet may be rubbing enclosing tube or pivot sockets may be overly tight. Readjust pivot sockets as required until a slight amount of side play is evident. If magnet is rubbing, loosen magnet clamp screw and shift magnet position.
5. If switch magnet assembly swings freely and mechanism still fails to actuate, check installation of control to be certain it is within the specified three (3°) degrees of vertical (use spirit level on side of enclosing tube in two places, 90° apart).
6. If mechanism is equipped with a mercury switch, examine glass tube closely, as previously described in preventive maintenance section. If switch is damaged, replace it immediately.

NOTE: As a matter of good practice, spare switches should be kept on hand at all times.

If switch mechanism is operating satisfactorily, a test of the complete control's performance is the next likely step.

1. Reconnect power supply and carefully actuate switch mechanism manually (using a non-conductive tool on electrical switch mechanism) to determine whether controlled equipment will operate.

CAUTION: With electrical power "on" care should be taken to avoid contact with switch leads and connections at terminal block.

2. If controlled equipment responds to manual actuation test, trouble may be located in level sensing portion of the control (displacers, spring, stem and magnetic attracting sleeve).

NOTE: Check first to be certain liquid is entering tank or vessel. A valve may be closed or pipe line plugged.

3. With liquid in tank or vessel, proceed to check level sensing action by removing switch housing assembly.

CAUTION: Be certain to pull disconnect switch or otherwise assure that electrical circuit(s) through control is deactivated. Close operating medium supply valve on controls equipped with pneumatic switch mechanisms.

   A. Disconnect wiring from supply side of switch mechanism(s) and remove electrical conduit or operating medium line connections to switch housing.
   B. Relieve pressure from tank or vessel and allow unit to cool.
   C. Remove switch housing assembly by loosening hex nut located immediately below housing base.

4. With switch housing assembly removed, inspect attracting sleeve and inside of enclosing tube for excessive corrosion or solids build-up which could restrict movement, preventing sleeve from reaching field of switch magnet.
5. If trouble still is not located, proceed to remove the entire sensing unit from the tank or vessel by unbolting head flange or unscrewing mounting bushing. Inspect displacer assembly and all internal parts for any signs of damage. Check assembly for binding by supporting head flange or mounting bushing over the edge of a bench and move displacer assembly by hand.

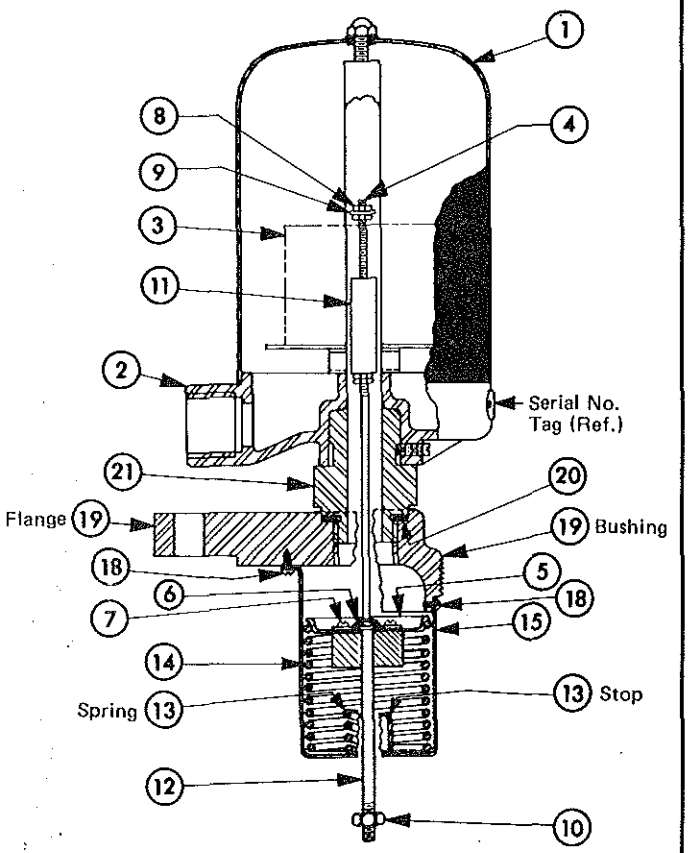
NOTE: When in doubt about the condition or performance of a Magnetrol control, return it to the factory. See "Our Service Policy" on back page.

The instructions contained in this bulletin are general and can be applied to most any Magnetrol displacement type control. If difficulties are encountered which can not be identified, consult with the factory or your local representative for assistance. A complete description of the trouble should be provided along with information concerning your piping and mounting arrangement, and a description of your operation sequence. Sketches or photographs showing the installation are also beneficial.

When communicating about your control, be certain always to specify the complete Model and Serial numbers.

STANDARD MODEL REPLACEMENT PARTS

TYPICAL MODEL A-103 or A-103-F
(Composite Section)



DISPLACER SETS

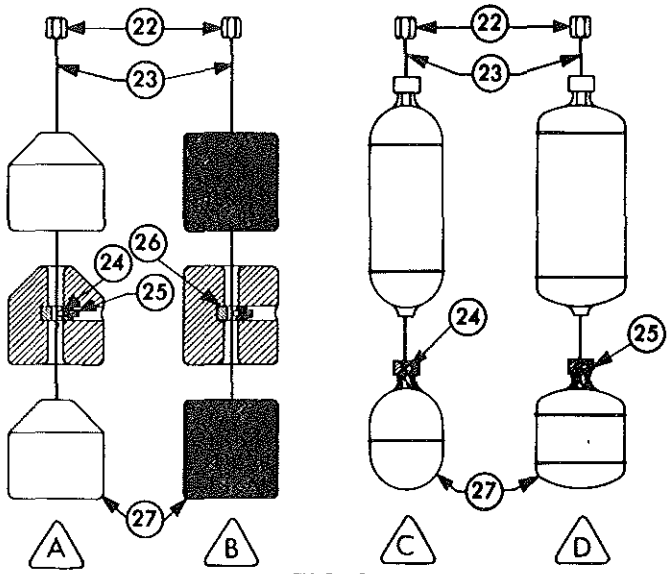
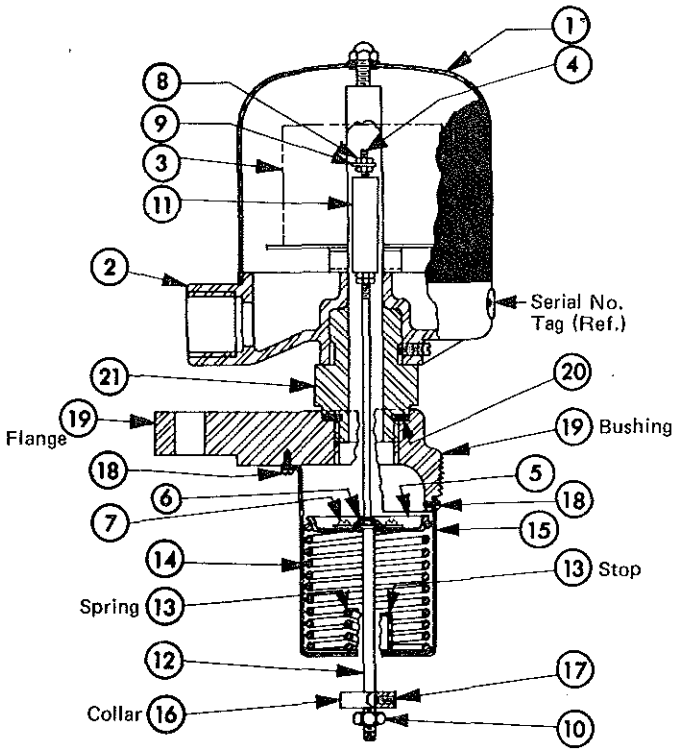


FIG. 2

TYPICAL MODEL A-153 or A-153-F
(Composite Section)



DISPLACER SETS

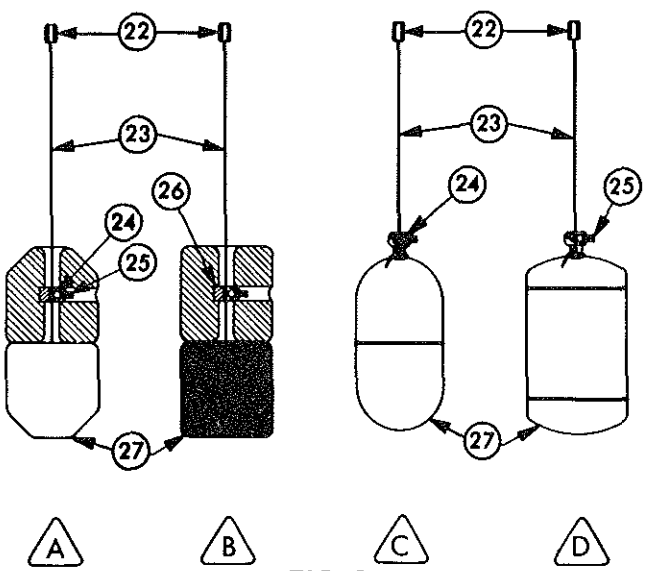


FIG. 3

CAUTION:

Location of jam nuts (item 9) on stem (item 4) must be maintained for proper switch actuation. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

STANDARD MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION		REPLACEMENT ASSEMBLIES ① MODEL A-103	A-103-F	A-153-F	A-153
1	Switch Housing Cover	Housing Kits	See Bulletin 42-680 for Ref. Type S-1 Housing Replacement Assemblies. Consult Local Representative on Types J-1, J-2 and M-1 Housings.			
2	Switch Housing Base					
3	Switch Mechanism	–	See Bulletin on Switch Mechanism Furnished (Listed on Page 11).			
4	Stem ②	Stem Kits ③	89-5523-001 Standard Sleeve 89-5524-001 Sheathed Sleeve			
5	Spring Guide					
6	Retaining Bracket					
7	Bracket Mtg. Screws					
8	Jam Nuts					
9	Guide Washer(s)					
10	Lock Nut					
11	Attraction Sleeve					
12	Connecting Link Ass'y.	Spring Kits ④	89-5303-001 Standard 89-5304-001 W/Karbate Displacers	89-5305-001 Standard 89-5306-001 W/Karbate Displacers	89-5307-001 Standard 89-5308-001 W/Karbate Displacers	89-5309-001 Standard 89-5310-001 W/Karbate Displacers
13	Spacer Spring or Stop					
14	Range Spring					
15	Spring Cup					
16	Stop Collar					
17	Set Screw					
18	Cup Mtg. Screws					
18	Cup Mtg. Screws	Mounting Kits	NOTE: Mounting Components Directly Affect Calibration of Displacement Type Controls. Should Replacement Kit Be Required, Control Should Be Returned to the Factory for Fitting of New Components and Recalibration. See Return Material Procedure on Back Page.			
19	Mounting Bushing					
	Mounting Flange					
20	E-Tube Gasket					
20	E-Tube Gasket	E-Tube Kits	89-5908-001 (Short) 89-5903-001 (Tall)		89-5908-001 (Short)	
21	Enclosing Tube					

ITEM	DESCRIPTION	REPLACEMENT DISPLACER SETS ⑤ MODELS A-103 and A-103-F: Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)	MODELS A-153 and A-153-F: Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)
22	Connector Nut	89-6110-001	89-6111-001	89-6112-001	89-6113-001	89-6114-001	89-6115-001	89-6116-001	89-6117-001
23	Displacer Cable								
24	Clamp Balls								
25	Set Screws								
26	Displacer Clamps								
27	Displacers								

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard base models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in above listing.

② Stem furnished must be cut to match length of old stem before assembly.

③ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeve is type 400 series stainless steel.

④ All spring Kits listed use standard inconel range springs. Consult local representative on Kits for optional models using stainless steel range springs.

⑤ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers. Displacer sets can not be interchanged without special control modifications and recalibration.

TANDEM STYLE CONTROLS

TWO LEVEL STAGE TANDEM CONTROLS

The Magnetrol two level stage tandem control combines the functions of two separate controls into a single unit – requiring only one opening into the tank or vessel upon which it is to be mounted. Two separate switch mechanisms are employed – each operated independently. There are two general types of controls – those with a "wide" differential at each level stage, and those with a "narrow" differential at each level stage.

A-103 SERIES (Wide Differential)

These controls were designed for a variety of functions, of which five of the most common switch and displacer arrangements are described in Figure 4 below.

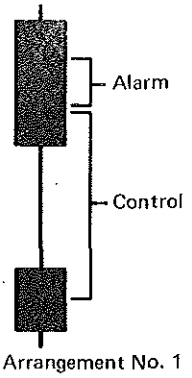
The A-103 Model is mounted by means of a 3" NPT cast iron mounting bushing. The A-103-F Model is furnished with a 4" cast iron mounting flange as standard and is available with larger flanges and/or flanges of other materials.

A-153 SERIES (Narrow Differential)

These units were designed principally for applications requiring both high and low level alarm functions in a single control, as described in Figure 5 below.

The A-153 Model is installed with a mounting bushing while the A-153-F Model is flange mounted version.

TYPICAL A-103 SERIES TANDEM CONTROL ARRANGEMENTS

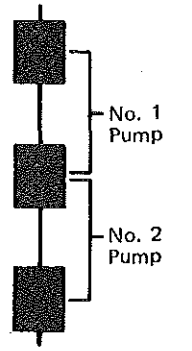


Arrangement No. 1

PUMP CONTROL PLUS ALARM

Arrangement No. 1 (illustrated): At the lowest level the pump starts. When the level rises to the middle displacer, the pump stops. If the level continues to rise, the upper displacer actuates the alarm switch which remains actuated until the level drops to the middle displacer.

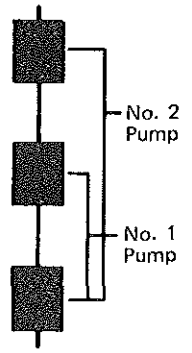
Arrangement No. 2: The sequence of Arrangement No. 1 can be reversed to provide pump start at high level and pump stop at low level followed by low level alarm operation.



Arrangement No. 3

CONTROL OF TWO PUMPS OF DIFFERENT CAPACITY

Arrangement No. 3 (illustrated): Two pumps are used to keep a tank filled. When the level falls to the middle displacer, a small No. 1 pump starts. A second larger pump is started should the level continue to fall to the bottom displacer.



Arrangement No. 4

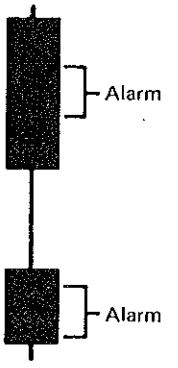
CONTROL OF TWO PUMPS

Arrangement No. 4 (illustrated): In this sequence No. 1 pump starts as the level rises to the middle displacer. Should the level continue to rise to the upper displacer, No. 2 pump is actuated. Both pumps operate until the level is dropped to the lower displacer.

Arrangement No. 5: The pumping sequence of Arrangement No. 4 can be reversed for a pump "fill" application.

FIG. 4

TYPICAL A-153 SERIES TANDEM CONTROL ARRANGEMENT



When properly installed, the normal level would be somewhere between the two displacers. Should the level rise to the upper displacer, the high level alarm switch will actuate and remain actuated until the level recedes. Conversely, should the level drop to the lower displacer, the low level alarm switch actuates and remains actuated until the level rises.

FIG. 5

CAUTION: Tandem style level controls are factory calibrated to function in one arrangement only to meet original customer specifications. Any variation in actual conditions from design conditions usually requires special control modifications. Consult with factory or local representative for assistance.

TANDEM STYLE CONTROLS – continued

THREE LEVEL STAGE TANDEM CONTROLS

A-103-3X SERIES (Wide Differential)

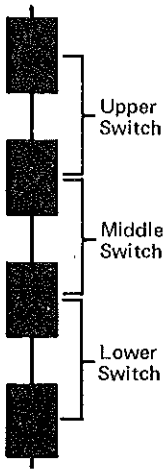
Magnetrol three level stage tandem controls are designed for applications where a single instrument is required to provide three electrically separate control signals in sequence. Three independent switch mechanisms are employed – operating in a special extended switch housing. Seven factory set switch and displacer arrangements are described in Figure 6 below.

The A-103-3X Model is mounted by means of a 3" NPT cast iron mounting bushing. The A-103-F-3X Model is furnished with a 4" cast iron mounting flange as standard and is available with larger flanges and/or flanges of other materials.

TYPICAL A-103-3X SERIES TANDEM CONTROL ARRANGEMENTS

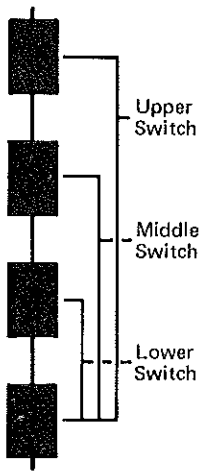
Control of three separate devices employing two common displacers.

Ⓐ



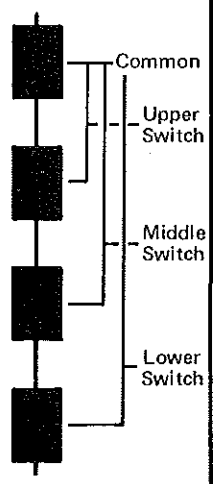
Control of three separate pumps on rising level. Pumps cut-in individually; stop simultaneously at lower displacer.

Ⓑ



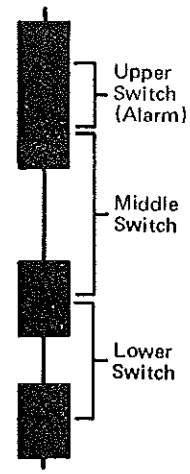
Control of three separate pumps on falling level. Pumps cut-in individually; stop simultaneously at upper displacer.

Ⓒ



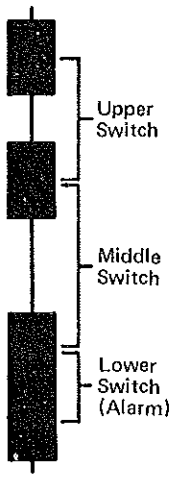
Control of two pumps of different capacity, plus high level alarm.

Ⓓ



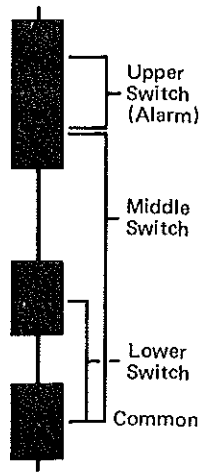
Control of two pumps of different capacity, plus low level alarm.

Ⓔ



Control of two pumps on rising level plus high level alarm. Pumps cut-in individually; stop simultaneously at lower displacer.

Ⓕ



Control of two pumps on falling level plus low level alarm. Pumps cut-in individually; stop simultaneously at upper displacer.

Ⓖ

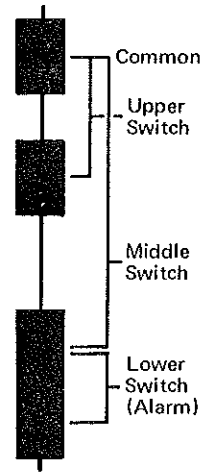
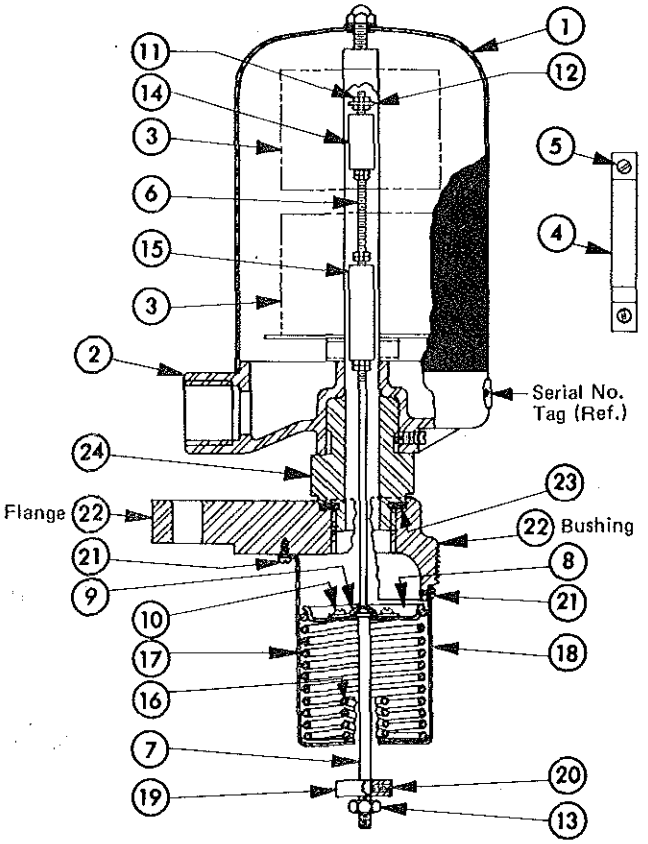


FIG. 6

TANDEM MODEL REPLACEMENT PARTS

TYPICAL A-103-TDM and A-103-F-TDM A-153-TDM and A-153-F-TDM UNITS
(Composite Section)



IMPORTANT: Many control models are specially tailored to meet specific customer specifications and therefore may contain special parts. When ordering replacement parts, always give serial number of control.

CAUTION:

Location of jam nuts (item 11) on stem (item 6) must be maintained for proper switch actuations. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

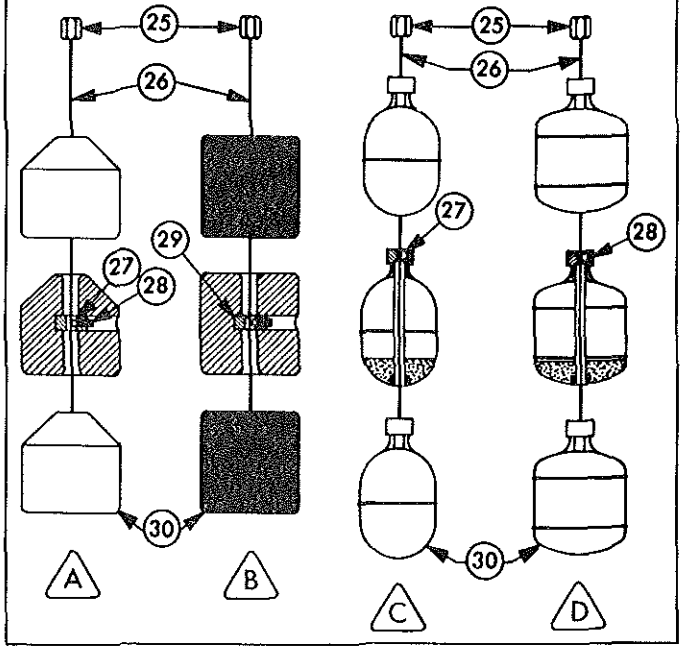
(*) IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

A-103-TDM and A-103-F-TDM DISPLACER SETS



A-153-TDM and A-153-F-TDM DISPLACER SETS

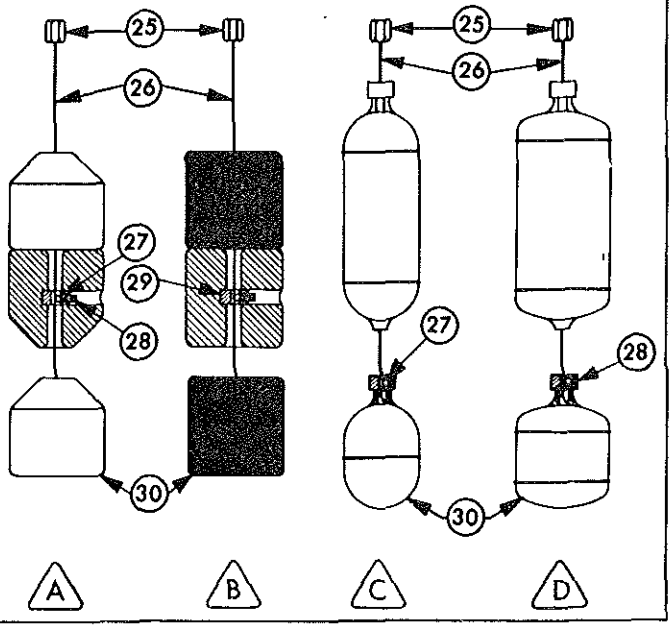


FIG. 7

NOTE:

(1) All replacement assemblies listed are furnished in Kit form for standard tandem models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in listing, page 9.

(2) Stem furnished must be cut to match length of old stem before assembly.

TANDEM MODEL REPLACEMENT PARTS — continued

ITEM	DESCRIPTION		REPLACEMENT ASSEMBLIES ①			
			MODEL			
			A-103-TDM	A-103-F-TDM	A-153-F-TDM	A-153-TDM
1	Switch Housing Cover	Housing Kits	See Bulletin 42-680 For Ref. Type S-1 Switch Housing Replacement Assemblies. Consult Local Representative on Types J-1, J-2 and M-1 Housings.			
2	Switch Housing Base					
3	Switch Mechanisms	—	See Bulletin on Switch Mechanisms Furnished (Listed on Page 11).			
4	Spacer Bracket	Spacer Kit	89-6919-001			
5	Rd. Hd. Screws					
6	Stem ②	Stem Kits ③	89-5525-001 Standard Sleeves 89-5526-001 Sheathed Sleeves	89-5527-001 Standard Sleeves 89-5528-001 Sheathed Sleeves	89-5525-001 Standard Sleeves 89-5526-001 Sheathed Sleeves	
7	Connecting Link					
8	Spring Guide					
9	Retaining Bracket					
10	Bracket Mtg. Screws					
11	Jam Nuts					
12	Guide Washer(s)					
13	Lock Nut					
14	Attraction Sleeve (upper)					
15	Attraction Sleeve (lower)					
16	Spacer Spring	Spring Kits ④	89-5311-001	89-5312-001	89-5311-001	
17	Range Spring					
18	Spring Cup					
19	Stop Collar					
20	Set Screw					
21	Cup Mtg. Screws					
21	Cup Mtg. Screws	*Mounting* Kits	NOTE: Mounting Components Directly Affect Calibration of Displacement Type Controls. Should Replacement Kit Be Required, Control Should Be Returned to the Factory for Fitting of New Components and Recalibration. See Return Material Procedure on Back Page.			
22	Mounting Bushing					
	Mounting Flange					
23	E-Tube Gasket					
23	E-Tube Gasket	E-Tube Kits	89-5903-001			
24	Enclosing Tube					

ITEM	DESCRIPTION	REPLACEMENT DISPLACER SETS ⑤							
		MODELS A-103-TDM and A-103-F-TDM				MODELS A-153-TDM and A-153-F-TDM			
		Porcelain A	Karbate B	Stainless Steel C	Stainless Steel D	Porcelain A	Karbate B	Stainless Steel C	Stainless Steel D
25	Connector Nut	89-6118-001	89-6119-001	89-6120-001	⑥ Special *Order Item.* See Important Order Note on Page 8.	89-6118-001	89-6119-001	89-6121-001	⑥ Special *Order Item.* See Important Order Note on Page 8.
26	Displacer Cable								
27	Clamp Balls								
28	Set Screws								
29	Displacer Clamps								
30	Displacers								

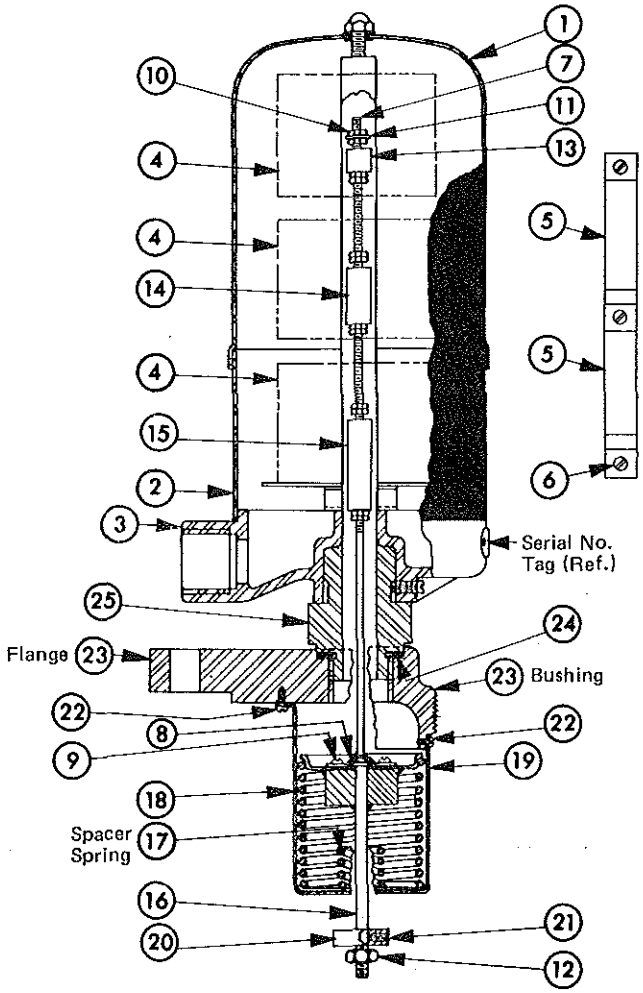
③ Sheathed attraction sleeves are used on models specified for corrosive service. *Standard sleeves are type 400 series stainless* steel.

④ Spring kits listed use inconel range springs. Consult local representative on kits for optional models using stainless steel range springs.

⑤ When ordering replacement displacer sets, be certain to specify *set which duplicates original set furnished both in type and* number of displacers. Displacer sets can not be interchanged without special control modifications and recalibration.

TRIPLEX TANDEM MODEL REPLACEMENT PARTS

TYPICAL A-103-3X-TDM and
A-103-F-3X-TDM UNITS
(Composite Section)



IMPORTANT: Many control models are specially tailored to meet specific customer specifications and therefore may contain special parts. When ordering replacement parts, always give Serial number of control.

CAUTION:

Location of jam nuts (item 10) on stem (item 7) must be maintained for proper switch actuations. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

⊛ IMPORTANT:

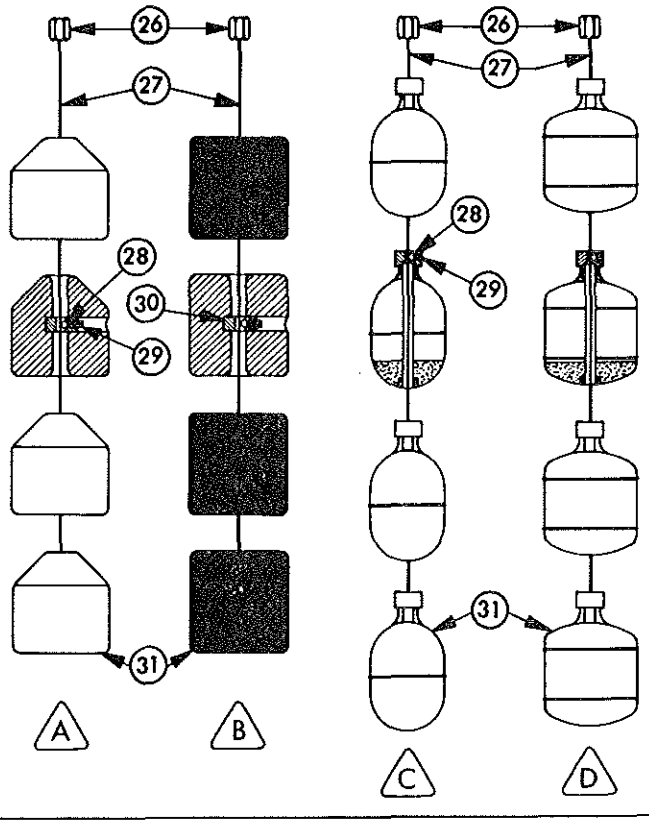
When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

FIG. 8

A-103-3X-TDM and A-103-F-3X-TDM
DISPLACER SETS



TRIPLEX TANDEM MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION	REPLACEMENT ASSEMBLIES ① MODEL A-103-3X-TDM	REPLACEMENT ASSEMBLIES ① MODEL A-103-F-3X-TDM
1	Switch Housing Cover	89-6528-001 Standard Housing ② 89-6529-001 Explosion Proof Housing	
2	Cover Extension		
3	Switch Housing Base		
4	Switch Mechanisms	See Bulletin on Mechanism Furnished.	
5	Spacer Brackets	89-6920-001 Spacer Kit	
6	Rd. Hd. Screws		
7	Stem ③	89-5529-001 Stem Kit w/Standard Sleeves 89-5530-001 Stem Kit w/Sheathed Sleeves ④ ⑤	
8	Retaining Bracket		
9	Bracket Mtg. Screws		
10	Jam Nuts		
11	Guide Washer(s)		
12	Lock Nut		
13	Attraction Sleeve (upper)		
14	Attraction Sleeve (middle)		
15	Attraction Sleeve (lower)		

ITEM	DESCRIPTION	REPLACEMENT ASSEMBLIES ① MODEL A-103-3X-TDM	REPLACEMENT ASSEMBLIES ① MODEL A-103-F-3X-TDM
16	Connecting Link Ass'y.	89-5313-001 Spring Kit ⑤ ⑥	89-5314-001 Spring Kit ⑤ ⑥
17	Spacer Spring		
18	Range Spring		
19	Spring Cup		
20	Stop Collar		
21	Set Screw		
22	Cup Mtg. Screws		
22	Cup Mtg. Screws	Mounting Kits (See Note ⑤ Below)	
23	Mounting Bushing		
	Mounting Flange		
24	E-Tube Gasket		
24	E-Tube Gasket	89-5902-001 E-Tube Kit	
25	Enclosing Tube		

ITEM	DESCRIPTION	DISPLACER SETS ⑦ Porcelain A	Karbate B	SST C	SST D
26	Connector Nut	89-6122-001	89-6123-001	⊛ Special Order Items. See Important Order Note on Page 10.	
27	Displacer Cable				
28	Clamp Balls				
29	Set Screws				
30	Displacer Clamps				
31	Displacers				

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard triplex tandem models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in above listings.

② Replacement standard housing kits are furnished with moisture proof epoxy coated housing covers only for NEMA classifications 1 through 5 and 12.

③ Stem furnished must be cut to match length of old stem before assembly.

④ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeves are type 400 series stainless steel.

⑤ Stem, spring, and mounting kit components directly affect calibration of triplex tandem model displacement controls. Should any of these replacement kits be required, control should be returned to the factory for fitting of new components and recalibration. See return material procedure on back page.

⑥ Spring kits listed use inconel range springs. Consult local representative on kits for optional models using stainless steel range springs.

⑦ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers.

NOTE: Refer to one of the following bulletins furnished with your control for switch mechanism replacement parts.

SWITCH MECHANISM (Model Suffix Number)	BULLETIN	REF. TYPE
S-1 & DPS-1 Mercury Switches	42-608	S-1
J-1 Bleed Type Pneumatic Valve	42-617	J-1
J-2 Non-Bleed Type Pneumatic Valve	42-621	J-2
S-1M & DPS-1M Dry Contact Switches	42-657	S-1
M-1 & M-4 Anti-Vibration Dry Contact Switches	42-670	M-1
SPS-1 & SPDPS-1 Anti-Vibration Mercury Switches	42-675	S-1

Guarantee

We guarantee to repair or to replace, at our option, any MAGNETROL Level or Flow Control which, within one year from date of shipment, exhibits any defect in material or workmanship, provided that: (1) the unit has been properly installed; and (2) it has been operated with the liquid and within the pressure, temperature, specific gravity and electric current or pneumatic supply limitations specified on the original purchase order or as stamped on the MAGNETROL instrument nameplate.

Important

OUR SERVICE POLICY

Owners of Magnetrol controls may request to return a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. If, once returned, the underlying cause of the trouble is found to be defective material or workmanship (within the guarantee period), the item will be either rebuilt, or replaced completely, without charge on an F.O.B. factory basis. If the trouble is the result of conditions beyond our control or is not covered by the guarantee, there will be a charge for labor and a charge for parts required to rebuild or replace the item.

In some cases it may be expedient to ship new parts or in extreme cases, a complete new control to replace the original before it is returned. If this is desired, inform us as to what parts are needed, the model number and the serial number of the control and repair part number. Credit for materials returned in such cases will be determined on the basis of the applicability of our guarantee.

No claims for labor or consequential damage will be allowed.

RETURN MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" tag be obtained from the factory for attachment to the goods. This is available through Magnetrol's local representative or by writing directly to the factory supplying the following information:

1. Installation Name
2. Description of Material
3. Production Number
4. Serial Number
5. Reason for Return
6. Desired Action

All shipments returned to the factory must be by Prepaid transportation.

All replacements will be shipped F.O.B. factory.

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Industriepark Blok E
9140 Zele, Belgium
Phone: 052-445901
Telex: 846-25944

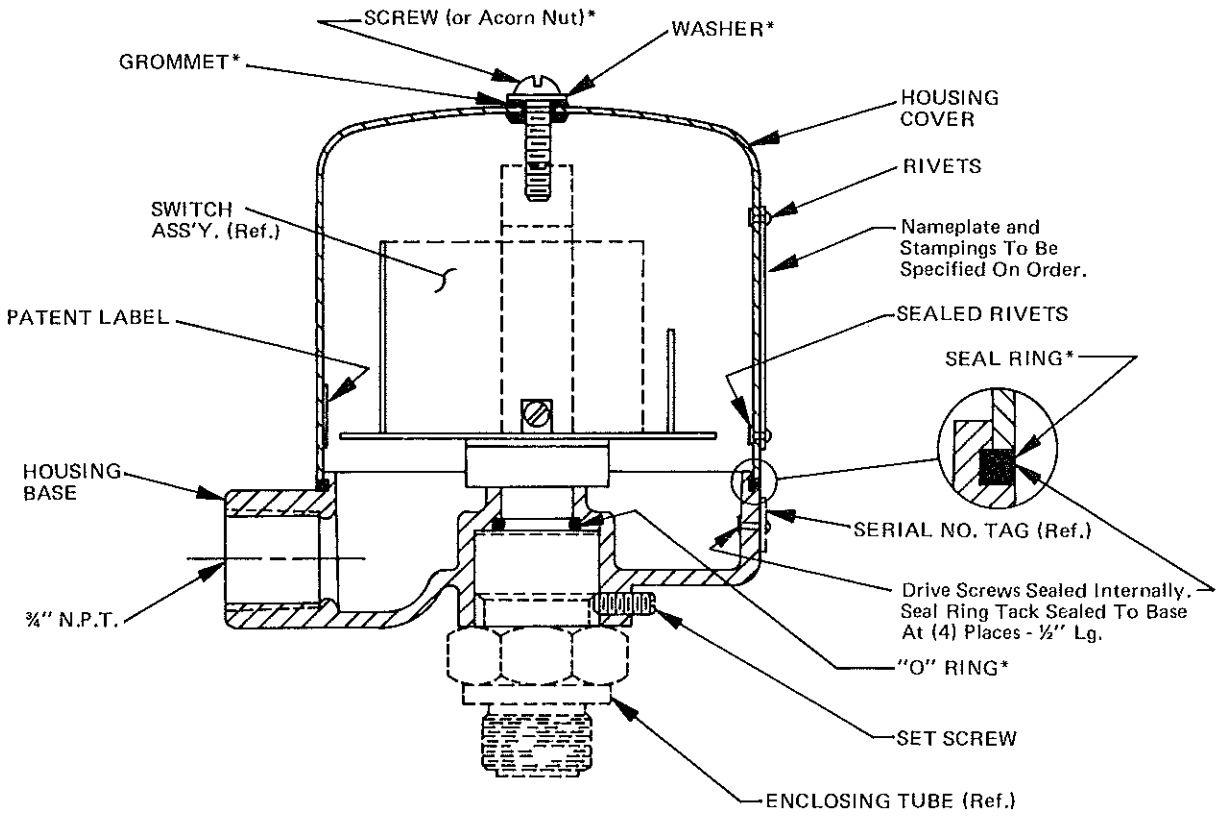
REPRESENTATIVES IN PRINCIPAL CITIES.

Printed in USA

MAGNETROL INTERNATIONAL

BULLETIN: 42-680.4
EFFECTIVE: October 1977
SUPERSEDES: November 1975

MAGNETROL TYPE S-1 SWITCH HOUSING REPLACEMENT ASSEMBLIES



TYPICAL STANDARD HOUSING ASSEMBLY

DESCRIPTION

Standard housing replacement assemblies are designed for applications ranging from general purpose indoor use to non-hazardous installations requiring a dust, water, lint, fiber and oil tight enclosure.

The manual reset (M.R.) assemblies utilize the same basic components as the standard units, but are limited to general purpose indoor applications where unit is not exposed to unusual conditions.

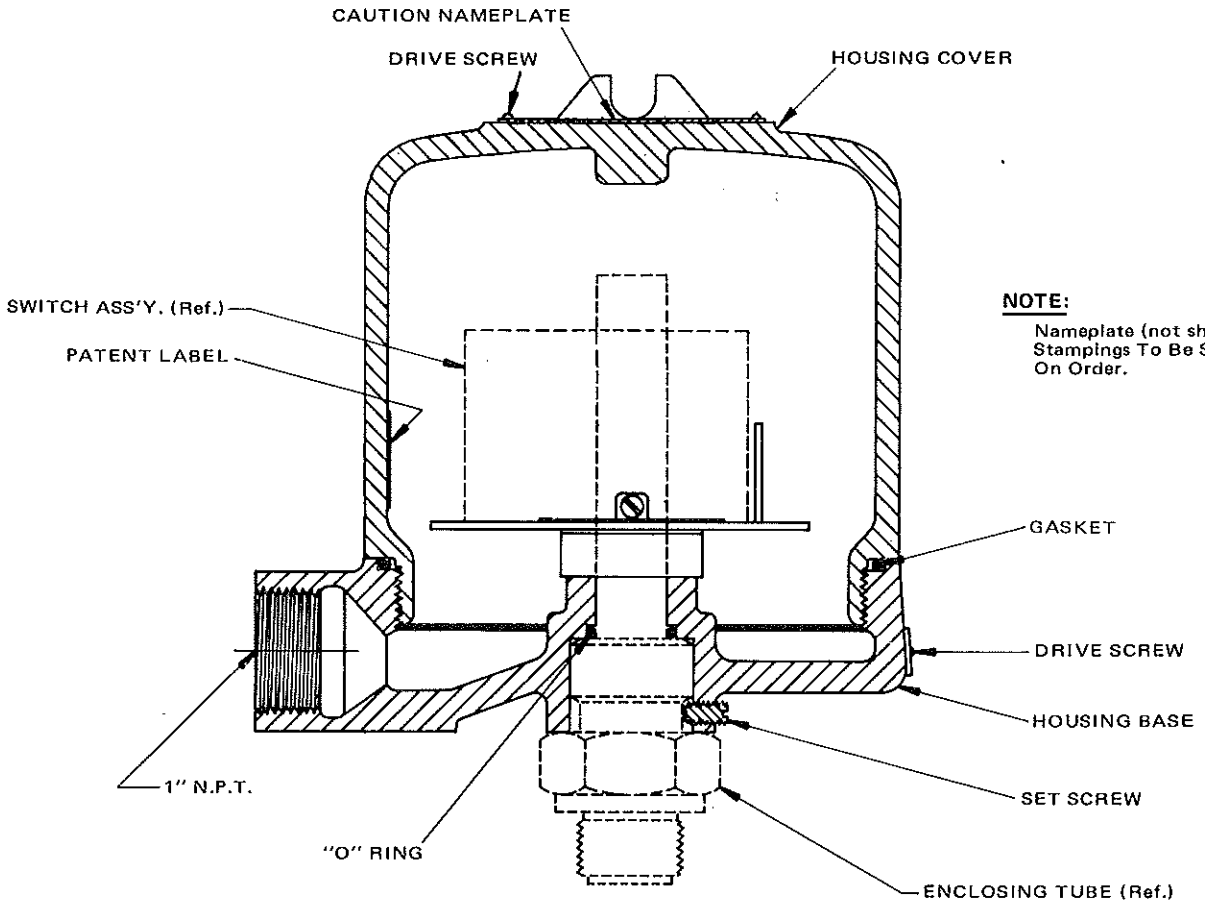
NOTE: Manual reset mechanism requires a hole in the side of the cover to accommodate the reset actuating plunger.

DESCRIPTION		NEMA ① TYPE	REPLACEMENT PART KIT NO.
Standard Housing Cover	Short (4")	NEMA 1 thru 5 & 12	89-6509-001 ②
	Tall (6")		89-6510-001 ②
Manual Reset Housing Cover	Short (4")	NEMA 1 (only)	89-6511-001 ②
	Tall (6")		89-6512-001 ②
Transparent "Lexan" Housing Cover Tall (6") Only		NEMA 1 thru 5 & 12	89-6522-001 ②
Housing Base (Std. & M.R.)		NEMA 1 thru 5 & 12	89-6505-001 ③
Cover Assembly Hardware *		NEMA 1 thru 5 & 12	89-6508-001

① National Electrical Manufacturers Association.
② Includes assembly hardware kit (89-6508-001).
③ Includes base assembly hardware.

(continued)

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TYPICAL EXPLOSION PROOF (E.P.) HOUSING ASSEMBLY

DESCRIPTION

Explosion proof housing replacement assemblies are designed for applications in hazardous atmospheric locations, as classified under types NEMA 7 and 9 of the National Electrical Code.

Housings equipped with submersible base are suitable for submersion under water, as classified under NEMA type 6 of the code.

IMPORTANT:

When ordering, please specify:

1. Model and Serial number of control.
2. Name and Number of replacement kit.

NOTE:

Consult your local representative on applications to meet NEMA and other codes not covered in this bulletin.

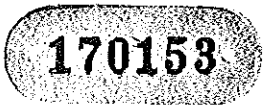
DESCRIPTION	NEMA ① TYPE	REPLACEMENT KIT PART NO.
Explosion Proof Housing Cover (4")	NEMA 6, 7 & 9	89-6513-001 ②
Explosion Proof Housing Cover (6")	NEMA 6, 7 & 9	89-6514-001 ②
Standard Explosion Proof Housing Base	NEMA 7 & 9	89-6515-001 ③
Explosion Proof Housing Base W/Drain	NEMA 7 & 9	89-6516-001 ③
Submersible Explosion Proof Housing Base	NEMA 6, 7 & 9	89-6517-001 ③

① National Electrical Manufacturers Association
② Includes cover assembly hardware.
③ Includes base assembly hardware.

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THIS IS A MAGNETROL® SERIAL NUMBER TAG

SERIAL NUMBERS — YOUR GUIDE TO PROMPT, ACCURATE SERVICE

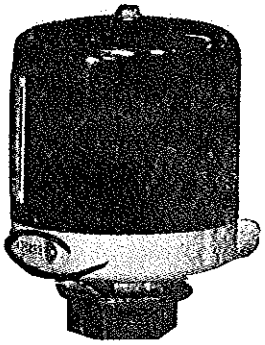
Should an electrical short circuit damage or physical damage make parts replacement necessary, be sure your purchase order includes the SERIAL NUMBER of your Magnetrol control. This will insure prompt delivery of the proper parts.

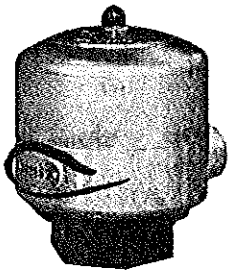
WHY SERIAL NUMBER?

The serial number of each Magnetrol control is recorded and cross-indexed with the production records. These records are then kept on micro film to provide a quick access "key" to the complete engineering of any given control. This file contains full information on the mechanism furnished, exact control action, the liquid or material for which the control was intended, its specific gravity, dielectric constant, pressure and temperature, etc. In addition, all drawings and specifications are included for any special parts used in the construction of non-standard model controls.

On the Type S-1 Moisture Proof Housings . . .

The Serial Number will be located at a point 180° from the conduit opening. This housing is distinguished by the black sheet-steel cover. Whether the cover is the standard "short" (illustrated), standard "tall" or "extended", the Type S-1 standard cover serial number will be in this location.

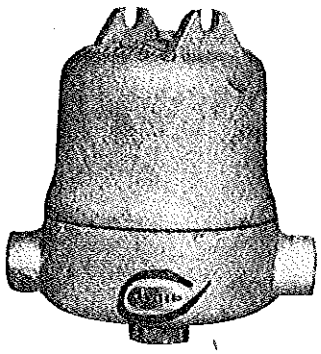




On the Type S-5 Splash-Proof Housings . . .

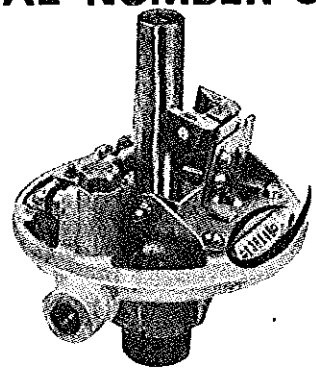
The Serial Number is also located at a point 180° from the conduit opening.

RECORD THE SERIAL NUMBER OF YOUR CONTROL



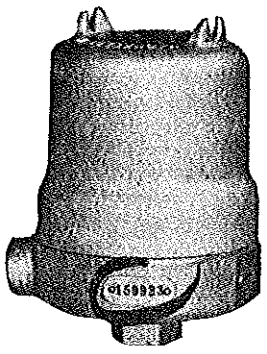
On the Type S-1 Double-tap Explosion- or Vapor-Proof Housing . . .

The Serial Number will be located at a point 90° from either of the conduit openings (one will be "plugged"). Whether the cover is the EP or VP short, tall or "extended", the Serial Number tag will be in this position.



On the Type J-1 Pneumatic Pilot Mechanism . . .

The Serial Number is located *inside* the housing. After the housing is removed, the Serial Number will be found riveted to the housing base.



On the Type S-1 or S-5 Explosion- or Vapor-Proof Housing . . .

The Serial Number will be located at a point 90° from the conduit opening, or 90° from the nameplate.

FORM: 41-310.2
November 1977

PRINTED IN U.S.A.

BULLETIN: 42-657.3
EFFECTIVE: August, 1975
SUPERSEDES: May, 1974

GENERAL INSTRUCTIONS FOR TYPE "S-1M" and TYPE "DPS-1M" SWITCH MECHANISMS

DESCRIPTION

TYPE S-1M SWITCH MECHANISM

The type S-1M switch mechanism uses a single SPDT dry contact switch and is designed to be interchangeable with the type S-1 Mercury switch mechanism used in most Magnetrol® liquid level controls and flow switches. It is completely self contained with numbered terminal strip and removeable dry contact switch. See bulletin 42-110 for further details and rating information.

TYPE DPS-1M SWITCH MECHANISM

The type DPS-1M mechanism uses two SPDT dry contact switches actuated by the same magnet, to obtain double pole action. This arrangement provides the capability to "break" both sides of a control circuit simultaneously or control two circuits of different voltage and current characteristics. A high temperature porcelain terminal block is featured as standard. Also see bulletin 42-110 for complete specifications.

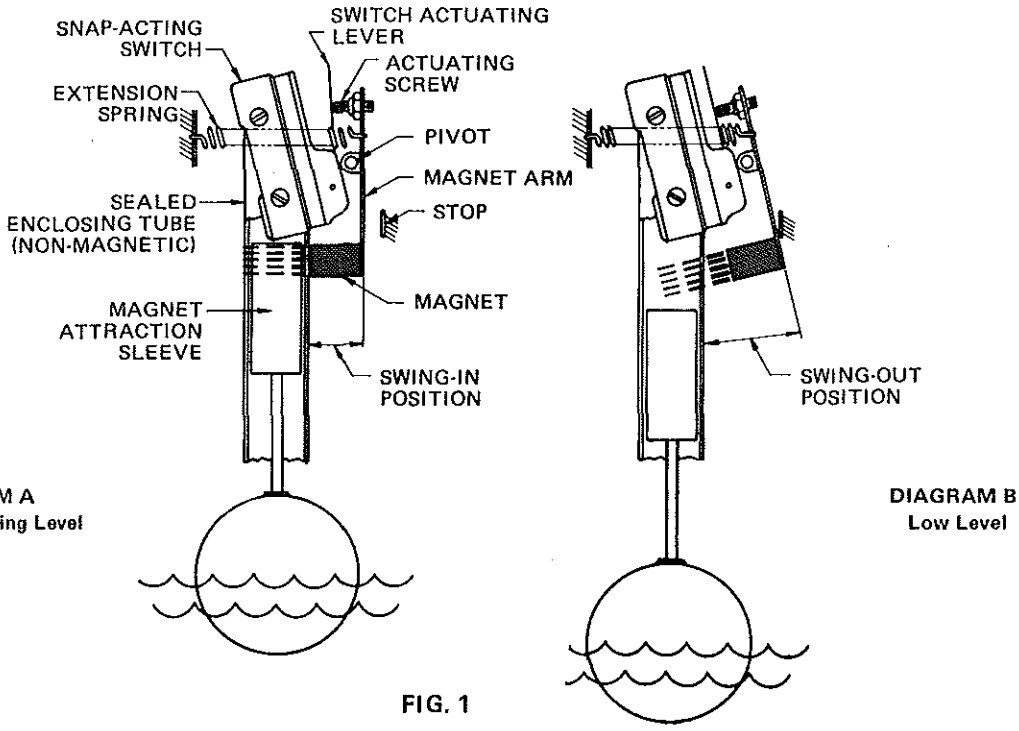


FIG. 1

OPERATING PRINCIPLE

Diagrams A and B illustrate the simple and foolproof Magnetrol operating principle. Switching action is obtained through the use of a magnetic sleeve actuated by a float (or flow sensing device) and a switching mechanism. These two basic component assemblies are separated by a non-magnetic, pressure-tight enclosing tube. A swinging magnet carriage, operating on precision stainless steel pivots, activates the switch.

OPERATING CYCLE

At "Normal Operating Level" of liquid in a storage vessel (diagram "A"), the float moves the magnetic sleeve up within the field of a switch magnet, drawing it in tightly to the enclosing tube. This causes the switch lever to release, "making" or "breaking" an electrical circuit. As liquid level recedes, the float pulls the magnetic sleeve downward until, at a pre-determined "Low Level", the switch magnet releases and swings outward away from the enclosing tube. This in turn re-actuates the switch lever, thus reversing switch action.

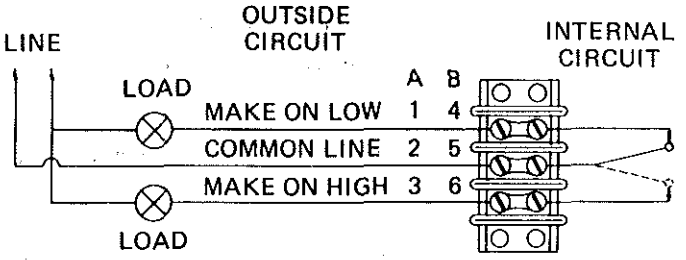
When liquid level returns to normal, the float once again moves the magnetic sleeve up the enclosing tube, causing the switch mechanism to assume its original position.

Switch mechanisms can be used singly or in multiples depending on operational requirements and switching action desired.

WIRING INSTRUCTIONS

S-1M MECHANISM

WIRING DIAGRAM

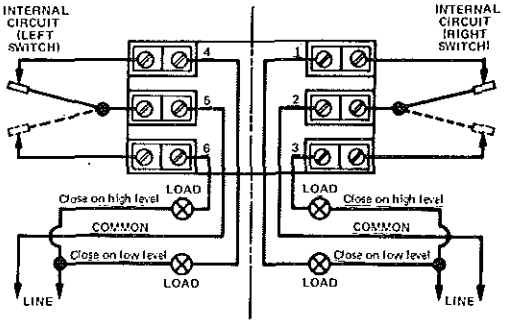


NOTE: When used on side mounted float-in-tank switches, the wiring diagram is reversed. (Make on Low becomes Make on High, etc.)

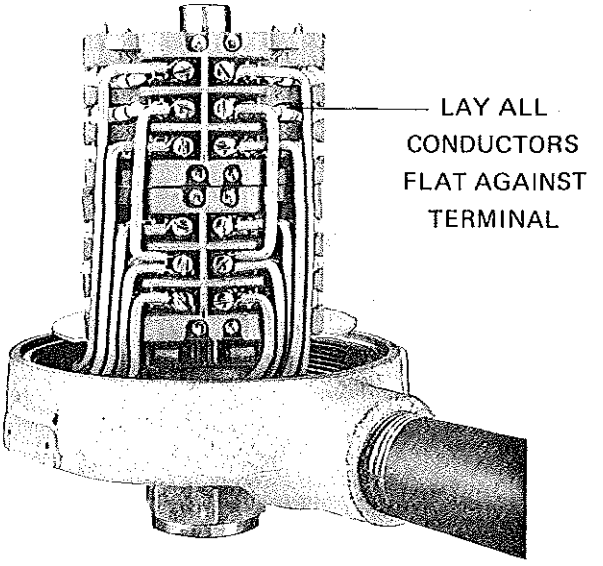
FIG. 2

DPS-1M MECHANISM

WIRING DIAGRAM



NOTE: – Double pole action is obtained by simultaneous operation of R.H. and L.H. single pole switches.
– When used on side mounted float-in-tank switches, the wiring diagram is reversed. (Make on High becomes Make on Low, etc.)



DPS-1M WIRING

Care must be exercised in positioning the incoming conductors to insure clearance between the conductors and the housing cover. Figure at right shows a recommended wiring practice for two DPS-1M mechanisms. All conductors are brought into the housing, wrapped around the enclosing tube under the baffle plate and then brought up to the proper terminal. Excess wire must be cut off before stripping ends. Use asbestos insulated wire suitable for at least 90°C if a high ambient temperature exists at the control or conduit. These wires need not extend beyond the first junction box.

FIG. 3

©MAGNETROL INTERNATIONAL 1974

REMOVING THE SWITCH MECHANISM

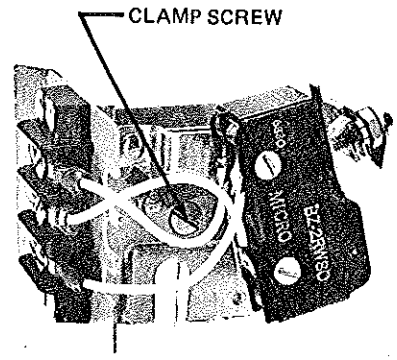


FIG. 4

All type S-1M and DPS-1M switch mechanisms can be easily removed from a Magnetrol control without disturbing piping connections or the rest of the control. Switch mechanisms are secured in the controls by means of a split clamp screw.

CAUTION: Before attempting to remove a switch mechanism, be certain to pull disconnect switch or otherwise assure that electrical circuit through control is deenergized.

1. Disconnect wiring from supply side of terminal block on switch mechanism(s). Note and record lead wire terminal locations.

NOTE: Measure location of switch mechanism(s) on enclosing tube and record for reference use during reassembly. Measure from top of enclosing tube to top of split mounting clamp on switch mechanism.

2. Loosen screw in split mounting clamp until mechanism slides freely on enclosing tube.
3. Remove small round head screw securing lower switch mechanism to baffle plate.
4. Carefully lift off switch mechanism(s) and place on clean surface, free of metal particles which may be attracted to switch magnet(s).
5. Replace switch mechanism(s) in reverse of steps 1 thru 4 above. Be certain, in the case of S-1M mechanisms, that assemblies are stacked in proper order on controls with multiple mechanisms.
   - "B" mechanism must be replaced first and attached to baffle plate, then followed by an "A" mechanism.
   - On controls with three or more mechanisms, an "A" mechanism must be positioned between two "B" mechanisms.

NOTE: All S-1M mechanisms have "A" or "B" identification markings placed next to terminal blocks.

REPLACING THE TYPE S-1M SWITCH

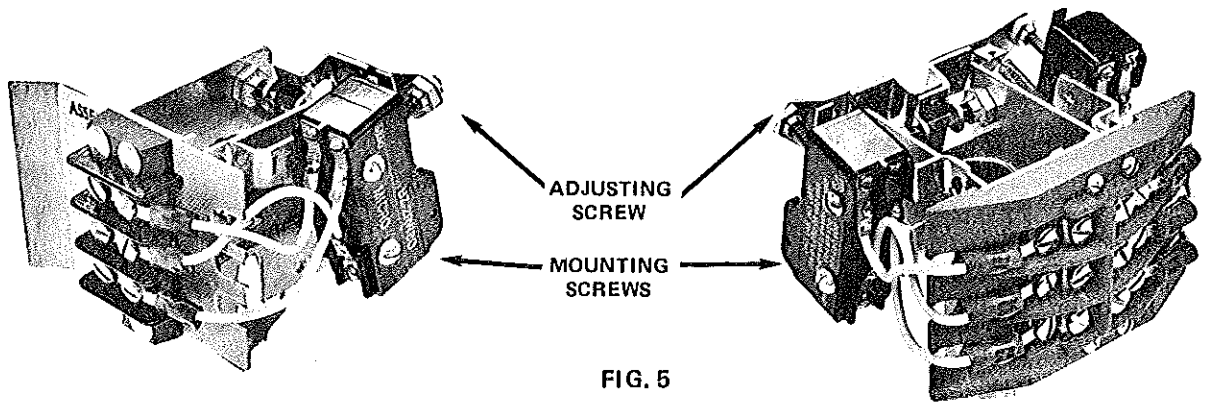


FIG. 5

Dry contact switches used in Magnetrol S-1M and DPS-1M switch mechanisms are easily removed and replaced when damaged or broken.

1. Disconnect Magnetrol control from power supply.
2. Disconnect switch leads from terminal block. Note and record terminal connections of switch to be replaced.
3. Remove two mounting screws holding existing switch.
4. Remove existing switch and install replacement switch in the same position, tightening mounting screws securely.

NOTE: For proper operation of the replacement switch, it must actuate in the middle portion of the pivoted magnet's swing.

5. Check switch action and adjust as follows:
   A. Slowly rotate the pivoted magnet by hand, back and forth through its angle of swing, listening closely for the actuating "click" of the switch in each direction.
   B. Check to see if there is equal additional over-travel of magnet in its swing after the switch "click" in either direction.
   C. If switch actuation is not correct, change adjustment of actuating screw using a 1/16" hexagon key wrench.

NOTE: If a single switch is being replaced on a DPS-1M mechanism, lever of second switch must be depressed and held to allow for the audible adjustment of new switch, as described above.

   D. With new switch in adjustment, release lever of second switch and perform "fine-tuning" of both switches to provide simultaneous actuation (clicks).
6. Re-connect power supply and test switch action by varying liquid level in the vessel or by "blowing down" float chamber.

REPLACEMENT PARTS

PART NUMBERS FOR TYPE S-1M and DPS-1M SWITCH MECHANISMS (W/SWITCHES)									
DESCRIPTION		MAXIMUM LIQUID TEMPERATURE							
		250°F				450°F			
CONTACTS	Elec. Current	Red Dot Magnet		Yellow Dot Magnet		Red Dot Magnet		Yellow Dot Magnet	
		"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism
SPDT (S-1M)	AC	89-7401-101	89-7401-102	89-7401-103	89-7401-104	89-7401-107	89-7401-108	89-7401-109	89-7401-110
	DC	–	–	89-7401-105	89-7401-106	–	–	–	–
Baffle Plate Ass'y.		36-5303-001 (RP-1011)							
DPDT (DPS-1M)	AC	89-7401-121		89-7401-122		89-7401-124		89-7401-125	
	DC	–		89-7401-123		–		–	
Baffle Plate Ass'y.		36-5305-001 (RP-6206)							

CAUTION: **When ordering replacement switch mechanisms, be certain to determine color dot on magnet. NEVER replace a mechanism having a red dot magnet with one having a yellow dot magnet, and vice versa.**

PART NUMBERS FOR DRY CONTACT SWITCHES ONLY									
For L.H. or "B" Mechanisms ①	MAXIMUM LIQUID TEMPERATURE				MAXIMUM LIQUID TEMPERATURE				For R.H. or "A" Mechanisms ①
	250°F		450°F		250°F		450°F		
	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	
AC CURRENT	89-7101-021		89-7101-023		89-7101-020		89-7101-022		AC CURRENT
DC CURRENT	–	89-7101-025	–	–	–	89-7101-024	–	–	DC CURRENT

NOTE:
1. "LEFT HAND" (L.H.) or "RIGHT HAND" (R.H.) designations, used to identify switches on DPS-1M mechanisms only, determined by viewing switch mechanism facing terminal block.

IMPORTANT:
When ordering, please specify:
1. Model and Serial number of control.
2. Name and Number of part.

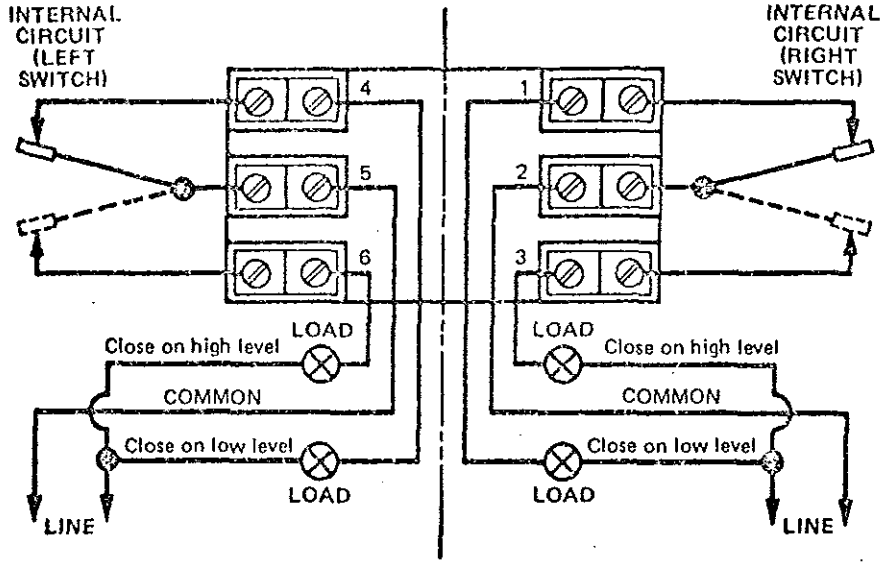
MAGNETROL
INTERNATIONAL, INCORPORATED
5300 Belmont Road • Downers Grove, Illinois 60515 • (312) 969-4000 • Telex 25-3085

PRINTED IN U.S.A.

11908550

TERMINAL CONNECTIONS
DOUBLE POLE SWITCH MECHANISMS

(DPS-1, SPDPS-1 or DPS-1M DPDT SWITCHES)



NOTES: – DOUBLE POLE ACTION IS OBTAINED BY SIMULTANEOUS OPERATION OF THE RIGHT AND LEFT SIDE SINGLE POLE SWITCHES.

– ABOVE SWITCHING ACTIONS APPLY TO S.P.D.T. SWITCHES. When S.P.S.T. SWITCHES ARE FURNISHED, DISREGARD THE UNUSED TERMINALS.

LIMERICK GENERATING STATIONS UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
P.O. NO. LX 239585
COLT/FMED ORDER NO. 11-700000

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

FOR Colt Industries/Fairbanks Morse

CUSTOMER ORDER B458960-0 Rev. 1 MAGNETROL ORDER M471492-101

MODEL A103F-EP/VP-S1MD4DC QUANTITY 8

TAG(S) F.M. P/N 11908550

SWITCH RATING: 2.2 AMPS @ 125 VOLTS DC TEMPERATURE OF PROCESS LIQUID 250 °F MAX.

CERTIFIED BY [signature] DATE 4-25-78

FORM: 42-623.2 MARCH 1975

MAGNETROL INTERNATIONAL

5300 BELMONT ROAD / DOWNERS GROVE, IL 60515 / AREA 312/969 4000

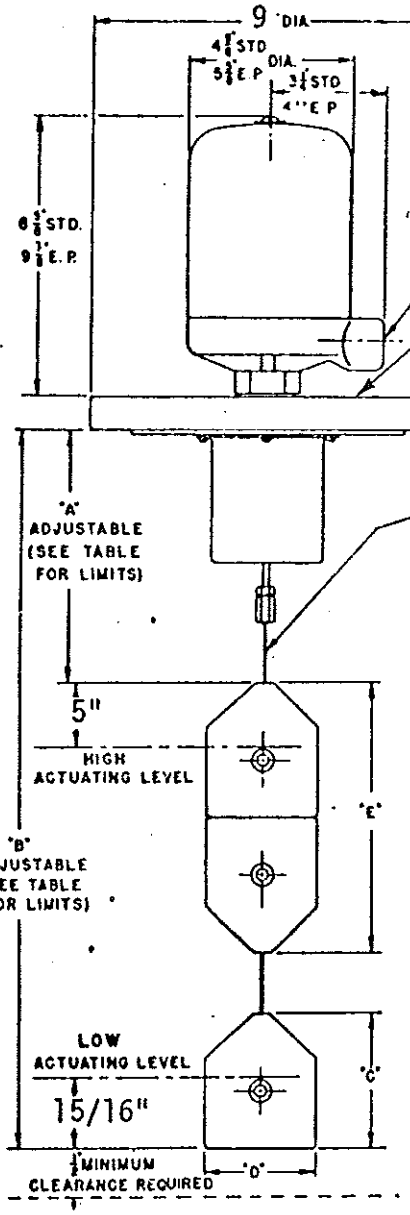
Printed in U.S.A.

11908550

INSTALLATION DIMENSIONS

MODEL A-103-F & A-103-F E.P.

NEMA VII Explosion proof/Vapor proof Housing



CONDUIT CONNECTIONS ¾" N.P.T. STANDARD HOUSING 1" N.P.T. EXPLOSION-PROOF HOUSING STD. AND E.P. HOUSINGS MAY BE ROTATED THROUGH 360°.

4" – 125 LB. CAST IRON FLANGE FURNISHED AS STANDARD.

ALLOW OVERHEAD CLEARANCE OF 15" FOR STANDARD TALL AND 15½" FOR E.P. TALL ABOVE THIS POINT FOR INSTALLATION.

10' DISPLACER CABLE FURNISHED AS STANDARD. INSTRUCTIONS FOR SETTING DISPLACERS ATTACHED TO CABLE.

FLANGE SPECIFICATIONS OTHER THAN STANDARD	
4 · 150 LBS	F.S. FLANGE
8 BOLT HOLES	3/4 · DIA
7-1/2 · DIAMETER BOLT CIRCLE	

Levels given are for .95 sp. gr. @ 115°F

TYPE OF DISPLACER	DIAMETER OF DISPLACERS "D"	HEIGHT OF LOWER DISPLACER "C"	HEIGHT OF UPPER DISPLACER (S) "E"	LIMITS OF DISPLACER ADJUSTMENT "A" MIN	"A" MAX	"B" MIN	"B" MAX
PORCELAIN	3 1/8"	3½"	7"	6"	9"7¼"	17¼"	10"5¾"
KARBATE	2½"	4½"	9"	5¼"	9"2¾"	19½"	10"5"
3"DIA STAINLESS STEEL	3"	6"	11"	5¾"	8"11"	24¼"	10"5¾"
3¾"DIA STAINLESS STEEL	3¾"	6"	6"	SET PER APPLICATION			

LIMERICK GENERATING STATIONS UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
P.O. NO. LX 239585
COLT/FMED ORDER NO. 11-700000

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

FOR Colt Industries/Fairbanks Morse

CUSTOMER ORDER B458960-0 Rev. 1 MAGNETROL ORDER M471492-101

MODEL A103F-EP/VP-S1MD4DC QUANTITY 8

SWITCH ACTION DPDT

DISPLACER TYPE ~~Porcelain~~ STAINLESS STEEL SWITCH HOUSING Explosion proof/Vapor proof

MIN. SP. GR. .70 MAX. PRESS. 225 P.S.I. MAX. TEMP. 115 °F. SERVICE LIQUID -

CERTIFIED BY J. J. Bajanowski DATE 4-25-78

TAG(S) F.M. P/N 11908550

FORM:: 45-503.1
November 1975

MAGNETROL INTERNATIONAL

Printed in U.S.A.

Form No. BF4141 A

Colt Industries

Fairbanks Morse Engine Division
701 Lawton Avenue
Beloit, Wisconsin 53511

THIS IS NOT A PURCHASE ORDER

DATE 5-13-88

REQUISITION FOR:
☐ EXPENSE
☐ MATERIAL
☐ RANCH ORDER_____

STATE RESALE PERMIT NUMBER
TAXABLE | NON-TAXABLE

AMOUNT IN STOCK
AMOUNT DUE
DUE ON ORDER NO.
USAGE LAST QUARTER

VENDOR NO._____
VENDOR Magnetrol
ADDRESS _____

SHIP TO: SAME AS ABOVE UNLESS OTHERWISE SPECIFIED
CARE OF: _____

SHIP VIA	TERMS	F.O.B.	PREPAID	COLLECT

MATERIALS TO BE AT DESTINATION ON DATE SPECIFIED (SPECIFY CALENDAR DAY).

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER

REQUISITION NO.	REQUISITIONED BY:	EST. COST	BUYER:	APPROVED BY
BR	F. Chase	$	S. Gebhardt	W. J. Sheets

ACCOUNT NO. (CODE)	REGISTER NO.	JOB NO. DELIVER TO: DEPT. NO.:
982-721		982

ITEM NO.	QUANTITY	F.M. PART NO.	DESCRIPTION (MUST BE COMPLETE)	PRICE NOT TO EXCEED
1	1	(11908550)	Please obtain vendor breakdown and part number for the ceramic terminal block as used on switch, F. O. transfer pump control. Vendor Dwg. No. Model A-103-F-EP/VP-Y-S1MD4DC Our "A" sheet attached. # 57-5000-001 - Whole Switch Mechanism (Must Order Entire Switch - Block Not Available Seperately.	$370.00

THIS IS NOT A REQUISITION

INTERNAL EXPLANATION:
Limerick 9825288

VARIANCE

CODE

NOTE: REFER TO INSTRUCTIONS ON REVERSE SIDE FOR USE AND ROUTING OF FORMS:

DISPOSITION OF REQUISITIONS

11908550

RECOMMENDED SPARE PARTS

IMPORTANT: When ordering parts, furnish the serial number of the Magnetrol.

CUSTOMER Colt Industries

CUST. P.O. NO. B-458960-0 PRODUCTION NO. M471492-101

MAGNETROL MODEL(S)

A103F-EP/VP-S1MD4DC

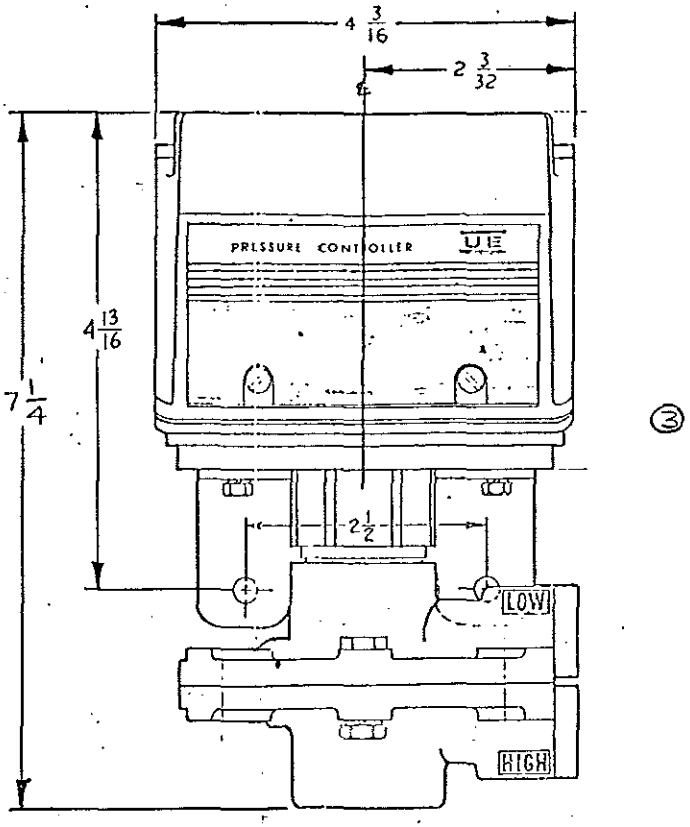
QUANTITY	PART NO.	DESCRIPTION	PRICE EACH F.O.B. FACTORY
		MERCURY SWITCH	
		SPST - Closes on Falling Level	
		Right Side	
		Left Side	
		MERCURY SWITCH	
		SPST - Closes on Rising Level	
		Right Side	
		Left Side	
		MERCURY SWITCH	
		Single Pole, Double Throw	
		Right Side	
		Left Side	
		MICRO-SWITCH	
		Single Pole, Double Throw	
4	89-7101-024	Right Side	47.00
4	89-7101-025	Left Side	47.00

57-5000-001 Switch mechanism with lapped blade

MINIMUM INVOICE: A minimum charge will be made on small purchases to cover packing, shipping, order processing, billing and other handling expenses, as follows: $35.00 within the U.S.A. and possessions, $45.00 Canada and Puerto Rico shipments and $50.00 elsewhere.

NOTE: All orders are subject to current prices at time of order placement.

MAGNETROL INTERNATIONAL
5300 BELMONT ROAD/DOWNERS GROVE, ILLINOIS 60515/AREA 312/969-4000



③

LIMERICK GENERATING STATION, UNITS 1&2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: UNITED ELECTRIC

③

VENDOR DWG. NO.: B-10750 : TYPE J300K-457

TITLE: SWITCH, PRESSURE DIFFERENCE

COLT OCT 17 1978 FM

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
3	11137	10-12 78	⑤ DELETE REFERENCE TO SPEC. PG. 42 43 REV.	DJD PMSH
2	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS ④	ULS
	10616	1-6-78	3. ADDED PICTURE, VENDOR & VENDOR DWG NO	SJV
1	10616	"	2. DELETE PARA. 2.7 SJV 1. PARA 2.2 DIAPHRAGM WAS PISTON	

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1742	3/25 77	ASSY. OR LO.	
DR. BY J. DORN	3/16/77	SCALE	
CHK'D. BY J. WHALEN	3/21 77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 553 | SHEET 1 OF 2

11 908 553

ORIGINAL

F.O. STRAINER PRESSURE DIFFERENCE ALARM FOR NUCLEAR STANDBY DIESEL/ GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS:

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 41, PARA. 6.1a - PAINTING

④* 1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

④* 1.1.3 PAGE 43, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

⑤

2. TECHNICAL SPECIFICATIONS:

2.1 PRESSURE DIFFERENCE SWITCH FOR HIGH PRESSURE ALARM ACROSS FUEL OIL STRAINER.

① 2.2 SENSING ELEMENT SHALL BE A DIAPHRAGM TYPE SUITABLE FOR OPERATION WITH #2 DIESEL FUEL AT A MAXIMUM LINE PRESSURE OF 150 PSI.

2.3 ACTUATION POINT SHALL BE ADJUSTABLE BETWEEN 5-30 PSI, FACTORY SET AT 15 PSI.

2.4 DIFFERENCE BETWEEN ACTUATION POINT AND REACTUATION POINT SHALL NOT EXCEED 5 PSI.

2.5 SWITCH SHALL BE SPDT, NON-MERCURY TYPE, RATED FOR 125 VOLT DC, .2 AMP.

2.6 SWITCH HOUSING SHALL BE NEMA TYPE 4.

② 2.8 MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

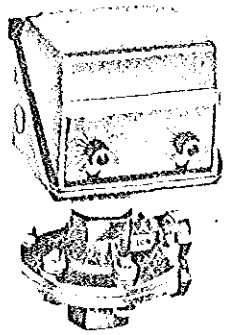
1 908 553

COLT OCT 17 1978

11 908 553

ORIGINAL

11908553



300K SERIES DIFFERENTIAL PRESSURE CONTROLLERS

ON-OFF TYPES	H300K, H302K, H303K, J300K, J302K, J303K
PROPORTIONING TYPES	SH300K, SH302K, SH303K, SJ300K, SJ302K, SJ303K, SSH302K, SSH303K, SSJ302K, SSJ303K

INSTALLATION AND MAINTENANCE INSTRUCTIONS

IM-300K
Rev. A

OPERATION

As differential pressure changes, a diaphragm sensor actuates 1, 2, or 3 snap switches or positions the wiper of a proportioning potentiometer. The controller settings are determined by positioning the switches or potentiometer by means of internally located adjustment screws (J types) or external knobs (H types).

PART I—INSTALLATION—ALL TYPES

1. Remove Cover
   — Cover is held on by two captive screws located below the blue panel.
   — On calibrated controls first pull off the knob (s).

2. Knockout Electrical Entrance
   Three cast-in knockouts for ½" conduit are located in the sides and back of the enclosure. These can be easily knocked out with a screwdriver. Place the end in groove and rap it sharply with a hammer.

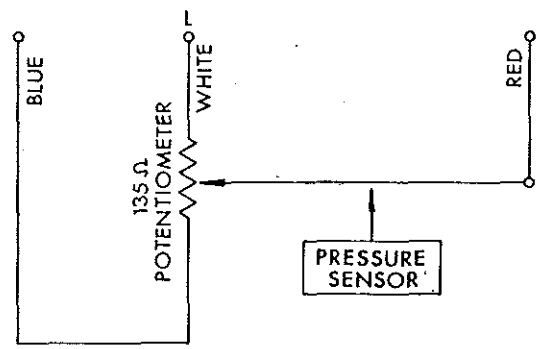
3. Mount the Controller
   Mount the case in any position. Locate it where vibration, shock and ambient temperature fluctuations are minimal. Mount it directly to a pipe via the pressure connections or to panel as follows (See mounting diagrams—Fig. 1.):

   To Surface Mount: Use the two holes in the mounting bracket supplied. For front side or top mounting, the bracket may be removed and repositioned on the base casting. In lieu of the bracket the case may be used. Knock them out in accordance with step 2.
   To Panel Mount: Position the bracket for front mounting, prepare a rectangular cutout in the panel to reveal the knob and scale, and drill two holes to clear #¼ screws.
   To Pipe Mount: Mount via the two NPT pressure connections. Always hold a wrench on the hex or flat portion of the pressure connection when tightening.

4. Make Wiring Connections
   A. On-Off Switch Types
      Connect conduit to the case and wire directly to the switch terminals in accordance with the job wiring requirements. Bring the wires up to the terminals from the rear of the case allowing enough slack so as not to retard switch movement when making setting adjustments. See Fig. 2.
      If manual reset switch is used lead wires are supplied, color coded as follows:

Common	White
Normally Closed	Blue
Normally Open	Black

   B. Proportioning Potentiometer Types
      Follow same procedure and caution as paragraph 4A above, except utilize wire nuts to connect wiring to leads of potentiometer. Wiring as follows:



   C. Combination Switch & Potentiometer Types
      Follow procedure of paragraph 4A & 4B above.

5. Adjust Settings for Internal Adjustment Types
   See adjustment procedure Part II

6. Replace Cover (and knobs if supplied)

PART II—ADJUSTMENTS—ON-OFF TYPES ONLY

SEE FIGURE 2

1. Non-Calibrated J300K Only
   Remove cover. Switch has screw adjustment inside enclosure. To raise the pressure setting turn the screw in (clockwise), one full turn corresponds to 10% of range. When making adjustments do not exceed the working range pressure rating of the control.

2. Types - J302K, J303K
   Remove cover. Follow same procedure as paragraph above. Switches may be set together or apart up to 100% of scale range. On dual switch models either switch may be set high. On 3-switch models, the third (or middle) switch has no over-travel mechanism and must always be set at the highest pressure when the switches are set apart. Altering the setting of one switch will usually have negligible effect on the other(s), however it's recommended that all settings be checked after each adjustment.

3. Calibrated Types - H300K, H302K, H303K
   Dials are factory calibrated for maximum accuracy at the scale midpoint. Recalibration of knob zero point may be desired at a critical pressure setting or after changing a switch. Proceed as follows:

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a) Turn the knob (s) to the desired calibration pressure.
b) Remove the knob (s) and cover.
c) Adjust screws per paragraph (1) until switch (es) trips at the knob setting.
d) Replace cover and knob (s).

4. Types With Adjustable On-Off Differential Switches
a) Types J300KD, 302KD, J303KD.
Differentials are varied by rotating the wheel using the switch mounting screw as an index. Increasing letters correspond to a wider differential. See Fig. 3A.
b) Types H300KD, H302KD, H303KD.

Differentials are varied by rotating the wheel. Clockwise turning corresponds to a wider differential. See Fig. 3B.

5. Types With Extra Wide On-Off Differential Switches
Types J300KF, J302KF, J303KF (1 and 2 switch only) - same procedure as paragraph 4a. above, adjust differentials up to appx. 50% of range.

6. Types With Manual Reset
Some models (suffix "G") incorporate a snap switch that, when actuated, remains tripped until pressure changes, and the reset button is depressed to reset position manually. On multi-switch controls, this switch must be set highest.

PART III—ADJUSTMENTS—PROPORTIONING TYPES ONLY

Potentiometers register 35% coil resistance at set point

SEE FIGURES 2 & 3C

1. General - Internal Adjustment Types SJ300K Only
Remove cover. Potentiometer has hex screw adjustment inside cover. To raise the pressure setting turn the screw in (clockwise), one full turn corresponds to 20% of range. When making adjustments do not exceed the working pressure rating of the control.

2. Dual Potentiometer Internal Adjustment Type SSJ300K Only
Remove cover and follow procedure in above paragraph. Potentiometers may be set together or apart up to 100% of scale range; either potentiometer may be set high. Altering the setting of one potentiometer will usually have negligible effect on the other, however, it's recommended that all settings be checked after each adjustment.

3. Calibrated Proportioning - Types SH300K & SSH302K
Dials are factory calibrated for maximum accuracy at the scale midpoint. Recalibration of the knob zero point may be desired at a critical pressure setting or after changing a potentiometer. Proceed as follows:

a) Turn the knob (s) to the desired calibration pressure.
b) Remove the knob (s) and cover.
c) Adjust screws per paragraph (1) until potentiometer (s) matches the knob setting.
d) Replace cover and knob (s).

PART IV—ADJUSTMENTS—COMBINATION ON-OFF/PROPORTIONING TYPES

1. Internal Adjustment Types SJ302K, SSJ303K, SJ303K - follow procedure for Internal Switch (Part II) and Internal Potentiometer (Part III) adjustments above.

2. External Adjustment - Types SH302K, SSH303K, SH303K - follow procedure for External Calibrated Switch (Part III) and External Calibrated Potentiometer (Part III) adjustments above.

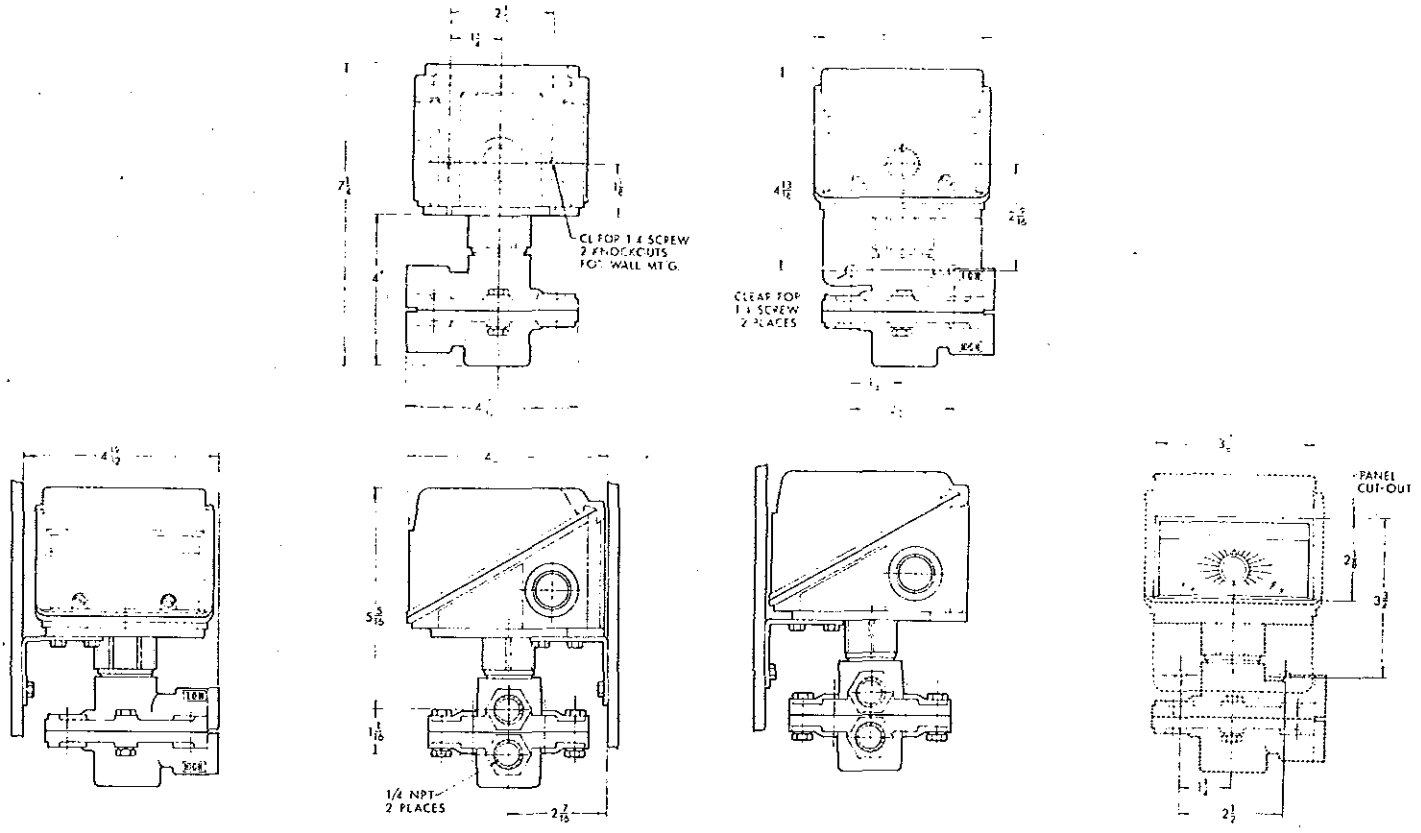
PART V—REPLACEMENT PARTS

Components most likely to require replacement are the switches or potentiometers. Replace as follows:

Switch Replacement
1. Disconnect Leadwires.
2. Remove the two mounting screws. On multi-switch controls first remove switch bias spring. See Fig. 2.
3. Insert replacement switch and replace screws.
4. Check switch set point and recalibrate if required. See Adjustments Part II.

Potentiometer Replacement
1. Disconnect Leadwires wire nuts.
2. Remove potentiometer mounting screws on multi-potentiometer controls, first remove potentiometer bias spring just as switch replacement above (Fig. 2).
3. Insert replacement potentiometer, replace mounting screws, reconnect wires with wire nuts.
4. Check control set points and recalibrate if required, following Adjustment procedure—Part III.

FIG. 1
MOUNTING DIAGRAM



SURFACE MT'G

PANEL MOUNTING

FIG. 2 GENERAL LAYOUT

NOTE: The middle switch assembly is omitted in dual switch controllers. The outer two switch assemblies are omitted in single switch controllers. "J" series controllers have internal screw adjustments. "H" series controllers have cam assemblies for external calibrated adjustment.

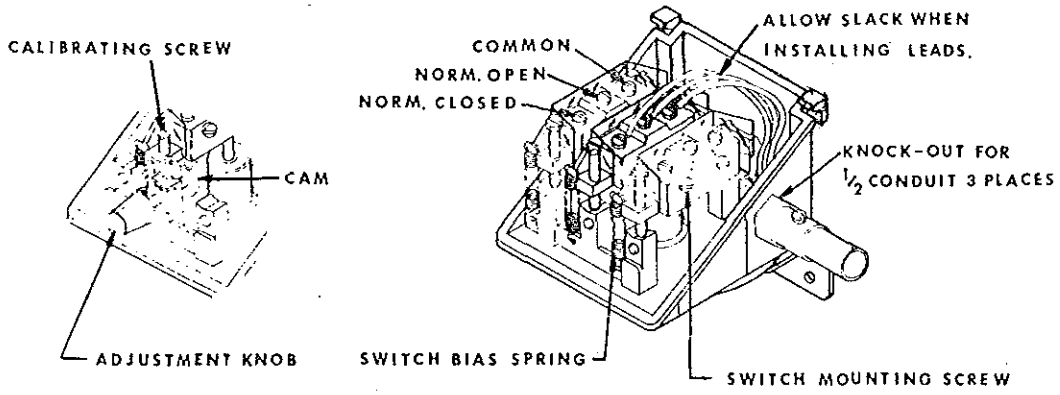


FIG. 3 ADJUSTMENTS

FIG. 3A

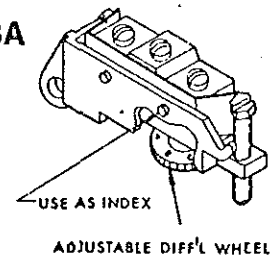


FIG. 3B

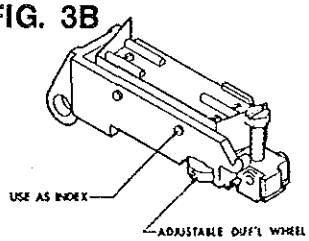


FIG. 3C

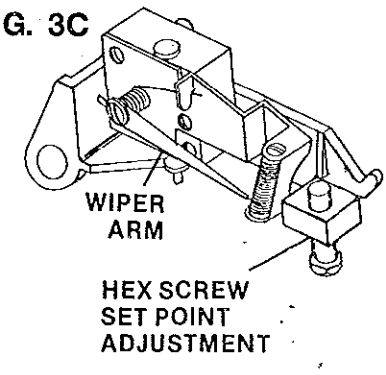
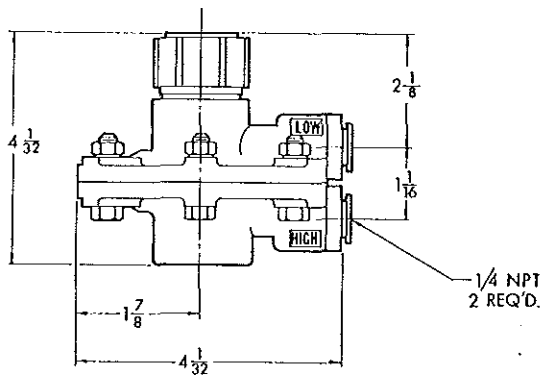
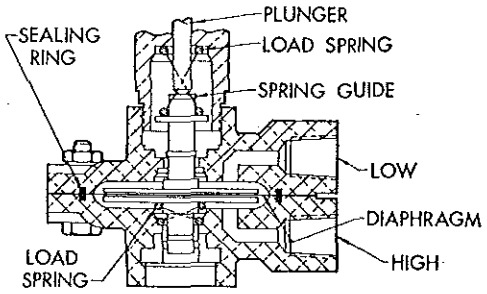
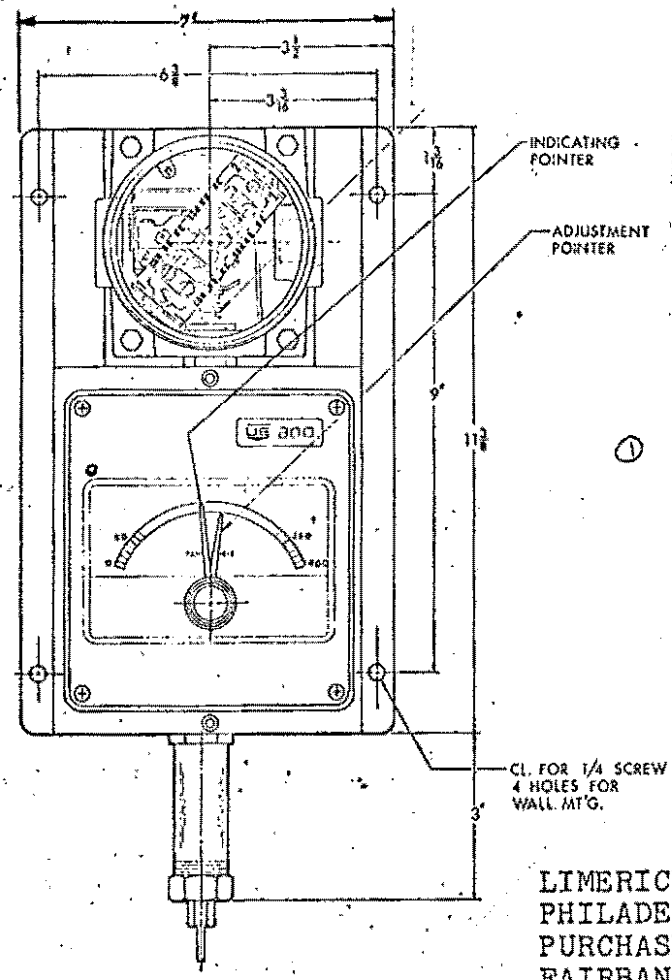


FIG. 4 SENSING ELEMENT







LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: UNITED ELECTRIC

①

VENDOR DWG. NO.: E-10811 Model 802PE-6BS

TITLE: SWITCH, TEMPERATURE INDICATING

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COLT 4-3 Kopp QA FM OCT 17 1978 App'd

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	11137	10-12-78	⑥ DELETE REF. TO SPEC PG. 4a 14a REV.	JNL/SJV
2	11014	8-7-78	ADD REV. STATE TO SUB TIER SPECS ⑤	WLG/MSD
1	10616	1-6-78	④ PARA. 2.4 WAS "SHALL BE DPDT"	SJV
1	10616	"	③ 0.5 AMP WAS 5 AMP ② DELETED PARA. 2.6	SJV
1	10616	"	① ADDED PICTURE, VENDOR & VENDOR DWG. NO.	SJV

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1742	3/25/77	ASSY. OR LO.	
DR. BY J. Dorn	3/16/77	SCALE	
CHK'D. BY J. WHALEN	3/21/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 554 | SHEET 1 OF 2

11 908 554

ORIGINAL

TEMPERATURE INDICATING SWITCH FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS:

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 41, PARA. 6.1a - PAINTING

(1) *

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

(5) *

1.1.3 PAGE 43, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

(6) (5) * SUBMIT PAGES 41 TO 43 REV 2

2. TECHNICAL SPECIFICATIONS:

2.1 TEMPERATURE INDICATING SWITCH WITH REMOTE SENSOR TO STOP THE FUEL OIL TRANSFER PUMP AND CLOSE FUEL OIL SOLENOID VALVE ON HIGH TEMPERATURE.

2.2 SENSING BULB, COMPLETE WITH SIX FEET OF CAPILLARY TUBE AND 3/4" NPT MOUNTING BUSHING, SHALL BE SUITABLE FOR #2 DIESEL FUEL.

2.3 TEMPERATURE SCALE SHALL READ 0-250°F WITH TEMPERATURE SET POINT ADJUSTABLE OVER THE FULL RANGE. SET POINT SHALL BE FACTORY SET AT 150°F.

(4)

2.4 SWITCH SHALL BE 2 SPDT OR DPDT, NON-MERCURY TYPE, RATED FOR 125 VOLT, DC, 0.5 AMP INDUCTIVE LOAD OR 120 VOLT, AC, 5 AMP. (3)

2.5 SWITCH HOUSING SHALL BE NEMA TYPE 7.

(2)

2.7 MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

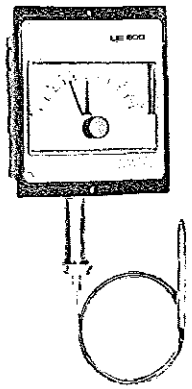
2.8 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

COLT OCT 17 1978 QA APP FM

11 908 554

ORIGINAL

11908554



800 SERIES ELECTRIC INDICATING TEMPERATURE CONTROLLERS AND THERMOMETERS

TYPES: 800, 800S, 800E*, T800, T800S, 802, 802S, 802P 802PS, 802PE*

INSTALLATION AND MAINTENANCE INSTRUCTIONS

IM-800
Rev. A

* Explosion-proof: Class I, Groups B, C, D, Class II, Groups E, F. & G and Class III

OPERATION

Temperature variations are sensed by the liquid-filled bulb which hydraulically transmits motion through a bellows to a rack-pinion mechanism which rotates the indicating pointer and actuates the precision snap-acting switches. Controller settings are made by turning the adjustment knobs causing the cams to reposition the precision snap switches in relation to the thermal sensing system.

Thermometer types T800 (with enclosure) and T800S (Skeleton) provide temperature indication only with no control switches.

PART I – INSTALLATION

1. Remove adjustment knobs and cover.

2. Knockout Electrical Entrance

   Two cast-in knockouts for ½" conduit are located in the sides of the enclosure. Either can be easily knocked out with a screwdriver by placing its blade in the groove and rapping its end sharply with a hammer.

3. Mount the Controller

   The controller may be mounted in any position to either a surface or panel (¼" thick maximum). Locate it where vibration, shock and ambient temperature fluctuations are minimum.

   Explosion-proof types must be mounted on a flat surface. See mounting diagrams, Fig. 1D.

   To Flush Mount: (not applicable to explosion-proof types).
   Cut out the panel as shown in Fig. 1A. Mount to the panel using the 2 holes located on the flange of the enclosure.

   To Panel Mount (Skeletons): Prepare the cutout, drilling the holes for the knob shaft and the mounting holes per Fig. 1C.

   To Surface Mount: Attach 2 mounting ears found in separate package to recessed areas on back side of enclosure by means of 2 self-tapping screws. Mount to surface per Fig. 1B. On dual switch explosion-proof types requiring seal fitting, install the nipple and the sealing fitting prior to surface mounting the controller.

4. Bulb and Capillary Mounting

   a. Fully immerse the bulb and 6" of capillary in the control zone. For best control it is generally desirable to place the bulb close to the heating or cooling source in order to sense temperature fluctuations quickly. Be sure to locate the bulb so it will not be exposed to temperatures beyond the instrument range limits.

   b. Place the remaining capillary adjacent to the control head so that it will sense the same ambient temperature.

   c. Factory calibration, unless specified otherwise, allows for 6" capillary tube in the control zone. If longer lengths are required recalibration may be necessary, in which case follow the procedures outlined in Part II.

   d. "C" style bulbs can be coiled or shaped to fit the installation. Avoid sharp bends and coils tighter than 2" radius. Do not bend "B" style bulbs.

   e. Avoid bending or coiling the capillary tube tighter than ½" radius. Exercise caution when making bends near the capillary ends.

   f. If a separable well or union connector is used follow separate instructions included.

5. Make Wiring Connections

   Caution: Live supply circuits should always be disconnected before wiring to controller.

   Enclosed units – Types 800, 802 and 802P:

   Connect the electrical conduit to the case securing it with a locknut.

   Wire through the knockout directly to the leadwires provided, color coded as follows:

	* Switch 1/Switch 2	
Common	Violet	Yellow
Normally Open	Blue	Orange
Normally Closed	Black	Red

   See Wiring Diagrams Fig. 2a and 2b.

   Skeleton Units – Types 8002, 802S and 802PS:

   Wire directly to the leadwires the same as above.

*In dual switch Types 802 and 802S the #1 switch set point may not be higher than that of the #2 switch.

In dual switch Types 802P and 802 PS the set point of the #1 switch may be either high or low with respect to that of the #2 switch.

In dual switch Type 802PE the #2 switch set point may not be higher than that of the #1 switch.

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Explosion-Proof Units – Types 800E and 802PE:

Connect the electrical conduit directly to the die-cast aluminum enclosure. Wire per the job requirements directly to the switch (single switch) or to the terminal block (dual switch). See Fig. 2c.

6. Switch Settings (Dual Switch Types Only)

The basic enclosed and skeleton dual switch controllers are furnished with a choice of individual or common adjustment of set points as described below:

Separate knob and pointer for each switch – Types 802 and 802S: Turn black knob for setting switch #2 and green-inserted knob for switch #1. Set points are shown by individual pointers and may be separated up to 100% of dial range apart (cannot cross over).

Single knob and pointer for both switches – Types 802P, 802PS and 802PE: Both switches are standardly factory set together within 5% of the adjustable range. The switches can also be set apart up to 50% of the dial range, and turning the knob positions both switch set points simultaneously, maintaining a constant separation between switches.

7. Replace Cover and Knob Adjustment

Controller is ready for operation. Turn setting pointer to desired control temperature and start up the process. To suit particular process conditions or for greater controller accuracy it may be desirable to make slight alterations to the set point or indicator reading. See Part II, paragraph 1 for instructions.

NOTE:

INDICATING POINTER DEFLECTION

The indicating pointer will read slightly low at bulb temperatures above the controller setting. This deflection is normal and repeatable (approximately .5% of scale range for single switch models) and is due to the transference of the switching mechanism load to the thermal system. It can be measured by moving the setting pointer from the high to the low end of the scale and observing the resultant indicating pointer deflection.

PART II – CONTROLLER'S CALIBRATION

(See General Layouts)

NOTE:

Prior to making any controller adjustments the cover and adjustment knobs should be removed. When adjustments are completed all applicable parts should be replaced.

1. In-Process Adjustments

1.1 Use an accurate test thermometer such as a thermocouple with its probe mounted directly to the center of the sensing bulb.

Before making any adjustments, allow process temperature to stabilize; i.e., successive on-off cycles repeat.

1.2 Compare mean process temperature with the mean temperature indicated by the instrument pointer.

Correct any difference by turning zero adjustment on thermal assembly. Turning in lowers indicated reading.

1.3 Compare mean process temperature with the adjustment pointer reading.

Correct any difference by loosening adjustment (A) and setting the adjustment pointer to the indicating pointer.

2. Adjusting Thermometer Types (T800, T800S)

2.1 Use the In-Process adjustments to check the control.

2.2 Differences between the test instrument and the thermometer can be corrected by turning the zero adjustment (Fig. 3) on the thermal assembly. Turning in lowers indicated reading.

3 Adjusting Single Switch Types (800, 800S, 800E)

3.1 Move the adjustment pointer up scale beyond the indicating pointer. This permits checking the set point by moving the lever arm upward with a finger or tool simulating thermal assembly movement.

3.2 Connect test lights to indicate switch operation or listen for the switch "click".

3.3 Loosen adjustment (A) until the adjustment pointer agrees with the indicating pointer (when the switch "clicks").

4. Adjusting Dual Switch Types (802P, 802PS)

4.1 If it is desired to adjust the set point of switch #1 below that of switch #2 turn the red set pointer up scale beyond the black indicating pointer by an amount greater than the desired difference between the switch settings. If it is not possible to do this because the black indicating pointer is registering too high a temperature then the thermal assembly sensing bulb temperature must be lowered in order to accomplish the adjustment.

To adjust the set point of switch #1 above that of switch #2 turn the red set pointer down scale till it agrees with the black indicating pointer. Both pointers must be below the upper scale limit by an amount greater than the desired difference between the switch settings.

The foregoing step enables the actuating lever to be moved by a finger or tool simulating thermal assembly movement.

4.2 Connect test lights to indicate switch operation or listen for the individual switch "clicks".

4.3 The set point of switch #1 may be adjusted by up to 50% of the range span above or below the #2 switch set point. Turn adjustment "B" clockwise to raise or

4.4 Check the results of any adjustments made by manipulating the actuating lever.

4.5 If it is necessary to align switch #2 to the red adjustment pointer loosen adjustment "A", set the adjustment pointer as required and tighten adjustment "A".

5. Adjusting Dual Switch Types

5.1 Connect test lights to indicate switch operation or listen for the individual switch "clicks"

5.2 The separation between switches is the difference between the high and low set points. The set points are determined by setting individual adjustment pointers and may be separated up to 100% of the scale range apart.

5.3 To align either switch to the adjustment pointer the corresponding adjustment A must be loosened and set the adjustment pointer to the indicator pointer.

NOTE:

Switch #1 cannot be set to operate at a higher setting than switch #2.

6. Adjusting Dual Switch Explosion-Proof Type

6.1 Remove the explosion-proof die-cast cover to permit access to the switches.

6.2 Move the adjustment pointer up scale beyond the indicating pointer by an amount greater than the desired difference between the switch settings. This permits checking the settings by moving the actuating lever upward with a finger or tool simulating thermal assembly movement.

6.3 Connect test lights to indicate switch operation or listen for the individual switch "clicks"

6.4 The set point of switch #1 is determined by the red adjustment pointer. The set point of switch #2 may be adjusted by up to 25% (optional 50% available) of the range span below the switch #1 set point by turning adjustment "D" in (right hand thread). See Fig. 4. The set point of switch #2 should not be above that of switch #1.

6.5 To align switch #1 to the adjustment pointer, loosen adjustment A and set the adjustment pointer to the scale.

7. Correction for Capillary Immersion

If the length of capillary immersed in the process differs from the amount immersed in the factory calibration bath, a calibration shift will occur. The error may be corrected as follows:

7.1 Move set pointer to highest temperature setting.

7.2 Note indicating scale reading with the head and sensor at room temperature.

7.3 Loosen the two thermal assembly mounting screws.

7.4 Reposition the housing index against the calibrations on the instrument case (or skeleton casting) at a rate of 1 division line per capillary length listed below. Move to the left if capillary is to be added to the process, or to the right if capillary is removed from the process.

Model No.	Range	Capillary Length/Division*
1	-180 to 120°F	2 Ft.
2	-125 to 350°F	1½ Ft.
3	-125 to 500°F	1 Ft.
4	- 40 to 120°F	4 Ft.
5	- 40 to 180°F	3 Ft.
6	0 to 250°F	2½ Ft.
7	0 to 400°F	2 Ft.
8	50 to 650°F	2 Ft.
M9	50 to 1000°F	2½ Ft.

*Added to or taken away from the process

7.5 Tighten the two thermal assembly mounting screws.

7.6 Note change in indicated scale reading (if any).

7.7 Turn zero adjustment C to bring indicating pointer reading back to the original reading noted in step 1. Turning in lowers indicated reading.

NOTE:

The thermal assembly can be returned to its original position by aligning its flange with the line scribed on the instrument case.

PART III – REPLACEMENT PARTS

(See Figs. 3 & 4)

Components most likely to require replacement are the thermal assembly and the switches. Replace as follows:

Thermal Assembly Replacement

1. Thermal assemblies are "pre-calibrated" at the factory and can easily be interchanged with the old one. Instructions are included with each replacement assembly.
   See Part II Para. 1 or 2 for zero adjustment.
2. Should the thermal assembly be removed temporarily for any reason, it should be replaced so that the edge of its flange corresponds with the line scribed on the instrument case.

Replacement of Switches

(The leadwire's configuration, though rather slack from the switch bank assembly to the wire clamp, is necessary for proper controller operation. This configuration should be duplicated when replacing a switch).

1. Turn the adjustment to the upper range limit. This will permit access to all (3) scale mounting screws.
2. Remove the scale and unscrew the screw holding pivot post mounting bracket. Be sure to save the (2) spacers under the bracket. (Dual switch types only).
3. Remove the tension spring from switch bank assembly.
4. The switch bank assembly can now be removed from the pivot post.

(Dual Switch Types)

   A. Disassemble switch #1 extension spring. This will permit access to whatever switch needs replacement.
   B. Insert new switches and leadwires on switch bank assemblies.
   C. Re-assemble switch #1 extension spring and re-install entire assembly onto pivot post.

(Single Switch Types)

   A. Remove the cover from the switch.
   B. Insert new switch and leadwires back into switch cover.
   C. Re-assemble switch assembly to pivot post.

5. Re-assemble switch bank assembly tension spring.
6. Install the (2) spacers and secure the pivot post mounting bracket.
7. Replace the scale, making sure that the scale mounting holes are properly fitted around the cast-in guides hidden by the screws.
8. Re-calibrate the set points following the procedures in Part II, paragraph 2 or 3 as applicable.

Replacement of Switches (Explosion-Proof Types)

(Single Switch Type)

1. Remove die-cast aluminum cover and disconnect (3) wires at switch terminals.
2. Remove (2) switch mounting screws, the switch and the insulator.
3. Install insulator with new switch and mount in control.
4. Connect wires at switch terminals and adjust temperature setting per Part II.

(Dual Switch Type)

1. Remove die-cast aluminum cover, unscrew and remove terminal block and insulator, letting terminal block hang.
2. Unscrew terminal block supports and remove (2) switch mounting screws, washers and wire guard.
3. Lift out dual switch bank and actuating lever assembly.
4. Disconnect (6) wires at switch terminals.
5. Assemble new switches and insulators to the switch bank assembly.
6. Connect wires at the switch terminals.
7. Install switch bank assembly, terminal block supports, insulators, wire guard and terminal block in controller.
8. Adjust temperature setting per Part II.

FIG. 1

FIG. 1A FLUSH MOUNTING

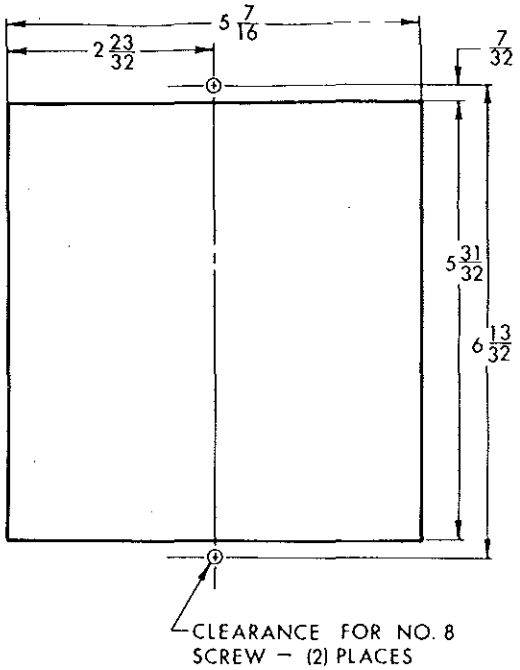


FIG. 1B SURFACE MOUNTING

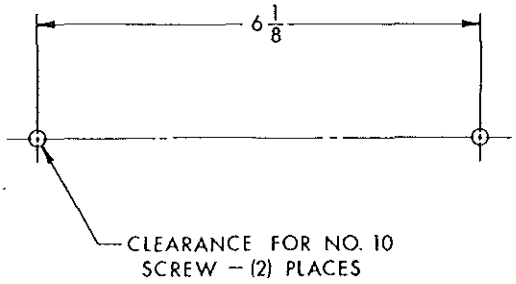
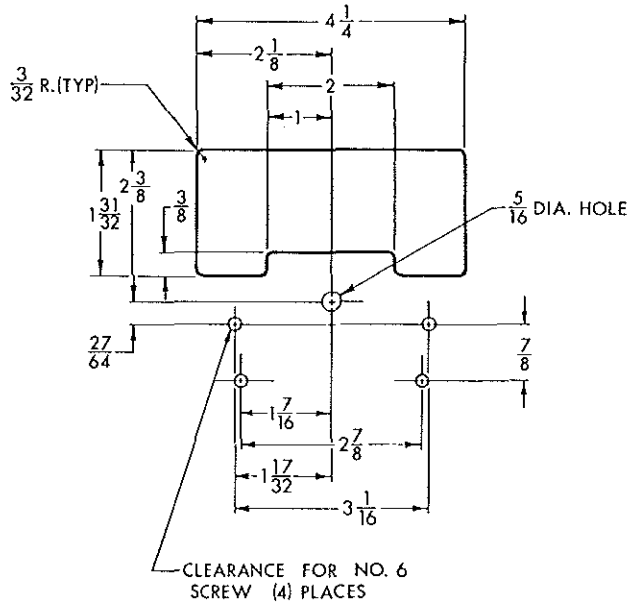


FIG. 1C PANEL MOUNTING (SKELETON)



(3/16 MAX. PANEL THICKNESS)

FIG. 1D EXPLOSION - PROOF MOUNTING

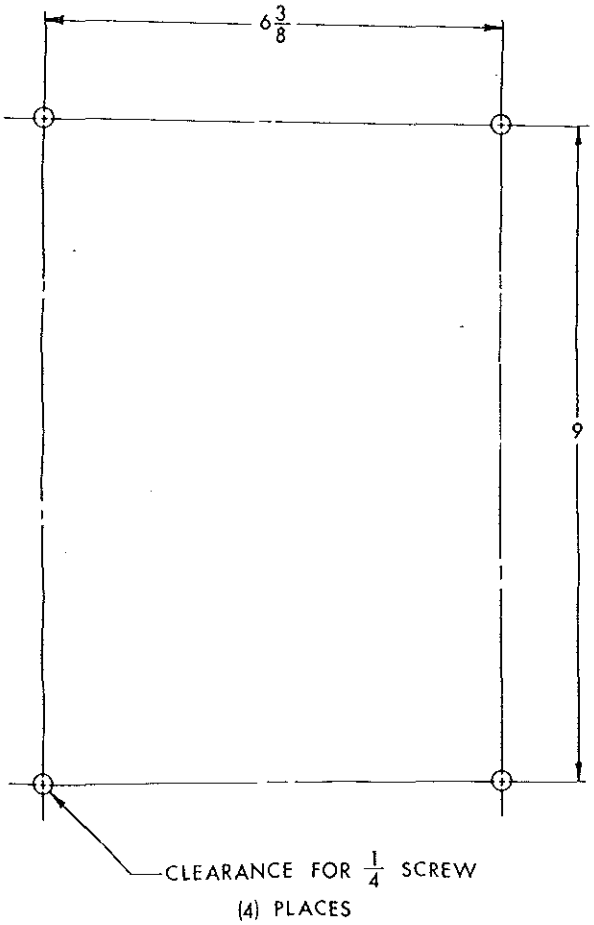


FIG. 2 WIRING DIAGRAMS

FIG 2A

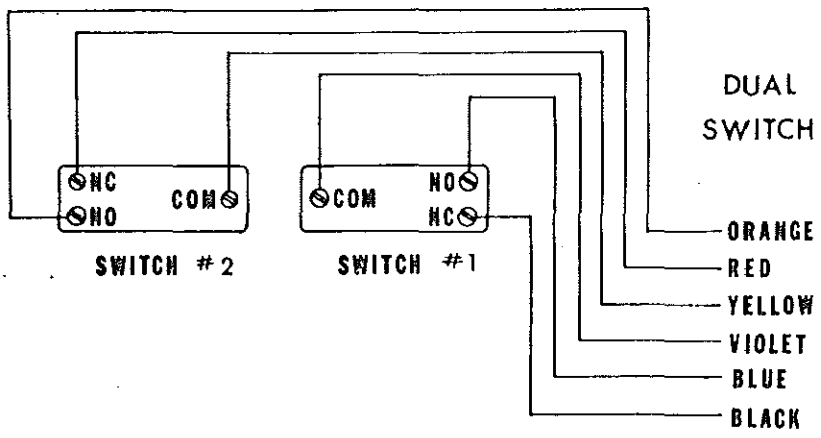
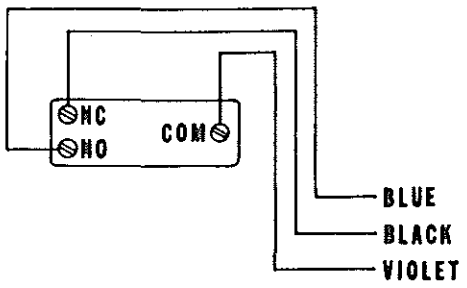


FIG 2B



SINGLE SWITCH

FIG 2C

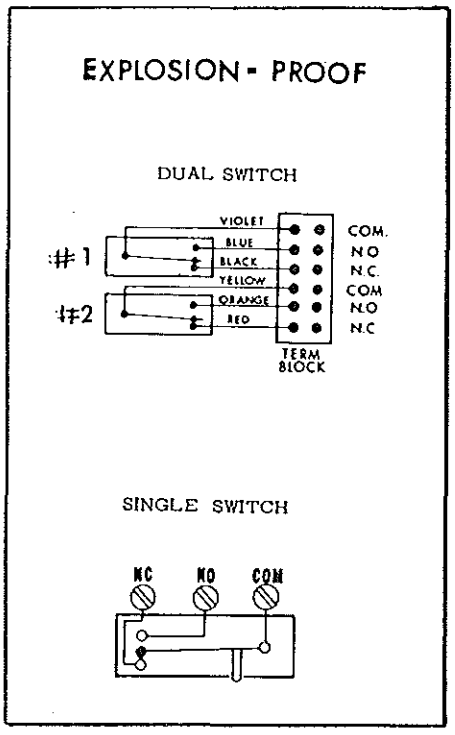
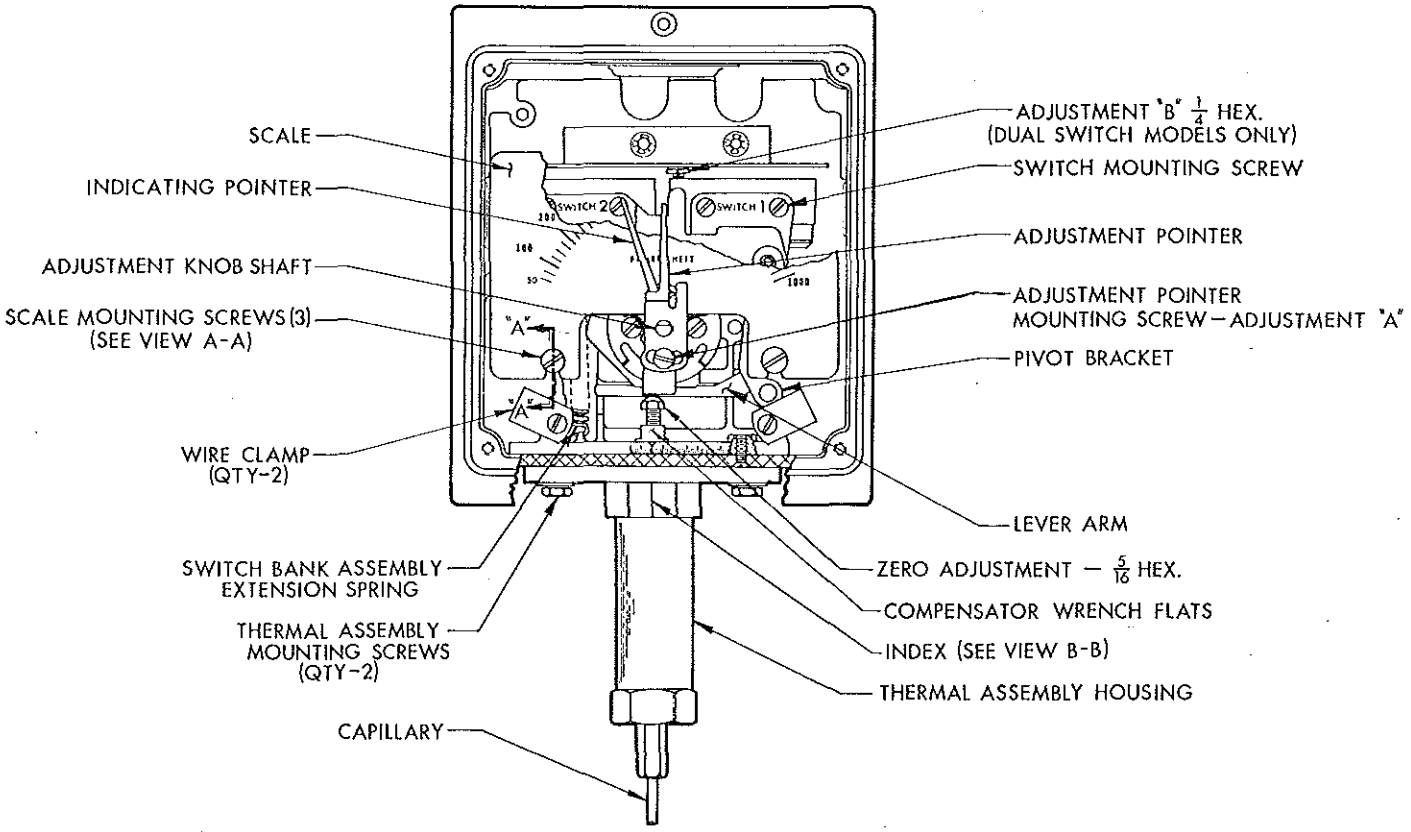
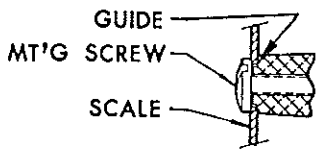


FIG. 3

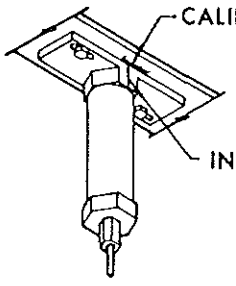
GENERAL LAYOUT (LEADWIRES OMITTED FOR CLARITY)

Dual switch version, Type 802P is shown below. In the single switch version Type 800 only one snap-acting switch is used. In the thermometer versions Types T800, and T800S the switch(es), adjustment knobs , pointer and associated parts are missing.





VIEW A—A
3 PLACES



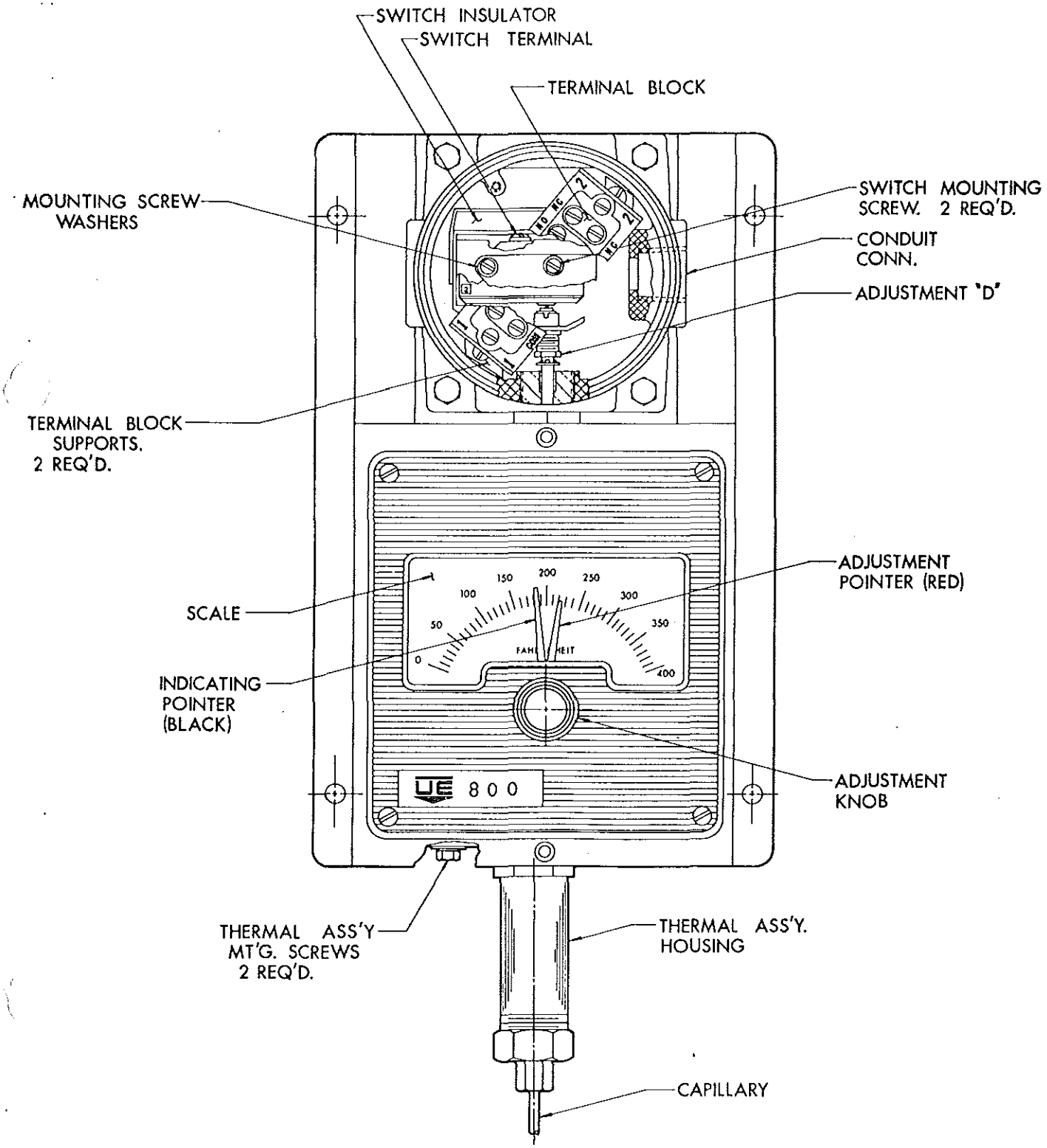
VIEW B—B

APPROX. WEIGHTS:

TYPE 800S	—	2 LBS. 7 1/2 OZ.
TYPE 802	—	3 LBS. 10 1/2 OZ.
TYPE 800E	—	8 LBS. 11 1/2 OZ.

FIG. 4 EXPLOSION-PROOF LAYOUT

Explosion-proof enclosure cover removed. Internal pointer adjustments in Figure 3 ame on explosion-proof types. Adjustment knobs and cover can be removed to permit access.

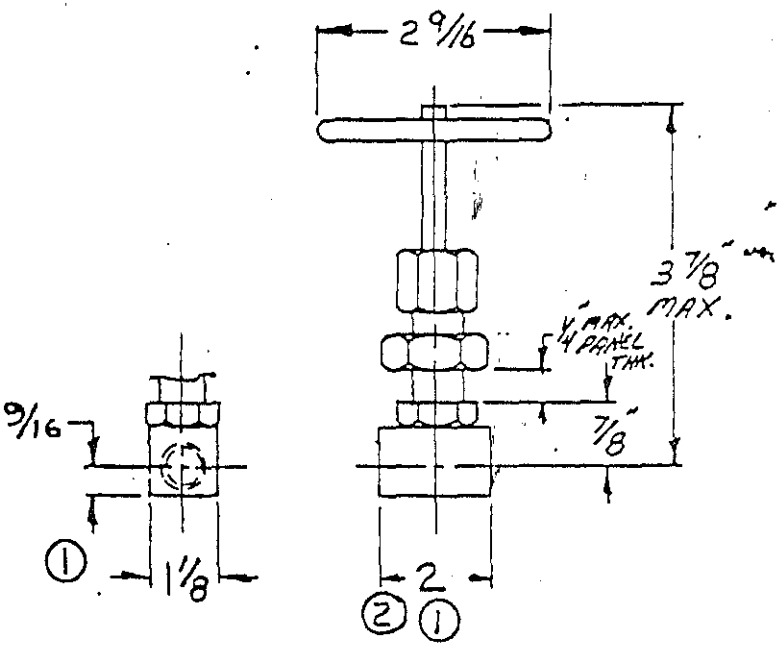


11 908 650

DESCRIPTION: INSTRUMENT SHUT-OFF VALVE

VENDOR NO: 6701053D (3)

VENDOR: DRAGON VALVES, INC.
13457 EXCELSIOR DR.
NORWALK, CAL. 90650



APPROVED Rev. 3 AUG 18 1977 QUALITY CONTROL

APPROVED Rev. 2 APR 21 1977 QUALITY CONTROL

APPROVED Rev. 1 APR 6 1977 QUALITY CONTROL

APPROVED Rev. 0 MAR 16 1977 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS (5)	
3	10437	8-30 77	SEE SH. 2 (4)	
2	10289	4-27 77	ADDED SEAT TYPE "D" (3)	
1	"	"	REVISED DIM WAS 1/8 (2)	
—	10276	4-15 77	DIM'S ADDED (1)	

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16/77	ASSY. OR LO.	
DR. BY HERTENSTEIN	2/23/77	SCALE	NL
CHK'D. BY R. NORMAN	3/1/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. R.O.Y.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 1 OF 4

I. GENERAL REQUIREMENTS:

A. CONNECTIONS: 1/4" NPT (F)
B. ORIFICE: .180" FULL OPEN (4)
C. MEDIA:

1. FUEL OIL (#2 DIESEL) AT 50 PSIG MEAN W/PULSATIONS TO 200 PSIG & 150°F.
2. COMPRESSED AIR @ 250 PSIG & 130°F.
3. LUBE OIL SERVICE @ 100 PSIG & 200°F.
4. WATER SERVICE @ 50 PSIG & 180°F.

D. FUNCTION: SHUT-OFF.

II. ASME SECTION III REQUIREMENTS:

A. "THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".

B. ASME COMPONENTS QUALITY ASSURANCE REQUIREMENTS DWG. 11 908 456 APPLIES TO THIS ORDER.

C. THE PRESSURE RETAINING AREA DESIGN SHALL CONFORM TO ND-3511.

APPROVED Rev. 3 QUALITY CONTROL
APPROVED Rev. 2 APR 1977 QUALITY CONTROL
APPROVED Rev. 1 QUALITY CONTROL
APPROVED Rev. 0 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	ORIFICE WAS (4) .214	A.P.
2	10289	4-27 77	SEE SH. 1	BHH
1	10276	4-15 77	SEE SH. 1	EHH A.P.

TITLE: VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.0 ± .060 0.00 ± .030 0.000 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16/77	ASSY. OR LO.	
DR. BY R. NORMAN	3/2/77	SCALE	
CHK'D. BY H.P.S.	3/2/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. R.D.M.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 2 OF 4

JUL 31 1978 APP

BF3009-2

II. ASME SECTION III REQUIREMENTS - CONT'D

D. STANDARD PRESSURE CLASS: ANSI 900 LB

E. DESIGN TEMPERATURE: 200°F MAX.

F. DESIGN ALLOWABLE STRESS VALUES: PER ND-3112.4 AND ND-3511. ATTACHED PIPE IS 1/4 SCHED. 80 OR 3/8 TUBE.

G. BOUNDRIES: PER NA-3254.1

H. MATERIALS:

1. MATERIALS SHALL BE NEW, SUITABLE FORTHE APPLICATION AND IN ACCORDANCE WITH ND-2120. BONNET, PACKING GLAND AND PACKING NUT SHALL BE SA-479 TYPE 316 STAINLESS STEEL. STEM AND DISC SHALL BE SA-564 GRADE 630 HIGH ALLOY P.H. STEEL. BODY SHALL BE SA-182 GRADE F-316.
2. IMPACT TESTING NOT REQUIRED.
3. MATERIALS SHALL BE CERTIFIED PER ND-2130 OF ASME SECTION III. CERTIFIED MATERIALS TEST REPORTS AND/OR MATERIAL MFGS. CERTIFICATES OF COMPLIANCE (AS APPLICABLE) SHALL BE FURNISHED TO COLT INDUSTRIES PURCHASING DEPARTMENT.

APPROVED Rev. 3 JUL 5 1977 QUALITY CONTROL

APPROVED Rev. 2 APR 21 1977 QUALITY CONTROL

APPROVED Rev. 1 QUALITY CONTROL

APPROVED Rev. C QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	SEE SHT 2	RAN
2	10289	4-27 77	SEE SH.1	RAN
1	10276	4-15 77	SEE SH. 1	RHH

TITLE
VALVE,
INSTRUMENT - 1/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16 77	ASSY. OR LO.
DR. BY R. NORMAN	3/2 77	SCALE
CHK'D. BY H.R.S.	3/2 77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. R.D.M.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 3 OF 4

JUL 31 1978 QA APP

BF3007-2

II. ASME SECTION III REQUIREMENTS - CONT'D

I. VENDOR TO FURNISH COPY OF DATA REPORT NPV-1 TO COLT INDUSTRIES PURCHASING DEPARTMENT.

J. CERTIFIED DESIGN SPECIFICATIONS AUTHORIZING CLASSIFICATION AND SPECIFYING DESIGN OF THIS COMPONENT ARE COLT DWG. NOS. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM", 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM", 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM".

III. SPECIAL REQUIREMENTS:

A. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBTED.

IV. COLT INDUSTRIES DUTIES:

A. PURCHASING, RECEIVING, INSPECTION, STORING, & DISBURSEMENT SHALL COMPLY WITH SECTION QC-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY CONTROL MANUAL.

B. PURCHASING DEPT. SHALL FORWARD THE FOLLOWING DOCUMENTS TO THE VENDOR AS PART OF THE ORDER:

1. COLT DWG. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM" REV. 1 (E) (S)
2. COLT DWG. 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM" REV. 1 (S)
3. COLT DWG. 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM" REV. 1 (S)
4. COLT DWG. 11 908 456 COLT/FMED Q.A. REQUIREMENTS ON VENDOR. REV. 4 (S)

APPROVED Rev. 3 AUG 5 1977 HRN QUALITY CONTROL
APPROVED Rev. 2 APR 21 1977 HRN QUALITY CONTROL
APPROVED Rev. 1 APR 6 1977 HRN QUALITY CONTROL
APPROVED Rev. 0 MAR 31 1977 HRN QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	MLS
3	10437	8-30 77	SEE SH. 2	H.R.S.
2	10289	4-27 77	SEE SH. 1	RHN
1	10276	4-15 77	SEE SH. 1	RHN

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

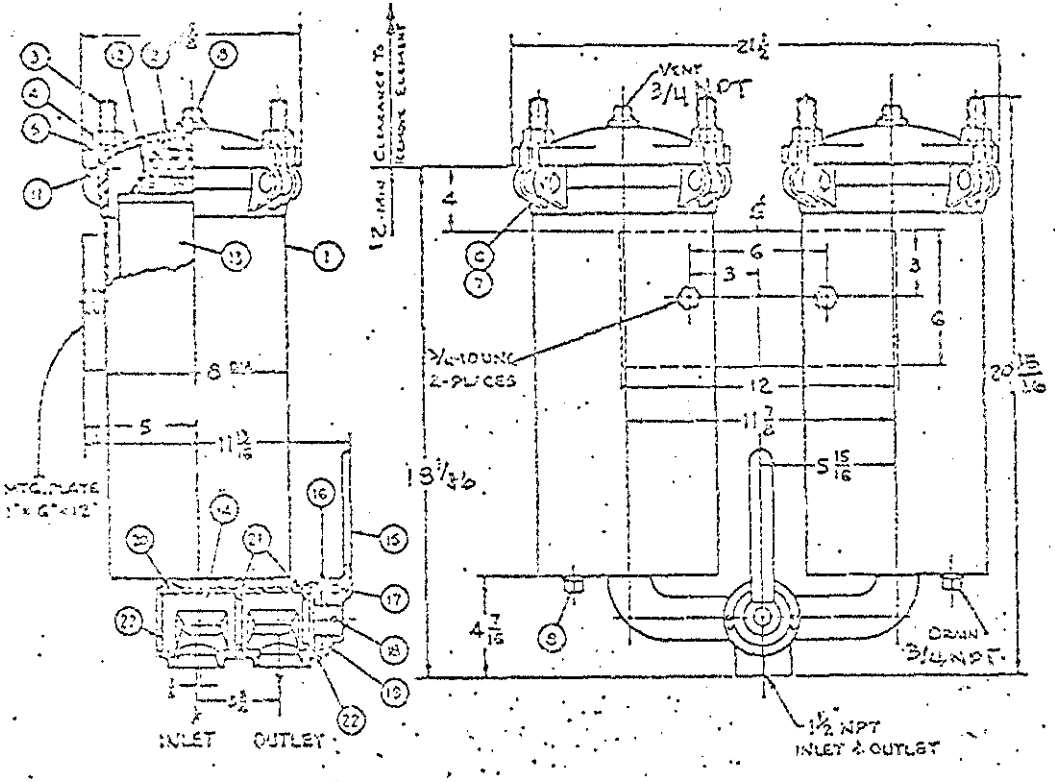
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16 77	ASSY. OR LO.
DR. BY R. NORMAN	3/2 77	SCALE
CHK'D. BY H. R. S.	3/2 77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. R.O.Y.M.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 4 OF 4

QA APP JUL 31 1978 FMI



VENDOR PART NO: 11-424-201

VENDOR: WM. W. NUGENT CO.
SKOKIE, ILLINOIS

APPROVED
Rev. 0
MAR 10 1977
QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
STRAINER,
F. O. DUPLEX

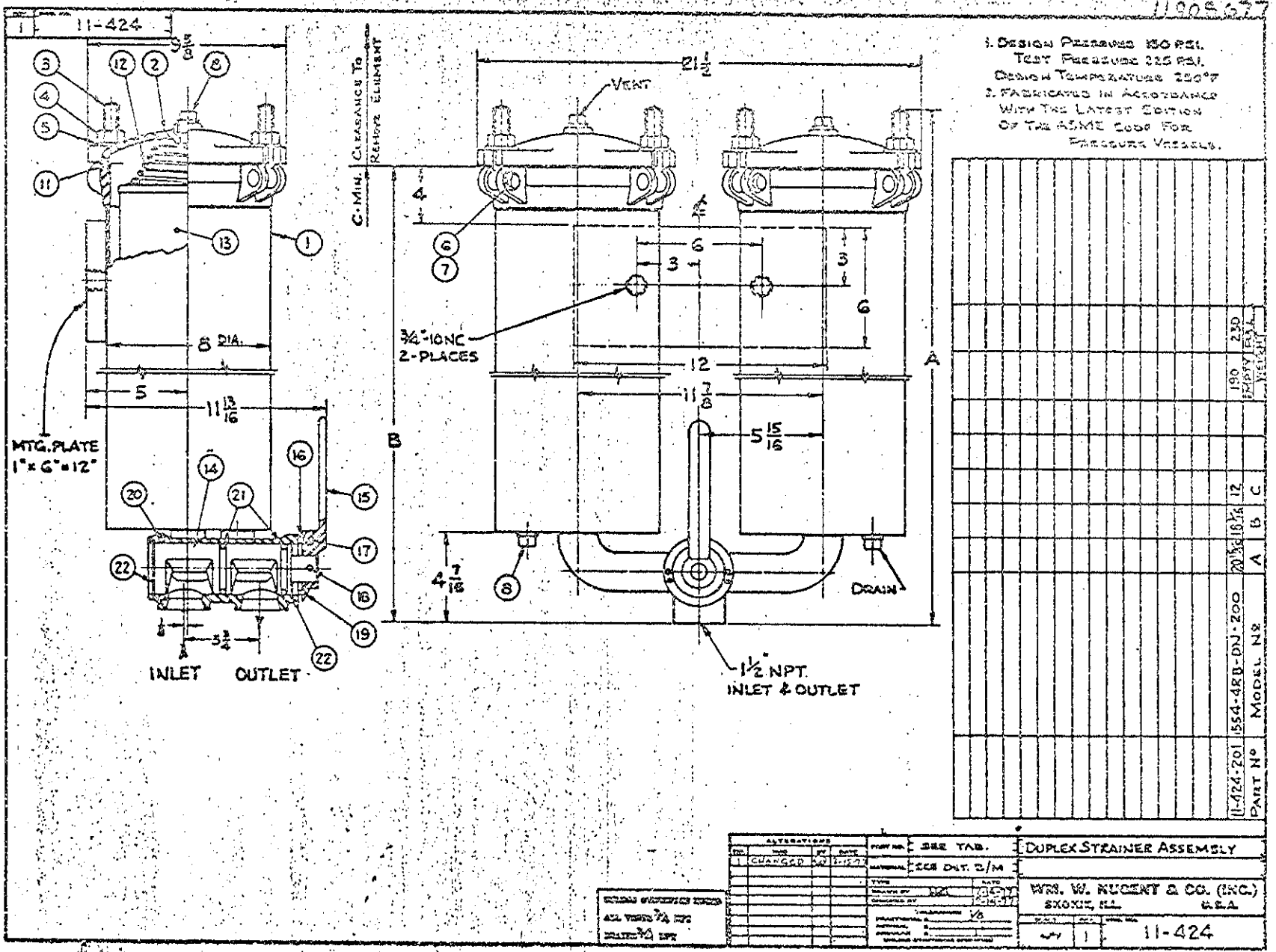
YOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± 010

Colt Industries — Fairbanks Morse Engine Division

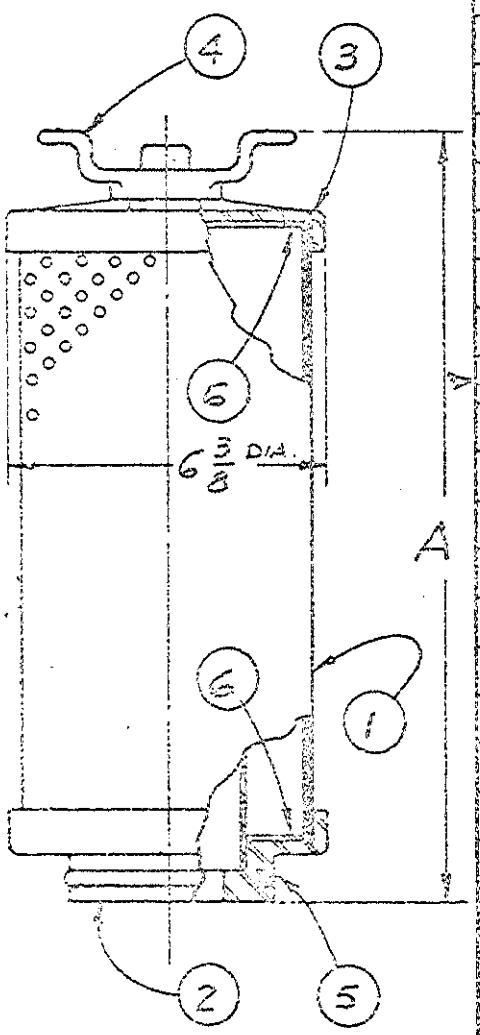
REL. NO. 10236	3/16/77	ASSY. OR LO.
DR. BY R. NORMAN	3/2 77	SCALE —
CHK'D. BY H. R. S.	3/9 77	HEAT TR.
MAT'L		

APPV.	CAST.	MAT'L.
	MACH.	ENGR. R. Norman
	WELD.	

SHEET SIZE A | DWG. NO. 11 908 677 | SHEET 1 OF 2


11-424
C. MIN. CLEARANCE TO REMOVE ELEMENT
VENT
DRAIN
MTG. PLATE 1" x 6" x 12"
3/4"-10 NC 2-PLACES
INLET
OUTLET
1 1/2" NPT. INLET & OUTLET
A
B
1. DESIGN PRESSURE 150 PSI. TEST PRESSURE 225 PSI. DESIGN TEMPERATURE 250°F
2. FABRICATED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASME CODE FOR PRESSURE VESSELS.
11-424-201 | 1554-4RB-DU-200 | MODEL NO | A | B | C | 12 | 190 | 230
PART NO | EMPTY WEIGHT | FULL WEIGHT
DUPLEX STRAINER ASSEMBLY
WM. W. NUGENT & CO. (INC.)
SIOUX, ILL. U.S.A.
11-424

DWG. NO. 30-055 | REV. 30



DASH Nº	MODEL	A	ITEM 1 STR. CY	ITEM 2 SPOOL	ITEM 3 COVER	ITEM 4 WING NUT	ITEM 5 O-RING	ITEM 6 SKET
~~200~~	~~4L-2140~~	~~31 13/16~~	~~30-300-201~~	~~30-004-203~~	30-058-001	30-053-001	01-061-011	~~01-047-004~~
202	4L-100	31 13/16	202	203				
203	4L-200	31 13/16	203	203				
204	1-2140	20 5/16	204	202				
205	1-100	20 5/16	205	202				
206	1-200	20 5/16	206	202				
207	4R-2140	11 1/4	207	201				
~~208~~	~~4R-100~~	~~11 1/4~~	~~208~~	~~204~~				
209	4R-200	11 1/4	209	201				
~~210~~	~~4L-150~~	~~31 13/16~~	~~210~~	~~203~~				
211	1-150	20 5/16	211	202				
212	4R-150	11 1/4	30-300-212	201				
213	DISCONTINUED			203				
214	DISCONTINUED			202				
215	DISCONTINUED			201				
216	4R-15MID	11 1/4	30-300-216	201	30-058-001	30-053-001		
217	4L-8 CAP. PL.	31 13/16	30-299-201	206	003	003		
218	4L-2140G	31 13/16	30-209-201	203	30-058-001	30-053-001		
219	1-2140G	20 5/16	202	202	001	001		
220	DISCONTINUED		203	203	001	001		
221	DISCONTINUED		204	202	001	001		
~~222~~	~~4L-140G~~	~~31 13/16~~	~~30-209-205~~	~~30-004-203~~	~~30-058-001~~	~~30-053-001~~	~~01-061-011~~	~~01-047-004~~

ALTERATIONS			
NO.	WAS	BY	DATE

PART NO. SEE TAB.

MATERIAL SEE TAB.

TYPE	DATE
DRAWN BY	5-12-70
CHECKED BY	5-12-70

TOLERANCES 1/8

FRACTIONAL ±

DECIMAL ±

ANGULAR ±

UNLESS OTHERWISE SPECIFIED

ELEMENT, STRAINER

WM. W. NUGENT & CO. (INC.)
SKOKIE, ILL. U.S.A.

SCALE	REV.	DRG. NO.
4/7	30	30-055

11008.177

LIST OF MATERIAL

3-[illegible]-77

ASSEMBLY 11-424-201 DUPLEX STRAINER 1554-4RB-DN-200 150#

ITEM NO.	DESCRIPTION	ROUGH NUMBER	FINISH NUMBER	QUAN.	MATERIAL	COST OR PRODUCTION
1.	SHELL ASSEMBLY.		21-175-201	1	.	
2.	COVER		35-001-001	2	SA395	
3.	EYE BOLT		30-023-003	8	SA325	
4.	NUT, HVY. HEX.		01-043-003	8	SA194-2H	
5.	WASHER		01-040-012	8	AISI-1010	
6.	RIVET		01-060-004	8	SA31-B	
7.	RETAINING RING		01-058-001	8	SAE-1075	
8.	PLUG, SQ. HD. 3/4 NPT		01-021-018	4	SA181-1	
9.	NAME PLATE		01-100-001	1	.	
10.	DECAL		01-091-002	1	.	
11.	O-RING		01-061-026	2	BUNA-N	
12.	SPRING		30-052-001	2	.	
13.	STRAINER ELEMENT		30-055-209	2	.	x
14.	DISTRIBUTOR PLUG		35-008-001	1	SA395	x
15.	HANDLE		35-010-001	1	SA395	x
16.	BALL		01-109-001	1	.	
17.	SPRING		35-011-001	1	.	
18.	ROLL PIN		01-065-005	1	.	
19.	ROLL PIN		01-065-002	2	.	
20.	O-RING		01-061-004	1	BUNA-N	
21.	O-RING		01-061-008	2	BUNA-N	
22.	RETAINING RING		01-057-004	2	SAE-1075	

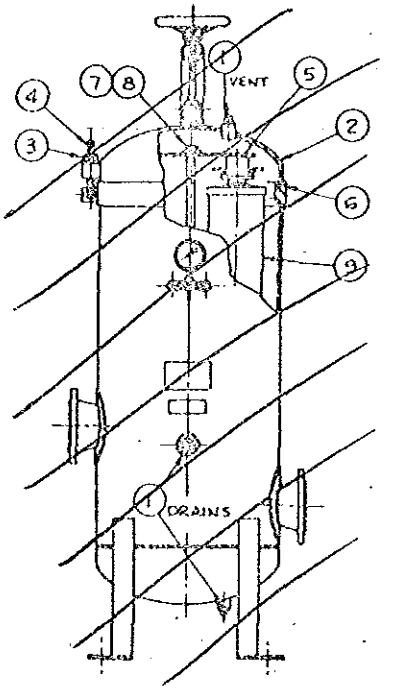
11800-77

1190677

STRAINER BASKET ASSEMBLY CLEANING OR REPLACEMENT SERIES 1554

When the differential pressure reaches 20 psi, the strainer basket assembly shall be removed and cleaned or replaced with genuine Nugent strainer screen cylinders. For replacement, refer to parts list or name plate for part number of strainer screen cylinder.

1. Drain completely by removing the ¾" NPT plug(s), located on the side or bottom of the strainer shell. During draining open vent (1), loosen nuts (3), and swing bolts (4) clear of cover lugs. Remove cover (2), ~~by lifting to clear positioning tabs located on shell ring.~~ DO NOT LAY COVER ON THE "O" RING SEALING SURFACE.
2. On single strainer basket assemblies, remove spring (10). ~~On multiple strainer basket assemblies, remove nut(s), washer(s) (7), and (8), and pressure plate (5).~~



CAUTION

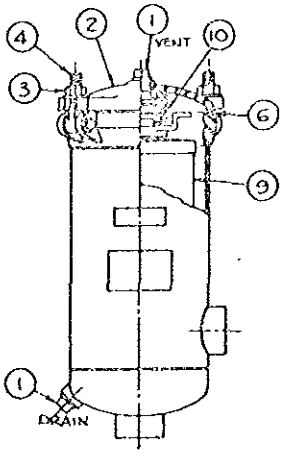
BEFORE REMOVING STRAINER BASKET ASSEMBLY(IES), CHECK TO MAKE SURE THAT THE LIQUID HAS BEEN COMPLETELY DRAINED.

3. Remove strainer basket assembly (9) by grasping wing nut and pulling straight up. A slight side to side motion may be required to break the adhesion between the "O" ring and strainer basket assembly seat. Inspect interior of vessel for dirt and damage, paying particular attention to the chamfered edge and inside diameter of the strainer basket assembly seat.

CAUTION

ON THE SERIES 1554 STRAINER THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

4. Disassemble strainer basket assembly by removing wing nut (14) and cover (13). Grasp strainer screen cylinder (11) and lift from spool (12).
5. Immerse strainer screen cylinder into a container of an alkaline detergent and/or an organic solvent. Agitation of the cleaning solution or the strainer cylinder will aid in the removal of surface contamination.
6. Reverse flush the strainer screen cylinder from the outside-in using the solution(s) mentioned above. The solution should be as clean as possible prior to and during the outside-in flush, in order to preclude the introduction of additional surface contamination. Compressed air may also be used to assist in removal of accumulated dirt.

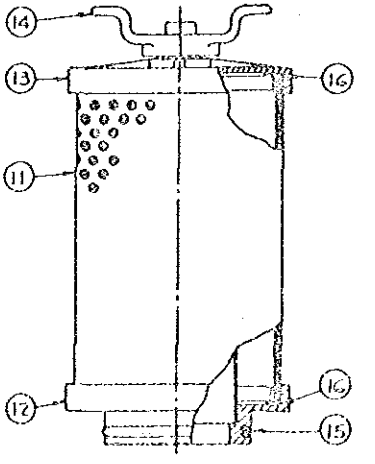


CAUTION

WHEN REVERSE FLUSHING THE STRAINER SCREEN CYLINDER UNDER PRESSURE (CLEANING SOLUTION OR AIR,) SPECIAL CARE SHOULD BE EXERCISED TO AVOID COLLAPSE OF THE FILTER CLOTH.

During reverse flushing, it is recommended that a cylinder be placed inside the strainer screen cylinder so as not to impinge the loosened dirt on the opposite side.

7. Inspect the gaskets (16) and, if satisfactory, assemble the strainer basket assembly by placing the strainer screen cylinder on the spool. Place the cover on top of the strainer screen cylinder and secure with wing nut.
8. Inspect "O" ring (15) for cuts, nicks, dirt, etc., and apply a film of lubricant. Lower strainer basket assembly onto the seat. DO NOT TIP OR ROTATE AFTER "O" RING CONTACTS SEAT.
9. Replace spring (10) on single strainer basket assemblies. ~~On multiple strainer basket assemblies replace pressure plate (5), washers and nuts. Torque to 50-60 lb.ft.~~ Inspect "O" ring (6) and replace pressure cover by lowering it onto the "O" ring. Align lugs before cover contacts "O" ring. DO NOT ROTATE COVER TO OBTAIN ALIGNMENT AFTER IT HAS CONTACTED "O" RING. Torque nuts to 70-80 lb.-ft.
10. Close drain(s) and fill vessel with fluid. In order to assure complete filling of vessel, release trapped air through vent located on cover. Check for leaks. After strainer has attained operating temperature, check the differential pressure. It should be less than 5 psi.



WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, ILL. 60076, U.S.A.
Telephone: 312/674-7782 TELEX: 724-312
EST. 1877 WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

11908677

INSTRUCTIONS FOR INSTALLING AND OPERATING NUGENT STRAINERS ~~AND FILTERS~~

GENERAL DATA

~~Filters may be furnished with or without internal bypass relief valves. If so equipped, they are preset at the factory to open at the maximum recommended element differential pressure. The valve(s) IS(ARE) NOT field adjustable.~~

Strainers cannot be equipped with internal bypass relief valves.

~~For lubricating oil filters not equipped with internal bypass relief valves, Nugent recommends the installation of a Model 1591 Dumping Valve to protect the element(s) from abnormal differential pressure.~~

If ~~filter or~~ strainer is not equipped with a gauge for determining differential pressure, it is recommended that gauges be installed in the inlet and outlet piping.

INSTALLATION INSTRUCTIONS

1. Locate unit so that there is adequate space for element removal. Refer to outline drawing for height needed.
2. Inspect piping leading to and from unit for scale, dirt, etc. and, if necessary, clean piping.
3. Remove protective covers from inlet and outlet piping and connect the filter or strainer. (Connections are clearly marked with pressure sensitive decals indicating the inlet and outlet connections, or refer to the outline drawing.)

CAUTION

DURING INSTALLATION, USE CARE SO AS NOT TO INTRODUCE DIRT INTO THE SYSTEM.

4. Remove cover and clean inside thoroughly. Inspect the element(s) for damage that may have occurred during shipment. Inspect cover gasket and gasket surface on cover. Replace cover. Torque head bolts to 70-80 lb.-ft. on sizes 1, 4L, and larger. ~~On the smaller sizes 0, 1R, 1S, torque to 15-20 lb.-ft.~~

CAUTION

ON ~~1116, 1576 AND~~ 1554 SERIES, THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL SINCE FLOW IS FROM THE INSIDE-OUT. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

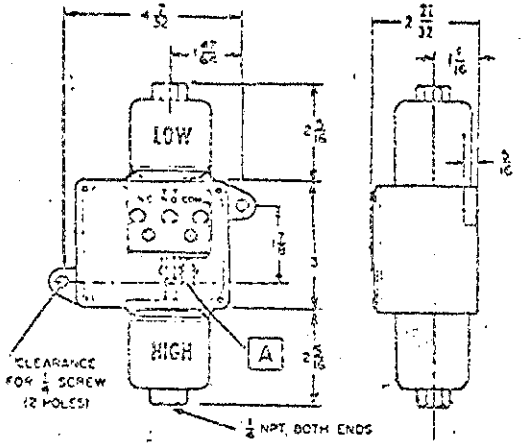
OPERATING INSTRUCTIONS

1. After ~~filter or~~ strainer has attained operating temperature, check the differential pressure across it. ~~On filters or strainers so equipped, this may be done with the three-way valve located underneath the pressure gauge. Turn the valve handle to upstream (inlet) side and read the pressure; turn the valve handle to downstream (outlet) side and read the pressure. The difference in pressure readings is the differential pressure across the element(s). Always return the valve to the "off" (center) position.~~
2. It is recommended that the differential pressure be checked daily, as it indicates the amount of contaminant build-up within the element(s). When this differential pressure reaches approximately 20 psi at normal operating temperature, the element(s) shall be removed and replaced with genuine Nugent element(s) ~~for series 1577, 1555 and 1576 filters.~~ Element(s) should be removed and replaced only after first referring to Nugent Co. element replacement instructions. The strainer screen cylinder shall be cleaned for series 1554 ~~and 1700 strainers or clean bags installed in series 1116 filters.~~ Strainer cylinders should be cleaned and ~~new filter bags~~ should be installed only after first referring to Nugent Co. cylinder cleaning and ~~bag~~ installation procedures.

EST. 1897 WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, ILL. 60076, U.S.A.
Telephone: 312/674-7782 TELEX: 724-312
WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

DESCRIPTION: UNITED ELECTRIC DIFFERENTIAL PRESSURE SWITCH WITH THE FOLLOWING FEATURES:

1. WITH NEMA TYPE 4 HOUSING
2. ON-OFF DIFFERENTIAL - 2-6 OZ. NOT ADJUSTABLE
3. DIFFERENTIAL PRESSURE RANGE - 0-6 PSI ADJUSTABLE
4. DIFFERENTIAL PROOF PRESSURE - 6 PSI
5. WORKING PRESSURE - 30" HG VAC TO 30 PSI
6. SPDT SWITCH RATING 0.5 AMPS INDUCTIVE LOAD @ 125 VDC.



VENDOR'S MODEL NUMBER: J21K-140

VENDOR: DURABLE CONTROLS
HARTLAND, WISCONSIN

ADJUSTMENT:
TURN HEAD SCREW [A] IN (R.H. THREAD) TO DECREASE SYSTEM DIFFERENTIAL PRESSURE SETTING.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

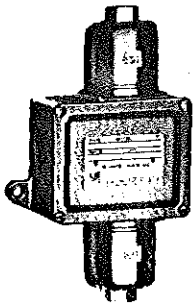
TITLE
SWITCH, PRESSURE DIFFERENTIAL 0-6 PSID

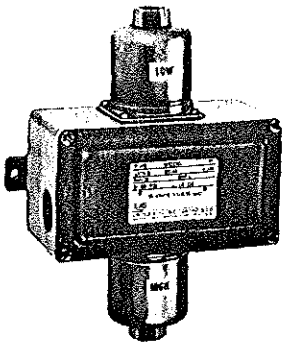
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10282	4/21/77	ASSY. OR LO.	
DR. BY H. STAUFFER	3/28/77	SCALE	
CHK'D. BY R. NORMAN	4/6/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENG.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 695 | SHEET OF





J21K

DIFFERENTIAL PRESSURE CONTROLS

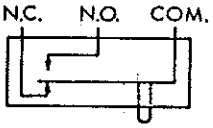
SPEC J21K/J27KB

REV. 1

SWITCH: Standardly 15 amp 125/250 VAC, Resistive

RECOMMENDED REPLACEMENT PART: The snap-action switch. To order specify "Switch Part No. 6259-223 for Type J21K and Switch Part No. 6259-223 & 233 for Type J27KB."

WIRING:



STOCK NO.		MODEL NO.	RANGE	ON-OFF DIFF'L.	PROOF PRESSURE	WORKING PRESSURE RANGE
J21K	J27KB					
		BRASS BELLOWS SENSOR (P/C BRASS, ¼ NPT FEM)				
		127	0 to 30" HG VACD	.4 to .6" HG	15 PSID	30 - 0" Hg Vac
9532	9537	140	0 to 6 PSID	.1 to .4 PSID	6 PSID	30" Hg Vac - 30 PSI
9538	9544	150	0 to 40 PSID	.3 to .7 PSID	40 PSID	30" Hg Vac - 180 PSI
		316L ST. ST. BELLOWS SENSOR (P/C 316L ST. ST., ¼ NPT FEM)				
		S127A	0 to 30" HG VACD	.4 to .6" HG	15 PSID	30 - 0" Hg Vac
9512		S140A	0 to 6 PSID	.1 to .4 PSID	6 PSID	30" Hg Vac - 30 PSI
		S150A	0 to 40 PSID	.3 to .7 PSID	40 PSID	30" Hg Vac - 180 PSI
		316L ST. ST. BELLOWS SENSOR (P/C 316L ST. ST., ⅛ NPT FEM)				
		S127B	0 to 30" HG VACD	.4 to .6" HG	15 PSID	30 - 0" Hg Vac
		S140B	0 to 6 PSID	.1 to .4 PSID	6 PSID	30" Hg Vac - 30 PSI
9519		S150B	0 To 40 PSID	.3 to .7 PSID	40 PSID	30" Hg Vac - 180 PSI
		PHOSPHOR BRONZE BELLOWS SENSOR (P/C BRASS, ¼ NPT F)				
9559		232	0 to 25 PSID	.6 to 1 PSID	25 PSID	30" Hg Vac - 110 PSI
9545	9558	254	0 to 90 PSID	2 to 4 PSID	90 PSID	30" Hg Vac - 200 PSI
		347 ST. ST. BELLOWS SENSOR (P/C 347 ST. ST.)				
9504		357	0 to 70 PSID	2 to 4 PSID	70 PSID	30" Hg Vac - 350 PSI

NOTES

ON-OFF DIFFERENTIAL: The difference between the actuation point and de-actuation point of the switch contact element.

DIFFERENTIAL PRESSURE RANGE . . . The limits of the difference between the two sensed pressures within which the snap switch may be adjusted to actuate and de-actuate.

DIFFERENTIAL PROOF PRESSURE . . . The maximum difference between the two sensed pressures to which the control may be exposed without harmful effect to performance (set point repeatability, etc.)

WORKING PRESSURE RANGE . . . The pressure limits to which each sensor can safely be exposed as long as Differential Proof Pressure is not exceeded.

MATERIALS

J21K - Enclosure - Die cast Aluminum, grey hammertone finish. Bellows Housing - Model 357 Aluminum, anodized. All other models, brass, nickel plated. Standard Housing modified to NEMA 4 requirements.

J27KB - Same as above.

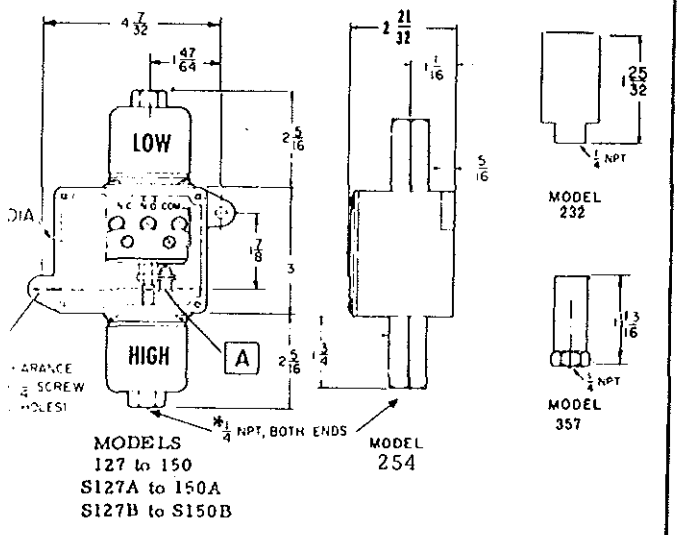
APPROXIMATE WEIGHT: J21K - 2 lbs. 7 oz.; **J27KB** - 2 lbs.

WHEN ORDERING CONTROLS: Order by "Type J21K (or J27KB) Stock No. _____." Stock numbers cover exact specifications above. If no Stock Number or if your requirements deviate from above chart specifications (e.g. 20 amp rating, special features, etc.) order by "Type J21K (or J27KB) Catalog Model _____" and indicate complete specifications.

OPTIONS: Many options permit "custom designing" of the J21K to fit individual needs, e.g. Switches (extra wide adjustable differential, 20 amp, manual reset, hi-ambient, adjustable switch differentials . . .); watertight construction (NEMA #4, cover gasket and watertight conduit fitting); special mountings, setting, etc. . . . consult UE.

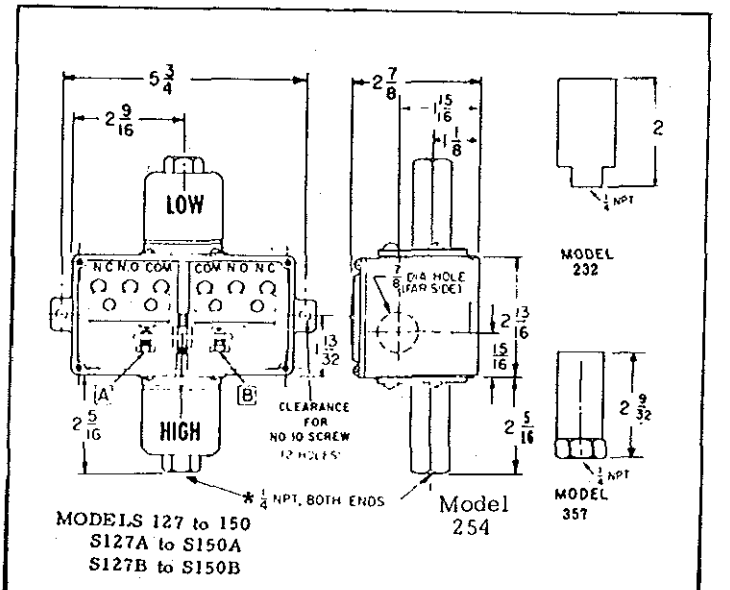
4/15/77

J21K



*Models S127B-S150B only, 1/2 NPT

J27KB



*Models S127B-S150B only, 1/2 NPT

'STMENT:

- Turn head screw [A] in (R.H. Thread) to decrease system differential pressure setting.

.B - Turn adjustment screws [A] or [B] in (R.H. Thread) to decrease system differential pressure settings. Switches may be set to operate together or apart as much as 50% of range span.

'ALLATION:

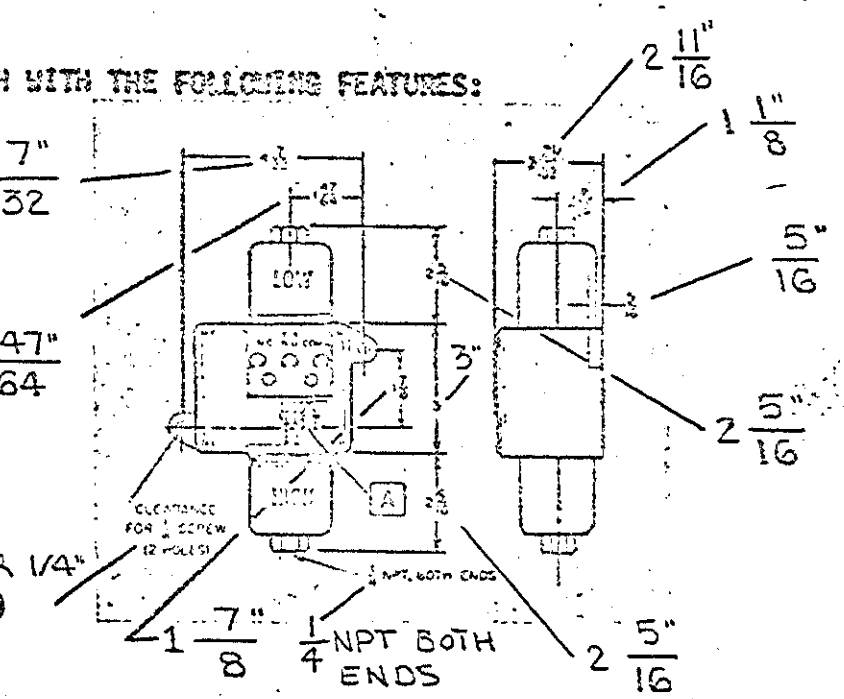
. - Surface mount in any position via two mounting ears. (CAUTION: Never turn this unit by grasping enclosure. Always hold a wrench on the bellows housing (or fitting) when connecting pressure joints.)

.B - Same as above.

UE® UNITED ELECTRIC CONTROLS COMPANY
85 SCHOOL STREET • WATERTOWN • MASS. 02172 • 617 926-1000
TELEX: 092-2445

DESCRIPTION: UNITED ELECTRIC DIFFERENTIAL PRESSURE SWITCH WITH THE FOLLOWING FEATURES:

1. WITH NEMA TYPE 4 HOUSING
2. ON-OFF DIFFERENTIAL - 5-11 OZ. NOT ADJUSTABLE
3. DIFFERENTIAL PRESSURE RANGE - 0-40 PSI ADJUSTABLE
4. DIFFERENTIAL PROOF PRESSURE - 135 PSI
5. WORKING PRESSURE - 30" HG VAC TO 40 PSI
6. SPDT SWITCH RATING 0.5 AMPS INDUCTIVE LOAD @ 125 VDC.



VENDOR'S MODEL NUMBER: J21K-150

VENDOR: DURABLE CONTROLS
MARYLAND, WISCONSIN

ADJUSTMENT:
TO INCREASE SCREW A IN (R.H. THREAD) TO DECREASE SYSTEM DIFFERENTIAL PRESSURE SETTING.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

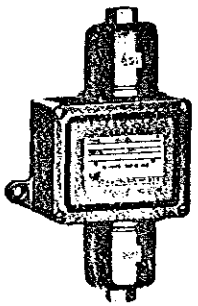
REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

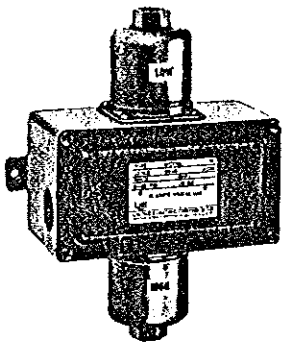
TITLE
SWITCH, PRESSURE DIFFERENTIAL 0-40PSID

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10776	4/21/78	ASSY. OR LO.	
DR. BY R. BARRETT	4/3/78	SCALE	—
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11 909 813		SHEET OF





J21K

DIFFERENTIAL PRESSURE CONTROLS

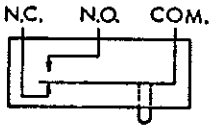
SPEC J21K/J27KB

REV. 1

SWITCH: Standardly 15 amp 125/250 VAC, Resistive

RECOMMENDED REPLACEMENT PART: The snap-action switch. To order specify "Switch Part No. 6259-223 for Type J21K and Switch Part No. 6259-223 & 233 for Type J27KB."

WIRING:



STOCK NO.		MODEL NO.	RANGE	ON-OFF DIFF'L.	PROOF PRESSURE	WORKING PRESSURE RANGE
J21K	J27KB					
			BRASS BELLOWS SENSOR (P/C BRASS, ¼ NPT FEM)			
		127	0 to 30" HG VACD	.4 to .6" HG	15 PSID	30 - 0" Hg Vac
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9538	9544	150	0 to 40 PSID	.3 to .7 PSID	40 PSID	30" Hg Vac - 180 PSI
			316L ST. ST. BELLOWS SENSOR (P/C 316L ST. ST., ¼ NPT FEM)			
		S127A	0 to 30" HG VACD	.4 to .6" HG	15 PSID	30 - 0" Hg Vac
9512		S140A	0 to 6 PSID	.1 to .4 PSID	6 PSID	30" Hg Vac - 30 PSI
		S150A	0 to 40 PSID	.3 to .7 PSID	40 PSID	30" Hg Vac - 180 PSI
			316L ST. ST. BELLOWS SENSOR (P/C 316L ST. ST., ⅛ NPT FEM)			
		S127B	0 to 30" HG VACD	.4 to .6" HG	15 PSID	30 - 0" Hg Vac
		S140B	0 to 6 PSID	.1 to .4 PSID	6 PSID	30" Hg Vac - 30 PSI
9519		S150B	0 To 40 PSID	.3 to .7 PSID	40 PSID	30" Hg Vac - 180 PSI
			PHOSPHOR BRONZE BELLOWS SENSOR (P/C BRASS, ¼ NPT F)			
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9545	9558	254	0 to 90 PSID	2 to 4 PSID	90 PSID	30" Hg Vac - 200 PSI
			347 ST. ST. BELLOWS SENSOR (P/C 347 ST. ST.)			
9504		357	0 to 70 PSID	2 to 4 PSID	70 PSID	30" Hg Vac - 350 PSI

NOTES

ON-OFF DIFFERENTIAL: The difference between the actuation point and de-actuation point of the switch contact element.

DIFFERENTIAL PRESSURE RANGE . . . The limits of the difference between the two sensed pressures within which the snap switch may be adjusted to actuate and de-actuate.

DIFFERENTIAL PROOF PRESSURE . . . The maximum difference between the two sensed pressures to which the control may be exposed without harmful effect to performance (set point repeatability, etc.)

WORKING PRESSURE RANGE . . . The pressure limits to which each sensor can safely be exposed as long as Differential Proof Pressure is not exceeded.

MATERIALS

J21K - Enclosure - Die cast Aluminum, grey hammertone finish. Bellows Housing - Model 357 Aluminum, anodized. All other models, brass, nickel plated. Standard Housing modified to NEMA 4 requirements.

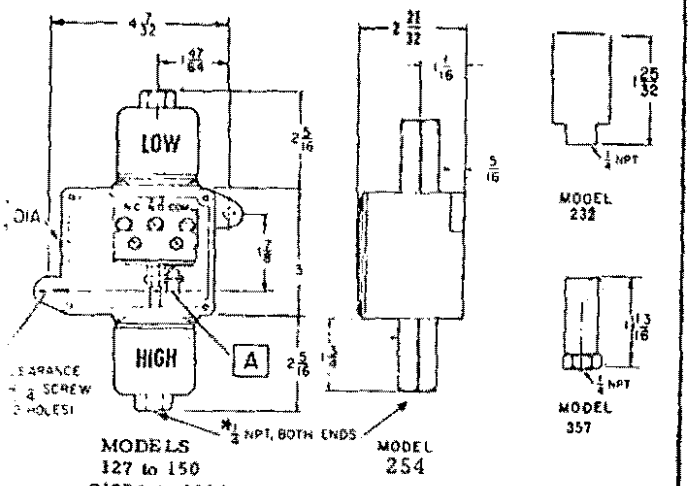
J27KB - Same as above.

APPROXIMATE WEIGHT: J21K - 2 lbs. 7 oz.; J27KB - 2 lbs.

WHEN ORDERING CONTROLS: Order by "Type J21K (or J27KB) Stock No. _____." Stock numbers cover exact specifications above. If no Stock Number or if your requirements deviate from above chart specifications (e.g. 20 amp rating, special features, etc.) order by "Type J21K (or J27KB) Catalog Model _____" and indicate complete specifications.

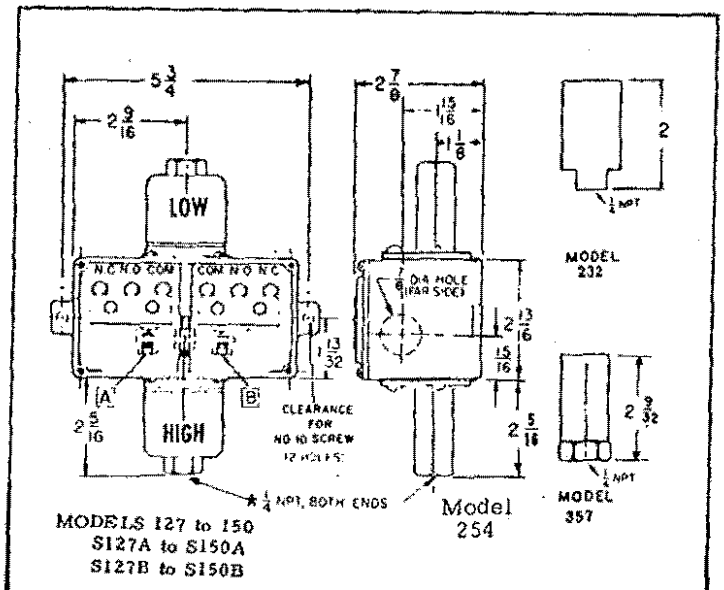
OPTIONS: Many options permit "custom designing" of the J21K to fit individual needs, e.g. Switches (extra wide adjustable differential, 20 amp, manual reset, hi-ambient, adjustable switch differentials . . .); watertight construction (NEMA #4, cover gasket and watertight conduit fitting); special mountings, setting, etc. . . . consult UE.

J21K



*Models S127B-S150B only, 1/2 NPT

J27KB



*Models S127B-S150B only, 1/2 NPT

'JSTMEN .

- Turn head screw [A] in (R.H.Thread) to decrease system differential pressure setting.

.B - Turn adjustment screws [A] or [B] in (R.H.Thread) to decrease system differential pressure settings. Switches may be set to operate together or apart as much as 50% of range span.

'ALLATION:

- Surface mount in any position via two mounting ears. (CAUTION: Never turn this unit by grasping enclosure. Always hold a wrench on the bellows housing (or fitting) when connecting pressure joints.)

B - Same as above.

UNITED ELECTRIC CONTROLS COMPANY
85 SCHOOL STREET • WATERTOWN • MASS 02172 • 617 926-1000
TELEX 092-2445

GRNL 7251

16100079

PURCHASE FROM:

WM. W. NUGENT & CO. INC.
SKOKIE, ILL.
① THEIR FIG. 1555-1RH-DN-B

② (REF.) REPLACEMENT FILTER ELEMENT 16107824

③ (REF.) REPLACEMENT .SHELL (CANISTER) GASKET #16105860

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	8078	5-4-72	③REF. REPLACE. (CANISTER) ADDED	
2	7396	10-2-70	②REF. NOTE ADDED	
1	7140	4-22-70	①WAS 1555FN-1R	

TITLE
FILTER
DUPLEX FUEL OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

FAIRBANKS, MORSE & CO.
DIESEL BELOIT, WISCONSIN ENGR

REL. NO. AM 903F	7/2/64	ASSY. OR LO.	
DR. BY P. MARTIN	3/3/64	SCALE	
CHK'D. BY F. J. D.	6/10/64	APPV.	C.E. 6/30/64
MAT'L PURCHASE		HEAT TR.	
SHEET SIZE A	DWG. NO. 16100079		SHEET OF

16100079

INSTRUCTIONS FOR INSTALLING AND OPERATING NUGENT STRAINERS AND FILTERS

GENERAL DATA

Filters may be furnished with or without internal bypass relief valves. If so equipped, they are preset at the factory to open at the maximum recommended element differential pressure. The valve(s) IS(ARE) NOT field adjustable.

Strainers cannot be equipped with internal bypass relief valves.

For lubricating oil filters not equipped with internal bypass relief valves, Nugent recommends the installation of a Model 1591 Dumping Valve to protect the element(s) from abnormal differential pressure.

If filter or strainer is not equipped with a gauge for determining differential pressure, it is recommended that gauges be installed in the inlet and outlet piping.

INSTALLATION INSTRUCTIONS

1. Locate unit so that there is adequate space for element removal. Refer to outline drawing for height needed.
2. Inspect piping leading to and from unit for scale, dirt, etc. and, if necessary, clean piping.
3. Remove protective covers from inlet and outlet piping and connect the filter or strainer. (Connections are clearly marked with pressure sensitive decals indicating the inlet and outlet connections, or refer to the outline drawing.)

CAUTION

DURING INSTALLATION, USE CARE SO AS NOT TO INTRODUCE DIRT INTO THE SYSTEM.

4. Remove cover and clean inside thoroughly. Inspect the element(s) for damage that may have occurred during shipment. Inspect cover gasket and gasket surface on cover. Replace cover. Torque head bolts to 70-80 lb.-ft. on sizes 1, 4L, and larger.

CAUTION

ON 1116, 1576 AND 1554 SERIES, THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL SINCE FLOW IS FROM THE INSIDE-OUT. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

OPERATING INSTRUCTIONS

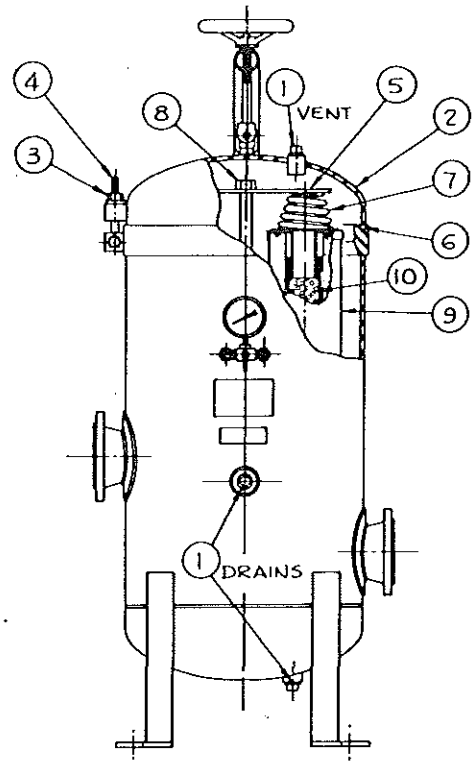
1. After filter or strainer has attained operating temperature, check the differential pressure across it. On filters or strainers so equipped, this may be done with the three-way valve located underneath the pressure gauge. Turn the valve handle to upstream (inlet) side and read the pressure; turn the valve handle to downstream (outlet) side and read the pressure. The difference in pressure readings is the differential pressure across the element(s). Always return the valve to the "off" (center) position.
2. It is recommended that the differential pressure be checked daily, as it indicates the amount of contaminant build-up within the element(s). When this differential pressure reaches approximately 20 psi at normal operating temperature, the element(s) shall be removed and replaced with genuine Nugent element(s) for series 1577, 1555 and 1576 filters. Element(s) should be removed and replaced only after first referring to Nugent Co. element replacement instructions. The strainer screen cylinder shall be cleaned for series 1554 and 1700 strainers, or clean bags installed in series 1116 filters. Strainer cylinders should be cleaned and new filter bags should be installed only after first referring to Nugent Co. cylinder cleaning and bag installation procedures.

EST. 1897
WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, ILL. 60076, U.S.A.
Telephone: 312/674-7782 TELEX: 724-312
WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

ELEMENT REPLACEMENT
SERIES 1555, 1577 AND 1576

When the differential pressure reaches 20 psi, the element(s) shall be removed and replaced with genuine Nugent element(s). Refer to parts list or name plate for part number of element(s) to be used in this filter.

1. Drain completely by removing the ¾" NPT plug(s) (1) located on the side and or bottom of the filter shell. During draining, open vent, loosen nuts (3), and swing bolts (4) clear of cover lugs. Remove cover (2) by lifting to clear positioning tabs located on shell ring. DO NOT LAY COVER ON THE "O" RING SEALING SURFACE.
2. On single stack filters, remove spring plate assembly (7) and strainer tube (10). On multiple stack filters, remove bolt(s) (8), pressure plate (5), spring plate assemblies (7), and strainer tubes (10).



CAUTION

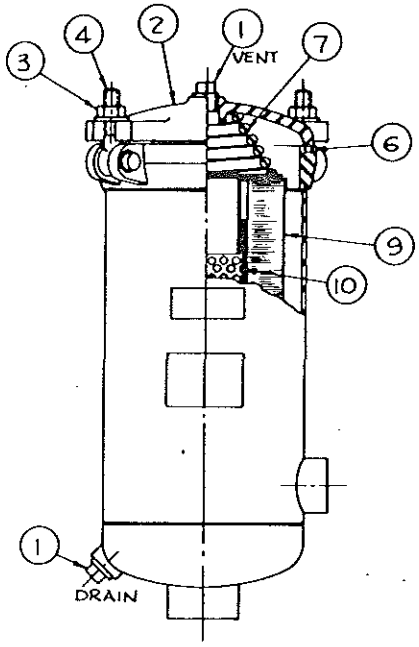
BEFORE REMOVING ELEMENT(S), CHECK TO MAKE SURE THAT THE LIQUID HAS BEEN DRAINED COMPLETELY.

3. Remove and discard the element(s) (9). Inspect interior of vessel for loose or broken parts and excessive accumulation of dirt.

CAUTION

INSPECTION OF THE VESSEL INTERIOR IS PARTICULARLY IMPORTANT ON THE SERIES 1576 FILTERS, SINCE THE INTERIOR IS THE CLEAN SIDE OF THE FILTER. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

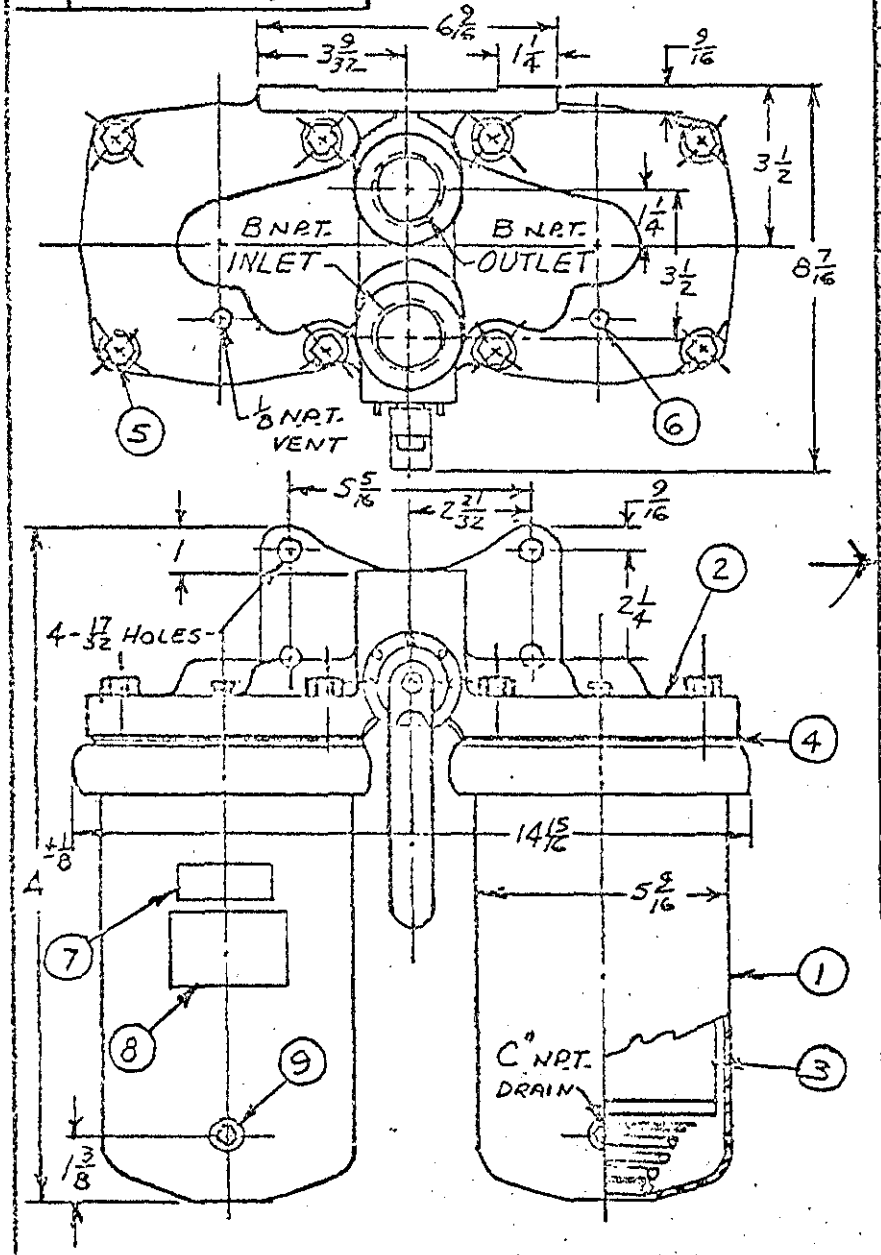
4. Remove new element(s) from shipping container and inspect for damage that may have occurred during shipment. Place element(s) over seat(s) protruding from bottom of vessel. Make sure that each element seats securely and insert strainer tube (10).
5. Replace spring plate assembly(ies) after checking condition of bypass valve(s) if filter is so equipped.
6. On multiple filters, replace pressure plate (5) and bolts (8). Tighten bolts until pressure plate makes contact with top of tie rod. When pressure plate is properly installed, there should be approximately 2½ inches between the top of the elements and the bottom of the pressure plate.
7. Inspect "O" ring (6) and replace cover by lowering it onto the "O" ring. Align lugs before cover contacts "O" ring. DO NOT ROTATE COVER TO OBTAIN ALIGNMENT AFTER IT HAS CONTACTED "O" RING. Torque nuts (3) to 70-80 lb.-ft. on sizes 1, 4L and larger.
8. Close drain(s) and fill vessel with fluid. In order to assure complete filling of vessel, release trapped air through vent located on cover. Check for leaks. After filter has attained operating temperature, check the differential pressure. It should be less than 5 psi.



EST. 1897

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WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

REV	DWG NO.
	12-014



PART Nº	MODEL Nº	A	B	C		WEIGHT EMPTY	WEIGHT FULL
12-014-201	1555-1RH-DY-B	15 11/16	1	1/8	STD.	45	55
202	1555-1RH-DN-B		1		STD.		
203	1555-1RH-DY-B		1 1/4				
204	1555-1RH-DN-B		1 1/4				
205	1555-1RH-DY-B		1 1/2				
206	1555-1RH-DN-B	15 11/16	1 1/2			45	55
207	1555-1SH-DY-B	24 15/16	1			60	72
208	1555-1SH-DN-B		1				
209	1555-1SH-DY-B		1 1/4		STD.		
210	1555-1SH-DN-B		1 1/4		STD.		
211	1555-1SH-DY-B		1 1/2				
212	1555-1SH-DN-B	24 15/16	1 1/2			60	72
213	1555-1RH-DN	15 11/16	1			41	—
214	1555-1RH-DN	15 11/16	1 1/4		CARRIER	41	—
215	1555-1RH-DY-B	15 11/16	1		GA. CONN.	45	55
216	1555-1RH-DN-B	15 11/16	1		GA. CONN.	45	55
217	1555-1SH-DN-B	24 15/16	1 1/4		GA. CONN.	60	72
218	1555-1SH-DN	24 15/16	1			60	72
219	1555-1RH-DXN	15 11/16	1		GA. CONN.	41	—
220	1555-1SH-DXN	25 7/16	1 1/4		CARRIER	41	—
221	1555-1SH-DXN	24 15/16	1 1/4		GA. CONN.	60	—
222	1555-1SH-DY-B	24 15/16	1 1/4	1/8	API-611 ALL STL	70	82
223	1555-1SH-DY-B	24 15/16	1 1/4	3/8	MAGN. PLUGS	60	72
224	1555-1SH-DY-B	24 15/16	1	1/8	API-611 ALL STL	70	82
225	1555-1SH-DN	24 15/16	1	1/8	API-612 ALL STL	70	82

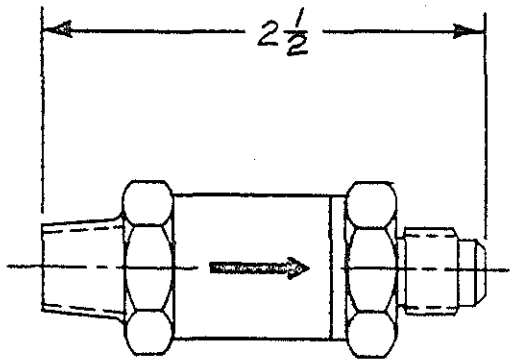
DESIGN PRESSURE 200 P.S.I.
TEST PRESSURE 300 P.S.I.
DESIGN TEMPERATURE 250°F.

FILTER ASSEMBLY
DUPLEX

SCALE	REV	DWG NO.
3-8		12-014

1010079

16 102 30



PURCHASE FROM REPUBLIC MANUFACTURING CO.
THEIR NO. 484-4-1 (BRASS)
(1/8 P x 1/4 T)

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE

CHECK VALVE
FREE FLOW

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. AM936V	11/11/64	ASSY. OR LO.
DR. BY E. ELHOLM	2/13/63	SCALE —
CHK'D. BY Zell	2/20/63	APPV. CEN 10/13/64
MAT'L PURCH		HEAT TR.

SHEET SIZE A | DWG. NO. 16102300 | SHEET OF

16 104 402

PURCH. FROM

REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD
CLEVELAND 35, OHIO

481-$\frac{1}{2}$ MPT TO FPT.-$1\frac{1}{2}$"
(AND10077) (AND10053)

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
CHECK VALVE

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 0004(A)	2/4 66	ASSY. OR LO.	
DR. BY R. WANIE	12/20/65	SCALE	~
CHK'D. BY [illegible]	1/17/66	APPV.	/ /
MAT'L ~		HEAT TR.	

SHEET SIZE A | DWG. NO. 16 104 402 | SHEET 1 OF 1

BF3009-2

2. LUBE OIL SYSTEM

Part No.	Description
11 901 403	Strainer 1-1/2"
11 902 918	Strainer 1"
11 905 631	Differential Pressure Switch
11 905 635	Three-Way Valve
11 906 081	Level Alarm Switch
11 906 211	Temperature Alarm Switch
11 906 212	Thermostat
11 906 720	Temperature Alarm Switch
11 906 729	Pressure Alarm Switch
11 908 164	Thermostatic By-Pass Valve
11 908 169	Fuel Flow Filter
11 908 170	Oil Heater
11 908 176	Pre-Lube Pump - Motor Driven
11 908 177	Circulating Pump - Motor Driven
11 908 180	Plug Valve 1/2"
11 908 181	Plug Valve 3/4"
11 908 183	Plug Valve 1-1/2"
11 908 185	Heat Exchanger
11 908 188	Fuel Flow Strainer
11 908 189	Check Valve
11 908 650	Isolation Valve
11 908 982	Flexible Connector 1-1/2"
11 908 983	Flexible Connector 1"
11 911 662	Sight Glass
11 911 811	Plug Valve 3/4"
16 101 330	Sump Oil Float Level Control

1190 703

Description: "Y" type 1-1/2" cast iron screwed strainer 1/8-10, .045 screen strainer.

Vendor: Leslie Company (1) (OR ANY SUITABLE VENDOR)
Lyndhurst, New Jersey

Piece/Part No.:

Drawing No.:

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified) ± 1/64

LAYOUT OR ASSEMBLY NUMBER

REV. NO.	DATE	CHANGE ORDER NO.	WAS
1 (1)	4-9-63	PC 176	NOTE ADDED

1/F

RELEASE NUMBER A0-239 DATE OF RELEASE 4-11-61

FAIRBANKS, MORSE & CO.
LOCOMOTIVE
ENGINEERING DEPARTMENT

DRAWN BY K. Ufford DATE 4-11-61 SCALE

CHECKED BY L. W. Cooper DATE 4-11-61

NAME

STRAINER - 1-1/2"

MATERIAL SPECIFICATION

APPROVED

SHEET SIZE A DWG. NO. 1190 1403

119029.3

Description: Cast iron 1/2" NPT in line strainer - 100 mesh cloth .0055 Openings.

Vendor: The Leslie Co.
Lynhurst N.J.

Piece/Part No.: 7000

Drawing No.:

NOTE: "Substitutes not permitted."

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: Strainer, Fuel Oil

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

FAIRBANKS, MORSE & CO.
BELOIT, WISCONSIN

DEPT. Diesel Engineering			
REL. NO. AM-3058	3/10/64	ASSY. OR LO.	
DR. BY L.W.Cooper	2/10/64	SCALE	
CHK'D. BY L.W.Cooper	2/10/64	APPV.	3/10/64
MAT'L.		HEAT TR.	
SHEET SIZE A	DWG. NO. 1902918		SHEET OF

DESCRIPTION: ALLEN-BRADLEY bulletin 836-T pressure difference switch with following features:

1. With NEMA Type 12 oiltight housing.
2. Adjustable difference 2½ to 20 psi.
3. Adjustable differential 2½ to 15 psi.
4. Line press. 30" vacum min. to 175 psi. max.
5. Max. allowable press. (surge) - 200 psi.

VENDOR'S CATALOG NO. 836T-D451J

VENDOR: ALLEN BRADLEY CO.
MILWAUKEE, WISCONSIN

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH Press. Difference

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205700(E)	12/17/69	ASSY. OR LO.
DR. BY L.W Cooper	10/31/69	SCALE
CHK'D. BY CAG	10/31/69	HEAT TR.
MAT'L		

APPV.	CAST.	MAT'L.	
	MACH.	ENGR.	
	WELD.		

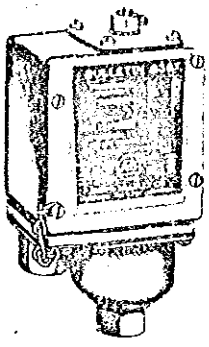
SHEET SIZE A | DWG. NO. 1905631 | SHEET OF

BF3009-2

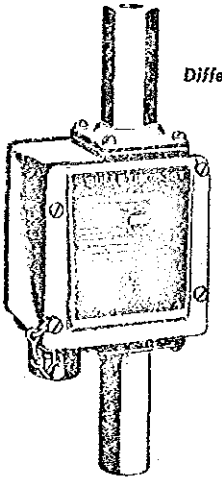
11905631

Industrial Pressure Switches

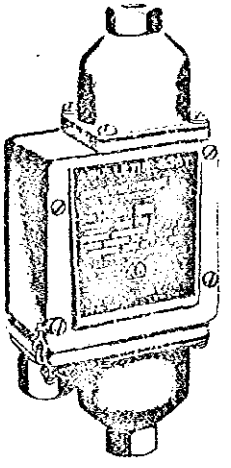
BULLETIN 836T
RENEWAL PARTS



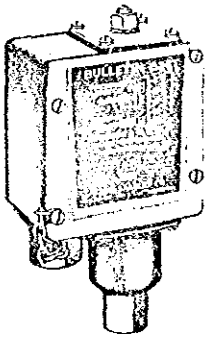
Bulletin 836T
Pressure Switch
Catalog Number
**836T-T251J*
Formerly
836-TJ7-BC



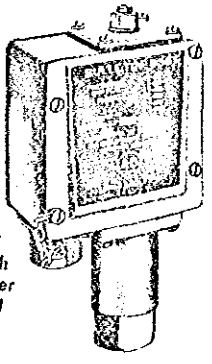
Bulletin 836T
Differential-Pressure Switch
Catalog Number
**836T-D453J*
Formerly
836-TD7-HA



Bulletin 836T
Differential-Pressure Switch
Catalog Number
**836T-D450J*
Formerly
836-TD7-BAV



Bulletin 836T
Pressure Switch
Catalog Number
**836T-T252J*
Formerly
836-TJ7-CC



Bulletin 836T
Pressure Switch
Catalog Number
**836T-T301J*
Formerly
836-TK7-RH

OPERATION — When a vacuum or pressure is applied to the control, a mechanism operates the snap action switch at a predetermined setting. The switch resets when the line pressure returns to the lower setting.

DESCRIPTION — The contact unit used in the pressure switch has two isolated circuits, one with normally open contacts and one with normally closed contacts. These contacts may be arranged for single pole double throw operation or separate circuit operation having the **same** polarity.

The operating pressure is adjustable externally by a screwdriver (or knob if specified) and the actual setting is shown by an indicator in a window near a calibrated scale on the nameplate. Provision is made for locking this setting if desired. A trip indicator is also supplied on all models to conveniently show when the switch contacts trip. The differential adjustment is inside the enclosure and the cover must be removed to change this setting.

Bellows are used in the 6 low pressure ranges up to 650 psi maximum and piston assemblies are used in the 550 psi to 5000 psi maximum ranges. A diaphragm is used on the vacuum switches.

If high surge pressures or high frequency pulsations are present, a pulsation snubber should be installed between the line and the switch to prevent false operation and damage to the switch especially in the bellows type.

OPERATING MECHANISM — Due to the integral construction of the operating mechanism in pressure switches, they must be returned to the Allen-Bradley Company, Milwaukee, for repairs.

CONTACT RATINGS—

Pilot Duty

AC

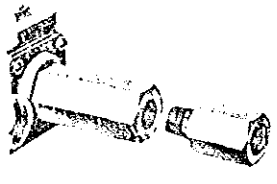
6 Amperes, 120 V
3 Amperes, 240 V
1.5 Amperes, 480 V
1.2 Amperes, 600 V

DC

0.4 Ampere, 115 V
0.2 Ampere, 230 V
0.1 Ampere, 550 V

ACCESSORIES

Pulsation Snubber



A pulsation snubber should be used when extreme pulsations or surges are present. Advise the factory of surge characteristics when ordering.

Catalog Number 836-N7
for Bellows Type
Catalog Number 836-N8
for Piston Type

Range Adjustment Knob



***836T-N12**

Locking Cap

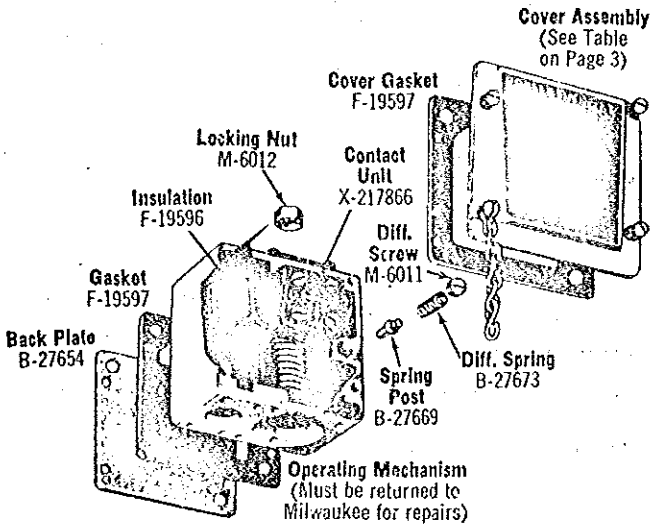


***836T-N13**

*Added or changed since previous issue.

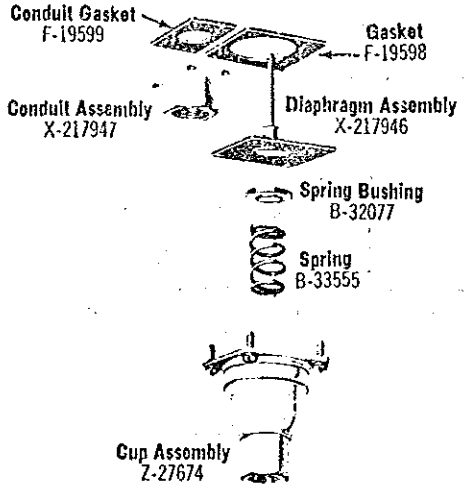
Renewal Parts List 836T-700 — December, 1969
Supersedes Parts List 836-700 Dated December, 1965

Replacement Parts Common to both Earlier Design and Latest Design Switches listed on this page.



Part of an exploded view of Catalog Number *836T-T250J

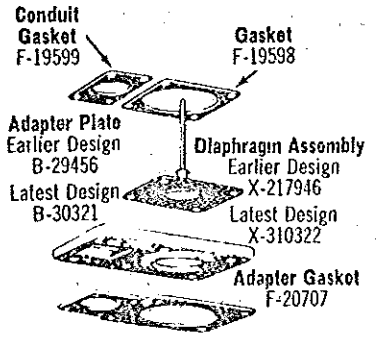
Formerly 836-TV7-DD



Illustrated parts are for use on switches having catalog numbers listed in the table below.

Earlier Design	
Catalog Number	Bellows Part Number
836-TJ7-BF	Z-21615
836-TJ7-BFR	Z-21616

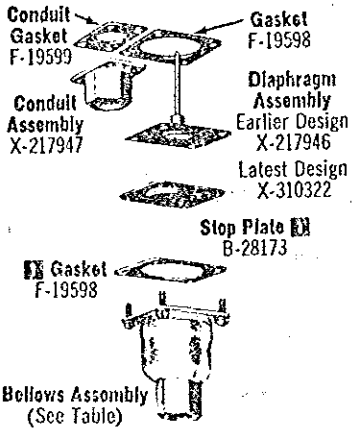
Latest Design		
Catalog Number		Bellows Part Number
Old	*New	
836-TJ7-BC	836T-T251J	Z-27664
836-TJ7-BCR	836T-T260J	Z-27665



Illustrated parts are for use on switches having catalog numbers listed in the table below.

Earlier Design	
Catalog Number	Bellows Part Number
836-TJ7-CF	Z-21617
836-TJ7-FD	Z-21618
836-TJ7-HD	Z-21619
836-TJ7-HDR	Z-21620
836-TJ7-KD	Z-21621
836-TJ7-LD	Z-21622

Latest Design		
Catalog Number		Bellows Part Number
Old	*New	
836-TJ7-CC	836T-T252J	Z-27666
836-TJ7-FC	836T-T253J	Z-27667
836-TJ7-FCR	836T-T261J	Z-27672
836-TJ7-HC	836T-T254J	Z-27668
836-TJ7-HCR	836T-T262J	Z-27673
836-TJ7-KBR	836T-T263J	Z-27671
836-TJ7-KC	836T-T255J	Z-27669
836-TJ7-LC	836T-T256J	Z-27670

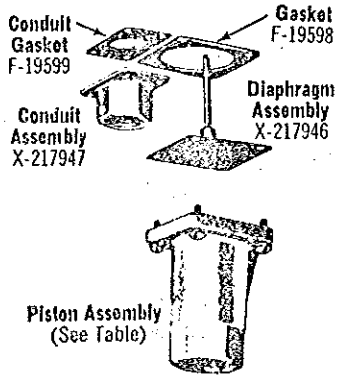


▣ These parts are not used on Latest Design Switches.

Illustrated parts are for use on switches having catalog numbers listed in the table below.

Earlier Design	
Catalog Number	Piston Part Number
836-TK7-NJ	Z-21627
836-TK7-RJ	Z-21629
836-TK7-SJ	Z-21631
836-TX7-TJ	Z-21632
836-TX7-UJ	Z-21626
836-TX7-VJ	Z-21628
836-TX7-WJ	Z-21630

Latest Design		
Catalog Number		Piston Part Number
Old	*New	
836-TK7-NH	836T-T300J	Z-21627
836-TK7-RH	836T-T301J	Z-21629
836-TK7-SH	836T-T302J	Z-21631
836-TK7-TH	836T-T303J	Z-21632
836-TX7-UH	836T-T350J	Z-21626
836-TX7-VH	836T-T351J	Z-21628
836-TX7-WH	836T-T352J	Z-21630
836-TX7-WJ-W	836T-T400J	Z-21630



*Added or changed since previous issue.

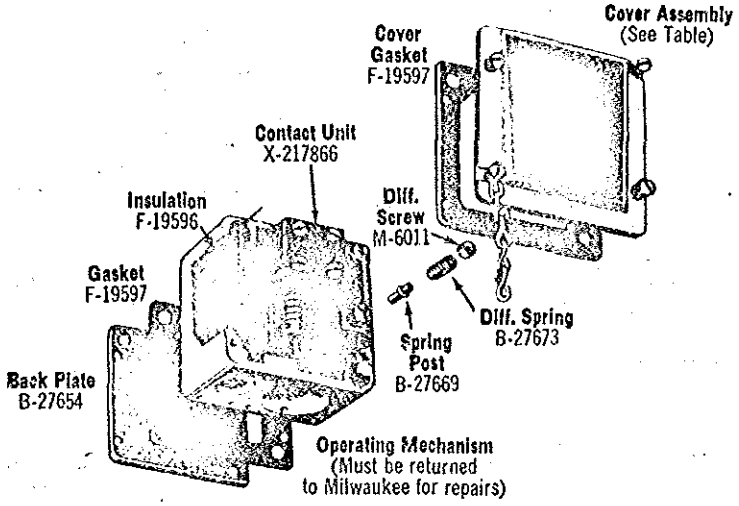
COVER ASSEMBLIES

Earlier Design			
Catalog Number	Part Number	Catalog Number	Part Number
836-TJ7-BF	[1]	836-TK7-NJ	[1]
836-TJ7-BFR		836-TK7-RJ	
836-TJ7-CF		836-TK7-SJ	
836-TJ7-FD		836-TK7-TJ	
836-TJ7-HD		836-TX7-UJ	
836-TJ7-HDR		836-TX7-VJ	
836-TJ7-KD		836-TX7-WJ	
836-TJ7-LD			

[1] Order per description of part, (cover assembly) and catalog number of switch.

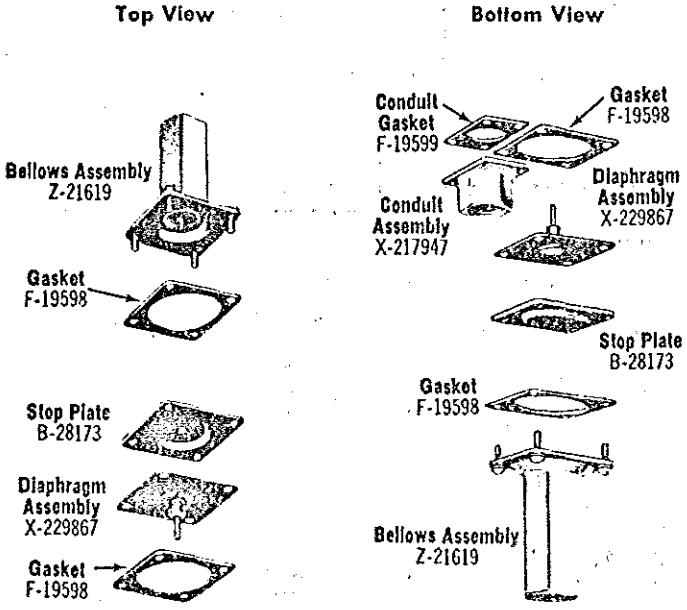
Latest Design					
Catalog Number		Part Number	Catalog Number		*Part Number
Old	*New		Old	*New	
836-TJ7-BC	836T-T251J	X-335121	836-TK7-NH	836T-T300J	X-413784
836-TJ7-BCR	836T-T260J	X-335122	836-TK7-RH	836T-T301J	X-413780
836-TJ7-CC	836T-T252J	X-335123	836-TK7-SH	836T-T302J	X-413782
836-TV7-DD	836T-T250J	X-335120	836-TK7-TH	836T-T303J	X-413783
836-TJ7-FC	836T-T253J	X-335124	836-TX7-UH	836T-T350J	X-413785
836-TJ7-FCR	836T-T261J	X-335129	836-TX7-VH	836T-T351J	X-413779
836-TJ7-HC	836T-T254J	X-335125	836-TX7-WH	836T-T352J	X-413781
836-TJ7-HCR	836T-T262J	X-335126	836-TX7-WJ-W	836T-T400J	X-335131
836-TJ7-KBR	836T-T263J	X-335130	836-TD7-CAV	836T-D451J	X-413776
836-TJ7-KC	836T-T255J	X-335127	836-TD7-FAV	836T-D452J	X-413777
836-TJ7-LC	836T-T256J	X-335128	836-TD7-HA	836T-D453J	X-413778

Replacement parts common to pressure switches listed below.



Part of an exploded view of Catalog Number *836T-D453J

Formerly 836-TD7-HA

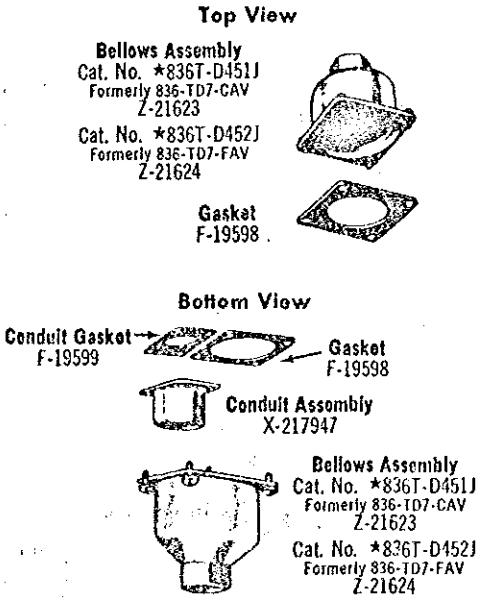


Part of an exploded view of Catalog Number *836T-D451J

Formerly 836-TD7-CAV

and Catalog Number *836T-D452J

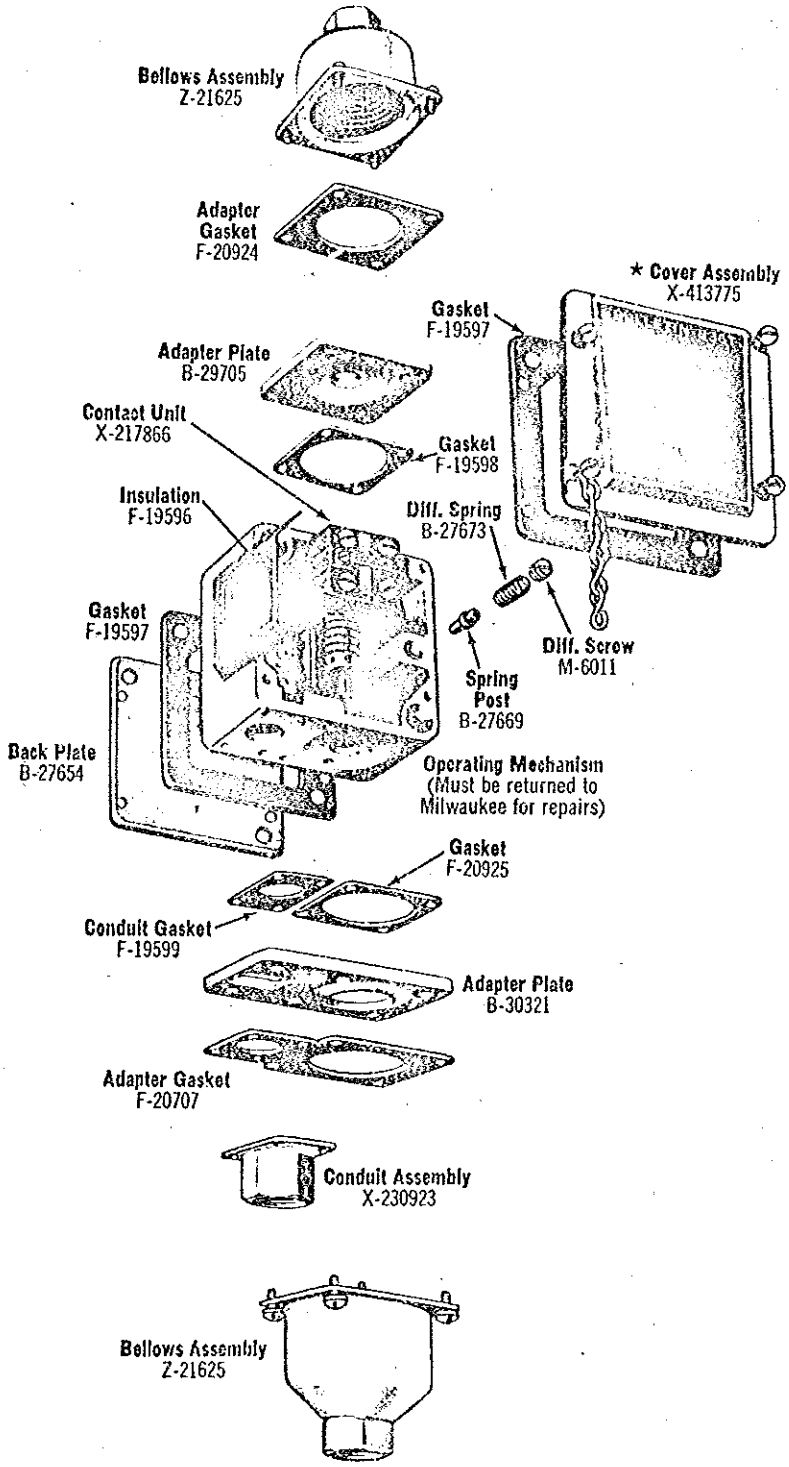
Formerly 836-TD7-FAV



*Added or changed since previous issue.

Exploded View of Catalog Number *836T-D450J

Formerly 836-TD7-BAV



ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and the series letter of switch. This renewal parts list applies also to these switches when used on control apparatus listed under other Bulletin numbers.

★Added or changed since previous issue.

11905635

DESCRIPTION: HOMESTEAD 1 1/2" SCREWED, 3WAY, 3 PORT, 90° TURN LUBRICATED PLUG VALVE, 200 PSI. O.W.G, STYLE E TO BE LUBRICATED WITH #78 LUBRICANT SIZE "B" STICK. TO INCLUDE HANDLE

VENDOR'S PART NO. 1 1/2" FIG. 605 STYLE E

VENDOR: HOMESTEAD VALVE MFG. CO.
CORAOPOLIS, PA.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: VALVE - 1 1/2" 3 WAY

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205700(V)	1/6 /70	ASSY. OR LO.
DR. BY L.W. Cooper	12/30/69	SCALE
CHK'D. BY L.W.C	12/30/69	HEAT TR.
MAT'L		

APPV.	CAST.	MAT'L.	
	MACH.	ENGR.	L. Wiley Cooper 12-30-69
	WELD.		

SHEET SIZE A | DWG. NO. 11905635 | SHEET 1 OF 1

DF3009-2

11 906 081

DESCRIPTION: Gorn Type GHP 5400 liquid level switch suitable for use with diesel engine jacket water (containing up to 50% ethylene glycol and corrosion inhibitors), fuel oil or lube oil at temperatures up to 250°F. and pressures up to 30 PSI. Operates on magnetic proximity principle. Suitable for use under conditions of continuous vibration of approximately 5 mils amplitude at 5 to 15 CPS. Furnish with the following features:

1. Brass switch cartridge with sil-brazed or integral 2-1/2" square flange 1/4" thick, 4 holes 0.31" dia. on 1.62" centers. Electrical lead end of cartridge to be 1/2" male NPT. Pressure test (cartridge only) at 60 PSI.
2. Buna "N" unicellular hard rubber sponge float.
3. SPDT switch rated at 0.25 amps, 125 volts D.C. or 5 amps at 115 volts A.C. for relay service. Furnish 18" leads potted in cortridge and color coded(with float in the down position):

   Common - Black
   N.O. - Blue
   N.C. - Red

VENDOR PC. NO.:

VENDOR DWG. NO.: GHF-5400-G13, Rev. B ①

VENDOR: Gorn Division
GAP Instrument Corp.
110 Marcus Blvd.
Hauppauge, New York 11787

NOTE: Switch actuates at approx 1/16" above center line for water and 1/8" above center line for diesel fuel on increasing fluid level. Reaction on decreasing fluid level occurs approx. 5/16" below actuation point of increasing level.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4 (H/F)	8469	4-2-73	① WAS REV. A	EB

TITLE: LIQUID LEVEL SWITCH, FLANGE MOUNTED

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .040 0.0- ± .000 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

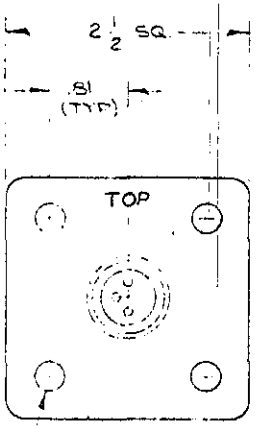
REL. NO. 205713	1/21/71	ASSY. OR LO.	P
DR. BY L.M. Cooper	1/18/71	SCALE	
CHK'D. BY L.M.C.	1/18/71	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

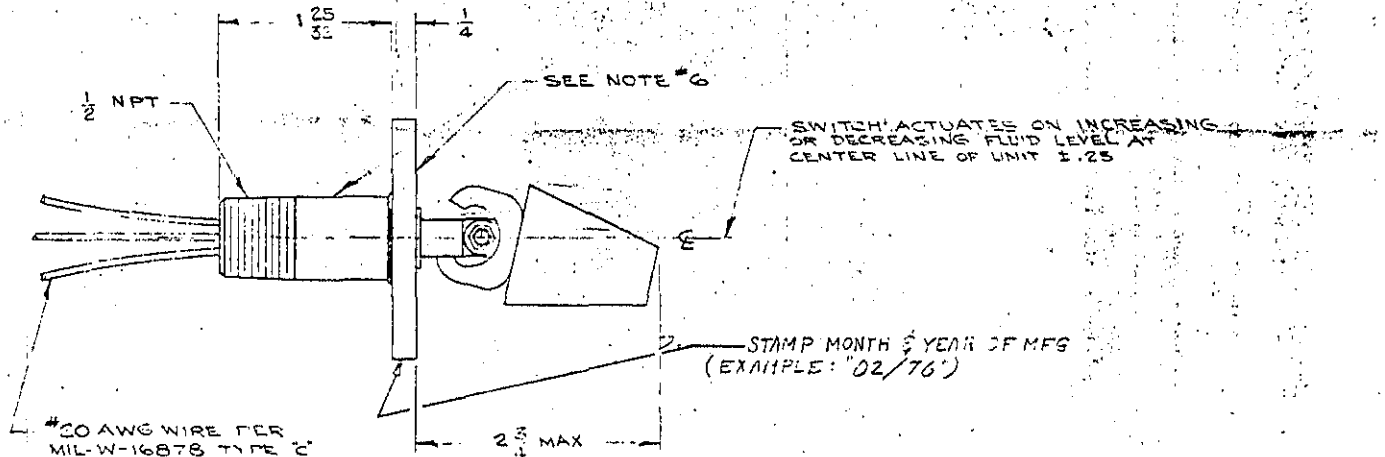
SHEET SIZE A | DWG. NO. 11 906 081 | SHEET 1 OF 1

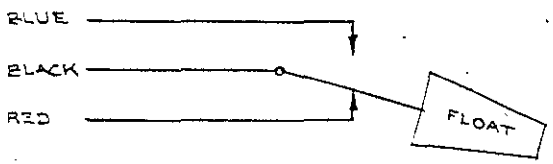
NOTES:

1. CARTRIDGE & FLANGE TO BE BRASS
2. OPERATING MEDIA :
   A. JACKET WATER WITH GLYCOL AND INHIBITORS.
   B. DIESEL FUEL. C. LUBE OIL
3. ELECTRICAL RATING : S.P.D.T CONTACTS.
   .25 AMPS AT 125 V.D.C.
4. OPERATING TEMPERATURE : UP TO 250°F
5. SYSTEM PRESSURE : 0-30 PSIG.
6. IF FLANGE AND CARTRIDGE ARE TWO PIECES PRESSURE TEST FOR LEAKAGE USING 60 PSIG.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
—	A	REVISED AND ADDED NOTES 5 & 6	2/1/90	[illegible]
—	B	REMOVED 25/32 DIM. ECO E770	3-23-92	[illegible]
B-2	C	ADDED: STAMP MONTH & YEAR OF MFG (EXAMPLE: "02/76") CJP	2-24-76	CJP
	D	REVISED LOGO, DATE STAMP LOC'N. SO-054	5/6/90	[illegible]







WIRING SCHEMATIC
SHOWN WITH FLOAT IN LOW LEVEL POSITION

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-D-70327.

GD 74C.4

	GHF-5400-613
NEXT ASS'Y.	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES ON DECIMALS:
X ± 1/32 XX ± .020 XXX ± .005

ANGLES: ± 1/2° FRACTIONS: ± 1/16

MATERIAL:

FINISH:

CONTR. NO. [illegible]

DR. J.J. 8/14/91

CHK.

APP'D [illegible] 5/7/92

APP'D [illegible]

APPROVED

BY DIRECTION OF

AEROSPACE CONTROL PRODUCTS, INC.
FLORIDA, IOWA

SWITCH, FLOAT, HORIZONTALLY MTD SPECIFICATION DWG

SIZE C | CAGE CODE [illegible] | GHF-5400-613 | REV D

SCALE FULL | UNIT WT. | SHEET 1 OF 1

11906 081

GHF-5400-613

DESCRIPTION: ALLEN BRADLEY bulletin 837 temperature switch with the following features:

1. Vertical immersion type.
2. Adjustable range 140 to 290°F.
3. Adjustable differential at middle setting 3½ to 28°F.
4. NEMA Type 4 Housing (watertight).
5. Contact block SPDT DC pilot duty rating 57.5 VA @ 125 Volts d.c.

VENDOR'S PART NO: 837-V3J

VENDOR: ALLEN BRADLEY
MILWAUKEE, WISC.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH Temperature 140-290°F

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .020 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205872	12/23/71	ASSY. OR LO.	
DR. BY L.W. Coop	9/30/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 1190621 1	SHEET 1 OF 1	

BF3009-2

PRESSURE SWITCHES • TEMPERATURE SWITCHES

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts

DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC 5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

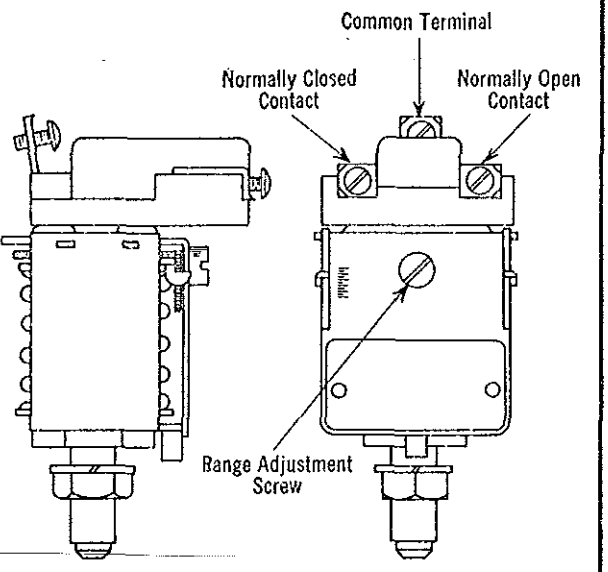
To adjust the controls to suit particular requirements, the following adjustments are to be made; these will apply to both the pressure and temperature controls.

FIXED DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount. It is not possible to change the differential between the cut-in and cut-out settings.

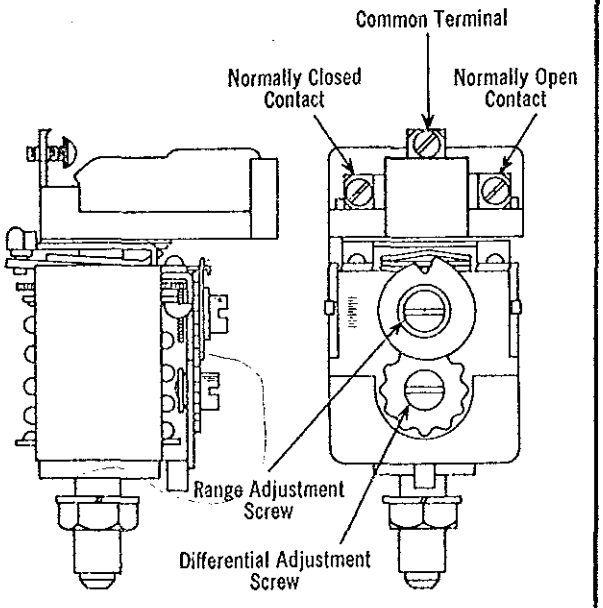
ADJUSTABLE DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount.

When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

Publication 836—5.0—November, 1969
Supersedes Instructions 836-800

DESCRIPTION: ALLEN BRADLEY bulletin 837 temperature switch with the following features:

1. Vertical immersion type.
2. Adjustable range 90 to 200°F.
3. Adjustable differential 2½ to 22°F at middle setting.
4. NEMA Type 4 Housing (water tight)
5. Contact block SPDT. D.C. pilot rating 57.5 VA @ 125 Volts d.c.

VENDOR'S PART NO: 837-V2J

VENDOR: ALLEN BRADLEY
MILWAUKEE, WISC.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH Temperature 90-200°F.

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205872	12/23/71	ASSY. OR LO.	
DR. BY L.W. Cooper	9/30/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11906212 | SHEET 1 OF 1

BF1003-2

PRESSURE SWITCHES • TEMPERATURE SWITCHES

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts
DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC { 5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

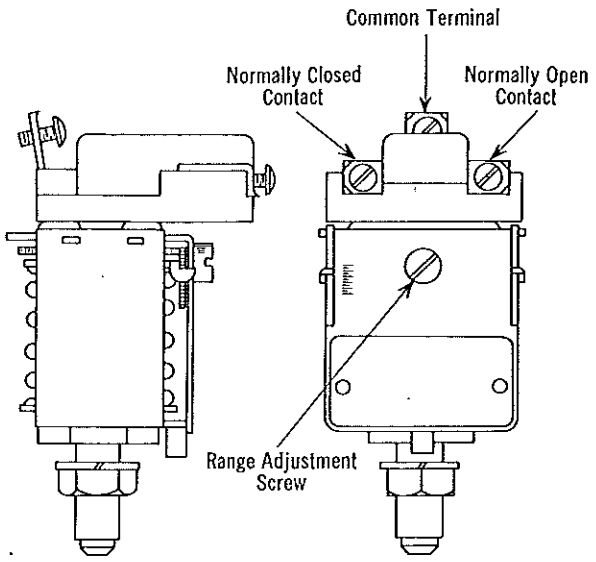
To adjust the controls to suit particular requirements, the following adjustments are to be made; these will apply to both the pressure and temperature controls.

FIXED DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount. It is not possible to change the differential between the cut-in and cut-out settings.

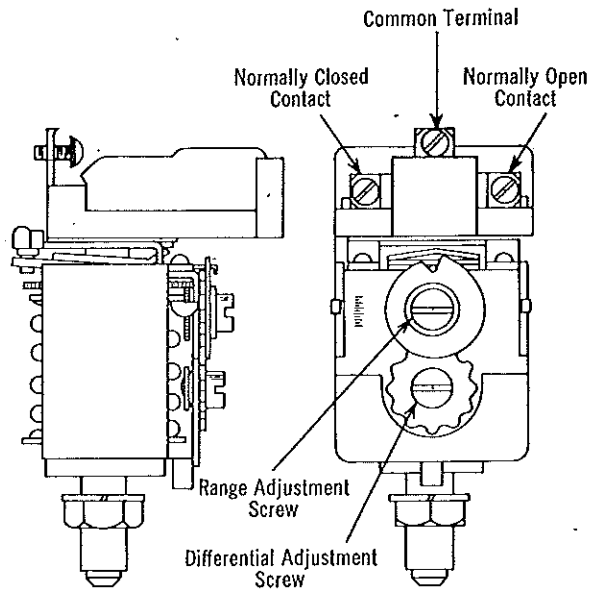
ADJUSTABLE DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount.

When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

Publication 836--5.0—November, 1969
Supersedes Instructions 836-800

11906720

DESCRIPTION: TEMPERATURE CONTROL, BULB AND CAPILLARY TYPE SPDT CONTACTS. ADJUSTABLE TRIP AND DIFFERENTIAL. WITH WELL. 6 FT ARMORED CAPILLARY

RANGE: 60 TO 160 °F DIFFERENTIAL: 2-18 °F

ENCLOSURE: NEMA TYPE 4

VENDOR: ALLEN BRADLEY
1201 S. SECOND ST.
MILWAUKEE, WIS. 58201

VENDOR PART NO.: 837A4J
837N6

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
SWITCH TEMPERATURE, BAND C

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. P5007	2/15/73	ASSY. OR LO.	
DR. BY R. OHL	2/3/73	SCALE —	
CHK'D. BY R. OHL	2/3/73	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11906720 | SHEET OF

DESCRIPTION: Detroit switch No.222-10 high shock pressure switch with the following features:

1. Range 3-50 psig
2. Max. pressure 80 psig
3. Differential - 2-6 psi
4. Contacts to open on increasing pressure
5. Single pole single throw switch
6. Watertight construction
7. 1/4" female NPT pressure connection

VENDOR'S PART NO. 222-1002 NB1

VENDOR: Detroit Switch, Inc.
1029 Beaver Ave.,
Pittsburgh, Pa.15233

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
SWITCH PRESSURE
HIGH SHOCK
3-50 PSIG

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 8441	3/22/73	ASSY. OR LO.	
DR. BY L.W.Cooper	3/13/73	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV.	CAST.	MAT'L	
	MACH.	ENGR. HEK	
	WELD.		
SHEET SIZE A	DWG. NO. 11 906 729	SHEET 1 OF 1	

3F3009-2

DETROIT SWITCH, INC.

Form 1871-C

DETROIT SWITCH P/N 2221002 NB-1
COLT INDUSTRIES P/N 11 906 729

Instructions

No. 222-10 CONTROL SWITCHES

DESIGNED TO MEET THE REQUIREMENTS AND WITHSTAND THE TEST FOR GRADE A CLASS 1 TYPE B OF NAVAL SHIP ENGINEERING CENTER MILITARY SPECIFICATIONS MIL-S-901 FOR HI-SHOCK, MIL-C-2212 FOR A.C. AND D.C. SWITCHING DEVICES, MIL-E-2036 FOR WATERTIGHT AND MIL-R-16743 FOR REFRIGERATION EQUIPMENT.

ENCLOSURE: WATERTIGHT
SERVICE: NAVY A
SHOCK: CLASS HI

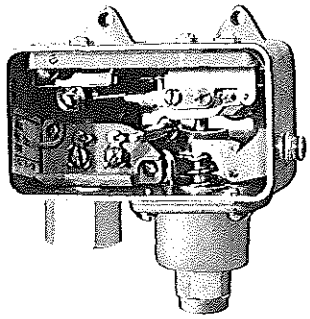


Fig. 1 — Screwdriver adjustment model.

The 222-10 Controls incorporate a seamless metallic bellows power element which, when actuated by pressure or temperature, operates the switch mechanism to open or close an electrical circuit. A permanent magnet in the switch mechanism provides a positive snap-action on both the opening and closing cycles. This snap-action prevents excessive arcing at the contacts.

ALARM PANEL (MIL-A-17196)

The switch may be used on vessels having an annunciator panel (Spec. MIL-A-17196) with a supervisory circuit continuously indicating whether ship's wiring between the panel and the alarm switch is in working order. To provide for this feature a Navy approved type resistor is connected across the switch terminal screws. This resistor is easily removed when switch is used on panels without this supervisory circuit.

INSTALLATION

Do not attach a pressure or direct connection temperature control by turning the case. Use a wrench on the power element hex.

Pressure Controls

Pressure controls may be installed directly at the point where the pressure is to be controlled, or mounted remotely and connected with standard pipe and fittings.

NOTE: On steam pressures over 15 pounds, a siphon (water seal) must be used to prevent damage to the control.

Temperature Controls, Direct Connection

Direct connection temperature controls must be installed with the thermal bulb in a free circulation of the medium to be controlled. Do not place the bulb in a dead end of pipe or any other location where it will not encounter the average temperature of the medium. Make certain there is sufficient room for the bulb in order that it will not be damaged by coming in contact with the bottom or side of the opening.

Temperature Controls, Remote Connection

Remote connection temperature controls are furnished with flexible tubing between the control and the thermal bulb. This permits mounting the control on a wall or any other convenient support.

Model NL (solid) thermal bulb must be installed within 75 Deg. of vertical pointing downward (with flexible tube coming out of upper end of bulb). Model NN (large coil) bulb must be installed within 75 Deg. of vertical upward (with flexible tube coming out of lower end of bulb).

The thermal bulb must be located in a free circulation of the liquid or other substance to be controlled. Do not place the bulb in a dead end of pipe or any other place where it will not meet the average temperature of the liquid or substance to be controlled.

Care should be taken not to put sharp bends in the flexible tube or damage the bulb by trying to install it where there is insufficient room.

Do not twist the flexible tube. When installing a control with a demountable union, assemble the union on the tubing, leaving it loose enough to turn freely on the tubing. After the bulb has been inserted to the desired position and the union has been screwed into place, tighten packing to prevent leakage. Be careful not to damage the tubing when tightening the union packing.

SETTING

The adjusting screw for setting the differential operating point, if adjustable differential is specified, is located inside the case and is exposed when the watertight cover is removed. Range adjustments may be made without removing the cover. This control is available with either screwdriver or knob range adjustment, located on the end of the case.

RANGE ADJUSTMENT: Screwdriver or knob adjustment establishes the point at which the switch will close. Range on screwdriver adjustment models is adjustable over the entire range of the control, while only one third of the range is normally adjustable on knob adjustment models.

If it is desired to adjust the knob adjustment models over the full range of the element, loosen range adjusting knob lock screw "A", Fig. 2. Remove screw "B", Fig. 2, and pull the knob out until the stop clears the locking clamp. Turn the stop on the knob past the clamp and replace the knob. Three full turns of the knob cover the entire range of the element.

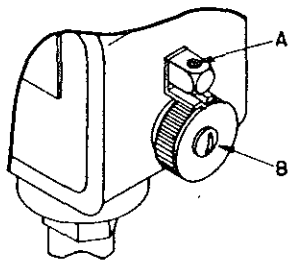


Fig. 2. Knob adjustment.

DIFFERENTIAL ADJUSTMENT (single pole, single throw only): Governs the point at which the switch opens, but does not affect the point at which the switch closes. The differential will vary with changes in range adjustment on *temperature* types but will remain constant on *pressure* types.

SWITCHES WHICH **OPEN** *THE CIRCUIT WITH INCREASING TEMPERATURE OR PRESSURE ARE ADJUSTED AS FOLLOWS:*

To Set: Turn differential screw counter-clockwise against stop for minimum differential. Bring temperature or pressure to point where circuit is to close. If contacts are open, turn range screw slowly clockwise until contacts just close. If contacts are already closed, turn range screw counter-clockwise until contacts open; then turn slowly clockwise until contacts just close. This fixes the closing point. Differential screw, which governs the point at which the contacts open, may be turned clockwise to widen the differential slightly.

SWITCHES WHICH **CLOSE** *THE CIRCUIT WITH INCREASING TEMPERATURE OR PRESSURE ARE ADJUSTED AS FOLLOWS:*

To Set: Turn differential screw counter-clockwise against stop for minimum differential. Bring temperature or pressure to point where circuit is to close. If contacts are open, turn range screw slowly counter-clockwise until contacts just close. If contacts are already closed, turn range screw clockwise until contacts open; then turn slowly counter-clockwise until contacts just close. This fixes the closing point.

Differential screw which governs the point at which the contacts open, may be turned clockwise to widen the differential slightly.

Double throw, dual contact types, double pole, and dual single pole single throw types are adjusted in exactly the same manner as the corresponding single throw, single pole switch shown above, except that the differential is factory set and is non-adjustable in the field.

NOTES: When adjusting temperature switches, all types, allow several minutes for thermal bulb to acquire proper temperature before making settings.

After adjusting all switches, check adjustments by observing an operating cycle.

When adjusting double throw switches all references to "contacts opening" or "contacts closing" refer to the **UPPER CONTACTS ONLY.**

ELECTRICAL RATINGS IN AMPS

SPST - SPDT* - DUAL SPST* - DUAL CONTACT DPST*				
VOLTAGE	INDUCTIVE		LOCKED ROTOR	
	A.C.	D.C.	A.C.	D.C.
115	16.0	9.6	96.0	96.0
230	8.0	4.8	48.0	48.0
440	4.0	2.5	25.0	25.0
550	3.2	2.0	19.2	20.0

* Lower Contact is rated at 1 amp D.C. and 16 amps A.C. at 115 V. Upper Contact is capable of direct control of motors up to 1 HP designed for voltages from 115 to 550 A.C. and D.C.

PRESSURE OPERATED

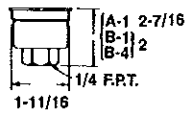


Fig. 1 - Models NA-1, NB-1 and NB-4

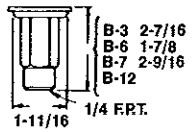


Fig. 2 - Models NB-3, NB-6, NB-7 and NB-12

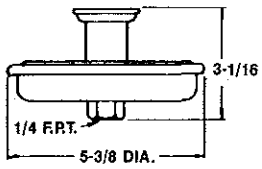


Fig. 3 - Models NC-1 and NC-2

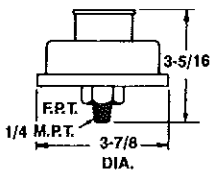


Fig. 4 - Models NC-3 and NC-4

TEMPERATURE OPERATED (STANDARD BULBS)

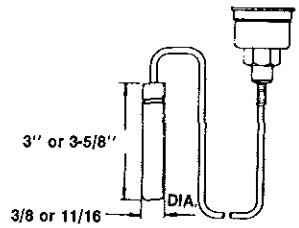


Fig. 5 - NL

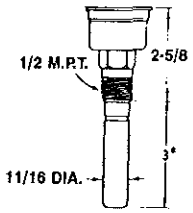


Fig. 6 - NH-1

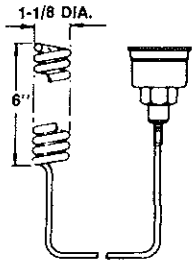


Fig. 7 - NN

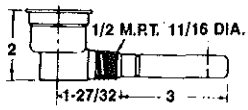


Fig. 8 - NH-2

DETROIT SWITCH, INC.

1025-33 BEAVER AVENUE
PITTSBURGH, PA. 15233

Phone 412 / 322-9144

GP-6/79 10M

PRINTED IN U. S. A.

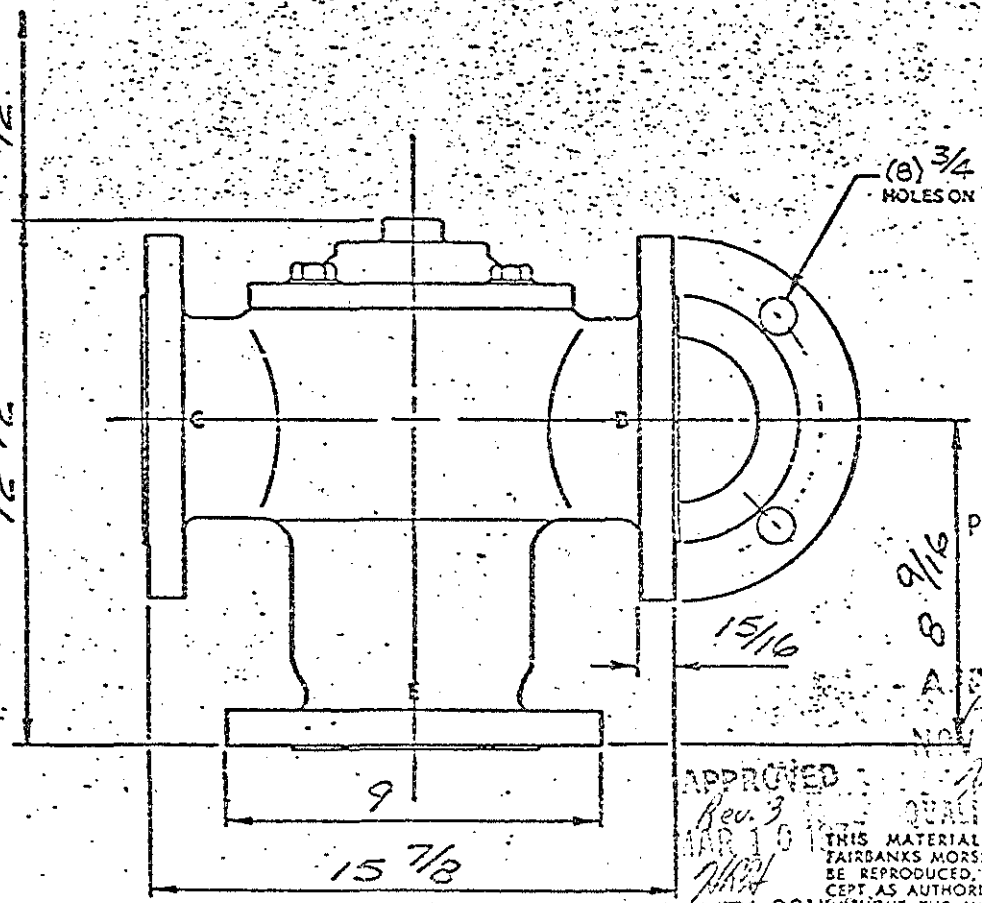
11 908 164

MAX. CLEARANCE REQUIRED FOR POPPET REMOVAL

VENDOR NO: 1
I-1285-Q-

VENDOR:
ROBERTSHAW CONTROLS
190 GORDON ST.
ELK GROVE VILLAGE, IL 60007

(1) SEE 11908456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR



(2)
LIMERICK GENERATING STAT.
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED Rev 4 MAR 22 1977 QUALITY CONTROL

APPROVED Rev 3 MAR 10 1977 QUALITY CONTROL

APPROVED Rev 2 NOV 12 1976 QUALITY CONTROL

APPROVED REV. 1 OCT 22 1976 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	10253	9-9-77	See Sheet 2	
3	10230	3-17-77	NENVD. IS FROM VEND. No. See Sheets 2 & 5	
2	10128	11-10-76	See Shts 3 & 4	
2	"	"	Added "Limerick Gen. Station----" (2)	
1	10097	10-29-76	Added "See 11908456 ..." note (1)	
1	"	"	See Sheet 1, 2 & 4	

TITLE
THREE-WAY THERMOSTATIC VALVE
4" LO. ASME III

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC1494 8-27-76 | ASSY. OR LO.
DR. BY P. ESTRADA 8/19/76 | SCALE —
CHK'D. BY L.W. Cooper 8-19-76 | HEAT TR.
MAT'L PURCHASE
APPV. CAST. | MACH. | WELD. | MAT'L | ENGR.

SHEET SIZE A | DWG. NO. 11 908 164 | SHEET 1 OF 5

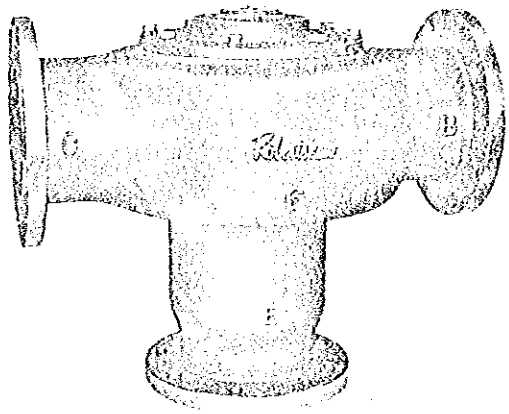
BF3009-2

Robertshaw
CONTROLS COMPANY

PRODUCT SPECIFICATION I-1285-P, Q, S, T

Temperature Regulator

I-1285-P, Q, S, T Series



GENERAL DESCRIPTION

The I-1285-P, Q, S & T Series Temperature Regulators are compact, self-contained and self-powered, three-way control valves especially adaptable to control of water and lubricating oil temperatures on internal combustion engines. The POWER PILL® element, located inside the poppet assembly, responds to the temperature of the medium surrounding it and provides the force necessary to position the poppet as the temperature of the liquid passing through the valve changes. Temperature regulation is achieved by the proportional action of the three-way valve which varies the amount of medium through or bypassing the cooler to maintain the desired temperature. Operation of the POWER PILL elements is unaffected by pressure changes in the system.

The POWER PILLS are factory-set for the specified control temperature and are not manually adjustable. By exchange of POWER PILL elements, the operating temperature may be changed in a very simple manner. Since all internal parts lift out with the valve bonnet, it is not necessary to remove the valve from the piping.

SPECIFICATIONS

A. CONSTRUCTION

Valve Body – Cast steel with 150 lb. ANSI flanges.

Trim –

3" – Brass poppet and seating surfaces.

4, 5, & 6" – Brass poppet with integral steel seating surfaces.

Poppet Seal – Split Buna-N "O"-ring (General Purpose, one red dot).

Split Polyacrylate "O"-ring (Lube Oil Service, two blue dots)

NOTE: Unless otherwise specified, General Purpose Seal is installed at factory, with additional Lube Oil Seal packed with valve.

Dimensions – See Figure 1.

B. OPERATING RANGES

Available temperature ranges are tabulated below.

The maximum valve body rating is 150 psi at 250° F.

CAUTION: Do not exceed maximum temperature/pressure rating.

C. MODELS AVAILABLE*

I-1285–S 8

MODEL NO.

CODE	SIZE
P	3"
Q	4"
S	5"
T	6"

NORMAL OPERATING TEMPERATURE AT MID-STROKE °F.			
STANDARD		SPECIAL	
CODE	TEMP.	CODE	TEMP.
18	120	24	60
1	130	16	75
15	140	22	80
4	150	20	90
5	155	19	100
10	160	25	110
11	165	2	135
12	170		
21	175		
13	180		
8	185		
17	190		
23	200		

*NOTE: For cast brass valve body, refer to I-1285-B thru G Series.

Form No. P-2331, Rev. B

ROBERTSHAW CONTROLS COMPANY
INDUSTRIAL INSTRUMENTATION DIVISION

INSTALLATION

A. GENERAL

Prior to installation, the valve body and parts should be checked to determine if any damage occurred in shipment. Any damage should be reported to the shipper as soon as possible. Foreign matter which may have entered the valve during packing or shipment should be removed.

B. LOCATION

The I-1285 may be installed indoors or out, provided the liquid to be controlled does not freeze. Temperature regulators should be installed as near as possible to the unit being controlled, and a pipeline strainer should be installed upstream.

C. POSITION

Although these valves will operate in any position, the best performance is achieved in the vertical upright position (E port down). When the four, five, or six inch regulators are to be installed up-side-down, the factory should be notified so that a special load spring may be supplied. (See Parts List).

D. SERVICE

Unless otherwise specified on the order, regulators are shipped with a general purpose split "O"-ring installed which is color coded with one red dot. If the regulator is to be used on lube oil service, the lube oil split "O"-ring (color coded with two blue dots), that is attached to the valve, should be installed.

Whenever synthetic* lube oils or special coolants are used, the factory should be consulted to determine compatability with split "O"-ring material.

*Not recommended for use with estar base synthetic lubricant.

VALVE MODEL	SIZE, In.	DIMENSION								
		A	B	C	D	F	G	H	M	X
I-1285-P	3"	11-3/16	7-1/2	13/16	10-1/2	4	3/4	6	6-3/4	10
I-1285-Q	4"	12-1/2	9	15/16	15-7/8	8	3/4	7-1/2	8-9/16	12
I-1285-S	5"	17-7/8	10	15/16	19-1/4	8	7/8	8-1/2	11-5/8	14
I-1285-T	6"	19-5/8	11	1	23-1/2	8	7/8	9-1/2	13-7/16	16

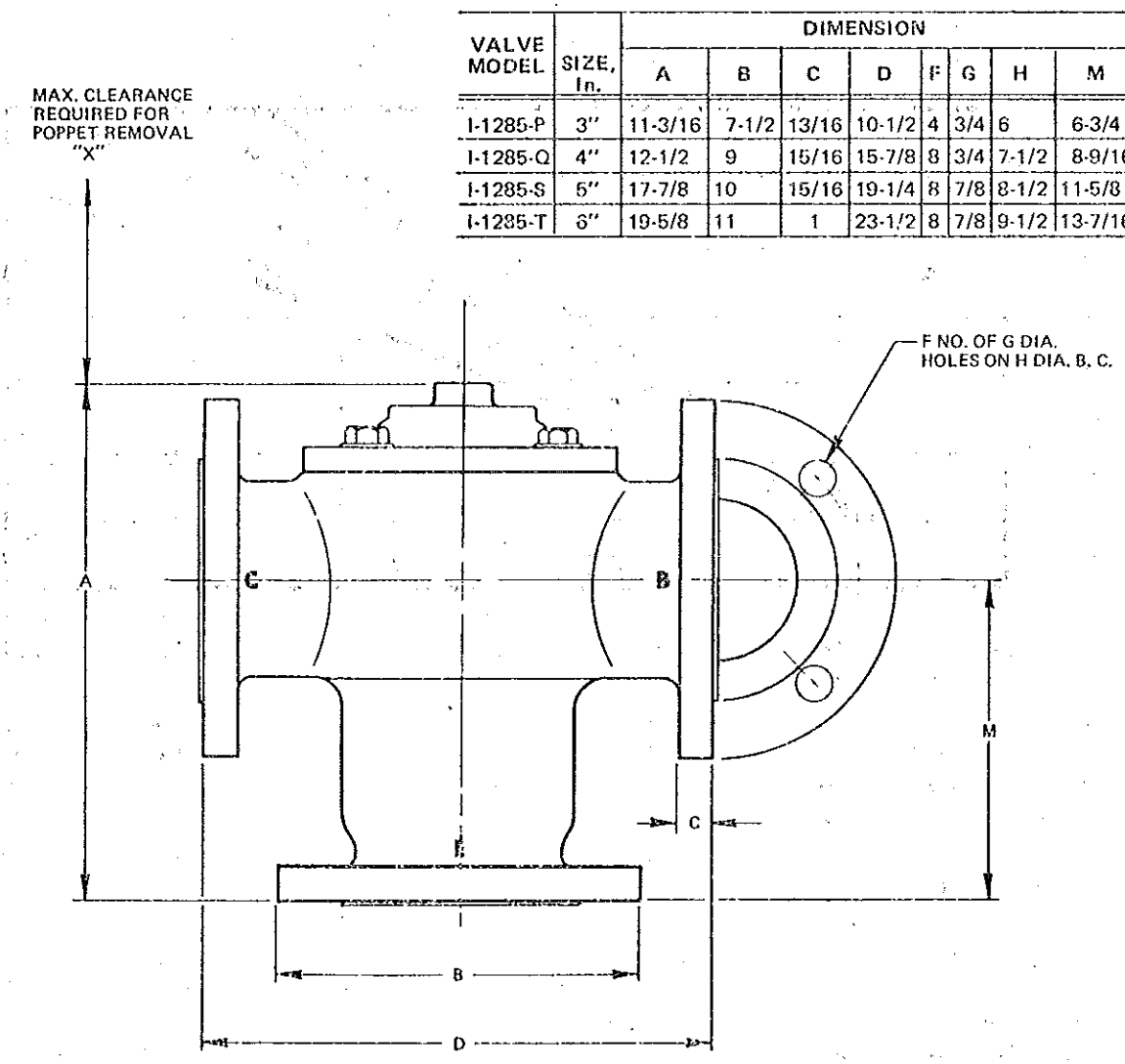
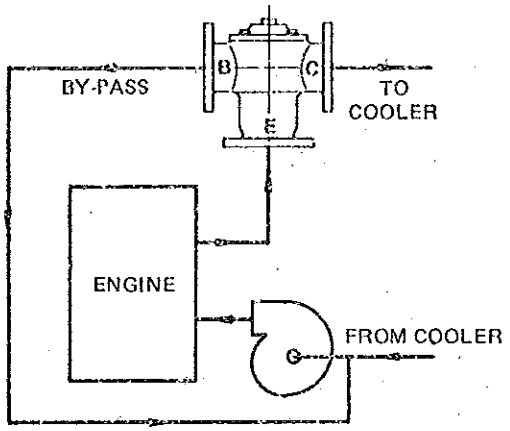
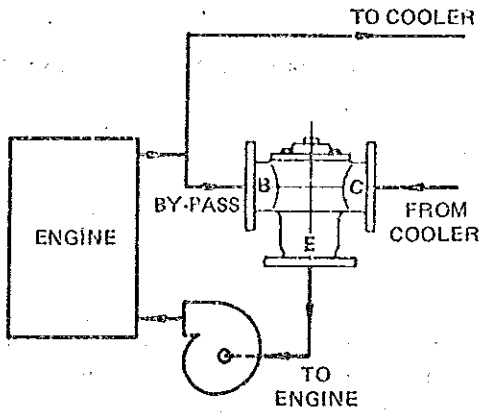


Figure 1

INSTALLATION (Cont'd)



PIPING SCHEMATIC — Used as diverting valve to control temperature leaving engine, most common application.



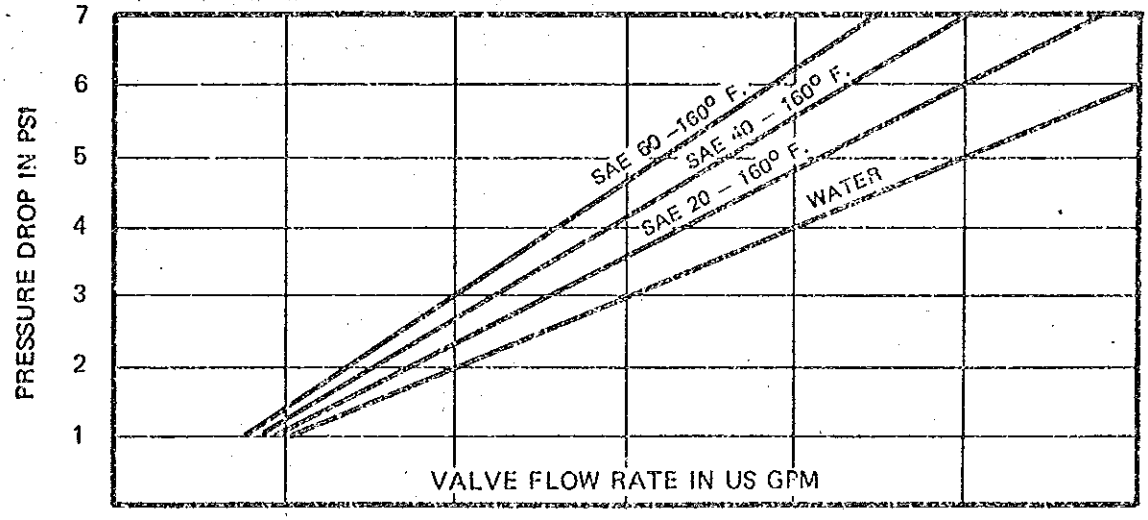
PIPING SCHEMATIC — Used as blending valve to control temperature entering engine.

Figure 2

OPERATION

With low temperature liquid surrounding the POWER PILL, the poppet is in the upward position which connects ports "E" and "B." As the temperature increases, the POWER PILL stem extends forcing the poppet downward. When the temperature reaches the control point of the regulator, the valve will be at mid-stroke. If the temperature continues to increase, the poppet will continue to move downward until the by-pass port (B) is completely closed off. (See Figure 4.)

FLOW COEFFICIENTS: Table below indicates the flow in U.S. G.P.M. at different pressure drops. C_V Coefficients are listed in column 1 under 1 psi pressure drop (water).



PORT SIZE							
3"	C – Cooler Port	107	151	188	214	239	262
	B – Bypass Port	116	164	201	232	260	284
	E – Mid Stroke	113	188	232	266	297	326
4"	C – Cooler Port	262	370	454	524	586	641
	B – Bypass Port	243	343	421	486	544	595
	E – Mid Stroke	324	457	561	648	725	794
5"	C – Cooler Port	408	576	706	816	911	1000
	B – Bypass Port	364	515	631	728	815	892
	E – Mid Stroke	500	707	865	1000	1120	1225
6"	C – Cooler Port	614	866	1060	1228	1375	1505
	B – Bypass Port	520	735	900	1040	1165	1275
	E – Mid Stroke	700	990	1210	1400	1570	1720

NOTE 1: C_V coefficients coincide with figures in first column.

NOTE 2: Data on "Mid-Stroke" shows total flow through inlet with valve in mid position.

NOTE 3: Normally for engine application, valve should be sized for total flow through cooler port, based on a pressure drop of 2 – 5 psi (incl.)

NOTE 4: Total leakage through seats and web, approximately 2% or less of total flow with O-Ring removed.

MAINTENANCE

A. RECOMMENDED SPARE PARTS

The following parts should be kept on hand for maintenance purposes:

1. Split "O"-ring seal.
2. Replacement power pills.
3. Bonnet gasket.

B. TROUBLE SHOOTING

If valve fails to make required stroke as temperature exceeds control point, check for:

1. Foreign matter interfering with poppet travel.
2. Swollen or damaged split "O"-ring seal. (See "Service," Page 2.)
3. Power pill failure.

If valve fails to return stroke as temperature drops below control point, check for:

1. Foreign matter interfering with poppet travel.
2. Swollen or damaged split "O"-ring seal. (See "Service," Page 2.)
3. Damaged load spring.
4. Power pill failure.

Excessive internal leakage between ports:

1. Damaged or worn out split "O"-ring seal. (See "Service," Page 2.)
2. Damaged or uneven valve seats.
3. Poppet not making complete stroke.

C. REPAIR

WARNING: Disassemble carefully – spring load forces present.

Replacing power pill elements:

1. Remove bonnet and poppet assembly from valve and place on wooden blocks. (See Figure 3.)
2. Loosen the bolts on top of the poppet and remove the stem and retainer by lifting upward.
3. Power pills and overrun assemblies may now be removed.
4. Reassemble as shown in Figures 4 through 7, depending on valve size.

Replacing split "O"-ring seal:

1. Remove bonnet and lift out the entire poppet assembly.
2. Remove old split "O"-ring and replace with a new one. (See "Service," Page 2.)
3. Replace poppet assembly, taking care not to cut or pinch ring.

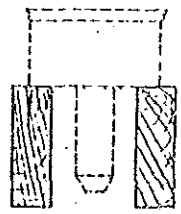


Figure 3

D. ADJUSTING THE I-1285

1. Rest the bottom of the poppet on blocks. (See Figure 3.)
2. Loosen stem locknut on inside of bonnet.
3. Place bonnet on the poppet assembly and adjust the stem until the poppet just touches seating surface on the bonnet.
4. Turn the stem into the bonnet one-half to one turn so that the poppet is securely seated.
5. Tighten locknut and bend the tab on the lock-washer.
6. The poppet and bonnet assemblies are now ready to install in the body.

E. REPAIR PARTS

For replacement part numbers, consult the parts list, Pages 5 and 6. When ordering give complete model number, spare part name and number, with quantity required.

Ordering Information:

Specify Model No. including suffix.

Order From:
ROBERTSHAW CONTROLS COMPANY
Industrial Instrumentation Division
P. O. Box 400
Knoxville, Tennessee 37901

PARTS LIST

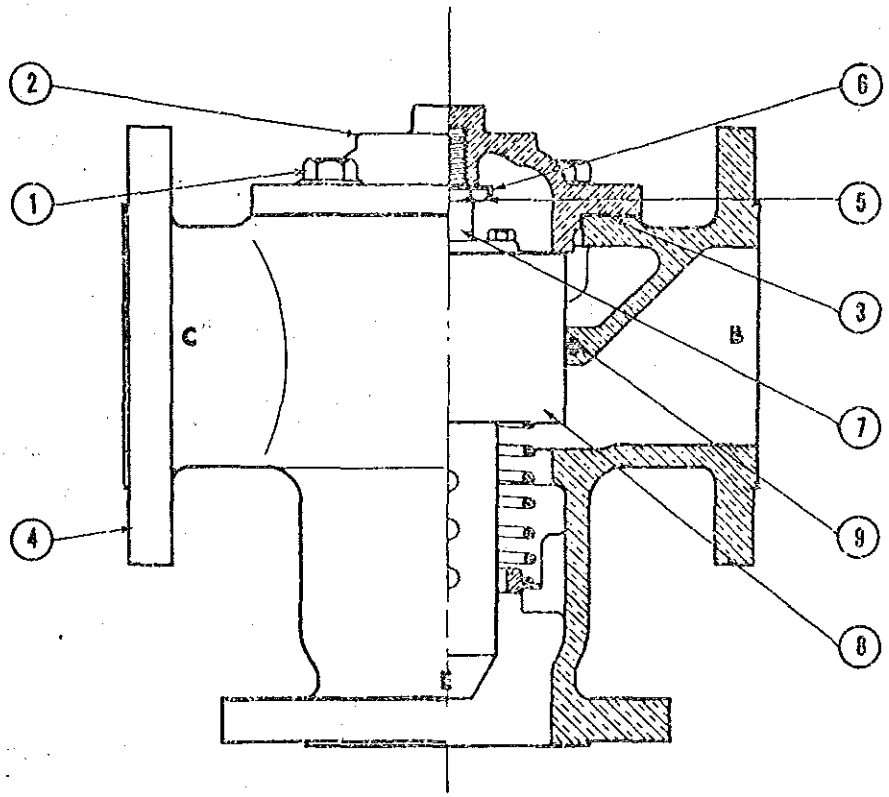


Figure 4

DETAIL NO.	DESCRIPTION	REGULATOR NUMBER & SIZE							
		I-1285-P 3"		I-1285-Q 4"		I-1285-S 5"		I-1285-T 6"	
		Part No.	No. Req'd	Part No.	No. Req'd	Part No.	No. Req'd	Part No.	No. Req'd
1	Cap Screw	3153-C	4	32322-A1	8	32322-B1	8	32322-B1	8
2	Bonnet & Seat Ring	81707-B1	1	20189-B1	1	20190-B1	1	20190-B1	1
3	Gasket	33110-A1	1	33110-A2	1	33110-A3	1	33110-A3	1
4	Valve Body & Seat Ring	81710-B1	1	84867-A1	1	84867-A2	1	84867-A3	1
5	Locknut	20195	1	20195	1	20195	1	20195	1
6	Lock Washer	20194	1	20194	1	20194	1	20194	1
7	Stem	20192	1	20685-B1	1	20686	1	20686	1
8	Poppet Assembly	See Fig. 5	1	See Fig. 5	1	See Fig. 6	1	See Fig. 7	1
9	Split "O"-Ring								
	A. Lube Oil Service	22777-B1	1	22777-C1	1	22777-E1	1	22777-E1	1
	B. General Purpose	22777	1	22777-D1	1	22777-F1	1	22777-F1	1

PARTS LIST (Cont'd)

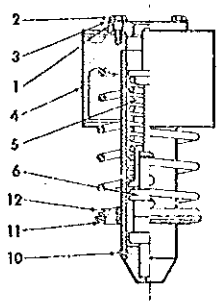


Figure 5
3" & 4" Sizes

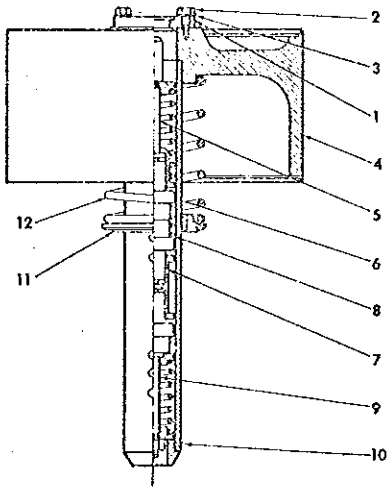


Figure 6
5" Size

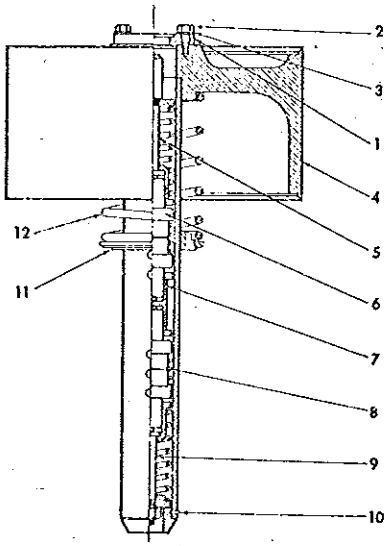


Figure 7
6" Size

DETAIL NO.	DESCRIPTION	REGULATOR NUMBER & SIZE							
		I-1285-P 3"		I-1285-Q 4"		I-1285-S 5"		I-1285-T 6"	
		Part No.	No. Req'd	Part No.	No. Req'd	Part No.	No. Req'd	Part No.	No. Req'd
*All	Complete Poppet Assembly	82157-E	1	82157-F	1	82157-B	1	82157-C	1
1	Retainer	30524-B1	1	30524-A1	1	30524-A1	1	30524-A1	1
2	Cap Screw	3889	3	3889	4	3889	4	3889	4
3	Lock Washer	22025	3	22025	4	22025	4	22025	4
4	Poppet & Pipe Assembly	82159-C2	1	82159-A1	1	82159-B1	1	82159-B2	1
5	Top Spring & Stem Assembly	82158-A1	1	82158-A1	1	82158-A1	1	82158-A1	1
*6	Thermo. Assembly	96995-A	2	96995-A	2	96995-A	3	96995-A	4
7	Spacer	--	--	--	--	30722-A1	1	30722-A1	1
8	Spring	--	--	--	--	20070	1	20070	1
9	Bottom Spring & Stem Assembly	--	--	--	--	82158-C1	1	82158-D1	1
10	Drive Screw	25033-A1	1	25033-A1	1	25033-A1	1	25033-A1	1
11	Spring Retainer	31105-D1	1	31105-D1	1	31105-B1	1	31105-B1	1
†12	Load Spring	19363	1	19863	1	30989-A1	1	30989-A1	1
†Springs for inverted valve service		--	--	--	--	28208-A1	1	28203-A1	1

*Add suffix number to thermo Assembly and/or Poppet Assembly per range code on Page 1.
EXAMPLE: Thermo Assembly 96995-A11 for 165 F. setpoint.

Robertshaw
CONTROLS COMPANY

U.S.: Industrial Instrumentation Division
FOREIGN: International Marketing Division
1701 Byrd Avenue
P. O. Box 26544
Richmond, Virginia 23261
TWX 710-956-0121 Tel: (804) 282-9561

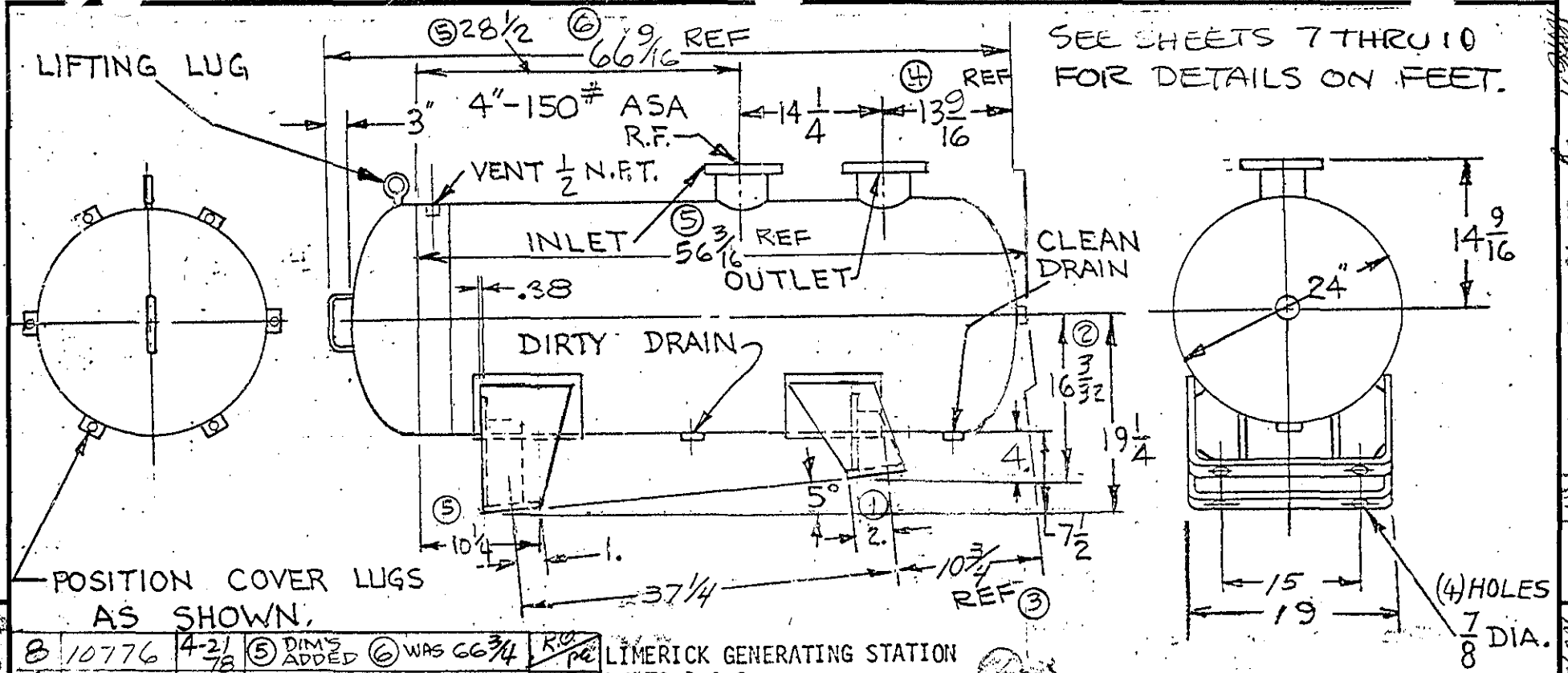
CANADA: Robertshaw Controls (Canada) LTD.
41 Medulla Avenue
Toronto, Ontario, Canada M8Z 5W1
Tel: (416) 233-5831
Twx: 610-492-1311
Telex: 06-967613

Mfg. at Knoxville, Tennessee

Q-2948 (Issue 5-75)

Printed in U.S.A.

11 908 169



8	10776	4-21-78	⑤ DIM'S ADDED ⑥ WAS 66 3/4	KO PE
8	"	"	③ ADDED REF ④ WAS 13 11/16	KO PE

VENDOR: WILLIAM W. NUGENT CO.
SKOKIE, ILL

APPROVED Rev 7 DEC 8 1977 QUALITY CONTROL

APPROVED Rev 6 NOV 22 1977 QUALITY CONTROL

APPROVED Rev 5 MAY 3 1977 QUALITY CONTROL

APPROVED Rev 4 MAR 15 1977 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

11	11814	4-10-80	SEE SHEET 2
10	11348	3-21-79	SHEET 11 ADDED
9	11014	8-7-78	ADD RAY STATE TO SUBTIER SPECS ①

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7	10599A	12-14-77	REVISED FEET & BRACE SEE SHT'S # 9 & 10	KO PE
7	"	"	② WAS 16 ① WAS 1'	KO PE
6	10599	12-2-77	WAS 1 OF 6 REVISED FEET & BRACE	PE BC
5	10312	5-6-77	SEE SH. 6	K.O
4	10239	3-21-77	See Sheets 2-6 Was Sheet 1 of 5	PHN RH
	"	"	Redrawn	PHN RH

CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
FILTER,
LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. Norman	3/10/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR. R.O.M.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 169 | SHEET 1 OF 11

DESCRIPTION: NUGENT MODEL 1555-214B-SY-W PRESSURE FILTER ASSEMBLY WITH THE FOLLOWING FEATURES:

I. GENERAL REQUIREMENTS:

A. FILTER TO BE MOUNTED 5° FROM THE HORIZONTAL POSITION.

B. FILTER TO BE SIZED FOR 175 HOURS CONTINUOUS FULL-FLOW POSITION.

C. FILTER ELEMENTS TO BE DESIGNED FOR REMOVING PARTICLES DOWN TO 5 MICRON SIZE AND ABSORB WATER CONTAMINATION.

D. DESIGN PRESSURE 150 PSIG.

E. TO HANDLE 500 GPM OF SAE 40 (1) LUBE OIL AT NORMAL OPERATING TEMPERATURE OF 185° + 5°F. -10°F.

F. WITH SEVEN (7) #30-400-203 DISC TYPE WATER ABSORBENT ELEMENTS.

G. WITH BY-PASS VALVE IN ALL SEVEN CENTER TUBES. VALVES TO OPEN AT 20 PSI.

H. TO BE PROVIDED WITH GAUGE CONNECTIONS BUT WITHOUT GAUGE.

element N83 4 L 5 OCS

11910106

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-10-80	(1) WAS SAE 30 LUBE OIL	W.P.S. LD
10	11348	3-21-79	SEE SHEET 1	
9	11014	8-7-78	See Sht. 1	
8	10776	4-21-78	SEE SHEET #1	K.O.
7	10599A	12-14-77	SEE SH'TS #1, 9 & 10	K.O.
6	10599	12-2-77	SEE SHT 1 WAS 2 OF 6	
5	10312	5-6-77	SEE SH. 1	KO
4	10239	3-21-77	See Sheet 1	RHN EH
4	"	"	REDRAWN Was Sheet 2 of 5	RHN EH

APPROVED Rev 7 DEC 8 1977 QUALITY CONTROL

APPROVED Rev. 6 NOV 22 1977 QUALITY CONTROL

APPROVED Rev. 5 MAY 3 1977 QUALITY CONTROL

APPROVED Rev. 4 MAR 15 1977 QUALITY CONTROL

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Colt Industries Fairbanks Morse Engine Division

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TITLE
FILTER,
LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

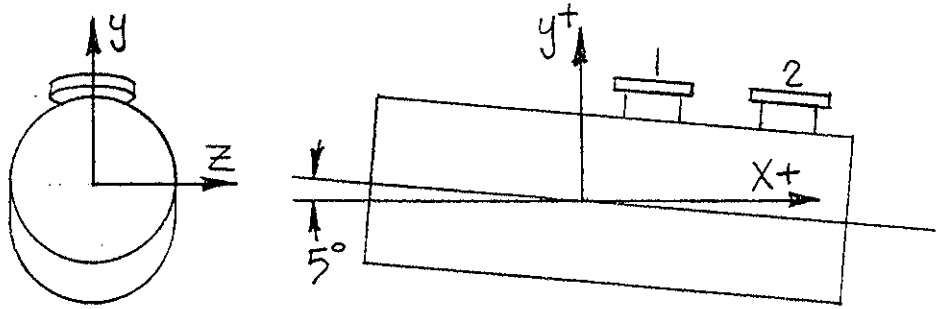
REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. Norman	3/10/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR. R.O.
	WELD.		

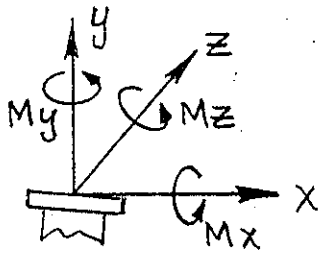
SHEET SIZE A | DWG. NO. 11 908 169 | SHEET 2 OF 10

BF3009-2

(1) II. DESIGN MECHANICAL LOADS:

(1) A. NOZZLE FORCES AND MOMENTS:





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Colt Industries — Fairbanks Morse Engine Division

(1) 1. FORCES ARE (+) WHEN ACTING IN DIRECTION OF ARROWS IN SKETCH. MOMENTS ARE (+) WHEN ACTING IN A CLOCKWISE DIRECTION WHEN LOOKING AT AXIS FROM ORIGIN TOWARD ARROW. F_d AND M_d CAN ACT IN ANY DIRECTION DUE TO SEISMIC NATURE. SELECT SENSE AND DIRECTION WHICH, WHEN COMBINED VECTORILY WITH THE OTHER FORCES AND MOMENTS, WILL RESULT IN THE MOST SEVERE STRAIN OF THE CONNECTION AND ITS ATTACHMENT TO THE VESSEL.

9	11014	8-7 78	See Sht. 1	NLS MSM
8	10776	4-21 78	SEE SHEET #1	K.D PE
7	10599A	12-14 77	SEE SH'T'S #1, 9, & 10	K.D PE

11	11814	4-10 80	SEE SHEET 2	MRS LPS
10	11348	3-23 79	SEE SHEET 1	

APPROVED Rev. 7 DEC 8 1977 QUALITY CONTROL

APPROVED Rev. 6 NOV 22 1977 QUALITY CONTROL

APPROVED Rev. 5 MAY 3 1977 QUALITY CONTROL

APPROVED Rev. 4 MAR 15 1977 QUALITY CONTROL

APPROVED Rev. 3 FEB 21 1977

REV. 2 DEC 23 1976

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
6	10599	12-2 77	SEE SHT 1 WAS 3 OF 6	PE RC
5	10312	5-6 77	SEE SH. 1	RHH B.O
4	10239	3-21 77	See Sheet 1 Was Sheet 3 of 5	RHH RH
4	"	"	Paras. Renumbered (1)	RHH RH
3	10207	3-2 77	SEE SHT. 1	RHH KAS
2	10156	12-24 76	REDRAWN	R.H. R.N.

TITLE
FILTER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY R. HUMKE	12/22/76	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 169 | SHEET 3 OF 11

BF3009-2

(1) 2.

CONNECTION		1	2
Fa (LB)	Y	1268	1268
	X	111	111
	Z	0	0
Fb (LB)	Y	0	0
	X	0	0
	Z	1590	-1590
Mb (FT-LB)	Y	0	0
	X	1193	- 861
	Z	0	0
Fc		N/A	N/A
Mc		N/A	N/A
Fd(LB)		403	403
Md(FT-LB)		289	289

Fa IS AXIAL FORCE DUE TO 100 PSI INTERNAL PRESSURE IN CONNECTION. THIS APPEARS AT THE CONNECTION BUT IS BALANCED INTERNALLY AND DOES NOT APPEAR AT SUPPORTS.
Fb IS FORCE FROM THERMAL EXPANSION AND/OR THRUST OF FLEXIBLE CONNECTORS IN ATTACHED PIPING.
Mb IS MOMENT FROM Fb.
Fd IS FORCE POSSIBLE FROM SEISMIC ACTION ON ATTACHED PIPING.
Md IS MOMENT FROM Fd

NOV 22 1977 QUALITY CONTROL APPROVED Rev. 5
MAY 3 1977 QUALITY CONTROL APPROVED Rev. 4
MAR 15 1977 QUALITY CONTROL APPROVED Rev. 3
FEB 21 1977 QUALITY CONTROL APPROVED Rev. 2
APPROVED Rev 1 DEC 8 1977 QUALITY CONTROL

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Colt Industries Fairbanks Morse Engine Division

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
8	10776	4-21-78	SEE SHEET #1	K.D. PE
7	10599A	12-14-77	SEE SH'TS #1, 9, & 10	K.D. PE
6	10599	12-2-77	SEE SHT 1 WAS 4 OF 6	PE P.C.
5	10312	5-6-77	SEE SH. 1	K.D.
4	10239	3-21-77	See Sheet 1 Was Sheet 4 of 5	R.H.N. F.H.D.
4	"	"	Para. Renumbered (1)	R.H.N. F.H.D.
3	10207	3-2-77	SEE SHT. 1	R.H.N. K.A.S.
2	10156	12-24-76	NEW SHEET ADDED	R.H. R.N.
1	11814	4-19-80	SEE SHEET 2.	H.R.S.
10	11348	3-21-79	SEE SHEET 1	L.D.
9	11014	8-7-78	See Sht. 1	W.L.S.

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TITLE
FILTER, LUBE OIL

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY R. HUMKE	12/22/76	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MATL.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 169 | SHEET 4 OF 4

COLT FM QA APP APR 1 1978 Rev. 9 COLT FM QA APP JUL 31 1978 Rev. 10 COLT FM QA APP FEB 26 1979 Rev. 11 QA APP APR 3 1980

BF3009-2

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Colt Industries — Fairbanks Morse Engine Division

(1) B. SUPPORT LOADS:

THE FOLLOWING LOADS ARE TO BE CONSIDERED WHEN DETERMINING THE REACTIONS AT THE COMPONENT SUPPORTS:

1. DEAD WEIGHT AND SEISMIC LOADS:

$F_{ey} = (-1 \pm 1.1)\ WT$
$F_{ex} = \pm\ 3WT$
$F_{ez} = \pm\ 3WT$

WHERE W_T = WEIGHT OF COMPONENT + WEIGHT OF CONTENTS.

THE ABOVE LOADS ARE TO BE CONSIDERED AS ACTING AT THE CG OF THE COMPONENT. THERE ARE NO MOMENTS AT THE CG RESULTING FROM THE DEAD WEIGHT OR THE SEISMIC LOAD OF THE COMPONENT AND ITS CONTENTS.

2. Fby, Fbx, Fbz, Fd, Fey, Fex & Fez EACH ACTING AT THEIR RESPECTIVE CONNECTION OR CG, VECTORILY ADDED. THE DIRECTION AND SENSE OF F_d MUST BE CHOSEN TO RESULT IN THE MOST SEVERE REACTION AT THE COMPONENT SUPPORTS.

3. Mby, Mbx, Mbz & Md ACTING AT THE C.G. ARE TO BE ADDED VECTORILY. THE SENSE OF M_d IS TO BE CHOSEN TO RESULT IN THE MOST SEVERE REACTION AT THE COMPONENT SUPPORTS.

4. THE TOTAL REACTION AT THE SUPPORTS IS THE SUM OF THE DEAD WEIGHT AND SEISMIC LOADS (a) PLUS THE FORCES AND MOMENTS (b) & (c) FOR EACH OF THE CONNECTIONS.

APPROVED Rev 7 DEC 8 1977 QUALITY CONTROL

APPROVED Rev. 6 NOV 28 1977 QUALITY CONTROL

APPROVED Rev. 5 MAR 1977 QUALITY CONTROL

APPROVED Rev. 4 MAR 16 1977 QUALITY CONTROL

APPROVED Rev. 3 FEB 21 1977 QUALITY CONTROL

APPROVED Rev. 2 Seer QUALITY CONTROL

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-7-80	SEE SHEET 2	
10	11348	3-31-78	SEE SHEET 1	LE
9	11014	8-7-78	SEE SHT. 1	
8	10776	4-21-78	SEE SHEET #1	
7	10599A	12-14-77	SEE SHT'S #1, 9, & 10	
6	10599	12-2-77	SEE SHT 1 WAS 5 OF 6	
5	10312	5-6-77	SEE SH. 1	
4	10239	3-21-77	See Sheet 1 Was Sheet 5 of 5	
4	"	"	Paras. Renumbered (1)	
3	10207	3-2-77	SEE SHT. 1	
2	10156	12-24-76	NEW SHEET ADDED	

TITLE: FILTER, LUBE OIL

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. / / ASSY. OR LO.
DR. BY R. HUMKE 12/22/76 SCALE
CHK'D. BY / / HEAT TR.
MAT'L
APPV. CAST. MAT'L
APPV. MACH. ENGR.
APPV. WELD.

SHEET SIZE A | DWG. NO. 11 908 169 | SHEET 5 OF 5

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COLT Rev. 10 Issued FEB 26 1979 QA FM APP
COLT Rev. 11 Issued APR 3 1980 QA FM APP
COLT Rev. 9 Issued APR 11 1978 QA FM APP
COLT Rev. 9 Issued JUL 31 1978 QA FM APP

BF3009-2

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Colt Industries — Fairbanks Morse Engine Division

III. SPECIAL REQUIREMENTS:

A. TO BE IN COMPLIANCE WITH COLT FMED QUALITY REQUIREMENTS FOR ASME IV & VIII (1) COMPONENTS ~~#11 908 456.~~ 11871599 (1) REV. 1 (7)

B. TO BE CONSTRUCTED AND CODE STAMPED IN ACCORDANCE WITH 1974 ASME SECTION VIII AND COMMONWEALTH OF PENNSYLVANIA REQUIREMENTS FOR BOILERS & UNFIRED PRESSURE VESSELS.

C. PAINTING AND PRIMING REQUIREMENTS.

1. SURFACES REQUIRING PRIME AND PAINT
TO BE SUPPLIED WITH VENDOR'S STANDARD SHOP PRIME ONLY. ALL INTERNAL AND EXTERNAL SURFACES SHALL BE THOROUGHLY AND COMPLETELY CLEANED OF ALL MILL SCALE, CUTTINGS, OIL, WELDING SPATTER, AND OTHER FOREIGN MATTER. THE SURFACES SHALL THEN FURTHER BE CLEANED TO A MINIMUM REQUIREMENT AS SET DOWN BY SSPC-3 (POWER TOOL CLEANING) PRIOR TO PRIMING AND SHIPMENT. THE DRY FILM THICKNESS SHALL BE AT LEAST 1.5 MILS, BUT NO MORE THAN 2.0 MILS. GOOD PAINT PRACTICE, AS STATED IN SSPC-PA-1 SHALL BE OBSERVED.
2. SURFACES NOT REQUIRING PRIME
MACHINED SURFACES SHALL BE PROTECTED WITH AT LEAST 4 MILS DRY FILM THICKNESS OF MIL-C-16173 GRADE 5 OR SIMILAR PRODUCT APPROVED BY BUYER.

D. MERCURY SHALL NOT BE USED IN ANY FORM IN THE FILTER PER BECHTEL SPEC. 8031-M-71, PG. 13, REV. 3, PARA. 4.1.j.

E. SPECIAL TOOLS SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.13.

F. SPARE PARTS LIST SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.14.

G. NAMEPLATES SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 42 & 43, REV. 2, PARA. 6.2.

IV. F. M. DUTIES:

A. ASME QUALITY ASSURANCE REQUIREMENTS DWG. ~~11 908 456.~~ 11871599-(1) REV. 1 (7)

B. SUPPLY COPY OF BECHTEL SPECIFICATION 8031-M-71, PG. 13, REV. 3, PARA. 4.1.j, PG. 36, REV. 3, PARAS. 4.13 & 4.14 AND PGS. 42 & 43, REV. 2, PARA. 6.2 WITH PURCHASE ORDER.

APPROVED Rev. 6 NOV 22 1977 QUALITY CONTROL

APPROVED Rev. 5 MAY 3 1977 QUALITY CONTROL

APPROVED Rev. 7 DEC 8 1977 QUALITY CONTROL

APPROVED Rev. 4 MAR 15 1977 QUALITY CONTROL

COLT FM FEB 26 1979 APP Rev. 10

COLT FM APR 1 1978 APP Rev. 9

COLT FM JUL 31 1978 APP Rev. 8

COLT FM APR 1 1978 APP Rev. 7

COLT FM APR 13 1980 APP Rev. 11

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
9	11014	8-7-78	See Sht. 1	NLS MSD
8	10776	4-21 78	SEE SHEET #1	K.D. PE
7	10599A	12-14 77	SEE SH'TS #1, 9, & 10	K.D. PE
6	10599	12-2 77	SEE SHT 1 WAS 6 OF 6	PE BC
5	10312	5-6 77	REVISED QA ASME DWG. NO. (1)	RHA K.D.
4	10239	3-21 77	See Sheet 1	RHA R.H.
4	"	"	Spec. Reqmts Sheet 6 Added	RHA R.H.

FT	11814	4-16-80	SEE SHEET 2	HRS
10	11348	3-21-79	SEE SHEET 1	LD

TITLE
FILTER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

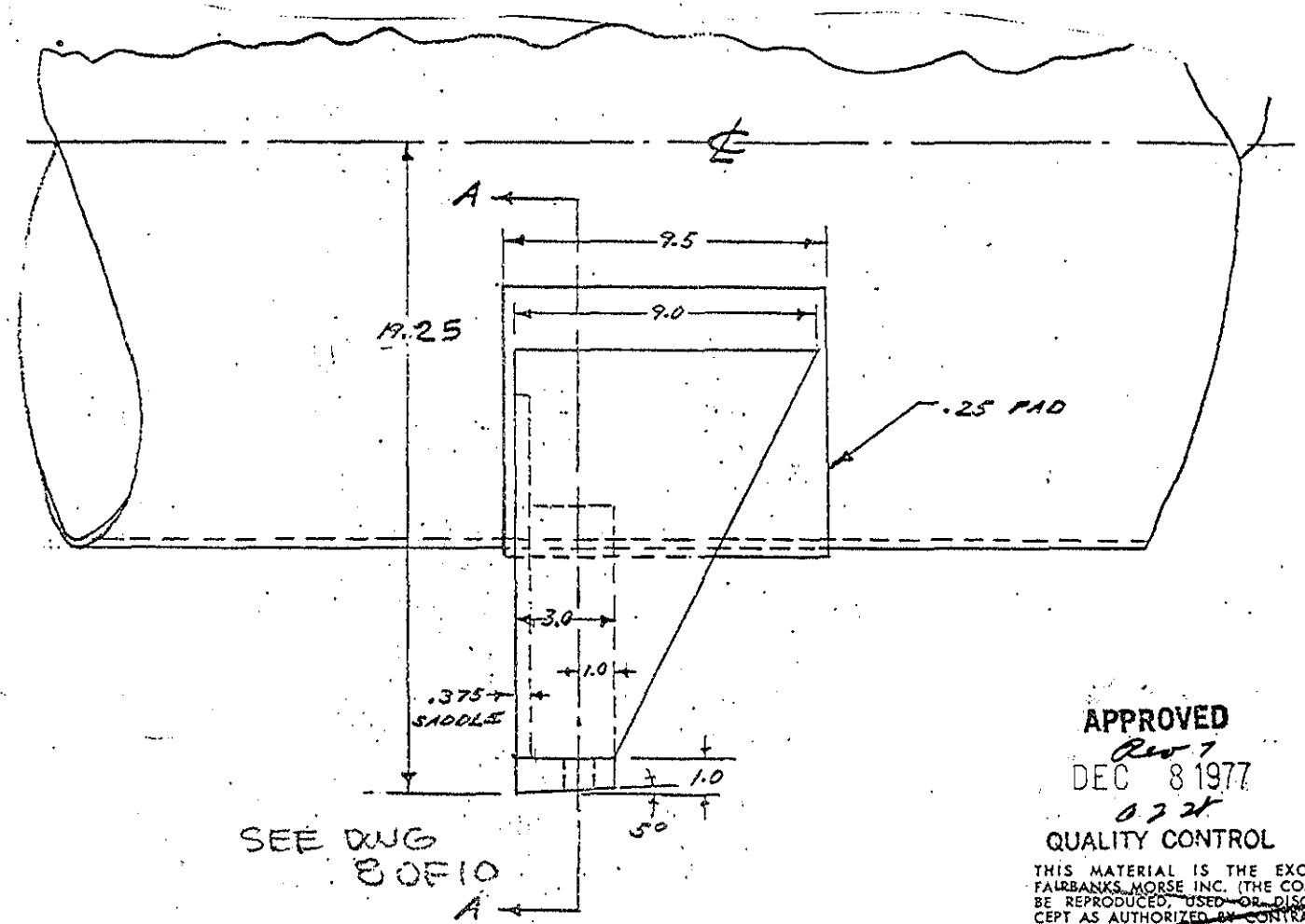
REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. Norman	3/10/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR. R.O.M.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 169 | SHEET 6 OF 11

BF3009-2

11908169

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Colt Industries — Fairbanks Morse Engine Division



APPROVED
Rev 7
DEC 8 1977
QUALITY CONTROL

APPROVED
Rev. 6
NOV 22 1977
QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-10 80	SEE SHEET 2	A.R.S.
10	11348	3-21 79	SEE SHEET 1	LJS
9	11014	8-7 78	See Sht. 1	ULS
8	10776	4-21 78	SEE SHEET #1	K.O.
7	10599A	12-14 77	SEE SHT's #1, 9, & 10	K.O.
6	10599	12-2 77	ADDED SHT 7	PG

TITLE
FILTER LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	B.C.	11/21/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

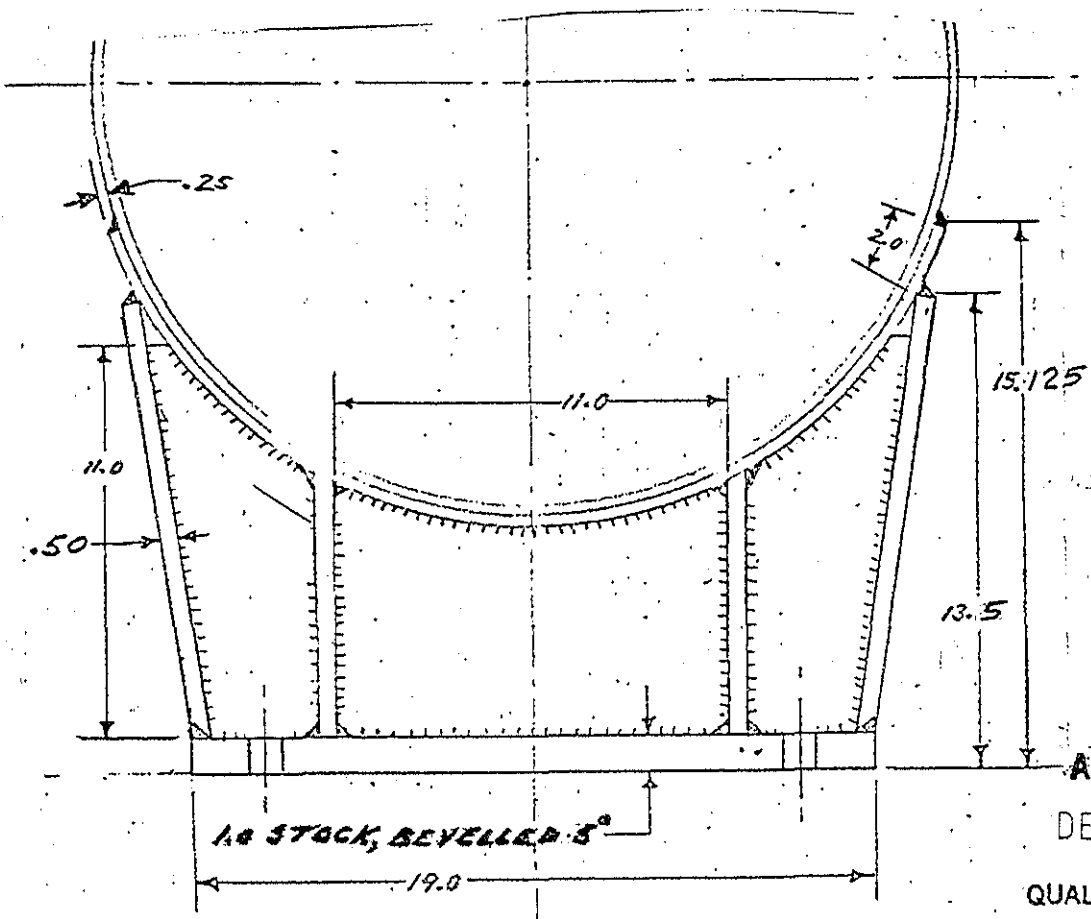
SHEET SIZE A | DWG. NO. 11908169 | SHEET 7 of 11

BF3009-2

APR 3 1980 QA FM APPROVED
FEB 26 1979 QA FM APP
JUL 31 1978 QA FM APP
APR 1 1978 QA FM APP

11908169

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Colt Industries
Fairbanks Morse Engine Division



SECTION A A

APPROVED Rev 7
DEC 8 1977
QUALITY CONTROL

APPROVED Rev. 6
NOV 22 1977
QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-10 80	SEE SHEET 2	W.P.S. Sub
10	11348	3-21 79	SEE SHEET 1	LDS
9	11014	8-7 78	See Sht. 1	NLS TMSR
8	10776	4-21 78	SEE SHEET #1	K.O. PE
7	10599A	12-14 77	SEE SH'TS #1, 9, & 10	K.O. RC
6	10599	12-2 77	ADDED SHT 8	PE BC

TITLE
FILTER LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

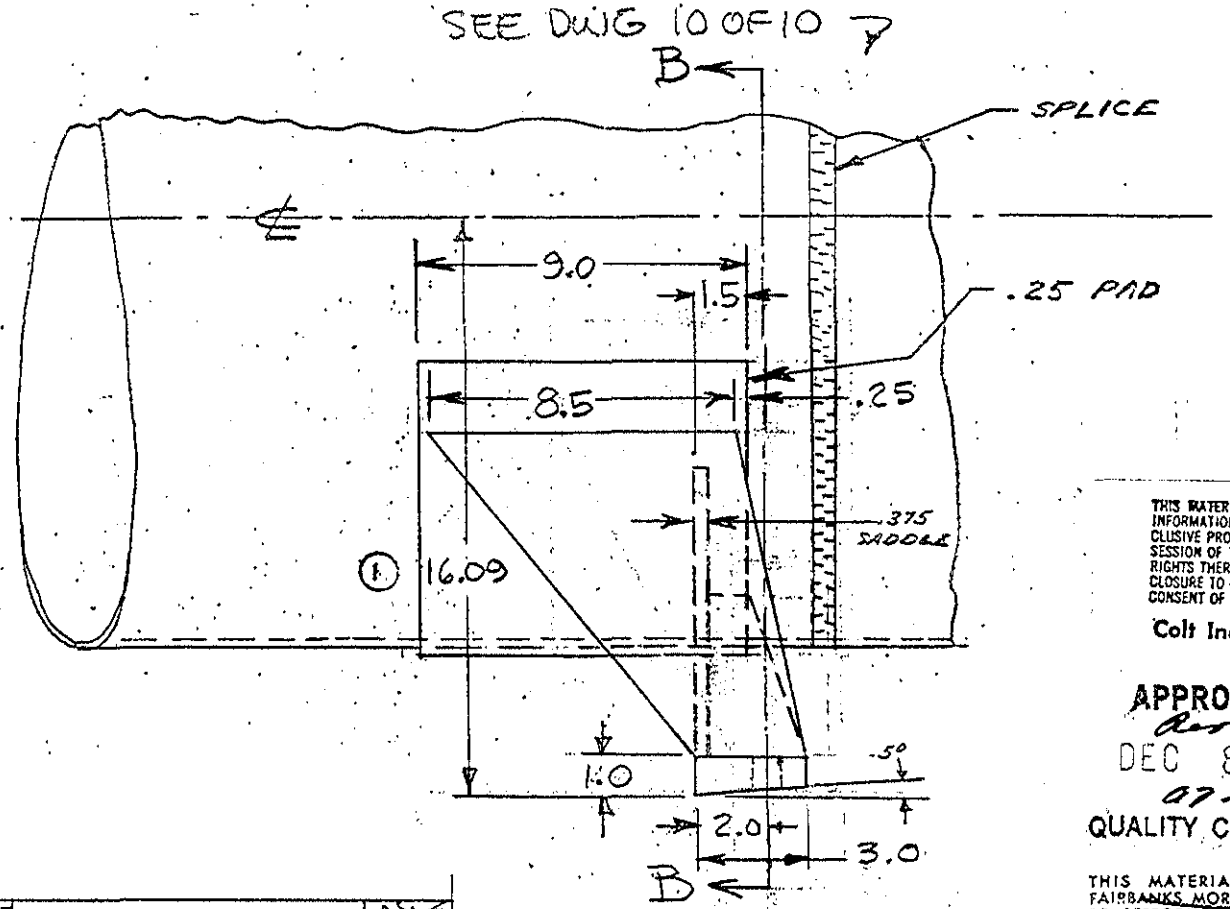
REL. NO.		/ /	ASSY. OR LO.
DR. BY B.C.		11/21/77	SCALE X
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11908169 | SHEET 8 OF 11

QA COLT Rev. 11/1/78 APR 3 1980
QA COLT Rev. 10/1/78 FEB 26 1979
QA COLT Rev. 7/1/78 JUL 31 1978
QA COLT Rev. 1/1/78 APR 1 1978

BF3009-2

11908169



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Colt Industries — Fairbanks Morse Engine Division

APPROVED Rev 7
DEC 8 1977
QUALITY CONTROL

APPROVED Rev 6
NOV 22 1977
QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-10-80	SEE SHEET 2	H.R.S. JWS
10	11348	3-3-79	SEE SHEET 1	LB
9	11014	8-7-78	See Sht. 1	NLS
8	10776	4-2-78	SEE SHEET #1	K.O PE
7	10599A	12-14-77	SEE SH'T'S #1 & 10	K.O PE
7	"	"	FOOT & BRACE REDESIGNED	K.O PE
7	"	"	(1) WAS 16.0	K.O DC
6	10599	12-2-77	ADDED SHT 9	PE BC

TITLE
FILTER
LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY B.C.		11/21/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR. JB
	WELD.		

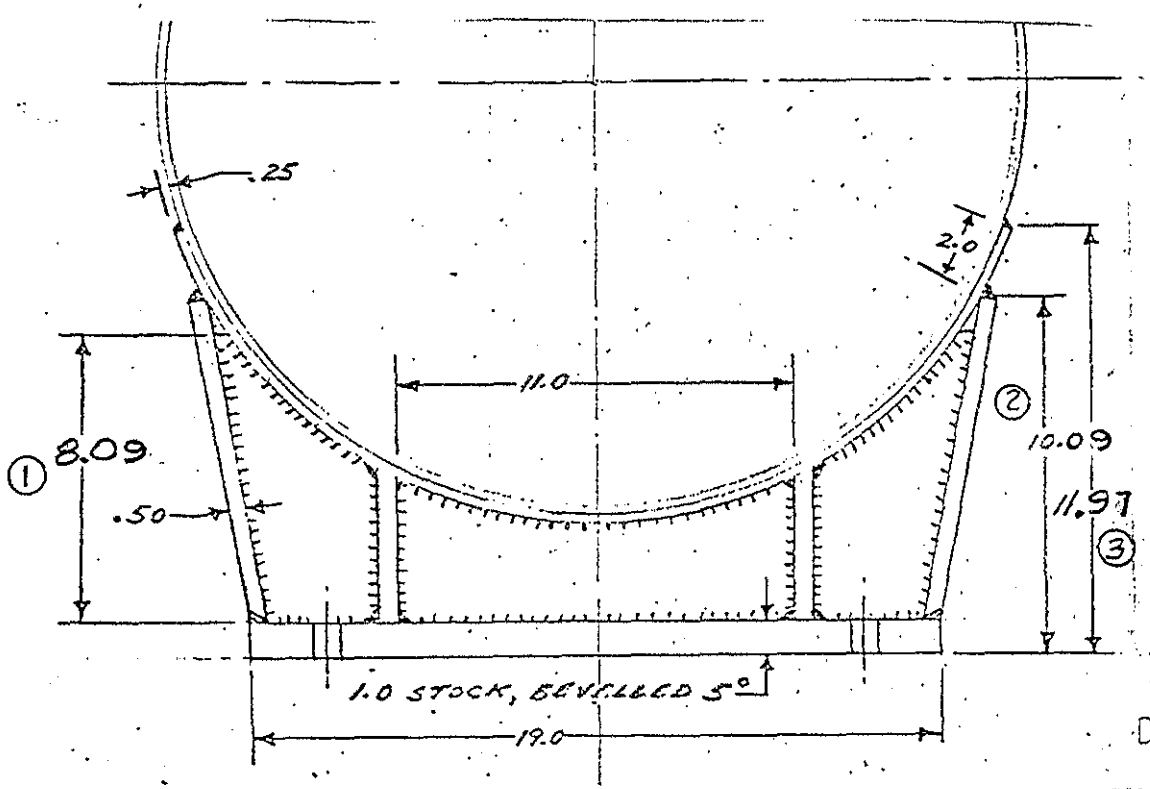
SHEET SIZE A | DWG. NO. 11908169 | SHEET 9 OF 11

BF3009-2

APR 11 1978 QA FM JULI
JUL 31 1978 QA APP FM JULI
FEB 26 1979 QA APP FM COLT
APR 3 1980 QA APP FM

11908169

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Colt Industries (V) Fairbanks Morse Engine Division



SECTION "B B"

APPROVED Rev 7 DEC 8 1977 QUALITY CONTROL

APPROVED Rev. 6 NOV 22 1977 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-10 80	SEE SHEET 2	MRS Gub
10	11348	3-21 79	SEE SHEET 1	LJ
9	11014	8-7-78	See Sht. 1	NLS MSM
8	10776	4-21 78	SEE SHEET #1	K.D. PE
7	10599A	12-14 77	SEE SH'TS #1 & 9	K.D. PE
7	"	"	① WAS 8.0 ② WAS 10.0 ③ WAS 11.875	K.D. PE
6	10599	12-2 77	ADDED SHT 10	PE PE

TITLE
FILTER LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries (V) Fairbanks Morse Engine Division

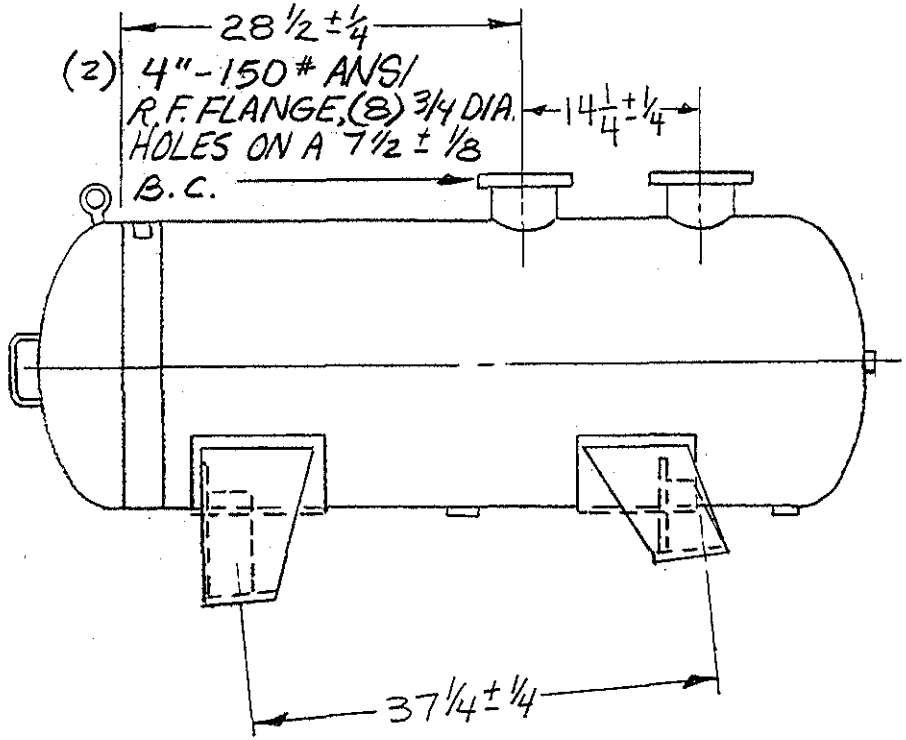
REL. NO.		/ /	ASSY. OR LO.
DR. BY B.C.		11/21 77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

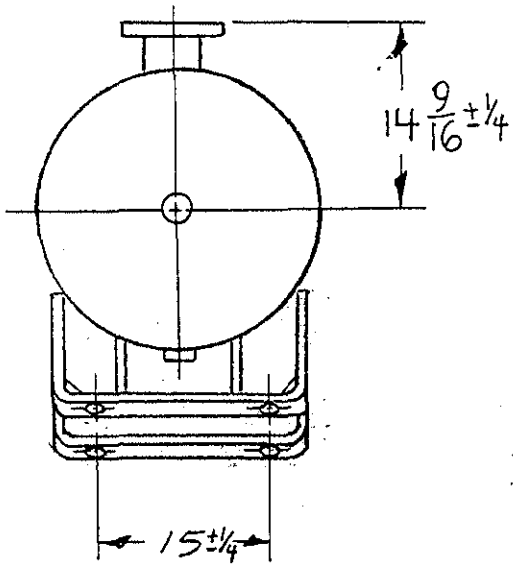
SHEET SIZE A | DWG. NO. 11908169 | SHEET 10 OF 11

BF3009-2

Rev. 11 APR 3 1980 QA APP
COLT Rev. 10 FEB 26 1979 QA APP FM
Rev. 9 JUL 31 1978 QA APP FM
Rev. 8 APR 11 1978 QA APP FM

11908169





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DIM'S. TO BE UTILIZED BY COLT ONLY

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
11	11814	4-10 80	SEE SHEET 2	A.P.S.
10	11348	3-21 79	SHEET 11 ADDED	LJD

TITLE
FILTER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — **Fairbanks Morse Engine Division**

REL. NO.		/ /	ASSY. OR LO.
DR. BY L. DYER		2/21 79	SCALE ~
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR
	WELD.		

SHEET SIZE A | DWG. NO. 11908169 | SHEET 11 OF 11

COLT Rec'd APR 3 1980 QA
COLT Rec'd FEB 26 1979 QA ADD

BF3009-2

INSTRUCTIONS FOR INSTALLING AND OPERATING NUGENT STRAINERS AND FILTERS

GENERAL DATA

Filters may be furnished with or without internal bypass relief valves. If so equipped, they are preset at the factory to open at the maximum recommended element differential pressure. The valve(s) IS(ARE) NOT field adjustable.

Strainers cannot be equipped with internal bypass relief valves.

For lubricating oil filters not equipped with internal bypass relief valves, Nugent recommends the installation of a Model 1591 Dumping Valve to protect the element(s) from abnormal differential pressure.

If filter or strainer is not equipped with a gauge for determining differential pressure, it is recommended that gauges be installed in the inlet and outlet piping.

INSTALLATION INSTRUCTIONS

1. Locate unit so that there is adequate space for element removal. Refer to outline drawing for height needed.
2. Inspect piping leading to and from unit for scale, dirt, etc. and, if necessary, clean piping.
3. Remove protective covers from inlet and outlet piping and connect the filter or strainer. (Connections are clearly marked with pressure sensitive decals indicating the inlet and outlet connections, or refer to the outline drawing.)

CAUTION

DURING INSTALLATION, USE CARE SO AS NOT TO INTRODUCE DIRT INTO THE SYSTEM.

4. Remove cover and clean inside thoroughly. Inspect the element(s) for damage that may have occurred during shipment. Inspect cover gasket and gasket surface on cover. Replace cover. Torque head bolts to 70-80 lb.-ft. on sizes 1, 4L, and larger. On the smaller sizes 0, 1R, 1S, torque to 15-20 lb.-ft.

CAUTION

ON 1116, 1576 AND 1554 SERIES, THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL SINCE FLOW IS FROM THE INSIDE-OUT. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

OPERATING INSTRUCTIONS

1. After filter or strainer has attained operating temperature, check the differential pressure across it. On filters or strainers so equipped, this may be done with the three-way valve located underneath the pressure gauge. Turn the valve handle to upstream (inlet) side and read the pressure; turn the valve handle to downstream (outlet) side and read the pressure. The difference in pressure readings is the differential pressure across the element(s). Always return the valve to the "off" (center) position.
2. It is recommended that the differential pressure be checked daily, as it indicates the amount of contaminant build-up within the element(s). When this differential pressure reaches approximately 20 psi at normal operating temperature, the element(s) shall be removed and replaced with genuine Nugent element(s) for series 1577, 1555 and 1576 filters. Element(s) should be removed and replaced only after first referring to Nugent Co. element replacement instructions. The strainer screen cylinder shall be cleaned for series 1554 and 1700 strainers or clean bags installed in series 1116 filters. Strainer cylinders should be cleaned and new filter bags should be installed only after first referring to Nugent Co. cylinder cleaning and bag installation procedures.

EST. 1897 WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, ILL. 60076, U.S.A.
Telephone: 312/674-7782 TELEX: 724-312
WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

ELEMENT REPLACEMENT
SERIES 1555, 1577 AND 1576

When the differential pressure reaches 20 psi, the element(s) shall be removed and replaced with genuine Nugent element(s). Refer to parts list or name plate for part number of element(s) to be used in this filter.

1. Drain completely by removing the ¾" NPT plug(s) (1) located on the side and/or bottom of the filter shell. During draining, open vent, loosen nuts (3), and swing bolts (4) clear of cover lugs. Remove cover (2) by lifting to clear positioning tabs located on shell ring. DO NOT LAY COVER ON THE "O" RING SEALING SURFACE.
2. On single stack filters, remove spring plate assembly (7) and strainer tube (10). On multiple stack filters, remove bolt(s) (8), pressure plate (5), spring plate assemblies (7), and strainer tubes (10).

CAUTION

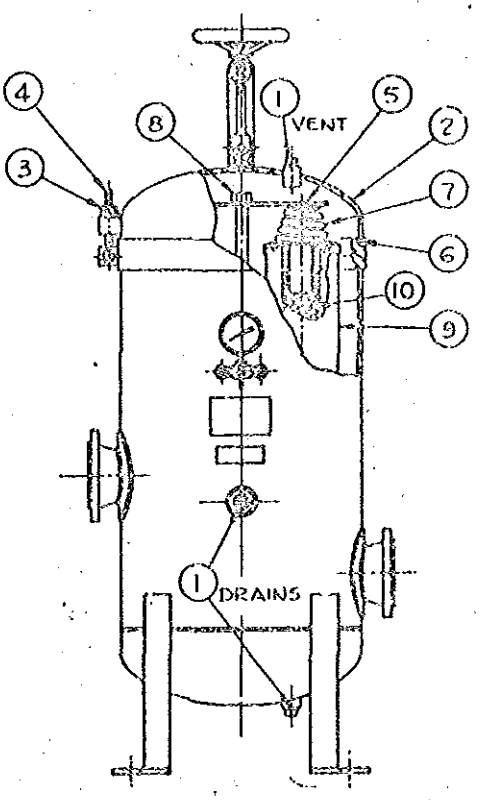
BEFORE REMOVING ELEMENT(S), CHECK TO MAKE SURE THAT THE LIQUID HAS BEEN DRAINED COMPLETELY.

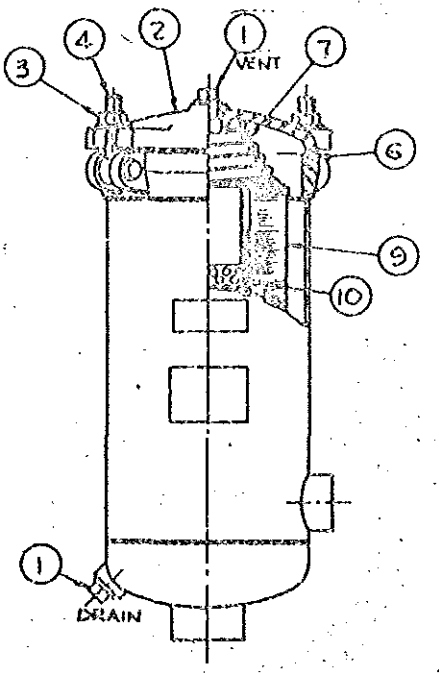
3. Remove and discard the element(s) (9). Inspect interior of vessel for loose or broken parts and excessive accumulation of dirt.

CAUTION

INSPECTION OF THE VESSEL INTERIOR IS PARTICULARLY IMPORTANT ON THE SERIES 1576 FILTERS, SINCE THE INTERIOR IS THE CLEAN SIDE OF THE FILTER. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

4. Remove new element(s) from shipping container and inspect for damage that may have occurred during shipment. Place element(s) over seat(s) protruding from bottom of vessel. Make sure that each element seats securely and insert strainer tube (10).
5. Replace spring plate assembly(ies) after checking condition of bypass valve(s) if filter is so equipped.
6. On multiple filters, replace pressure plate (5) and bolts (8). Tighten bolts until pressure plate makes contact with top of tie rod. When pressure plate is properly installed, there should be approximately 2½ inches between the top of the elements and the bottom of the pressure plate.
7. Inspect "O" ring (6) and replace cover by lowering it onto the "O" ring. Align lugs before cover contacts "O" ring. DO NOT ROTATE COVER TO OBTAIN ALIGNMENT AFTER IT HAS CONTACTED "O" RING. Torque nuts (3) to 70-80 lb.-ft. on sizes 1, 4L and larger.
8. Close drain(s) and fill vessel with fluid. In order to assure complete filling of vessel, release trapped air through vent located on cover. Check for leaks. After filter has attained operating temperature, check the differential pressure. It should be less than 5 psi.





WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, IL. 60076, U.S.A.
Telephone: 312/674-7782 TELEX: 724-312
EST. 1897 WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

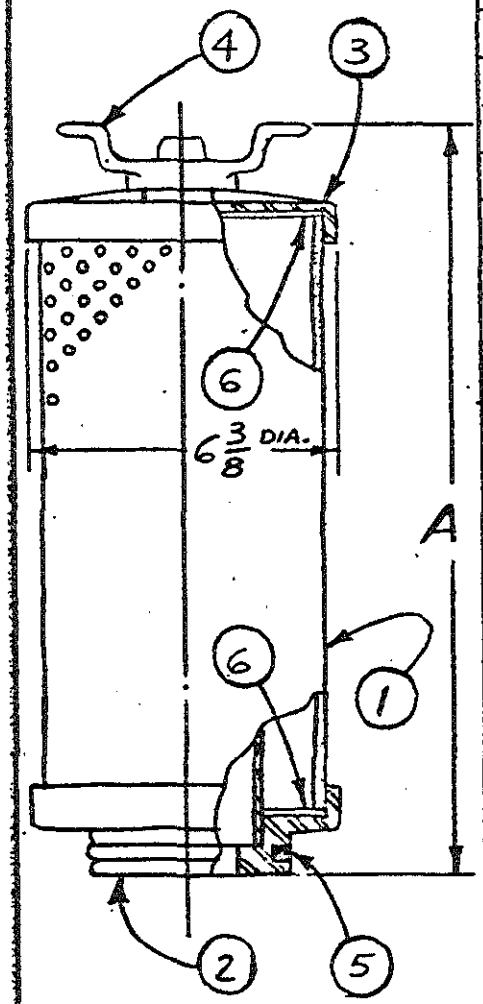
LIST OF MATERIAL

ASSEMBLY 10-263-209 FILTER 1555-214B-SY-W 150#

Item No.	Description	Rough Number	Finish Number	Quan.	Matl.	Cost or Production
1.	SHELL ASSEMBLY		20-227-204	1		
2.	COVER ASSEMBLY	30-002-013	30-001-205	1	SA515-70	X
3.	VALVE ASSEMBLY		30-025-205	1		LESS GAUGE
4.	EYE BOLT		30-023-004	12	SA325	
5.	NUT, HVY. HEX.		01-043-003	12	SA194-2H	
6.	WASHER		01-040-012	12	AISI-1010	
7.	RIVET		01-060-004	12	SA31-B	
8.	RETAINING RING		01-058-001	12	SAE 1075	
9.	PLUG, SQ. HD. 3/4 N.P.T.		01-021-018	3	SA181-1	
10.	NAME PLATE		01-100-001	1		
11.	DECAL		01-091-002	1		
12.	PRESSURE PLATE	30-104-010	30-063-201	1		X
13.	SPRING PLATE ASSY.		30-026-206	7		
14.	O-RING		30-024-004	1	BUNA-N	
15.	ELEMENT		30-400-203	7		X
16.				0		
17.	STRAINER TUBE		30-285-203	7		
18.	BOLT		01-056-001	3	SA307	
19.	PLUG, SQ. HD. 1/4 N.P.T.		01-021-015	1	SA181-1	

11/9/66 GSA

DRG NO. 30-055 | REV. 30



DASH Nº	MODEL	A	ITEM 1 STR. CYL.	ITEM 2 SPOOL	ITEM 3 COVER	ITEM 4 WING NUT	ITEM 5 O-RING	ITEM 6 GASKET
201	4L-2140	31 13/16	30-300-201	30-004-203	30-058-001	30-053-001	01-061-011	01-047-004
202	4L-100	31 13/16	202	203				
203	4L-200	31 13/16	203	203				
204	1-2140	20 5/16	204	202				
205	1-100	20 5/16	205	202				
206	1-200	20 5/16	206	202				
207	4R-2140	11 1/4	207	201				
208	4R-100	11 1/4	208	201				
209	4R-200	11 1/4	209	201				
210	4L-150	31 13/16	210	203				
211	1-150	20 5/16	211	202				
212	4R-150	11 1/4	30-300-212	201				
213	DISCONTINUED		?	203				
214	DISCONTINUED		?	202				
215	DISCONTINUED		?	201				
216	4R15M10	11 1/4	30-300-216	201	30-058-001	30-053-001		
217	4L-8M CAD. PL.	31 13/16	30-299-201	206	30-058-003	30-053-003		
218	4L-2140G	31 13/16	30-209-201	203	30-058-001	30-053-001		
219	1-2140G	20 5/16	30-209-202	202				
220	DISCONTINUED		30-209-203	203				
221	DISCONTINUED		30-209-204	202				
222	4L-100G	31 13/16	30-209-205	30-004-203	30-058-001	30-053-001	01-061-011	01-047-004

ALTERATIONS			
NO	WAS	BY	DATE
21	ADDED	HB	4-23-71

PART NO. SEE TAB.

MATERIAL SEE TAB.

TYPE		DATE
DRAWN BY	HB	5-12-70
CHECKED BY	HR	5-12-70

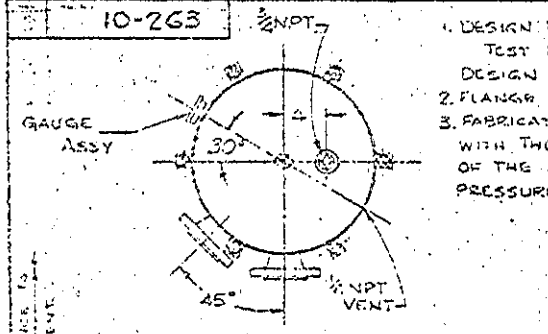
TOLERANCES 1/8
FRACTIONAL ± ____
DECIMAL ± ____
ANGULAR ± ____
UNLESS OTHERWISE SPECIFIED

ELEMENT, STRAINER

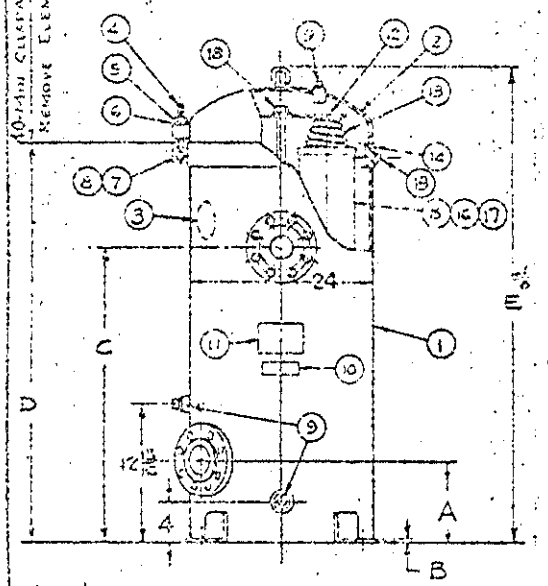
WM. W. NUGENT & CO. (INC.)
SKOKIE, ILL. U.S.A.

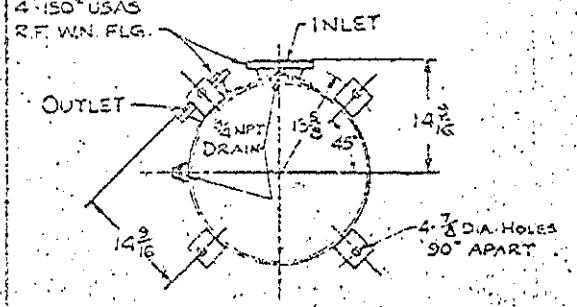
SCALE	REV	DRG NO.
4/1	30	30-055

10-263



1. DESIGN PRESSURE 150 P.S.I.
   TEST PRESSURE 225 P.S.I.
   DESIGN TEMPERATURE 250°F.
2. FLANGE BOLT HOLES STRADDLE ℄
3. FABRICATED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASME CODE FOR PRESSURE VESSELS.





PART NO	F.M. NO	MODEL NO	A	B	C	D	E		REMARKS	EMPTY FILTER WEIGHT
209	11-906-559	1555-2148-SY-W	8	1/2	20 3/16	50 7/16	60 5/8		LESS GAUGE	
208	11-906-456	1555-3218-SY-B	8	1/2	29 3/16	68 3/16	78 3/4		LESS GAUGE	900 1030
207	11-906-404	〃	8	1/2	25 1/4	〃	〃		〃	〃
206	11-906-294	〃	8	1/2	25 1/4	〃	〃		〃	〃
205	11-906-205	〃	8	1/2	25 1/4	〃	〃		〃	〃
204	11-906-097	〃	8	1/2	25 1/4	〃	〃		〃	〃
203	11-906-083	〃	8	1/2	25 1/4	〃	〃		〃	〃
202	11-905-736	〃	8	1/2	25 1/4	〃	〃		〃	〃
10-263-201		1555-3218-SY-B	6 1/2	3/8	25 1/4	68 3/16	78 3/4			900 1030

ALTERATIONS			
NO.	WAS	BY	DATE
8	ADDED	MM	8-2-72
9	ADDED	MM	10-18-72

PART NO. SEE TAB.
MATERIAL SEE DET. B/M

TYPE		DATE
DRAWN BY	MM	7-30-69
CHECKED BY	WJ	7-30-69

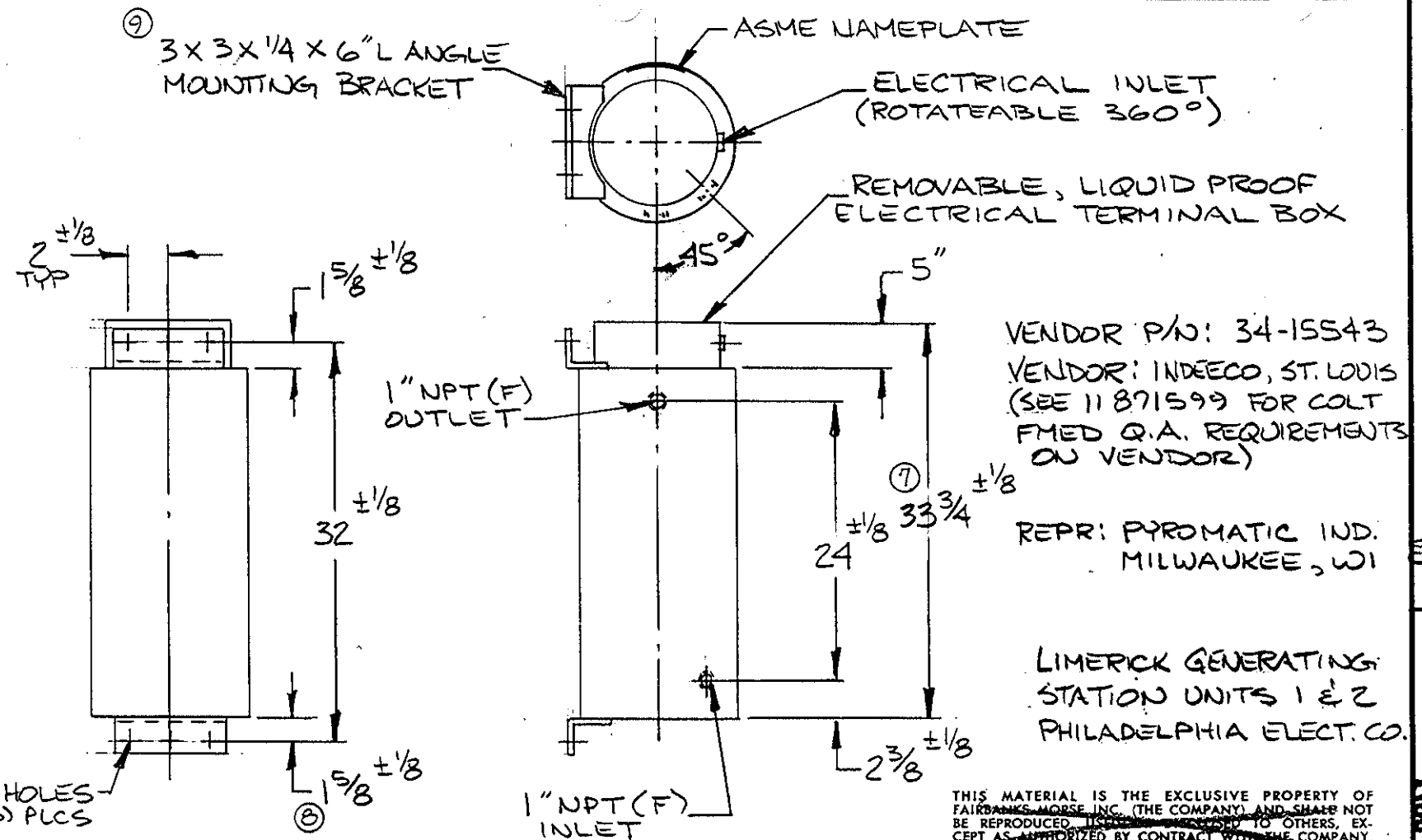
TOLERANCES
FRACTIONAL ± 1/8
DECIMAL ±
ANGULAR ±
UNLESS OTHERWISE SPECIFIED

FILTER ASSEMBLY

WM. W. NUGENT & CO. (INC.)
SKOKIE, ILL. U.S.A.

SCALE	REV.	DRG. NO.
1/17	9	10-263

11 908170



VENDOR P/N: 34-15543
VENDOR: INDEECO, ST. LOUIS
(SEE 11 871599 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR)

REPR: PYROMATIC IND. MILWAUKEE, WI

LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECT. CO.

PROPRIETARY
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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
10	11137	10-12 78	SEE SHEET 4	
9	11049	8-15 78	ADDED TOLERANCES ⑧ WAS 1 1/8" ⑨ WAS 2"X2"	
9	"	"	⑦ WAS 34 3/4 REVISED & REDRAWN	RN

TITLE
HEATER; LUBE OIL, 6KW

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	P. ESTRADA	8/30/78	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L	PURCHASE		
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908170 | SHEET 1 OF 4

COLT FM OCT 17 1978 QA APP
COLT FM AUG 22 1978 QA APP

BF3009-2

DESCRIPTION INDEECO 6 KW LUBE OIL HEATER WITH THE FOLLOWING FEATURES:

A. GENERAL:

1. 6 KW - 12 WATTS PER IN^2 (FOR LUBE OIL HEATING)
2. RATED 500 V - 3 PHASE - 60 HZ
3. WITHOUT THERMOSTAT
4. FOR VERTICAL WALL MOUNTING WITH BRACKETS, CONDUIT OPENING INLET AND OUTLET CONNECTIONS PER SKETCH ON FIRST SHEET
5. WITH 1" FEMALE PIPE THREAD INLET AND OUTLET
6. WITH RAINPROOF TERMINAL COVER (NEMA 3 - MINIMUM)

B. SPECIAL REQUIREMENTS:

1. HEATER TO BE CONSTRUCTED AND CODE STAMPED IN ACCORDANCE WITH ASME SECTION IV 1977 EDITION. RATED WORKING PRESSURE 100 PSI. MAXIMUM WORKING TEMPERATURE 225°F.

   A. (FOR WELDING PROCEDURES, SEE SHEET 4, B.1.A)

2. COMMONWELATH OF PENNSYLVANIA REQUIREMENTS FOR BOILER AND UNFIRED PRESSURE VESSEL AS DESCRIBED ON FORM 8031-PCR REV. 2 DATED, MARCH 7, 1975 APPLY TO THIS COMPONENT. COLT PURCHASING DEPT. TO FURNISH A COPY OF THE ABOVE FORM AS PART OF THE ORDER.

PROPRIETARY
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Colt Industries Fairbanks Morse Engine Division
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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
10	11137	10-12 78	SEE SHEET 4	
9	11049	8-15 78	REVISED & REDRAWN SEE SHEET 1	

TITLE
HEATER
LUBE OIL
6 KW

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY P. ESTRADA		8/30/76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 170 | SHEET 2 OF 4

BF3009-2

B. SPECIAL REQUIREMENTS (CONT'D)

4. COMPONENT SHALL BE DESIGNED TO WITHSTAND SEISMIC FORCES OF 1.1 X WT. VERTICAL AND 3.0 X WT. HORIZONTAL ACTING SIMULTANEOUSLY.

5. CONNECTIONS LOADS: ATTACHED PIPE IS 1" SCHEDULE 80 PIPE.

6. PAINTING AND PRIMING REQUIREMENTS:

a. SURFACES REQUIRING PRIME AND PAINT

TO BE SUPPLIED WITH VENDOR'S STANDARD SHOP PRIME ONLY. ALL INTERNAL AND EXTERNAL SURFACES SHALL BE THOROUGHLY AND COMPLETELY CLEANED OF ALL MILL SCALE, CUTTINGS, OIL, WELDING SPATTER, AND OTHER FOREIGN MATTER. THE SURFACES SHALL THEN FURTHER BE CLEANED TO A MINIMUM REQUIREMENT AS SET DOWN BY SSPC-3 (POWER TOOL CLEANING) PRIOR TO PRIMING AND SHIPMENT. THE DRY FILM THICKNESS SHALL BE AT LEAST 1.5 MILS BUT NO MORE THAN 2.0 MILS. GOOD PAINT PRACTICE, AS STATED IN SSPC-PA-1 SHALL BE OBSERVED.

b. SURFACES NOT REQUIRING PRIME

MACHINED SURFACES SHALL BE PROTECTED WITH AT LEAST 4 MILS DRY FILM THICKNESS OF MIL-C-16173 GRADE 5 OR SIMILAR PRODUCT APPROVED BY BUYER.

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
M/F				
10	11137	10-12 78	SEE SHEET 4	
9	11049	8-15 78	REVISED & REDRAWN SEE SHEET 1	RN

TITLE
HEATER
LUBE OIL
6 KW

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	P. ESTRADA	8/30/76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 170 | SHEET 3 OF 4

COLT QA OCT 17 1978 APP
COLT FM AUG 22 1978 QA APP

BF3009-2

7. SPECIAL TOOLS SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.13.

8. SPARE PARTS LIST SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.14.

9. NAMEPLATES SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 42 & 43, REV. 2, PARA. 6.2.

C. F. M. DUTIES:

1. SUPPLY COPY OF BECHTEL SPECIFICATION 8031-M-71, PG. 13, REV. 3, PARA. 4.1.j.
PG. 36, REV. 3, PARAS. 4.13 & 4.14 AND PGS. 42 & 43, REV. 2, PARA. 6.2.
COLT FMED DWG. NO. 11871599* AND COMM. OF PENNA. FORM 8031-PCR, REV. 2 WITH PURCHASE ORDER.
*11871599-REV 1

B.1.A WELDING PROCEDURES:

1. WHEN COATED ELECTRODES ARE USED, THEY SHALL BE LOW-HYDROGEN TYPE.

2. FLUX CORED WIRE E70T-1 MAY BE USED IN THE SPRAY TRANSFER RANGE.

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
10	11137	10-12 78	ADD REV STATE TO 11871599	TMSH
9	11049	8-15 78	REVISED & REDRAWN SEE SHEET 1	RN

TITLE

HEATER
LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY P. ESTRADA		8/30/76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 170 | SHEET 4 OF 4

BF3009-2

QA APP OCT 17 1978
COLT FM AUG 22 1978 QA APP

Quik Shaft Inc
Engine Division
701 Lawton Avenue
Beloit, Wisconsin 53511
A division of the Colt Industries Operating Corp

QUOTATION INQUIRY

THIS IS NOT AN ORDER

DATE 11/17/86

REFER TO THIS NUMBER IN ANY CORRESPONDENCE

No. BQ 25537

PURCHASING DEPARTMENT

TO K. Mullen
INDEECO
% Pyro-Matic Inc
11901 W. Dearborn Ave
Wauwatosa, Wisconsin 53226

2/3/87
VD: T. Chase
Limerick

Your proposal considered only in this form. Attach additional sheets, photos, etc., as necessary.

Itemize all prices, discounts and charges separately.

Show taxes, if applicable, separately.

We reserve the right to accept all or part, or decline the whole, there is no obligation to buy.

Attach complete specifications for any substitutions or design changes offered. We invite your suggestions.

The terms and conditions appearing on the reverse side hereof will become a part of any order. The buyer will not be responsible for fabrication of any portion of an order beyond quantity released by shipping schedule appearing on face of Purchase Order, nor for quantities fabricated in advance of time necessary to meet schedule. Partial shipments, other than as scheduled, are not authorized.

Shipments must be made complete as scheduled.

PLEASE QUOTE AT ONCE ON THE FOLLOWING: THIS IS NOT AN ORDER

REPLY MUST BE IN BEFORE: November 28, 1986

FOR SHIPMENT TO:

ITEM	QUANTITY	F.M. PART NO.	DESCRIPTION	NET PRICE	UNIT	LEAD TIME REQUIRED
			PUT ON CRT 25L22-020S-A2			
1	2		25-L22-020S-A2 - Element (for 11908170) L. O. Heater	$ 152.46	ea	8 weeks
2	2		38W36-150C-AD - Element (for 11908172) J. W. Heater	$ 185.71	ea	
			+ $50.00 for reports if needed			
			APPLICABLE ASME CODE IS IV, 1977 Edition			
			Stamp 30 - ASME DATA REPORT FORMS (as applicable)			
			Limerick Put on CRT 2/4/87			

PRICES FIRM FOR ACCEPTANCE BEFORE JUN'87

THE UNDERSIGNED OFFERS THE PRICES, TERMS AND DELIVERY SET FORTH

VIA TRUCK F.O.B. St. Louis TERMS Net 30
ROUTING DELIVERED

DATE 11/20/86 SIGNED D Ellis

K. Mullen BUYER

NOTE CONDITIONS REVERSE SIDE
DUPLICATE - RETURN FOR YOUR FILE

FORM NO. 34-7140-83-1

INDEECO INDUSTRIAL ENGINEERING & EQUIPMENT CO.

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS FOR SERIES 56 ELECTRIC HOT WATER BOILERS, INSTANTANEOUS WATER HEATERS AND OIL PREHEATERS

GENERAL INSTRUCTIONS

1. Install the heater in the position checked on the reverse side of this sheet.
2. CAUTION: DO NOT TURN ON HEATING ELEMENTS UNTIL TANK IS COMPLETELY FULL OF LIQUID. Permanent damage may result if elements are energized when heater is dry.

PLUMBING INSTALLATION INSTRUCTIONS

1. Pipe the incoming liquid to the nipple marked "Inlet." Pipe the hot outgoing liquid from the nipple marked "Outlet."
2. Install a pressure gauge and temperature gauge in the outlet line.
3. If this heater is not furnished with a relief valve, and it is being installed in a closed system, install a relief valve in the outlet line. Normally, a pressure relief valve is sufficient unless your local code requires a pressure-temperature relief valve.
4. This equipment is designed to operate at the maximum pressure and temperature shown on the nameplate.
5. Large size heaters are furnished with flanged immersion heaters, secured to the vessel head with eight (8) bolts. After the heater has run through one or two heating cycles, these bolts should be retightened.

ELECTRICAL INSTALLATION INSTRUCTIONS

1. Follow the wiring diagram included with this instruction sheet. An additional copy is attached inside the heater terminal compartment.
2. Heaters operating at more than 250 volts may require a separate low voltage control circuit. If this heater is furnished with remotely mounted magnetic contactors, the control voltage is shown on the contactor enclosure nameplate. If this heater has built-in magnetic contactors, the control voltage is shown on the control circuit terminal block unless a control circuit transformer has also been provided.
3. All connections must be sized to carry the heater load per Table 310-12 of the National Electrical Code. However, wiring insulation should be rated for at least 90° C. If wiring material for your application is not readily available, consult factory for assistance.
4. Ground the preheater. Normally, it will be grounded through the conduit feeding the preheater. However, if non-metallic conduit or flexible metallic conduit are used, a separate grounding connection is required.

425 Hanley Industrial Court Area Code 314 644-4300 St. Louis, Missouri 63144

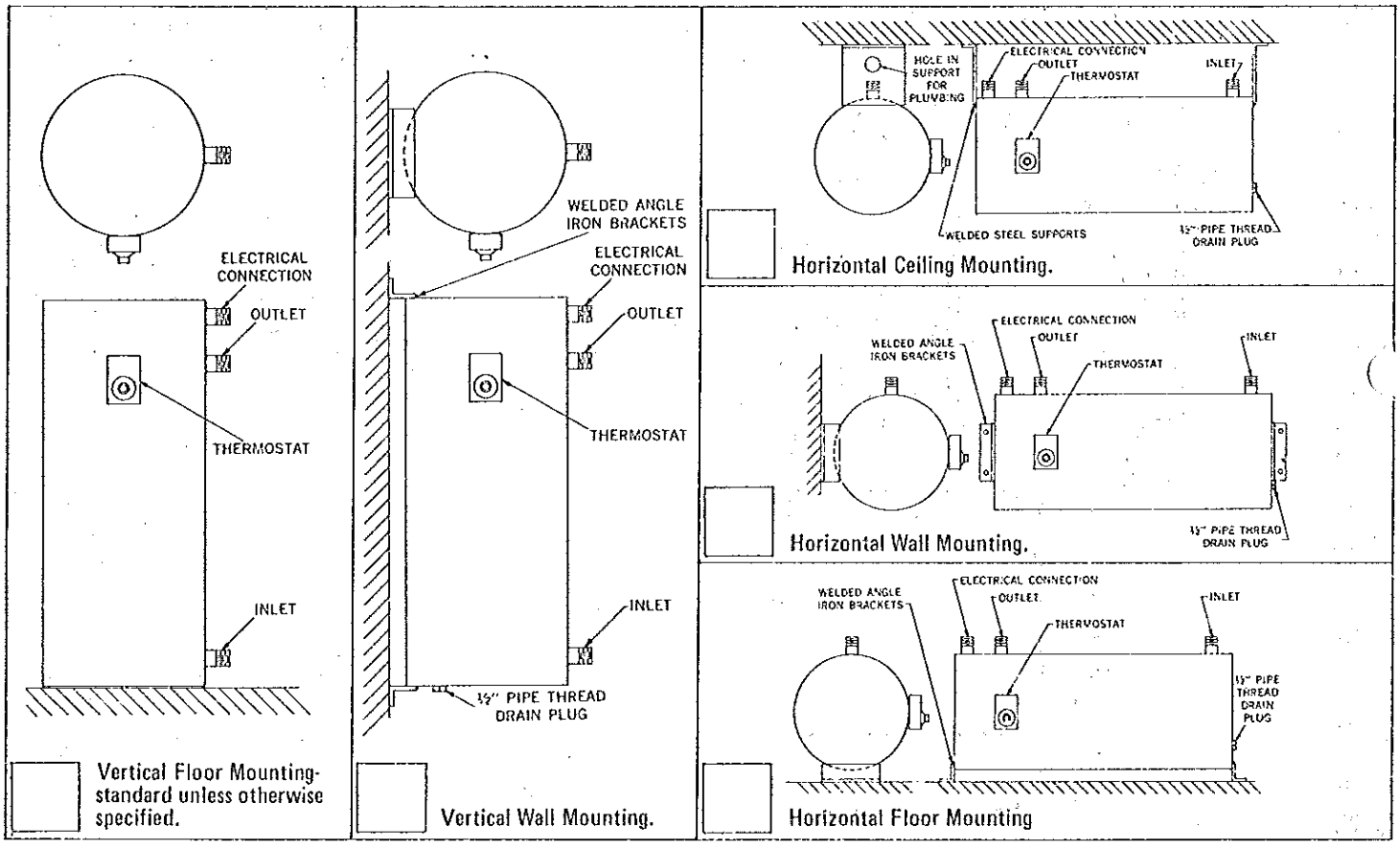
INDEECO INDUSTRIAL ENGINEERING & EQUIPMENT CO.

MOUNTING INSTRUCTIONS FOR PREHEATERS

This heater has been constructed for the mounting marked below. It must be mounted in this manner, otherwise, improper operation or damage may result.

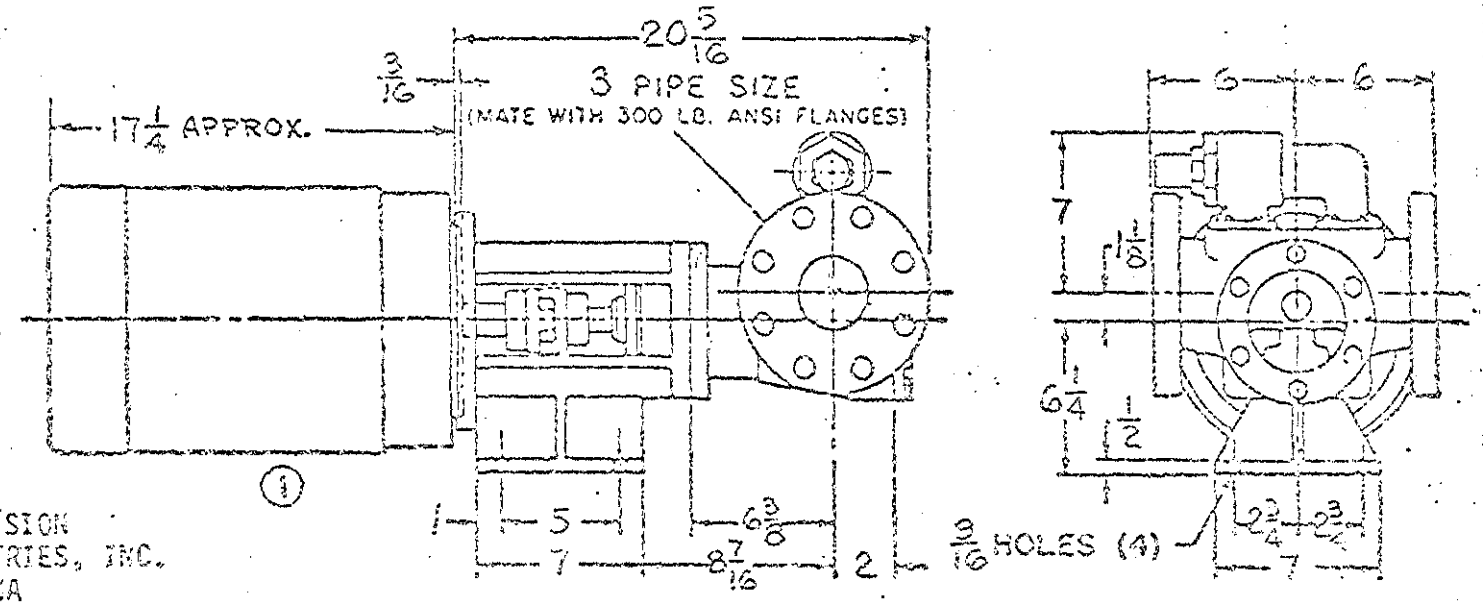
OPERATING AND MAINTENANCE INSTRUCTIONS

1. If flanged immersion heaters are furnished, periodically retighten the bolts that secure them to the vessel head.
2. To operate this preheater, fill the tank completely with liquid, energize the main supply disconnect, and set the controlling thermostat to the desired temperature.
3. If this heater has a manual reset high limit thermostat, be sure that the reset button is pressed in.



425 Hanley Industrial Court Area Code 314 644-4300 St. Louis, Missouri 63144

DESCR. ION: VIKING AS-93-M STEEL EXTERNAL FLANGE BRACK.. HORIZONTAL MOUNTED PUMP WITH "M" DRIVE AND WESTINGHOUSE 5 HP, 1150 RPM, 460 VOLT, 3 PHASE, 60 HZ, ODP FRAME MOTOR.



VENDOR: VIKING PUMP DIVISION
HOUDAILLE INDUSTRIES, INC.
CEDAR FALLS, IOWA

REPR: WALTER B. ROM & SONS, INC.
1060 N. 115TH STREET
WAUWATOSA, WI

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11-77	See Shts 2-6	
2	"	"	KEDRAIN, ELECTRIC MOTOR ADDED (1)	

TITLE: PUMP SET, PRE-LUBE
35 GPM, 5 HP, 1150 RPM

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .030 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. NORMAN	1/27/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		ENGR.
	MACH.		
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 176 | SHEET 1 OF 7

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

INTRODUCTION

The illustrations used in this article are for identification purposes only and *should not be used for ordering parts.* Secure a parts list from the factory or a Viking representative. Always give complete name of part, part number and material with the model and serial number of the pump when ordering repair parts. The unmounted pump or unit model and serial number can be found on a nameplate attached to the pump or base.

In the Viking model number system, the basic size letters are combined with the series number (93) indicating both the unmounted or mounted pump units.

UNMOUNTED PUMP	UNIT
FLANGE MOUNTED FLANGED PORTS	Units are designated by the unmounted pump model numbers followed by a letter indicating drive style. M—Horizontal Direct Drive IM—Vertical In-line Direct Drive
GG93 HJ93 HL93 AS93 AK93 AL93	

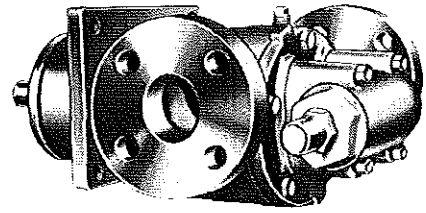


FIGURE 1
GG, HJ and HL SIZE 93 SERIES
Unmounted Pump with Flanged Ports

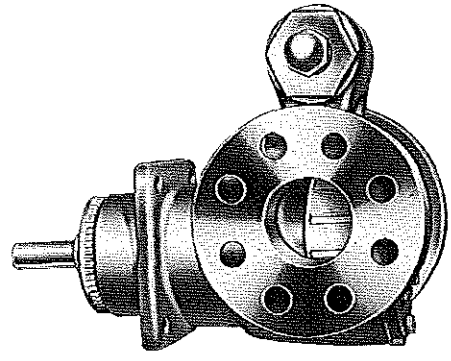


FIGURE 2
AS, AK and AL SIZE 93 SERIES
Unmounted Pump with Flanged Ports

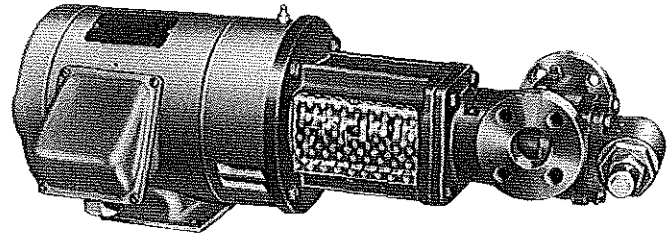


FIGURE 3
SERIES 93M
Horizontal Mounted Unit
With Tapped Ports

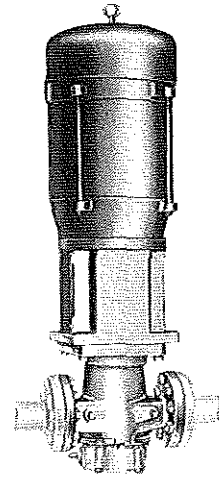


FIGURE 4
SERIES 93IM
Vertical Mounted Unit
With Flanged Ports

Maintenance

Series 93 pumps are designed for long, trouble free life under a wide variety of application conditions with a minimum of maintenance, however the following should be considered:

1. END CLEARANCE ADJUSTMENT—After long term operation it is sometimes possible to improve the performance of the pump, without major repair, thru adjustment of end clearance of the pump. Refer to instructions under Reassembly of the pump for information regarding this procedure.
2. CLEANING THE PUMP—It is good practice to keep the pump as clean as possible. This will facilitate inspection, adjustment and repair work and help prevent omission of lubrication to fittings covered or hidden with dirt.
3. STORAGE—If the pump is to be stored or not used for any appreciable length of time it should be drained and a light coat of lubricating and preservative oil should be applied to the internal parts. Lubricate all fittings.

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

Disassembly

1. Remove the head capscrews.
2. Remove the head and O-Ring gasket.

CAUTION: AVOID TILTING THE HEAD DOWN, AS THE IDLER MAY SLIDE OFF.

3. Remove the idler from the idler pin. If the idler pin is worn, the head, idler pin and the idler bushing should be replaced.
   If the idler bushing is worn, it is strongly recommended that the idler and bushing be replaced. This bushing can be replaced in the field, but is very difficult. It is a brittle material, and extreme care should be taken to prevent breaking when it is being installed in the idler. If it is cracked in the idler, this bushing will quickly disintegrate. A hydraulic press should be used to install carbon graphite bushings. Be sure the bushing is started straight. DO NOT STOP the pressing operation until the bushing is in the proper position.
4. Remove the locknut from the shaft. A piece of brass rod or hardwood inserted in the port opening will hold the shaft from turning.
5. The rotor and shaft can now be removed from the casing. The spring and rotary member of the mechanical seal will come out with the shaft.

NOTE: On the HJ and HL size pumps the bearing housing and double row ball bearing must be removed before the snap ring in the shaft can be removed. The rotor and shaft cannot be removed until the snap ring is removed from the shaft.

6. Loosen the two (2) setscrews in the end of the bearing housing, turn the bearing housing counterclockwise and remove from the casing. Remove the snap ring from the bearing housing on GG, HJ and HL size pumps and the double row ball bearing can be removed. On the AS, AK, and AL size pumps you must loosen the setscrews in the outer ring of the bearing housing and remove bearing housing end cap, closure and bearing collar. Use a spanner wrench to remove the end cap.

Wash the bearing thoroughly and examine. If there is any evidence of wear or damage, a new bearing should be used.

7. Remove the snap ring and casing ball bearing in the GG, HJ and HL size pumps. Remove the bearing spacer in the AS, AK and AL size pumps. The bearing retainer washer, located between the casing bearing and seal seat, can now be removed if it did not stay on the rotor shaft when the shaft was removed.
8. The seal seat or stationary part of the seal can now be removed from the casing.
9. The casing should be examined for wear, particularly at the seal area between the port openings.

All parts should be checked for wear before the pump is put together. When making major repairs, such as replacing a rotor and shaft, it is usually advisable to also install a new head and idler.

Reassembly

1. Installing New Seal: See Figure 5. The seal is simple to install and good performance will result if care is taken in its installation.

NOTE: Never touch the sealing faces with anything except the fingers or a clean cloth. Clean the rotor hub, shaft and seal seat housing in the casing, making sure they are clean and free from dirt and grit.

Coat the outside diameter of the seal seat and the inside diameter of the seal housing bore with light oil. With thumb and forefinger, push the seal seat into place in the casing.

Place the tapered sleeve (furnished with replacement seals) on the shaft as far as it will go. Thin end must be toward end of shaft. See Figure 5. Coat the inside of the rotary member and the outside of the tapered sleeve with light oil. Be sure the shaft is free of nicks and burrs. Place the spring and rotary member on the shaft, spring first, over the sleeve and against the hub of the rotor. *Remove the tapered sleeve.*

2. Flush the sealing faces of both the rotary member and seal seat with light oil and install rotor and shaft. Push the rotor and shaft into the casing slowly until the ends of the rotor teeth are just beyond the face of the casing.

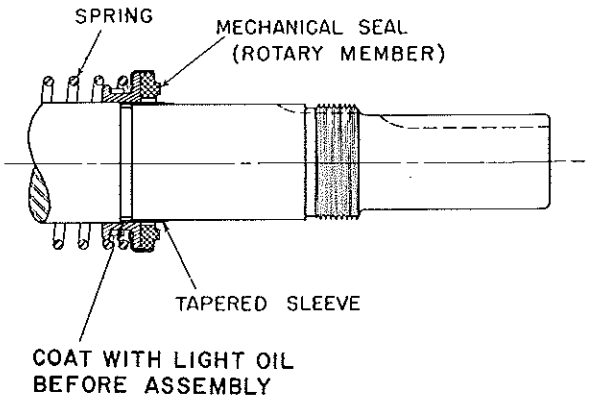


FIGURE 5

3. Place the idler on the idler pin and the O-ring head gasket on the head. Place the head assembly on the pump and tighten the capscrews evenly and securely. The seal is now automatically compressed to its proper working length.
4. Pack the single row ball bearing with grease and install in the casing. Install the snap ring in GG, HJ and HL pumps.

NOTE: The AS, AK and AL pumps do not have a snap ring, but the bearing retainer washer must be

assembled over the end of the shaft before the bearing is assembled.

5. Place the bearing spacer over the shaft and against the single row ball bearing in the casing. (AS, AK, & AL size pumps).
6. Install the snap ring in the groove in the shaft on the HJ or HL size pumps.
7. Pack the lubrication chamber between the casing ball bearing and the double row ball bearing in the bearing housing approximately half full with *lithium base ball bearing grease.*
8. Pack the double row ball bearing with *lithium base ball bearing grease* and press into the bearing housing. Install the snap ring to hold the bearing in place.

NOTE: On AS, AK and AL pumps, install the closure in the bearing housing end cap. Put the bearing spacer sleeve in the closure and install this in the bearing housing and tighten securely.

9. Start the bearing housing into the casing. Turn by hand until tight. This forces the rotor against the head. Replace and tighten the locknut on the shaft. Insert a piece of brass or hardwood through the port opening between the rotor teeth to keep the shaft from turning.
10. Adjust the pump end clearance as follows:

Thrust Bearing Adjustment

Loosen the two setscrews in the bearing housing and turn counterclockwise ½" measured on the outside of the bearing housing of GG, HJ and HL size pumps. This represents approximately .003" end clearance. On the AS, AK and AL size pumps, turn the thrust bearing assembly counterclockwise two notches which represents approximately .003" end clearance.

NOTE: Be sure the shaft can be rotated freely. If not, turn the bearing housing counterclockwise until the shaft can be turned. Be sure set screws are tightened securely after adjustment is made. High viscosity liquids require additional end clearance. The amount of end clearance depends on the viscosity of the liquid being pumped.

Valve Instructions

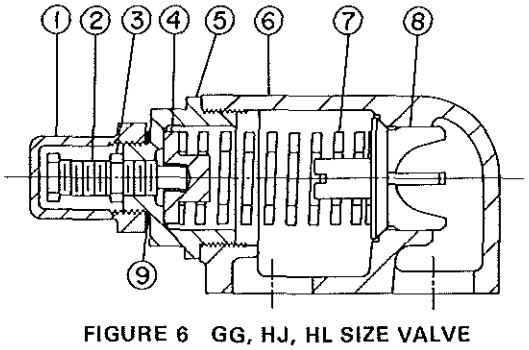


FIGURE 6 GG, HJ, HL SIZE VALVE

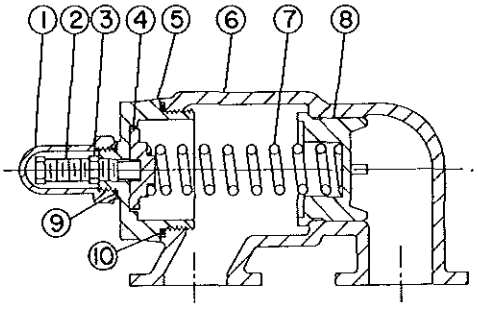


FIGURE 7 AS, AK, AL SIZE VALVE

LIST OF PARTS

1. Valve Cap	6. Valve Body
2. Adjusting Screw	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	10. Bonnet Gasket

Disassembly

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and repair or replace as necessary.

Reassembly

Follow the procedure outlined under disassembly.

If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

Pressure Adjustment

If the pressure setting of the valve is to be changed from that which the factory has set, the following instructions should be carefully followed: Remove the valve cap which covers the adjusting screw, and loosen the lock nut which locks the adjusting screw so pressure setting will not change during operation of pump. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the relief valve will allow while pump is in operation.

Important

In ordering parts for relief valve on head, always be sure to give Model and Serial Number of pump as it appears on name plate and the name of the part wanted. When ordering springs, be sure to give the pressure setting desired.

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

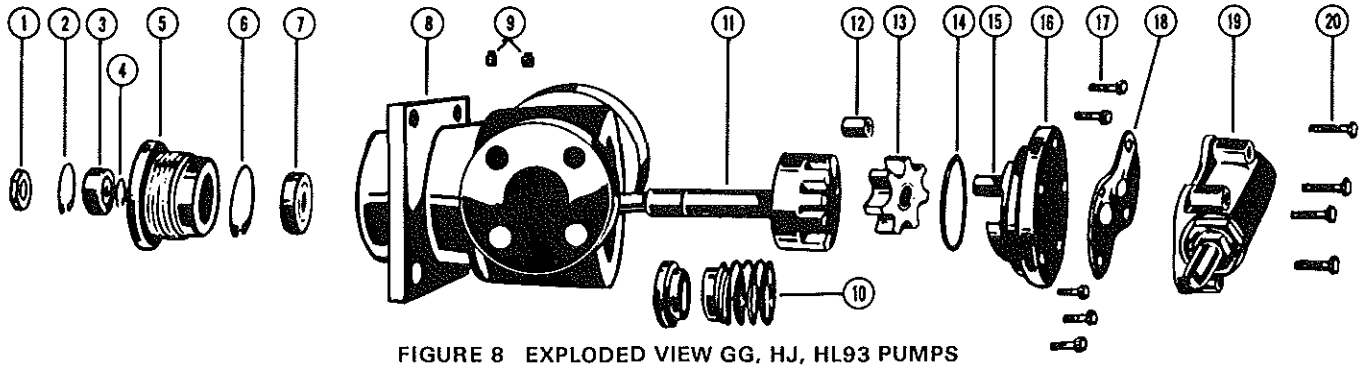


FIGURE 8 EXPLODED VIEW GG, HJ, HL93 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	11	Rotor and Shaft	Not Illus.	Mounting Bracket (For 56C, 143TC & 145TC Frame Motors)
2	Snap Ring, Outer	12	Idler Bushing		
3	Ball Bearing, Outer	13	Idler and Bushing	Not Illus.	Mounting Bracket (For 182TC & 184TC Frame Motors)
4	*Snap Ring for Shaft	14	O-Ring Gasket for Head		
5	Bearing Housing with Setscrews	15	Idler Pin	Not Illus.	Capscrew for Pump to Bracket (4-Req'd)
6	Snap Ring, Inner	16	Head (Valve Type) and Idler Pin		
7	Ball Bearing, Inner	17	Capscrew for Head (5-Req'd)	Not Illus.	Capscrew For Motor to Bracket (4-Req'd) (For 56C, 143TC & 145TC Frame Motors)
8	Casing	18	Gasket for Relief Valve		
9	Pipe Plug — 1/4" (2-Req'd)	19	Internal Relief Valve (Complete)	Not Illus.	Capscrew For Motor to Bracket (4-Req'd) (For 182TC & 184TC Frame Motors)
10	Mechanical Seal (Complete)	20	Capscrew for Valve (4-Req'd)		

*NOT USED ON GG SIZE PUMPS

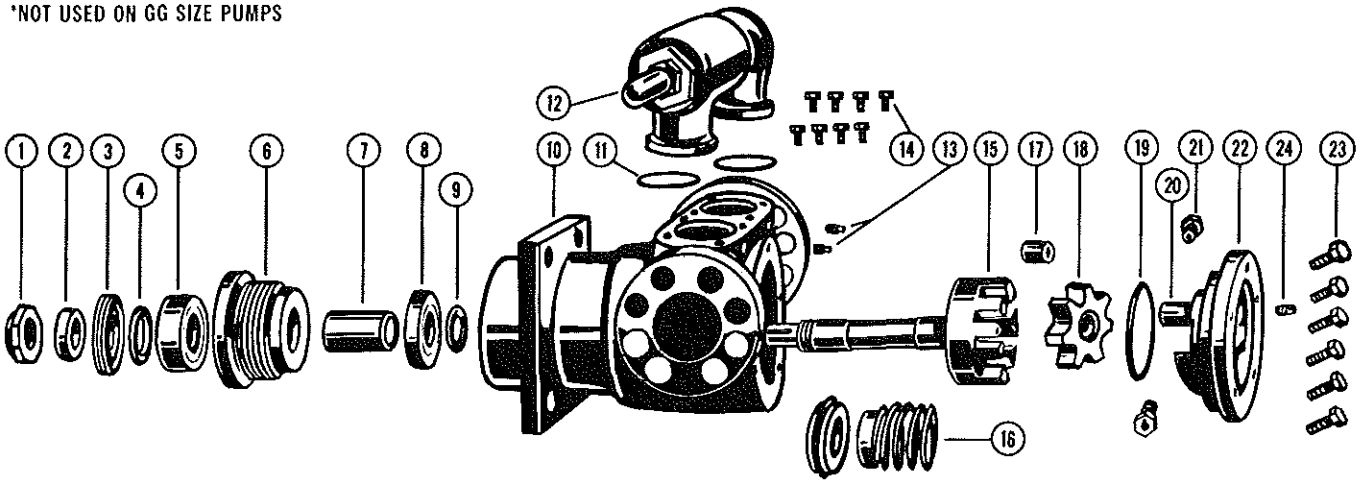


FIGURE 9 EXPLODED VIEW AS, AK, AL93 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	11	O-Ring Valve Gasket (2-Req'd)	21	Check Valve (2-Req'd)
2	Bearing Spacer Collar	12	Internal Relief Valve (Complete)	22	Head (Plain) and Idler Pin
3	End Cap for Bearing Housing	13	Pipe Plug — 1/4" (2-Req'd)	23	Capscrews for Head (6-Req'd)
4	Closure for Bearing Housing	14	Capscrews for Valve (8-Req'd)	24	Pipe Plug — 1/8"
5	Ball Bearing (2-Row)	15	Rotor and Shaft	Not Illus.	Mounting Bracket (For 182TC, 184TC, 213TC, 215TC, 254TC & 256TC Frame Motors)
6	Bearing Housing with Setscrews	16	Mechanical Seal (Complete)		
7	Bearing Spacer	17	Idler Bushing	Not Illus.	Capscrew for Pump & Motor to Bracket (4-Req'd) (For 182TC thru 256TC Frame Motors)
8	Ball Bearing (1-Row)	18	Idler and Bushing		
9	Bearing Retainer Washer	19	O-Ring Head Gasket		
10	Casing, Opposite Ports	20	Idler Pin		

PRINTED IN U.S.A.

11908176

Installation and Maintenance Instructions for your Westinghouse Medium Motor

I.L. 2930-11TD

RECEIVING

1. Check Nameplate Data.

2. Turn shaft by hand to check that it turns freely.

3. Request "Receiving and Storage Instructions" for long-term storage indoors or any storage outdoors.

4. Lifting eyebolts are designed for raising the motor alone and should be removed after installing motor.

Warning: The following safety precautions *must* be observed:

1. Electric rotating machinery and high voltage can cause serious or fatal injury if improperly installed, operated or maintained. Responsible personnel should be familiarized with NEMA MG2, safety standards for construction and guide for selection, installation and use of electric motors and generators, national electric code and all local safety requirements.

2. All power sources to the motor and to the accessory devices should be de-energized and disconnected and all rotating parts should be at standstill.

3. Lifting means, when supplied, are intended for lifting the motor *only*. When two lifting devices are supplied with the motor a dual chain must be used.

4. Suitable protection must be used when working near machinery with high noise levels.

5. Safeguard or protective devices must not be by-passed or rendered inoperative.

6. The frame of this machine must be grounded in accordance with the National Electrical Code and applicable local codes.

7. Avoid contact with start or run capacitors in single-phase motors until a safe discharge procedure has been followed.

8. A suitable enclosure should be provided to prevent access to the motor by other than authorized personnel. Extra caution should be observed around motors that are automatically controlled or have automatic re-setting relays as they may restart unexpectedly.

9. Enclose all belts to prevent injury from broken belts.

10. Shaft key must be fully captive before motor is started.

11. Provide proper safeguards for personnel against possible failure of motor-mounted brake, particularly on applications involving over-hauling loads.

LOCATION

1. Dripproof motors are intended for use where atmosphere is relatively clean, dry, and non-corrosive. Keep windings clean with a soft brush, cloth or suction.

2. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations. The drain plug in the end bracket must be removed periodically to drain accumulated condensation.

3. Explosionproof motors are built for use in hazardous locations as indicated by Underwriters' label on the motor.

Note: In all cases, no surrounding structure should obstruct normal flow of ventilating air through or over the motor.

INSTALLATION

Fasten securely to a flat base with maximum size bolts. All ball or roller bearing normal thrust motors may be mounted in any position. Do not drive sheaves, couplings, sprockets or pinions on motor shaft.

Direct Drive

Align shafts accurately. If reverse rotation is detrimental to the driven device check rotation BEFORE connecting the motor to the load. See "start up".

V-Belt Drive

1. Mount motor sheave close to bearing housing.

2. Allow sufficient clearance for rotor end play.

3. Sheave diameter should not be less than NEMA recommended value. See NEMA MG1-14.42.

4. Align sheaves carefully, tighten belts only enough to prevent slippage.

Flange Motor

Fits are accurately machined to mate with driven equipment. Mating surfaces must be free of dirt or burrs and solidly engaged. The assembly should turn freely without stressing shaft and bearings from misalignment and thrust.

ELECTRICAL CONNECTIONS

1. Connect motor per nameplate to correct power supply.

2. Install all wiring, fusing and grounding in accordance with National Electrical Code and local requirements.

3. Identify motor auxiliary devices such as space heaters or temperature sensors. Connect in proper circuits and insulate from motor power cables.

Wound Rotor Motors

a) Connect cables from secondary control to brushholder assembly. Bring cables through squeeze connector on front bracket, where provided.

b) Slip rings must be maintained smooth and true. Machine to restore proper surface for brushes.

c) Brushes must make good contact with slip rings along the whole face of brush. If needed, grind brushes in with fine sandpaper. Do not use lubricants. Service ports are provided for inspection of slip rings and brushes. Spring pressure is preset at about 1 lb. on 213-286T frames and 4 lbs. on 324-449T frames.

d) Must use same grade of brushes.

START UP

1. Disconnect load and start motor. Check direction of rotation. If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY. Interchange any two leads of a three phase motor. Reconnect a single phase motor per nameplate instructions. Fans on fan cooled motors that have directional rotation nameplates must be reversed on shaft if rotation is changed.

2. Connect load. The motor should start quickly and run smoothly. If not, shut power off at once. Recheck the assembly including all connections before restarting. For single phase motors, also examine capacitor wiring and mechanism for switching between starting and running.

3. If excessive vibration is noted, check for loose mounting bolts, too flexible motor support structure or transmitted vibration from adjacent machinery. Periodic vibration checks should be made; foundations often settle.

4. Operate under load for short period of time; check operating current against nameplate.

LUBRICATION: BALL OR ROLLER BEARINGS

Grease lubricated bearings as furnished are adequate for a long period of operation without relubrication. A good maintenance schedule for regreasing will vary widely depending on motor size, speed, duty and environment.

Frequency of Relubrication

The following table suggests relubrication intervals for motors on normal, steady running, light duty indoor loads in relatively clean atmosphere at 40°C (104°F) ambient temperature or less:

Type of Grease

Use Westinghouse 53701RY grease unless a special grease is specified on the nameplate. Some equivalent greases are:

Chevron SRI-2 – Standard Oil of California
Premium RB – Texaco Inc.
Unirex N2 – Exxon
Dolium R – Shell Oil Company
Rykon Premium – American Oil

Procedure for Relubrication

When regreasing, stop motor, remove outlet plug, and add amount of grease per reference table with hand lever gun only. Discontinue at once if grease appears at outlet plug, this may occur before specified amount is used, run for about ten minutes before replacing outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end; if the outlet plug is not accessible at surface of hood, it is the spring relief type and need not be removed when regreasing.

LUBRICATION: SLEEVE BEARINGS

Before starting the motor, fill both reservoirs through the filler plug with best quality, clean motor oil. The oil should have a viscosity of from 180 to 200 SSU (equivalent to SAE No. 10). During operation, no oil should be added until it drops below the full level. Do not flood the bearing. At about 2 year intervals, dismantle and thoroughly wash out the bearing housing, using hot kerosene oil.

Type of Enclosure	Insulation	Frame Size		
		143 to 215T	254 to 326T	364 to 449T
Open – DP	B	2 yrs.	18 mo.	1 yr.
Enclosed – FC Open – DP	B F	18 mo.	1 yr.	9 mo.
Enclosed – NV Enclosed – FC Open – DP Enclosed – Lint Free – FC	B F H B	1 yr.	9 mo.	6 mo.
Enclosed – NV Enclosed – FC Enclosed – Lint Free – FC	F H F	9 mo.	6 mo.	3 mo.

Note:
FOR MOTORS OVER 1800 RPM – Use 1/2 of tabled period.
FOR SEVERE DUTY – DUSTY LOCATIONS – Use 1/3 of tabled period.

Volume – Reference Table

Shaft Diameter (At Face of Bracket)	Amount of Grease to Add
3/4" to 1-1/4"	1/8 cu. in. or 0.1 oz.
1-1/4" to 1-7/8"	1/4 cu. in. or 0.2 oz.
1-7/8" to 2-3/8"	3/4 cu. in. or 0.6 oz.
2-3/8" to 3-3/8"	2 cu. in. or 1.6 oz.

Caution: Overgreasing is a major cause of bearing and motor failure. Make sure dirt and contaminants are not introduced when adding grease.

WARRANTY

Westinghouse warrants that the products sold by it will, upon shipment, be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during a period of one year after the date of installation or eighteen months from date of shipment, Westinghouse shall, upon prompt written notice from the purchaser, correct such non-conformity by repair or replacement, f.o.b. factory, of the defective part or parts. Correction in the manner provided above shall constitute a fulfillment of all liabilities of Westinghouse with respect to the quality of the products. The foregoing warranty is exclusive and in lieu of all other warranties of quality whether written, oral, or implied (including any warranty of merchantability or fitness for purpose).

The remedy(ies) provided above shall be purchaser's sole remedy(ies) for any failure of Westinghouse to comply with the warranty provisions, whether claims by the purchaser are based in contract or in tort (including negligence).

Westinghouse Electric Corporation
Medium Motor and Gearing Division, Buffalo, NY 14240
Printed in U.S.A.

INSTALLATION

General

Before installation is started a few items of a general nature should be considered.

1. *Location* — always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.
2. *Accessibility* — the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.
3. *Port Arrangement* — since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see Figure 1. The right angle ports are normally right-hand, see Figure 2; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.

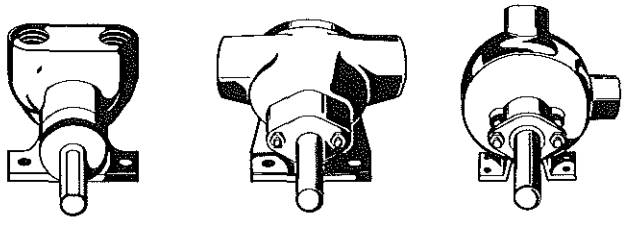


FIGURE 1

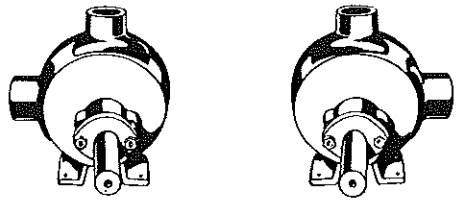


FIGURE 2

4. *Suction/Discharge* — shaft rotation will determine which port is suction and which discharge. A look at Figure 3 will show how rotation determines which port is which; as the pumping elements (gears) come out of mesh, point "A" on Figure 3, liquid is drawn into the suction port; as the gears come into mesh, point "B", the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump.

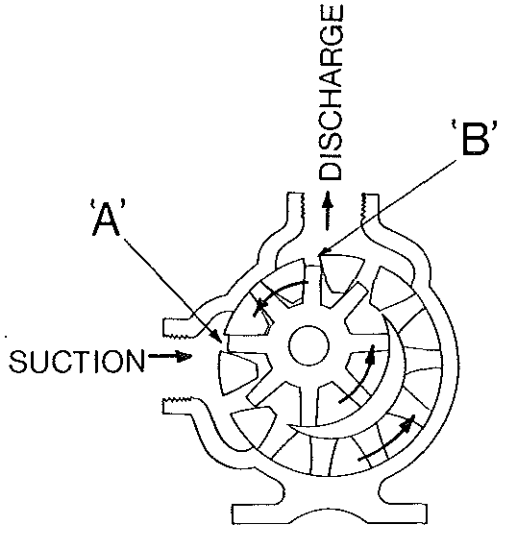
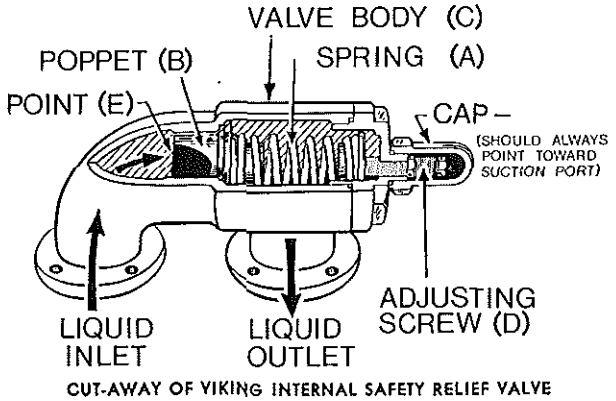


FIGURE 3

5. *Safety Relief Valve* — the Viking pump is a positive displacement pump. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for *this liquid to go — discharge line is blocked or* closed — the pressure will build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. To prevent the possibility of any one or more of these things happening in case of unintentional closing of the discharge line, the use of a safety relief valve is recommended. A safety relief valve will *relieve the pressure at a predetermined value, thus* protecting the entire system.



CUT-AWAY OF VIKING INTERNAL SAFETY RELIEF VALVE

FIGURE 4

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

The safety relief valve mounted on Viking pumps (optional on many models) and most in-line valves are of the spring loaded poppet design. See Figure 4. The spring (A) holds poppet (B) against the seat in the valve body (C) with a given force determined by the spring size and by how tightly it is compressed by the adjusting screw (D). The pump discharge pressure pushes against the under side of the poppet at point (E). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve. As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This pressure is the relief valve setting.

Viking pumps can be furnished with either an internal safety relief valve — one which directs the flow from the valve back to the suction side of the pump — or a return-to-tank valve which directs the flow through piping back to the supply tank. See Figure 5. An inline safety relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank should also be as short and large as possible.

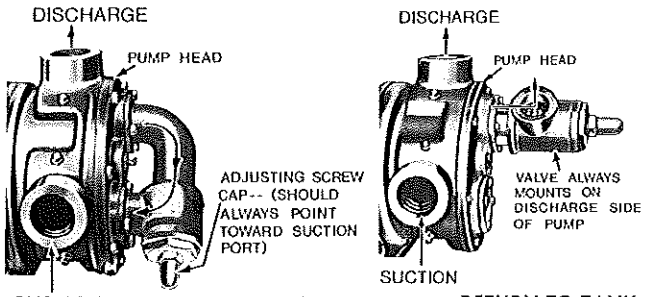


FIGURE 5

NOTE: on some models the safety relief valve is mounted on the pump casing instead of the pump head.

The spring loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should **not** be used as a pressure or flow control device. **It is intended strictly as a safety relief valve.**

CAUTION: THE INTERNAL TYPE SAFETY RELIEF VALVE MOUNTED ON THE VIKING PUMP SHOULD ALWAYS HAVE THE CAP OR BONNET POINTED TOWARD THE SUCTION SIDE OF THE PUMP. THE RETURN-TO-TANK TYPE SAFETY RELIEF VALVE SHOULD ALWAYS BE MOUNTED ON THE DISCHARGE SIDE OF THE PUMP. IF PUMP ROTATION IS REVERSED CHANGE THE RELIEF VALVE. TURN THE INTERNAL TYPE END FOR END; MOVE THE RETURN-TO-TANK TYPE TO THE OTHER PORT.

The pressure at which either type valve by-passes can be changed by turning the adjusting screw.

For details on maintenance of the relief valve see Technical Service Sheet covering your model series.

Foundation

Every pump should have a good foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

A certified print of the pumping unit should be used in preparing the foundation. Ask for one. If a separate foundation is provided, make it at least two inches wider and longer than the base of the unit.

When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

Alignment

CHECK ALIGNMENT AFTER MOUNTING

The pump, drive, and motor were properly aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **CHECK IT!**

1. Check pump ports to be sure they are square and in proper position; shim or move pump as required.
2. If the pump is driven by a flexible coupling(s), either direct connected to the motor or through a reducer, remove any coupling guards or covers and check alignment of the coupling halves. A straightedge (a piece of key stock works nicely) across the coupling must rest evenly on both rims at the top, bottom, and sides. See Figure 6.

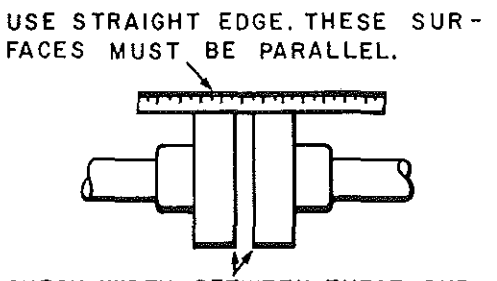


FIGURE 6

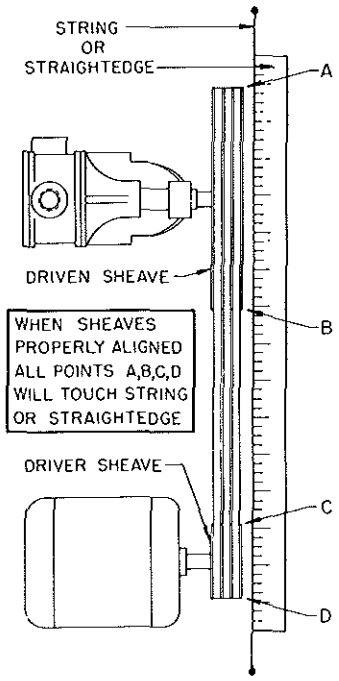


FIGURE 6A

3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See Figure 6A.
4. Make a final check on alignment after piping is hooked up. See item 13 under "Installation — Piping".

Figures 7, 8, and 9 show typical units — direct, gear reducer and V-belt drive.

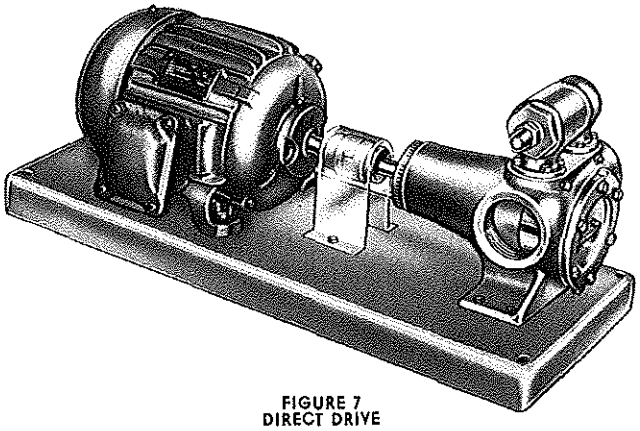


FIGURE 7
DIRECT DRIVE

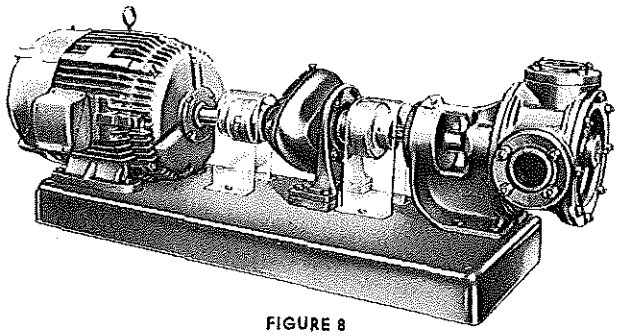


FIGURE 8
GEAR REDUCER DRIVE

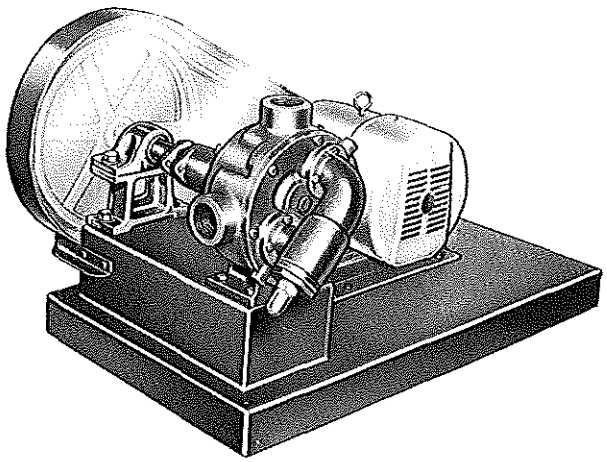


FIGURE 9
V-BELT DRIVE

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

Piping

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size piping, both suction and discharge, refer to Viking General Catalog Section 510.

Before starting layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.
2. Be sure the inside of the pipe is clean before hooking it up.
3. *Foot valve* — When pumping a light liquid with a suction lift, a foot valve at the end of the suction piping will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot valve is big enough so that it doesn't cause excessive line loss.
4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See Figure 10.

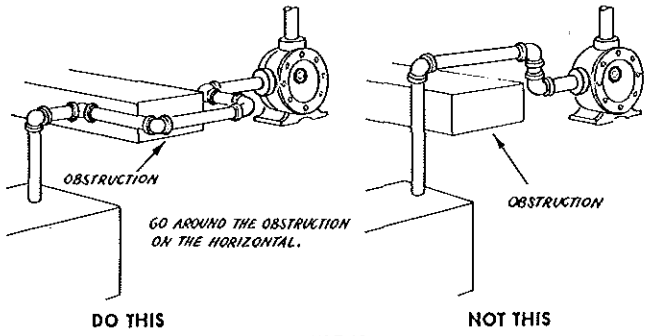


FIGURE 10

5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
6. For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no foot valve. See Figure 11.
7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted or put into a bind.

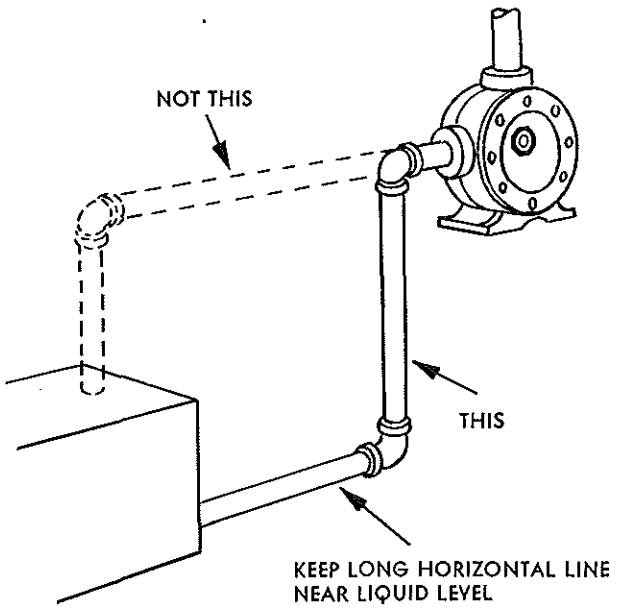


FIGURE 11

8. *Strainer* — It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be fine enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving him pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects.
9. If the pump is not equipped with a safety relief valve, consideration should be given to mounting one in the discharge line. See discussion on safety relief valves under START UP.
10. The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.

11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.
12. All joints of the piping system should be tight; pipe dope or teflon tape will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.
13. *Alignment* — Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size standard duty pumps.
14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the liquid pumped.

START UP

Before pushing the "start" button, check the following:

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. Check alignment — See suggestions under "Installation — Alignment" in this manual.
3. Check piping to be sure there is no strain on the pump casing.
4. Rotate the pump shaft by hand to be sure it turns freely.
5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under "Installation — General" item 4 in this manual.
6. Check any safety relief valve to be sure it is installed correctly. See discussion on safety relief valve under "Installation — General".
7. Check suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below liquid level.
8. Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the liquid to go.
9. Lubricate any grease fitting on the pump using a good, general purpose #2 ball bearing grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended.
10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.
11. Do **not** use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.
12. Check to be sure all guards are in place.
13. Now you are ready to push the "start" button — gently.

If the pump begins to deliver liquid within 60 seconds, you're in business. If it does not, push the "stop" button. Do **not** run the pump longer than one minute without liquid in it; you will ruin it. Review the steps just outlined, consider what the suction and discharge gauges indicate, see page 6 ; if everything appears to be in order, put some liquid in the pump, a lubricating liquid is best. This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver, the cause may be one or more of the following:

1. Suction line air leaks; vacuum gauge reading should help determine if this is the problem.
2. End of suction pipe not submerged deep enough in liquid.
3. Suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, suggest you review again all points given under START UP; read through Trouble-Shooting in this manual and try again. If it still does not pump, contact your Viking representative.

TROUBLE-SHOOTING

A Viking pump which is properly installed and maintained will give long and satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to *install a vacuum*

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

gauge in the suction port and a pressure gauge in the discharge port. Readings on these gauges often will give a clue as to where to start looking for the trouble.

Vacuum Gauge — Suction Port

1. High reading would indicate —
   a. Suction line blocked — foot valve stuck, gate valve closed, strainer plugged.
   b. Liquid too viscous to flow through the piping.
   c. Lift too high.
   d. Line too small.
2. Low reading would indicate —
   a. Air leak in suction line.
   b. End of pipe not in liquid.
   c. Pump is worn.
   d. Pump is dry — should be primed.
3. Fluttering, jumping, or erratic reading —
   a. Liquid vaporizing.
   b. Liquid coming to pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
   c. Vibrating from cavitation, misalignment, or damaged parts.

Pressure Gauge — Discharge Port

1. High reading would indicate —
   a. High viscosity and small and/or long discharge line.
   b. Gate valve partially closed.
   c. Filter plugged.
   d. Vertical head did not consider a high specific gravity liquid.
   e. Line partially plugged from build up on inside of pipe.
   f. Liquid in pipe not up to temperature.
   g. Liquid in pipe has undergone a chemical reaction and has solidified.
   h. Relief valve set too high.
2. Low reading would indicate —
   a. Relief valve set too low.
   b. Relief valve poppet not seating properly.
   c. Bypass around the pump partially open.
   d. Too much extra clearance.
   e. Pump worn.
3. Fluttering, jumping, or erratic reading —
   a. Cavitation.
   b. Liquid coming to pump in slugs.
   c. Air leak in suction line.
   d. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A. Pump does not pump.
   1. Lost its prime — air leak, low level in tank, foot valve stuck.
   2. Suction lift too high.
   3. Rotating in wrong direction.
   4. Motor does not come up to speed.
   5. Suction and discharge valves not open.
   6. Strainer clogged.
   7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
   8. Pump worn out.
   9. Any changes in the liquid system, or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.

B. Pump starts, then loses its prime.
   1. Supply tank empty.
   2. Liquid vaporizing in the suction line.
   3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
   4. Worn out.

C. Pump is noisy.
   1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
   2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the liquid, raise the liquid level closer to the pump; if the liquid is above the pump, increase the head of liquid.
   3. Check alignment.
   4. May have a bent shaft or rotor tooth. Straighten or replace.
   5. Relief valve chatter; increase pressure setting.
   6. May have to anchor base or piping to eliminate or reduce vibration.
   7. May be a foreign object trying to get into the pump through the suction port.

D. Pump not up to capacity.
   1. Starving or cavitating — increase suction pipe size or reduce length.
   2. Strainer partially clogged.
   3. Air leak in suction piping or along pump shaft.
   4. Running too slowly; is motor the correct speed and is it wired up correctly.
   5. Bypass line around pump partially open.
   6. Relief valve set too low or stuck open.
   7. Pump worn out.

E. Pump takes too much power.
   1. Running too fast — Is correct motor speed, reducer ratio, sheave size, etc. being used.
   2. Is liquid more viscous than unit sized to handle; heat the liquid, increase the pipe size, slow the pump down, or get a bigger motor.
   3. Discharge pressure higher than calculated, check with pressure gauge. Increase size or

reduce length of pipe, reduce speed (capacity), or get bigger motor.

4. Packing gland drawn down too tight.
5. Pump misaligned.
6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

F. Rapid Wear.

On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. **Rapid wear,** occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. Some of the causes, evidence and cures are listed here.

CAUSE	EVIDENCE	CURE
1. Abrasives	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
2. Corrosion	Rust, general overall aggressive attack or sloughing off of metal.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3. Exceeding operating limits	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat.	Review General Catalog for operating limits on particular model involved.
4. Insufficient extra clearance	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your distributor or the factory with details of the application so that information regarding proper extra clearance may be provided.
5. Lack of lubrication	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all zerks are greased before starting and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6. Misalignment	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7. Run dry	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing color because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the cost per gallon pumped.

A. Lubrication — Grease all zerks after every 500 hours of operation or after 60 days, whichever occurs first. If service is severe, grease more often. Do it gently with a hand gun. Use a #2 ball bearing grease. If it is hot, use a heavier grease; if cold, use a lighter one.

B. Packing Adjustment — Occasional packing adjustment may be required to keep leakage to a slight weep; if impossible to reduce leakage by gentle tightening, replace packing or use different type. See Technical Service (TS) Manual on particular model series for details on repacking.

C. End Clearance Adjustment — After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See TS manual on particular model series for procedure on adjusting end clearance for pump involved.

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

D. Examine Internal Parts — Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. See TS manual on particular model series for procedure in removing head of the pump. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.

E. Cleaning the Pump — A clean pump is easier to inspect, lubricate, adjust, and runs cooler; plus, it looks better.

F. Storage — If a pump is to be out of service or stored for a long time, drain it and protect it from rusting inside and out.

DO'S AND DON'TS

Do's and don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

Installation —

1. Do install pump as close to supply tank as possible.
2. Do leave working space around the pumping unit.
3. Do use large, short, and straight suction piping.
4. Do install a strainer in the suction line.
5. Do double-check alignment after the unit is mounted and piping is hooked up.
6. Do provide a safety relief valve for the discharge side of the pump.
7. Do cut out the center of gaskets used as port covers on flanged port pumps.
8. Do record pump model number and serial number and file for future reference.

Operation —

1. Don't run pump at speeds faster than shown in the catalog for your model.
2. Don't require pump to develop pressures higher than those shown in the catalog for your model.
3. Don't operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. Don't operate pumps without all guards being in place.
5. Don't operate pump without a safety relief valve on the pump or in the discharge piping; be sure valve is mounted and set correctly.
6. Don't exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.
7. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

Maintenance —

1. Do make sure any pump that has handled high vapor pressure liquids (LP-Gas, ammonia, Freons, etc.) has been vented before it is disassembled.
2. Do make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
3. Don't drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump; it may drop on your foot, plus, it may get nicked or gouged.
4. Don't stick fingers in the ports of a pump! The close running parts may trim more than your fingernails if the pump is rotated.
5. Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
6. Do remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
7. Do **obtain,** read and keep maintenance instructions furnished with your pump.

WARRANTY

Viking warrants (unless otherwise specified) all pumps and pump parts manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any pump or pump parts sold by Viking prove to be defective in workmanship or material under normal use and service, and if such pump or pump parts are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the pump or pump parts are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, F.O.B. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking pump or pump part are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of Houdaille Industries, Inc. or Viking Pump Division is authorized to alter this warranty.

F-21502-JR

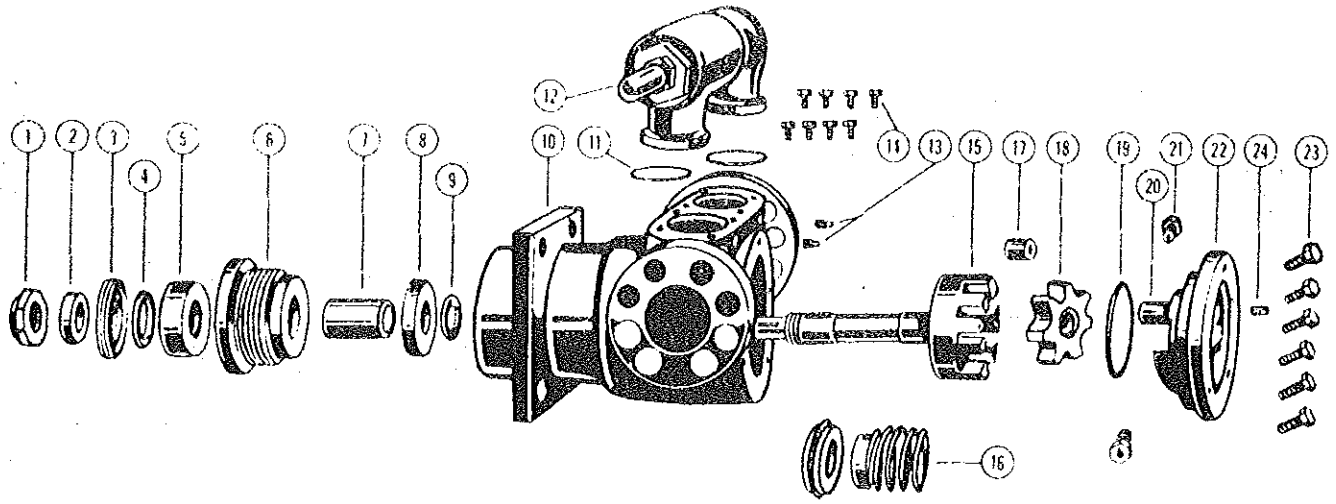
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PAGE	R120 22
EFFECTIVE	6-28-76
SUPERSEDING	4-18-75

VIKING HEAVY-DUTY STEEL VERTICAL INLINE UNMOUNTED PUMP

PARTS LIST MODEL AS93 for Units AS93IM

SUPERSEDES ALL PREVIOUS LISTS

SUBJECT TO CHANGE WITHOUT NOTICE
F.O.B. CEDAR FALLS, IOWA



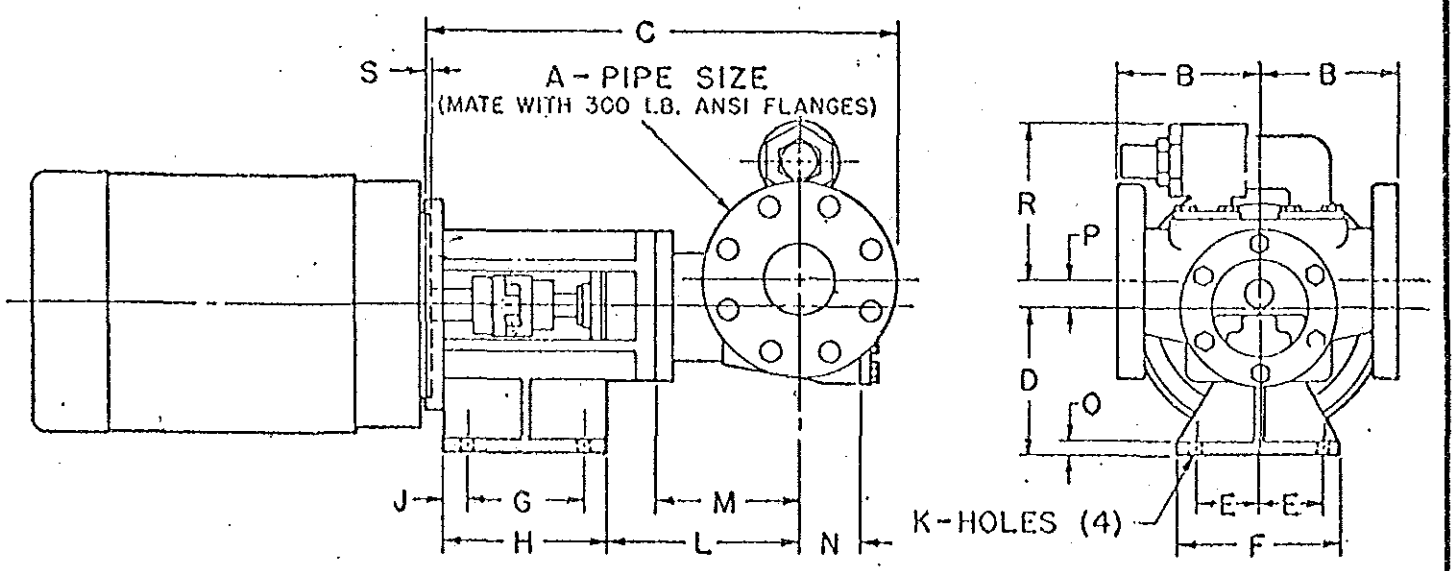
ITEM	PART NO	DESCRIPTION	MATERIAL	PRICE EA.
1	2-505-012-376	Locknut	Steel	$ 3.50
2	2-288-029-210	Bearing Spacer Collar	Steel	3.50
3	2-140-015-781	End Cap for Bearing Housing	Zinc Alloy	5.00
4	2-283-052-378 *	Closure for Bearing Housing (Trostel #03BRS-224-140-4)	Standard	3.50
5	2-055-016-375 *	Ball Bearing (2-Row) (New Dep. #5306)	Steel	26.00
6	3-060-035-922	Bearing Housing with Setscrews	Aluminum Alloy	20.00
7	2-755-020-210	Bearing Spacer	Steel	7.00
8	2-055-042-375 *	Ball Bearing (1-Row) (New Dep. #9606)	Steel	15.00
9	2-805-045-375	Bearing Retainer Washer	Steel	4.00
10	2-203-810-271	Casing	Steel	450.00
11	2-512-007-860 *	O-Ring Valve Gasket (2-Req'd)	Standard	.85 ea.
12	3-795-524	Internal Relief Valve (Complete)	Steel External	164.00
13	2-542-004-376	Pipe Plug-1/4" (2-Req'd)	Steel	.40 ea.
14	2-150-019-255	Capscrew for Valve (8-Req'd)	Steel	.05 ea.
15	3-568-151-312-20 *	Rotor and Shaft	Ductile Iron & Steel	92.00
16	2-477-015-999 *	Mechanical Seal (Complete)	Standard	25.00
17	2-108-003-880	Idler Bushing	Carbon Graphite	21.00
18	3-419-006-380 *	Idler and Bushing	Ductile Iron & Carbon Graphite	49.00
19	2-512-022-860 *	O-Ring Head Gasket	Standard	2.75
20	2-435-011-281	Idler Pin	Hardened Steel	7.00
21	2-790-011-376	Check Valve (2-Req'd)	Steel	1.75 ea.
22	3-375-009-416 *	Head (Plain) and Idler Pin	Steel & Hardened Steel	234.00
23	2-150-020-255	Capscrew for Head (6-Req'd)	Steel	.20 ea.
24	2-542-001-376	Pipe Plug-1/8"	Steel	.20
not illus.	2-313-006-806-62	Pipe Flange Gasket (2-Req'd)	Standard	1.75 ea.
2 thru 6	3-060-016-999	Bearing Housing Assembly (Complete)	Standard	58.00

Minimum Billing $15.00

PURCHASE ORDER NO. B-451445-0
CONTRACT NO. 700000

* Recommended Spares

When ordering parts, be sure to give PART NO., NAME OF PART, MATERIAL, MODEL & SERIAL NO. of pump as it appears on nameplate.



MODEL NO.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S
AS93M	3	6	$20\frac{5}{16}$	$6\frac{1}{4}$	$2\frac{3}{4}$	7	5	7	1	$\frac{9}{16}$	$8\frac{7}{16}$	$6\frac{3}{8}$	2	$\frac{1}{2}$	$1\frac{1}{8}$	7	$\frac{3}{16}$
													51				
AK93M													2				
													51				
AL93M													$2\frac{1}{2}$				
		152	516	159	70	178	127	178	25	14	214	162	64	13	29	178	5

NOTE: Dimensions shown in shaded area are millimeters, others are in inches.

MODELS

FOR Walter B. Rom & Son, Inc.
Wauwatosa, Wisconsin 53226
ORDER NO. F-21502-JR
REQ. NO. Colt Industries
Beloit, Wisconsin 53511

REFERENCE Milwaukee
INVOICE NO. E-43773
ORDER NO. B-451445-0
MODEL NO. AS-93M, Opposite Ports, 3"300#Flg.
RELIEF VALVE With Stl. Internal SET AT 75 PSI
CONSTRUCTION Steel Head & Casing - Ductile Iron Rotor & Idler - Carbon Graphite Idler Bushing - Buna N O-Ring Gaskets - 2-477-015 Seal - 3-795-524 Steel Internal Valve with Cast Iron Poppet

MISCELLANEOUS MOTOR: 7-1/2 HP, 1200 RPM, 254TC Frame,
SERVICE: Liquid SAE 30, 35 GPM, 100 SSU Visc. 160 Deg. F. Temp., 50 # Discharge Head, Flooded Suction
TAG: Colt Part # 11-908-176 PRE LUBE PUMPS Colt P.O.# B-451445-0

DRAWING NO. AV-399

0124F229 1/24/77
CERTIFICATION NUMBER DATE

BY Ed Reichardt ENGR. DEPT.

DRAWN BY BLASBERG DATE 6-2-75
CHECKED BY E.R. DATE "

THIS PRINT IS CERTIFIED

VIKING PUMP HOUDAILLE
Viking Pump Division, Houdaille Industries, Inc.
Cedar Falls, Iowa 50613 U.S.A.

JAN 25 1977

STEEL EXTERIOR

MODEL AS-93

LM- 4-1910-2942 Flange Mounted Pump With Steel Internal Valve - 3" 300# Opp.Flgd.Ports
Steel Casing & Head - Ductile Iron Rotor & Idler - Carbon Graphite
Idler Bushing - Buna N O-Ring Gaskets - 2-477-015 Seal - 3-795-524 Dwg.No. 4-1910-2942-501
Steel Internal Valve With Cast Iron Poppet

Item	SUB-ASSEMBLY NO.	PART NO.		MATERIAL	Qty.	DESCRIPTION
1		2-203-810-271		Steel	1	CASING, 3" 300# Opp.Flgd. Ports
2		2-805-045-375	C	Steel	1	WASHER, Bearing Retainer
3		2-055-042-375		Steel	1	BEARING, Ball 1 Row - 1 Seal
4		2-542-004-376	C	Steel	2	PIPE PLUG 1/4
5	3-568-151-312-34	2-568-005-150-34		Duct.Iron	1	ROTOR
* 6		2-652-005-260		Steel	1	SHAFT, Rotor
7		2-596-010-375	C	Steel	1	KEY, Rotor
8	3-419-006-380-42	2-419-005-150-40		Duct.Iron	1	IDLER
* * 9		2-108-003-880-02		C.G.	1	BUSHING, Idler
10	3-375-009-416	2-375-009-271		Steel	1	HEAD
* * 11		2-435-011-281		Stl.Carb.	1	IDLER PIN
12		2-790-011-376	C	Steel	2	CHECK VALVE
13		2-542-001-376	C	Steel	1	PIPE PLUG 1/8
14		2-150-020-255	C	Steel	6	CAPSCREW 7/16 NC 7/8
15	3-795-524-000 -18			Steel	1	RELIEF VALVE, Set 75 #
16		2-150-019-255	C	Steel	8	CAPSCREW 5/16 NC 5/8
* 17		2-477-015-999		Standard	1	MECHANICAL SEAL
80	3-060-016-999			Aluminum	1	BEARING HOUSING Assembly
18		2-755-020-210		Steel	1	BEARING SPACER
19		2-505-012-376	C	Steel	1	NUT, Self Locking 1-1/8 NF
* 20		2-512-022-860	C	Buna N	1	GASKET, Head O-Ring
* 21		2-512-007-860	C	Buna N	2	GASKET, Relief Valve O-Ring
* 22		2-313-006-806-62	C	Comp.Asb.	2	GASKET, 3" 300# Pipe Flange

THIS LIST OF MATERIAL
FOR REPLACEMENT PARTS
NOT FOR PRODUCTION DEPT

NOTE
ALWAYS GIVE
MODEL & SERIAL
NO. WHEN ORDERING
PARTS

* RECOMMENDED SPARE PARTS

*RECOMMENDED SPARE ASSEMBLIES

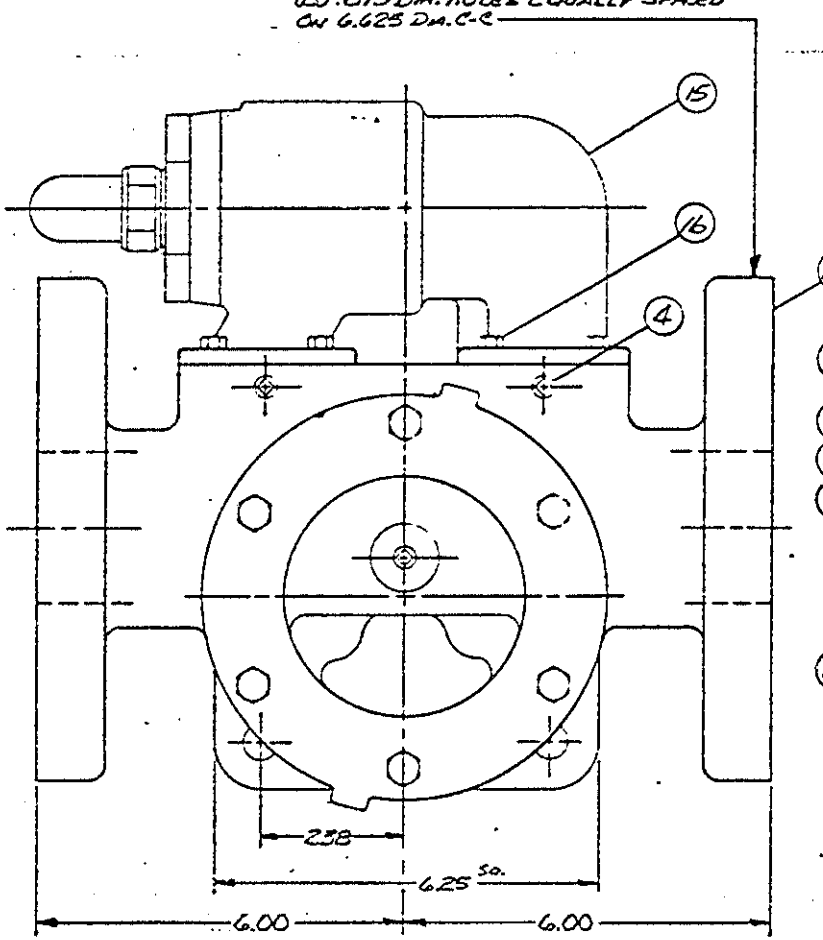
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LM 4-1910-2942-501	ENGR		EX. END CL .002

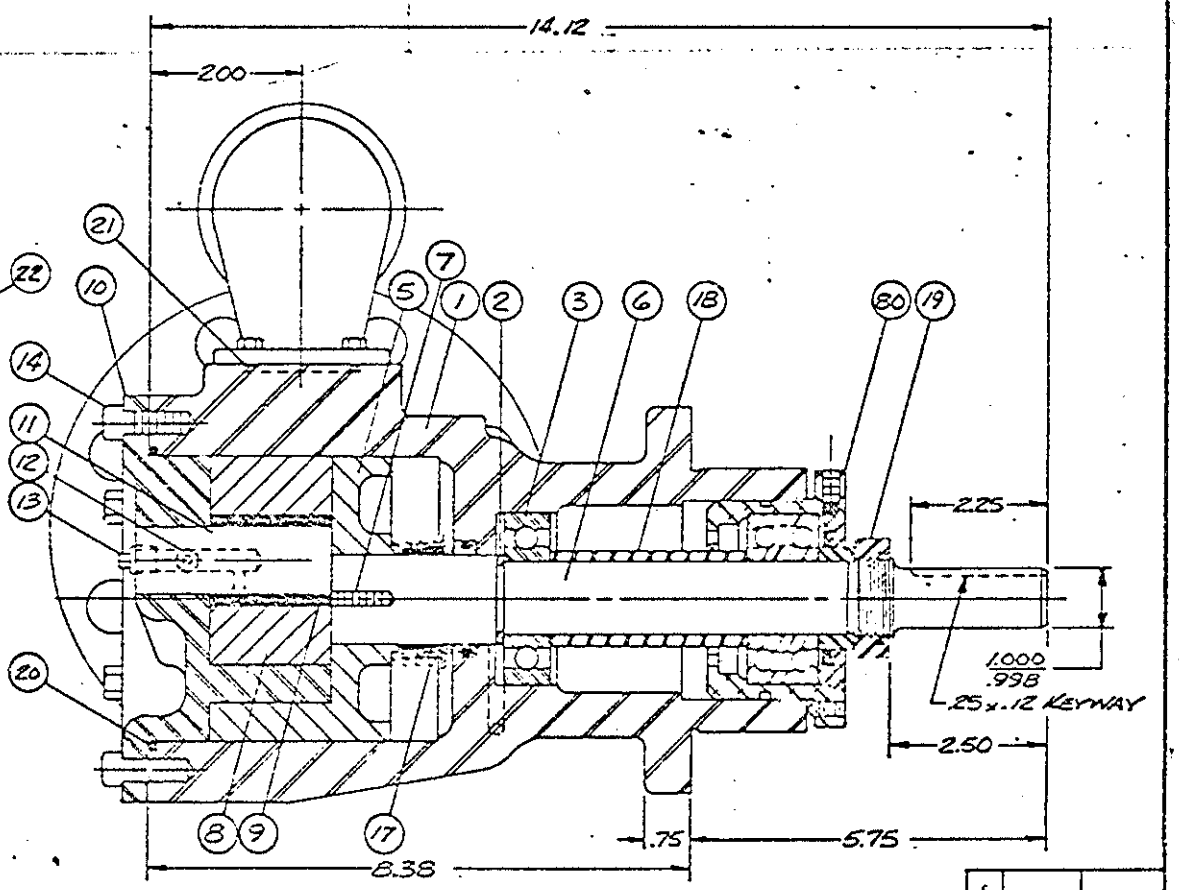
JAN 25 1977

Form No. 311-E LAL VIKING PUMP DIVISION, HOUDAILLE INDUSTRIES, INC. CEDAR FALLS, IOWA 50613

JAN 25 1977

PORTS: 3"-300# PIPE FLANGES, 8.25" O.D.
(8) .875 DIA. HOLES EQUALLY SPACED
ON 6.625 DIA. C-C





FOR ITEM 15 SEE DRWG & LM 3-795-524
FOR ITEM 80 SEE DRWG & LM 3-060-016

REV	CHANGED	DATE
C		
B		
A		

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PATTERN NO.		AS HALF	DATE 1-24-77
DRAWN B.Y.	MATERIAL E.R.	VIKING PUMP HOUDAILLE	MODEL AS93 PUMP CONSTRUCTION PER LIST OF MATERIALS LM 4-1910-2942-501
APPROVED			DRAWING NO. 4-1910-2942-501

JAN 25 1977

List of Material FOR 3-060-016 Bearing Housing Assembly MODEL

CONSTRUCTION Aluminum For AS & AK & AL-195 DRG. NO. 3-060-016

CUSTOMER

Item	SUB-ASSEMBLY NO.	PART NO.		MATERIAL	Qty.	DESCRIPTION
81		2-060-013-722		A-20 Irid.	1	BEARING HOUSING
82		2-055-016-375		Steel	1	BEARING, Ball (2-Row)
83		2-140-015-781		Zinc, Irid.	1	CAP, Bearing Housing End
84		2-596-004-375	C	Steel	2	SETSCREW 5/16 NC 5/16
85		2-490-008-902	C	Nylon	2	INSERTS (1/4 OD x 1/8)
86		2-596-028-375	C	Steel	2	SETSCREW 1/4 NC 5/8
87		2-288-029-210		C-11	1	COLLAR, Bearing Spacer
88		2-283-~~052~~-378	C	St.&Buna N	1	CLOSURE

see ~~Viton~~ letter dated 4/25/83

UL

NOTES

	APPROVAL		CHANGES		EXTRA CLEARANCE	LMT. NO.
TEST SPEC.	MADE [illegible] DATE 6-12-62	1	NO. 2167-A	DATE 1-2-68	O.D. ROTOR	
SHOP NO.	CHECK [illegible] DATE 6-12-62		NO.	DATE	I.D. ROTOR	
SHEET NO. 1 OF 1	SPECS [illegible] DATE 6-12-1962		NO.	DATE	O.D. IDLER	
LM 3-060-016 1	ENGR. [illegible] DATE —		NO.	DATE	BEARINGS	
			NO.	DATE	END CL.	

Form No. 311-D

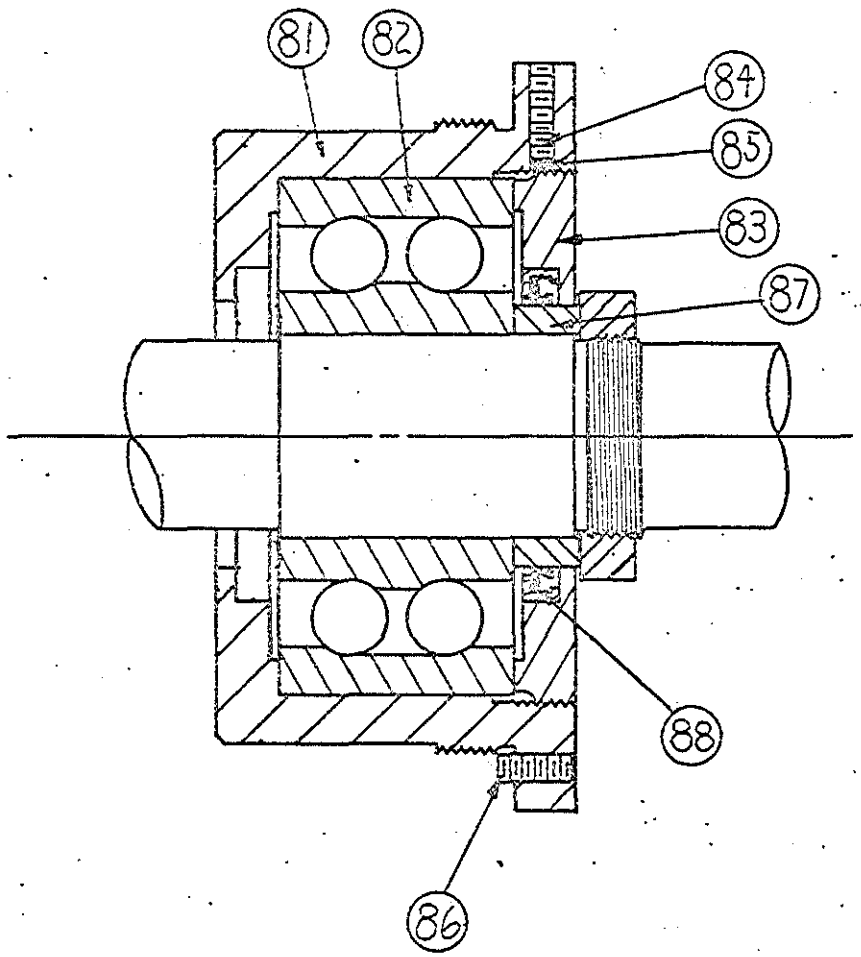
Viking Pump Co.

CEDAR FALLS, IOWA

b1s

JAN 25 1977

3-060-016



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REF	CHANGED	DATE
C		
B		
A		

PATTERN No.		SCALE NONE	DATE 8-6-70
DRAWN M.J.S.	CHECKED A.B./E.R.	VIKING PUMP HOUDAILLE	Bearing Housing Assembly- Aluminum for AS, AK and AL195 pumps
APPROVED		Viking Pump Division, Houdaille Industries, Inc. Cedar Falls, Iowa 50613 U.S.A.	DRAWING No. 3-060-016. SIZE A

LM- 3-795-524 Relief Valve For AS, AK, AL, J, K, KK Pump MODEL 3-795-524

All Steel Except Cast Iron Poppet - 304 Stainless Steel Springs - DRG. NO. 3-795-524

Buna N O-Ring Gaskets

Item	SUB-ASSEMBLY NO.	PART NO.	MATERIAL	Qty.	DESCRIPTION	PRESSURE RANGE J-K-KK / AS-~~85~~ 75	PRESSURE RANGE ~~AK-195~~ / ~~AL-195~~
1		2-795-014-271	Steel	1	BODY		
2		2-796-026-100	C.I.	1	POPPET		
~~3~~		~~2-763-018-610~~	~~304 S.S.~~	~~1~~	~~SPRING~~	~~15-50~~	~~20-60~~
~~3~~		~~2-763-018-610~~	304 S.S.	1	SPRING	51-80	~~61-90~~
3		~~2-763-019-610~~	~~304 S.S.~~	~~1~~	~~SPRING~~	~~81-150~~	~~91-160~~
~~3~~		~~2-763-018-610~~	~~304 S.S.~~	~~1~~	~~SPRING~~	~~151-225~~	~~161-225~~
4		2-763-019-610	304 S.S.	1	SPRING	*	*
5		2-799-043-375	Steel	1	SPRING GUIDE		
6		2-512-018-860 C	Buna N	1	GASKET, Bonnet		
7		2-797-006-271	Steel	1	BONNET		
8		2-503-006-376 C	Steel	1	LOCKNUT		
9		2-596-006-376 C	Steel	1	ADJUSTING SCREW		
10		2-511-008-860 C	Buna N	1	GASKET, Adj. Screw Cap		
11		2-798-007-271	Steel	1	CAP, Adjusting Screw		

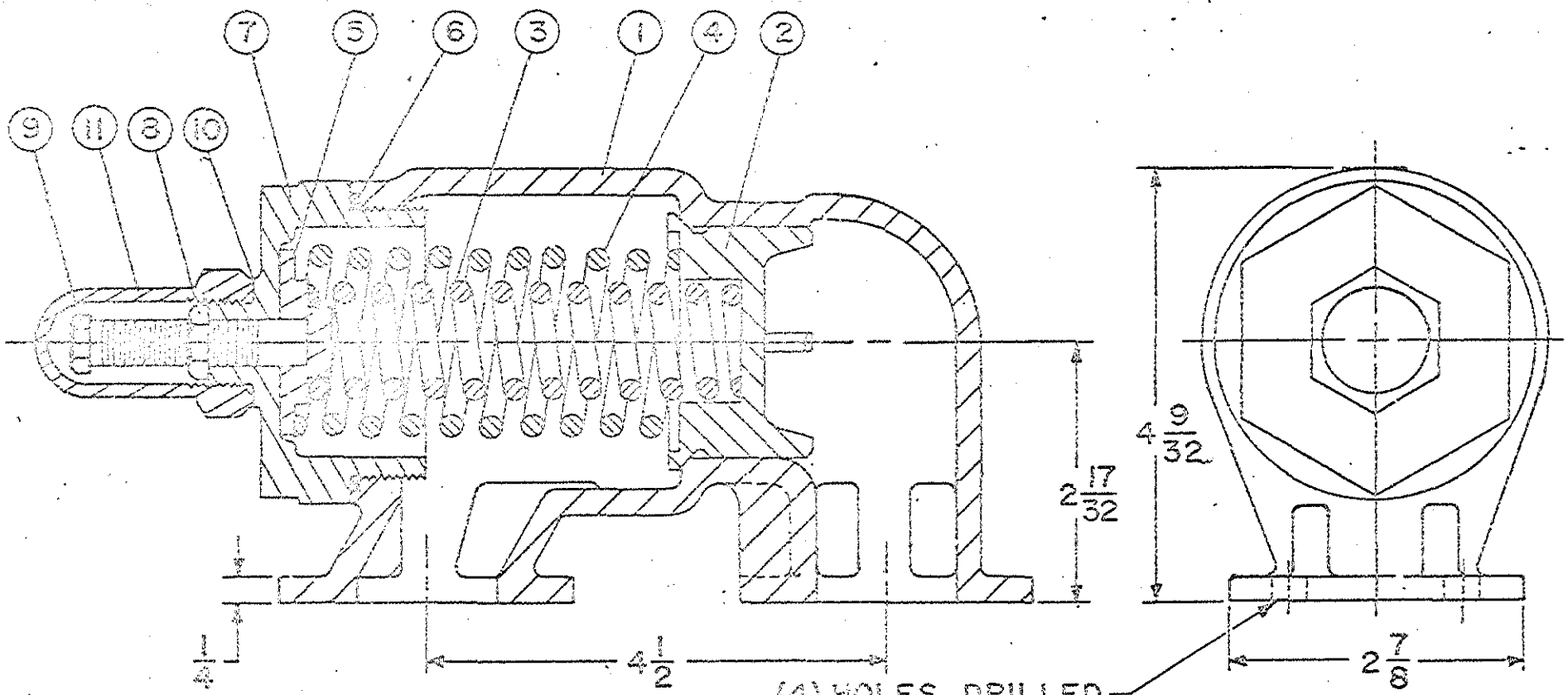
NOTE: * = REFER TO ADJUSTING SETTING CHARTS FOR MAXIMUM PRESSURE SETTINGS.

3-795-524

JAN 25 1977

SHEET NO. 1 OF 1	MADE A.R. 1-4-73	4301 11-76	
	CHECK		
LM 3-795-524	ENGR		EX. END CL.

JAN 25 1977



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REF.	CHANGED	DATE
C		
B		
A		

PATTERN No.	SCALE NONE	DATE 1-10-73
DRAWN BOOROM	CHECKED E.R.	
APPROVED		

VIKING PUMP HOUDAILLE

Viking Pump Division, Houdaille Industries, Inc
Cedar Falls, Iowa 50613 U.S.A.

INTERNAL RELIEF VALVE ALL STEEL EXCEPT CAST IRON POPPET - BUNA N O-RINGS FOR AS, AK, AL, J, K, & KK PUMPS.

DRAWING No. 3-795-524

DRG A SIZE

Form 454C

Service	Lube Oil	Req'n. No.	8031-M-71	Item No.
Plant	Limerick Gen.	Spec. No.	8031-M-71	No. Req'd. 8 (1 per diesel)
Location	Pottstown	P.O. No.		Cost Code See M/R
Drawing Ref		Layout	Process	Viking A593M 2

LINE NO.		
1	Liquid Pumped / Newtonian or Non-N.	SAE 30
2	Viscosity (SSU) (CS): Norm. Temp. / Min. Temp. / Max. Temp.	100 SSU 160°F
3	Vapor Press. (PSIA): Norm. Temp. / Min. Temp. / Max. Temp.	
4	Temperature (°F): Norm. / Min. / Max.	
5	Specific Gravity / Pour Point / Flash Point @ °F	
6	Solids: Type / % by vol. / Abrasive / Shape / Distr. / Density	
7	Gases: Entr. / Dis'd. / Solubility (% by Vol. at 30" Hg. abs.)	
8	Flow: Rating / Min. / Max. (GPM)	35 2
9	Pressure: Outlet / Inlet / Diff. Max ΔP (PSIG)	50 0 200 2
10	NPSH: Available / Req'd. @ ℄ Suction (PSIG)	— 4.9 PSIA
11	Type of Pump	Rotary 2
12	RPM / Rotation Facing Coupling	1150 CW
13	Efficiency / BHP Rating / BHP Max	57% 1.8 —
14	Relief Valve: Internal - Setting / External - Setting (PSIG)	75 NA
15	Suction Conn.: Size / Rating / Facing / Position	3" 300# FLAT RIGHT
16	Discharge Conn.: Size / Rating / Facing / Position	3" 300# FLAT LEFT
17	Mfr. Brg. No.: Radial / Thrust	NEW DEPARTURE 5306
18	Base Plate: Pump (& Gear) Only / Comb. W. Driver (& Gear)	2-074-015 ALUMINUM BY VIKING
19	Coupling: Mfr. / Model Size / Guard / Dr. Half Mtd.	LOVEJOY AL150
20	Seal: Packing Size, No., Type / Mech. Seal Mfr., No.	CRANE DWG. E-SP-7597 CODE: B2? 871-2561-B
21	Lubrication: Main, Type / Secondary, Type / Max. Micron	NLGI #2
22	Cooling: Water GPM., Pr. / Quench / Steam Jacket	NA
23	Material: Case	STEEL
24	Rotors	DUCTILE IRON
25	Shaft / Shaft Sleeve	STEEL
26	Throat ~~Bushing~~ BEARING	STEEL
27	Lantern Ring / Gland	NA
28	Relief Valve	STEEL
29	Base Plate	NA
30	Cooling Piping / Steam Piping	NA
31	Seal Piping / Lubrication Piping	NA
32	Driver: Type (Motor - ~~Turbine~~ - Gear) / RPM / HP (A.C.)	MOTOR BY CUSTOMER 2 2
33	Furn. By / Weight / Dwg. / Mfr.	Seller
34	Bearing Description: Radial, No. / Thrust, No.	
35	Lubrication: Radial / Thrust / Cooling	
36	High Speed Cplg.: Mfr. / Model / Furn. By	
37	Drawings: Outline / Sectional / Perf. Curve	AV-399 4-1910-2942-501 PC #120-26
38	Net Weight	110 LBS. LESS POWER
39	Inspection: Std. / QA	Yes
40	Testing: Ultrasonic / Eddy Cur. / Mag. Part. / Liq. Pen. / Radiogr.	Manufacturer's Standards
41	Hydrostatic / Witness // NPSH / Witness	Yes
42	Performance / Witness / Disassembly	Yes Yes
43	Quality Assurance: Mfr. Std. / Documented	Per 8031-G-13
44	Codes	DEMA, ASME, ASTM, API, SNT
45	Seismic Design Req's	Class I Seismic
46		1AP532, 1BP532, 1CP532, 1DP532
47	Equipment No.	2AP532, 2BP532, 2CP532, 2DP532

FILL IN ALL BLANKS: IF NOT APPLICABLE MARK "NA"

NO.	DATE	REVISIONS
2	7-30-71	Issued for Purchase
1	3-25-71	Reissued for Bids
0	6-11-71	Issued for Bids

NOTES

ORIGIN

ROTARY PUMP DATA SHEET

A.C. MOTOR-DRIVEN PRE-LUBE PUMP FOR DIESEL GENERATOR
LIMERICK GENERATING STATION UNITS 1 & 2

PHILADELPHIA ELECTRIC COMPANY

JOB NO.	
8031	
DATA SHEET NUMBER	REV.
8031-M-71-DS-7	2

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JAN 21 1971

2-2-70 M305E

WALTER B. ROM & SON, INC.

THE PUMP PEOPLE

1060 N. 115th STREET, WAUWATOSA, WI 53226, 414/771-3683

WISCONSIN 800/242-1625

March 1, 1977

Viking Pump Company
11430 W. Bluemound Road
Wauwatosa, Wis. 53226

Ref: F-21500-JR (B-45443-0) E-43771
F-21501-JR (B451444-0) E-43772
F-21502-JR (B451445-0) E43773

11908176
3-14-84 New certification sheet to be issued per Jack Risley Rom furnished a 5 HP Electric motor.

Attn: Mr. Howard Parker

Dear Howard:

We have received a change of order from Colt regarding the above orders, requesting Viking to furnish Westinghouse motors since "IE" Nuclear motors are not required.

There is also a change in the Seismic requirements. While the complete Seismic anaylsis is not required, pump set must withstand forces of 1.1 G Vertical and 3 G Horizontal maximum acting simultaneously as a result of a Seismic event and retain its structural intergity. Viking to advise us the maximum flange loading permissible simultanesouly with above "G" forces.

Colt seems to think Viking engineering could do this calculation, however I was told by Viking that Hissong Consultants of Mt. Vernon, Ohio, would do the calculation for $810.00 net each for different model, which is O.K. with Colt. At the present time Jim Dennis has put a hold on the above order since Feb. 5, because I told him that Colt might request that Viking furnish the drivers.

The reason for this letter is to have you familiar with the change before sending it to the factory.

Every seven of ten engines built at Beloit are for stand-by power in nuclear power plants, and orders are becoming more complicated. We think that one person at Cedar Falls should be responsible, like John Young (Government and Marine).

With the original order we attached Form BF-4910, Paragraphs 5, 6, 19, and 23 will still apply to this change order.

(a) Order F-21500-JR, Viking is to advise cost of Westinghouse motors.
(b) Order F-21501-JR, Viking to add cost of mounting Baldor motor.
(c) Order F-21502-JR, Viking is to advise cost of Westinghouse motors. We originally recommended that Colt furnish a

7-1/2 HP, 1200 RPM, 254 TC motor. However, Colt seems to think they can get by with a 5 HP, 1200 RPM, 215 TC motor, which I think would be no problem.

The factory should fill out the following data sheets and return to us.

(a) Pumps: 8031-M-71 DS-7
(b) Westinghouse motor form 182 REV.

Also send 12 Certified new dimension prints including motor length dimensions.

It wont be necessary to furnish part lists with prices and recommended spares for one year, we took care of this earlier.

Also check if there is any change in price for Seismic information.

Very truly yours,

Walter B. Rom & Son, Inc.

Jack Risler

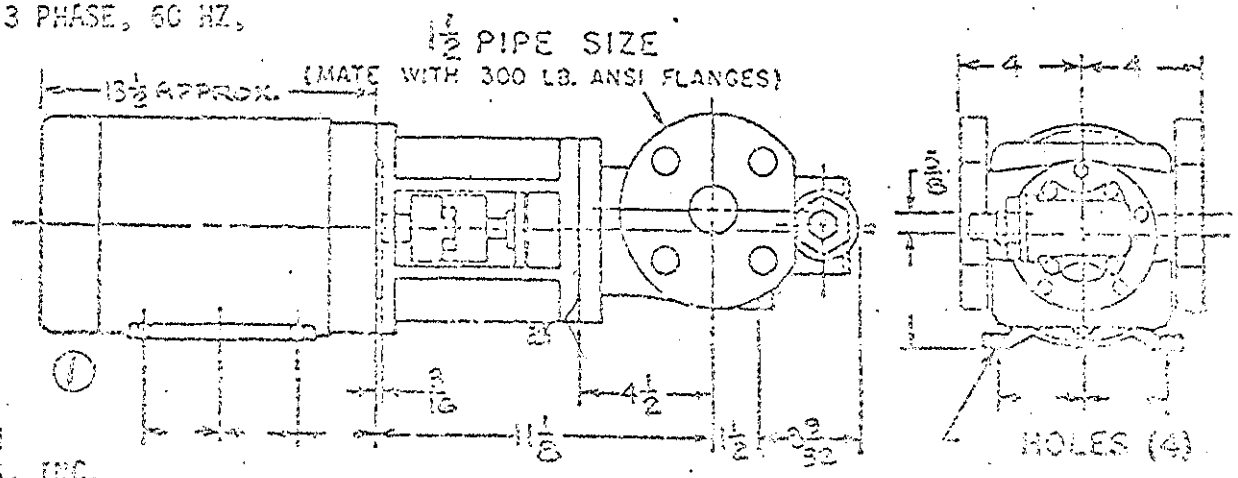
Jack Risler
Industrial Division

JR/pr

DESCRIPTION: VIKING ~~HJ-493-M~~ STEEL EXTERNAL FLANGE BRACKET HORIZONTAL MOUNTED PUMP WITH "N" DRIVE AND WESTINGHOUSE 3 HP, 1150 RPM, 460 VOLT, 3 PHASE, 60 HZ, 213 TC FRAME MOTOR.

Now Per C/O 10067 12/23/87

MODEL NO. HJ-493-M



VENDOR: VIKING PUMP DIVISION
HOUDAILLE INDUSTRIES, INC.
CEDAR FALLS, IOWA

REPR: WALTER B. ROM & SONS, INC.
1060 N. 115TH STREET
WAUWATOSA, WI

NOTE:
MISSING DIM'S TO BE SUPPLIED LATER

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10197	2-11-77	See Shts 2-6	
2	"	"	REDRAWN, ELECTRIC MOTOR ADDED (1)	

TITLE
PUMP SET, LUBE
OIL CIRCULATING
13 GPM, 3 HP, 1150 RPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .030 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	—	/ /	ASSY. OR LO.
DR. BY	R.H.NORMAN	1/26/77	SCALE
CHK'D. BY	—	/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MACH.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 177 | SHEET 1 OF

INTRODUCTION

The illustrations used in this article are for identification purposes only and *should not be used for ordering parts*. Secure a parts list from the factory or a Viking representative. Always give complete name of part, part number and material with the model and serial number of the pump when ordering repair parts. The unmounted pump or unit model and serial number can be found on a nameplate attached to the pump or base.

In the Viking model number system, the basic size letters are combined with the series number (93) indicating both the unmounted or mounted pump units.

UNMOUNTED PUMP	UNIT
FLANGE MOUNTED FLANGED PORTS	Units are designated by the unmounted pump model numbers followed by a letter indicating drive style. M — Horizontal Direct Drive IM — Vertical In-line Direct Drive
GG93 HJ93 HL93 AS93 AK93 AL93	

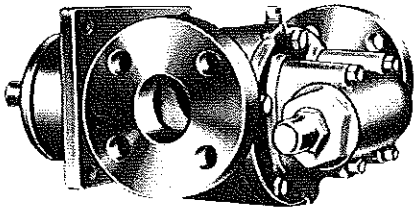


FIGURE 1
GG, HJ and HL SIZE 93 SERIES
Unmounted Pump with Flanged Ports

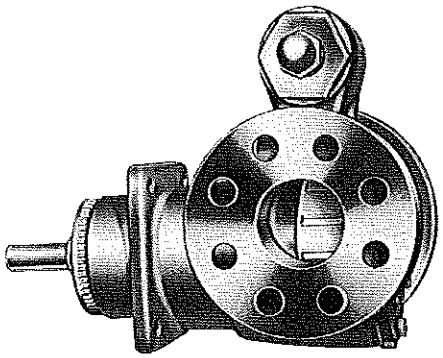


FIGURE 2
AS, AK and AL SIZE 93 SERIES
Unmounted Pump with Flanged Ports

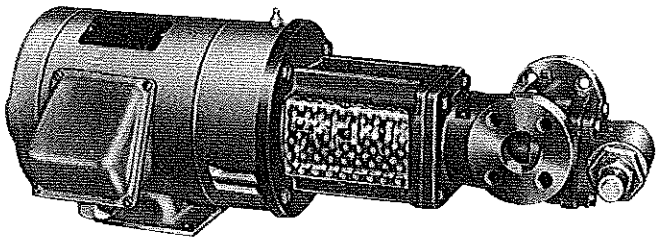


FIGURE 3
SERIES 93M
Horizontal Mounted Unit
With Tapped Ports

Maintenance

Series 93 pumps are designed for long, trouble free life under a wide variety of application conditions with a minimum of maintenance, however the following should be considered:

1. END CLEARANCE ADJUSTMENT—After long term operation it is sometimes possible to improve the performance of the pump, without major repair, thru adjustment of end clearance of the pump. Refer to instructions under Reassembly of the pump for information regarding this procedure.
2. CLEANING THE PUMP—It is good practice to keep the pump as clean as possible. This will facilitate inspection, adjustment and repair work and help prevent omission of lubrication to fittings covered or hidden with dirt.
3. STORAGE—If the pump is to be stored or not used for any appreciable length of time it should be drained and a light coat of lubricating and preservative oil should be applied to the internal parts. Lubricate all fittings.

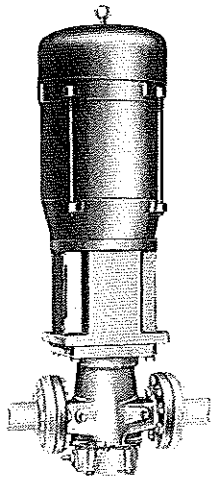


FIGURE 4
SERIES 93IM
Vertical Mounted Unit
With Flanged Ports

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

Disassembly

1. Remove the head capscrews.
2. Remove the head and O-Ring gasket.

CAUTION: AVOID TILTING THE HEAD DOWN, AS THE IDLER MAY SLIDE OFF.

3. Remove the idler from the idler pin. If the idler pin is worn, the head, idler pin and the idler bushing should be replaced.
   If the idler bushing is worn, it is strongly recommended that the idler and bushing be replaced. This bushing can be replaced in the field, but is very difficult. It is a brittle material, and extreme care should be taken to prevent breaking when it is being installed in the idler. If it is cracked in the idler, this bushing will quickly disintegrate. A hydraulic press should be used to install carbon graphite bushings. Be sure the bushing is started straight. DO NOT STOP the pressing operation until the bushing is in the proper position.
4. Remove the locknut from the shaft. A piece of brass rod or hardwood inserted in the port opening will hold the shaft from turning.
5. The rotor and shaft can now be removed from the casing. The spring and rotary member of the mechanical seal will come out with the shaft.

NOTE: On the HJ and HL size pumps the bearing housing and double row ball bearing must be removed before the snap ring in the shaft can be removed. The rotor and shaft cannot be removed until the snap ring is removed from the shaft.

6. Loosen the two (2) setscrews in the end of the bearing housing, turn the bearing housing counterclockwise and remove from the casing. Remove the snap ring from the bearing housing on GG, HJ and HL size pumps and the double row ball bearing can be removed. On the AS, AK, and AL size pumps you must loosen the setscrews in the outer ring of the bearing housing and remove bearing housing end cap, closure and bearing collar. Use a spanner wrench to remove the end cap.

Wash the bearing thoroughly and examine. If there is any evidence of wear or damage, a new bearing should be used.

7. Remove the snap ring and casing ball bearing in the GG, HJ and HL size pumps. Remove the bearing spacer in the AS, AK and AL size pumps. The bearing retainer washer, located between the casing bearing and seal seat, can now be removed if it did not stay on the rotor shaft when the shaft was removed.
8. The seal seat or stationary part of the seal can now be removed from the casing.
9. The casing should be examined for wear, particularly at the seal area between the port openings.

All parts should be checked for wear before the pump is put together. When making major repairs, such as replacing a rotor and shaft, it is usually advisable to also install a new head and idler.

Reassembly

1. Installing New Seal: See Figure 5. The seal is simple to install and good performance will result if care is taken in its installation.

NOTE: Never touch the sealing faces with anything except the fingers or a clean cloth. Clean the rotor hub, shaft and seal seat housing in the casing, making sure they are clean and free from dirt and grit.

Coat the outside diameter of the seal seat and the inside diameter of the seal housing bore with light oil. With thumb and forefinger, push the seal seat into place in the casing.

Place the tapered sleeve (furnished with replacement seals) on the shaft as far as it will go. Thin end must be toward end of shaft. See Figure 5. Coat the inside of the rotary member and the outside of the tapered sleeve with light oil. Be sure the shaft is free of nicks and burrs. Place the spring and rotary member on the shaft, spring first, over the sleeve and against the hub of the rotor. *Remove the tapered sleeve.*

2. Flush the sealing faces of both the rotary member and seal seat with light oil and install rotor and shaft. Push the rotor and shaft into the casing slowly until the ends of the rotor teeth are just beyond the face of the casing.

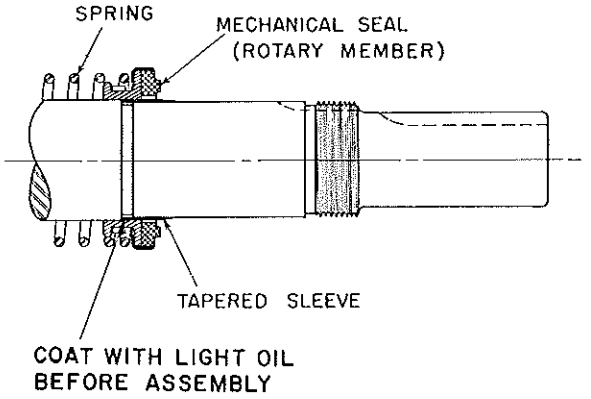


FIGURE 5

3. Place the idler on the idler pin and the O-ring head gasket on the head. Place the head assembly on the pump and tighten the capscrews evenly and securely. The seal is now automatically compressed to its proper working length.
4. Pack the single row ball bearing with grease and install in the casing. Install the snap ring in GG, HJ and HL pumps.

NOTE: The AS, AK and AL pumps do not have a snap ring, but the bearing retainer washer must be

assembled over the end of the shaft before the bearing is assembled.

5. Place the bearing spacer over the shaft and against the single row ball bearing in the casing. (AS, AK, & AL size pumps).
6. Install the snap ring in the groove in the shaft on the HJ or HL size pumps.
7. Pack the lubrication chamber between the casing ball bearing and the double row ball bearing in the bearing housing approximately half full with *lithium base ball bearing grease.*
8. Pack the double row ball bearing with *lithium base ball bearing grease* and press into the bearing housing. Install the snap ring to hold the bearing in place.

NOTE: *On AS, AK and AL pumps, install the closure* in the bearing housing end cap. Put the bearing spacer sleeve in the closure and install this in the bearing housing and tighten securely.

9. Start the bearing housing into the casing. Turn by hand until tight. This forces the rotor against the head. Replace and tighten the locknut on the shaft. Insert a piece of brass or hardwood through the port opening between the rotor teeth to keep the shaft from turning.
10. Adjust the pump end clearance as follows:

Thrust Bearing Adjustment

Loosen the two setscrews in the bearing housing and turn counterclockwise ½" measured on the outside of the bearing housing of GG, HJ and HL size pumps. This represents approximately .003" end clearance. On the AS, AK and AL size pumps, turn the thrust bearing assembly *counterclockwise two notches which* represents approximately .003" end clearance.

NOTE: Be sure the shaft can be rotated freely. If not, turn the bearing housing counterclockwise until the shaft can be turned. Be sure set screws are tightened securely after adjustment is made. High viscosity liquids require additional end clearance. The amount of end clearance depends on the viscosity of the liquid being pumped.

Valve Instructions

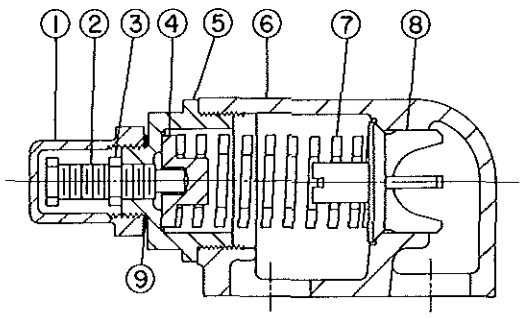


FIGURE 6 GG, HJ, HL SIZE VALVE

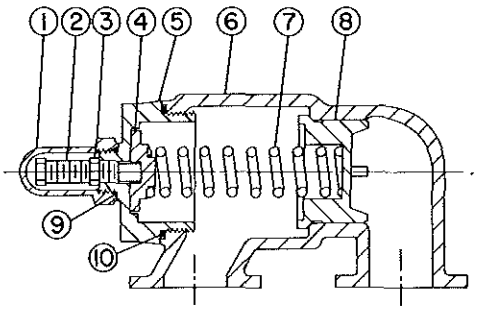


FIGURE 7 AS, AK, AL SIZE VALVE

LIST OF PARTS

1. Valve Cap	6. Valve Body
2. Adjusting Screw	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	10. Bonnet Gasket

Disassembly

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and repair or replace as necessary.

Reassembly

Follow the procedure outlined under disassembly.

If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

Pressure Adjustment

If the pressure setting of the valve is to be changed from that which the factory has set, the following instructions should be carefully followed: Remove the valve cap which covers the adjusting screw, and loosen the lock nut which locks the adjusting screw so pressure setting will not change during operation of pump. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the relief valve will allow while pump is in operation.

Important

In ordering parts for relief valve on head, always be sure to give Model and Serial Number of pump as it appears on name plate and the name of the part wanted. When ordering springs, be sure to give the pressure setting desired.

VIKING HEAVY-DUTY PUMPS

93 SERIES (STEEL EXTERNALS)

MAINTENANCE AND REPAIR INSTRUCTIONS

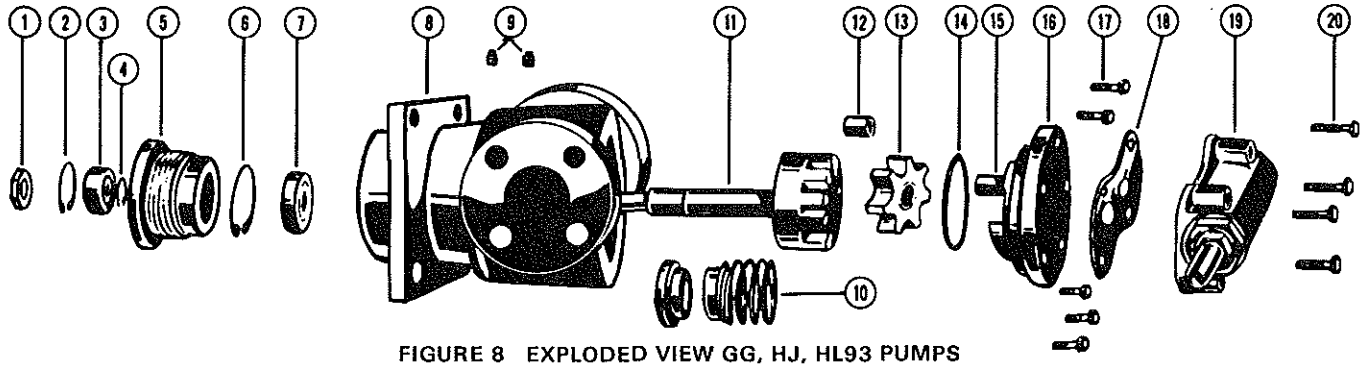


FIGURE 8 EXPLODED VIEW GG, HJ, HL93 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	11	Rotor and Shaft	Not Illus.	Mounting Bracket (For 56C, 143TC & 145TC Frame Motors)
2	Snap Ring, Outer	12	Idler Bushing		
3	Ball Bearing, Outer	13	Idler and Bushing	Not Illus.	Mounting Bracket (For 182TC & 184TC Frame Motors)
4	*Snap Ring for Shaft	14	O-Ring Gasket for Head		
5	Bearing Housing with Setscrews	15	Idler Pin	Not Illus.	Capscrew for Pump to Bracket (4-Req'd)
6	Snap Ring, Inner	16	Head (Valve Type) and Idler Pin		
7	Ball Bearing, Inner	17	Capscrew for Head (5-Req'd)	Not Illus.	Capscrew For Motor to Bracket (4-Req'd) (For 56C, 143TC & 145TC Frame Motors)
8	Casing	18	Gasket for Relief Valve		
9	Pipe Plug — 1/4" (2-Req'd)	19	Internal Relief Valve (Complete)	Not Illus.	Capscrew For Motor to Bracket (4-Req'd) (For 182TC & 184TC Frame Motors)
10	Mechanical Seal (Complete)	20	Capscrew for Valve (4-Req'd)		

*NOT USED ON GG SIZE PUMPS

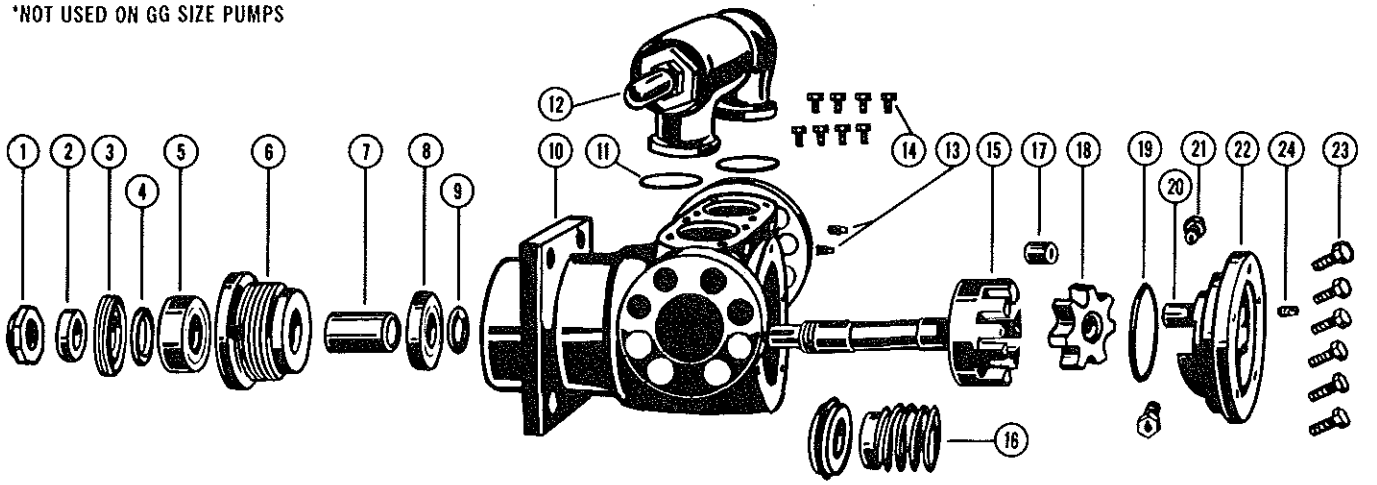


FIGURE 9 EXPLODED VIEW AS, AK, AL93 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	11	O-Ring Valve Gasket (2-Req'd)	21	Check Valve (2-Req'd)
2	Bearing Spacer Collar	12	Internal Relief Valve (Complete)	22	Head (Plain) and Idler Pin
3	End Cap for Bearing Housing	13	Pipe Plug — 1/4" (2-Req'd)	23	Capscrews for Head (6-Req'd)
4	Closure for Bearing Housing	14	Capscrews for Valve (8-Req'd)	24	Pipe Plug — 1/8"
5	Ball Bearing (2-Row)	15	Rotor and Shaft	Not Illus.	Mounting Bracket (For 182TC, 184TC, 213TC, 215TC, 254TC & 256TC Frame Motors)
6	Bearing Housing with Setscrews	16	Mechanical Seal (Complete)		
7	Bearing Spacer	17	Idler Bushing	Not Illus.	Capscrew for Pump & Motor to Bracket (4-Req'd) (For 182TC thru 256TC Frame Motors)
8	Ball Bearing (1-Row)	18	Idler and Bushing		
9	Bearing Retainer Washer	19	O-Ring Head Gasket		
10	Casing, Opposite Ports	20	Idler Pin		

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INSTALLATION

General

Before installation is started a few items of a general nature should be considered.

1. *Location* — always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.
2. *Accessibility* — the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.
3. *Port Arrangement* — since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see Figure 1. The right angle ports are normally right-hand, see Figure 2; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.

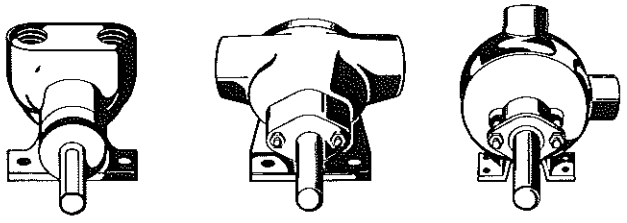


FIGURE 1

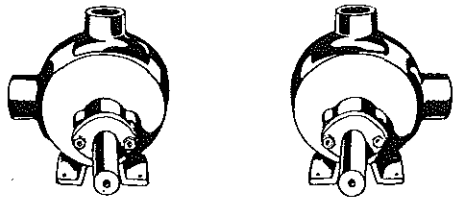


FIGURE 2

4. *Suction/Discharge* — shaft rotation will determine which port is suction and which discharge. A look at Figure 3 will show how rotation determines which port is which; as the pumping elements (gears) come out of mesh, point "A" on Figure 3, liquid is drawn into the suction port; as the gears come into mesh, point "B", the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump.

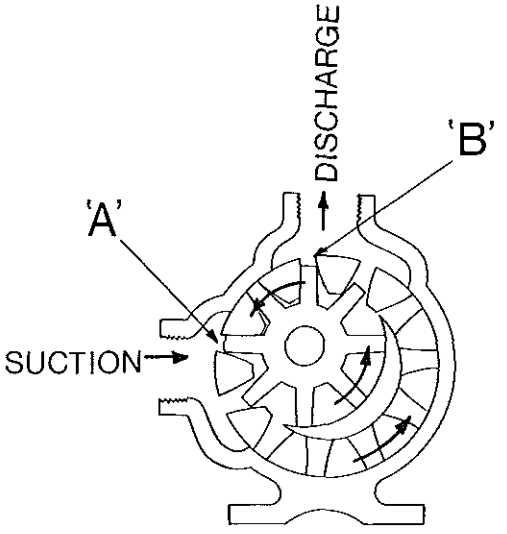
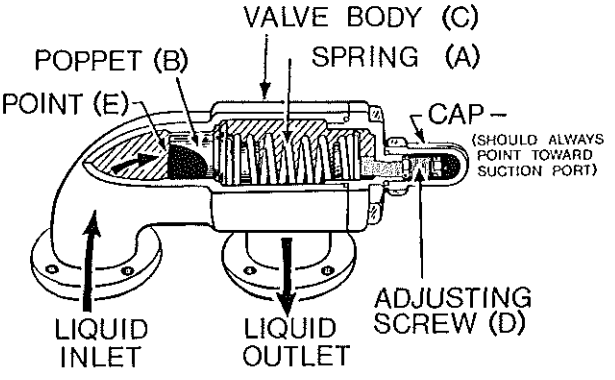


FIGURE 3

5. *Safety Relief Valve* — the Viking pump is a positive displacement pump. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for this liquid to go — discharge line is blocked or closed — the pressure will build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. To prevent the possibility of any one or more of these things happening in case of unintentional closing of the discharge line, the use of a safety relief valve is recommended. A safety relief valve will relieve the pressure at a predetermined value, thus protecting the entire system.



CUT-AWAY OF VIKING INTERNAL SAFETY RELIEF VALVE

FIGURE 4

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

The safety relief valve mounted on Viking pumps (optional on many models) and most in-line valves are of the spring loaded poppet design. See Figure 4. The spring (A) holds poppet (B) against the seat in the valve body (C) with a given force determined by the spring size and by how tightly it is compressed by the adjusting screw (D). The pump discharge pressure pushes against the under side of the poppet at point (E). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve. As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This pressure is the relief valve setting.

Viking pumps can be furnished with either an internal safety relief valve — one which directs the flow from the valve back to the suction side of the pump — or a return-to-tank valve which directs the flow through piping back to the supply tank. See Figure 5. An inline safety relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank should also be as short and large as possible.

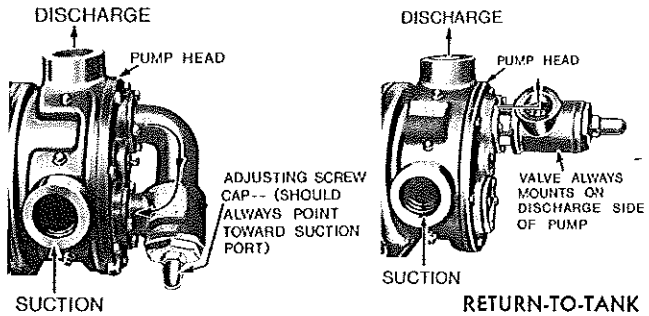


FIGURE 5

NOTE: on some models the safety relief valve is mounted on the pump casing instead of the pump head.

The spring loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should **not** be used as a pressure or flow control device. **It is intended strictly as a safety relief valve.**

CAUTION: THE INTERNAL TYPE SAFETY RELIEF VALVE MOUNTED ON THE VIKING PUMP SHOULD ALWAYS HAVE THE CAP OR BONNET POINTED TOWARD THE SUCTION SIDE OF THE PUMP. THE RETURN-TO-TANK TYPE SAFETY RELIEF VALVE SHOULD ALWAYS BE MOUNTED ON THE DISCHARGE SIDE OF THE PUMP. IF PUMP ROTATION IS REVERSED CHANGE THE RELIEF VALVE. TURN THE INTERNAL TYPE END FOR END; MOVE THE RETURN-TO-TANK TYPE TO THE OTHER PORT.

The pressure at which either type valve by-passes can be changed by turning the adjusting screw.

For details on maintenance of the relief valve see Technical Service Sheet covering your model series.

Foundation

Every pump should have a good foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

A certified print of the pumping unit should be used in preparing the foundation. Ask for one. If a separate foundation is provided, make it at least two inches wider and longer than the base of the unit.

When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

Alignment

CHECK ALIGNMENT AFTER MOUNTING

The pump, drive, and motor were properly aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **CHECK IT!**

1. Check pump ports to be sure they are square and in proper position; shim or move pump as required.
2. If the pump is driven by a flexible coupling(s), either direct connected to the motor or through a reducer, remove any coupling guards or covers and check alignment of the coupling halves. A straightedge (a piece of key stock works nicely) across the coupling must rest evenly on both rims at the top, bottom, and sides. See Figure 6.

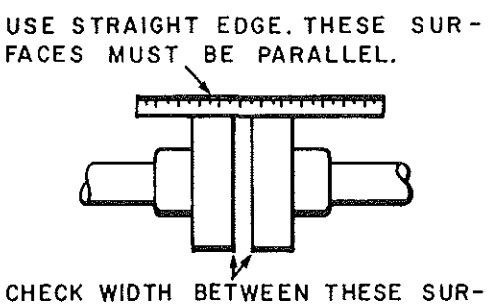


FIGURE 6

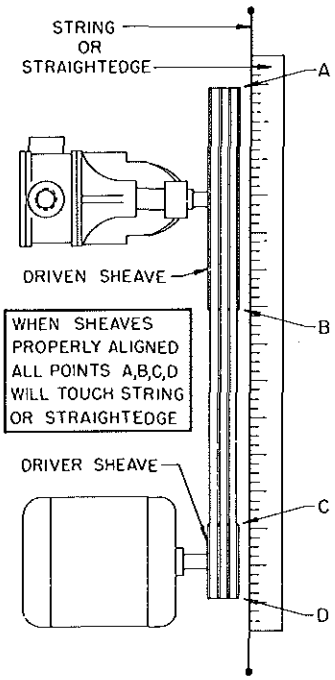


FIGURE 6A

3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See Figure 6A.
4. Make a final check on alignment after piping is hooked up. See item 13 under "Installation — Piping".

Figures 7, 8, and 9 show typical units — direct, gear reducer and V-belt drive.

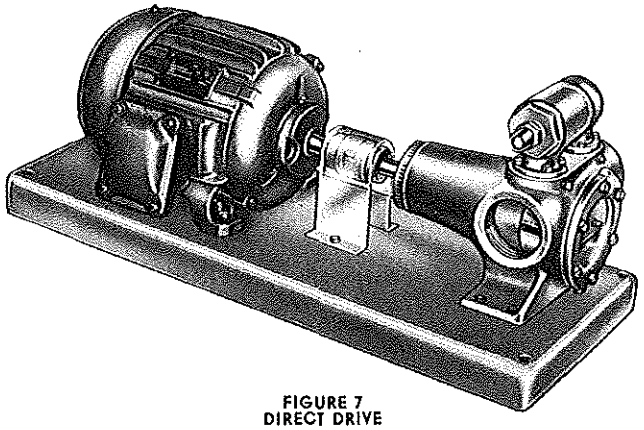


FIGURE 7
DIRECT DRIVE

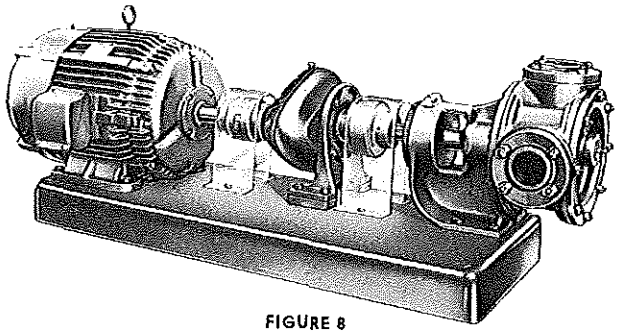


FIGURE 8
GEAR REDUCER DRIVE

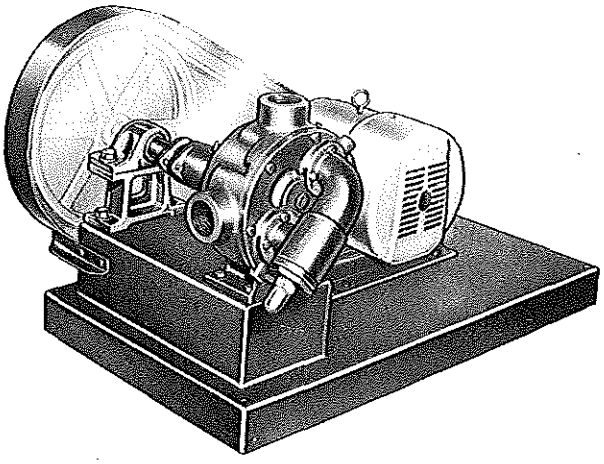


FIGURE 9
V-BELT DRIVE

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

Piping

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size piping, both suction and discharge, refer to Viking General Catalog Section 510.

Before starting layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.
2. Be sure the inside of the pipe is clean before hooking it up.
3. *Foot valve* — When pumping a light liquid with a suction lift, a foot valve at the end of the suction piping will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot valve is big enough so that it doesn't cause excessive line loss.
4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See Figure 10.

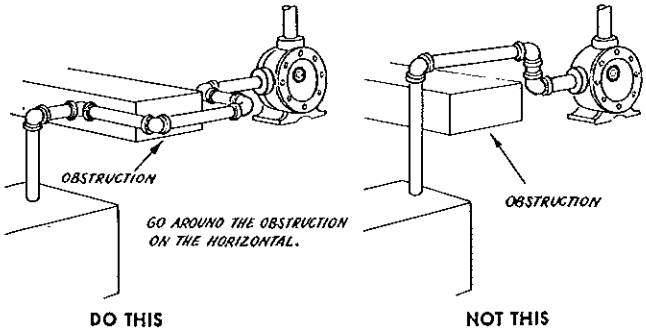


FIGURE 10

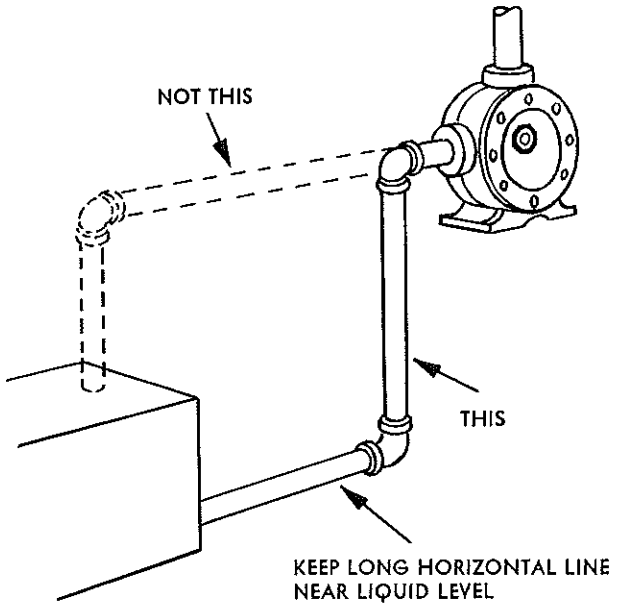


FIGURE 11

5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
6. For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no foot valve. See Figure 11.
7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted or put into a bind.
8. *Strainer* — It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be fine enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving him pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects.
9. If the pump is not equipped with a safety relief valve, consideration should be given to mounting one in the discharge line. See discussion on safety relief valves under START UP.
10. The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.

11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.
12. All joints of the piping system should be tight; pipe dope or teflon tape will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.
13. *Alignment* — Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size standard duty pumps.
14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the liquid pumped.

START UP

Before pushing the "start" button, check the following:

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. Check alignment — See suggestions under "Installation — Alignment" in this manual.
3. Check piping to be sure there is no strain on the pump casing.
4. Rotate the pump shaft by hand to be sure it turns freely.
5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under "Installation — General" item 4 in this manual.
6. Check any safety relief valve to be sure it is installed correctly. See discussion on safety relief valve under "Installation — General".
7. Check suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below liquid level.
8. Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the liquid to go.
9. Lubricate any grease fitting on the pump using a good, general purpose #2 ball bearing grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended.
10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.
11. Do **not** use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.
12. Check to be sure all guards are in place.
13. Now you are ready to push the "start" button — gently.

If the pump begins to deliver liquid within 60 seconds, you're in business. If it does not, push the "stop" button. Do **not** run the pump longer than one minute without liquid in it; you will ruin it. Review the steps just outlined, consider what the suction and discharge gauges indicate, see page 6 ; if everything appears to be in order, put some liquid in the pump, a lubricating liquid is best. This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver, the cause may be one or more of the following:

1. Suction line air leaks; vacuum gauge reading should help determine if this is the problem.
2. End of suction pipe not submerged deep enough in liquid.
3. Suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, suggest you review again all points given under START UP; read through Trouble-Shooting in this manual and try again. If it still does not pump, contact your Viking representative.

TROUBLE-SHOOTING

A Viking pump which is properly installed and maintained will give long and satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to *install a vacuum*

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

gauge in the suction port and a pressure gauge in the discharge port. Readings on these gauges often will give a clue as to where to start looking for the trouble.

Vacuum Gauge — Suction Port

1. High reading would indicate —
   a. Suction line blocked — foot valve stuck, gate valve closed, strainer plugged.
   b. Liquid too viscous to flow through the piping.
   c. Lift too high.
   d. Line too small.
2. Low reading would indicate —
   a. Air leak in suction line.
   b. End of pipe not in liquid.
   c. Pump is worn.
   d. Pump is dry — should be primed.
3. Fluttering, jumping, or erratic reading —
   a. Liquid vaporizing.
   b. Liquid coming to pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
   c. Vibrating from cavitation, misalignment, or damaged parts.

Pressure Gauge — Discharge Port

1. High reading would indicate —
   a. High viscosity and small and/or long discharge line.
   b. Gate valve partially closed.
   c. Filter plugged.
   d. Vertical head did not consider a high specific gravity liquid.
   e. Line partially plugged from build up on inside of pipe.
   f. Liquid in pipe not up to temperature.
   g. Liquid in pipe has undergone a chemical reaction and has solidified.
   h. Relief valve set too high.
2. Low reading would indicate —
   a. Relief valve set too low.
   b. Relief valve poppet not seating properly.
   c. Bypass around the pump partially open.
   d. Too much extra clearance.
   e. Pump worn.
3. Fluttering, jumping, or erratic reading —
   a. Cavitation.
   b. Liquid coming to pump in slugs.
   c. Air leak in suction line.
   d. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A. Pump does not pump.
   1. Lost its prime — air leak, low level in tank, foot valve stuck.
   2. Suction lift too high.
   3. Rotating in wrong direction.
   4. Motor does not come up to speed.
   5. Suction and discharge valves not open.
   6. Strainer clogged.
   7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
   8. Pump worn out.
   9. Any changes in the liquid system, or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.

B. Pump starts, then loses its prime.
   1. Supply tank empty.
   2. Liquid vaporizing in the suction line.
   3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
   4. Worn out.

C. Pump is noisy.
   1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
   2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the liquid, raise the liquid level closer to the pump; if the liquid is above the pump, increase the head of liquid.
   3. Check alignment.
   4. May have a bent shaft or rotor tooth. Straighten or replace.
   5. Relief valve chatter; increase pressure setting.
   6. May have to anchor base or piping to eliminate or reduce vibration.
   7. May be a foreign object trying to get into the pump through the suction port.

D. Pump not up to capacity.
   1. Starving or cavitating — increase suction pipe size or reduce length.
   2. Strainer partially clogged.
   3. Air leak in suction piping or along pump shaft.
   4. Running too slowly; is motor the correct speed and is it wired up correctly.
   5. Bypass line around pump partially open.
   6. Relief valve set too low or stuck open.
   7. Pump worn out.

E. Pump takes too much power.
   1. Running too fast — Is correct motor speed, reducer ratio, sheave size, etc. being used.
   2. Is liquid more viscous than unit sized to handle; heat the liquid, increase the pipe size, slow the pump down, or get a bigger motor.
   3. Discharge pressure higher than calculated, check with pressure gauge. Increase size or

reduce length of pipe, reduce speed (capacity), or get bigger motor.

4. Packing gland drawn down too tight.
5. Pump misaligned.
6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

F. Rapid Wear.

On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. **Rapid wear,** occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. Some of the causes, evidence and cures are listed here.

CAUSE	EVIDENCE	CURE
1. Abrasives	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
2. Corrosion	Rust, general overall aggressive attack or sloughing off of metal.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3. Exceeding operating limits	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat.	Review General Catalog for operating limits on particular model involved.
4. Insufficient extra clearance	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your distributor or the factory with details of the application so that information regarding proper extra clearance may be provided.
5. Lack of lubrication	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all zerks are greased before starting and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6. Misalignment	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7. Run dry	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing color because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the cost per gallon pumped.

A. Lubrication — Grease all zerks after every 500 hours of operation or after 60 days, whichever occurs first. If service is severe, grease more often. Do it gently with a hand gun. Use a #2 ball bearing grease. If it is hot, use a heavier grease; if cold, use a lighter one.

B. Packing Adjustment — Occasional packing adjustment may be required to keep leakage to a slight weep; if impossible to reduce leakage by gentle tightening, replace packing or use different type. See Technical Service (TS) Manual on particular model series for details on repacking.

C. End Clearance Adjustment — After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See TS manual on particular model series for procedure on adjusting end clearance for pump involved.

VIKING ROTARY PUMPS

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

D. Examine Internal Parts — Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. See TS manual on particular model series for procedure in removing head of the pump. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.

E. Cleaning the Pump — A clean pump is easier to inspect, lubricate, adjust, and runs cooler; plus, it looks better.

F. Storage — If a pump is to be out of service or stored for a long time, drain it and protect it from rusting inside and out.

DO'S AND DON'TS

Do's and don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

Installation —

1. Do install pump as close to supply tank as possible.
2. Do leave working space around the pumping unit.
3. Do use large, short, and straight suction piping.
4. Do install a strainer in the suction line.
5. Do double-check alignment after the unit is mounted and piping is hooked up.
6. Do provide a safety relief valve for the discharge side of the pump.
7. Do cut out the center of gaskets used as port covers on flanged port pumps.
8. Do record pump model number and serial number and file for future reference.

Operation —

1. Don't run pump at speeds faster than shown in the catalog for your model.
2. Don't require pump to develop pressures higher than those shown in the catalog for your model.
3. Don't operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. Don't operate pumps without all guards being in place.
5. Don't operate pump without a safety relief valve on the pump or in the discharge piping; be sure valve is mounted and set correctly.
6. Don't exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.
7. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

Maintenance —

1. Do make sure any pump that has handled high vapor pressure liquids (LP-Gas, ammonia, Freons, etc.) has been vented before it is disassembled.
2. Do make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
3. Don't drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump; it may drop on your foot, plus, it may get nicked or gouged.
4. Don't stick fingers in the ports of a pump! The close running parts may trim more than your fingernails if the pump is rotated.
5. Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
6. Do remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
7. Do **obtain,** read and keep maintenance instructions furnished with your pump.

WARRANTY

Viking warrants (unless otherwise specified) all pumps and pump parts manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any pump or pump parts sold by Viking prove to be defective in workmanship or material under normal use and service, and if such pump or pump parts are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the pump or pump parts are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, F.O.B. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking pump or pump part are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of Houdaille Industries, Inc. or Viking Pump Division is authorized to alter this warranty.

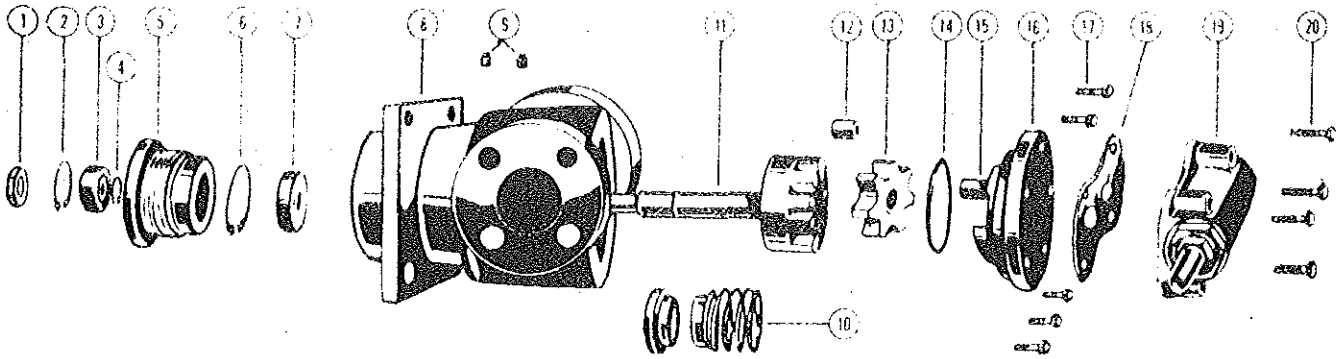
SECTION	R120
PAGE	R120.20
EFFECTIVE	4-18-75
SUPERSEDING	5-25-73

VIKING HEAVY-DUTY STEEL VERTICAL INLINE UNMOUNTED PUMP

PARTS LIST **MODEL HJ93** for Units **HJ93IM**

SUPERSEDES ALL PREVIOUS LISTS

SUBJECT TO CHANGE WITHOUT NOTICE
F.O.B. CEDAR FALLS, IOWA



ITEM	PART NO	DESCRIPTION	MATERIAL	PRICE EA.
1	2-505-005-376	Locknut	Steel	$ 1.30
2	2-555-007-375 *	Snap Ring,Outer	Steel	1.30
3	2-055-013-375 *	Ball Bearing, Outer (New Dep.#5605)	Steel	21.00
4	2-556-006-375 *	Snap Ring for Shaft	Steel	.85
5	3-060-038-956	Bearing Housing with Setscrews	Aluminum	15.00
6	2-555-008-375 *	Snap Ring,Inner	Steel	.85
7	2-055-014-375 *	Ball Bearing, Inner (New Dep.#Z9505)	Steel	13.00
8	2-193-871-271	Casing	Steel	292.00
9	2-542-004-376	Pipe Plug-1/4" (2-Req'd)	Steel	40 ea.
10	2-475-001-999 *	Mechanical Seal (Complete)	Standard	21.00
11	3-566-251-012 *	Rotor and Shaft	Iron & Steel	58.00
	3-566-251-312-20		Ductile Iron & Steel	143.00
12	2-095-012-880	Idler Bushing	Carbon Graphite	11.00
13	3-418-200-080 *	Idler and Bushing	Iron & Carbon Graphite	21.00
14	2-512-001-860 *	O-Ring Gasket for Head	Standard	.85
15	2-433-004-281	Idler Pin	Hardened Steel	3.50
16	3-370-206-416	Head (Plain) and Idler Pin	Steel & Hardened Steel	115.00
	3-371-202-416 *	Head (Valve Type) and Idler Pin	Steel & Hardened Steel	123.00
17	2-150-004-255	Capscrew for Head (5-Req'd)	Steel	.05 ea.
18	2-316-003-806-30 *	Relief Valve Gasket	Standard	.20
19	3-795-251	Internal Relief Valve (Complete)	Steel External	66.00
20	2-150-008-255	Capscrew for Valve (4-Req'd)	Steel	.20 ea.
2, 3, 5	3-060-011-999	Bearing Housing Assembly (Complete)	Standard	38.00
not illus.	2-308-018-806-62	Pipe Flange Gasket (2-Req'd)	Standard	1.30 ea.

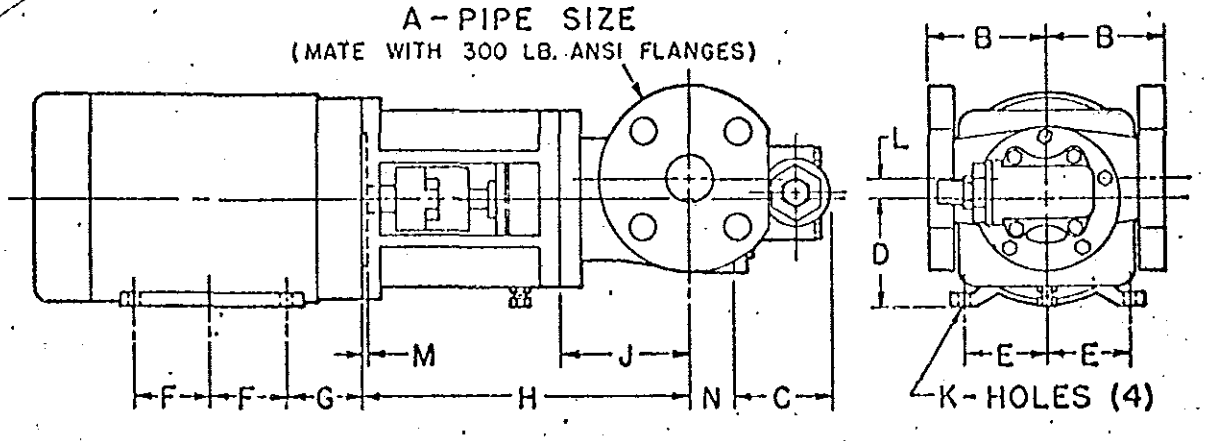
PURCHASE ORDER NO. B-451443-0
CONTRACT NO. 700000

* RECOMMENDED SPARES

Minimum Billing $15.00

When ordering parts, be sure to give PART NO., NAME OF PART, MATERIAL, MODEL & SERIAL NO. of pump as it appears on nameplate.

120.20



MODEL NO.	A	B	C	J	L	M	N	MOTOR FRAME	D	E	F	G	H	K
GG93M	1	4	$2\frac{21}{32}$	$3\frac{7}{16}$	$\frac{5}{8}$	$\frac{3}{16}$	$1\frac{1}{8}$	56C	$3\frac{1}{2}$	$2\frac{7}{16}$	$1\frac{1}{2}$	$2\frac{9}{16}$	$8\frac{7}{8}$	$\frac{11}{32}$ x $1\frac{1}{4}$
										62	38	65		9x32
								143TC		$2\frac{3}{4}$	2	$2\frac{7}{8}$		$\frac{11}{32}$
											51			
								145TC			$2\frac{1}{2}$			
										89	70	64	73	225	9
								182TC	$4\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{7}{16}$	$9\frac{9}{16}$	$\frac{13}{32}$
											57			
								184TC			$2\frac{3}{4}$			
		102	67	87	16	5	29		114	95	70	87	243	10
HJ93M	$1\frac{1}{2}$	4	$3\frac{9}{32}$	$4\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{16}$	$1\frac{1}{2}$	56C	$3\frac{1}{2}$	$2\frac{7}{16}$	$1\frac{1}{2}$	$2\frac{9}{16}$	$11\frac{1}{8}$	$\frac{11}{32}$ x $1\frac{1}{4}$
										62	38	65		9x32
								143TC		$2\frac{3}{4}$	2	$2\frac{7}{8}$		$\frac{11}{32}$
											51			
								145TC			$2\frac{1}{2}$			
										89	70	64	73	283	9
HL93M								182TC	$4\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{7}{16}$	$11\frac{13}{16}$	$\frac{13}{32}$
											57			
								184TC			$2\frac{3}{4}$			
										114	95	70	87	300	10
								213TC	$5\frac{1}{4}$	$4\frac{1}{4}$	$2\frac{3}{4}$	$4\frac{1}{2}$	$12\frac{9}{16}$	$\frac{13}{32}$
		102	83	114	16	5	38		133	108	70	114	319	10

NOTE: Dimensions shown in shaded area are millimeters, others are inches.

MODELS

FEB 1 1977

FOR Walter E. Rom & Son, Inc.
Wauwatosa, Wisconsin 53226
ORDER NO. F-21500-JR
REQ. NO. Colt Industries,
Beloit, Wisconsin 53511

REFERENCE Milwaukee
INVOICE NO. E-43771
ORDER NO. B-451443-0
MODEL NO. HJ-93M, Opposite Ports, 1-1/2"300# Flg.
RELIEF VALVE With Steel Internal SET AT 75 PSI
CONSTRUCTION Steeh Head and Casing - Iron Fitted
Carbon Graphite Idler Bushing - 2-475-001 Seal -
una N O-Ring Head Gasket - 3-795-251 Steel Valve
with Cast Iron Poppet

MISCELLANEOUS MOTOR: 3 HP, 1200 RPM, 213TC Frame
SERVICE: Liquid SAE 30, 13-15 GPM, 100-150 SSU
Normal (95%) Cold Start 3000-5000 SSU (5%)Visc.
60-160 Deg.F. Temperature, 50 PSI Discharge Hea
Flooded Suction
MARK & TAG: Colt PO # B-451443-0, Part # 11-908
-177 LUBE OIL CIRCULATING PUMP

DRAWING NO. GV-934

0124F329 — CERTIFICATION NUMBER
1/27/77 — DATE

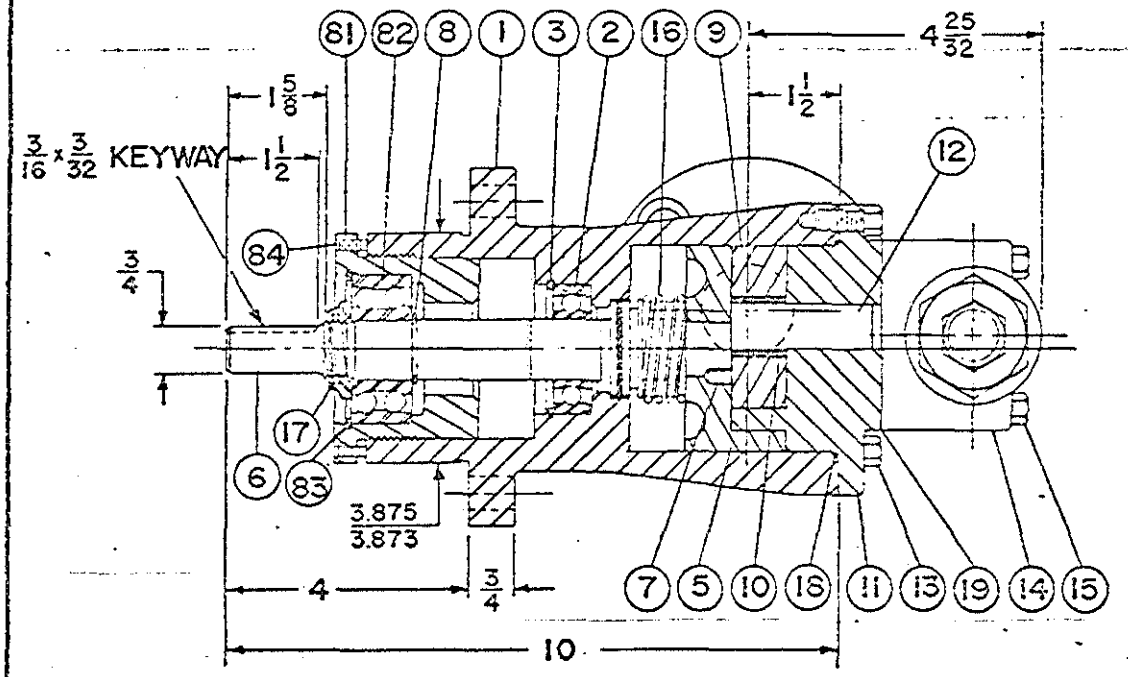
BY Ed. Richenberg — ENGR. DEPT.

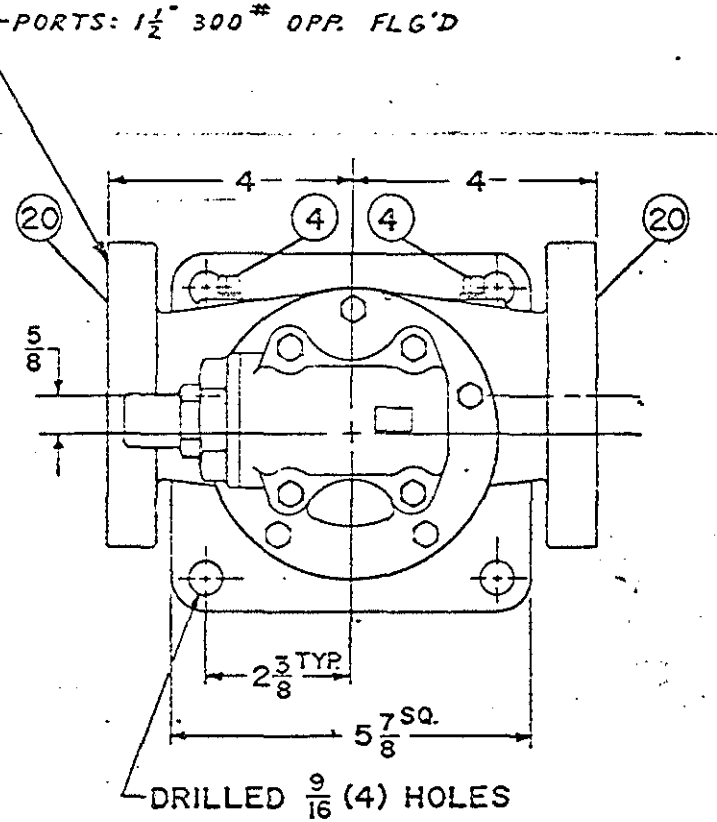
DRAWN BY BLASBERG DATE 6-2-75
CHECKED BY E.R. DATE

THIS PRINT IS CERTIFIED

VIKING PUMP HOUDAILLE
Viking Pump Division, Houdaille Industries, Inc.
Cedar Falls, Iowa 50613 U.S.A.

FEB 1 1977





FOR ITEM 14, SEE LM & DWG. 3-795-251
FOR ITEM 80, SEE LM 3-060-011

REF	CHANGED	DATE
C		
B		
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PATTERN No.

SCALE HALF | DATE 1-31-77

DRAWN BOOROM | CHECKED A.B.

APPROVED

VIKING PUMP [HJ 93] OUDAILLE

Viking Pump Division, Houdaille Industries, Inc. Cedar Falls, Iowa, U.S.A.

MODEL HJ93 CONSTRUCTION PER LIST OF MATERIAL LM 4-1487-2942-501

DRAWING No. 4-1487-2942-501

DRG SIZE E

FEB 1 1977

LM- 4-1487-2942 300# Flange Mounted Pump With Steel Internal Valve - 1-1/2" Opp. Flgd. Ports
Steel Head and Casing - Iron Fitted - Carbon Graphite Idler Bushing
2-475-001 Seal - Buna N O-Ring Head Gasket - 3-795-251 Steel Valve
With Cast Iron Poppet
Walter B. Rom & Son, Inc. # F-21500-JR Viking Invoice # E-43771 Colt Industries
TAG: # B-451443-0 Colt Part # 11-908-177 Lube Oil Circulating Pump

	Item	SUB-ASSEMBLY NO.	PART NO.		MATERIAL	Qty.	DESCRIPTION
	1		2-193-871-271		Steel	1	CASING, 1-1/2" 300# Opp. Flgd. Port
	2		2-055-014-375		Steel	1	BEARING, Ball (1-Row, 1-Seal)
	3		2-555-008-375	C	Steel	1	SNAP RING, Internal
	4		2-542-004-376	C	Steel	2	PIPE PLUG 1/4
	5	3-566-251-012-24	2-566-203-100-24		C.I.	1	ROTOR
*	6		2-632-005-260		Steel	1	SHAFT, Rotor
	7		2-596-032-375	C	Steel	1	KEY, Rotor
	8		2-556-031-375	C	Steel	1	SNAP RING, External
	9	3-418-200-080-42	2-418-200-100-40		C.I.	1	IDLER
* *	10		2-095-012-880-02		C.G.	1	BUSHING, Idler
* *	11	3-371-202-416	2-371-204-271		Steel	1	HEAD, Valve Type
	12		2-433-004-281		Stl. Carb.	1	IDLER PIN
	13		2-150-004-255	C	Steel	5	CAPSCREW 5/16 NC 3/4
	14	3-795-251-000-04			Steel	1	RELIEF VALVE, Set 75 #
	15		2-150-008-255	C	Steel	4	CAPSCREW (5/16 NC 2-1/2) Valve
*	16		2-475-001-999		Standard	1	MECHANICAL SEAL
	80	3-060-011-999			Aluminum	1	BEARING HOUSING Assembly
	17		2-505-005-376	C	Steel	1	NUT, Self Lock Hex 7/8 NF
*	18		2-512-001-860	C	Buna N	1	GASKET, O-Ring (Head)
*	19		2-316-003-806-30C		Comp. Asb.	1	GASKET, Relief Valve
*	20		2-308-018-806-62C		Comp. Asb.	2	GASKET, 1-1/2" Pipe Flange 300#

THIS LIST OF MATERIAL
FOR REPLACEMENT PARTS
NOT FOR PRODUCTION DEPT.

RECOMMENDED SPARE PARTS
RECOMMENDED SPARE ASSEMBLIES

NOTE: (1) Stamp "HJ" On Top Of Boss On Head.
(2) Put Titeseal On Relief Valve Gasket

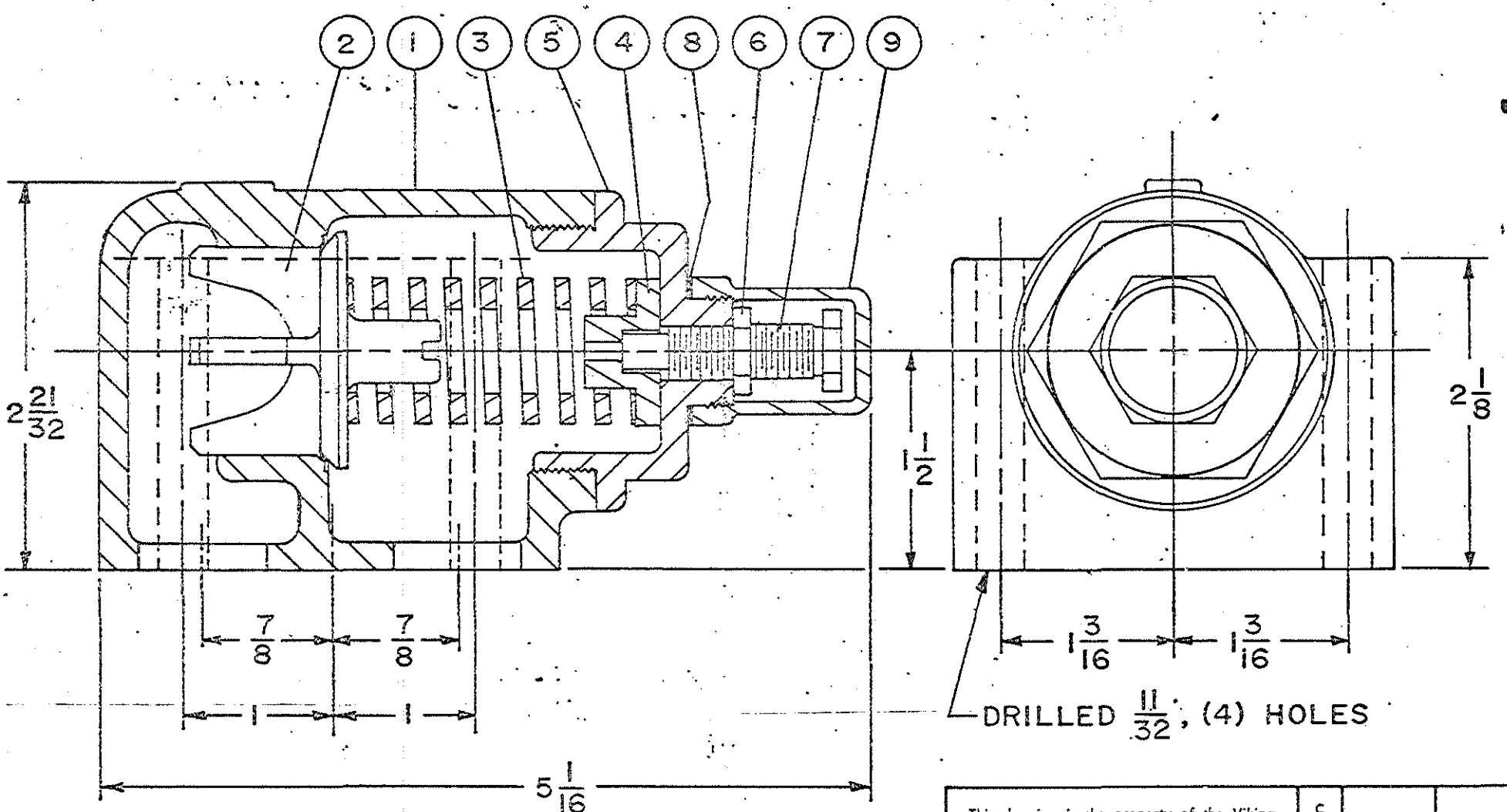
NOTE
ALWAYS GIVE MODEL & SERIAL NO. WHEN ORDERING PARTS

FEB 1 1977

4-1487-2942-501

Hdlb Assy. 2937 #30 Test. 2206
SHEET NO. 1 OF 1 MADE A.R. 6-21-73 3736 2-12-74
CHECK MK 4198 4-76
LM 4-1487-2942-501 ENGR Was 4-1487-2941-502 EX. END CL. .002

FEB 1 1977



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REF.	CHANGED	DATE
C		
B		
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PATTERN No.

SCALE FULL

DATE 10-28-71

DRAWN BOOROM

CHECKED E.R.

APPROVED

VIKING PUMP HOUDAILLE

Viking Pump Division, Houdaille Industries, Inc
Cedar Falls, Iowa 50613 U.S.A.

INTERNAL RELIEF VALVE - ALL STEEL EXCEPT IRON POPPET - CAD. PLATED STEEL SPRING FOR HJ & HL195 PUMPS.

DRAWING No. 3-795-251

DRG. A SIZE

LM- 3-795-251 Relief Valve For HJ195 & HL195 Pumps 17-HRV

All Steel Except Iron Poppet - Cad. Plated Steel Spring DWG. NO. 3-795-251

Item	SUB-ASSEMBLY NO.	PART NO.		MATERIAL	Qty.	DESCRIPTION			
							PRESSURE RANGE		
							H	HJ	HL
1		2-795-005-271		Steel	1	BODY			
2		2-796-005-100		C.I.	1	POPPET			
3		2-761-003-371	C	St.Cad.Plt.		SPRING	25-50	25-50	40-50
		2-761-004-371		St.Cad.Plt.		SPRING	51-80	51-80	51-80
		2-761-016-371		St.Cad.Plt.		SPRING	81-150	81-160	81-165
4		2-799-007-375	C	Steel	1	SPRING GUIDE			
5		2-797-003-271		Steel	1	BONNET			
6		2-503-004-376	C	St.Cad.Plt.	1	LOCKNUT			
7		2-595-004-376	C	St.Cad.Plt.	1	ADJUSTING SCREW			
8		2-305-009-808	C	Fiber	1	GASKET, Adjusting Screw Cap			
9		2-798-004-376	C	St.Cad.Plt.	1	CAP, Adjusting Screw			

1. LAP VALVE POPPET INTO SEAT WHEN ASSEMBLING VALVE
2. SEAL BONNET TO BODY WITH TITESEAL

FEB 1 1977

SHEET NO. 1 OF 1 | MADE FCV 8-20-70 | 3155 5-72

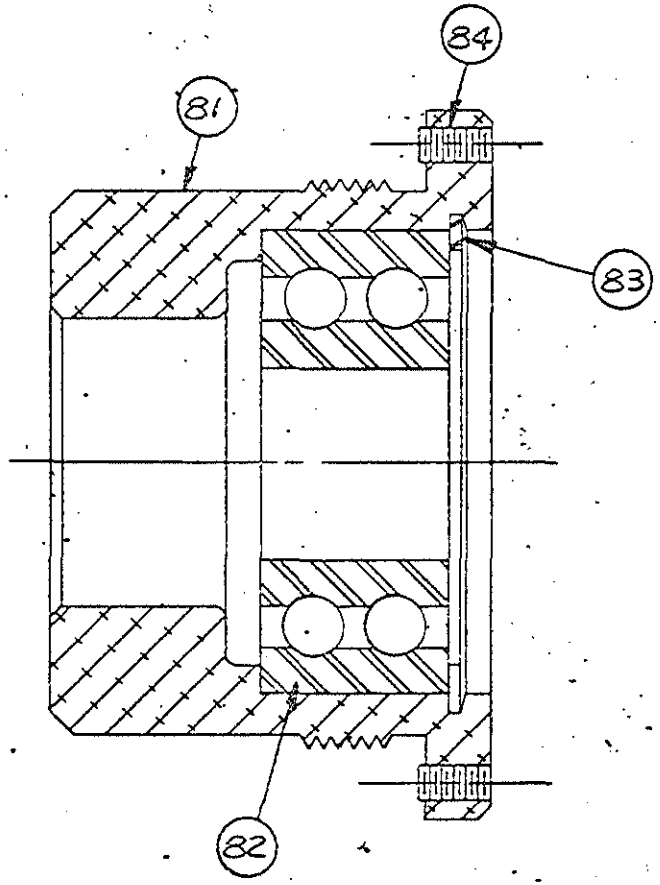
CHECK RMK 8-20-70

ENGR

LM 3-795-251- | EX. END CL.

3-795-251

FEB 1 1977



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REF.	CHANGED	DATE
C		
B		
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PATTERN No.	SCALE FULL	DATE 12-17-75	BEARING HOUSING ASSEMBLY - ALUMINUM FOR "HJ" & "HL" - 195 HEAVY DUTY PUMPS
DRAWN CHRISTEN	CHECKED E.R.	VIKING PUMP HOUDAILLE Viking Pump Division, Houdaille Industries, Inc. Cedar Falls, Iowa 50613 U S A	
APPROVED			DRAWING No. 3-060-011 — DRG. A SIZE

Form 455-C

LM- FOR 3-060-011 Bearing Housing Assembly

CONSTRUCTION - Aluminum For HJ, HL-195

DRG. NO. 3-060-011

Item	SUB-ASSEMBLY NO.	PART NO.	MATERIAL	Qty.	DESCRIPTION
81		2-060-003-707	Alum. A-10 Irid.	1	BEARING HOUSING
82		2-055-013-375	Steel	1	BALL BEARING (2 Row - 1 Shield)
83		2-555-007-375 C	Steel	1	SNAP RING
84		2-596-003-375 C	Steel	2	SET SCREW #10-32x 3/8

FEB 1 1977

3-060-011

SHEET NO. OF	MADE		
	CHECK		
LM 3-060-011	ENGR		EX. END CL.

Service Lube Oil	Req'n. No. 8031-M-71	Item No	No Req'd. 8 (1 per diesel)
Plant Limerick Gen. Sta	Spec. No. 8031-M-71	Cost Code	See M/R
Location Pottstown	P.O. No.		
Draw'g Ref (Layout)	Process		Viking HJ93 2

LINE NO					
1	Liquid Pumped / Newtonian or Non-N.		SAE 30		
2	Viscosity (SSU) (CS): Norm. Temp. / Min. Temp. / Max. Temp.		100 — 5000 .550		
3	Vapor Press. (PSIA): Norm. Temp. / Min. Temp. / Max. Temp.				
4	Temperature (°F): Norm. / Min. / Max.		60° — 160°F		
5	Specific Gravity / Pour Point / Flash Point @ .....°F				
6	Solids: Type / % by vol. / Abrasive / Shape / Distr. / Density				
7	Gases: Entr. / Dis'd. / Solubility (% by Vol. at 30" Hg. abs.)				
8	Flow: Rating / Min. / Max. (GPM)	15			2
9	Pressure: Outlet / Inlet / Diff. Max ΔP (PSIG)	50	0	25	1
10	NPSH: Available / Req'd. @ ℄ Suction (PSIG)	—	2.7 PSIA		
11	Type of Pump	ROTARY			
12	RPM / Rotation Facing Coupling	1150	CW		
13	Efficiency / BHP Rating / BHP Max	30 %	1.5	NA	2
14	Relief Valve: Internal - Setting / External - Setting (PSIG)	75			
15	Suction Conn.: Size / Rating / Facing / Position	1½" 300# FLAT RIGHT			
16	Discharge Conn.: Size / Rating / Facing / Position	1½" 300# FLAT LEFT			
17	Mfr. Brg. No., Radial / Thrust	NEW DEPARTURE #5605			
18	Base Plate: Pump (& Gear) Only / Comb. W. Driver (& Gear)	2-081-020 IRON BY VIKING			
19	Coupling: Mfr. / Model Size / Guard / Dr. Half Mtd.	LOVEJOY AL-100			
20	Seal: Packing Size, No., Type / Mech. Seal Mfr., No.	CMMNT DWG. D-SP-68M CODE I B2 P-811-2561-B			
21	Lubrication: Main, Type / Secondary, Type / Max. Micron	NLGI #2			
22	Cooling: Water GPM., Pr. / Quench / Steam Jacket	NA			
23	Material: Case	STEEL			
24	Rotors	CAST IRON			
25	Shaft / Shaft Sleeve	STEEL			
26	Throat ~~Bushing~~ BEARING	STEEL			
27	Lantern Ring / Gland	NA			
28	Relief Valve	STEEL			
29	Base Plate	NA			
30	Cooling Piping / Steam Piping	NA			
31	Seal Piping / Lubrication Piping	NA			
32	Driver: Type (Motor - Turbine - Gas) / RPM / HP (A.C.)	MOTOR BY CUSTOMER			
33	Furn. By / Weight / Dwg. / Mfr.	Seller			
34	Bearing Description: Radial, No. / Thrust, No.				
35	Lubrication: Radial / Thrust / Cooling				
36	High Speed Cplg.: Mfr. / Model / Furn. By				
37	Drawings: Outline / Sectional / Perf. Curve	GV-934 No SECTIONAL PC#120-1012			
38	Net Weight	50 LBS LESS POWER			
39	Inspection: Std. / QA	Yes			
40	Testing: Ultrasonic / Eddy Cur. / Mag. Part. / Liq. Pen. / Radiogr.	Manufacturer's Standards			
41	Hydrostatic / Witness // NPSH / Witness	Yes			
42	Performance / Witness / Disassembly	Yes	Yes		
43	Quality Assurance: Mfr. Std. / Documented		Per 8031-G-1		
44	Codes	DEMA, ASME, ASTM, API, SNT			
45	Seismic Design Req'ts	Class I Seismic			
46		1AP535, 1BP535, 1CP535, 1DP535			
47	Equipment No.	2AP535, 2BP535, 2CP535, 2DP535			

FILL IN ALL BLANKS: IF NOT APPLICABLE MARK "NA"

NO.	DATE	REVISIONS
2	7-30-71	Issued for Purchase
1	5-27-71	Reissued for Bids
0	2-11-71	Issued for Bids

NOTES

ORIGIN

ROTARY PUMP DATA SHEET

A.C. MOTOR-DRIVEN STANDBY CIRCULATING LUBE PUMP

LIMERICK GENERATING STATION UNITS 1 & 2

PHILADELPHIA ELECTRIC COMPANY

JOB NO. 8031

DATA SHEET NUMBER: 8031-M-71-DS-8

REV. 2

2-2-70 M309E

FEB 1 1977

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11908177

Installation and Maintenance Instructions for your Westinghouse Medium Motor

I.L. 2930-11TD

RECEIVING

1. Check Nameplate Data.

2. Turn shaft by hand to check that it turns freely.

3. Request "Receiving and Storage Instructions" for long-term storage indoors or any storage outdoors.

4. Lifting eyebolts are designed for raising the motor alone and should be removed after installing motor.

Warning: The following safety precautions *must* be observed:

1. Electric rotating machinery and high voltage can cause serious or fatal injury if improperly installed, operated or maintained. Responsible personnel should be familiarized with NEMA MG2, safety standards for construction and guide for selection, installation and use of electric motors and generators, national electric code and all local safety requirements.

2. All power sources to the motor and to the accessory devices should be de-energized and disconnected and all rotating parts should be at standstill.

3. Lifting means, when supplied, are intended for lifting the motor *only*. When two lifting devices are supplied with the motor a dual chain must be used.

4. Suitable protection must be used when working near machinery with high noise levels.

5. Safeguard or protective devices must not be by-passed or rendered inoperative.

6. The frame of this machine must be grounded in accordance with the National Electrical Code and applicable local codes.

7. Avoid contact with start or run capacitors in single-phase motors until a safe discharge procedure has been followed.

8. A suitable enclosure should be provided to prevent access to the motor by other than authorized personnel. Extra caution should be observed around motors that are automatically controlled or have automatic re-setting relays as they may restart unexpectedly.

9. Enclose all belts to prevent injury from broken belts.

10. Shaft key must be fully captive before motor is started.

11. Provide proper safeguards for personnel against possible failure of motor-mounted brake, particularly on applications involving over-hauling loads.

LOCATION

1. Dripproof motors are intended for use where atmosphere is relatively clean, dry, and non-corrosive. Keep windings clean with a soft brush, cloth or suction.

2. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations. The drain plug in the end bracket must be removed periodically to drain accumulated condensation.

3. Explosionproof motors are built for use in hazardous locations as indicated by Underwriters' label on the motor.

Note: In all cases, no surrounding structure should obstruct normal flow of ventilating air through or over the motor.

INSTALLATION

Fasten securely to a flat base with maximum size bolts. All ball or roller bearing normal thrust motors may be mounted in any position. Do not drive sheaves, couplings, sprockets or pinions on motor shaft.

Direct Drive

Align shafts accurately. If reverse rotation is detrimental to the driven device check rotation BEFORE connecting the motor to the load. See "start up".

V-Belt Drive

1. Mount motor sheave close to bearing housing.

2. Allow sufficient clearance for rotor end play.

3. Sheave diameter should not be less than NEMA recommended value. See NEMA MG1-14.42.

4. Align sheaves carefully, tighten belts only enough to prevent slippage.

Flange Motor

Fits are accurately machined to mate with driven equipment. Mating surfaces must be free of dirt or burrs and solidly engaged. The assembly should turn freely without stressing shaft and bearings from misalignment and thrust.

ELECTRICAL CONNECTIONS

1. Connect motor per nameplate to correct power supply.

2. Install all wiring, fusing and grounding in accordance with National Electrical Code and local requirements.

3. Identify motor auxiliary devices such as space heaters or temperature sensors. Connect in proper circuits and insulate from motor power cables.

Wound Rotor Motors

a) Connect cables from secondary control to brushholder assembly. Bring cables through squeeze connector on front bracket, where provided.

b) Slip rings must be maintained smooth and true. Machine to restore proper surface for brushes.

c) Brushes must make good contact with slip rings along the whole face of brush. If needed, grind brushes in with fine sandpaper. Do not use lubricants. Service ports are provided for inspection of slip rings and brushes. Spring pressure is preset at about 1 lb. on 213-286T frames and 4 lbs. on 324-449T frames.

d) Must use same grade of brushes.

START UP

1. Disconnect load and start motor. Check direction of rotation. If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY. Interchange any two leads of a three phase motor. Reconnect a single phase motor per nameplate instructions. Fans on fan cooled motors that have directional rotation nameplates must be reversed on shaft if rotation is changed.

2. Connect load. The motor should start quickly and run smoothly. If not, shut power off at once. Recheck the assembly including all connections before restarting. For single phase motors, also examine capacitor wiring and mechanism for switching between starting and running.

3. If excessive vibration is noted, check for loose mounting bolts, too flexible motor support structure or transmitted vibration from adjacent machinery. Periodic vibration checks should be made; foundations often settle.

4. Operate under load for short period of time; check operating current against nameplate.

LUBRICATION: BALL OR ROLLER BEARINGS

Grease lubricated bearings as furnished are adequate for a long period of operation without relubrication. A good maintenance schedule for regreasing will vary widely depending on motor size, speed, duty and environment.

Frequency of Relubrication

The following table suggests relubrication intervals for motors on normal, steady running, light duty indoor loads in relatively clean atmosphere at 40°C (104°F) ambient temperature or less:

Type of Grease

Use Westinghouse 53701RY grease unless a special grease is specified on the nameplate. Some equivalent greases are:

Chevron SRI-2 – Standard Oil of California
Premium RB – Texaco Inc.
Unirex N2 – Exxon
Dolium R – Shell Oil Company
Rykon Premium – American Oil

Procedure for Relubrication

When regreasing, stop motor, remove outlet plug, and add amount of grease per reference table with hand lever gun only. Discontinue at once if grease appears at outlet plug, this may occur before specified amount is used, run for about ten minutes before replacing outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end; if the outlet plug is not accessible at surface of hood, it is the spring relief type and need not be removed when regreasing.

LUBRICATION: SLEEVE BEARINGS

Before starting the motor, fill both reservoirs through the filler plug with best quality, clean motor oil. The oil should have a viscosity of from 180 to 200 SSU (equivalent to SAE No. 10). During operation, no oil should be added until it drops below the full level. Do not flood the bearing. At about 2 year intervals, dismantle and thoroughly wash out the bearing housing, using hot kerosene oil.

Type of Enclosure	Insulation	Frame Size		
		143 to 215T	254 to 326T	364 to 449T
Open – DP	B	2 yrs.	18 mo.	1 yr.
Enclosed – FC Open – DP	B F	18 mo.	1 yr.	9 mo.
Enclosed – NV Enclosed – FC Open – DP Enclosed – Lint Free – FC	B F H B	1 yr.	9 mo.	6 mo.
Enclosed – NV Enclosed – FC Enclosed – Lint Free – FC	F H F	9 mo.	6 mo.	3 mo.

Note:
FOR MOTORS OVER 1800 RPM – Use 1/2 of tabled period.
FOR SEVERE DUTY – DUSTY LOCATIONS – Use 1/3 of tabled period.

Volume – Reference Table

Shaft Diameter (At Face of Bracket)	Amount of Grease to Add
3/4" to 1-1/4"	1/8 cu. in. or 0.1 oz.
1-1/4" to 1-7/8"	1/4 cu. in. or 0.2 oz.
1-7/8" to 2-3/8"	3/4 cu. in. or 0.6 oz.
2-3/8" to 3-3/8"	2 cu. in. or 1.6 oz.

Caution: **Overgreasing is a major cause of bearing and motor failure. Make sure dirt and contaminants are not introduced when adding grease.**

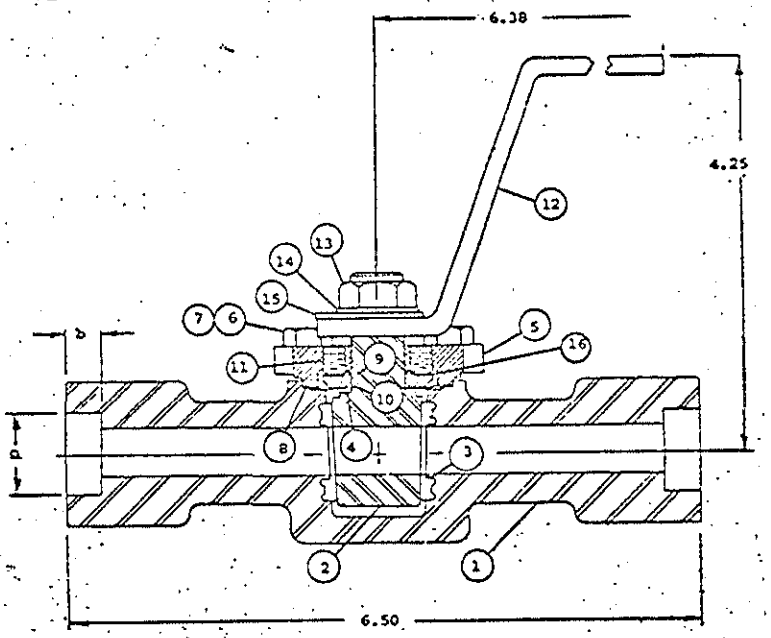
WARRANTY

Westinghouse warrants that the products sold by it will, upon shipment, be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during a period of one year after the date of installation or eighteen months from date of shipment, Westinghouse shall, upon prompt written notice from the purchaser, correct such non-conformity by repair or replacement, f.o.b. factory, of the defective part or parts. Correction in the manner provided above shall constitute a fulfillment of all liabilities of Westinghouse with respect to the quality of the products. The foregoing warranty is exclusive and in lieu of all other warranties of quality whether written, oral, or implied (including any warranty of merchantability or fitness for purpose).

The remedy(ies) provided above shall be purchaser's sole remedy(ies) for any failure of Westinghouse to comply with the warranty provisions, whether claims by the purchaser are based in contract or in tort (including negligence).

Westinghouse Electric Corporation
Medium Motor and Gearing Division, Buffalo, NY 14240
Printed in U.S.A.

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	b	D
1/2"	.38	.86
3/4"	.50	1.07

VENDOR NO: 1/2" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP. ELK GROVE, IL 60007

SEE 11908456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR. ①

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED Rev 2 NOV 3 1976 QUALITY CONTROL

APPROVED REV. 7 OCT 19 1976 QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10998	6-26-78	SEE SH. 2	
4	10611C	1-27-78	SEE SHEETS 2,3,4	LM PE
3	10629	1-13-78	SEE SHEET #2	LM PE
2	10128	11-10-76	See Shts 3 & 4	
1	10102	10-29-76	SEE SHEETS 3&4	
	"	"	①ADDED "SEE 11908456..." NOTE	

TITLE
VALVE, PLUG
1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	PC 1503	9/ 3/76	ASSY. OR LO.
DR. BY	P. ESTRADA	8/ 30/76	SCALE
CHK'D. BY	L.W. Cooper	9/2/76	HEAT TR.
MAT'L	PURCHASE		

APPV.		
	CAST.	MAT'L
	MACH.	ENGR.
	WELD.	

SHEET SIZE A | DWG. NO. 11 908 180 | SHEET 1 OF 4

BF3009-2

COLT FM JUN 14 1978 Rev. 5 QA APP
COLT FM JAN 2 1978 Rev. 4 QA APP
COLT FM JUL 6 1978 QA APP
COLT FM JAN 6 1978

11907495 11908183
11908180 11908509
11908181 11909685
11909686

Maintenance and Repair Instructions

For Tufline Valves ½" & ¾" Also 1" Ductile Iron Valves

Tufline valves are designed and built to give long, trouble-free service. Properly applied, adjusted and operated, they should require minimum attention. In most cases, a simple adjustment, as described below, is all that is necessary. In such cases, please first read these instructions carefully. If there are any questions, consult your Tufline valve representative.

Adjustments

Loss of Seal

All Tufline valves are factory adjusted for bubble-tight shutoff at 100 psi air pressure. Normally, no further adjustment is required. If seepage does occur at the plug shank or downstream, tighten the Allen-head screws uniformly ¼ turn at a time. Operate valve and check for leakage before tightening further.

Hard Turning

Torque adjustments should not be made before operating a valve for at least 12 hours under service conditions, since the initial breakaway torque normally reduces with usage and temperature. Otherwise, valve may become too loose. If still too tight, reduce torque by loosening Allen-head screws uniformly ¼ turn at a time. After operating valve, repeat as necessary, but no more than 2 or 3 times, or else leakage may occur. If valve is on cold service and after adjustment it is still too hard to turn, try heating valve with lamp or similar source of mild heat, being careful not to exceed temperature of 400°F. **

Normal Running Torques

Size	Ft./lbs. at Stem
½"	10
¾"	15
1" DI Only	15

Valve Repairs

Field repair of valves may be satisfactorily performed by carefully carrying out the following instructions, but should be weighed against the advantage of returning valves to the factory for repair where possible. Because of the specialized equipment available at the factory, such repairs can be performed in many instances more economically than in the field, even considering transportation charges back and forth. Also, factory repaired valves carry the standard new valve guarantee and, of course, are tested to the same specifications as new valves.

Parts Nomenclature and Identification

Since 1956 several model improvements have been introduced. For proper nomenclature and parts identification, check your latest Tufline catalog carefully before ordering replacements. Although parts are designed for maximum interchangeability between sizes, types and models of valves, in certain instances they are not interchangeable and must be specifically identified. If you have any questions, consult your local Tufline office.

Tools and Equipment for Field Repair

Special

Sizing Plug	½"-¾" Required
Plunger	½"-¾" Optional*

*Or a piece of round bar stock of the sleeve OD.

**DO NOT EXCEED A TEMPERATURE OF 300° F WITH XOMOX 7 TRIM AND 225°F WITH UHMWP TRIM

Standard

Arbor Press (U-clamp or jack can also be used)
Sharp Knife
Drill
Allen & Standard Wrench Sets

Consult your regional office on availability of special tools.

Sleeve Replacement

Valve Removed from Service

IMPORTANT! If the valve has been used on a hazardous fluid, make certain it has been thoroughly cleaned before disassembly. Loosen the cover bolts about 3 to 4 turns each, and then turn the plug to release any trapped pressure within the valve.

Removal of Sleeve

(a) To remove the handle washer, handle and static eliminator (spring), remove the Allen-head bolt.

(b) Remove the cover bolts and cover.

(c) Remove the plug and top seals by turning the plug with the hub-handle wrench.

(d) Slip the top seals—thrust collar, formed metal diaphragm, TFE delta ring and TFE diaphragms—from the plug. All that remains is the TFE sleeve in the valve body. (There may be a TFE thrust disc lying in the bottom of the valve. Remove. It need not be replaced.)

(e) To remove the sleeve, cut it with a sharp knife half way between the ports. Care should be taken not to score the valve body.

(f) After the sleeve has been cut from top to bottom, insert a screwdriver behind the sleeve and curl the sleeve away from the body. Remove the sleeve.

(g) Clean the body and the plug. They should not be eroded, and the plug's surface should be smooth. If the finish of the plug is questionable, replace.

Replacement of Sleeve

(a) The sleeve has been sized and taped. (Do not remove tape until ready to use.) Remove the tape and insert the sleeve in the valve body.

(b) Place the "plunger" on top of the sleeve and press the sleeve into valve body. An arbor press is normally required. (For in-line replacement, a U-clamp or jack should be used.)

(c) Place the "sizing plug" in the sleeve and press the sizing plug to the bottom of the valve body. If you have a silicone lubricant, spray the sizing plug before inserting. Remove the sizing plug with the jackscrew, if necessary.

(d) When the sleeve is in the body, the upstream and downstream ports must be drilled out. Use a standard drill and drill out the ports in the sleeve to conform to the valve body by drilling through the ports. Then take a sharp knife and trim the burrs or excess Teflon around the port area.

(e) Insert the standard plug. The top of the plug should drop within approximately ¼" of the counterbore. If it does not, resize with the sizing plug.

(f) Reassembly: replace the standard plug and follow with the TFE diaphragm, TFE delta ring, formed metal diaphragm, and thrust collar. Note: Always use a *new TFE* diaphragm, delta ring and formed metal diaphragm.

(g) Back out the adjusting screws in the cover so that they are one thread within the inside of the cover.

(h) Replace the cover and cover bolts and tighten securely. The tightening of the cover can be done more easily if the valve is placed under an arbor press and the plug is pressed downward. (Do not pull the plug in with the cover. It will tend to cut the Teflon diaphragm.)

(i) Adjust the Allen-head adjusting screws ¼ turn at a time. Rotate the plug with the handle and hub, and continue to tighten as necessary until the normal running torques, shown under the valve adjustment paragraph, are achieved.

(j) Replace the static eliminator, handle, handle washer and Allen-head bolt.

Tufline, division of Xomox, 4444 Cooper Road, Cincinnati, Ohio 45242

TUFLINE®

Maintenance and repair instructions for 1″ thru 4″ plug valves

Adjustments

Tufline valves are designed and built to give long, trouble-free service. Properly applied, adjusted and operated, they should require minimum attention. In most cases, a simple adjustment, as described below, is all that is necessary. In such cases, please first read these instructions carefully. If there are any questions, consult your Tufline valve representative.

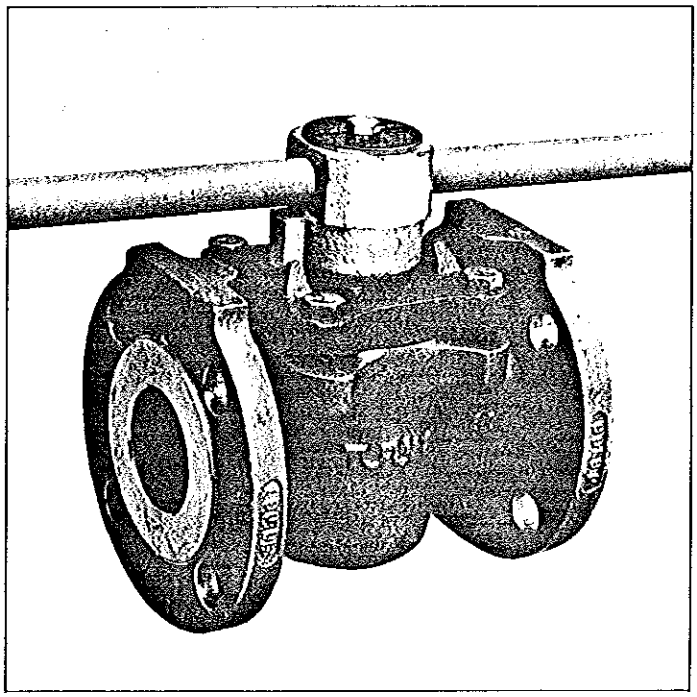
Loss of seal. All Tufline valves are factory adjusted for bubble-tight shutoff at 100 psi air pressure. Normally, no further adjustment is required. If seepage does occur at the plug shank or downstream, tighten the Allen-head screws uniformly ¼ turn at a time. Operate valve and check for leakage before tightening further.

Hard turning. Torque adjustments should not be made before operating a valve for at least 12 hours under service conditions, since the initial breakaway torque normally reduces with usage and temperature. Otherwise, valve may become too loose. If still too tight, reduce torque by loosening Allen-head screws uniformly ¼ turn at a time. After operating valve, repeat as necessary, but no more than 2 or 3 times, or else leakage may occur. If valve is on cold service and after adjustment it is still too hard to turn, try heating valve with lamp or similar source of mild heat, being careful not to exceed temperature of 400°F.**

Normal running torques

Size	TFE Ft.-lbs. at stem	UHMWPE Ft.-lbs. at stem
1″	15	30
1½″	20	40
2″	30	60
3″	50	100
4″	70	140

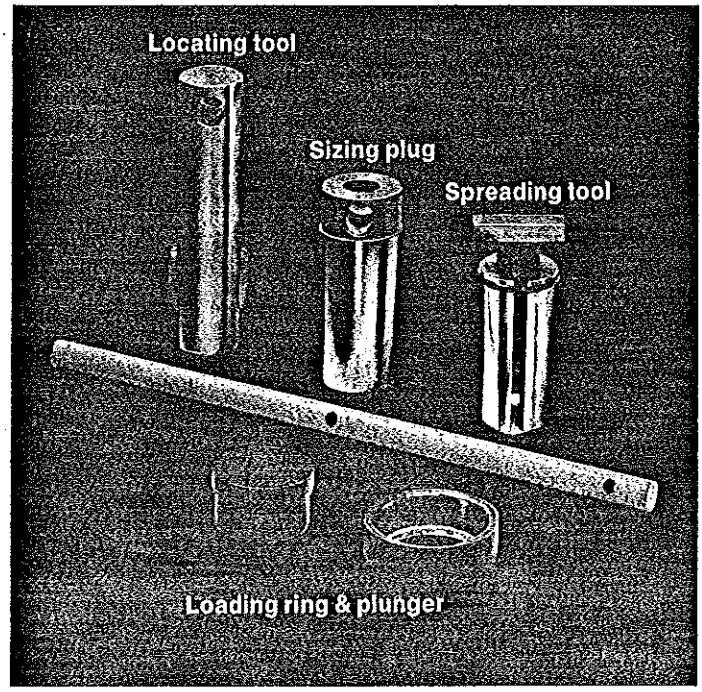
** DO NOT EXCEED A TEMPERATURE OF 300°F WITH XOMOX 7 TRIM AND 225°F WITH UHMWP TRIM

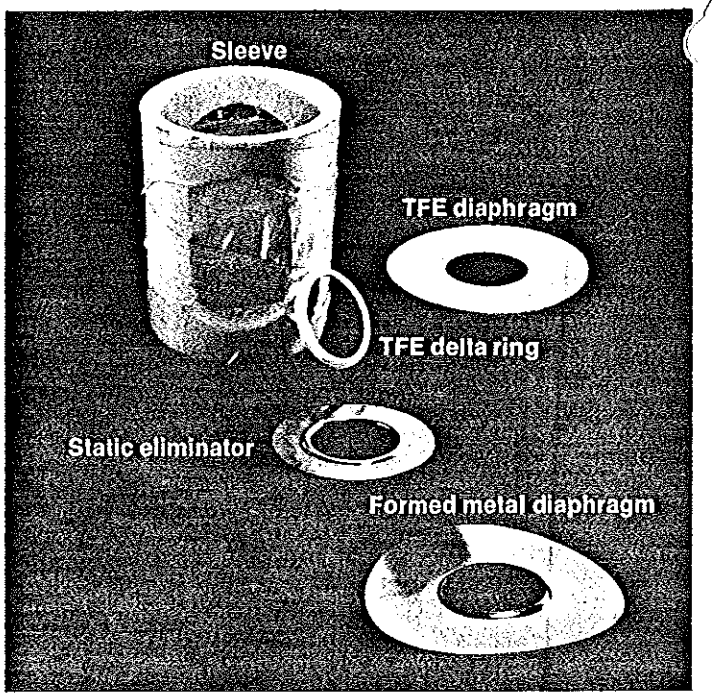


Valve repairs

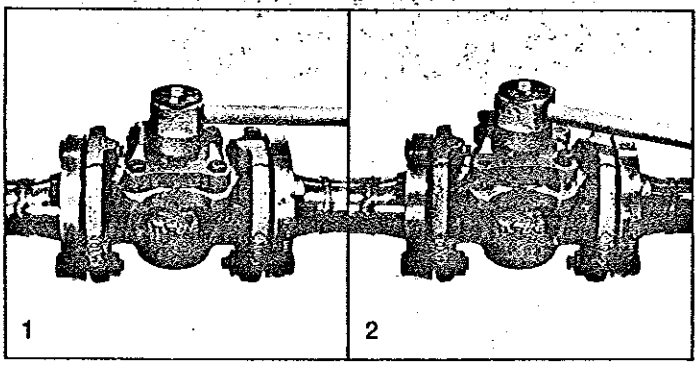
Field repair of 1″-4″ sizes may be satisfactorily performed by carefully carrying out the following instructions, but again should be weighed against the advantage of returning valves to factory for repair where this is possible. Because of the specialized equipment available at the factory, such repairs can be performed in many instances more economically than in the field, even considering transportation charges back and forth. Also, factory repaired valves carry the standard new valve guarantee, and, of course, are tested to the same specifications as new valves.

Special tools and equipment for field repair*





*Special tools and repair kit available from Tufline regional offices



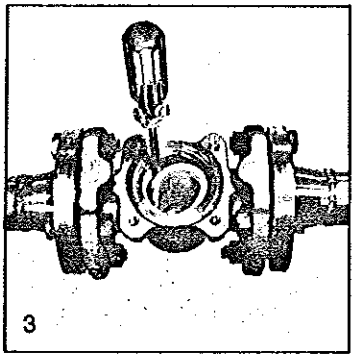
Disassembly

Important! If valve has been used on hazardous fluids, make certain it has been thoroughly cleaned before disassembly!

(1) Typical valve installation before repair is started.

(2) Remove two (2) cover bolts and loosen the other two bolts three to four turns. Rotate the plug to release any trapped pressure within the valve. Then remove the other two (2) cover bolts and lift the plug and cover assembly out of the valve.

Sleeve removal

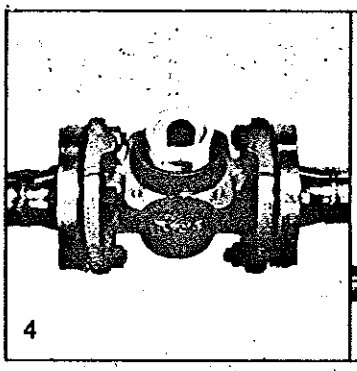


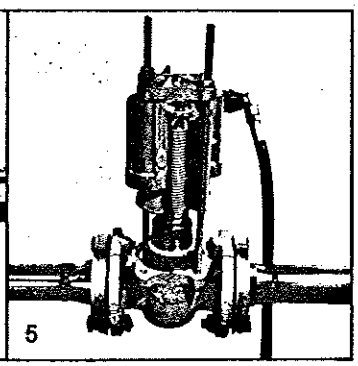
(3) To remove the sleeve, use a screwdriver or a sharp knife and cut the sleeve between the ports. Care should be taken not to score the valve body.

After the sleeve has been cut from top to bottom, insert a screwdriver behind the sleeve and curl the sleeve away from the valve body, removing the sleeve by prying it out of the body.

Clean the body and plug. They should not be eroded, and the plug surfaces should be smooth. If the finish of the plug is questionable, replace.

Sleeve replacement

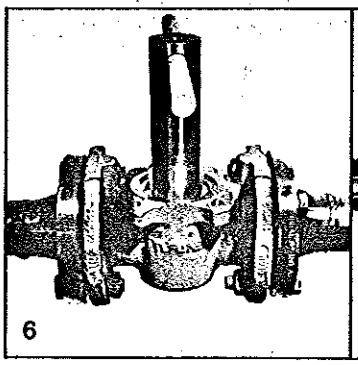

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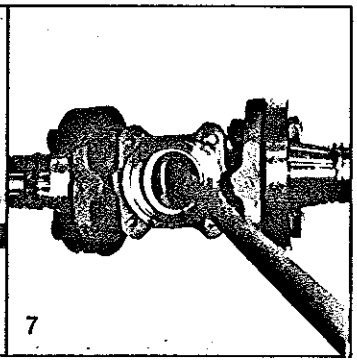

5

(4) The sleeve has been sized and taped. Do not remove tape until ready to use!

Place the loading ring in the counterbore of the body. Insert the sleeve so that its port is 90° from being aligned with the waterway of the body.

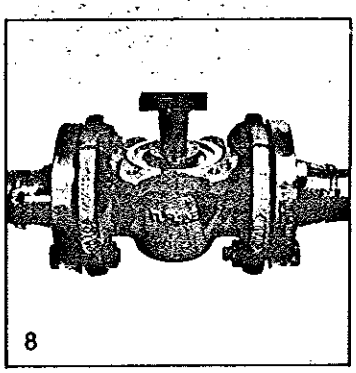
Press the sleeve through the loading ring until the bottom of the sleeve is past the top of the retaining lips in the body. Then manually rotate the sleeve until the port of the sleeve is lined up with the port of the body.


6


7

(5) Using two (2) threaded rods and the valve cover, make a press arrangement over the top of the valve body. Place the plunger on top of the sleeve. With a portapower unit, press the sleeve into the valve body, using the large diameter of the plunger, then reversing to the small side of the plunger to press through the loading ring.

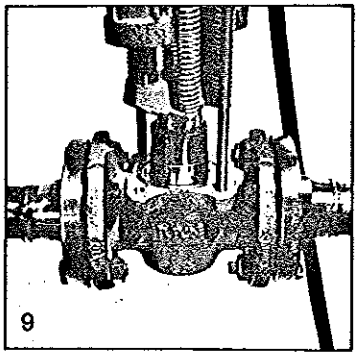
(6) When the sleeve is in the body, the locating tool is inserted and turned to position the edges of the sleeve behind the lips (the protruding edge of the body that surrounds each port). Press firmly on the locating tool and rotate until the sleeve has turned and the sleeve edges at the port have popped behind the lips. You should be able to feel this through the tool and should also hear the pop. The sleeve should now be in perfect alignment and the edges at the port should be against the body behind the lips.


8

(7) The bottom of the sleeve should rest on the lower ledge of the body and the top of the sleeve should be tucked under the upper ledge of the body. Make sure the sleeve is pressed tightly against the body by rolling the valve handle or a bar in a stirring motion around the opening of the valve body.

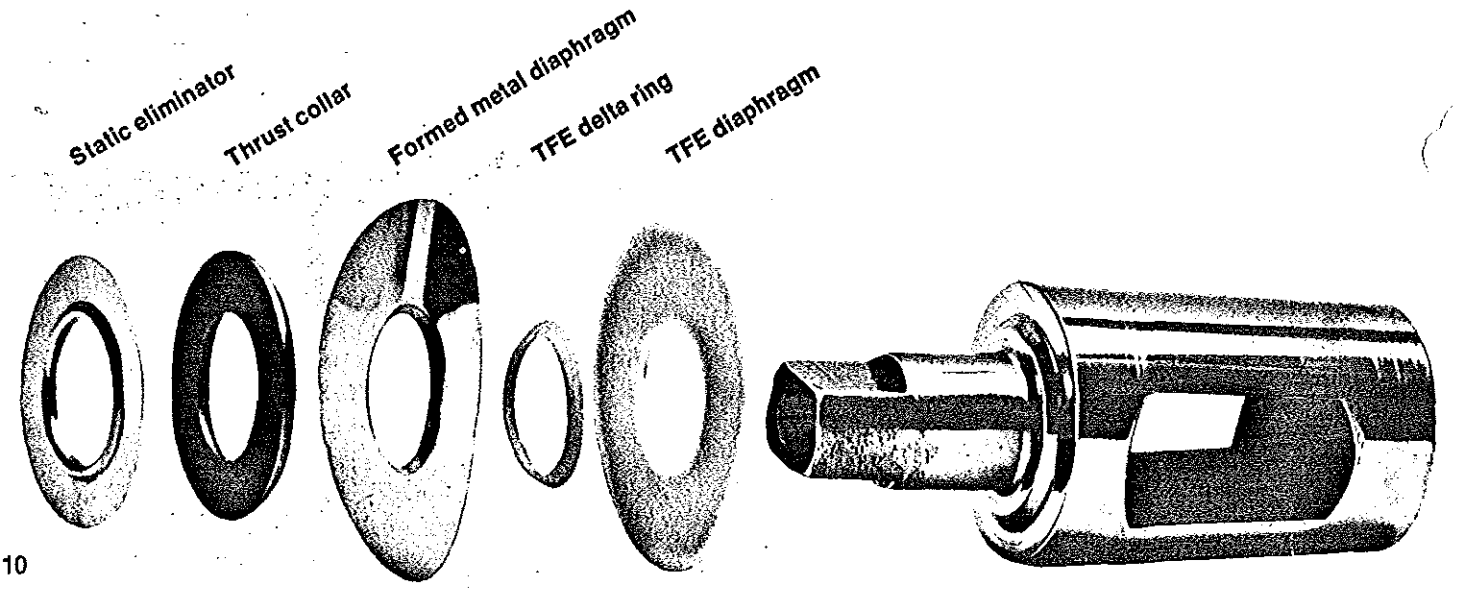
(8) The sleeve must also be pressed to the valve body around the ports. A spreading tool is inserted into the sleeve and pressed to the bottom of the valve. This positions the sleeve so that it will not be torn when sizing with the sizing tool.

Plug replacement


9

(9) Place the sizing plug into the valve body. Then, using the portapower, press the sizing plug to the bottom of the valve body. Remove the sizing plug with a jackscrew if necessary. Insert the standard plug with ports in an open position.

Note: The top of the plug should drop within approximately ¼" of the counterbore. If it does not, resize with the sizing plug. There may be a small excess of TFE around the ports which should be trimmed with a sharp knife.



10

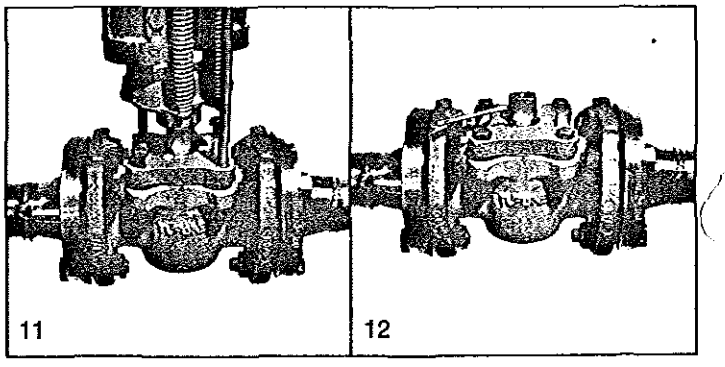
Reassembly

(10) Replace the TFE diaphragm, TFE delta ring, formed metal diaphragm, thrust collar and static eliminator. *Except for the thrust collar, these are new parts supplied in the repair kit.*

Back out the adjusting screws in the cover so that one thread is showing inside the cover.

(11) Install the cover. Then, using the portapower, press the plug into the valve body so the cover is floating in the counterbore. Install the two cover bolts and tighten securely, while holding the plug down. Then release the portapower and remove the studs, inserting the other two cover bolts and tightening them securely.

(12) Adjust the socket-head adjusting screws ¼ turn at a time. Rotate the plug with the handle and the hub, and continue to tighten as necessary until the normal running torques, shown under "Adjustments," are achieved. Replace the hub and bar wrench, nameplate and hex-head hub bolt. If satisfactory tightness is not obtained, please contact your Tufline representative.



11 12

Replacement of UHMWPE sleeve

Materials of construction are different from those of the standard valves, but the same general procedures as set forth above are to be followed.

TUFLINE
Division of Xomox Corporation
4444 Cooper Road, Cincinnati, Ohio 45242
Phone 513 793-7000

Recommended tooling for sleeve replacement for plug valves (except figure 061)
Sizes 1/2" - 12"

PART NAME	1/2" & 3/4"	1"	1½"	2"	2½" & 3"	4"	6"	8"	10"	12"
SLEEVE SHRINK DIE	002570	002571	002572	002471	002803	002472	003965	004180	004275	005248
SLEEVE RELEASE PLUNGER	N/A	002839	002840	002843	002844	002845	002825	002826	002827	002828
LOADING RING *	001959	002574	002575	002473	002576	003128	003964	004273	004274	005250
PLUNGER *	001960	001440	001441	001442	001443	001836	001444	300693	300694	300695
TURNING TOOL *	N/A	001412	004370	004372	004373	004376	003486			
SPREADING TOOL *	N/A	004368	004369	004371	004374	004375	003485			
SIZING DIE *	003937	002587	002588	002589	002590	002470	003978	004276	004277	005249
KIT FOR UHMW	961834	961835	961836	961837	961838	961839	962371			
KIT FOR TFE & X7 *	963858	962372	962373	962374	963859	963860	963899			

*Included in kit for TFE and X7
For Prices call TUFLINE Cincinnati, OH 513-745-6000

TUFLINE

Division of Xomox Corporation Cincinnati, Ohio 45242 Manufacturers of Tufline Valves

Specification Number: Z-5498-A

RECOMMENDED SPARE PARTS FOR ½"- 4" PLUG VALVES
(EXCEPT FIGURE 061)

TUFLINE

Division of Xomox Corporation Cincinnati, Ohio 45242 Manufacturers of Tufline Valves

VALVE SIZE	TFE SLEEVE PART NO.	TFE DIAPHRAGM PART NO.	FORMED METAL DIAPHRAGM PART NO.	TFE DELTA RING PART NO.	STATIC ELIMINATOR * PART NO.
1/2" & 3/4" 150 LB	183435	013441	029373	013443	023917
1/2" & 3/4" 300 LB	283435	013441	029373	013443	023917
1" DI 150 LB	180281	012279	029374	013066	023596
1" DI 300 LB	280747	012279	029374	013066	023596
1" Alloy 150 LB	182281	012279	029374	013066	023596
1" Alloy 300 LB	282281	012279	029374	013066	023596
1½" 150 LB	182418	012416	029375	013067	023598
1½" 300 LB	282418	012416	029375	013067	023598
2" 150 & 300 LB	282287	012284	029376	013068	023599
2½" & 3" 150 & 300 LB	285128	012388	029377	013068	023599
4" 150 & 300 LB	285129	012300	029378	013069	023600

*Static Eliminator is not required with gear or actuator operated valves.

For prices call TUFLINE Cincinnati, Ohio 513-745-6000.

Specification Number: Z-5484-A

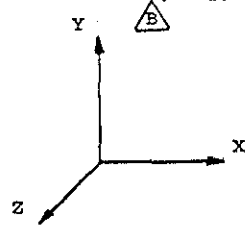
Fig. 1366SW Size 1"
Wrench Operated
TFE Sleeve & Seals
Mat'l: CF8M/CF8M
Nuclear Class 3
ASME Section III Class 3 (B)

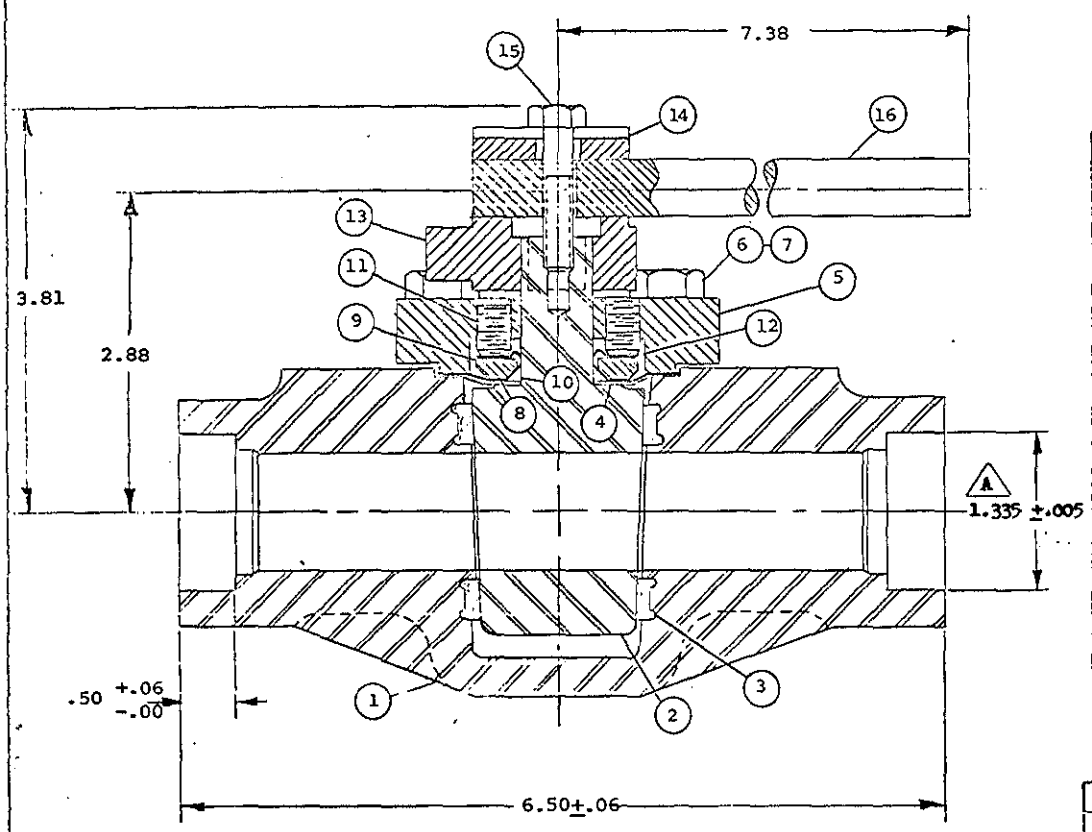
Limerick Generating Station Units 1 & 2
Philadelphia Electric Company
Spec. No. 8031-M-71
Emergency Diesel Generators
Purchase Order No. LX239585
Colt/FMED Order No. 11-700000 (B)
Tufline Order No. E-72395

Fx = 17,8751lbs.
Fy = 6,345 lbs.
Fz = 6,345 lbs.

Mx = 1,055 ft-lbs.
My = 525 ft-lbs
Mz = 525 ft-lbs.

XOMOX CORPORATION
4444 Cooper Road
Cincinnati, Ohio 45242





Bill of Material

No.	Qty.	Part Name	material
1	1	Body	ASME SA351, Gr. CF8M
2	1	Plug	ASME SA351, Gr. CF8M
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Cover	ASME SA351, Gr. CF8
6	4	Cover Studs	ASME SA193, Gr. B8 Cl. 1
7	4	Cover Nuts	ASME SA194, Gr. 8
8	1	Metal Diaphragm	ASTM A167, Type 302
9	1	Thrust Collar	ASTM A167, Type 304
10	1	Delta Ring	TFE
11	3	Adjustment Screws	AISI 303/Silver Plated
12	1	Static Eliminator	AISI 302
13	1	Wrench Hub	Ductile Iron/Painted
14	1	Name Plate	Stainless Steel
15	1	Hub Bolt	Steel/Zinc Plated
16	1	Wrench Handle	Steel/Painted

APP.	BY	SCN #	DATE	REV.
			4/3/78	B
	[illegible]	146	12/6/77	A

UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ±.50 IN.
ALL ANGULAR TOLERANCES ±2½°. DO NOT SCALE DWGS.

DWN ZOK | CHKD. R.J. | APP. [illegible] | DATE 10/7/77

Fig. 1366SW Size 1"
Wrench Operated

SPEC. NO. NP2117-B

Tufline DIVISION OF XOMOX CORPORATION
4444 COOPER ROAD, CINCINNATI, OHIO 45242

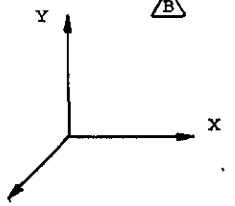
Fig. 1366SW Size 2"
Wrench Operated
TFE Sleeve & Seals
Mat'l: CF8M/CF8M
Nuclear Class 3
ASME Section III Class 3 (B)

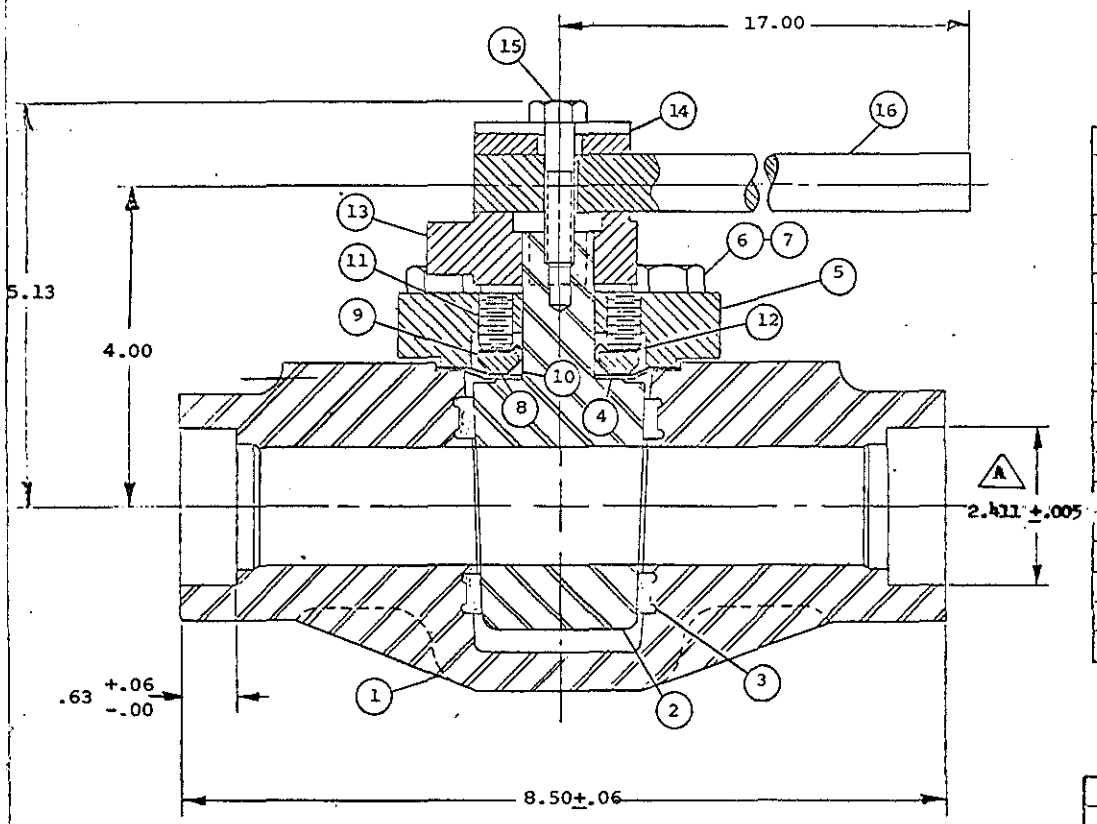
Limerick Generating Station Units 1 & 2
Philadelphia Electric Company
Spec. No. 8031-M-71
Emergency Diesel Generators
Purchase Order No. LX 239585
Colt/PMED Order No. 11-700000 (B)
Tufline Order No. E-72396

XOMOX CORPORATION
4444 Cooper Road
Cincinnati, Ohio 45242
(B)

Fx = 46,920 lbs.
Fy = 30,990 lbs.
Fz = 30,990 lbs.

Mx = 5160 ft-lbs.
My = 2580 ft-lbs.
Mz = 2580 ft-lbs.

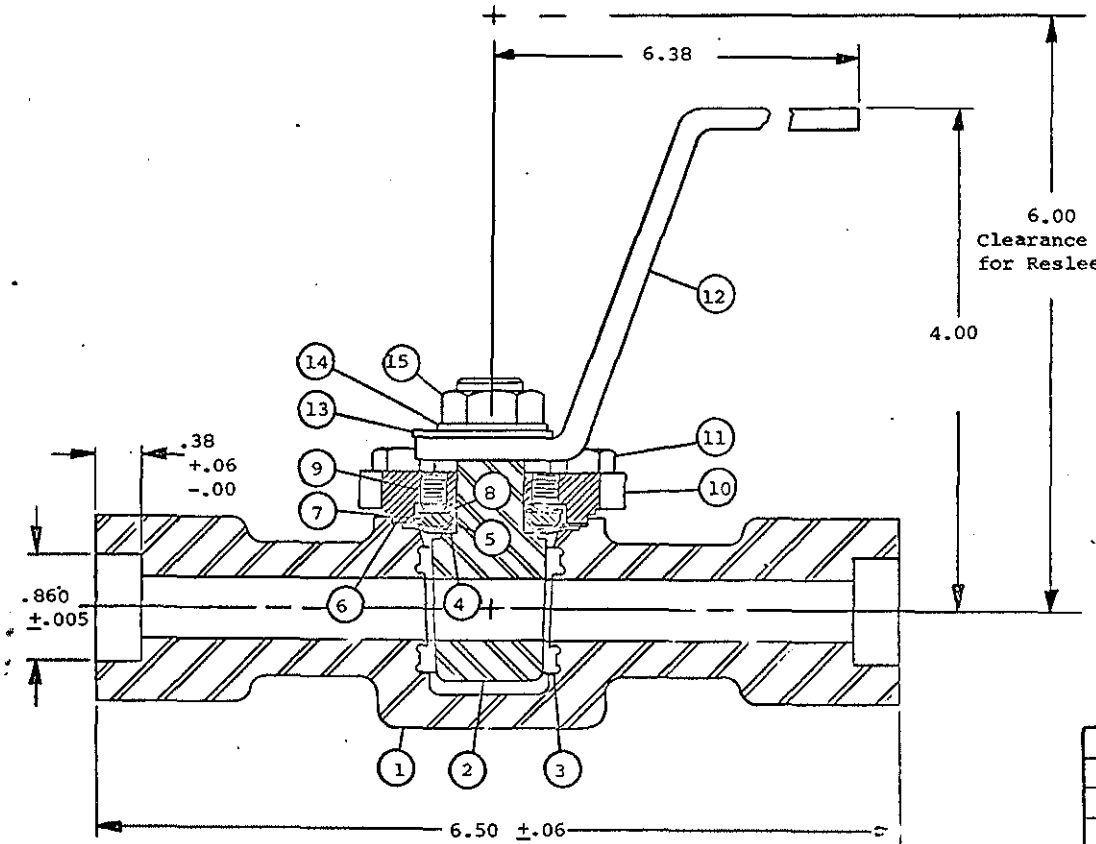




Bill of Material			
No.	Qty.	Part Name	Material
1	1	Body	ASME SA351, Gr. CF8M
2	1	Plug	ASME SA351, Gr. CF8M
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Cover	ASME SA351, Gr. CF8.
6	4	Cover Studs	ASME SA193, Gr. B8, Cl. 1
7	4	Cover Nuts	ASME SA194, Gr. 8
8	1	Metal Diaphragm	ASTM A168, Type 302
9	1	Thrust Collar	ASTM A167, Type 304
10	1	Delta Ring	TFE
11	3	Adjustment Screws	AISI 303/Silver Plated
12	1	Static Eliminator	AISI 302
13	1	Wrench Hub	Malleable Iron/Painted
14	1	Name Plate	Stainless Steel
15	1	Hub Bolt	Steel/Zinc Plated
16	1	Wrench Handle	Steel/Painted

					UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ±.50 IN. ALL ANGULAR TOLERANCES ±2½°. DO NOT SCALE DWGS.
					DWN. JK CHKD. R.d APP. g DATE 10/7/77
					Fig. 1366SW Size 2" Wrench Operated — SPEC. NO. NP2118-B
			3-31-78	B	
	JK	146	12/6/77	A	Tufline DIVISION OF XOMOX CORPORATION 4444 COOPER ROAD, CINCINNATI, OHIO 45242
APP.	BY	SCN #	DATE	REV.	

Fig. 1366 SW Size 1/2"
Socket Weld Ends
Wrench Operated
Customer Order # D-443532 Rev. 9
Tufline Order # E-73807
Weight: 5#
Nuclear Class 3



Bill of Materials

No.	Qty.	Part Name	Material
1	1	Body	ASME SA 351 CF8M
2	1	Plug	ASME SA 351 CF8M
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Delta Ring	TFE
6	1	Metal Diaphragm	ASTM A167, Type 302
7	1	Thrust Collar	ASTM A167, Type 304
8	1	Static Eliminator	AISI 302
9	3	Adjustment Screws	AISI 303/Silver Plated
10	1	Cover	ASME SA 351 CF8
11	4	Cover Bolts	ASME SA 193 B6
12	1	Wrench Handle	Steel/Painted
13	1	Name Plate	AISI 302
14	1	Lockwasher	Steel/Zinc Plated
15	1	Wrench Hub	AISI 304

Metal Tag: P.O. 443532-N
Part Number: 11909686

APP.	BY	SCN #	DATE	REV.

UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ±.50 IN.
ALL ANGULAR TOLERANCES ±2½°. DO NOT SCALE DWGS.

DWN. JN	CHKD.	APP.	DATE 5/25/78

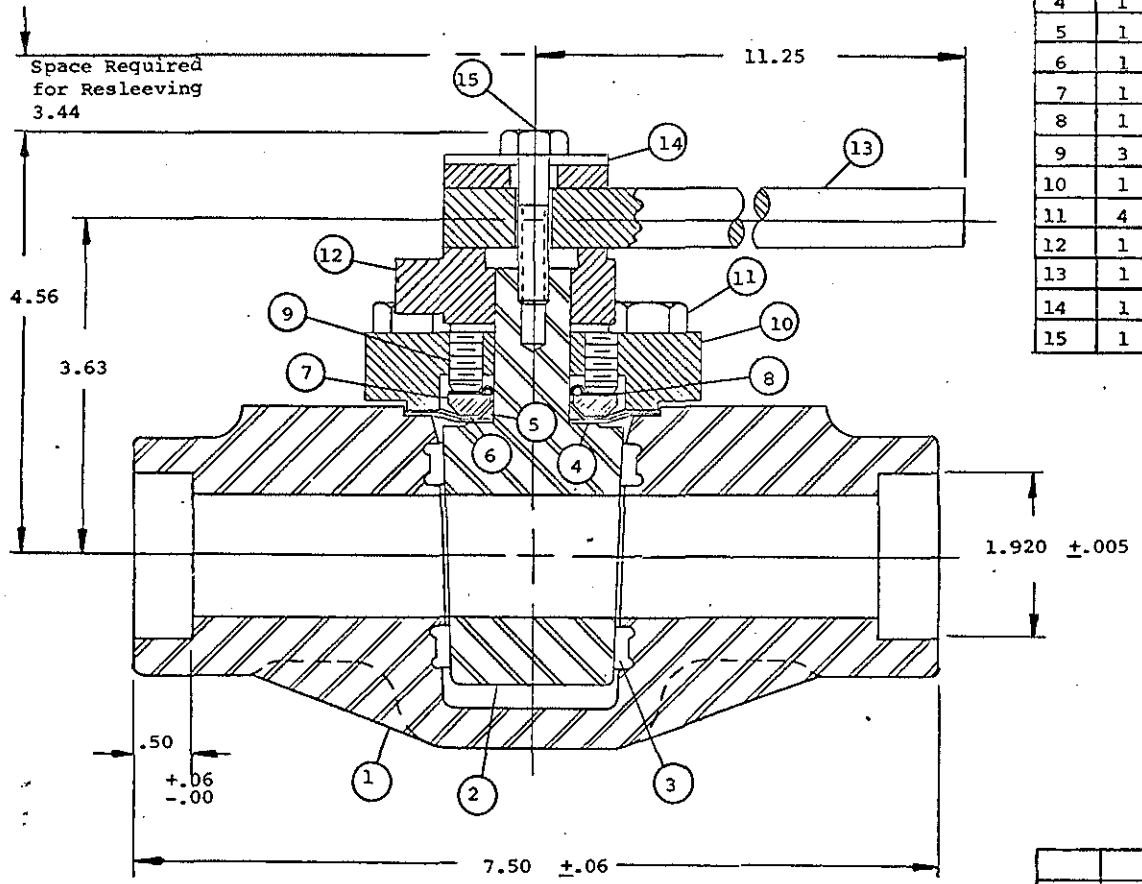
Fig. 1366 SW Size 1/2"
Wrench Operator

SPEC. NO. NP 2475-B

Tufline DIVISION OF XOMOX CORPORATION
4444 COOPER ROAD, CINCINNATI, OHIO 45242

Fig. 1366 SW Size 1½"
Socket Weld Ends
Wrench Operator
Customer Order # D-443532 Rev. 9
Tufline Order # E-73807
Weight: 18#

Nuclear Class 3



Bill of Materials			
No.	Qty.	Part Name	Material
1	1	Body	ASME SA351 CF8M
2	1	Plug	ASME SA351 CF8M
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Delta Ring	TFE
6	1	Metal Diaphragm	ASTM A167, Type 302
7	1	Thrust Collar	ASTM A167, Type 304
8	1	Static Eliminator	AISI 302
9	3	Adjustment Screws	AISI 303/Silver Plated
10	1	Cover	ASME SA351 CF8
11	4	Cover Bolts	ASME SA193 B6
12	1	Wrench Hub	Malleable Iron/Painted
13	1	Wrench Handle	Steel/Painted
14	1	Name Plate	AISI 302
15	1	Hub Bolt	Steel/Zinc Plated

Metal Tag: 443532-N
Part Number: 11909685

APP.	BY	SCN #	DATE	REV.

UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ± .50 IN.
ALL ANGULAR TOLERANCES ± 2½°. DO NOT SCALE DWGS.

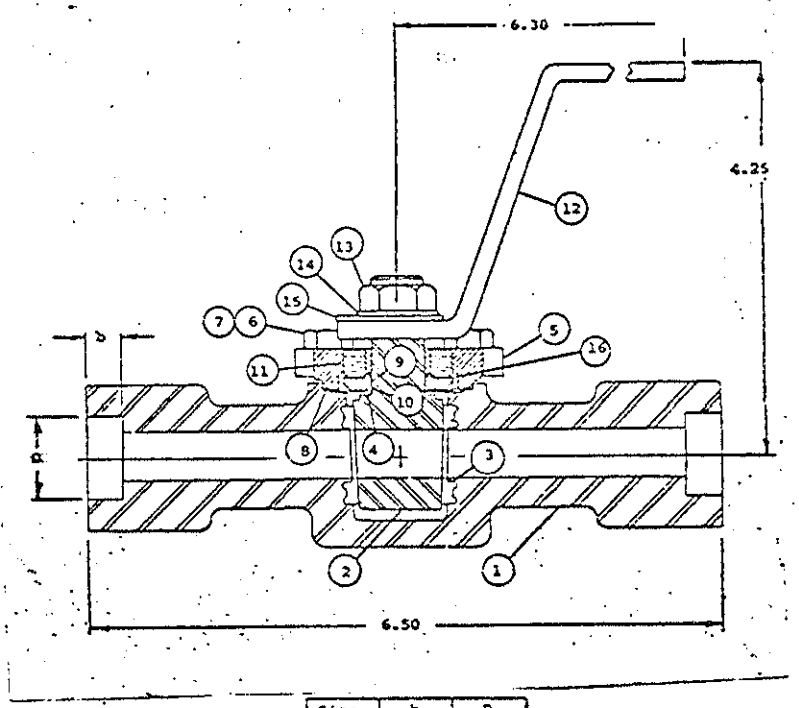
DWN JH | CHKD RJ. | APP. VT | DATE 5/25/78

Fig. 1366 SW Size 1½
Wrench Operator

SPEC. NO.
NP 2476-B

Tufline DIVISION OF XOMOX CORPORATION
4444 COOPER ROAD, CINCINNATI, OHIO 45242

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	b	D
1/2"	.38	.06
3/4"	.50	1.07

VENDOR NO: 3/4" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP.
ELK GROVE, IL 60007

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED REV. 2 JAN 25 1977 QUALITY CONTROL

Rev 1 QUALITY CONTROL

APPROVED Rev. 3 1977 QUALITY CONTROL

COLT FM JUN 14 1973 QA APP

COLT FM JAN 16 1978 QA APP

(1) See 11908456 for Colt/FMED Q.A. Requirements on Vendor.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10979	6-26-78	SEE SHT 2	HRS
4	10629	1-13-77	SEE SHEET 2	LM
3	10556	11-19-77	SEE SHEET 2	PE GDL
2	10128A	11-30-77	See sheet 3	RJN
1	10128	11-10-76	See Shts 3 & 4	R.H. CMH
1	"	11-10-76	Added "See 11908456 ....Note (1)	R.H. LMH

TITLE
VALVE, PLUG
3/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

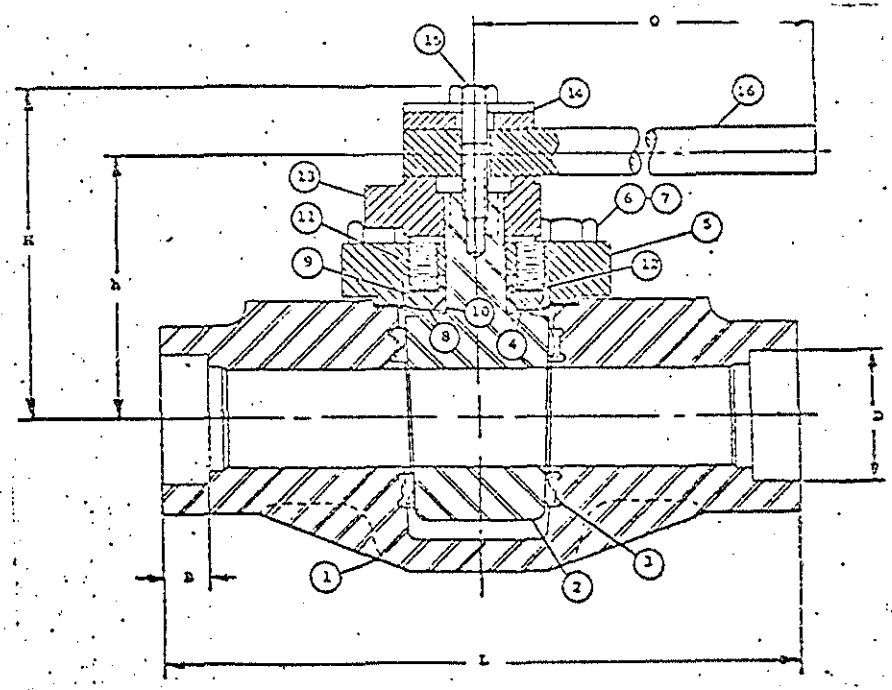
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC 1503	9/3/76	ASSY. OR LO.	
DR. BY P. ESTRADA	8/30/76	SCALE	
CHK'D. BY L.W. Cooper	9/2/76	HEAT TR.	
MAT'L PURCHASE			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 181 | SHEET 1 OF 4

BF3009-2

"1. COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	L	D	B	h	N	O
1"	6.50	1.33	.50	3.81	2.69	7.38
1½"	7.50	1.92	.50	4.56	3.63	11.25
2"	8.50	2.41	.63	5.13	4.00	17.00

VENDOR NO: 1-1/2" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP.
ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR. ①

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED Rev 2 DEC 22 1976 QUALITY CONTROL

APPROVED REV. 1 OCT 22 1976 QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10128	11-10-76	See Shts 3 & 4	R.H. 11/9/76
1	10102	10-29-76	SEE SHEETS 3 & 4	R.H. 11/9/76
1	"	"	①ADDED " SEE 11 908 456..." NOTE	R.H. 11/9/76

TITLE
VALVE, PLUG
1-1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC1503	9/3 /76	ASSY. OR LO.	
DR. BY P. ESTRADA	8/30 /76	SCALE	
CHK'D. BY L.W. Cooper	9/2 /76	HEAT TR.	
MAT'L PURCHASE			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 183 | SHEET 1 OF 4

BF3009-2

TUFLINE

Maintenance and Repair Instructions

For 1"-4" Plug Valves

Tufline valves are designed and built to give long, trouble-free service. Properly applied, adjusted and operated, they should require minimum attention. In most cases, a simple adjustment, as described below, is all that is necessary. In such cases, please first read these instructions carefully. If there are any questions, consult your Tufline valve representative.

Adjustments

Loss of Seal

All Tufline valves are factory adjusted for bubble-tight shutoff at 100 psi air pressure. Normally, no further adjustment is required. If seepage does occur at the plug shank or downstream, tighten the Allen-head screws uniformly ¼ turn at a time. Operate valve and check for leakage before tightening further.

Hard Turning

Torque adjustments should not be made before operating a valve for at least 12 hours under service conditions, since the initial breakaway torque normally reduces with usage and temperature. Otherwise, valve may become too loose. If still too tight, reduce torque by loosening Allen-head screws uniformly ¼ turn at a time. After operating valve, repeat as necessary, but no more than 2 or 3 times, or else leakage may occur. If valve is on cold service and after adjustment it is still too hard to turn, try heating valve with lamp or similar source of mild heat, being careful not to exceed temperature of 400°F.

Normal Running Torques

Size	TFE Ft.-lbs. at Stem	UHMWPE Ft.-lbs. at Stem
1"	15	22
1½"	20	30
2"	30	45
3"	50	75
4"	70	105

Valve Repairs

Field repair of 1"-4" sizes may be satisfactorily performed by carefully carrying out the following instructions, but again should be weighed against the advantage of returning valves to factory for repair where this is possible. Because of the specialized equipment available at the factory, such repairs can be performed in many instances more economically than in the field, even considering transportation charges back and forth. Also, factory repaired valves carry the standard new valve guarantee and, of course, are tested to the same specifications as new valves.

Parts Nomenclature and Identification

Since 1956 several model improvements have been introduced. For proper nomenclature and parts identification, check your latest Tufline catalog carefully before ordering replacements. Although parts are designed for maximum interchangeability between sizes, types and models of valves, in certain instances they are not interchangeable and must be specifically identified. If you have any questions, consult your local Tufline office.

Tools and Equipment for Field Repair

Special

Loading Ring	1"-4" Required
Sizing Plug	1"-4" Required
Plunger	1"-4" Optional*
Spreader	1"-4" Optional**

*Or a piece of round bar stock of the loading ring I.D.
**Or a piece of half round bar stock less than loading ring I.D.

Standard

Arbor Press (U-clamp or jack can be used on small valves)
Large Screw Driver
Sharp Knife
Crowbar
Allen & Standard Wrench Sets
Consult your regional office on availability of special tools.

Sleeve Replacement

Valve Removed from Service

IMPORTANT! If the valve has been used on a hazardous fluid, make certain that it has been thoroughly cleaned before disassembly. Loosen the cover bolts about 3 to 4 turns each, and then turn the plug to release any trapped pressure within the valve.

Removal of Sleeve -- Lip Design Valve

(a) To remove the handle and hub, remove the Nyloc bolt.

(b) Remove the cover bolts and cover.

(c) Remove the plug and top seals by turning the plug with the hub-handle wrench.

(d) Slip the top seals -- static eliminator, thrust collar, metal diaphragm, TFE delta ring and TFE diaphragms -- from the plug. All that remains is the TFE sleeve in the valve body. (There may be a TFE thrust disc lying in the bottom of the valve. Remove. It need not be replaced.)

(e) To remove the sleeve, cut it with a sharp knife halfway between the ports. Care should be taken not to score the valve body.

(f) After the sleeve has been cut from top to bottom, insert a screwdriver behind the sleeve and curl the sleeve away from the body. Remove the sleeve.

(g) Clean the body and the plug. They should not be eroded and the plug's surface should be smooth. If the finish of the plug is questionable, replace.

Replacement of Sleeve

(a) Place the "loading ring" in the counterbore of the body.

(b) The sleeve has been sized and taped. (Do not remove tape until ready to use.) Remove the tape and insert the small end of the sleeve in the loading

ring so that it will enter the body inwardly offset ¼" from perfect alignment to clear the metal "lips" (protruding edge of the body that surrounds each port).

(c) Place the "plunger" on top of the sleeve and press the sleeve into the valve body with an arbor press. Reverse the plunger and use the small side of the plunger to press through the loading ring.

(d) When the sleeve is in the body, use a crowbar through the ports of the valve to turn the sleeve and to position the edges of the sleeve behind the "lips". The sleeve should now be in perfect alignment, and its edges at the ports should be against the valve body and locked behind the "lips".

(e) The bottom of the sleeve should rest on the lower ledge of the body, and the top of the sleeve should be tucked under the upper ledge of the body. (Make sure the sleeve is pressed tightly against the body.) To accomplish this, roll the valve handle or a bar in a stirring motion around the opening of the body.

(f) The sleeve must also be pressed to the valve body around the ports. A "spreading" tool is inserted into the sleeve and pressed to the bottom of the valve. This positions the sleeve so that it will not be torn when sizing with the sizing tool. A spreader is not required for out-of-the-line repairs, although it is helpful. A piece of half round bar stock with radius less than the I.D. of the loading ring can be used by pressing the sleeve against the body through the ports.

(g) Place the "sizing plug" in the sleeve and press the sizing plug to the bottom of the valve body. If you have a silicone lubricant, spray the sizing plug before inserting.

(h) Remove the sizing plug, with the jackscrew if necessary. Insert the standard plug with ports in open position. The top of the plug should drop within approximately ¼" of the counterbore for the top seal. If it does not, resize with the sizing plug.

(i) There may be a small excess of TFE around the ports or around the top and the bottom of the sleeve, which should be trimmed with a sharp knife.

(j) Reassembly: replace the standard plug and follow with the TFE diaphragm, the TFE delta ring, formed metal diaphragm, thrust collar and static eliminator. Note: Always use a *new* TFE diaphragm, delta ring and formed metal diaphragm.

(k) Back out the adjusting screws in the cover so that one thread is showing inside of the cover.

(l) Replace the cover and the cover bolts and tighten securely. The tightening of the cover can be done more easily if the valve is placed under an arbor press and the plug is pressed downward. Do not apply pressure on the cover. It will tend to cut the Teflon diaphragm. Press down only on the plug shank.

(m) Adjust the Allen-head adjusting screws ¼ turn at a time. Rotate the plug with the handle and the hub and continue to tighten as necessary until the normal running torque values, shown under the valve adjustment paragraph, are achieved.

(n) Replace the hub and bar wrench, nameplate and Nyloc bolt.

If satisfactory tightness is not obtained, please contact your Tufline representative.

Replacement of Sleeve (In Line)

Follow the standard instructions as outlined above, except use the following steps in lieu of those steps under "Replacement of Sleeve" above.

(c) A U-clamp or a jack would normally be used in place of an arbor press.

(d) When the sleeve is in the body, a "turning tool" is inserted in the sleeve and turned to position the edges of the sleeves behind the "lips" (protruding edge of the body that surrounds each port). Press down firmly on the "turning tool" and rotate until the sleeve has turned and the sleeve edges at the port have "popped" behind the lips. You should be able to feel this through the tool and should also hear the "pop". The sleeve should now be in perfect alignment, and the edges at the port should be against the body behind the "lips". (This "turning tool" is available from your regional office.)

Replacement of UHMWPE Sleeve

Follow the same general procedures as set forth in these instructions except as follows.

(a) Additional tooling will be required.

Sleeve Shrinking Die	1"-4" Required
Sleeve Shrinking Plunger	1"-4" Required
Sleeve Unloading Plunger	1"-4" Optional*

*Or a piece of round barstock.

(b) The UHMWPE sleeve is supplied untaped. Before the sleeve is put into the valve body, it is necessary to shrink the diameter.

(c) Place the sleeve in the sleeve shrinking die and press to the bottom using the sleeve shrinking plunger and an arbor press.

(d) Remove the sleeve from the shrinking die using the unloading plunger and immediately put sleeve into the valve body as described in section "Replacement of Sleeve".

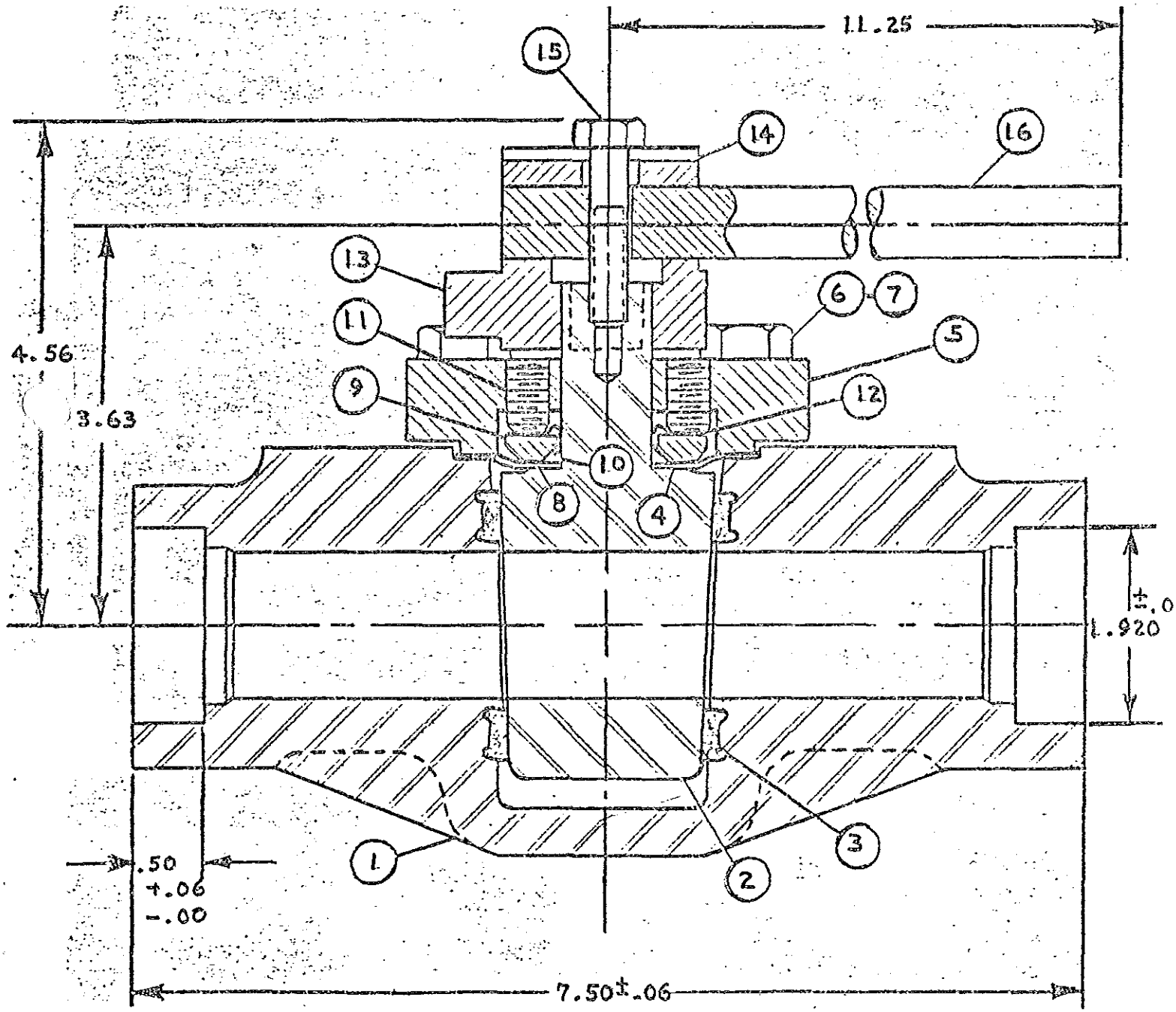
XOMOX CORPORATION
4444 Cooper Road
Cincinnati, Ohio 45242

Bill of Material			
No.	Qty.	Part Name	Material
1	1	Body	ASME SA216, Gr. WCB
2	1	Plug	ASME SA351, Gr. CF8M
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Cover	ASME SA216, Gr. WCB
6	4	Cover Studs	ASME SA193, B7
7	4	Cover Nuts	ASME SA194, 2H
8	1	Metal Diaphragm	ASTM A167, Type 302
9	1	Thrust Collar	ASTM A167, Type 304
10	1	Delta Ring	TFE
11	3	Adjustment Screws	AISI 303/Silver Plated
12	1	Static Eliminator	AISI 302
13	1	Wrench Hub	Malleable Iron/Painted
14	1	Name Plate	Stainless Steel
15	1	Hub Bolt	Steel/Zinc Plated
16	1	Wrench Handle	Steel/Painted

		DWN. KM	CHKD [illegible]	APP [illegible]	DATE 3/7/77
		NAME 1½" 0366SW			SPEC. No. NP1692-B
DATE	REV.	TUFLINE DIVISION OF XOMOX CORPORATION 4444 COOPER ROAD · CINCINNATI, OHIO 45242			

Style 0366SW Size 1½"
Socket Weld Ends,
Nuclear Class 3
O. #B-443532-N
N./11908183
Tufline Order #E-71728

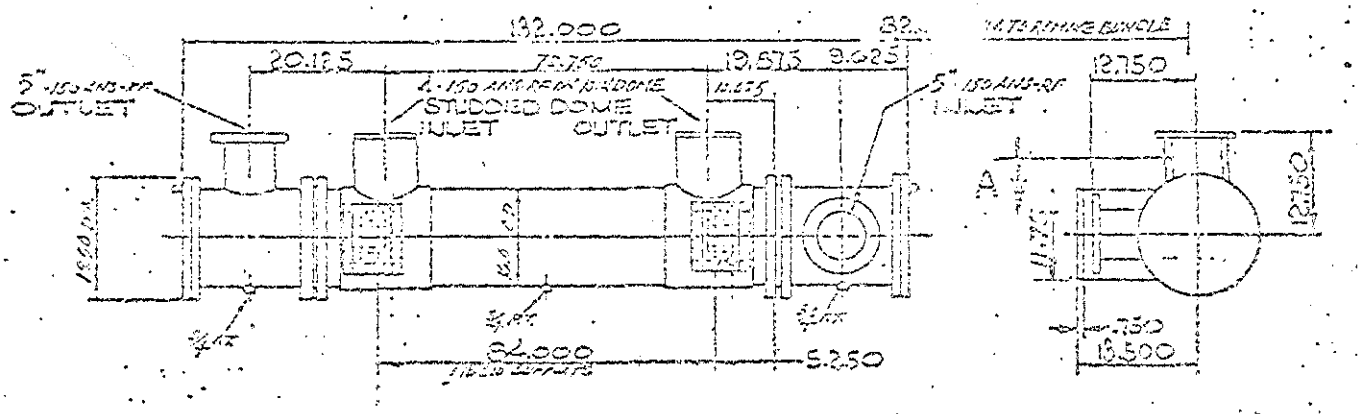
Class 300 Plug Valve

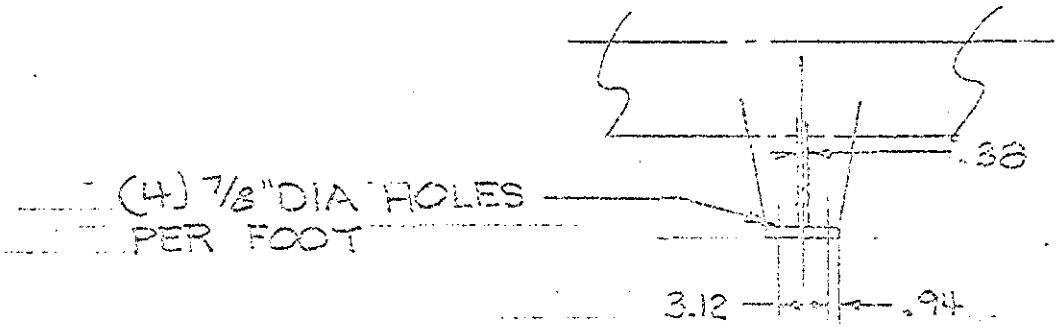


Recommended Spare Parts
Fig. 066 & 0366 Socket Weld
Size 1/2" - 2"
150# & 300#
Fig. 066 & 0366 Butt Weld
Size 3" - 4"
150# & 300#

Part Name	Valve Size					
	1/2&3/4	1	1-1/2	2	3	4
TFE Sleeve	283425	282281	282418	282287	285128	285129
TFE Diaphragm	013441	012279	012416	012284	012388	012300
Formed Metal Diaphragm	029373	029374	029375	029376	029377	029378
TFE Delta Ring	013443	013066	013067	013068	013068	013069
Static Eliminator*	026013	023596	023598	023599	023599	023600
Sizing Die	003937	002587	002588	002589	002590	002470
Loading Ring	Not Req	002574	002575	002473	002576	003128

*Static Elminator is not required with gear or actuator operated valves.





SECTION "A"

APPROVED
Rev. 3
MAR 19 1977
QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10231	3-17-77	Was Sheet 1 of 10	
3	"	"	REDRAWN	

TITLE
HEAT EXCHANGER
LUBE OIL
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .040 0.0- ± .020 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.
DR. BY P. Lanstrum	3/7/77	SCALE
CHK'D. BY	/ /	HEAT TR.
MAT'L		

APPV.		
	CAST.	MAT'L.
	MACH.	ENGR.
	WELD.	R.O.M.

SHEET SIZE A | DWG. NO. 11 903 785 | SHEET 1 OF 1

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP
BUFFALO, N.Y. 14240

OPERATING INSTRUCTIONS AND PARTS LIST

TYPE CPS, CP & CPK EXCHANGERS

INSTALLATION

1. Provide sufficient clearance at the channel or bonnet end of unit to permit removal of tube bundles from shells. On the floating head end, a space of 3 or 4 feet should be provided to permit the removal of the floating head.
2. Provide valves and by-passes in the piping system so that both the shells and tube bundles may be by-passed to permit cutting out the unit for inspection or repairs.
3. Provide convenient means for frequent cleaning of the unit as suggested under "Maintenance."
4. Provide thermometer wells and pressure gage connections in all piping to and from the unit, as near the unit as possible.
5. Provide necessary air vent cocks so that the unit can be purged to prevent or relieve vapor or gas binding of either the tube bundles or the shell.
6. Foundations must be adequate so that exchangers will not settle and cause piping strains. Foundation bolts should be set to allow for setting inaccuracies. In concrete footings, pipe sleeves at least one size larger than bolt diameter slipped over the bolt and cast in place are best for this purpose, as they allow the bolt center to be adjusted after the foundation has set.
7. Loosen foundation bolts at one end of unit to allow free expansion of shells. Oval holes in foundation brackets are provided for this purpose.
8. Set exchangers level and square so that pipe connections may be made without forcing.
9. Inspect all openings in exchanger for foreign material. Remove all wooden plugs and shipping pads just before installing. Do not expose units to the elements with pads or other covers removed from nozzles or other openings since rain water may enter the unit and cause severe damage due to freezing.
10. Be sure entire system is clean before starting operation to prevent plugging of tubes with sand or refuse. The use of strainers or settling tanks in pipe lines leading to the unit is recommended.
11. Drain connections should not be piped to a common closed manifold.
12. To guard against pulsation of fluids caused by reciprocating pumps, compressors or other equipment a surge drum should be installed.

OPERATION

A heat exchanger is a pressure vessel designed for operation at certain specific limits of pressure and temperature, and the system must be safeguarded with safety valves and controls so that these design conditions are not exceeded and that all operating personnel are alerted.

1. When placing a unit in operation, open the vent connections and start to circulate the cold medium only. Be sure that the passages in the exchanger are entirely filled with the cold fluid before closing the vents. The hot medium should then be introduced gradually until all passages are filled with liquid. Then, close vents and slowly bring the unit up to temperature.
2. Start operation gradually. Do not admit hot fluid to the unit suddenly when it is empty or cold. Do not shock unit with cold fluid when it is hot.
3. In shutting down, flow of hot medium should be shut off first. If it is necessary to stop circulation of cooling medium, the circulation of hot medium should also be stopped by by-passing or otherwise.
4. Do not operate equipment under conditions in excess of those specified on nameplate.
5. In all installations, there should be no pulsation of fluids since this causes vibration and strain with resulting leaks.
6. All gasketed joints should be rechecked for tightness after the unit has been heated to prevent leaks and blowing out gaskets.
7. The packed end joints on Lube Oil Coolers may require adjustment from time to time to eliminate slight leakage. This joint contains Neoprene packing rings which require only a small amount of bolting pressure to seal tight.

Many heat exchangers handle fluids which are irritating or dangerous to the human system and could cause problems if bolted and packed joints are not maintained in a leak tight condition both at operating pressures and temperatures, and also at no flow, ambient conditions.

If fluids are not irritating or dangerous a leak will at least cause a slippery situation on the floor below.

Since one fluid in the heat exchanger is at higher temperatures, any leaks might cause burns.

If leakage should appear at the packed end joint after the cooler is placed in operation, the bolting should be pulled up only enough to stop it. This can be accomplished by taking a one-half turn on each successive bolt starting at one point and continuing around the cooler until all leakage has been eliminated. Do not tighten this joint any more than is required to stop the initial leakage.

When the packing has been repeatedly tightened to the point where there is almost a metal-to-metal contact between the bonnet (or channel) and shell flanges, the two packing rings should be replaced. To accomplish this, proceed as follows:

(A) Remove the bonnet (or channel), lantern ring, and all packing rings from the cooler.
(B) Clean the packing ring recess in both the bonnet (or channel) and shell flanges and the latern ring, if necessary.
(C) Place one of the new packing rings over the floating tube sheet and slide it, into the recess in the shell flange. Be sure the packing ring is not twisted and fits squarely into this recess.
(D) Place the lantern ring over the floating tube sheet and slide it against the first packing ring.
(E) Place the second new packing ring over the floating tube sheet and slide it against the lantern ring, making sure the packing ring is not twisted.
(F) With the studbolts pulled up only finger tight, the bonnet (or channel) should be positioned so that the second packing ring is secure in the recess of the bonnet (or channel) flange.
(G) Each bolt should now be pulled up only one or two turns.
(H) When the cooler is either hydrostatically tested or placed in operation, any final adjustment should be made as previously described.

8. Be sure that all parts of the system are clean and in proper operating condition. An exchanger cannot perform properly unless all connected equipment is functioning properly, yet, the exchanger is frequently blamed for non-performance when the actual trouble is elsewhere in the system.

Observe the following precautions to obtain maximum performance:

(A) Exchanger must be full of fluid in both shell and tube sides.
(B) Provide periodic venting if air tends to accumulate in system.
(C) Maintain rated flow of both mediums.
(D) Avoid excessive flow of cooling water in exchangers used as coolers. It is a frequent cause of tube failure through erosion, and may decrease cooling efficiency, especially with heavy oils.
(E) Inspect exchanger periodically and clean thoroughly when necessary, especially inside of the tubes.

MAINTENANCE

1. Provide convenient means for frequent cleaning of heat exchangers as suggested below:

(A) Circulating hot wash oil or light distillate through tubes or shell at good velocity will effectually remove sludge or other similar soft deposits.
(B) Soft salt deposits may be washed out by circulating hot fresh water.
(C) Some cleaning compounds on the market, such as "Oakite" may be used to advantage for removing sludge or coke, provided hot wash oil or water, as described above, does not give satisfactory results.
(D) If none of the above described methods are effective for the removal of hard scale or coke a mechanical means may be used.

When the heat exchanger is cleaned, it is important that full characteristics of the fouling material and the cleaning agent be known and care exercised in handling them according to instructions.

2. Frequently and at regular intervals, observe interior and exterior condition of all tubes and keep them clean. Neglect in keeping all tubes clean may result in complete stoppage of flow through some tubes, with consequent overheating of these tubes as compared to surrounding tubes, resulting in severe expansion strains and leaking tube joints.

When shutting down for repairs it is imperative that all fluids be drained from the heat exchanger and that no bolting be loosened until the pressures are down to atmospheric and the temperatures of the parts are down to ambient.

3. Do not attempt to clean tubes by blowing steam through individual tubes. This overheats the tube and results in the same severe expansion strains and leaks as in plugged tubes.
4. Do not blow out heat exchangers with air when fluids normally handled are of an inflammable nature.
5. Do not open heads until all pressure is off equipment and the unit drained.
6. Do not handle tube bundles with hooks or other tools which might damage tubes. Bundles should be moved about on cradles or skids.
7. Do not tighten bolts until gasket is positioned properly. This precaution will eliminate one cause for taking down units because of leaks.

Since many of the removeable components or the heat exchanger, particularly in the larger sizes are too heavy for men to handle care must be used to take this weight with proper rigging to avoid injury.

When a heat exchanger is dismantled for any cause, it is recommended that new gaskets be used in reassembly. This will tend to lessen the possibility of future leaks. Because composition gaskets become brittle and dry out, they do not provide an effective seal when reused. Metal or metal jacketed gaskets when compressed initially tend to match their gasket contact surfaces. In so doing, they are work hardened to the point that their reuse provides an imperfect seal and possible damage to the gasket contact surfaces of the heat exchanger.

8. To tighten a loose tube joint, use a suitable roller type tube expander. Do not roll tubes that are not leaking as it needlessly thins the tube wall.
9. Exchangers subject to fouling or scaling should be cleaned periodically. A light sludge or scale coating on the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicates cleaning is necessary, if the unit has been checked for air or vapor binding and this has been found not to be the cause. Since the difficulty of cleaning increases rapidly as the scale thickens or deposit increases, the intervals between cleanings should not be excessive.
10. To clean or inspect inside of tubes, remove channel covers (or bonnets). Do not remove channels.

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP
BUFFALO, N.Y. 14240

TYPE CPS, CP & CPK EXCHANGERS

11. To locate leaking joints between tube and tube sheet or a split tube, proceed as follows:

Channel Type
(a) Remove channel covers.
(b) Apply hydrostatic pressure in shell.

Bonnet Type
(a) Remove bonnets.
(b) Bolt test rings in place with gaskets and packing.
(c) Apply hydrostatic pressure in shell.

Use only cold liquid for hydrostatic test. The point where the water escapes indicates the defective tube or joint.

12. When removing tube bundles from exchangers for inspection or cleaning, care should be exercised to avoid damage by improper handling. Although tube bundles are often of great weight, the tubes are small and of relatively thin metal. The dead weight of the bundle, therefore, should never be supported on individual tubes, but should rest on those parts that are designed to carry it, i.e., the tube sheets, support plates or wood blocks, cut to fit the periphery of the bundle. In withdrawing tube bundles, it is recommended that rods or steel cables be passed through two or more of the tubes and the load taken on the floating tube sheet. Rods should be threaded and provided with nuts and should pass through a bearing plate at either end of the bundle. A soft wood filler board should be inserted between bearing plates and tube sheets, in order to prevent damage to tube ends. A forged steel eye bolt which may be screwed into either plate is used for pulling and lifting.

When steel cables are used for lifting, the cable is threaded through one tube and returned through another. Loops are formed in the ends of the cable by use of thimbles and wire rope clips. A hard wood spreader block is inserted between the cable and the floating tube sheet to prevent crushing of tube end.

If the tube bundle has been in service for a considerable length of time without being removed it may be necessary to use a hydraulic jack on the floating tube sheet to get it started. A good sized steel bearing plate should be inserted between jack and tube sheet and the tube ends protected by means of a filler board.

Tube bundles may be raised horizontally by means of slings formed by bending light plates into a U-Form and attaching lifting lugs to the ends of the sheets. Baffles can be easily bent and damaged by dragging a bundle over a rough surface. Diameter of the baffles is practically the same as the inside of the shell and a close fit must be maintained for the apparatus to function properly. Any damage to baffles should, therefore, be carefully avoided.

In cleaning a tube bundle, tubes should not be hammered on with any metallic tool. In case it is necessary to use scrapers, care should be exercised to see that the scraper is not sharp enough to cut the metal of the tubes.

The following are safe loads for rods and eye bolts:

RODS

Size Tubes	Size Rods	Safe Load per Rod
5/8"	3/8"	1000 lbs.
3/4"	1/2"	2000 lbs.
1"	5/8"	3000 lbs.

EYE BOLTS

Size	Safe Load
3/4"	4000 lbs.
1"	6000 lbs.
1 1/4"	10000 lbs.
1 1/2"	15000 lbs.

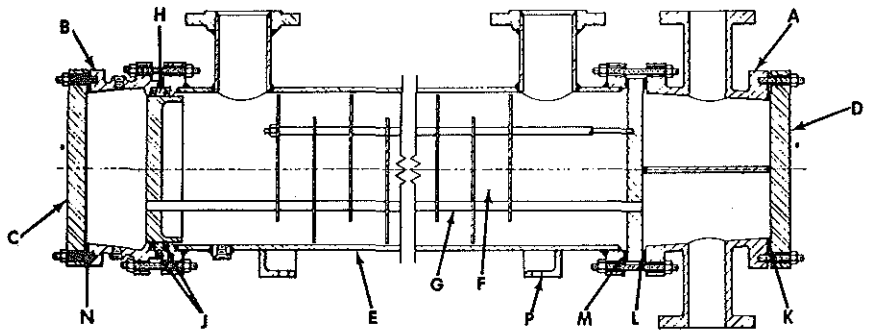
PARTS LIST

Any parts listed below and indicated alphabetically on the typical cross sectional drawings can be furnished.

When ordering parts, use part name indicated in parts list. Give cooler size and serial number as stamped on name plate of cooler. Special care in following above instructions will facilitate quick shipment.

If parts are required in materials of construction differing from those originally furnished, specify the desired changes and reason for changing.

CHANNEL TYPE



A. CHANNEL, STATIONARY END
B. CHANNEL, PACKED END.
C. CHANNEL COVER, PACKED END
D. CHANNEL COVER, STATIONARY END
E. SHELL ASSEMBLY
F. BUNDLE ASSEMBLY, Consisting of:
   1. Stationary Tube Sheet
   2. Floating Tube Sheet
   3. Tubes
   4. Baffle Plates
G. TUBE
H. LANTERN RING
J. PACKING RINGS
K. GASKET, STATIONARY CHANNEL COVER
L. GASKET, TUBE SHEET TO CHANNEL
M. GASKET, TUBE SHEET TO SHELL
N. GASKET, PACKED CHANNEL COVER
P. CRADLE ASSEMBLY

WARRANTY

WARRANTY OF SELLER'S PRODUCTS—Except where a different express written warranty has been issued with respect to a particular product, no warranty of any kind, express or implied, is extended by the Seller to any person or persons other than its direct Buyers. To direct Buyers, the Seller warrants only that it will furnish by freight a replacment for, or at its option repair any product of its manufacture or part or portion thereof, proved to its satisfaction to be defective in material or workmanship under normal use and service within one year from the date the equipment is first placed in use, or two years from the date of shipment, whichever shall be less.

The Seller shall have no responsibility for the performance of any product sold by it under conditions varying materially from those under which such product is usually tested under existing industry standards, nor for any damage to the product from abrasion, erosion, corrosion, deterioration or the like due to abnormal temperatures or the influence of foreign matter or energy, nor for the design or operation of any system of which any such product may be made a part or for the suitability of any such product for any particular application.

The Seller shall not be liable for any cost or expense, including, without limitation, labor expense, in connection with the removal or replacement of alleged defective equipment or any part or portion thereof, nor for incidental or consequential damages of any kind, nor under any circumstances for any damage beyond the price of the goods sold. Any freight allowance in connection with a replacement will be on the same terms as were applicable to the original sale, except that a replacement for a product or part or portion thereof which is proved to the Seller's satisfaction to be defective in material or workmanship as provided herein above, will in any event be furnished with freight (but not local cartage) allowed, inside the continental United States (excluding Alaska and Hawaii), to the first destination.

OTHER WARRANTIES—The foregoing warranty is in lieu of all other warranties of any kind, express or implied, and of all other obligations or liabilities, on the part of the Seller. The Seller neither assumes, nor does it authorize any other person to assume on its behalf, any other liability in connection with the sale of its products.

GOODS OF OTHER MANUFACTURERS—Goods of other manufacturers sold by the Seller are nor warranted except by express warranties which may be issued in writing from time to time with respect to a particular product or a particular sale; but the Seller will endeavor to secure for its direct Buyers the benefits of warranties extended by the manufacturers of such goods sold but not manufactured by the Seller.

RP _____

RECOMMENDED SPARE PARTS LIST

EXCHANGER P/N 5-047-17-096-005
(4-750-17-096-001)
S/N 9-20008-02

COLT 11908187
INTERCOOLER WATER COOLER

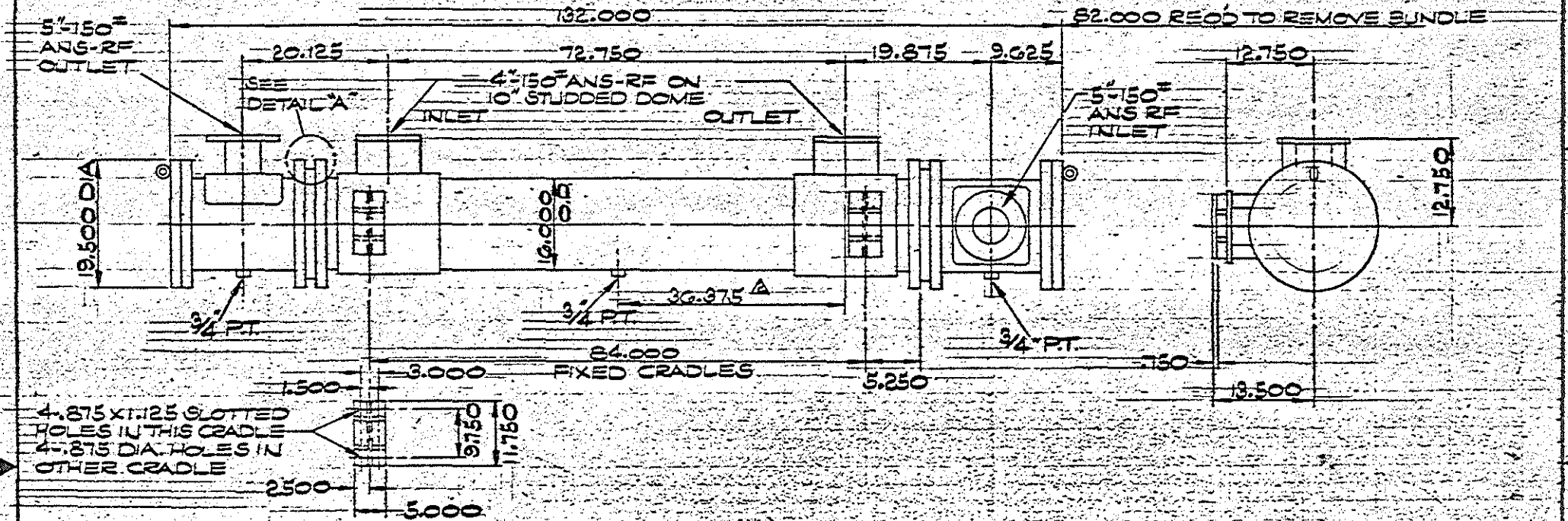
NUMBER REQUIRED/ EXCHANGER	DESCRIPTION	PART NUMBER
2	Gaskets	3-298-8-00-901-17
2	Gaskets	3-299-8-00-901-17
2	Packing Rings	3-359-8-00-905-17

P/N 5-047-17-096-005
(4-750-15-096-004)
S/N 9-20008-03
Colt 11908186
Jacket Water Cooler

2	Gaskets	3-298-8-00-901-15
2	Gaskets	3-299-8-00-901-15
2	Packing Rings	3-359-8-00-905-15

P/N 5-046-15-096-021
S/N 9-20008-04
Colt 11908185
Lube Oil Cooler

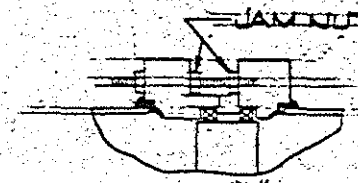
4	Gaskets	3-299-8-00-901-15
2	Packing Rings	3-359-8-00-905-15



THIS UNIT CONFORMS TO ASME SECT III, CLASS 3
1974 SUMMER ADDENDUM 1976

CODE:

DESCRIPTION	MATERIAL	A.S.M.E.	CORR
SHELL PIPE	SMLS ST.	SA106-B	.062
SHELL FLANGE	FO. ST.	SA266-C	
DOME PIPE	SMLS ST.	SA106-B	.062
DOME FLANGE	FO. ST.	SA266-C	.062
COUPLING	FGD ST.	SA105	
CRADLE	FO. ST.	SA266-C	
REINF PAD	FO. ST.	SA266-C	
CHANNEL PIPE	SMLS ST.	SA106-B	.062
CHANNEL FLANGE	FO. ST.	SA266-C	
NOZZLE PIPE	SMLS ST.	SA106-B	.062
NOZZLE FLANGE	FO. ST.	SA266-C	
COUPLING	FGD ST.	SA105	
CHANNEL COVER	FO. ST.	SA266-C	.062
REINF PAD	FO. ST.	SA266-C	
BAFFLE	STEEL		
TUBESHEET	MUNTZ	SA178 A-C	
TUBE	90/10 CU-NI	SB359 A-CTW	
TIEROD			
TIEROD NUT			
SPACERS			
BOLT	ALLOY ST.	SA193-B7	
NUT	ST.	SA194-2H	
GASKET	ASB		
PACKING	NEOPRENE		
PIPE PLUGS	FGD ST.	SA105	



NOTE
1. STUDS AND JAM NUTS ASSEMBLED TO SHELL WITH JAM NUTS IN DOTTED POSITION, AGAINST SHELL PCKD. FLG. AS SHOWN. AFTER UNIT IS SUCCESSFULLY HYDRO-TESTED, TIGHTEN JAM NUTS TO POSITION SHOWN

	DESIGN	TEST	TEMP. F
SHELLSIDE	150#	225#	300°F
TUBESIDE	150#	225#	200°F

ITEM				DESCRIPTION	MATERIAL	SIZE	PART NUMBER	REV
17								
16								
15								
14		16		HEX NUT DOME	SA194-2H	.625-11TPI	2-122-5-00-902-07	A
13		16		STUD DOME	SA193-B7	.625-11TPI-TP.-3.00 LG	2-012-5-10-901-12	A
12		112		HEX NUT	SA194-2H	.625-11TPI	2-122-5-00-902-07	A
11		16		STUDBOLT STA	SA193-B7	.625-11TPI-TP.-5.50 LG	2-012-5-10-901-22	A
10		32		STUDBOLT COVS	SA193-B7	.625-11TPI-TP.-4.50 LG	2-012-5-10-901-16	A
9		3		PIPE PLUG	SA105	3/4" PT. SIZE	2-135-5-96-901-05	A
8		4		GASKET	ASBESTOS		8-299-8-00-901-15	A
7		2		PACKING RING	NEOPRENE		8-359-8-00-905-15	A
6		1		LANTERN RING	CAST IRON		8-338-7-00-902-15	A
5		2		COVER ASSY	STEEL		4-300-15-115-008	A
4		1		CHANNEL ASSY	STEEL		4-302-15-215-017	B
3		1		CHANNEL ASSY	STEEL		4-300-15-215-035	B
2		1		BUNDLE ASSY			4-110-15-096-003	B
1		1		SHELL ASSY	STEEL		4-605-15-096-012	B

1 REVISED S.S. HEAD & FLG. TO FORGED TYPE, CAGED SEIZER PROTECTED WELDS. PCC
2 ADDED SEIZER LOCATION PEC 9/77

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP BUFFALO, N.Y.

TITLE: E-5096 CRK EXCHANGER

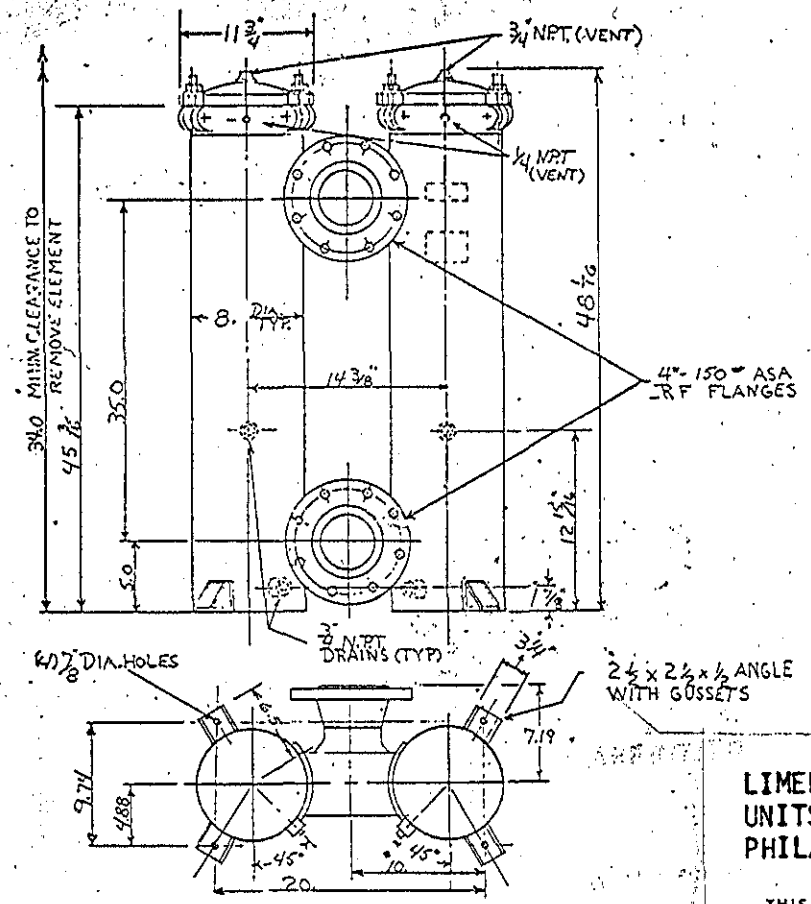
SIZE C | 5-046-15-096-021 | REV 2

FACTORY ORDER NO. 9-20008-04

11/2008/85A

PROPRIETARY
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Colt Industries — Fairbanks Morse Engine Division



VENDOR PART NO: 1554-4L2B-SPN-200

VENDOR: WM. W. NUGENT CO.
SKOKIE, ILL

APPROVED
Rev. 4
MAY 3 1977
QUALITY CONTROL
APPROVED
Rev. 3
MAR 10 1977
QUALITY CONTROL
APPROVED
REV. 2
DEC 23 1976

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	SEE SHEET 2	H.R.S.
6	11348	3-21 79	ADDED SHEET 7	
5	11014	8-7-78	ADD REV. STATE TO SUB TIER SPECS. (2)	WLS
4	10312	5-6 77	SEE SHS. 2 & 6	
3	10236	3-16 77	See Sheets 6 & Bas Sheet 1 of 5	H.R.S.
2	10156	12-24 76	REDRAWN	

TITLE
STRAINER,
LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. HUMKE	12/22/76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 188 | SHEET 1 OF 7

BF3009-2

QA CONT APP FM APR 3 1980
QA APP FM MAR 1 1979
QA APP FM JUL 31 1978

DESCRIPTION: NUGENT 1554-4L2B-SPN-200 STRAINER IN THE FOLLOWING FEATURES:

A. GENERAL:

1. WITH 30-300-203 STRAINER CYLINDERS CORRESPONDING TO A 200 MESH WITH A 74 MICRON RETENTION.
2. TO HANDLE 500 GPM OF SAE 40 OIL @ NORMAL OPERATION TEMPERATURE 180°F.
3. DESIGN PRESSURE 150 PSIG. (1)
4. INLET AND OUTLET CONNECTION TO BE 4" 150# A.S.A. R.F. FLANGES.
5. SPECIFIC PARAGRAPH COVERING THIS COMPONENT IS PAR. 4.3.4.c. PAGE 18 OF BECHTEL POWER CORP. SPEC. NO. 8031-M-71, REV. 3 DATED 5/13/76, WHICH STATES THAT THE EFFECTIVE AREA OF THE SCREENING SHALL BE SUFFICIENTLY LARGE TO GIVE AN INITIAL PRESSURE DROP OF NOT MORE THAN ONE POUND ACROSS THE STRAINER ASSEMBLY. VENDOR IS TO FURNISH DOCUMENT CONFIRMING COMPLIANCE WITH THE ABOVE REQUIREMENTS.

B. SPECIAL REQUIREMENTS:

1. STRAINER TO BE CONSTRUCTED AND CODE STAMPED IN ACCORDANCE WITH ASME SECTION VIII 1974 EDITION.
2. COMMONWEALTH OF PENNSYLVANIA REQUIREMENTS FOR BOILER AND UNFIRED PRESSURE VESSEL AS DESCRIBED IN FORM 8031 PCR, REV. 2 DATED MARCH 7, 1975 APPLY TO THIS COMPONENT.
3. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBITED.
4. TO BE IN COMPLIANCE WITH COLT FMED QUALITY REQUIREMENTS FOR ASME COMPONENTS ~~#11 908 456.~~ 11871599 (1)

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Colt Industries — Fairbanks Morse Engine Division

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APPROVED Rev. 3 MAR 10 1977 QUALITY CONTROL

REV. 2 DEC 3 1976 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	(1) WAS SAE 30 LUBE OIL	R.S.
6	11348	3-21 79	SEE SHEET 1	
5	11014	8-7-78	See Sht. 1	NLS
4	10312	5-6 77	SEE SH. 1	RHW
4	"	5-6 77	REV. QA APME DWG. NO. (1)	RHW
3	10236	3-16 77	See sht. 6, Was Sheet 2 of 5	
2	10156	12-24 76	REDRAWN	R.R.

TITLE
STRAINER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. HUMKE	12/22 76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR.
	WELD.		

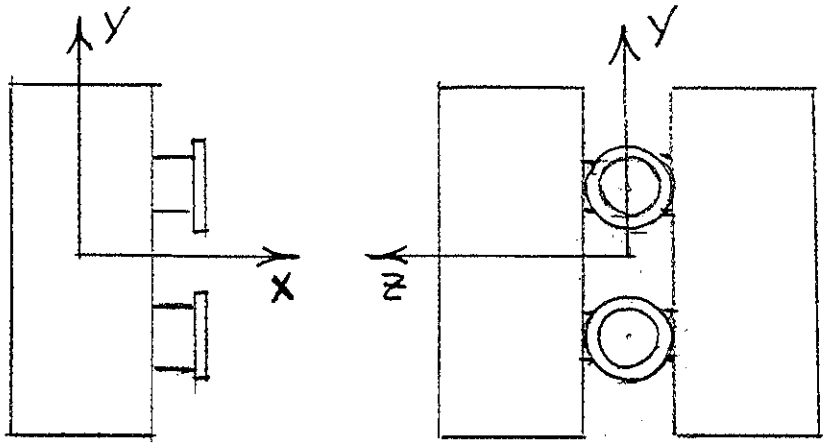
SHEET SIZE A | DWG. NO. 11 908 188 | SHEET 2 OF 7

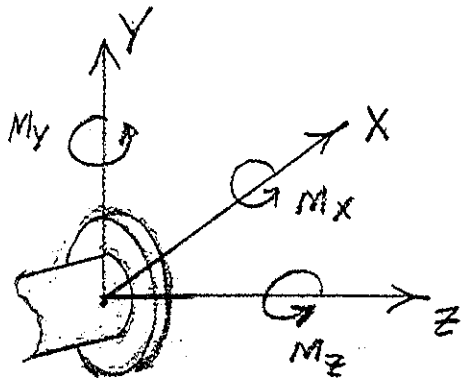
BF3009-2

Rev. 7 APR 3 1980 QA CM APP FM
Rev. 6 MAR 1 1979 QA APP FM
Rev. 5 JUL 31 1978 QA APP

B. - (CONTD)

5. NOZZLE FORCES AND MOMENTS:





a. FORCES ARE (+) WHEN ACTING IN DIRECTION OF ARROWS IN SKETCH. MOMENTS ARE (+) WHEN ACTING IN A CLOCKWISE DIRECTION WHEN LOOKING AT AXIS FROM ORGIN TOWARD ARROW. F_d AND M_d CAN ACT IN ANY DIRECTION DUE TO SEISMIC NATURE. SELECT SENSE AND DIRECTION WHICH, WHEN COMBINED VECTORILY WITH THE OTHER FORCES AND MOMENTS, WILL RESULT IN THE MOST SEVERE STRAIN OF THE CONNECTION AND ITS ATTACHMENT TO THE VESSEL.

APPROVED Rev. 4 MAY 3 1977 QUALITY CONTROL

APPROVED Rev. 3 MAR 10 1977 QUALITY CONTROL

APPROVED Rev. 2 DEC 23 1976 QUALITY CONTROL

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Colt Industries — Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	SEE SHEET 2	M.R.S.
6	11348	3-21 79	SEE SHEET 1	
5	11014	8-7- 78	See Sht. 1	ULS MSD
4	10312	5-6 77	SEE SH. 1	RHK
3	10236	3-16 77	See Shts. 6 Was Sheet 3 of 5	RHK M.R.S.
2	10156	12-24 76	REDRAWN	R.H. K.N.

TITLE
STRAINER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. HUMKE	12/22 76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			

APPV.		
	CAST.	MAT'L
	MACH.	ENGR.
	WELD.	

SHEET SIZE A | DWG. NO. 11 908 188 | SHEET 3 OF 7

QA APP MAR 1 1979 FM
QA APP APR 3 1980 FM
QA APP JUL 31 1978 FM

BF3009-2

B.5. - (CONTD)

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Colt Industries Fairbanks Morse Engine Division

b.

CONNECTION		1	2
F_a (LB)	X	1273	1273
	Y	0	0
	Z	0	0
F_b (LB)	X	0	0
	Y	1273	0
	Z	-1022	-1590
M_b (FT-LB)	X	0	0
	Y	+1065	928
	Z	+1269	0
F_c(LB)		N/A	N/A
M_d(FT-LB)		N/A	N/A
F_d (LB)	*	403	403
M_d(FT-LB)	*	289	289

F_a IS AXIAL FORCE DUE TO 100 PSI INTERNAL PRESSURE IN CONNECTION. THIS APPEARS AT THE CONNECTION BUT IS BALANCED INTERNALLY AND DOES NOT APPEAR AT SUPPORTS.

F_b IS FORCE FROM THERMAL EXPANSION AND/OR THRUST OF FLEXIBLE CONNECTORS IN ATTACHED PIPING.

M_b IS MOMENT FROM F_b.

F_d IS FORCE POSSIBLE FROM SEISMIC ACTION ON ATTACHED PIPING.

M_d IS MOMENT FROM F_d.

APPROVED Rev. 4 MAY 3 1977 QUALITY CONTROL

APPROVED Rev. 3 MAR 10 1977

APPROVED Rev. 2 DEC 21 1976

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	SEE SHEET 2	H.R.S.
6	11348	3-21 79	SEE SHEET 1	
5	11014	8-7-78	See Sht. 1	NLS
4	10312	5-6 77	SEE SH. 1	RHH
3	10236	3-16 77	See Sht. -6 Was sheet 4 of 5	RHH H.R.S.
2	10156	12-24 76	REDRAWN	R.H. R.N.

TITLE
STRAINER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. HUMKE	12/22 76	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 188 | SHEET 4 OF 7

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Rev. 7 APR 3 1980 QA
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B. - (CONTD)

6. SUPPORTS LOADS:

THE FOLLOWING LOADS ARE TO BE CONSIDERED WHEN DETERMINING THE REACTIONS AT THE COMPONENT SUPPORTS:

a. DEAD WEIGHT AND SEISMIC LOADS:

$F_{ey} = (-1 \pm 1.1)\ W_T$
$F_{ex} = \pm 3\ W_T$
$F_{ez} = \pm 3\ W_T$

WHERE W_T = WEIGHT OF COMPONENT + WEIGHT OF CONTENTS.

THE ABOVE LOADS ARE TO BE CONSIDERED AS ACTING AT THE CG OF THE COMPONENT. THERE ARE NO MOMENTS AT THE CG RESULTING FROM THE DEAD WEIGHT OR THE SEISMIC LOAD OF THE COMPONENT AND ITS CONTENTS.

b. F_{by}, [redacted], F_{bz}, F_d, F_{ey}, F_{ex}, & F_{ez} EACH ACTING AT THEIR RESPECTIVE CONNECTION OR CG, VECTORILY ADDED. THE DIRECTION AND SENSE OF F_d MUST BE CHOSEN TO RESULT IN THE MOST SEVERE REACTION AT THE COMPONENT SUPPORTS.

c. M_{by}, [redacted], M_{bz} & M_d ACTING AT THE CG ARE TO BE ADDED VECTORILY. THE SENSE OF M_d IS TO BE CHOSEN TO RESULT IN THE MOST SEVERE REACTION AT THE COMPONENT SUPPORTS.

d. THE TOTAL REACTION AT THE SUPPORTS IS THE SUM OF THE DEAD WEIGHT AND SEISMIC LOADS (a) PLUS THE FORCES AND MOMENTS (b) & (c) FOR EACH OF THE CONNECTIONS.

APPROVED Rev. 4 MAY 3 1977 QUALITY CONTROL

APPROVED Rev. 3 MAR 10 1977 QUALITY CONTROL

REV. 2 QUALITY CONTROL

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	SEE SHEET 2	R.R.S.
6	H348	3-21 79	SEE SHEET 1	
5	11014	8-7 78	See Sht. 1	NLS
4	10312	5-6 77	SEE SH. 1	RHH
3	10236	3-16 77	See Sht 6 Was sheet 5 of 5	RHH
2	10156	12-24 76	REDRAWN	R.H. R.H.

TITLE
STRAINER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BR. HUMKE	12/22 76	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 188 | SHEET 5 OF 7

BF3009-2

QA CWT Rev. 7 APR 3 1980 FM
QA MAR 1 1979 APP
QA JUL 31 1978 Rev. 5 FM

PROPRIETARY
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Colt Industries Fairbanks Morse Engine Division

B. - (CONT'D)

7. PAINTING AND PRIMING REQUIREMENTS:

   a. SURFACES REQUIRING PRIME AND PAINT
   TO BE SUPPLIED WITH VENDOR'S STANDARD SHOP PRIME ONLY. ALL INTERNAL AND EXTERNAL SURFACES SHALL BE THOROUGHLY AND COMPLETELY CLEANED OF ALL MILL SCALE, CUTTINGS, OIL, WELDING SPATTER, AND OTHER FOREIGN MATTER. THE SURFACES SHALL THEN FURTHER BE CLEANED TOA MINIMUM REQUIREMENT AS SET DOWN BY SSPC-3 (POWER TOOL CLEANING) PRIOR TO PRIMING AND SHIPMENT. THE DRY FILM THICKNESS SHALL BE AT LEAST 1.5 MILS, BUT NO MORE THAN 2.0 MILS. GOOD PAINT PRACTICE, AS STATED IN SSPC-PA-1 SHALL BE OBSERVED.

   b. SURFACES NOT REQUIRING PRIME
   MACHINED SURFACES SHALL BE PROTECTED WITH AT LEAST 4 MILS DRY FILM THICKNESS OF MIL-C-16173 GRADE 5 OR SIMILAR PRODUCT APPROVED BY BUYER.

8. SPECIAL TOOLS SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.13.

9. SPARE PARTS LIST SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.14.

10. NAMEPLATES SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 42 & 43, REV. 2, PARA. 6.2.

C. F.M. DUTIES:

1. SUPPLY COPY OF BECHTEL SPECIFICATION 8031-M-71, PG. 13, REV. 3, PARA. 4.1.j, PG. 36, REV. 3, PARAS. 4.13 & 4.14 AND PGS. 42 & 43, REV. 2, PARA. 6.2, COLT FMED DWG. NO. ~~11 908 456~~ AND 11 87 599 Rev. 1 COMM. OF PENNA. FORM 8031-PCR, REV. 2 WITH PURCH. ORDER.

APPROVED Rev. 4 MAY 3 1977

APPROVED Rev. 3 MAR 10 1977

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	SEE SHEET 2	MRS.
6	11348	3-21 79	SEE SHEET 1	
5	11014	8-7-78	See Sht. 1	ULS
4	10312	5-6 77	SEE SH. 1	
4	"	5-6 77	REV. QA. ASME DWG. NO. (1)	RHN EB
3	10236	3-16 77	Added Sht. 6	MRS

TITLE
STRAINER, CONTROL
LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

QUALITY CONTROL

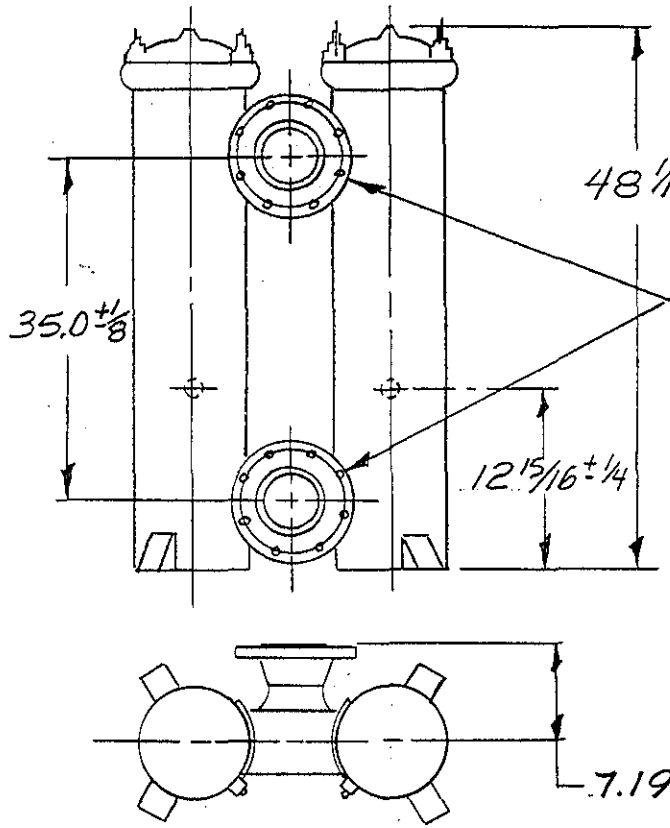
Colt Industries Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY R. NORMAN		3/2 77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR. R.D.M.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 188 | SHEET 6 OF 7

BF3009-2

11908188



4" 150# ANSI R.F. FLANGE, (8) 3/4 DIA. HOLES ON A 7 1/2" ± 1/8 B.C.

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Colt Industries — Fairbanks Morse Engine Division

DIM'S. TO BE UTILIZED BY COLT ONLY.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
7	11814	4-10 80	SEE SHEET 2	M.R.S.
6	11348	3-21 79	SHEET 7 ADDED	LD

TITLE
STRAINER, LUBE OIL

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY Lila Dyer	2/21 79	SCALE ~	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. JR	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11908188 | SHEET 7 OF 7

BF3009-2

COLT MAR 1 6 1979 QA APP
COLT APR 3 1980 QA APP FM

INSTRUCTIONS FOR INSTALLING AND OPERATING NUGENT STRAINERS AND FILTERS

GENERAL DATA

Filters may be furnished with or without internal bypass relief valves. If so equipped, they are preset at the factory to open at the maximum recommended element differential pressure. The valve(s) IS(ARE) NOT field adjustable.

Strainers cannot be equipped with internal bypass relief valves.

For lubricating oil filters not equipped with internal bypass relief valves, Nugent recommends the installation of a Model 1591 Dumping Valve to protect the element(s) from abnormal differential pressure.

If filter or strainer is not equipped with a gauge for determining differential pressure, it is recommended that gauges be installed in the inlet and outlet piping.

INSTALLATION INSTRUCTIONS

1. Locate unit so that there is adequate space for element removal. Refer to outline drawing for height needed.
2. Inspect piping leading to and from unit for scale, dirt, etc. and, if necessary, clean piping.
3. Remove protective covers from inlet and outlet piping and connect the filter or strainer. (Connections are clearly marked with pressure sensitive decals indicating the inlet and outlet connections, or refer to the outline drawing.)

CAUTION

DURING INSTALLATION, USE CARE SO AS NOT TO INTRODUCE DIRT INTO THE SYSTEM.

4. Remove cover and clean inside thoroughly. Inspect the element(s) for damage that may have occurred during shipment. Inspect cover gasket and gasket surface on cover. Replace cover. Torque head bolts to 70-80 lb.-ft. on sizes 1, 4L, and larger. On the smaller sizes 0, 1R, 1S, torque to 15-20 lb.-ft.

CAUTION

ON 1116, 1576 AND 1554 SERIES, THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL SINCE FLOW IS FROM THE INSIDE-OUT. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

OPERATING INSTRUCTIONS

1. After filter or strainer has attained operating temperature, check the differential pressure across it. On filters or strainers so equipped, this may be done with the three-way valve located underneath the pressure gauge. Turn the valve handle to upstream (inlet) side and read the pressure; turn the valve handle to downstream (outlet) side and read the pressure. The difference in pressure readings is the differential pressure across the element(s). Always return the valve to the "off" (center) position.
2. It is recommended that the differential pressure be checked daily, as it indicates the amount of contaminant build-up within the element(s). When this differential pressure reaches approximately 20 psi at normal operating temperature, the element(s) shall be removed and replaced with genuine Nugent element(s) for series 1577, 1555 and 1576 filters. Element(s) should be removed and replaced only after first referring to Nugent Co. element replacement instructions. The strainer screen cylinder shall be cleaned for series 1554 and 1700 strainers or clean bags installed in series 1116 filters. Strainer cylinders should be cleaned and new filter bags should be installed only after first referring to Nugent Co. cylinder cleaning and bag iinstallation procedures.

EST. 1877 WM. W. NUGENT & CO. (INC.) 3440 CLEVELAND ST. SKOKIE, ILL. 60076, U.S.A.
Telephone: 312/674-7782 TELEX: 724-312
WM. W. NUGENT & CO., LTD., Vancouver 9, B.C., Canada

STRAINER BASKET ASSEMBLY CLEANING OR REPLACEMENT SERIES 1554

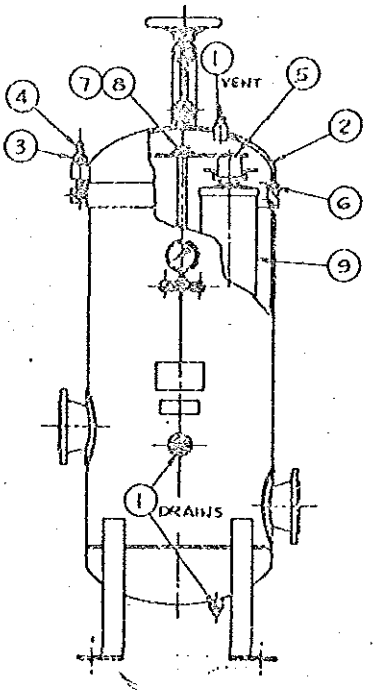
When the differential pressure reaches 20 psi, the strainer basket assembly shall be removed and cleaned or replaced with genuine Nugent strainer screen cylinders. For replacement, refer to parts list or name plate for part number of strainer screen cylinder.

1. Drain completely by removing the ¾" NPT plug(s), located on the side or bottom of the strainer shell. During draining open vent (1), loosen nuts (3), and swing bolts (4) clear of cover lugs. Remove cover (2), by lifting to clear positioning tabs located on shell ring. DO NOT LAY COVER ON THE "O" RING SEALING SURFACE.
2. On single strainer basket assemblies, remove spring (10). On multiple strainer basket assemblies, remove nut(s), washer(s) (7), and (8), and pressure plate (5).

CAUTION

BEFORE REMOVING STRAINER BASKET ASSEMBLY(IES), CHECK TO MAKE SURE THAT THE LIQUID HAS BEEN COMPLETELY DRAINED.

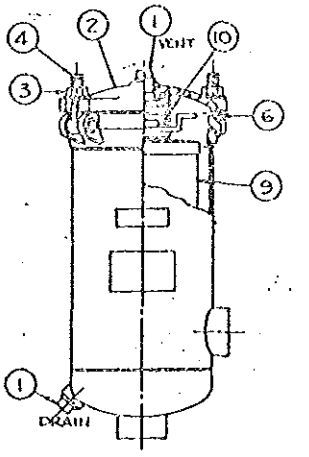
3. Remove strainer basket assembly (9) by grasping wing nut and pulling straight up. A slight side to side motion may be required to break the adhesion between the "O" ring and strainer basket assembly seat. Inspect interior of vessel for dirt and damage, paying particular attention to the chamfered edge and inside diameter of the strainer basket assembly seat.



CAUTION

ON THE SERIES 1554 STRAINER THE MAIN BODY IS THE CLEAN SIDE OF THE VESSEL. ANY DIRT PRESENT COULD GET INTO THE SYSTEM AND CAUSE FAILURE OF THE EQUIPMENT WHICH THIS UNIT IS TO PROTECT.

4. Disassemble strainer basket assembly by removing wing nut (14) and cover (13). Grasp strainer screen cylinder (11) and lift from spool (12).
5. Immerse strainer screen cylinder into a container of an alkaline detergent and/or an organic solvent. Agitation of the cleaning solution or the strainer cylinder will aid in the removal of surface contamination.
6. Reverse flush the strainer screen cylinder from the outside-in using the solution(s) mentioned above. The solution should be as clean as possible prior to and during the outside-in flush, in order to preclude the introduction of additional surface contamination. Compressed air may also be used to assist in removal of accumulated dirt.

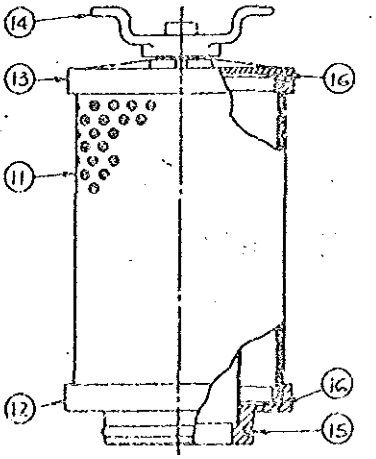


CAUTION

WHEN REVERSE FLUSHING THE STRAINER SCREEN CYLINDER UNDER PRESSURE (CLEANING SOLUTION OR AIR,) SPECIAL CARE SHOULD BE EXERCISED TO AVOID COLLAPSE OF THE FILTER CLOTH.

During reverse flushing, it is recommended that a cylinder be placed inside the strainer screen cylinder so as not to impinge the loosened dirt on the opposite side.

7. Inspect the gaskets (16) and, if satisfactory, assemble the strainer basket assembly by placing the strainer screen cylinder on the spool. Place the cover on top of the strainer screen cylinder and secure with wing nut.
8. Inspect "O" ring (15) for cuts, nicks, dirt, etc., and apply a film of lubricant. Lower strainer basket assembly onto the seat. DO NOT TIP OR ROTATE AFTER "O" RING CONTACTS SEAT.
9. Replace spring (10) on single strainer basket assemblies. On multiple strainer basket assemblies replace pressure plate (5), washers and nuts. Torque to 50-60 lb.-ft. Inspect "O" ring (6) and replace pressure cover by lowering it onto the "O" ring. Align lugs before cover contacts "O" ring. DO NOT ROTATE COVER TO OBTAIN ALIGNMENT AFTER IT HAS CONTACTED "O" RING. Torque nuts to 70-80 lb.-ft.
10. Close drain(s) and fill vessel with fluid. In order to assure complete filling of vessel, release trapped air through vent located on cover. Check for leaks. After strainer has attained operating temperature, check the differential pressure. It should be less than 5 psi.



LIST OF MATERIAL

7-75

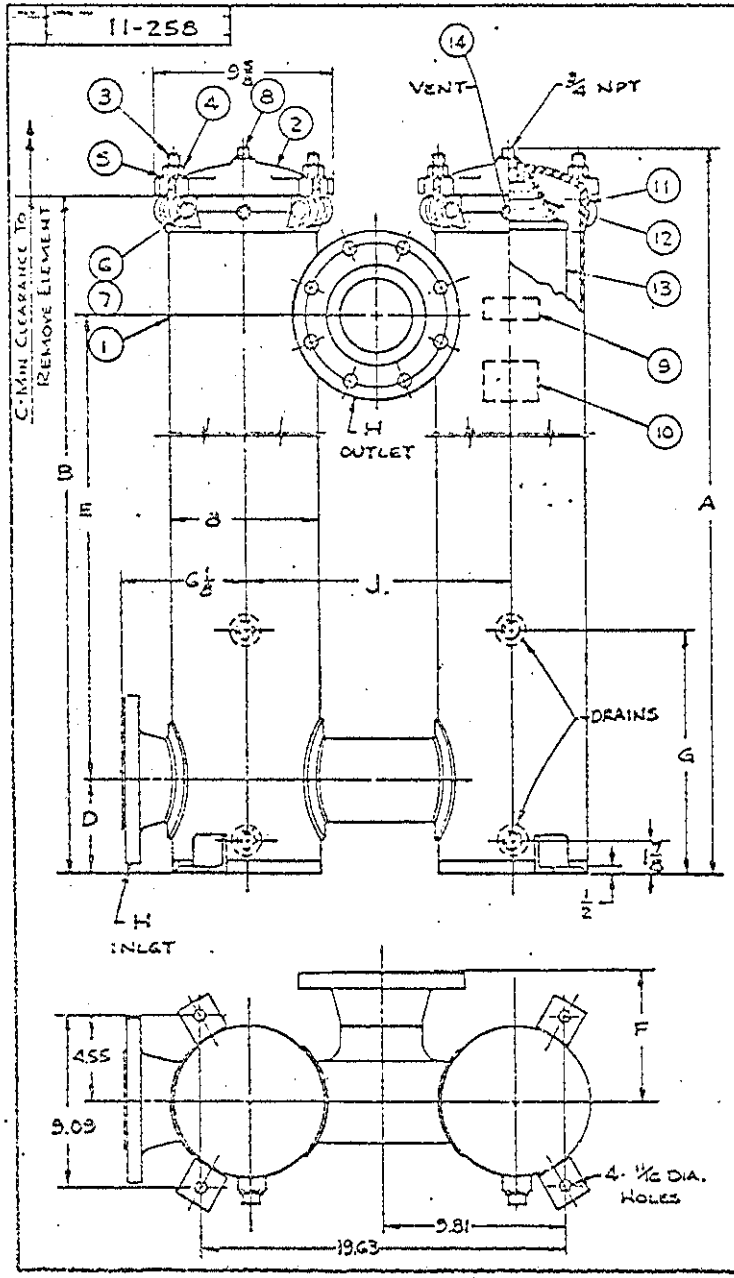
ASSEMBLY 11-258-204 STRAINER 1554-4L2B-SPN-200 CODE STAMP 150#

ITEM NO.	DESCRIPTION	ROUGH NUMBER	FINISH NUMBER	QUAN.	MATERIAL	COST OR PRODUCTION
1.	SHELL ASSY.		21-115-201	1		
2.	COVER		35-001-001	2	SA395	
3.	EYE BOLT		30-023-003	8	SA325	
4.	NUT, HVY. HEX.		01-043-003	8	SA194-2H	
5.	WASHER		01-040-012	8	AISI-1010	
6.	RIVET		01-060-004	8	SA31-B	
7.	RETAINING RING		01-058-001	8	SAE 1075	
8.	PLUG, SQ. HD. 3/4 NPT		01-021-018	6	SA181-1	
9.	NAME PLATE		01-224-001	1		
10.	DECAL		01-091-002	1		
11.	O-RING		01-061-026	2	BUNA-N	
12.	SPRING		30-052-001	2		
13.	ELEMENT		30-055-203	2		x
14.	PLUG, SQ. HD. 1/4 NPT		01-021-015	2	SA181-1	

Sheet No. 3

Page No.

11-258



DASH Nº	MODEL Nº	A	B	C	D	E	F	G	H	J	WEIGHT EMPTY	WEIGHT FULL
201	1554-4L2B-SPN-200	48 1/16	45 5/16	34	5	35	7 5/16	12 5/16	4-150# USAS RF	14 3/8		
202	1554-4L2B-SPN-200	48 1/16	45 5/16	34	5	35	7 5/16	12 5/16	4-150# USAS RF	14 3/8		
203	1554-4L2B-SPN-200	48 1/16	45 5/16	34	5	20 1/16	7 5/16	12 5/16	4-150# USAS RF	14 3/8		
204	1554-4L2B-SPN-200	48 1/16	45 5/16	34	5	35	7 5/16	12 5/16	4-150# USAS RF	14 3/8		

1. DESIGN PRESSURE 150 PSI
   TEST PRESSURE 225 PSI
   DESIGN TEMPERATURE 250°F.
2. FLANGE BOLT HOLES STRADDLE ℄
3. FABRICATED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASME CODE FOR PRESSURE VESSELS.

DASH Nº	F.M. P/N	REMARKS
204	11-907-424	ASME CODE STAMP
203	11-907-265	ASME CODE STAMP
202	11-907-029	ASME CODE STAMP
201	11-906-998	NO CODE STAMP

UNLESS OTHERWISE NOTED
ALL VENTS 1/8 NPT
DRAINS 3/8 NPT

PART NO SEE TAB.
MATERIAL SEE DET B.M.
DRAWN 1-5-74
CHECKED 1-5-74
TOLERANCES X/8

STRAINER ASSEMBLY

W.M. W. NUGENT & CO. (INC.)
SKOKIE, ILL. U.S.A.

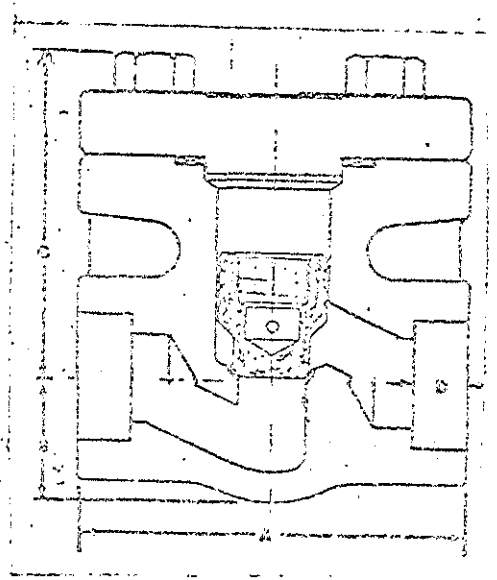
SIZE
SCALE
DWG NO 11-258

VENDOR NO:

VENDOR: HENRY VOGT MACHINE CORP.
P.O. BOX 1978
LOUISVILLE, KENTUCKY 40201

(1) SEE 11902456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR.

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size (Inches)	¾"	⅞"	1"	1¼"	1½"	1¾"	2"	2½"
W—Weight, Pounds, Approximate	2.6	2.8	3.7	5.6	8.5	12	17.5	25.5
A—Center to End, Inches	3⅛	3⅛	3⅛	3⅛	4⅝	5⅛	6⅛	7⅛
B—Center to Bottom, Inches	2	2	2	2⅛	2⅞	3⅛	3⅛	3⅞
C—Center to Top, Inches	2⅝	2⅝	2⅝	2⅝	3½	4⅛	4½	5⅛
T—Depth of Socket, Inches	⅜	⅜	⅜	½	½	⅝	⅝	¾

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED
REV 1
OCT 22 1976
QUALITY ASSURANCE

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10128	11-15-76	See Sht. 3.	
3	10097	10-29-76	Added "See 11902456. ... Note (1)	
1	10097	"	See Sheets 1, 2, & 3	

TITLE
VALVE, CHECK
1-1/2
ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .030
DECIMAL MACHINING TOLERANCES
0.- ± .010 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Power Systems Division

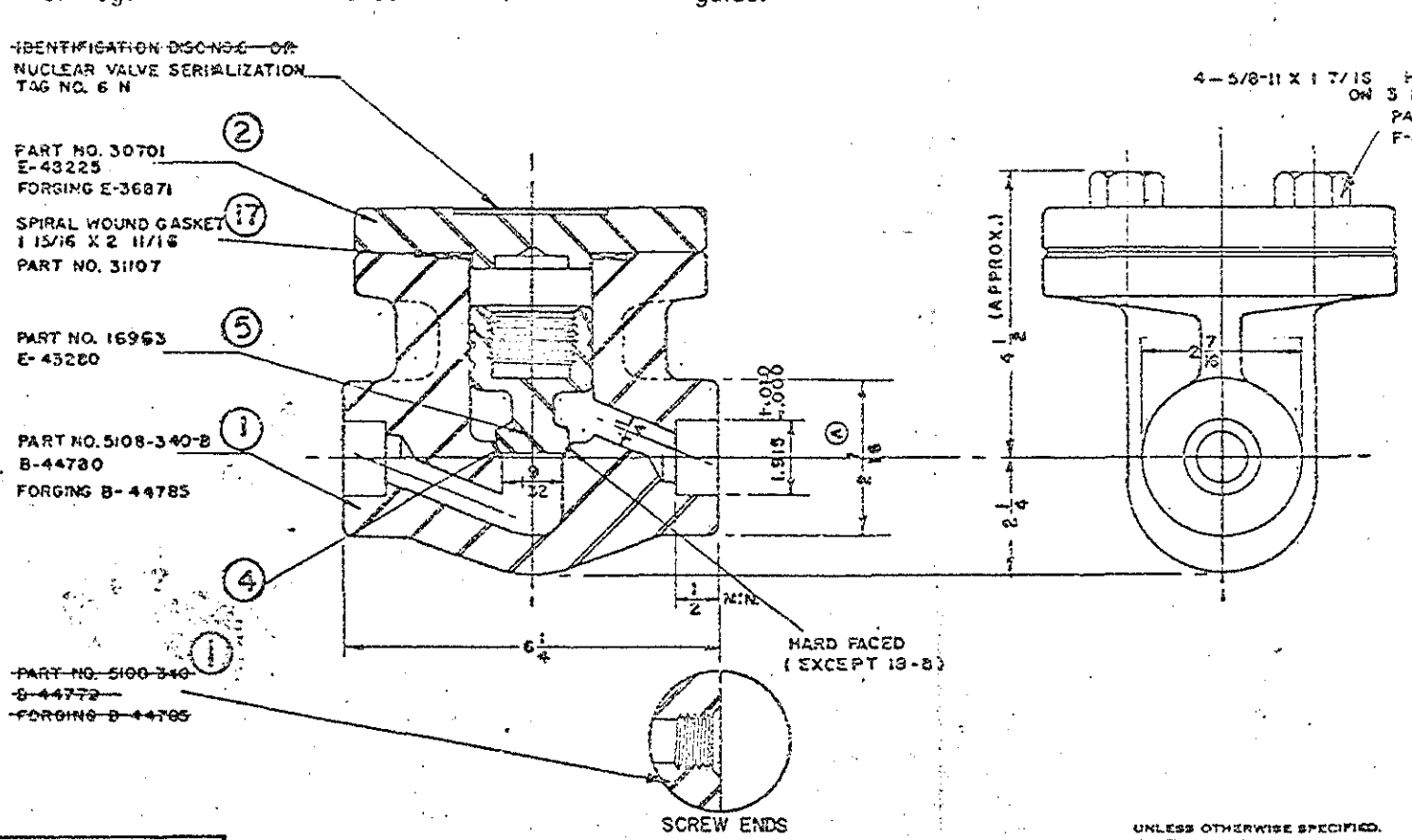
REL. NO. PC 1503	9/13/76	ASSY. OR LC.
DR. BY P. ESTRADA	8/30/76	SCALE
CHK'D. BY L. WILLOUGHBY	9/2/76	HEAT TR.
MAT'L. PURCHASE		
APPV. CAST.		MAT'L.
APPV. MACH.		TOOL
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 902 189 | SHEET 1 OF 3

REPAIRING CHECK VALVES

Leakage through seat and disc is not always easy to detect, but when definitely known to exist, immediate repair is recommended since delay may permanently injure the disc or seat, or both. If seating surfaces show galling, slight pittings, grooving or indentations not deeper than 0.010", lapping will usually restore to tight closure. Defects beyond 0.010" cannot be corrected by lapping but seating surfaces can be remachined or new parts installed. For relapping the seat and disc of Vogt check valves, use a fine and a coarse grade emery-base compound, such as Clover Compound A and D. Apply a light coat of the fine, or A, compound to the seating surface of disc or stem, insert disc or stem into seat, and lap using an oscillating motion. Lap a few minutes and then wipe seating surfaces clean; this will clearly show extent of damage. If bad, use the coarse, or D, compound and lap until all defects are removed; then finish with a fine, or A, compound. It is recommended that Vogt piston check valves do not require lapping fixtures as the bore of the valve body serves as a guide.

REVISION RECORD					
No.		DATE	FROM	TO	BY
1	P.N	9-27-76	ADDED	5108-340	CT
2	A	2-1-77	2 8/16	2 7/16	RK



CONTRACT NO. LIMERICK 700000
LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

EM. PART NO. 11908189

COLT INDUSTRIES
P.O. B-454208-N
VOGT INVOICE NO. 214677-NUC.

MATERIAL:
A.S.M.E. SECTION III
NUCLEAR CLASS 3
"N" STAMP VALVES

R.E.K
2-1-77

WEIGHT = 16.5 LBS. (APPROX.)

HENRY VOGT MACHINE CO.
LOUISVILLE KY.

3/4 COMPACT DESIGN CHECK VALVE-HORIZONTAL TYPE-FORGED STEEL- BOLTED BONNET-GASKET JOINT (SPIRAL WOUND)-70° INTEGRAL SEAT BODY GUIDED DISC CHECK-SOCKET WELD ENDS ~~& THREADED ENDS~~
150 ~~300~~ ~~600~~ ANSI.

UNLESS OTHERWISE SPECIFIED.
FRACTIONAL DIMENSIONS ± .015
DECIMAL DIMENSIONS ± .005
MACHINED SURFACES 125 FINISH.

REDRAWN WITHOUT CHANGE 1-23-75

E-48564	REV. NO.	1	2
		9-27-76	2-1-77

E-48564

DRAWN BY R.E.K. ORIG. DATE 3-12-73
CHECKED BY
CHIEF ENG.
SCALE NONE

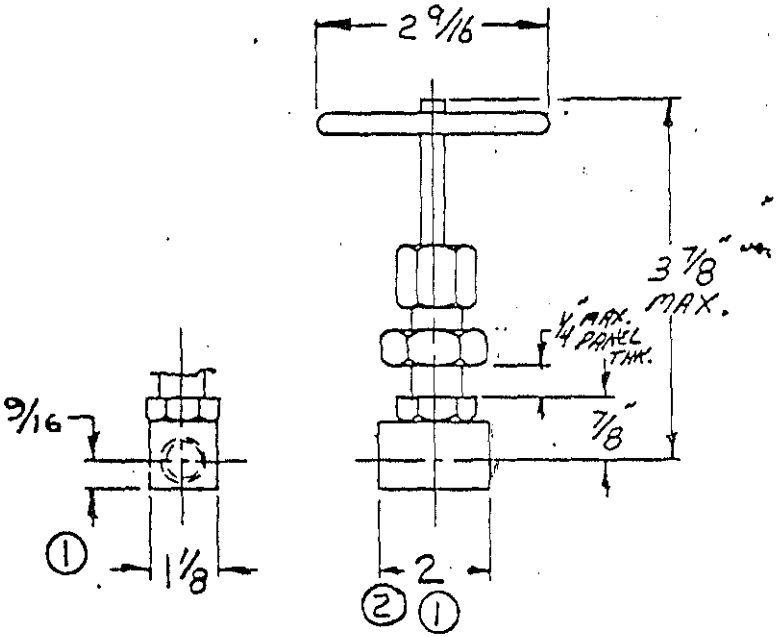
11908189

11 908 650

DESCRIPTION: INSTRUMENT SHUT-OFF VALVE

VENDOR NO: 6701053D (3)

VENDOR: DRAGON VALVES, INC.
13457 EXCELSIOR DR.
NORWALK, CAL. 90650



APPROVED Rev.3 AUG 18 1977 QUALITY CONTROL

APPROVED Rev.2 APR 21 1977 QUALITY CONTROL

APPROVED Rev.1 APR 6 1977 QUALITY CONTROL

APPROVED Rev.0 MAR 16 1977 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS (5)	WLS TWSP
3	10437	8-30 77	SEE SH. 2 (4)	H.P.S.
2	10289	4-27 77	ADDED SEAT TYPE D (3)	RHH KP
2	"	"	REVISED DIM WAS 1/8 (2)	RHH KP
1	10276	4-15 77	DIM'S ADDED (1)	RHH KP

TITLE: VALVE, INSTRUMENT - 1/4" ASME SECT. III, CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16/77	ASSY. OR LO.
DR. BY HERTENSTEIN	2/23/77	SCALE
CHK'D. BY R. NORMAN	3/1/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. R.D. YAL
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 1 of 4

BF3008-2

I. GENERAL REQUIREMENTS:

A. CONNECTIONS: 1/4" NPT (F)
B. ORIFICE: .180" FULL OPEN (4)
C. MEDIA:

1. FUEL OIL (#2 DIESEL) AT 50 PSIG MEAN W/PULSATIONS TO 200 PSIG & 150°F.
2. COMPRESSED AIR @ 250 PSIG & 130°F.
3. LUBE OIL SERVICE @ 100 PSIG & 200°F.
4. WATER SERVICE @ 50 PSIG & 180°F.

D. FUNCTION: SHUT-OFF.

II. ASME SECTION III REQUIREMENTS:

A. "THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".

B. ASME COMPONENTS QUALITY ASSURANCE REQUIREMENTS DWG. 11 908 456 APPLIES TO THIS ORDER.

C. THE PRESSURE RETAINING AREA DESIGN SHALL CONFORM TO ND-3511.

APPROVED Rev. 3 JLH QUALITY CONTROL
APPROVED Rev. 2 APR 21 1977 JLH QUALITY CONTROL
APPROVED Rev. 1 JLH QUALITY CONTROL
APPROVED Rev. 0 JLH QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	ORIFICE WAS (4) .214	
2	10289	4-27 77	SEE SH. 1	BHH
1	10276	4-15 77	SEE SH. 1	EHH

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1 64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 . ± .060 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16/77	ASSY. OR LO.	
DR. BY R. NORMAN	3/2/77	SCALE	
CHK'D. BY H.P.S.	5/2/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. R.D.M.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 2 OF 4

JUL 31 1978 APP

II. ASME SECTION III REQUIREMENTS - CONT'D

D. STANDARD PRESSURE CLASS: ANSI 900 LB

E. DESIGN TEMPERATURE: 200°F MAX.

F. DESIGN ALLOWABLE STRESS VALUES: PER ND-3112.4 AND ND-3511. ATTACHED PIPE IS 1/4 SCHED. 80 OR 3/8 TUBE.

G. BOUNDRIES: PER NA-3254.1

H. MATERIALS:

1. MATERIALS SHALL BE NEW, SUITABLE FORTHE APPLICATION AND IN ACCORDANCE WITH ND-2120. BONNET, PACKING GLAND AND PACKING NUT SHALL BE SA-479 TYPE 316 STAINLESS STEEL. STEM AND DISC SHALL BE SA-564 GRADE 630 HIGH ALLOY P.H. STEEL. BODY SHALL BE SA-182 GRADE F-316.
2. IMPACT TESTING NOT REQUIRED.
3. MATERIALS SHALL BE CERTIFIED PER ND-2130 OF ASME SECTION III. CERTIFIED MATERIALS TEST REPORTS AND/OR MATERIAL MFGS. CERTIFICATES OF COMPLIANCE (AS APPLICABLE) SHALL BE FURNISHED TO COLT INDUSTRIES PURCHASING DEPARTMENT.

APPROVED Rev. 3 APR 21 1977 QUALITY CONTROL

APPROVED Rev. 2 APR 21 1977 QUALITY CONTROL

APPROVED Rev. 1 QUALITY CONTROL

APPROVED Rev. C QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	SEE SHT 2	
2	10289	4-27 77	SEE SH. 1	RAH
1	10276	4-15 77	SEE SH. 1	RHH RPS

TITLE
VALVE,
INSTRUMENT - 1/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.0 ± .060 0.00 ± .030 0.000 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16 77	ASSY. OR LO.
DR. BY R. NORMAN	3/2 77	SCALE
CHK'D. BY H.R.S.	3/2 77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. R.D.W.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 3 OF 4

JEI REV Y 1978 QA AP JUL 31

BF3009-2

II. ASME SECTION III REQUIREMENTS - CONT'D

I. VENDOR TO FURNISH COPY OF DATA REPORT NPV-1 TO COLT INDUSTRIES PURCHASING DEPARTMENT.

J. CERTIFIED DESIGN SPECIFICATIONS AUTHORIZING CLASSIFICATION AND SPECIFYING DESIGN OF THIS COMPONENT ARE COLT DWG. NOS. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM", 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM", 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM".

III. SPECIAL REQUIREMENTS:

A. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBTED.

IV. COLT INDUSTRIES DUTIES:

A. PURCHASING, RECEIVING, INSPECTION, STORING, & DISBURSEMENT SHALL COMPLY WITH SECTION QC-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY CONTROL MANUAL.

B. PURCHASING DEPT. SHALL FORWARD THE FOLLOWING DOCUMENTS TO THE VENDOR AS PART OF THE ORDER:

1. COLT DWG. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM" REV. 1 (E) (S)
2. COLT DWG. 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM" REV. 1
3. COLT DWG. 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM" REV. 1 (S)
4. COLT DWG. 11 908 456 COLT/FMED Q.A. REQUIREMENTS ON VENDOR. REV. 4 (S)

APPROVED Rev. 3 APR 21 1977 QUALITY CONTROL

APPROVED Rev 2 APR 21 1977 QUALITY CONTROL

APPROVED Rev. 1 APR 6 1977 QUALITY CONTROL

APPROVED Rev. 0 MAR 31 1977 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	LLS
3	10437	8-30 77	SEE SH. 2	H.R.S.
2	10289	4-27 77	SEE SH. 1	RMN
1	10276	4-15 77	SEE SH. 1	RMN H.R.S.

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	10236	3/16 77	ASSY. OR LO.
DR. BY	R. NORMAN	3/2 77	SCALE
CHK'D. BY	H. R. S.	3/2 77	HEAT TR.
MAT'L			
APPV. CAST.			MAT'L
APPV. MACH.			ENGR. R.O.
APPV. WELD.			

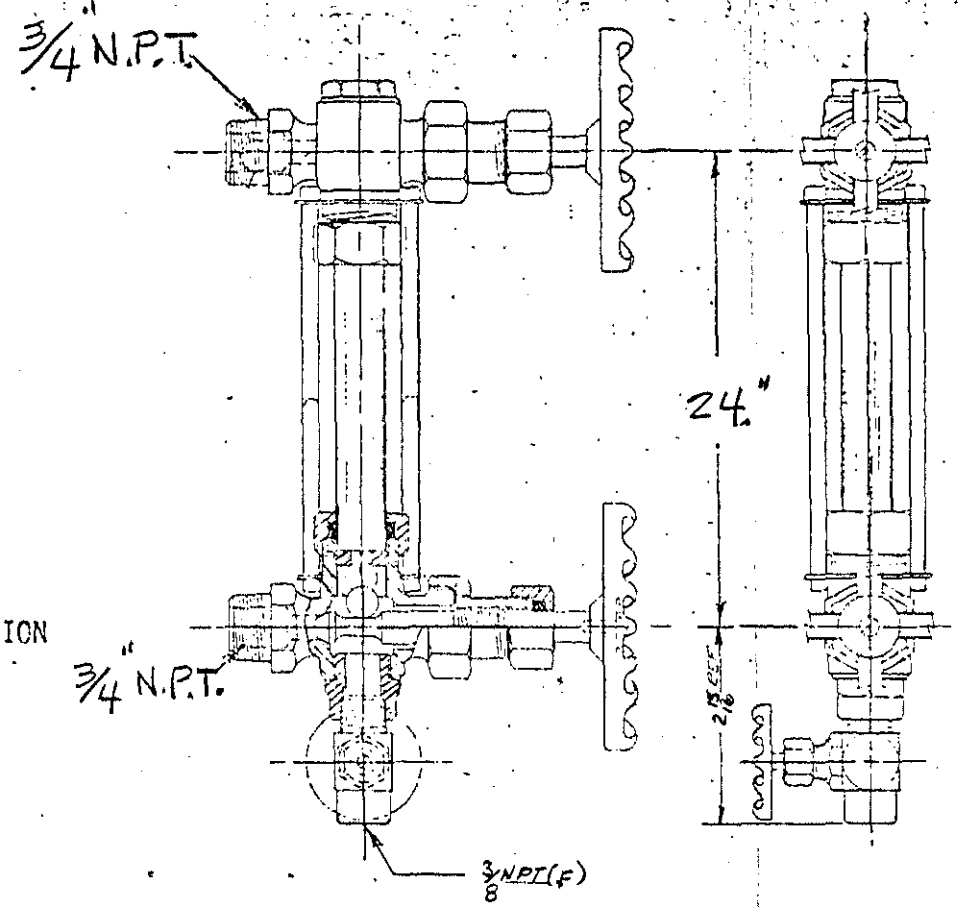
SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 4 OF 4

QA APP JUL 31 1978

Drawing Not Available In
Original Contract Manual

D.R. 11-8970

1191166



VENDOR PART NO.: 54A

VENDOR: ESSEX BRASS CORPORATION
P. O. BOX 4607
DETROIT, MI 48234

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REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D. BY

TITLE

SIGHT GLASS,
LUBE OIL TANK

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	1628	10/24/79	ASSY. OR LO.
DR. BY	K. OSTOIC	10/8/79	SCALE
CHK'D. BY	J. HARSH	10/22/79	HEAT TR.
MAT'L	PURCH.		
APPV.	CAST.		MAT'
	MACH.		EN
	WELD.		PE

SHEET SIZE A | DWG. NO. 1191166 2 | SHEET 1 OF 2

D.R. 110-3970

11911662

DESCRIPTION: ESSEX BRASS NO. 54A "NAVY" DIRECT READING. LIQUID LEVEL INDICATORS PER THE FOLLOWING:

I. GENERAL REQUIREMENTS:

A. CONNECTIONS - 3/4" NPT INLET AND OUTLET, 3/8" NPT (F) DRAIN

B. MEDIA: OIL

C. VALVE BODIES: CAST BRONZE

D. TYPE 2 AUTOMATIC - HAS AUTOMATIC BALL CHECK, SUITABLE FOR A MAXIMUM WORKING PRESSURE OF 300 PSI

E. CLASS A GENERAL - GUARD ROD PROTECTION FOR GAUGE GLASS

F. 24" CENTER DISTANCE WITH A 3/4" X 22" GLASS TUBE

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
SIGHT GLASS
LUBE OIL TANK

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

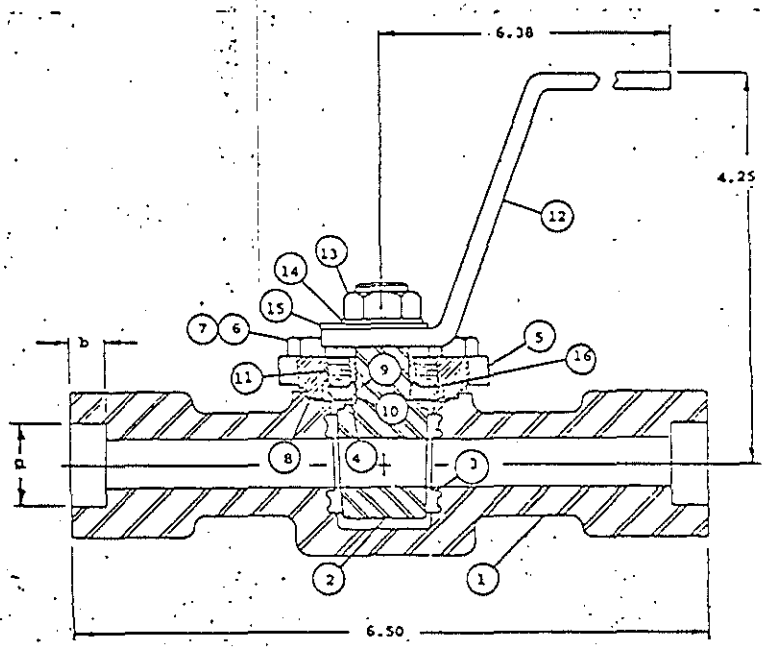
Colt Industries — Fairbanks Morse Engine Division

REL. NO.	11628	10/24/79	ASSY. OR LO.
DR. BY	K. OSTOIC	10/18/79	SCALE
CHK'D. BY	J. HARSH	10/22/79	HEAT TR.
MAT'L	PURCH.		
APPV.	CAST.		MAT'L
	MACH.		ENG'G PE
	WELD.		

SHEET SIZE A | DWG. NO. 11911662 | SHEET 2 OF 2

11911811

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	b	D
3/4"	.50	1.07

VENDOR NO: 3/4" FIG. 0366SW -

VENDOR: TUFLINE DIVISION OF XOMOX CORP.
ELK GROVE, IL 60007

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

See 11908456 for Colt/FMED Q.A. Requirements on Vendor.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
VALVE, PLUG
3/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11464	5/25/79	ASSY. OR LO.	
DR. BY T. RYAN	5/23/79	SCALE	~
CHK'D. BY J. HAESLI	5/23/79	HEAT TR.	
MAT'L. PURCHASE			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. PE	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11911811		SHEET 1 OF 3

QA APP
COLT FM MAY 23 1979

PE3029-2

DESCRIPTION: TUFLINE FIG. 0366SW TEFLON SLEEVE NON-LUBRICATED SOCKET WELD PLUG VALVE WITH THE FOLLOWING FEATURES:

I. GENERAL REQUIREMENTS:

STANDARD DESIGN RATING: 300 LB.
DESIGN CONDITIONS: MAXIMUM PRESSURE ALLOWED AT 200°F

II. ASME SECTION III REQUIREMENTS:

A. "THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".

B. ALL MATERIALS SHALL COMPLY WITH REQUIREMENTS OF ND-2121 OF ASME SECT. III. SPECIFIC MATERIALS AS FOLLOWS:

1. BODY & BONNET MATERIAL TO BE ASME SA-216 GRADE WCB.
2. PLUG MATERIAL TO BE ASME SA-479 TYPE 316.

C. DESIGN ALLOWABLE STRESS VALUES SHALL COMPLY WITH ND-3112-4 OF ASME SECTION III.

D. MATERIAL TO BE CERTIFIED IN ACCORDANCE WITH ND-2130 OF ASME SECTION III. COPIES OF CERTIFIED MATERIALS, TEST REPORTS AND MATERIAL MANUFACTURER'S CERTIFICATES OF COMPLIANCE (AS APPLICABLE) SHALL BE FURNISHED TO COLT INDUSTRIES PURCHASING DEPT.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
VALVE, PLUG
3/4
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11464	5/2579	ASSY. OR LO.	
DR. BY T. RYAN	5/23/79	SCALE	
CHK'D. BY J. HANSEN	5/23/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. PE	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11 911 811		SHEET 2 OF 3

COLT MAY 23 1979 APP
FM

E. VALVE DESIGN TO CONFORM TO ND-3511 OF ASME SECT. III (PRESSURE TEMPERATURE RATING AND WALL THICKNESS). ATTACHED PIPE IS 3/4" SCHEDULE 80 PIPE.

F. VENDOR TO FURNISH COPY OF DATA REPORT NPV-1 TO COLT INDUSTRIES PURCHASING DEPARTMENT.

G. CERTIFIED DESIGN SPECIFICATIONS AUTHORIZING CLASSIFICATION AND SPECIFYING DESIGN OF THIS COMPONENT IS COLT DWG. NO. 11871105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM".

III. SPECIAL REQUIREMENTS:

A. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBITED.

IV. COLT INDUSTRIES DUTIES;

A. PURCHASING, RECEIVING, INSPECTION, STORING, & DISBURSEMENT SHALL COMPLY WITH SECTION QA-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY ASSURANCE MANUAL.

B. PURCHASING DEPT. SHALL FORWARD THE FOLLOWING DOCUMENTS TO THE VENDOR AS PART OF THE ORDER:

1. COLT DWG. 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM:

2. COLT DWG. 11908456 COLT/FMED Q.A. REQUIREMENTS ON VENDOR.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
VALVE, PLUG
3/4
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

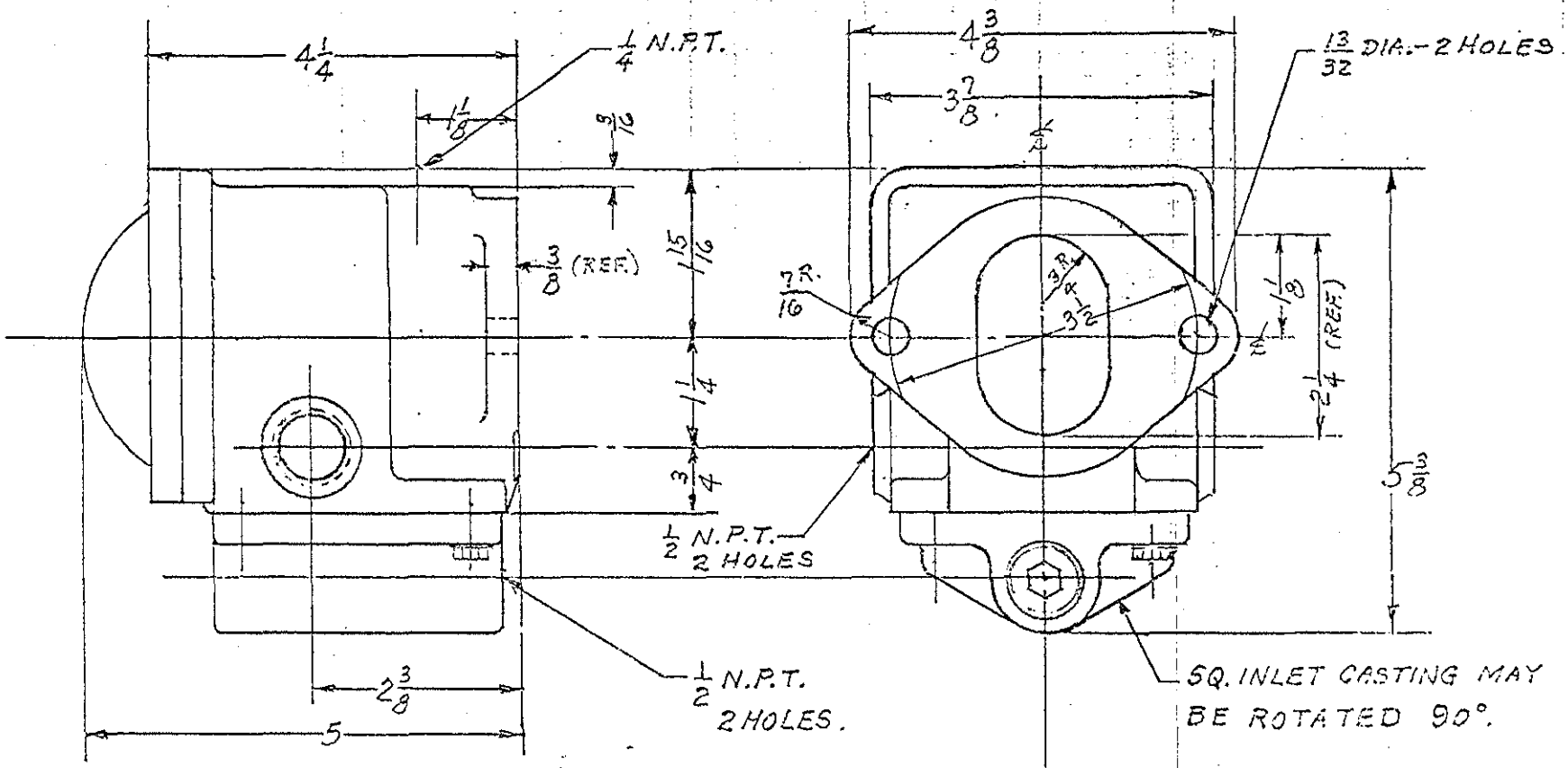
Colt Industries — Fairbanks Morse Engine Division

REL. NO.	11464	5/25/79	ASSY. OR LO.
DR. BY	T. RYAN	5/23/79	SCALE
CHK'D. BY	J. MARSH	5/23/79	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR. PE
	WELD.		

SHEET SIZE	DWG. NO.	SHEET
A	11 911 811	3 OF 3

MAY 23 1979

16101332



MODEL RA-K REN OIL LEVEL REGULATOR FOR DIRECT CRANKCASE MOUNTING WITH KIT TO CONNECT TO SUPPLY TANK.

PURCHASE FROM:- POWER PLUS CORPORATION, 5474-ALHAMBRA AVE., LOS ANGELES 32, CALIFORNIA.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: OIL LEVEL REGULATOR 5¼x7¼ O.P. ENG.

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. AJ1475	7/20/64	ASSY. OR LO. 16101332	
DR. BY K.E.T.	7/13/64	SCALE	
CHK'D. BY F.J.D.	7/17/64	APPV.	1 / 1
MAT'L PURCHASE		HEAT TR.	
SHEET SIZE A	DWG. NO. 16101330		SHEET OF

MFGR.

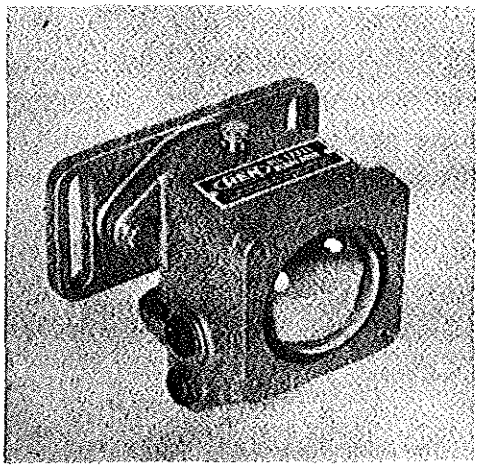
POWER PLUS CORP.
P.O.Box 38424
Houston, Texas 77088

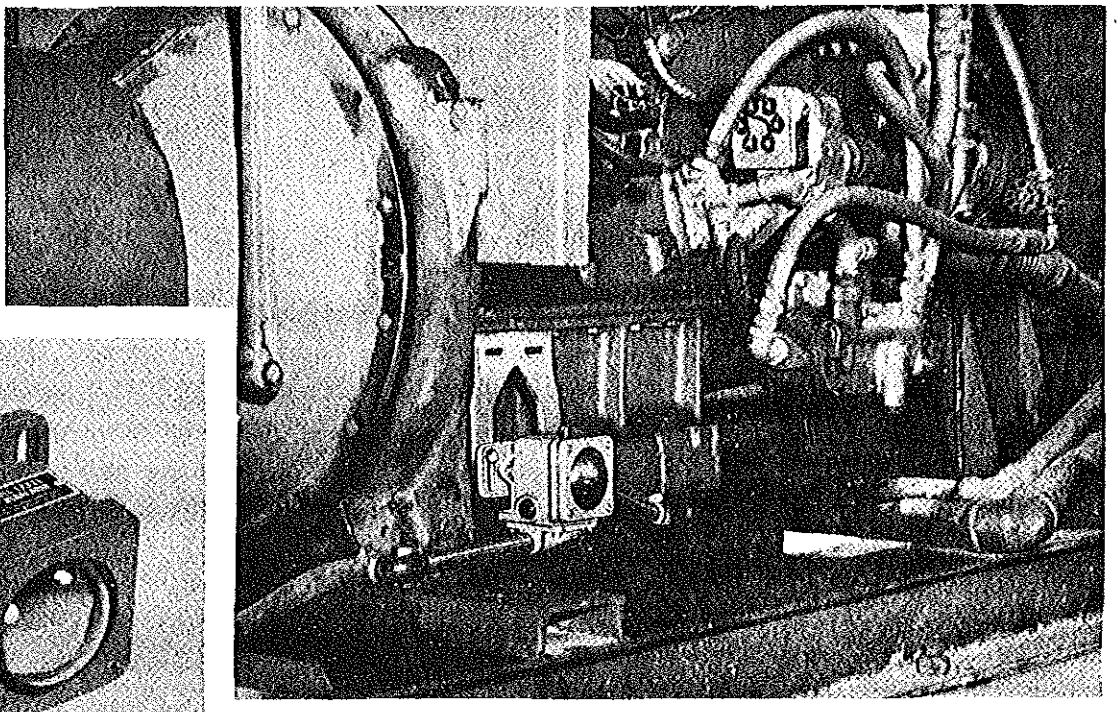
REN INDUSTRIES, INC.
P.O.Box 2469
Bayamon, Puerto Rico 00619

REN
MODEL RAB
REN OIL LEVEL REGULATOR

MODEL RAB REN OIL LEVEL REGULATOR FOR UNIVERSAL APPLICATION TO MULTI-CYLINDER ENGINES (INTERCHANGEABLE WITH MODEL RB)

ALL REGULATORS EQUIPPED WITH LOW LEVEL SHUTDOWN CONTACT.





Model RAB REN Oil Level Regulator maintains constant oil level in the cranckcase of this engine in waterflood service.

The REN Model RAB Oil Level Regulator supersedes and is interchangeable with the Model RB for universal application to multi-cylinder engines. (The same mounting bracket is used for both.) This model provides the user with greater flexibility in that it may also be adapter-mounted on engines and compressors equipped with a sight glass.

From a separate supply tank at or near the engine, the Regulator delivers only that amount of oil required to maintain a constant oil level in the engine crankcase. Especially designed for application to engine crankcases, the REN Oil Level Regulator employs a ruggedly designed float valve which is insensitive to vibration.

The Model RAB REN Oil Level Regulator is intended for mounting on or adjacent to engine crankcases with the centerline of the window in the regulator adjusted to the same height as the level of oil in the crankcase. This model Regulator is usually installed on the Model RK-2 pan mounting bracket which is bolted in place by using two of the engine oil pan bolts. (See diagram on opposite side.)

A universal mounting kit which includes pan mounting bracket, hose fittings and supply line hose is available. (Order RAB-K) See catalog sheet on Model RA REN Oil Level Regulator for direct adapter installations.

Provision is made for the installation of a pressure equalizing vent line when installing on engines which operate with a negative pressure in the crankcase or on engines which have a tendency to build up pressure in the crankcase. (See diagram on opposite side.)

The REN Oil Level Regulator body is a heavy aluminum casting. A quarter inch thick plexi-glass sight window is provided in front of the casting to indicate visibly the accurate function of the regulator and to show the oil level. To insure the cleanliness of the oil to be delivered to the engine crankcase, a fine mesh screen and sediment bowl are used. Since the regulator valve is continually immersed in clean oil, wear and vibration considerations are eliminated.

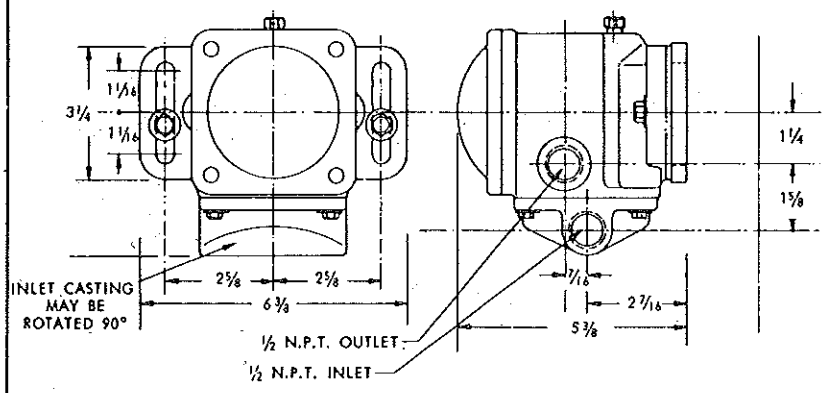
Savings of up to 50% in oil consumption are proved by thousands of REN Oil Level Regulator installations. The REN Regulator eliminates the most costly phase in the operation of stationary engines; that of frequent manual filling and checking of crankcases. Protection is provided against damage frequently caused by manual filling of crankcases through the introduction of contaminants and abrasive foreign matter. Intervals between engine overhauls are frequently extended as much as 50% due to the maintenance of a safe, low level of clean lubricating oil.

Supply tanks and stands are available in 5, 15, 30 and 55 gallon sizes. The 15 and 30 gallon supply tanks are also available with a universal mounting bracket which permits installation of the tank on structural members, walls or in other locations where a stand would be impractical. (See catalog pages on supply systems.)

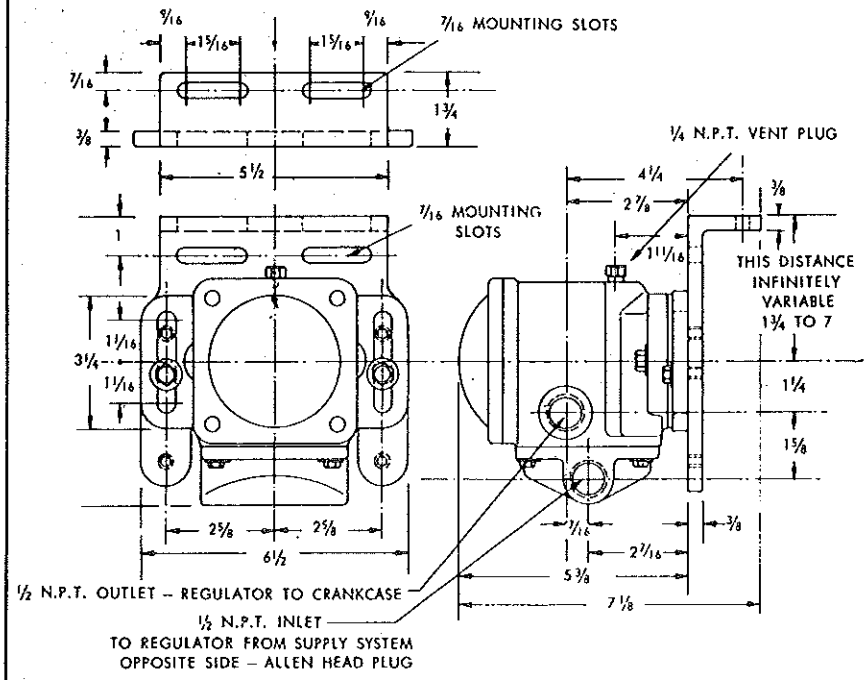
The Model RAB REN Oil Level Regulator is frequently installed with the REN Slow-Flow Meter which accurately records the engine lubricating oil make-up requirements.

Printed in U.S.A.

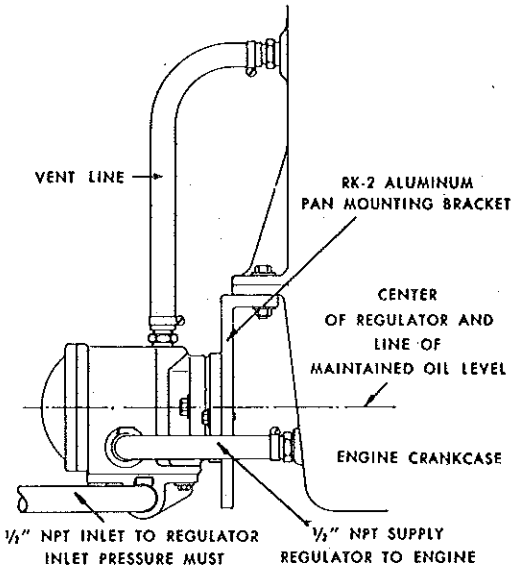
DIMENSIONS RAB OIL LEVEL REGULATOR



DIMENSIONS RAB OIL LEVEL REGULATOR WHEN INSTALLED ON MOUNTING BRACKET



VENTING INSTRUCTIONS



Most multi-cylinder engines have an operating crankcase presssure approximately atmospheric. However some engines tend to develop a positive pressure while others develop a negative pressure in the crankcase.

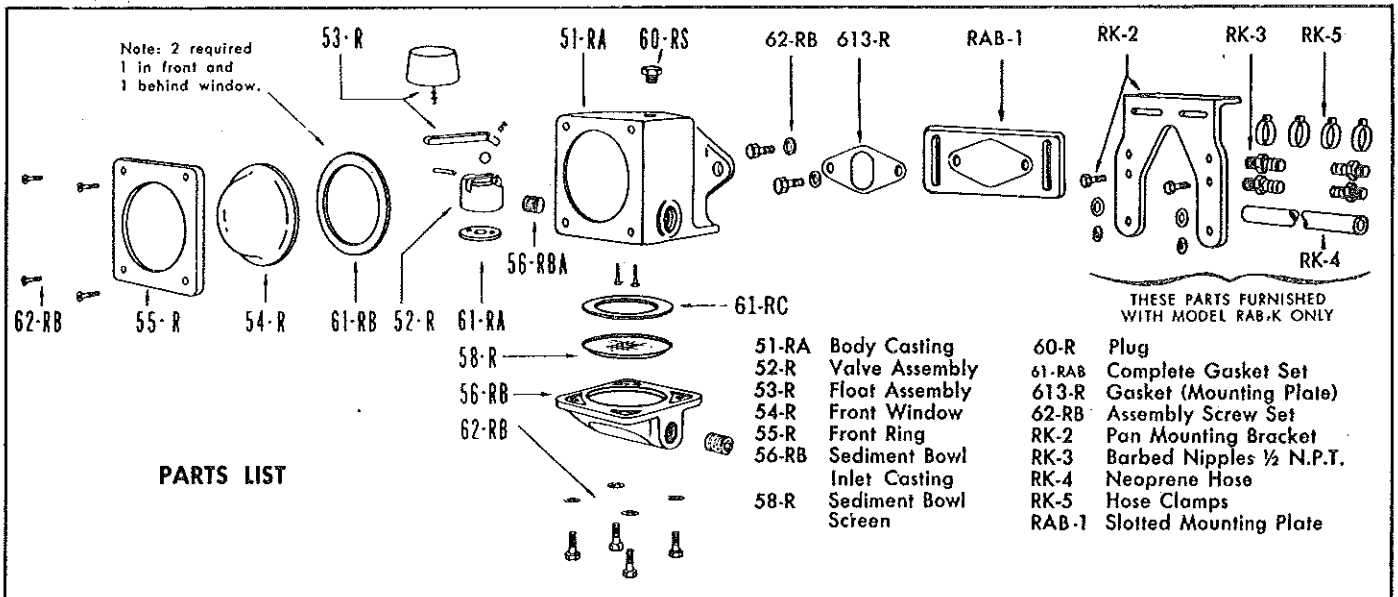
In these engines and in those engines which either do not have adequate crankcase venting or which venting might become restricted, it will be necessary to install a pressure equalizing vent line.

The vent line should be installed by removing the brass 1/4" pipe plug on the top of the regulator and providing a line of not less than 3/8" I.D. between the regulator and the crankcase. The vent opening into the crankcase should be located well above the regulated oil level and should be installed so that it will be self draining and not form a fluid trap.

If space limitations prohibit mounting on the crankcase, the regulator may be mounted in a level position as close as possible on an adjacent member.

RK-2 regulator pan-mounting bracket may be inverted and installed on the engine skid if preferred.

5, 15, 30 and 55 gallon oil supply tanks and stands are equipped with calibrated sight gauge, dust proof filler cap and vent tube and shut-off valve.



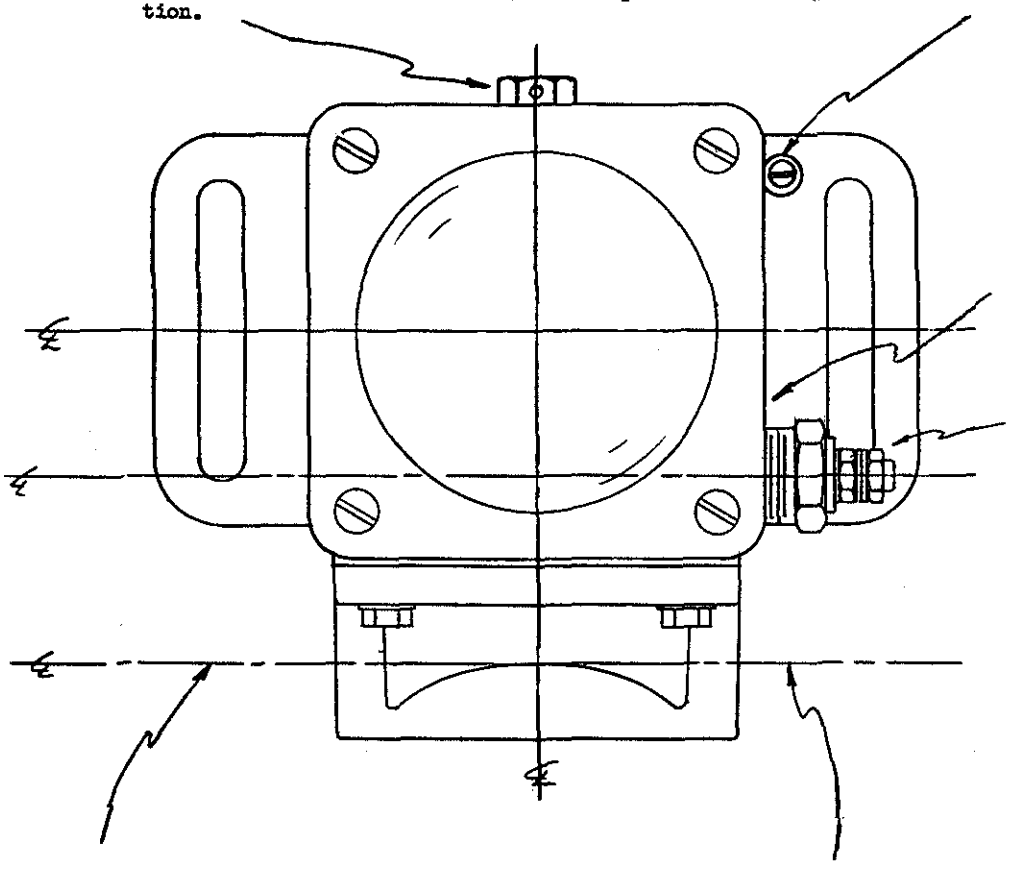
PARTS LIST

51-RA	Body Casting	60-R	Plug
52-R	Valve Assembly	61-RAB	Complete Gasket Set
53-R	Float Assembly	613-R	Gasket (Mounting Plate)
54-R	Front Window	62-RB	Assembly Screw Set
55-R	Front Ring	RK-2	Pan Mounting Bracket
56-RB	Sediment Bowl Inlet Casting	RK-3	Barbed Nipples 1/2 N.P.T.
		RK-4	Neoprene Hose
58-R	Sediment Bowl Screen	RK-5	Hose Clamps
		RAB-1	Slotted Mounting Plate

PRINTED IN U.S.A.

B&J Prtg 447-6190

VENT If engine or compressor with which regulator is used operates with crankcase pressure other than atmospheric, remove drilled vent plug from 1/4"-tapped top port and install 3/8" I.D. line to crankcase, entering well above oil level. This pressure-equalizing line must be well-drained to avoid the formation of oil blocks which would prevent normal operation.



GROUNDING TERMINAL (BODY) When grounding switch is used, complete electrical circuit through grounding terminal unless regulator is already adequately grounded through its mounting.

OUTLET PORTS A 1/2"-tapped outlet port is provided at each side of regulator body. Run hose from one of these to the crankcase sump at a point well below the desired oil level. Avoid any upward loop which could form an oil-air block.

GROUNDING SWITCH The grounding switch may be placed in the unused outlet port at either side of the regulator. It may be used to activate an external electrical circuit for any purpose such as a signal light, alarm or magneto cut-off, in response to abnormally low oil level, such as would occur following exhaustion of the supplied oil.

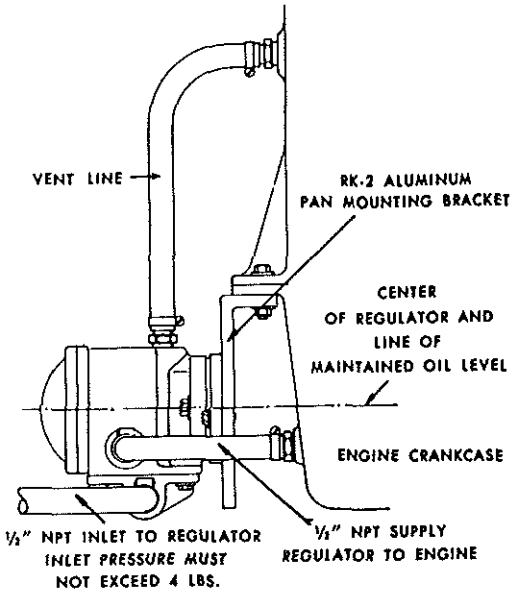
Note on low oil level: If insufficient oil is present in the crankcase sump before starting, the normal reduction in level which occurs when the oil goes into circulation may cause the grounding switch to respond. The remedy is to add oil until the normal running amount is present. After a normal shut-down, the return of oil to the sump should result in a level within the regulator well above the center of the front window.

OIL SUPPLY TO REGULATOR A 1/2"-tapped supply port is provided at each side of regulator bottom casting. Use plug provided to plug unused side. Supply oil to regulator at any positive head up to 12 feet or gage pressure up to 5 psi.

Printed in U.S.A.

REN POWER PLUS CORPORATION HOUSTON, TEXAS					FOR MODEL RA, RAB
ASSEMBLY OR PART CONNECTIONS - REN RA REGULATOR					SUPERSEDES
DATE 9-68	DWG. BY N	SCALE –	MAT'L –	NO. REQ'D –	DWG. NO. 101-70

INSTALLATION INSTRUCTIONS
MODEL RAB REN OIL LEVEL REGULATOR

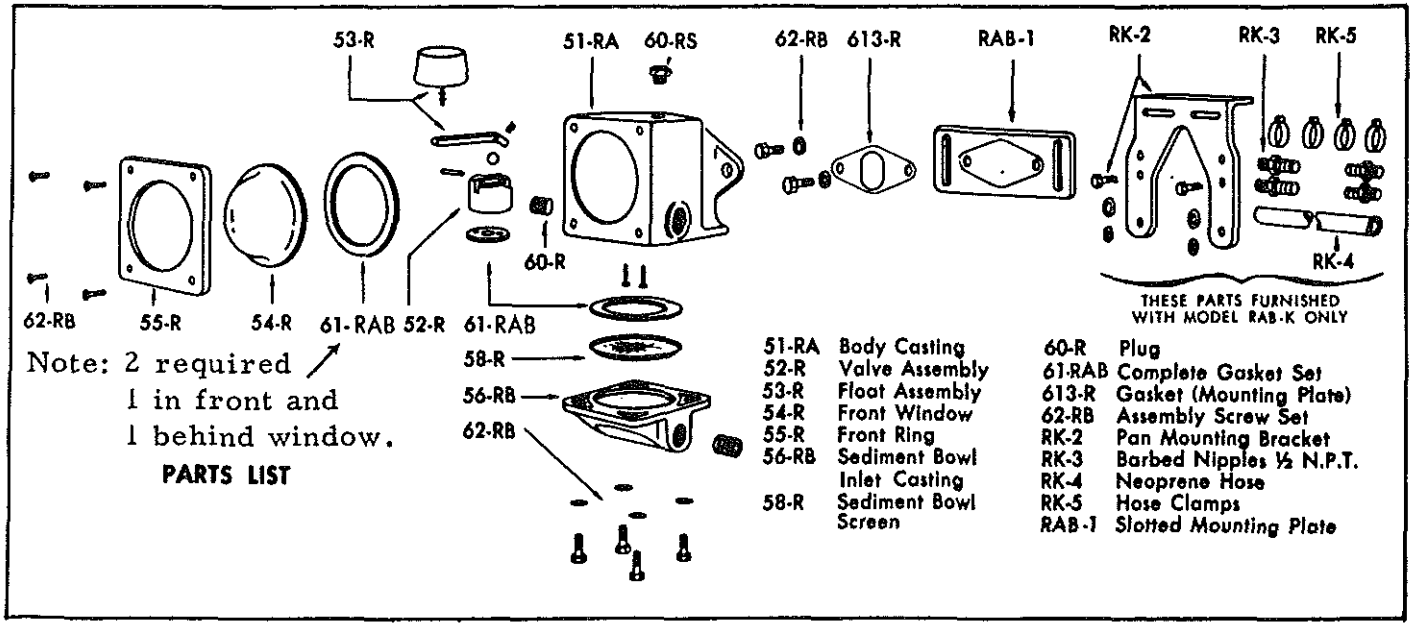


Most multi-cylinder engines have an operating crankcase pressure approximately atmospheric. However, some engines tend to develop a positive pressure while others develop a negative pressure in the crankcase. In these engines and in those engines which either do not have adequate crankcase venting or which venting might become restricted, it will be necessary to install a pressure equalizing vent line. The vent line should be installed by removing the brass 1/4" pipe plug on the top of the regulator and providing a line of not less than 3/8" I.D. between the regulator and the crankcase. The vent opening into the crankcase should be located well above the regulated oil level and should be installed so that it will be self draining and not form a fluid trap.

If space limitations prohibit mounting on the crankcase, the regulator may be mounted in a level position as close as possible on an adjacent member. RK-2 regulator pan-mounting bracket may be inverted and installed on the engine skid if preferred.

After unit is installed as shown on schematic diagram on top of brochure, manually fill engine to "low" or "add" oil mark on dipstick without starting engine. Adjust oil level regulator so that oil level in regulator is at the center of the front window. Be sure to allow sufficient time for the oil level to equalize between the regulator and crankcase before fastening regulator securely. This is the operating level. Start engine and allow time for the regulator to replace oil that is picked up and is in circulation throughout the engine. When the engine is shut down, you will note that the drainback from the engine will raise the static level in the regulator front window. This is normal and as soon as engine is restarted, level will pull down to the same operating level.

5, 15, 30 and 55 gallon oil supply tanks and stands are equipped with calibrated sight gauge, dustproof filler cap and vent tube and shut-off valve.



Note: 2 required
1 in front and
1 behind window.

PARTS LIST

51-RA	Body Casting
52-R	Valve Assembly
53-R	Float Assembly
54-R	Front Window
55-R	Front Ring
56-RB	Sediment Bowl Inlet Casting
58-R	Sediment Bowl Screen
60-R	Plug
61-RAB	Complete Gasket Set
613-R	Gasket (Mounting Plate)
62-RB	Assembly Screw Set
RK-2	Pan Mounting Bracket
RK-3	Barbed Nipples ½ N.P.T.
RK-4	Neoprene Hose
RK-5	Hose Clamps
RAB-1	Slotted Mounting Plate

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3. JACKET WATER SYSTEM

Part No.	Description
11 906 076	Pressure Switch
11 906 211	Temperature Alarm Switch
11 906 212	Thermostat
11 908 165	Thermostatic By-Pass Valve
11 908 172	Water Heater
11 908 178	Circulating Pump - Motor Driven
11 908 180	Plug Valve 1/2"
11 908 181	Plug Valve 3/4"
11 908 183	Plug Valve 1-1/2"
11 908 186	Heat Exchanger
11 908 192	Check Valve
11 908 552	Level Alarm Switch
11 908 650	Isolation Valve
11 908 982	Flexible Connector 1/2"
11 908 984	Flexible Connector 1-1/2"
11 910 548	Relief Valve
11 911 663	Sight Glass
11 911 811	Plug Valve 3/4"
12 994 129	Flexible Connector 6"

DESCRIPTION: ALLEN BRADLEY BULETIN 836 OPEN TYPE PRESSURE SWITCH WITH FOLLOWING FEATURES:

1. Adjustable range -- 0-30 psi.
2. Adjustable differential 0.4 to 4 psi
3. Max. allowable press -80 psi

VENDOR'S PART NO: 836-C3

VENDOR: ALLEN-BRADLEY

FOR VENDOR LITERATURE
SEE TAB 1

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH, PRESS. 0-30 psi

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .040 0.0- ± .020 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 20573	3/21/72	ASSY. OR LO.	
DR. BY	/ /	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1130607 | SHEET OF

PRESSURE SWITCHES • TEMPERATURE SWITCHES

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts

DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC | 5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

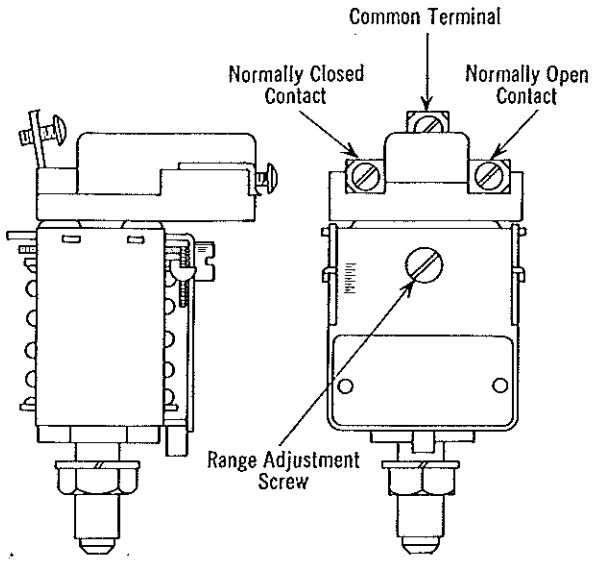
To adjust the controls to suit particular requirements, the following adjustments are to be made; these will apply to both the pressure and temperature controls.

FIXED DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount. It is not possible to change the differential between the cut-in and cut-out settings.

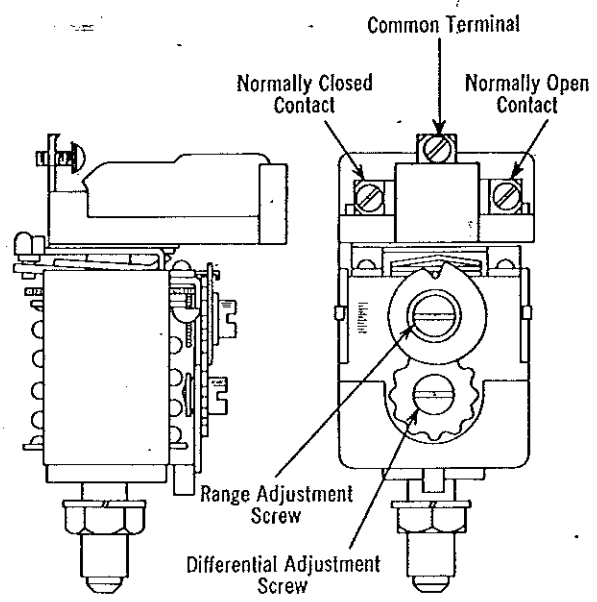
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When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

Publication 836—5.0—November, 1969
Supersedes Instructions 836-800

DESCRIPTION: ALLEN BRADLEY bulletin 837 temperature switch with the following features:

1. Vertical immersion type.
2. Adjustable range 140 to 290°F.
3. Adjustable differential at middle setting $3\frac{1}{2}$ to 28°F.
4. NEMA Type 4 Housing (watertight).
5. Contact block SPDT DC pilot duty rating 57.5 VA @ 125 Volts d.c.

VENDOR'S PART NO: 837-V3J

VENDOR: ALLEN BRADLEY
MILWAUKEE, WISC.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH Temperature 140-290°F

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205872 12/23/71 ASSY
DR. BY L.W.Coom
CHK'D. BY
MAT'L

FOR VENDORS LITERATURE
SEE TAB 2

APPV. CAST. MAT'L.
APPV. MACH. ENGR.
APPV. WELD.

SHEET SIZE A DWG. NO. 11906211 SHEET 1 OF 1

BF3009-2

PRESSURE SWITCHES • TEMPERATURE SWITCHES

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts
DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC { 5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

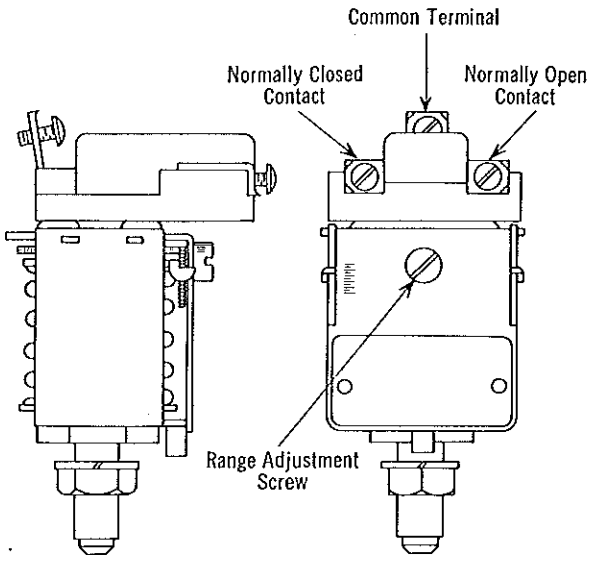
To adjust the controls to suit particular requirements, the following adjustments are to be made; these will apply to both the pressure and temperature controls.

FIXED DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount. It is not possible to change the differential between the cut-in and cut-out settings.

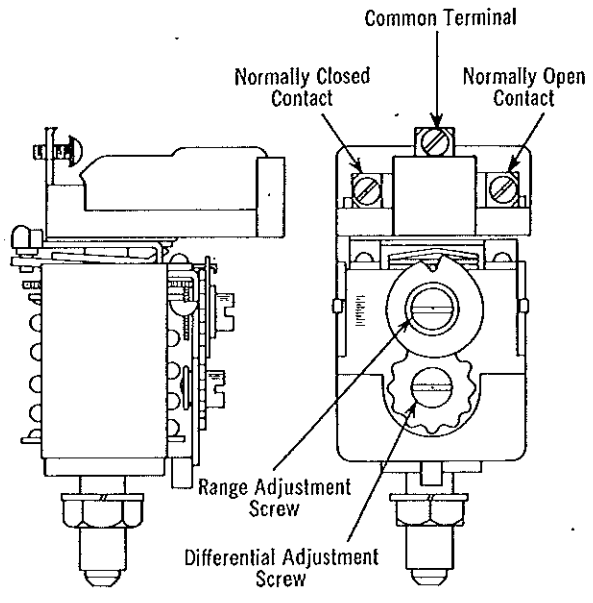
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FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

Publication 836—5.0—November, 1969
Supersedes Instructions 836-800

DESCRIPTION: ALLEN BRADLEY bulletin 837 temperature switch with the following features:

1. Vertical immersion type.
2. Adjustable range 90 to 200°F.
3. Adjustable differential 2½ to 22°F at middle setting.
4. NEMA Type 4 Housing (water tight)
5. Contact block SPDT. D.C. pilot rating 57.5VA @ 125 Volts d.c.

VENDOR'S PART NO: 837-V2J

VENDOR: ALLEN BRADLEY
MILWAUKEE, WISC.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH Temperature 90-200°F.

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power

REL. NO. 205872, 12-2-71
DR. BY L.W. Coop
CHK'D. BY
MAT'L
APPV. CAST MACH WELD. MAT'L ENGR.

FOR VENDORS LITERATURE
SEE TAB 2

SHEET SIZE A | DWG. NO. 11906212 | SHEET 1 OF 1

BF3009-2

PRESSURE SWITCHES • TEMPERATURE SWITCHES

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts
DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC: 5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

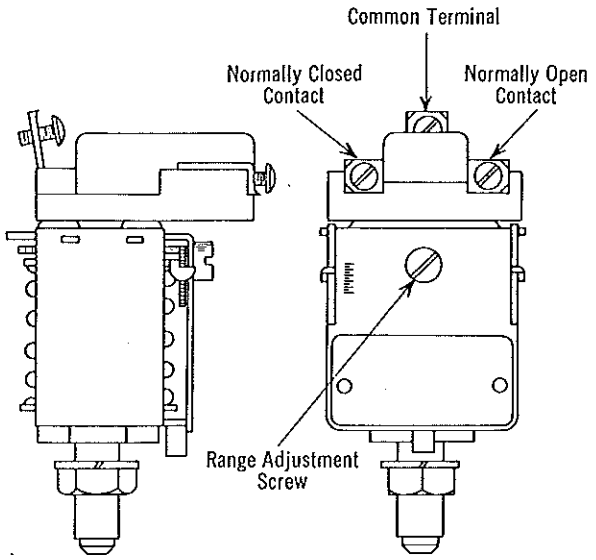
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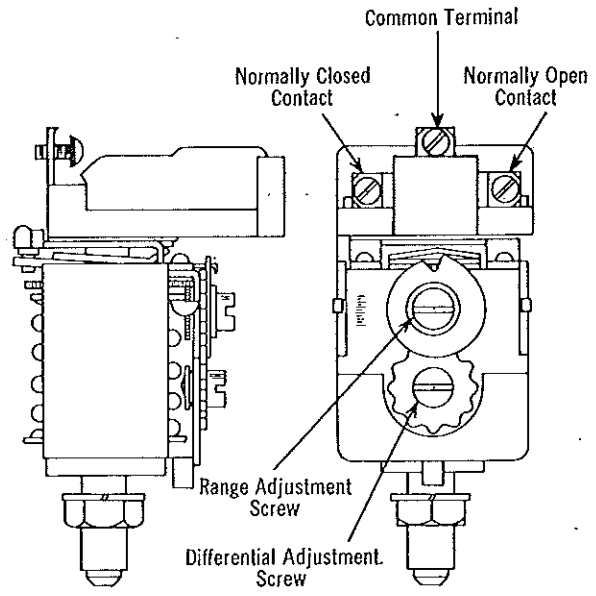
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When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL

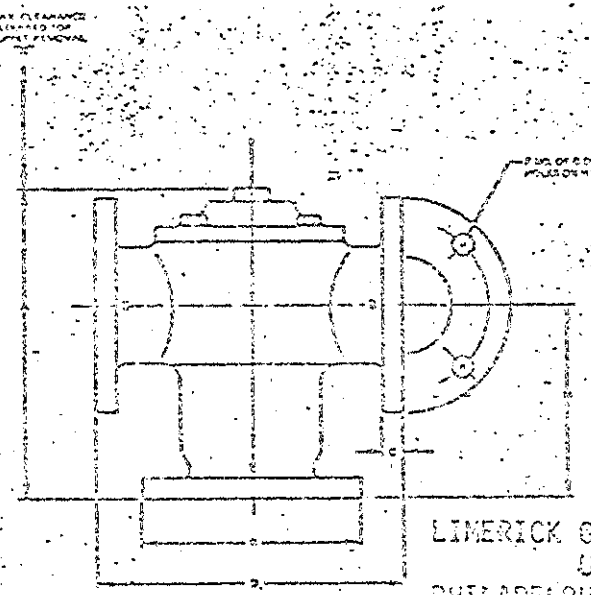


ADJUSTABLE DIFFERENTIAL



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

Publication 836—5.0—November, 1969
Supersedes Instructions 836-800



LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

VENDOR NO: I-1285-S-.

VENDOR: ROBERTSHAW CONTROLS CO.
100 GORDON ST.
ELK GROVE VILLAGE, IL 60007

SEE 11908456 FOR COLT/FMD Q.A. REQUIREMENTS ON VENDOR (1)

VALVE MODEL	SIZE	DIMENSION A	B	C	D	E	G	H	M	N	SHIPPING WEIGHT LBS.
1-1/2-150-S	1½"	4-1/8	6	3½	7-5/8	4	3/4"	4-3/8	5-3/16	3	40
2-150-S	2"	4-1/2	7	3-7/16	10	4	3/4"	4-3/8	5-1/2	3	70
3-150-S	3"	10-1/2	7-1/2	5-3/4	10-1/2	4	3/4"	6	6-3/4	3	80
4-150-S	4"	12-3/16	9	7-11/16	13-7/8	4	3/4"	7-1/2	8-3/16	3	150
6-150-S	6"	15-1/16	12	9-3/16	18	4	7/8"	9-1/2	11-1/2	4	320
8-150-S	8"	18	15	12-1/16	23-1/2	4	7/8"	9-1/2	11-1/2	4	550

12-85-S

Rev. 3

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, OR WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	102250	2-17-77	See Sheets 2 & 5	
2	10128	11-10-76	See Shts 3 & 4	
2	"	"	Added Limerick Gen. Station----- (2)	
1	10097	10-24-76	Added "See 11908456 ..." Note (1)	
1	10097	"	See Sheet 1, 2, 24	

TITLE
VALVE, THERMOSTATIC
3-WAY 54
ASME SECT. III CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .007
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .040 0.0- ± .010 0.00- ± .010

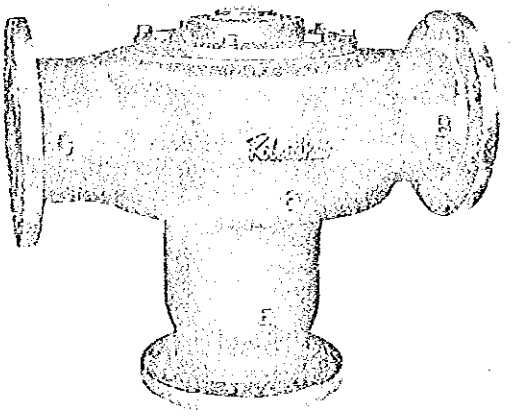
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO: PC1494 8-27-76 ASST. OR NO.
DR. BY L.M. Cooper 8/12/76 SCALE
CHK'D. BY P. Esteban 9/14/76 HEAT TR.
MAT'L PURCHASE
APPV. CAST. MAT'L
MACH.
WELD.

SHEET SIZE A DWG. NO. 11 909 165 SHEET 1 OF

Robertshaw
CONTROLS COMPANY

Temperature Regulator
I-1285-P, Q, S, T Series



GENERAL DESCRIPTION

The I-1285-P, Q, S & T Series Temperature Regulators are compact, self-contained and self-powered, three-way control valves especially adaptable to control of water and lubricating oil temperatures on internal combustion engines. The POWER PILL® element, located inside the poppet assembly, responds to the temperature of the medium surrounding it and provides the force necessary to position the poppet as the temperature of the liquid passing through the valve changes. Temperature regulation is achieved by the proportional action of the three-way valve which varies the amount of medium through or bypassing the cooler to maintain the desired temperature. Operation of the POWER PILL elements is unaffected by pressure changes in the system.

The POWER PILLS are factory-set for the specified control temperature and are not manually adjustable. By exchange of POWER PILL elements, the operating temperature may be changed in a very simple manner. Since all internal parts lift out with the valve bonnet, it is not necessary to remove the valve from the piping.

SPECIFICATIONS

A. CONSTRUCTION

Valve Body – Cast steel with 150 lb. ANSI flanges.

Trim –
3" – Brass poppet and seating surfaces.
4, 5, & 6" – Brass poppet with integral steel seating surfaces.

Poppet Seal – Split Buna-N "O"-ring (General Purpose, one red dot).
Split Polyacrylate "O"-ring (Lube Oil Service, two blue dots)

NOTE: Unless otherwise specified, General Purpose Seal is installed at factory, with additional Lube Oil Seal packed with valve.

Dimensions – See Figure 1.

B. OPERATING RANGES

Available temperature ranges are tabulated below.

The maximum valve body rating is 150 psi at 250° F.

CAUTION: Do not exceed maximum temperature/pressure rating.

C. MODELS AVAILABLE*

I-1285–S 8

MODEL NO.

CODE	SIZE
P	3"
Q	4"
S	5"
T	6"

NORMAL OPERATING TEMPERATURE AT MID-STROKE °F.			
STANDARD		SPECIAL	
CODE	TEMP.	CODE	TEMP.
18	120	24	60
1	130	16	75
15	140	22	80
4	150	20	90
5	155	19	100
10	160	25	110
11	165	2	135
12	170		
21	175		
13	180		
8	185		
17	190		
23	200		

*NOTE: For cast brass valve body, refer to I-1285-B thru G Series.

Form No. P-2331, Rev. B

ROBERTSHAW CONTROLS COMPANY
INDUSTRIAL INSTRUMENTATION DIVISION

INSTALLATION

A. GENERAL

Prior to installation, the valve body and parts should be checked to determine if any damage occurred in shipment. Any damage should be reported to the shipper as soon as possible. Foreign matter which may have entered the valve during packing or shipment should be removed.

B. LOCATION

The I-1285 may be installed indoors or out, provided the liquid to be controlled does not freeze. Temperature regulators should be installed as near as possible to the unit being controlled, and a pipeline strainer should be installed upstream.

C. POSITION

Although these valves will operate in any position, the best performance is achieved in the vertical upright position (E port down). When the four, five, or six inch regulators are to be installed up-side-down, the factory should be notified so that a special load spring may be supplied. (See Parts List).

D. SERVICE

Unless otherwise specified on the order, regulators are shipped with a general purpose split "O"-ring installed which is color coded with one red dot. If the regulator is to be used on lube oil service, the lube oil split "O"-ring (color coded with two blue dots), that is attached to the valve, should be installed.

Whenever synthetic* lube oils or special coolants are used, the factory should be consulted to determine compatability with split "O"-ring material.

*Not recommended for use with estar base synthetic lubricant.

VALVE MODEL	SIZE, In.	DIMENSION								
		A	B	C	D	F	G	H	M	X
I-1285-P	3"	11-3/16	7-1/2	13/16	10-1/2	4	3/4	6	6-3/4	10
I-1285-Q	4"	12-1/2	9	15/16	15-7/8	8	3/4	7-1/2	8-9/16	12
I-1285-S	5"	17-7/8	10	15/16	19-1/4	8	7/8	8-1/2	11-5/8	14
I-1285-T	6"	19-5/8	11	1	23-1/2	8	7/8	9-1/2	13-7/16	16

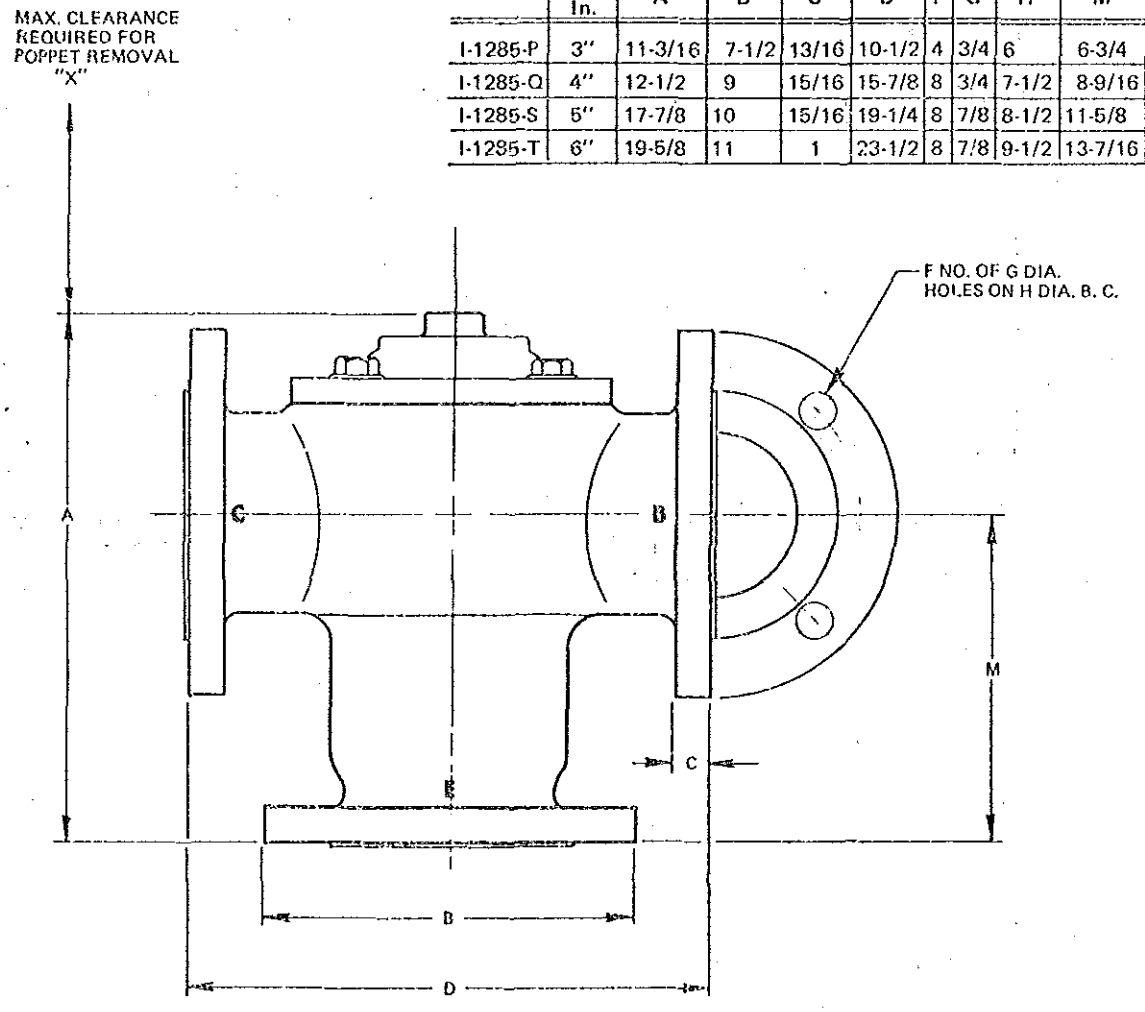
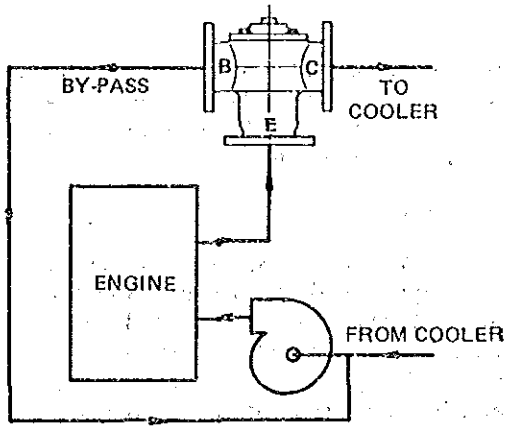
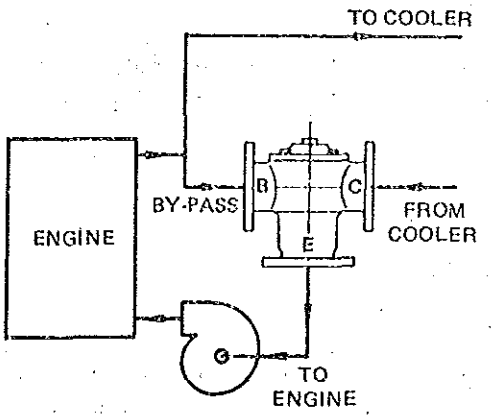


Figure 1

INSTALLATION (Cont'd)



PIPING SCHEMATIC — Used as diverting valve to control temperature leaving engine, most common application.



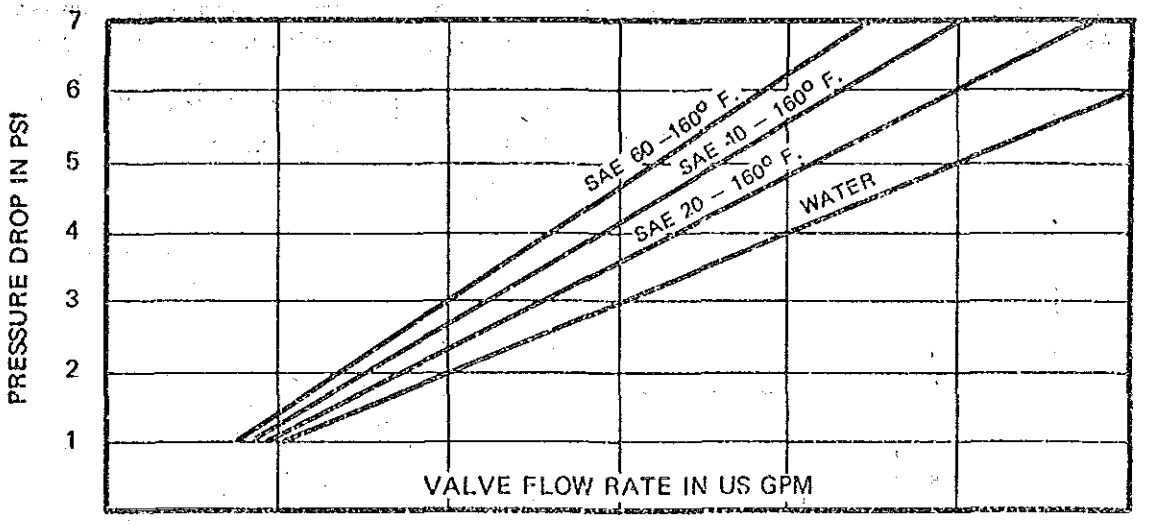
PIPING SCHEMATIC — Used as blending valve to control temperature entering engine.

Figure 2

OPERATION

With low temperature liquid surrounding the POWER PILL, the poppet is in the upward position which connects ports "E" and "B." As the temperature increases, the POWER PILL stem extends forcing the poppet downward. When the temperature reaches the control point of the regulator, the valve will be at mid-stroke. If the temperature continues to increase, the poppet will continue to move downward until the by-pass port (B) is completely closed off. (See Figure 4.)

FLOW COEFFICIENTS: Table below indicates the flow in U.S. G.P.M. at different pressure drops. C_V Coefficients are listed in column 1 under 1 psi pressure drop (water).



PORT SIZE							
	C – Cooler Port	107	151	188	214	239	262
3"	B – Bypass Port	116	164	201	232	260	284
	E – Mid Stroke	113	188	232	266	297	326
	C – Cooler Port	262	370	454	524	586	641
4"	B – Bypass Port	243	343	421	486	544	595
	E – Mid Stroke	324	457	561	648	725	794
	C – Cooler Port	408	576	706	816	911	1000
5"	B – Bypass Port	364	515	631	728	815	892
	E – Mid Stroke	500	707	865	1000	1120	1225
	C – Cooler Port	614	866	1060	1228	1375	1505
6"	B – Bypass Port	520	735	900	1040	1165	1275
	E – Mid Stroke	700	990	1210	1400	1570	1720

NOTE 1: C_V coefficients coincide with figures in first column.

NOTE 2: Data on "Mid-Stroke" shows total flow through inlet with valve in mid position.

NOTE 3: Normally for engine application, valve should be sized for total flow through cooler port, based on a pressure drop of 2 – 5 psi (incl.)

NOTE 4: Total leakage through seats and web, approximately 2% or less of total flow with O-Ring removed.

MAINTENANCE

A. RECOMMENDED SPARE PARTS

The following parts should be kept on hand for maintenance purposes:

1. Split "O"-ring seal.
2. Replacement power pills.
3. Bonnet gasket.

B. TROUBLE SHOOTING

If valve fails to make required stroke as temperature exceeds control point, check for:

1. Foreign matter interfering with poppet travel.
2. Swollen or damaged split "O"-ring seal. (See "Service," Page 2.)
3. Power pill failure.

If valve fails to return stroke as temperature drops below control point, check for:

1. Foreign matter interfering with poppet travel.
2. Swollen or damaged split "O"-ring seal. (See "Service," Page 2.)
3. Damaged load spring.
4. Power pill failure.

Excessive internal leakage between ports:

1. Damaged or worn out split "O"-ring seal. (See "Service," Page 2.)
2. Damaged or uneven valve seats.
3. Poppet not making complete stroke.

C. REPAIR

WARNING: Disassemble carefully – spring load forces present.

Replacing power pill elements:

1. Remove bonnet and poppet assembly from valve and place on wooden blocks. (See Figure 3.)
2. Loosen the bolts on top of the poppet and remove the stem and retainer by lifting upward.
3. Power pills and overrun assemblies may now be removed.
4. Reassemble as shown in Figures 4 through 7, depending on valve size.

Replacing split "O"-ring seal:

1. Remove bonnet and lift out the entire poppet assembly.
2. Remove old split "O"-ring and replace with a new one. (See "Service," Page 2.)
3. Replace poppet assembly, taking care not to cut or pinch ring.

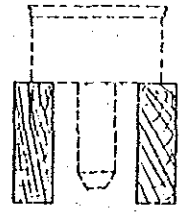


Figure 3

D. ADJUSTING THE I-1285

1. Rest the bottom of the poppet on blocks. (See Figure 3.)
2. Loosen stem locknut on inside of bonnet.
3. Place bonnet on the poppet assembly and adjust the stem until the poppet just touches seating surface on the bonnet.
4. Turn the stem into the bonnet one-half to one turn so that the poppet is securely seated.
5. Tighten locknut and bend the tab on the lock-washer.
6. The poppet and bonnet assemblies are now ready to install in the body.

E. REPAIR PARTS

For replacement part numbers, consult the parts list, Pages 5 and 6. When ordering give complete model number, spare part name and number, with quantity required.

Ordering Information:

Specify Model No. including suffix.

Order From:
ROBERTSHAW CONTROLS COMPANY
Industrial Instrumentation Division
P. O. Box 400
Knoxville, Tennessee 37901

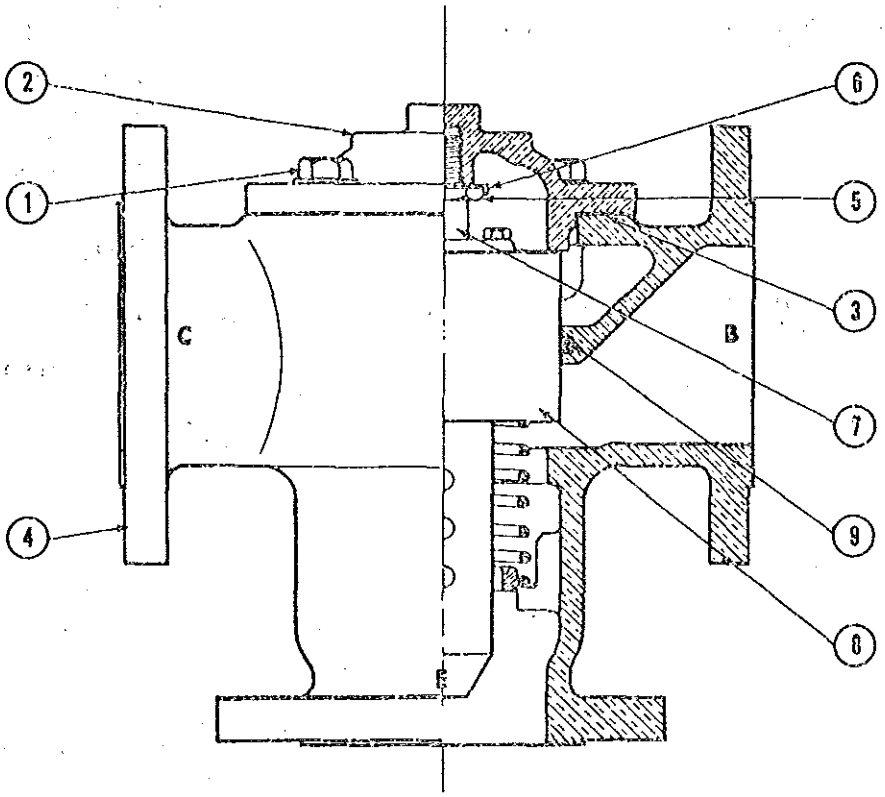
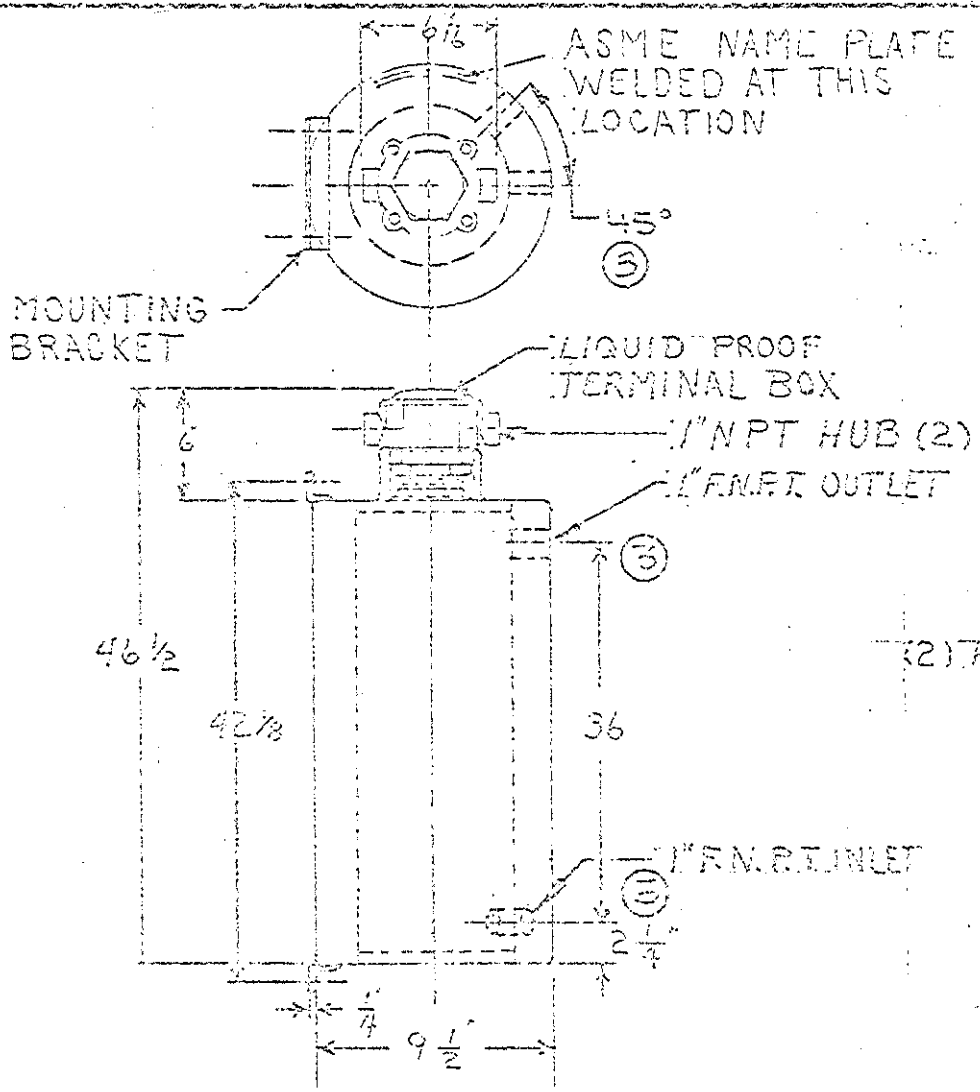


Figure 4

DETAIL NO.	DESCRIPTION	REGULATOR NUMBER & SIZE							
		I-1285-P 3"		I-1285-Q 4"		I-1285-S 5"		I-1285-T 6"	
		Part No.	No. Req'd	Part No.	No. Req'd	Part No.	No. Req'd	Part No.	No. Req'd
1	Cap Screw	3153-C	4	32322-A1	8	32322-B1	8	32322-B1	8
2	Bonnet & Seat Ring	81707-B1	1	20189-B1	1	20190-B1	1	20190-B1	1
3	Gasket	33110-A1	1	33110-A2	1	33110-A3	1	33110-A3	1
4	Valve Body & Seat Ring	81710-B1	1	84867-A1	1	84867-A2	1	84867-A3	1
5	Locknut	20195	1	20195	1	20195	1	20195	1
6	Lock Washer	20194	1	20194	1	20194	1	20194	1
7	Stem	20192	1	20685-B1	1	20686	1	20686	1
8	Poppet Assembly	See Fig. 5	1	See Fig. 5	1	See Fig. 6	1	See Fig. 7	1
9	Split "O"-Ring								
	A. Lube Oil Service	22777-B1	1	22777-C1	1	22777-E1	1	22777-E1	1
	B. General Purpose	22777	1	22777-D1	1	22777-F1	1	22777-F1	1



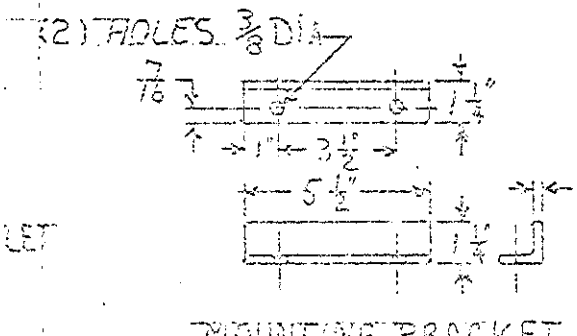
VENDOR PART NO: 34-12136

VENDOR: INDEECO, ST. LOUIS, MO

REPR: PYROMATIC INDUSTRIALS
MILWUAKEE, WI

SEE 11 908 456 FOR COLT FMEC Q.A. REQUIREMENTS ON VENDOR. (11)

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.



MOUNTING BRACKET

APPROVED Rev. 3 MAR 10 1977 QUALITY CONTROL

APPROVED Rev. 4 MFG. OCT 23 1980 QUALITY CONTROL

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REV NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	10236	5-16-77	Was Sheet 1 of 3	
3	"	"	SEE SHEET 3 of 4	
3	"	"	RELOCATED INLET & OUTLET (3)	
2	10129	11-10-76	See Sht. 3	
1	10102	10-29-76	DASH NO. SEE 11 908 456 Sht. 2	

TITLE
HEATER
JACKET WATER
15.0 KW

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 030
DECIMAL MACHINING TOLERANCES
0.- ± .030 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	PC1503	9/3/76	ASSY. OR LO.
DR. BY	D. HAYDEN	8/30/76	SCALE
CHK'D. BY	[illegible]	8/31/76	HEAT TR.
MAT'L.	PURCHASED		
APPV. CAST.		MATL.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 172 | SHEET 1 OF 4

Engine Division
701 Lawton Avenue
Beloit, Wisconsin 53511

A division of the Colt Industries Operating Corp

QUOTATION INQUIRY

THIS IS NOT AN ORDER

DATE 11/17/86

REFER TO THIS NUMBER IN ANY CORRESPONDENCE

No. BQ 25537

PURCHASING DEPARTMENT

TO Kay Mullen
INDEECO
% Pyro-Matic Inc
11901 W. Dearborn Ave
Wauwatosa, Wisconsin 53226

2/3/87
TO: T. Chase
Limerick

Your proposal considered only in this form. Attach additional sheets, photos, etc., as necessary.

Itemize all prices, discounts and charges separately.

Show taxes, if applicable, separately.

We reserve the right to accept all or part, or decline the whole, there is no obligation to buy.

Attach complete specifications for any substitutions or design changes offered. We invite your suggestions.

The terms and conditions appearing on the reverse side hereof will become a part of any order. The buyer will not be responsible for fabrication of any portion of an order beyond quantity released by shipping schedule appearing on face of Purchase Order, nor for quantities fabricated in advance of time necessary to meet schedule. Partial shipments, other than as scheduled, are not authorized.

Shipments must be made complete as scheduled.

PLEASE QUOTE AT ONCE ON THE FOLLOWING: THIS IS NOT AN ORDER

REPLY MUST BE IN BEFORE November 28, 1986

FOR SHIPMENT TO:

ITEM	QUANTITY	F.M. PART NO.	DESCRIPTION	NET PRICE	UNIT	LEAD TIME REQUIRED
			Put on CRT 25L22-020S-A2			
1	2		25-L22-020S-A2 - Element (for 11908170) L. O. Heater	$ 152.46	ea	8 weeks
2	2		38W36-150C-AD - Element (for 11908172) J. W. Heater	$ 185.71	ea	
			+ $50.00 for reports if needed			
			APPLICABLE ASME CODE IS IV, 1977 Edition			
			Stamp 30 - ASME DATA REPORT FORMS (as applicable)			
			Limerick Put on CRT 2/4/87			

PRICES FIRM FOR ACCEPTANCE BEFORE JUN'87

THE UNDERSIGNED OFFERS THE PRICES, TERMS AND DELIVERY SET FORTH

VIA TRUCK ROUTING F.O.B. St. Louis DELIVERED TERMS Net 30

K. Mullen BUYER

DATE 11/20/86 SIGNED D Ellis

NOTE CONDITIONS REVERSE SIDE
DUPLICATE - RETURN FOR YOUR FILE

FORM NO. 34-7140-83-1

INDEECO INDUSTRIAL ENGINEERING & EQUIPMENT CO.

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS FOR SERIES 56 ELECTRIC HOT WATER BOILERS, INSTANTANEOUS WATER HEATERS AND OIL PREHEATERS

GENERAL INSTRUCTIONS

1. Install the heater in the position checked on the reverse side of this sheet.
2. CAUTION: DO NOT TURN ON HEATING ELEMENTS UNTIL TANK IS COMPLETELY FULL OF LIQUID. Permanent damage may result if elements are energized when heater is dry.

PLUMBING INSTALLATION INSTRUCTIONS

1. Pipe the incoming liquid to the nipple marked "Inlet." Pipe the hot outgoing liquid from the nipple marked "Outlet."
2. Install a pressure gauge and temperature gauge in the outlet line.
3. If this heater is not furnished with a relief valve, and it is being installed in a closed system, install a relief valve in the outlet line. Normally, a pressure relief valve is sufficient unless your local code requires a pressure-temperature relief valve.
4. This equipment is designed to operate at the maximum pressure and temperature shown on the nameplate.
5. Large size heaters are furnished with flanged immersion heaters, secured to the vessel head with eight (8) bolts. After the heater has run through one or two heating cycles, these bolts should be retightened.

ELECTRICAL INSTALLATION INSTRUCTIONS

1. Follow the wiring diagram included with this instruction sheet. An additional copy is attached inside the heater terminal compartment.
2. Heaters operating at more than 250 volts may require a separate low voltage control circuit. If this heater is furnished with remotely mounted magnetic contactors, the control voltage is shown on the contactor enclosure nameplate. If this heater has built-in magnetic contactors, the control voltage is shown on the control circuit terminal block unless a control circuit transformer has also been provided.
3. All connections must be sized to carry the heater load per Table 310-12 of the National Electrical Code. However, wiring insulation should be rated for at least 90° C. If wiring material for your application is not readily available, consult factory for assistance.
4. Ground the preheater. Normally, it will be grounded through the conduit feeding the preheater. However, if non-metallic conduit or flexible metallic conduit are used, a separate grounding connection is required.

425 Hanley Industrial Court Area Code 314 644-4300 St. Louis, Missouri 63144

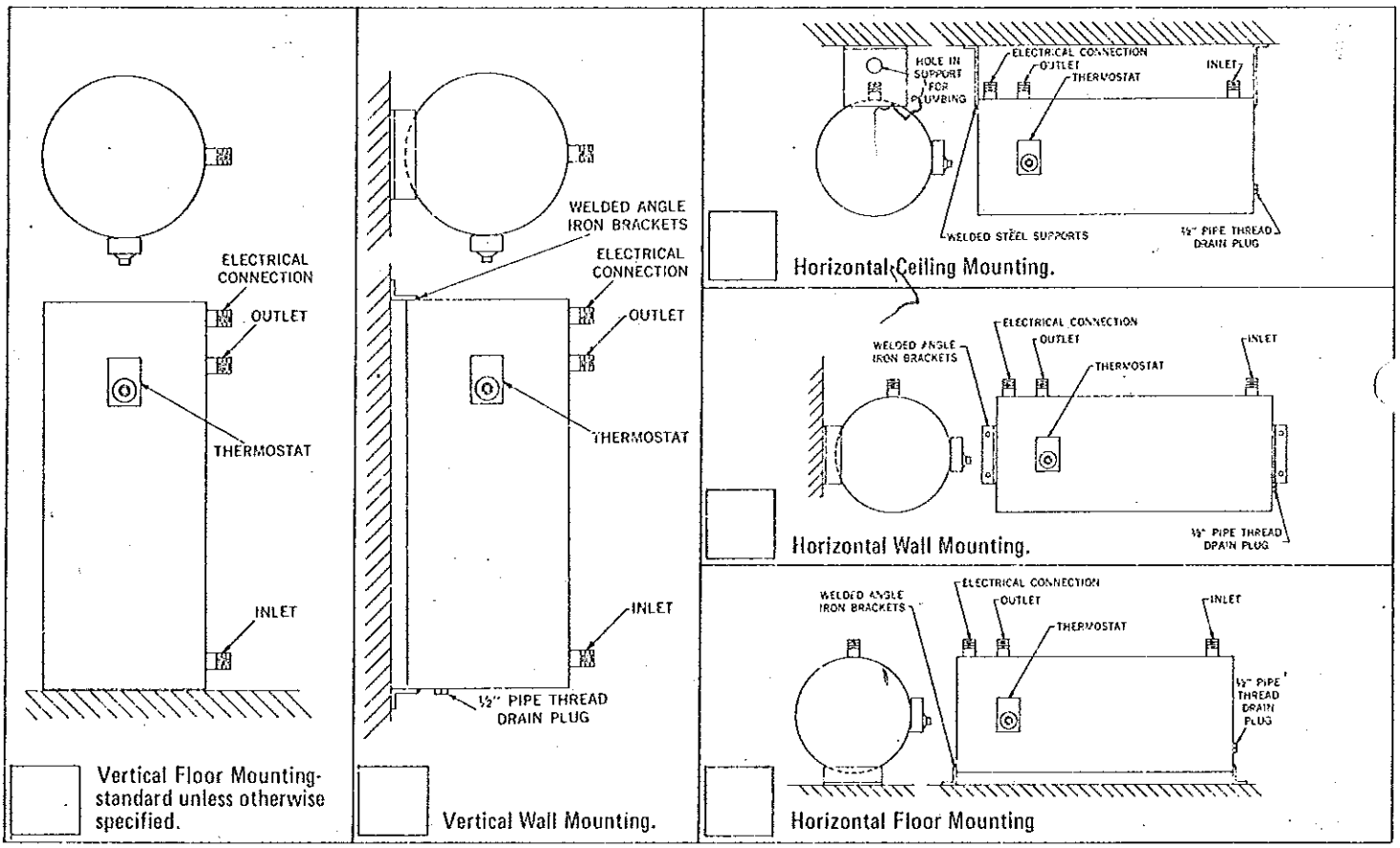
INDEECO INDUSTRIAL ENGINEERING & EQUIPMENT CO.

MOUNTING INSTRUCTIONS FOR PREHEATERS

This heater has been constructed for the mounting marked below. It must be mounted in this manner, otherwi improper operation or damage may result.

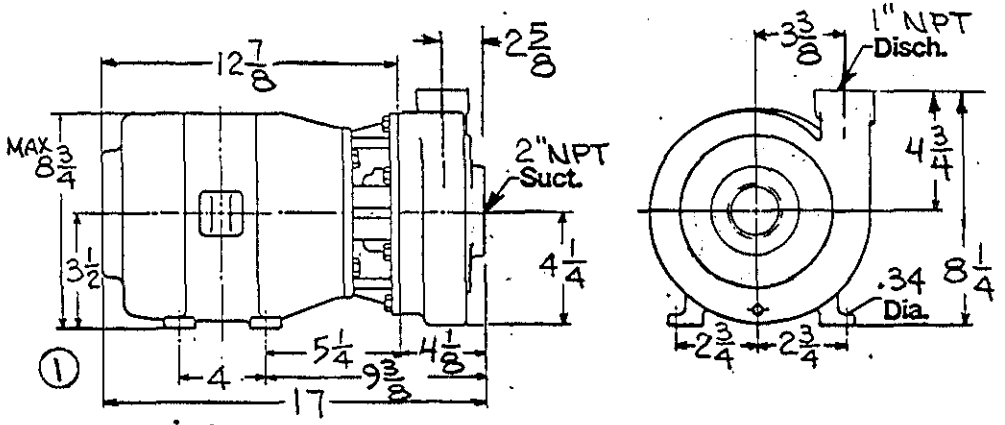
OPERATING AND MAINTENANCE INSTRUCTIONS

1. If flanged immersion heaters are furnished, periodically retighten the bolts that secure them to the vessel head.
2. To operate this preheater, fill the tank completely with liquid, energize the main supply disconnect, and set the controlling thermostat to the desired temperature.
3. If this heater has a manual reset high limit thermostat, be sure that the reset button is pressed in.



425 Hanley Industrial Court Area Code 314 644-4300 St. Louis, Missouri 63144

DESCRIPTION: PEERLESS SERIES "C" END SUCTION PUMP TYPE 610 AM AND WESTINGHOUSE 1 HP, 1750 RPM, 460 VOLT, 3 PHASE, 60 HZ 143 JM FRAME MOTOR.



Per Jack Rider
Seal P/N 2687526
4/25/88

VENDOR: FMC CORP.
PUMP DIVISION
INDIANAPOLIS, IND

REPR: WALTER B ROM & SONS, INC
1060 N. 115TH STREET
WAUWATOSA, WI

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11-77	SEE SHTS 2-6	
2	"	"	REDRAWN, ELECTRIC MOTOR ADDED (1)	

TITLE
PUMP SET, CENTRIFUGAL
END SUCTION
40 GPM, 1 HP, 1750 RPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY R. NORMAN	1/27/77	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 178 | SHEET 1 OF 6

BF3009-2

I. PUMP:

A. GENERAL REQUIREMENTS:

1. TO HAVE IMPELLER TRIMMED TO 4-3/4" TO DELIVER 40 GPM @ 20' TDH @ 1750 RPM.

2. COMPLETE PUMP TO BE HYDROSTATICALLY TESTED TO 60 PSIG.

3. FOR WATER CIRCULATION.

4. TO BE EQUIPPED WITH MECHANICAL SEAL.

~~5. MINIMUM BEARING LIFE 5 YEARS CONTINUOUS OPERATION (AVERAGE LIFE 25 YEARS).~~

B. LOADING CONDITIONS:

1. WORKING PRESSURE 40 PSI MAX.

2. IMPACT LOADS NEGLIGIBLE.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11-77	Deleted Par. I.A.5	
2	"	"	SEE SHTS 1&3-6	
2	"	"	REDRAWN, PARA. IDENT. REVISED	

TITLE
PUMP SET, CENTRIFUGAL
END SUCTION
40 GPM, 1 HP, 1750 RPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY R.NORMAN	1/27/77	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 178 | SHEET 2 OF 6

BF3009-2

(1) II. MOTOR:

A. GENERAL INFORMATION:

1. THE APPLICATION OF THIS MOTOR IS DRIVING A CENTRIFUGAL IN A STANDBY HEATING SYSTEM OF A DIESEL ENGINE OF AN EMERGENCY GENERATOR SET. MOTOR OPERATION IS CONTINUOUS.
2. INSULATION - CLASS B.
3. MECHANICAL FEATURES - OPEN DRIP PROOF.
4. AMBIENT TEMP. - 40°C.
5. SERVICE FACTOR - 1.15
6. MOTOR WILL BE TYPE "B" NEMA DESIGN

III. PUMP SET:

A. SPECIAL REQUIREMENTS:

1. THE PUMP SET IS TO BE TESTED AND/OR ANALYZED AS FOLLOWS:

a. HYDROSTATIC TEST (SEE I.A.2) ABOVE.

(2) b. WHILE COMPLETE SEISMIC ANALYSIS IS NOT REQUIRED, PUMP SET MUST WITHSTAND FORCES OF 1.1G VERTICAL AND 3 G HORIZONTAL MAXIMUM ACTING SIMULTANEOUSLY AS A RESULT OF A SEISMIC EVENT AND RETAIN ITS STRUCTURAL INTEGRITY. VENDOR TO ADVISE COLT THE MAXIMUM FLANGE LOADING PERMISSIBLE SIMULTANEOUSLY WITH ABOVE "G" FORCES.

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11 77	See Shts 1 &2, 4-6	R.H. F.H.
2	"	"	Removed F.M. Duties	R.H. F.H.
2	"	"	Revised Loading Reqmts (2)	R.H. F.H.
2	"	"	Redrawn, Electric Motor added (1)	R.H. F.H.

TITLE: PUMP SET, CENTRIFUGAL END SUCTION
40 GPM, 1 HP, 1750 RPM

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. NORMAN	1/27/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 178 | SHEET 3 OF 6

BF3009-2

III. PUMP SET - CONT'D

(1) B. PAINTING AND PRIMING REQUIREMENTS:

SURFACES REQUIRING PRIME AND PAINT

TO BE SUPPLIED WITH VENDOR'S STANDARD SHOP PRIME ONLY. ALL INTERNAL AND EXTERNAL SURFACES SHALL BE THOROUGHLY AND COMPLETELY CLEANED OF ALL MILL SCALE, CUTTINGS, OIL, WELDING SPATTER, AND OTHER FOREIGN MATTER. THE SURFACES SHALL THEN FURTHER BE CLEANED TO A MINIMUM REQUIREMENT AS SET DOWN BY SSPC-3 (POWER TOOL CLEANING) PRIOR TO PRIMING AND SHIPMENT. THE DRY FILM THICKNESS SHALL BE AT LEAST 1.5 MILS, BUT NO MORE THAN 2.0 MILS. GOOD PAINT PRACTICE, AS STATED IN SSPC-PA-1 SHALL BE OBSERVED.

SURFACES NOT REQUIRING PRIME

MACHINED SURFACES SHALL BE PROTECTED WITH AT LEAST 4 MILS DRY FILM THICKNESS OF MIL-C-16173 GRADE 5 OR SIMILAR PRODUCT APPROVED BY BUYER.

(2) C. VENDOR TO COMPLETE BECHTEL FORM 8031-M-71-DS-13, REV. 2 ROTARY PUMP DATA SHEET AS SOON AS POSSIBLE FOLLOWING RECEIPT OF ORDER AND RETURNED TO COLT INDUSTRIES, PURCHASING DEPARTMENT.

(2) D. VENDOR TO COMPLETE BECHTEL FORM 182, REV. 2/18/70 (P & I FORM #G-162, SHEET 2) AND SUBMIT FOR APPROVAL.

(3) E. MERCURY SHALL NOT BE USED IN ANY FORM IN THE PUMP SET PER BECHTEL SPEC. 8031-M-71, PG. 13, REV. 3, PARA. 4.1.j.

(3) F. SPECIAL TOOLS SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.13.

(3) G. SPARE PARTS LIST SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 36, REV. 3, PARA. 4.14.

(3) H. NAMEPLATES SHALL BE SUPPLIED PER BECHTEL SPEC. 8031-M-71, PG. 42 & 43, REV. 2, PARA. 6.2.

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11 77	Added Spec. Reqmts D,E,F,G & H (3)	RHH R.K.
2	"	"	See Shts 2-3 & 5,6	RHH R.K.
2	"	"	Added Vendor's Req. for Data Sheets (2)	RHH R.K.
2	"	"	Added Painting & Priming Reqmts (1)	RHH R.K.

TITLE
PUMP SET, CENTRIFUGAL END. SUCTION
40 GPM, 1 HP, 1750 RPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.		/ /	ASSY. OR LO.
DR. BY	R. NORMAN	1/27/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 178 | SHEET 4 OF 6

BF3009-2

(1) IV. F. M. DUTIES:

A. SUPPLY COPY OF BECHTEL DATA SHEET 8031-M-71-DS-13, REV. 2, BECHTEL FORM 182, REV. 2/18/70 (P & I FORM #G-162 SHEET 2), AND BECHTEL SPECIFICATION 8031-M-71, PG. 13, REV. 3, PARA. 4.1.j, PG. 36, REV. 3, PARAS. 4.13 & 4.14 AND PGS. 42 & 43, REV. 2, PARA. 6.2 WITH PURCHASE ORDER.

(2) V. PUMP PERFORMANCE CURVE IS ATTACHED.

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Colt Industries Fairbanks Morse Engine Division

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	10187	2-11-77	See Shts 1-4 & 6	R.H. R.H.
2	"	"	Added V.-Pump Perf Ref (2)	R.H. R.H.
2	"	"	Added FM Duties (1)	R.H. R.H.

TITLE
PUMP SET, CENTRIFUGAL
END SUCTION
40 GPM, 1 HP, 1750 RPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries Fairbanks Morse Engine Division

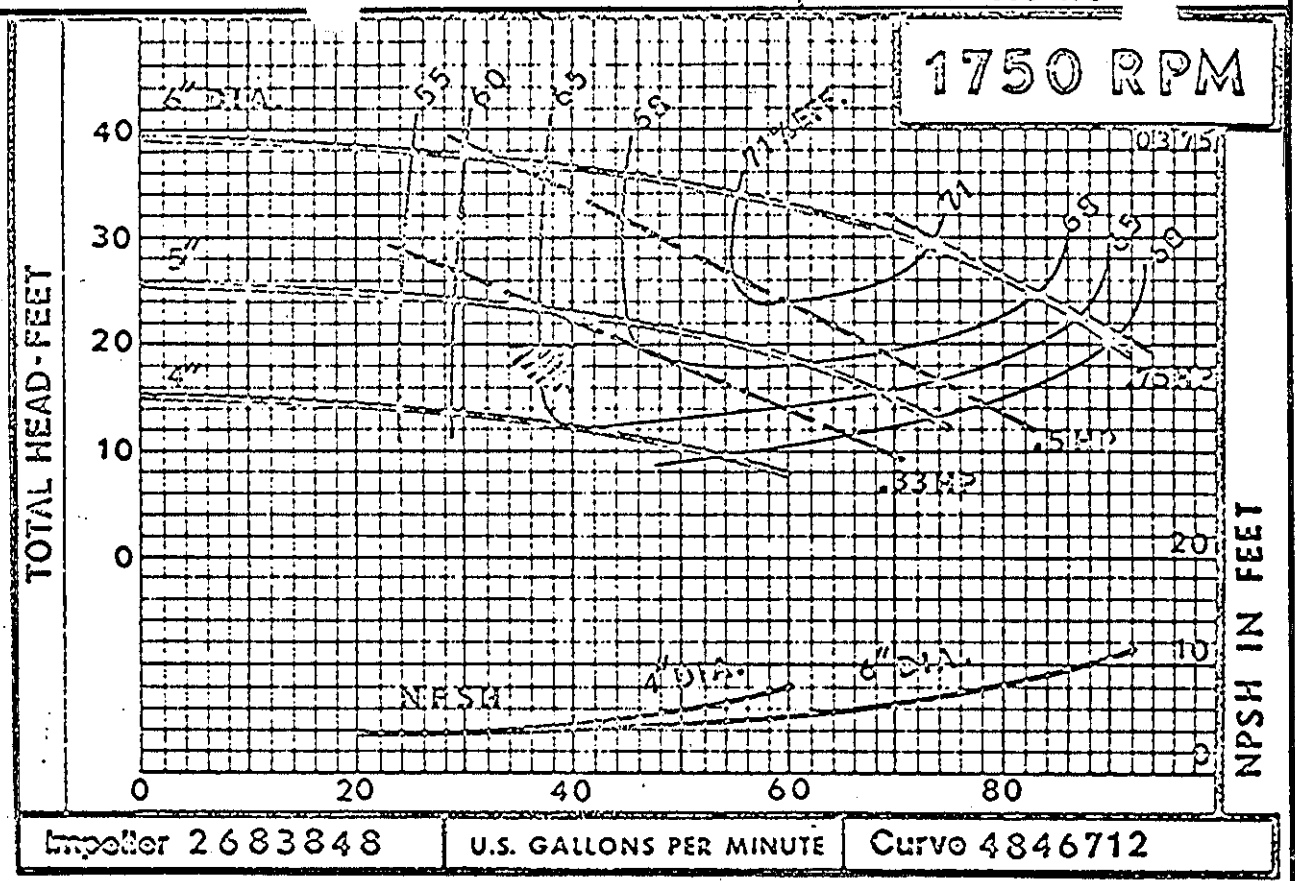
REL. NO.		/ /	ASSY. OR LO.
DR. BY R. NORMAN		1/27/77	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 908 178 | SHEET 5 OF 6

BF3009-2

PROPRIETARY
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Colt Industries — Fairbanks Morse Engine Division



Impeller 2683848 | U.S. GALLONS PER MINUTE | Curve 4846712

FOR REFERENCE ONLY - NOT CERTIFIED

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10187	2-11-77	SEE SHTS 1-5	
1	"	"	ADDED PUMP PERF. CURVES	

TITLE
PUMP SET, CENTRIFUGAL
END SUCTION
40 GPM, 1 HP, 1750 RPM

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY R.NORMAN	1/27/77	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 178 | SHEET 6 OF 6

BF3009-2

SEALTYPE PUMP

End suction close coupled pumps

Series C

Instructions

- Installation
- Operation
- Maintenance

Read this entire book

before attempting to install, operate or repair this pump. Properly installed, your Peerless pump will give you satisfactory, dependable service. We urge that you read carefully these step-by-step instructions, to simplify any problems of installation, operation or repair.

Failure to read and comply with installation and operating instructions will void the responsibility of the manufacturer and may also result in bodily injury as well as property damage.

This book is intended to be a permanent part of your pump installation and should be preserved in a convenient location for ready reference. If these instructions should become soiled obtain a new copy from Peerless Pump. Include pump model and/or serial number with your request.

WARRANTY

New equipment manufactured by Seller is warranted to be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment; Seller's obligation under this warranty being limited to repairing or replacing at its option any part found to its satisfaction to be so defective provided that such part is, upon request, returned to Seller's factory from which it was shipped, transportation prepaid. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment. This warranty does not cover parts repaired outside Seller's factory without prior written approval. Seller makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture, since the same are usually covered by warranties of the respective manufacturers thereof.

In the event, notwithstanding the terms of this agreement, it is determined by a court of competent jurisdiction that an express warranty has been given by Seller to Purchaser with respect to the head, capacity or other like performance characteristics of said equipment, Seller's liability for breach of the same shall be limited to accepting return of such equipment F.O.B. plant of manufacture, refunding any amount paid thereon by Purchaser (less depreciation at the rate of 15% per year if Purchaser has used equipment for more than thirty (30) days) and cancelling any balance still owing on the equipment.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SELLER SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Peerless Pump
An Indian Head Company

4846187
MODIFIED

IMPORTANT SAFETY PRECAUTIONS

Pump parts, and the tools and rigging equipment used in installing pumps, are heavy and may easily cause personal injury if dropped or carelessly handled. The normal precautions and safety rules associated with the erection of heavy machinery, in regard to manual lifting, use of power equipment, and handling of tools, must be observed in the installation of this pump.

Petroleum-base cleaning solvents are flammable. Smoking by personnel in the vicinity of these solvents is extremely hazardous and must not be permitted.

Do not work under a heavy suspended object unless there is a positive support under it to stop its fall in event of sling or hoist failure. Disregard of this warning could result in grave personal injury.

Before opening the conduit box of an electric motor, be certain that the current to the motor is shut off. An electrical shock from contact with live motor leads can be fatal.

Before attempting repairs to pump open the disconnect switch to electric motor. This prevents accidental running of pump motor. Starting motor during pump repair activities could damage pump and may cause personal injury.

Because cap screws have a tendency to loosen on shipment retighten all cap screws to casing and to motor adapter before installing pump. Refer to reassembly instructions paragraph 10 for torque values.

WARNING

The pumps described by this manual must not be installed in any manner except as specified herein, and must not be operated at a speed or a flow capacity different than those specified at the time of original construction. If you are unsure of originally specified speed or flow capacity, or any changes to speed or flow capacity are being considered, do not proceed without consulting the Peerless Pump factory or serious equipment damage and failure may result. The pump must be operated within the limitations described by the pressure-temperature table reproduced below.

Maximum Working Pressure		Pumped Liquid Temperature
175 PSIG	@	20° - 150°F
165 PSIG	@	200°F maximum allowable for iron fitted construction
150 PSIG	@	250°F maximum allowable for bronze fitted construction

These pumps must not be used to pump any fluid other than that specified for the order. Liquids to be pumped must be non-corrosive and non-abrasive or damage can occur to the pump. The liquid pumped by a mechanical seal version of a pump with bronze fitted construction must not contain hydrocarbons or the mechanical seal will be damaged and pump failure will result. Note: Mechanical seals which will not be damaged by the presence of hydrocarbons are available and may be obtained from the factory. Such seals are standard in mechanical seal versions of pumps with iron fitted construction. Violation of this warning will void the warranty and may result in serious property damage or grave personal injury.

INTRODUCTION

UPON RECEIPT OF PUMP EQUIPMENT –

Check carefully to see that all of the equipment has been received. Report immediately any shortages or damages to the transportation company handling the shipment, noting the extent of the damage or shortage on the freight bill and bill of lading.

Do not leave the unit exposed to weather or construction hazards. The pump may become mechanically damaged. This pump is a well designed and carefully manufactured unit. It should be given the same attention accorded to any precision machine.

The satisfactory operation of a pump depends to a large extent upon proper installation. These instructions cannot answer every question that may arise as each installation will be different. The installer and the operator of this equipment must use good judgement to adapt these procedures to his installation.

PUMP TYPES

Type C End Suction pumps are furnished in two types, PACKED and MECHANICAL SEAL. Either version may be furnished in bronze fitted or iron fitted construction in accord with original specification.

INSTALLATION

WARNING Do not work under a heavy suspended object unless there is a positive support under it to stop its fall in event of sling or hoist failure. Disregard of this warning could result in grave personal injury.

LOCATION: The pump should be installed in a clean, well-drained and ventilated location, and be accessible for inspection and proper care. Ample room should be provided for installation and removal.

FLOOR MOUNTING: A raised concrete foundation may be provided for convenience of elevation but it is not required if the floor is level. If a concrete foundation is provided it should be solid and rigid to support the complete unit without deflection or vibration.

PIPING: The suction and discharge piping should not be smaller than the inlet or outlet connections of the pump. The piping should be arranged to avoid an excessive number of elbows, tees and other fittings. Avoid pockets and loops in the suction line. Be sure the suction connections are tight because air leakage can cause a reduction in pump capacity or loss of prime.

CAUTION Make certain that the pump is free from piping strains which may cause misalignment, resulting in a possible binding of the rotating element. Avoid springing the piping into line and use caution when tightening the connections. Provide a suitable means (other than the pump) to support the weight of the suction and discharge piping. It is important, particularly in new pipe lines, that the piping is properly cleaned of all foreign material. Failure to adhere to these precautions can result in equipment damage and malfunction.

WIRING AND CONTROLS: For electric motor drives connect power supply to conform with national and local codes. Line voltage and wire capacity must match the ratings stamped on the motor nameplate. DO NOT USE ANY OTHER VOLTAGE.

PUMP ROTATION: Momentarily operate the motor to check that the pump shaft rotates counterclockwise (looking toward pump inlet) as shown by the arrow on the pump casing. Do not allow motor to run in reverse (opposite to arrow) direction for any length of time.

CAUTION Prime pump before starting motor or damage can occur to internal pump parts.

PRIMING: A centrifugal pump must be primed before it can be operated. If run dry, damage can occur to close-clearance rotating parts and will destroy packing and mechanical seal faces. Also, if not primed properly, it will not deliver fluid. Prime in one of the following ways:

a. If the system has suction pressure, bleed all air from the pump casing and suction pipe by opening the pipe plug provided at top of the casing. Rotate the shaft a few times if possible to evacuate any air trapped inside the impeller passages.

b. If the system has a suction lift and there is a foot valve in the suction pipe, fill the pump casing and suction pipe with water from an outside source. At the same time, let the trapped air escape through the pipe plug at the top of the casing.

c. If the system has a suction lift but no foot valve, use a vacuum pump or ejector operated by air, steam, water, engine exhaust, etc., to evacuate the air from the pump case and suction pipe by connecting the ejector to the priming connection on the top of the casing.

~~Note: On packed pumps applied to systems where the suction pressure varies between lift and about 15 psi, a lantern ring with water seal piping is to be used. Order from factory.~~

OPERATION

BEFORE STARTING THE PUMP:

1. Never operate or spin the pump unless it is fully primed. (See "Priming".)
2. Turn the shaft by hand to see that it rotates freely.
3. Check that the voltage and frequency on the motor nameplate match the current supply.
4. Be sure the motor is wired for correct voltage.
5. Check that all thermal overload relays are of the proper size and "set" for operation.
6. Be sure the valve in the suction line is open. The discharge valve should be closed.
7. Review remainder of these instructions.

AFTER STARTING THE PUMP:

1. Check the pump rotation with the direction of the arrow on the pump casing. If necessary, change direction.
2. Check the pump for evidence of rubbing or binding which may have been caused by piping strains.
3. Slowly open the discharge valve.
4. See that all pipe connections are tight.

~~5. On packed pumps, make certain that a slight amount of water escapes from the stuffing box at the gland. This water is required to lubricate the packing.~~

LOCATING TROUBLE

IF PUMP AND MOTOR FAIL TO START:

1. Check for blown fuses or a tripped thermal overload relay.
2. Shaft may be stuck or binding due to rubbing of clogged impeller or other mechanical defect. ~~On packed pump the gland may be too tight, thus binding the shaft.~~
3. Starter contacts may be corroded, shorted, or terminal connections may be broken somewhere in the circuit.
4. The wiring hookup or voltage provided may be incorrect or switches may not be "set" for operation.

IF INSUFFICIENT OR NO WATER IS DELIVERED:

1. Pump may not be primed. (See "Priming").
2. The speed may be too slow. Check for low voltage.
3. The required discharge pressure may be higher than anticipated.
4. Suction pressure may be lower than anticipated.
5. The impeller may be clogged or damaged.
6. Wrong rotation. Check direction of shaft rotation with arrow on the pump casing.
7. The suction or discharge lines may be clogged or valves in lines may not be fully open.

IF PUMP LOSES PRIME:

1. The suction line may be leaking.
2. The suction pressure may be too low.
3. The pumped liquid may contain air or gas.

IF PUMP VIBRATES OR IS NOISY:

1. The foundation may be insufficient or not secure.
2. The impeller may be partially clogged causing an unbalanced condition.
3. Mechanical defects may be evident, such as a bent shaft, rotating element binding or worn bearings.
4. Suction or discharge pipes may not be anchored sufficiently.
5. The pump may be vapor bound – not fully primed. (See "Priming").
6. Insufficient net positive suction head available; cavitation.

MAINTENANCE

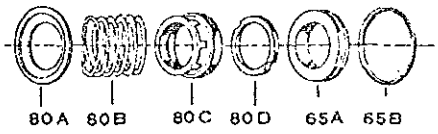
To insure the best operation of the pump, make a systematic and periodic inspection to check the following:

1. See that the driver is up to speed. Check driver manufacturer's instructions for periodic maintenance requirements.
2. See that the electrical control equipment is clean and contacts are in good condition.
3. Check operation of the pump. See that it runs smoothly and is reasonably quiet.
4. ~~On packed pump, see that some leakage occurs from the gland (17).~~

CAUTION Where the pump is installed in an unheated location, precaution must be taken to protect the pump and pipe lines from freezing. If the unit is to remain idle for long periods during cold weather, the pump must be drained by removing the drain plug in the bottom of the casing (1). Reprime pump when reused.

LUBRICATION: No pump lubrication is required. Adhere to the motor manufacturer's recommendations for lubricating the motor.

MECHANICAL SEAL



*80A Spring Retainer
80B Spring
80C Seal Bellows Assy
80D Sealing Washer
65A Floating Seat
65B Seat Ring

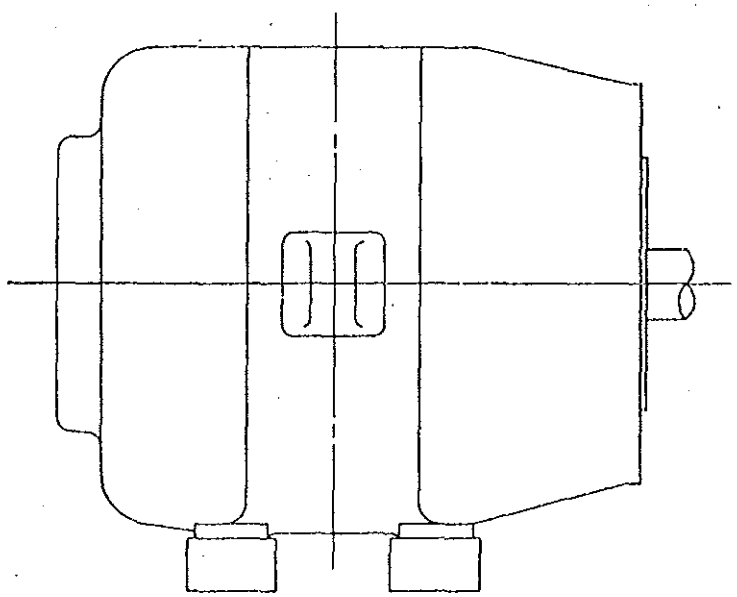
* Some pumps have a step turned on the impeller hub to accept the spring and therefore do not have or use a spring retainer.

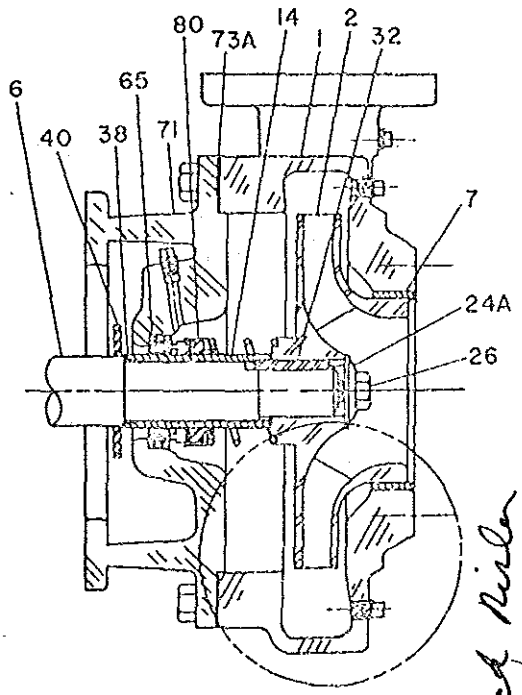
PUMP REMOVAL

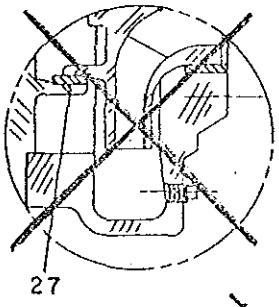
WARNING Always take adequate precaution to prevent accidental running of pump motor, before starting to remove pump from base. Starting motor during pump removal could damage pump and may cause personal injury.

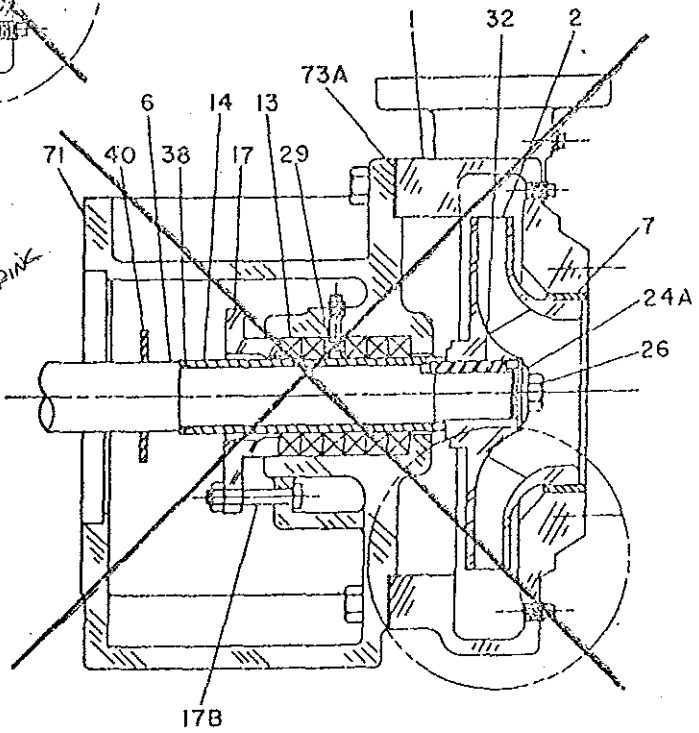
1. Open the disconnect switch to cut off power to the motor. Temporarily tie switch open and attach note: DO NOT CLOSE SWITCH – PUMP REPAIR IN PROCESS.
2. Close valves in suction and discharge lines.
3. Disconnect the motor leads and carefully mark them so they can be reconnected in the exact same order.
4. Remove plug from bottom of casing (1, Figure 1) and drain casing.
5. Disconnect suction and discharge lines.
6. Remove the hold-down bolts and move pump to bench for disassembly.

WARNING Before opening conduit box of electric motor be certain that the current to the motor is shut off. An electrical shock from contact with live motor leads can be fatal.









1 Casing
2 Impeller
6 Shaft
7 Casing Ring
~~18 Packing~~
14 Shaft Sleeve w/ O RING
~~17 Gland~~
~~17B Gland Bolt~~
24A Impeller Washer
26 Impeller Lock Screw
~~27 Adapter Ring~~
~~29 Lantern Ring (optional)~~
32 Impeller Key
38 Shaft Sleeve Gasket — OBSOLETE
40 Deflector
65 Mechanical Seal, Stationary Element
71 Adapter
73A Casing Gasket
80 Mechanical Seal, Rotating Element

2691519 w/ o RING 7-29-93 T. Ryan

Per Jack Nila Sales p/n SB 26876 26 Glendale S/B SALENTINE 4/4 2 58 4700 IN MILWAUKEE

Figure 1. Type C End Suction Pumps

48461

PUMP DISASSEMBLY

Disassemble pump in the following manner:

~~NOTE: The pump may be either packed or with a mechanical seal. Procedures for the two types of sealing differ slightly.~~

1. Remove any seal piping (tubing) that may be present between pump discharge and stuffing box of adapter (71, Figure 1).
2. Take out all screws and remove casing (1) and casing gasket (73A). If necessary, lightly tap with plastic hammer at several places to loosen casing from adapter.
3. Insert a rod of suitable diameter into a passage of impeller (2) and hold while loosening impeller lock screw (26). Remove lock screw and impeller washer (24A).
4. Slide impeller from end of shaft (6) and remove impeller key (32). If impeller is hard to remove, use a small wood block against adapter and pry carefully at several points around impeller to loosen.
5. For the mechanical seal pump, very carefully remove seal parts (80A thru 80D). Be particularly careful not to scratch or damage lapped surface of sealing washer (80D). Store seal parts in suitable container; lapped surface of sealing washer must be up and covered.

~~6. For the packed pump, loosen both gland bolts (47B) and pull gland (47) out slightly to relax packing (43).~~

7. Remove screws and slide adapter (71) off from shaft. Use care not to scratch shaft sleeve (14).
8. Carefully push floating seat (65A) from adapter, avoiding scratching or other damage to lapped surface. Use narrow, flat screwdriver to lift and work O-ring (65B) from seat. Store seat with remaining mechanical seal parts with lapped surface up and covered.

~~9. Remove gland (47), packing (43) and lantern ring (29) (if furnished) from adapter (for packed pump).~~

10. Slide shaft sleeve (14), shaft sleeve gasket (38) and deflector (40) from shaft.
11. Remove casing ring (7) from casing *only if damaged or worn to excess* (refer to Repair).

CLEANING

WARNING Petroleum - base cleaning solvents are flammable. Smoking or open flames in the vicinity of these solvents is extremely hazardous and must not be permitted. Disregard of this warning could result in grave personal injury.

Clean all metal parts with a solvent. Use a bristle brush (not metal or wire) to remove tightly adhering deposits. A fiber scraper may be used to remove the gasket and shellac from casing flanges. Blow dry with clean dry compressed air.

CAUTION Never use hydrocarbon liquids (oil or solvent) to clean mechanical seal parts. Use of oil or solvent will deteriorate material used for manufacture of the seal.

Clean seal parts using a mild soap solution. Rub only with finger to remove dirt. Rinse with clear water and dry with mild air stream. Use care not to damage or scratch lapped surfaces.

INSPECTION

Visually inspect and replace parts that are damaged and affecting the serviceability or sealing. Emphasize inspection of mating parts having relative motion – casing rings, for example. Perform detailed inspection as follows:

1. Check O-rings, gaskets, and seals for shrinkage, cracks, nicks or tears.

~~2. Check packing rings for excessive compression, fraying or shredding, embedded particles (dirt or metal). Replace if defective in any way.~~

3. Examine impeller passages for cracks, dents, gouges or embedded material.
4. Inspect shaft sleeves (14) for excessive wear. Replace sleeves that are worn. Replace gasket.
5. Inspect lapped surfaces of sealing washer and floating seat for chipping, gouges, nicks, scratches or other damage. These surfaces must be free from any defect. If lapped surfaces are damaged, replace the entire seal.

REPAIR

When ordering repair parts give the complete pump nameplate data (nameplate on the pump casing) plus the name and item number of the part shown on sectional view.

Remove burrs, nicks, and scratches from non-critical areas with a fine stone or crocus cloth.

1. Impeller and Casing Wear. If the pump capacity falls off due to wear on the impeller and casing ring, repair is made by replacing the casing ring. The inside diameter of the casing ring should be 0.008" to 0.012" larger than the impeller skirt diameter.
2. Normally, when the pump is completely disassembled, all gaskets, O-rings and seals.

should be replaced at reassembly. If the O-ring for the floating seat of the mechanical seal is not damaged, it may be reused with the other, satisfactory seal parts.

REASSEMBLY

WARNING The replacement electric motor must be of the same voltage, RPM and frame number as original motor. If replacement motor is of higher RPM pump will develop excessive pressure and horsepower causing pump and equipment damage and personal injury.

Reassemble pump in the following manner:

1. Install deflector (40), shaft sleeve gasket (38) and shaft sleeve (14) on shaft. Be sure gasket is completely contained by sleeve and that sleeve bottoms on shaft shoulder. Position deflector midway between end of sleeve and grease retainer. Align sleeve slot with key slot of shaft.

2. For the packed pump, slide the gland (17) and lantern ring (29) over the shaft sleeve to abut the deflector.

CAUTION Use care not to mar or scratch the lapped surfaces of floating seat and sealing washer when installing mechanical seal. Damage to these surfaces will result in leakage and will require replacement of the entire seal.

3. For the mechanical seal pump, lubricate the O-ring (65B), groove in floating seat (65A) and seat cavity in adapter (71) with any of MOLY-COTE®, 3% detergent solution, mild soap solution, glycerine, ethelyne glycol or silicone grease, DC No. 55.
4. Install floating seat in the adapter with lapped surface facing away from adapter shoulder. Apply lubricant (step 3 above) to entire surface of shaft sleeve and carefully install adapter. Use care not to cock or scrape floating seat on sleeve. Seat adapter (71) against motor, tapping very lightly with plastic hammer, then install screws and tighten uniformly. Rotate shaft by hand to check that there is no binding or hang-up.
5. In the same manner ac in step 4, lubricate the entire surface of shaft sleeve and the bores of sealing washer (80D) and spring bellows assembly (80C). Carefully install sealing washer, lapped surface toward floating seat and spring bellows assembly on shaft sleeve and slide along to contact floating seat. Install spring (80B) and spring retainer (80A) if used.

6. For the packed pump, install the adapter (71) in the same manner as in step 4 except shaft sleeve need not be lubricated.

CAUTION Be sure at all times that the gland enters the box square to the shaft so that uniform pressure is exerted around the packing. A tipped gland is an invitation for binding and leakage.

7. In order, install 3 rings of packing (13), the lantern ring (29) (if furnished) and 2 rings of packing in adapter cavity. When lantern ring is not furnished, install 5 rings of packing. Stagger the joint of each packing ring approximately 180° from adjacent rings. Be sure each ring is square with the shaft. Use a split bushing and the gland (17) to move rings to the bottom of the cavity. When all packing rings are in place, position the gland (17) and loosely seat on packing, using gland bolts (17B). Tighten as required to limit leakage after pump is running.
8. Install impeller key (32) in shaft keyway. Make sure that key enters slot in shaft sleeve. Align impeller (2) with key and install on shaft. Tap impeller hub lightly with plastic hammer to seat against shaft sleeve. For the mechanical seal pump, guide the spring retainer and spring to seat on the shoulder as impeller is installed. Be sure spring is correctly seated against bellows assembly.
9. Install impeller washer (24A) and impeller lock screw (26). Restrain impeller with rod inserted in one passage and securely tighten screw. Rotate shaft by hand to check for free movement.
10. Lightly coat both sides of casing gasket (73A) with a non-hardening sealing compound, such as grease and graphite. Position on adapter making sure that holes are aligned. Install casing (1), tapping lightly with plastic hammer to seat on adapter. Install screws and tighten uniformly in a star pattern. The cap screws are SAE Grade 5 and are to be tightened to the following minimum torque values for dry threads.

Size	Torque
3/8	30 ft - lbs
7/16	50 ft - lbs
1/2	75 ft - lbs
5/8	155 ft - lbs

11. Install seal piping (tubing) (if used) between pump discharge and stuffing box of adapter.

NOTICE:

Materials of construction, specifications, dimensions, design features, and application information, where shown in this bulletin, are subject to change and/or modification without notice by Peerless Pump at their option.

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Pearless Pump
An Indian Head Company

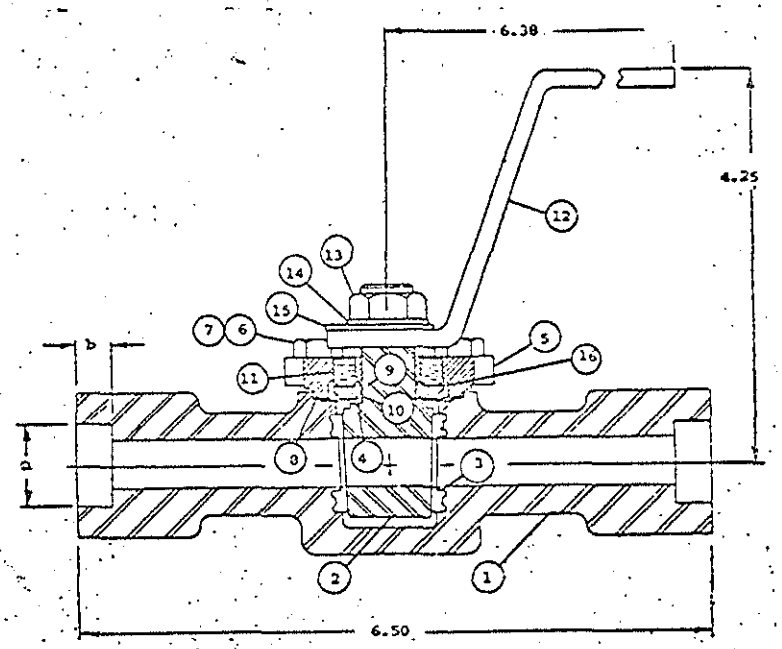
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1200 Sycamore Street Montebello, CA 90640 (213) 726-1232

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PRINTED IN U.S.A.

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	b	D
1/2"	.38	.66
3/4"	.50	1.07

VENDOR NO: 1/2" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP. ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR. (1)

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED Rev 2 [illegible] 1978 [illegible]

APPROVED REV. 1 [illegible] 1978 [illegible]

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10998	6-26 78	SEE SH. 2	[illegible]
4	10644C	1-27 78	SEE SHEETS 2,3,4	LM PE
3	10629	1-13 78	SEE SHEET #2	LM PE
2	10128	11-10- 76	See Shts 3 & 4	R.H. [illegible]
1	10102	10-29 76	SEE SHEETS 3&4	[illegible]
	"	"	(1) ADDED "SEE 11908456..." NOTE	[illegible]

TITLE
VALVE, PLUG
1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC 1503 9/ 3/76 ASSY. OR LO.
DR. BY P. ESTRADA 8/30/76
CHK'D. BY L.W.C.
MAT'L PUR(
APPV. CAST. MACH. WELD. ENGR.

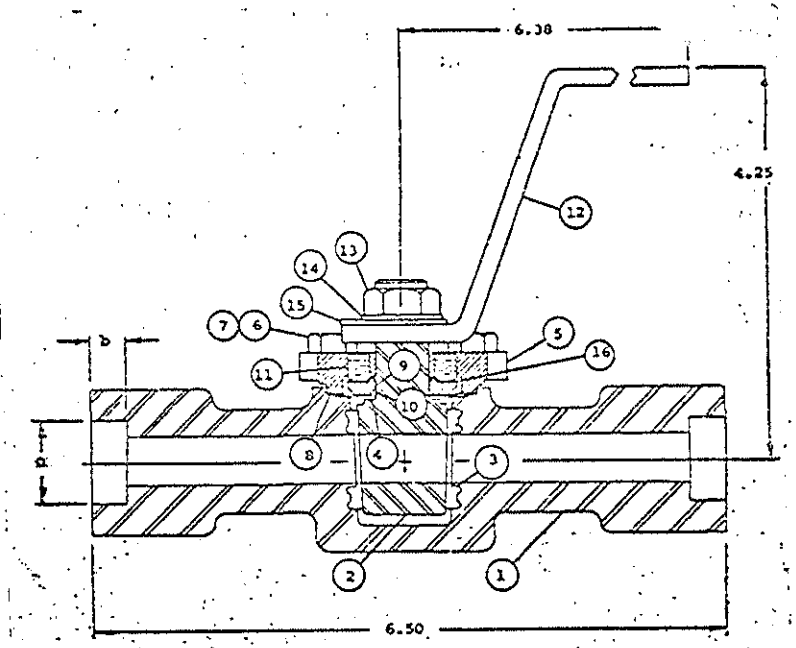
FOR VENDORS LITERATURE
SEE TAB 2

SHEET SIZE A | DWG. NO. 11 908 180 | SHEET 1 OF 4

BF3009-2

COLT FM JAN 6 1978 QA APP
COLT FM JUL Rev. 4 JAN 2 1978 QA APP
COLT FM Rev. 5 JUN 14 1978 QA APP

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Size	b	D
1/2"	.38	.06
3/4"	.50	1.07

VENDOR NO: 3/4" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF
XOMOX CORP.
ELK GROVE, IL 60007

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED
REV. 2
JAN 25 1977
QUALITY CONTROL

APPROVED
Rev 1
QUALITY CONTROL

APPROVED
Rev 3
1977
QUALITY CONTROL

(1) See 11908456 for Colt/FMED Q.A. Requirements on Vendor.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10998	6-26-78	SEE SH2	TRS
4	10629	1-13-78	SEE SHEET 2	LM
3	10556	11-14-77	SEE SHEET 2	PE GDJ
2	10128A	1/28/77	See sheet 3	RHN
1	10128	11-10-76	See Shts 3 & 4	R.H.
1	"	11-10-76	Added "See 11908456 ....."Note (1)	R.H.

TITLE
VALVE, PLUG
3/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC 1503	9/3 76	ASSY. OR I
DR. BY P. ESTRADA	8/30 76	
CHK'D. BY L. Wi Cooper		
MAT'L PURC		
APPV. CAST.		
APPV. MACH.		
APPV. WELD.		
ENGR.		

FOR VENDORS LITERATURE
SEE TAB 2

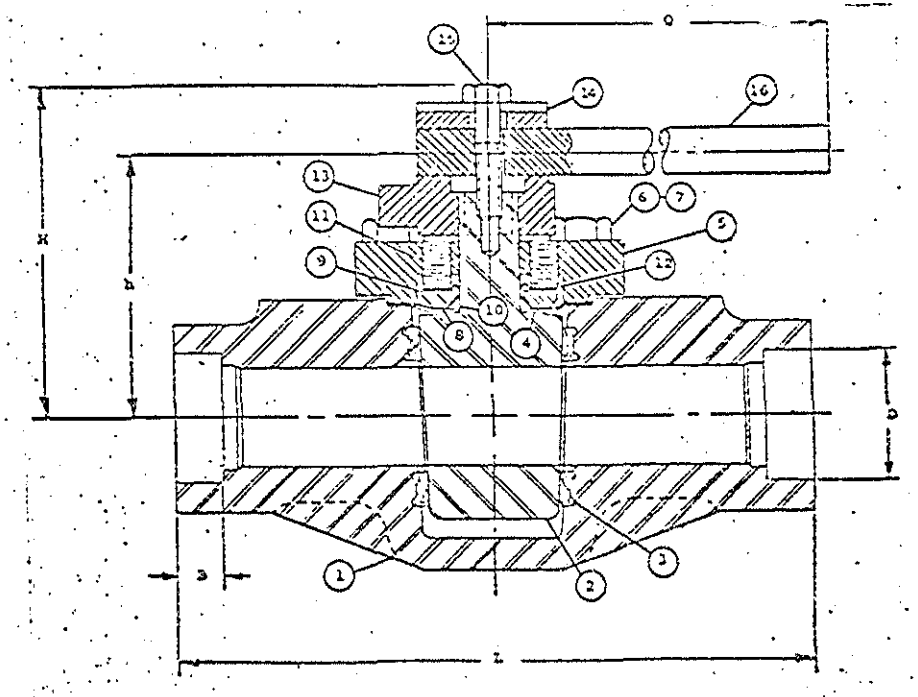
SHEET SIZE A | DWG. NO. 11 908 181 | SHEET 1 OF 4

COLT FM JUN 14 1973 QA APP

COLT FM JAN 16 1978 QA APP

BF3009-2

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	L	D	B	h	H	O
1"	6.50	1.33	.50	3.81	2.03	7.38
1½"	7.50	1.92	.50	4.56	3.63	11.25
2"	8.50	2.41	.63	5.13	4.00	17.00

VENDOR NO: 1-1/2" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP. ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR. ①

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

Approved Rev 2 12/1/77

Rev. 1 OCT 22 1976

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10128	11-10-76	See Shts 3 & 4	P.H. [illegible]
1	10102	10-29-76	SEE SHEETS 3 & 4	P.H. [illegible]
1	"	"	①ADDED "SEE 11908456... "NOTE	[illegible]

TITLE
VALVE, PLUG
1-1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

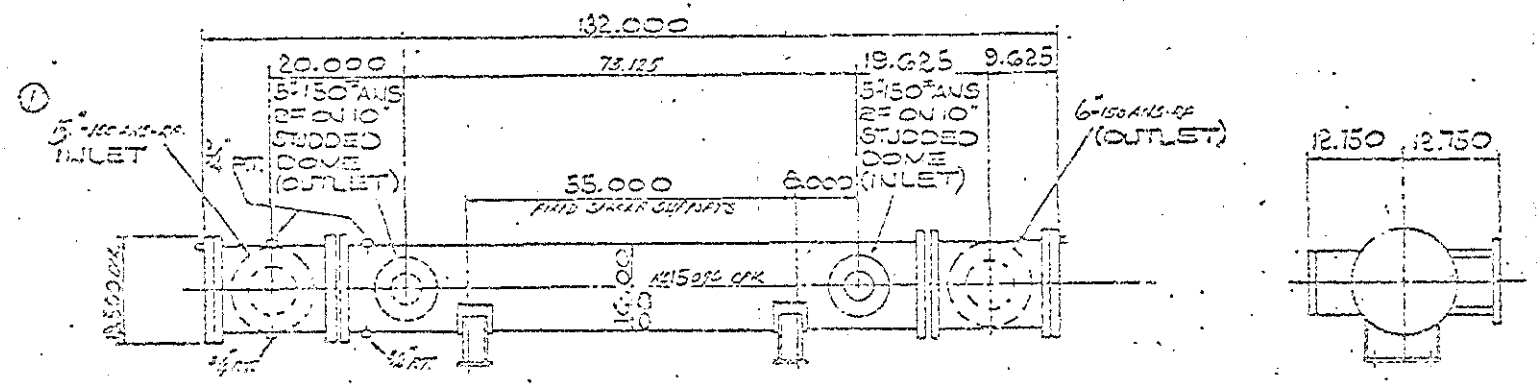
Colt Industries
Fairbanks Morse Power Systems Division

REL. NO. PC1503 9/3 '76 ASSY. OR
DR. BY P. ESTRADA 8/30 '76
CHK'D. BY L.W. Cooper
MAT'L PUR...
APPV. CAST. MACH. WELD. ENGR.

FOR VENDORS LITERATURE SEE TAB 2

SHEET SIZE A DWG. NO. 11 908 183 SHEET 1 OF 4

SF3009-2



VENDOR DWG. NO: 5-047-17-096-005

VENDOR: AMERICAN STANDARD HEAT TRANSFER DIV.
320 E. OGDEN AVENUE
HINSDALE, ILL 60521

APPROVED Rev. 3 MAR 10 1977 QUALITY CONTROL

APPROVED Rev. 4 APR 1977 QUALITY CONTROL

APPROVED Rev. 5 DEC 22 1978 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
F	10283	3-21-77	SEE SHEET 2 of 6	
4	"	"	CHANGED FLG FROM 6" TO 5" (1)	
3	10231	3-17-77	Has Sht. 1 of 3	
2	10156	12-23-76	Rel'd Init.	

TITLE
HEAT EXCHANGER
JACKET WATER
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASST. OR LO.
DR. BY R. HUMKE	12/21/76	SCALE
CHK'D. BY	/ /	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 785 | SHEET

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP
BUFFALO, N.Y. 14240

TYPE CPS, CP & CPK EXCHANGERS

11. To locate leaking joints between tube and tube sheet or a split tube, proceed as follows:

Channel Type
(a) Remove channel covers.
(b) Apply hydrostatic pressure in shell.

Bonnet Type
(a) Remove bonnets.
(b) Bolt test rings in place with gaskets and packing.
(c) Apply hydrostatic pressure in shell.

Use only cold liquid for hydrostatic test. The point where the water escapes indicates the defective tube or joint.

12. When removing tube bundles from exchangers for inspection or cleaning, care should be exercised to avoid damage by improper handling. Although tube bundles are often of great weight, the tubes are small and of relatively thin metal. The dead weight of the bundle, therefore, should never be supported on individual tubes, but should rest on those parts that are designed to carry it, i.e., the tube sheets, support plates or wood blocks, cut to fit the periphery of the bundle. In withdrawing tube bundles, it is recommended that rods or steel cables be passed through two or more of the tubes and the load taken on the floating tube sheet. Rods should be threaded and provided with nuts and should pass through a bearing plate at either end of the bundle. A soft wood filler board should be inserted between bearing plates and tube sheets, in order to prevent damage to tube ends. A forged steel eye bolt which may be screwed into either plate is used for pulling and lifting.

When steel cables are used for lifting, the cable is threaded through one tube and returned through another. Loops are formed in the ends of the cable by use of thimbles and wire rope clips. A hard wood spreader block is inserted between the cable and the floating tube sheet to prevent crushing of tube end.

If the tube bundle has been in service for a considerable length of time without being removed it may be necessary to use a hydraulic jack on the floating tube sheet to get it started. A good sized steel bearing plate should be inserted between jack and tube sheet and the tube ends protected by means of a filler board.

Tube bundles may be raised horizontally by means of slings formed by bending light plates into a U-Form and attaching lifting lugs to the ends of the sheets. Baffles can be easily bent and damaged by dragging a bundle over a rough surface. Diameter of the baffles is practically the same as the inside of the shell and a close fit must be maintained for the apparatus to function properly. Any damage to baffles should, therefore, be carefully avoided.

In cleaning a tube bundle, tubes should not be hammered on with any metallic tool. In case it is necessary to use scrapers, care should be exercised to see that the scraper is not sharp enough to cut the metal of the tubes.

The following are safe loads for rods and eye bolts:

RODS

Size Tubes	Size Rods	Safe Load per Rod
5/8"	3/8"	1000 lbs.
3/4"	1/2"	2000 lbs.
1"	5/8"	3000 lbs.

EYE BOLTS

Size	Safe Load
3/4"	4000 lbs.
1"	6000 lbs.
1 1/4"	10000 lbs.
1 1/2"	15000 lbs.

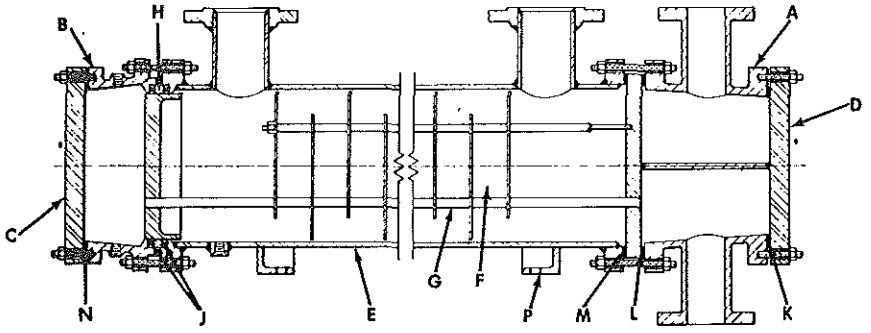
PARTS LIST

Any parts listed below and indicated alphabetically on the typical cross sectional drawings can be furnished.

When ordering parts, use part name indicated in parts list. Give cooler size and serial number as stamped on name plate of cooler. Special care in following above instructions will facilitate quick shipment.

If parts are required in materials of construction differing from those originally furnished, specify the desired changes and reason for changing.

CHANNEL TYPE



A. CHANNEL, STATIONARY END
B. CHANNEL, PACKED END.
C. CHANNEL COVER, PACKED END
D. CHANNEL COVER, STATIONARY END
E. SHELL ASSEMBLY
F. BUNDLE ASSEMBLY, Consisting of:
   1. Stationary Tube Sheet
   2. Floating Tube Sheet
   3. Tubes
   4. Baffle Plates
G. TUBE
H. LANTERN RING
J. PACKING RINGS
K. GASKET, STATIONARY CHANNEL COVER
L. GASKET, TUBE SHEET TO CHANNEL
M. GASKET, TUBE SHEET TO SHELL
N. GASKET, PACKED CHANNEL COVER
P. CRADLE ASSEMBLY

WARRANTY

WARRANTY OF SELLER'S PRODUCTS—Except where a different express written warranty has been issued with respect to a particular product, no warranty of any kind, express or implied, is extended by the Seller to any person or persons other than its direct Buyers. To direct Buyers, the Seller warrants only that it will furnish by freight a replacement for, or at its option repair any product of its manufacture or part or portion thereof, proved to its satisfaction to be defective in material or workmanship under normal use and service within one year from the date the equipment is first placed in use, or two years from the date of shipment, whichever shall be less.

The Seller shall have no responsibility for the performance of any product sold by it under conditions varying materially from those under which such product is usually tested under existing industry standards, nor for any damage to the product from abrasion, erosion, corrosion, deterioration or the like due to abnormal temperatures or the influence of foreign matter or energy, nor for the design or operation of any system of which any such product may be made a part or for the suitability of any such product for any particular application.

The Seller shall not be liable for any cost or expense, including, without limitation, labor expense, in connection with the removal or replacement of alleged defective equipment or any part or portion thereof, nor for incidental or consequential damages of any kind, nor under any circumstances for any damage beyond the price of the goods sold. Any freight allowance in connection with a replacement will be on the same terms as were applicable to the original sale, except that a replacement for a product or part or portion thereof which is proved to the Seller's satisfaction to be defective in material or workmanship as provided herein above, will in any event be furnished with freight (but not local cartage) allowed, inside the continental United States (excluding Alaska and Hawaii), to the first destination.

OTHER WARRANTIES—The foregoing warranty is in lieu of all other warranties of any kind, express or implied, and of all other obligations or liabilities, on the part of the Seller. The Seller neither assumes, nor does it authorize any other person to assume on its behalf, any other liability in connection with the sale of its products.

GOODS OF OTHER MANUFACTURERS—Goods of other manufacturers sold by the Seller are nor warranted except by express warranties which may be issued in writing from time to time with respect to a particular product or a particular sale; but the Seller will endeavor to secure for its direct Buyers the benefits of warranties extended by the manufacturers of such goods sold but not manufactured by the Seller.

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP
BUFFALO, N.Y. 14240

OPERATING INSTRUCTIONS AND PARTS LIST

TYPE CPS, CP & CPK EXCHANGERS

INSTALLATION

1. Provide sufficient clearance at the channel or bonnet end of unit to permit removal of tube bundles from shells. On the floating head end, a space of 3 or 4 feet should be provided to permit the removal of the floating head.
2. Provide valves and by-passes in the piping system so that both the shells and tube bundles may be by-passed to permit cutting out the unit for inspection or repairs.
3. Provide convenient means for frequent cleaning of the unit as suggested under "Maintenance."
4. Provide thermometer wells and pressure gage connections in all piping to and from the unit, as near the unit as possible.
5. Provide necessary air vent cocks so that the unit can be purged to prevent or relieve vapor or gas binding of either the tube bundles or the shell.
6. Foundations must be adequate so that exchangers will not settle and cause piping strains. Foundation bolts should be set to allow for setting inaccuracies. In concrete footings, pipe sleeves at least one size larger than bolt diameter slipped over the bolt and cast in place are best for this purpose, as they allow the bolt center to be adjusted after the foundation has set.
7. Loosen foundation bolts at one end of unit to allow free expansion of shells. Oval holes in foundation brackets are provided for this purpose.
8. Set exchangers level and square so that pipe connections may be made without forcing.
9. Inspect all openings in exchanger for foreign material. Remove all wooden plugs and shipping pads just before installing. Do not expose units to the elements with pads or other covers removed from nozzles or other openings since rain water may enter the unit and cause severe damage due to freezing.
10. Be sure entire system is clean before starting operation to prevent plugging of tubes with sand or refuse. The use of strainers or settling tanks in pipe lines leading to the unit is recommended.
11. Drain connections should not be piped to a common closed manifold.
12. To guard against pulsation of fluids caused by reciprocating pumps, compressors or other equipment a surge drum should be installed.

OPERATION

A heat exchanger is a pressure vessel designed for operation at certain specific limits of pressure and temperature, and the system must be safeguarded with safety valves and controls so that these design conditions are not exceeded and that all operating personnel are alerted.

1. When placing a unit in operation, open the vent connections and start to circulate the cold medium only. Be sure that the passages in the exchanger are entirely filled with the cold fluid before closing the vents. The hot medium should then be introduced gradually until all passages are filled with liquid. Then, close vents and slowly bring the unit up to temperature.
2. Start operation gradually. Do not admit hot fluid to the unit suddenly when it is empty or cold. Do not shock unit with cold fluid when it is hot.
3. In shutting down, flow of hot medium should be shut off first. If it is necessary to stop circulation of cooling medium, the circulation of hot medium should also be stopped by by-passing or otherwise.
4. Do not operate equipment under conditions in excess of those specified on nameplate.
5. In all installations, there should be no pulsation of fluids since this causes vibration and strain with resulting leaks.
6. All gasketed joints should be rechecked for tightness after the unit has been heated to prevent leaks and blowing out gaskets.
7. The packed end joints on Lube Oil Coolers may require adjustment from time to time to eliminate slight leakage. This joint contains Neoprene packing rings which require only a small amount of bolting pressure to seal tight.

Many heat exchangers handle fluids which are irritating or dangerous to the human system and could cause problems if bolted and packed joints are not maintained in a leak tight condition both at operating pressures and temperatures, and also at no flow, ambient conditions.

If fluids are not irritating or dangerous a leak will at least cause a slippery situation on the floor below.

Since one fluid in the heat exchanger is at higher temperatures, any leaks might cause burns.

If leakage should appear at the packed end joint after the cooler is placed in operation, the bolting should be pulled up only enough to stop it. This can be accomplished by taking a one-half turn on each successive bolt starting at one point and continuing around the cooler until all leakage has been eliminated. Do not tighten this joint any more than is required to stop the initial leakage.

When the packing has been repeatedly tightened to the point where there is almost a metal-to-metal contact between the bonnet (or channel) and shell flanges, the two packing rings should be replaced. To accomplish this, proceed as follows:

(A) Remove the bonnet (or channel), lantern ring, and all packing rings from the cooler.
(B) Clean the packing ring recess in both the bonnet (or channel) and shell flanges and the latern ring, if necessary.
(C) Place one of the new packing rings over the floating tube sheet and slide it, into the recess in the shell flange. Be sure the packing ring is not twisted and fits squarely into this recess.
(D) Place the lantern ring over the floating tube sheet and slide it against the first packing ring.
(E) Place the second new packing ring over the floating tube sheet and slide it against the lantern ring, making sure the packing ring is not twisted.
(F) With the studbolts pulled up only finger tight, the bonnet (or channel) should be positioned so that the second packing ring is secure in the recess of the bonnet (or channel) flange.
(G) Each bolt should now be pulled up only one or two turns.
(H) When the cooler is either hydrostatically tested or placed in operation, any final adjustment should be made as previously described.

8. Be sure that all parts of the system are clean and in proper operating condition. An exchanger cannot perform properly unless all connected equipment is functioning properly, yet, the exchanger is frequently blamed for non-performance when the actual trouble is elsewhere in the system.

Observe the following precautions to obtain maximum performance:

(A) Exchanger must be full of fluid in both shell and tube sides.
(B) Provide periodic venting if air tends to accumulate in system.
(C) Maintain rated flow of both mediums.
(D) Avoid excessive flow of cooling water in exchangers used as coolers. It is a frequent cause of tube failure through erosion, and may decrease cooling efficiency, especially with heavy oils.
(E) Inspect exchanger periodically and clean thoroughly when necessary, especially inside of the tubes.

MAINTENANCE

1. Provide convenient means for frequent cleaning of heat exchangers as suggested below:

(A) Circulating hot wash oil or light distillate through tubes or shell at good velocity will effectually remove sludge or other similar soft deposits.
(B) Soft salt deposits may be washed out by circulating hot fresh water.
(C) Some cleaning compounds on the market, such as "Oakite" may be used to advantage for removing sludge or coke, provided hot wash oil or water, as described above, does not give satisfactory results.
(D) If none of the above described methods are effective for the removal of hard scale or coke a mechanical means may be used.

When the heat exchanger is cleaned, it is important that full characteristics of the fouling material and the cleaning agent be known and care exercised in handling them according to instructions.

2. Frequently and at regular intervals, observe interior and exterior condition of all tubes and keep them clean. Neglect in keeping all tubes clean may result in complete stoppage of flow through some tubes, with consequent overheating of these tubes as compared to surrounding tubes, resulting in severe expansion strains and leaking tube joints.

When shutting down for repairs it is imperative that all fluids be drained from the heat exchanger and that no bolting be loosened until the pressures are down to atmospheric and the temperatures of the parts are down to ambient.

3. Do not attempt to clean tubes by blowing steam through individual tubes. This overheats the tube and results in the same severe expansion strains and leaks as in plugged tubes.
4. Do not blow out heat exchangers with air when fluids normally handled are of an inflammable nature.
5. Do not open heads until all pressure is off equipment and the unit drained.
6. Do not handle tube bundles with hooks or other tools which might damage tubes. Bundles should be moved about on cradles or skids.
7. Do not tighten bolts until gasket is positioned properly. This precaution will eliminate one cause for taking down units because of leaks.

Since many of the removeable components or the heat exchanger, particularly in the larger sizes are too heavy for men to handle care must be used to take this weight with proper rigging to avoid injury.

When a heat exchanger is dismantled for any cause, it is recommended that new gaskets be used in reassembly. This will tend to lessen the possibility of future leaks. Because composition gaskets become brittle and dry out, they do not provide an effective seal when reused. Metal or metal jacketed gaskets when compressed initially tend to match their gasket contact surfaces. In so doing, they are work hardened to the point that their reuse provides an imperfect seal and possible damage to the gasket contact surfaces of the heat exchanger.

8. To tighten a loose tube joint, use a suitable roller type tube expander. Do not roll tubes that are not leaking as it needlessly thins the tube wall.
9. Exchangers subject to fouling or scaling should be cleaned periodically. A light sludge or scale coating on the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicates cleaning is necessary, if the unit has been checked for air or vapor binding and this has been found not to be the cause. Since the difficulty of cleaning increases rapidly as the scale thickens or deposit increases, the intervals between cleanings should not be excessive.
10. To clean or inspect inside of tubes, remove channel covers (or bonnets). Do not remove channels.

RP _____

RECOMMENDED SPARE PARTS LIST

EXCHANGER P/N 5-047-17-096-005
(4-750-17-096-001)
S/N 9-20008-02

COLT 11908187
INTERCOOLER WATER COOLER

NUMBER REQUIRED/ EXCHANGER	DESCRIPTION	PART NUMBER
2	Gaskets	3-298-8-00-901-17
2	Gaskets	3-299-8-00-901-17
2	Packing Rings	3-359-8-00-905-17

P/N 5-047-17-096-005
(4-750-15-096-004)
S/N 9-20008-03
Colt 11908186
Jacket Water Cooler

2	Gaskets	3-298-8-00-901-15
2	Gaskets	3-299-8-00-901-15
2	Packing Rings	3-359-8-00-905-15

P/N 5-046-15-096-021
S/N 9-20008-04
Colt 11908185
Lube Oil Cooler

4	Gaskets	3-299-8-00-901-15
2	Packing Rings	3-359-8-00-905-15

Item No.	Matl. Stat.	From Dept.	Quan. Reqd	Total Quan.	Description	Matl & Spec	Sizes/Pattern No	Part Number	Dwg. Size
24									
23					FOR ELEVATION DWG SEE			5-047-17-096-005	C
22									
21									
20									
19									
18									
17		CERT	16		HEX NUT DOME	STEEL SA194-2H	.750-10TPI	2-122-5-00-902-08	A
16		CERT	16		STUD DOME	ALLOY STL SA193-B7	.750-10TPI-TFL-3.250LG	2-012-5-12-901-13	A
15		CERT	12		HEX NUT	STEEL SA194-2H	.625D-11 TPI	2-122-5-00-902-07	A
14		CERT	16		STUDBOLT STA.	ALLOY STL SA193-B7	.625 D-11 TPI-TFL-5.50 LG	2-012-5-10-901-22	A
13									
12		CERT	32		STUDBOLT COVS.	ALLOY ST. SA193-B7	.625D.-11 T.PI.-TFL-4.50LG	2-012-5-10-901-18	A
11		CERT	4		PIPE PLUG	FGD ST. SA105	3/4 P.T. SIZE	2-135-5-96-901-05	A
10			4		GASKET	ASBESTOS		3-299-8-00-901-15	A
9									
8			2		PACKING RING	NEOPRENE		3-359-8-00-905-15	A
7			1		LANTERN RING	CAST IRON		3-338-7-00-902-15	A
6									
5		PEC	2		COVER	STEEL		4-500-15-115-008	A
4			1		CHANNEL FLO.	STEEL		4-302-15-215-016	B
3			1		CHANNEL STA.	STEEL		4-300-15-215-034	B
2			1		BUNDLE			4-110-15-096-002	B
1		PEC	1		SHELL	STEEL		4-605-15-096-011	B

REV #	REVISIONS	DATE

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MADE Steele DATE 5/31/77

CHECK FJU DATE

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP BUFFALO, N.Y. 14240

TITLE BILL OF MATERIAL "CPK"

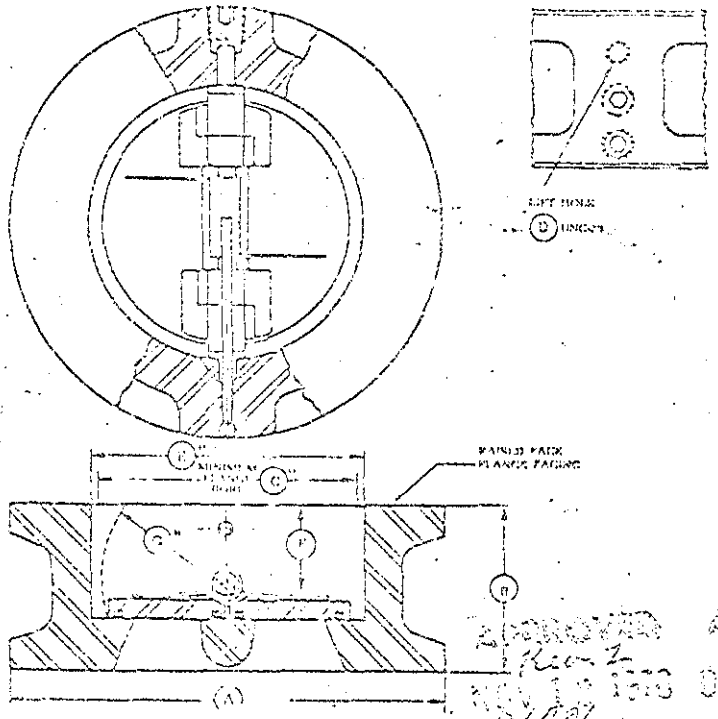
SIZE	PART NUMBER	REV
A	4-750-15-096-004	

FACTORY ORDER NO. 9-20008-03

A01-03-01-D TPC

11/08/77

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



VENDOR PART NO:

VENDOR: MISSION MFG. CO.
HOUSTON, TEXAS

REPR: WALTER B. ROM & SON INC.
7050 N 115TH ST.
WAUWATOSA, WI

(1) SEE 11908456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR.
LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

SIZE	SERIES	TYPE FACING	(A) D	(B)	(C) D	(D)	(E) D	(F)	(G) R
5"	150	RF RAISED	7 5/8	3 3/8	4 13/16	3/8 -.16	5 9/16	1 1/2	2 3/16

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10128	11-10-76	See Shts 2, 3 & 4	
1	10077	10-29-76	Added "See 11908456..." Note (1)	
0	"	"	See Sheet 1 & 4	

TITLE
VALVE, CHECK
5"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

DEL. NO. PL1503	9/3/76	ASSY. OR LO.
DR. BY P. ESTRADA	8/30/76	SCALE
CHK'D. BY L.W. Cooper	9/2/76	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 192 | SHEET 1 OF 4

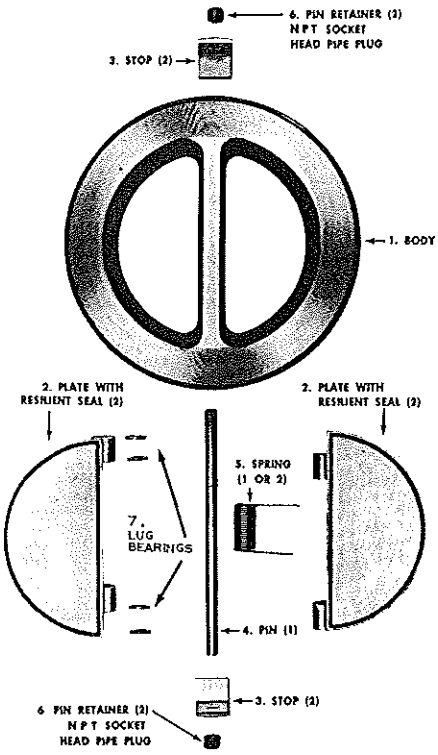
MISSION* VALVE AND PUMP CO.
A DIVISION OF MISSION MANUFACTURING COMPANY
P. O. BOX 4209 • HOUSTON, TEXAS 77014
(713) 462-3461
Shipping Address — 8760 Clay Road
Cable Address — "Missoman"

EXPORT OFFICE
30 Rockefeller Plaza — New York 10020
Cable Address — "Missoman"

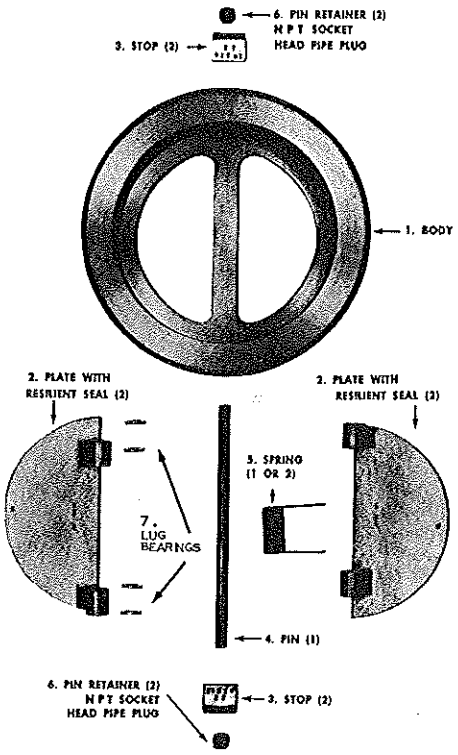
MISSION MANUFACTURING CO., LTD.
Berkeley Square House, Berkeley Square, London, W1, England
Cable Address — "Missoman"

Printed in U.S.A.

*AN OPERATING UNIT OF TRW INC.



Upstream Side



Downstream Side

Duo-Chek Check Valve Assembly

1. Clean all parts with a suitable solvent.
2. Position the Plates (2) within the Body (1), aligning the lugs with the pin retainer holes.
3. Install the Stops (3), one at each end of the Plates, between the plate and the body.
4. Align these parts by temporarily installing the Pin (4).
5. Withdraw the Pin (4) part way, far enough to permit installation of the Spring (5), and lug bearings (7).
6. Wind up the Spring one-half turn to obtain initial torsion. Install the spring with spring arms flat on the plates. These spring arms will extend from underneath the Pin (4).
7. Push the Pin (4) through, holding the spring in position so that the pin passes through the coils. Thread lug bearings (7) on pin at the same time.
8. Install Pin Retainer (6). The pin retainers are assembled at our plant and wrapped with Teflon tape to facilitate removal in the field and to insure a positive thread seal. Some similar tape or thread compound should be used during re-assembly.

Duo-Chek Check Valve Disassembly

1. Remove the two Pin Retainers (6).
2. Depress the Spring (5) to free the Pin (4).
3. Push the Pin (4) out of the Body (1) while holding the spring firmly, since it is preloaded and may snap out of the valve as the pin is withdrawn.
4. Remove the Spring (5), Stops (3), Plates (2) and lug bearings (7).

RECOMMENDED SPARE PARTS

1 yr. Service: 1 pin, 1 spring, 4 lug bearings.
2 yr. Service: 1 complete set spare parts.

NOTE: Specify Valve Size, Figure Number, Model Number, Quantity and Part Name of Parts desired when placing Spare Parts Orders.

MISSION*
VALVE AND PUMP CO.
A DIVISION OF MISSION MANUFACTURING COMPANY

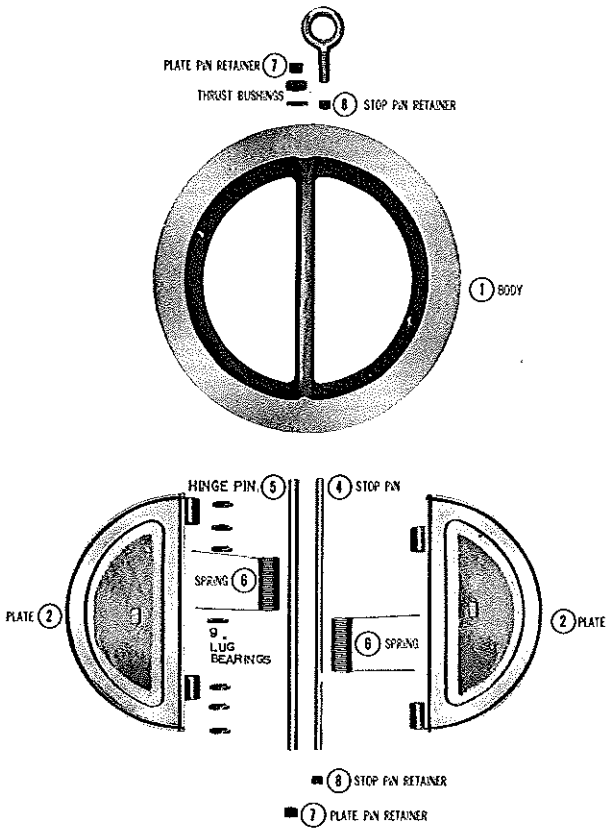
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Cable Address — "Missoman"

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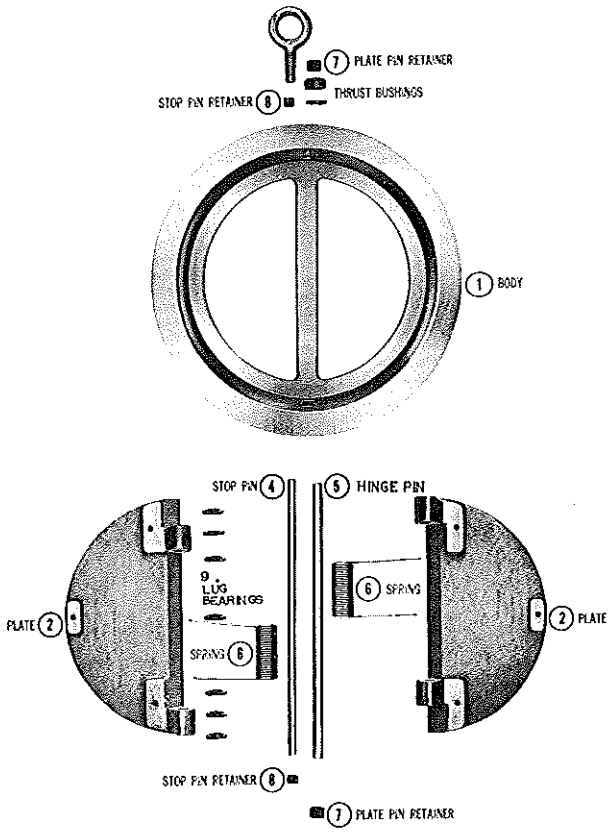
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Upstream Side



Downstream Side

Duo-Chek Check Valve Assembly

1. Clean all parts with a suitable solvent.
2. Position the Plates (2) within the Body (1), aligning the lugs with the pin retainer holes.
3. Align these parts by temporarily installing the Hinge Pin (5).
4. Withdraw the Hinge Pin (5) part way, far enough to permit installation of the Spring (6), and lug bearings (9).
5. Wind up the spring one-half turn to obtain initial torsion. Install the spring with spring arms flat on the plates. These spring arms will extend from underneath the Hinge Pin (5).
6. Push the Hinge Pin (5) through, holding the spring in position so that the pin passes through the coils. Thread lug bearings (9) on pin at same time.
7. Install Hinge Pin Retainer (7). The pin retainers are assembled at our plant and wrapped with Teflon tape to facilitate removal in the field and to insure a positive thread seal. Some similar tape or thread compound should be used during re-assembly.
8. Install Stop Pin (4) and Pin Retainer (8).

Duo-Chek Check Valve Disassembly

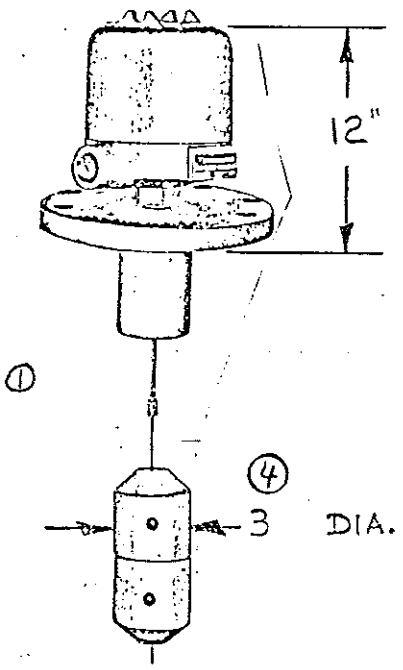
1. Remove Stop Pin Retainers (8) and Stop Pin (4).
2. Remove the two Hinge Pin Retainers (7).
3. Depress the Spring (6) to free the Hinge Pin (5).
4. Push the Hinge Pin (5) out of the Body (1) while holding the spring firmly, since it is preloaded and may snap out of the valve as the pin is withdrawn.
5. Remove the Spring (6), Plates (2), and lug bearings (9).

NOTE: Specify Valve Size, Figure Number, Model Number, Quantity and Part Name of Parts desired when placing Spare Parts Orders.

RECOMMENDED SPARE PARTS

1 yr. Service: 1 pin, 1 spring, set of lug bearings.
2 yr. Service: 1 complete set spare parts.

11 908 552



LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: MAGNETROL

①

⑥

VENDOR DWG. NO.: MODEL ~~A-153-F-EP/VP-Y-S1M3DG~~
NEW # A-15-1138-DK - for computer QW 5-27-82

TITLE: SWITCH, J. W. LEVEL ALARM

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	12221	3-18-81	⑥ ADDED "Y" IN VENDOR PART NO.	H.R.S.
4	"	"	⑤ ADDED DISPL. MAT. ④ 3 DIA WAS 3 1/8 DIA	H.R.S. JWD
3	11137	10-12-78	③ DELETE REFER. TO SPEC Pgs 42 & 48 REV.	MTP
2	11014	8-7-78	ADD REV. STATE TO SUBTIER SPECS ②	NLS
1	10616	1-6-78	① ADDED PICTURE, VENDOR & VENDOR DWG. NO.	SJV

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1742	3/25/77	ASSY. OR LO.	
DR. BY J. Dorn	3/16/77	SCALE	
CHK'D. BY J. WHALEN	3/21/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. HJR 7/5	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 552 | SHEET 1 OF 2

ORIGINAL

11 908 552

COLT OCT 17 1979 CA

COLT Rev. 3 Aug 79 CA

COLT 3/16/81 Rev. 4 QA

908 552

JACKET WATER LEVEL ALARM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORP. SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 41, PARA. 6.1a - PAINTING

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3a - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

(3)

2. TECHNICAL SPECIFICATIONS

2.1 DISPLACEMENT TYPE, SINGLE SWITCH, LEVEL ALARM FOR LOW LEVEL ALARM.

2.2 DISPLACERS SHALL BE SUITABLE FOR USE IN DEMINERALIZED WATER AT 210°F MAXIMUM; DISPLACERS SHALL BE ADJUSTABLE (5) ALONG THE LENGTH OF THE STEM. DISPLACER MAT. STAINLESS STEEL.

2.3 DISPLACER STEM SHALL BE 4 FT. LONG

2.4 MOUNTING CONNECTION SHALL BE A 4" - 150 LB RAISED FACE STEEL FLANGE, ANSI

2.5 SWITCH SHALL BE SPDT, NON-MERCURY TYPE, RATED FOR 125 VOLT DC, .2 AMP

2.6 SWITCH HOUSING SHALL BE NEMA TYPE 4

2.7 THE COMPONENT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMUTANEOUSLY.

2.8 MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.9 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

QA COLT 3/6/69

COLT OCT 17 1970 QA Rev 3 add

REV. 3 3/6/69

REV. 2

REV. 1

REV. 4

Colt Industries / Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 552	SHEET 2 OF 2

ORIGINAL

11908552

BULLETIN: 45-607.1
EFFECTIVE: May 1977
SUPERSEDES: April 1976

INSTRUCTION MANUAL and PARTS LIST
MODEL A-103 and A-153 SERIES
LIQUID LEVEL CONTROLS

DESCRIPTION

The Model A-103 series controls are single stage "wide" differential type units designed primarily for pump or valve control applications in liquid make-up service on tanks or vessels.

The Model A-153 series controls are single stage "narrow" differential displacement units designed for high or low level alarm service.

Each standard A-103 and A-153 control utilizes a single switch mechanism and is top mounted to a tank or vessel by means of a threaded or flanged pipe connection.

Optional multistage "tandem" versions of the A-103 and A-153 controls employ multiple switch mechanisms to combine various control and alarm functions into a single instrument.

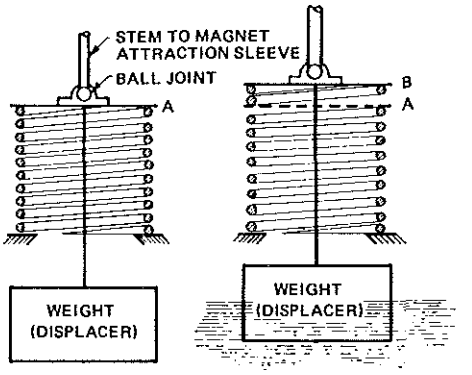
OPERATING PRINCIPLE

Magnetrol® displacer type controls "pick-up" level travel by utilizing Archimedes' principle. "Any body immersed in a liquid is "buoyed up" by a force equal to the weight of the liquid the body displaces."

The illustration at right shows the relationship of all parts at "low liquid level" and "high liquid level." The "body" takes the form of one or more weights called displacers, hung on a stem, and suspended from a support spring. When the liquid level is below the displacer(s), the spring will come to fixed position "A". When the liquid level rises to the center of the displacer(s) the downward load on the spring is lightened allowing it to move to position "B". This happens even though the weights are heavier than the liquid and do not "float". The spring is always partially compressed from the downward load. It is the varying weight of this load by liquid displacement that causes the spring to be compressed MORE or LESS. This movement is transmitted to the switch mechanism. See bulletin on switch mechanism for its operating principle.

Since MOVEMENT OCCURS ONLY WHEN THE LIQUID LEVEL REACHES A DISPLACER, the point at where switch action is desired can be varied anywhere within the displacer stem length. Loosen the set screw clamp at the center of the displacer and slide the displacer to the point where switch action is desired, then retighten clamp.

FIG. 1



INSTALLATION

Adjust the displacers on the displacer cable for the desired switch actuating levels. (Instruction tag attached to cable.) Screw displacer cable fitting to threaded connecting link protruding from underside of control.

Be sure there are no tubes, rods, or other obstacles in the tank or vessel to interfere with the operation of the displacers. No guides into the tank are necessary unless liquid turbulence is excessive, in which case a "guide pipe" or "stilling tube" is recommended. The I.D. of the pipe or tube should be at least 1" larger than the displacer diameter, open at the bottom end and with several vent holes located above the maximum high level of the liquid.

Check installation of pipe or tube to be certain it is plumb.

IMPORTANT: Before attaching Magnetrol control to tank or vessel, check with level to see that tank mounting flange or spud is within 3° of horizontal. Proper operation of the control depends on the switch housing being within 3° of vertical.

WIRING INSTRUCTIONS

NOTE: If control is equipped with pneumatic switch mechanism, disregard these instructions and refer to instruction bulletin on mechanism furnished for air (or gas) connections.

Most Magnetrol control switch housings are designed to provide 360° positioning of conduit outlet by loosening the set screw(s) located under the housing base. Diagrams of the control's internal electrical circuits (switching action between terminals) will be found in the switch mechanism instruction bulletin included, as listed on page 11.

On high temperature applications (above 250°F.) asbestos covered wire should be used between control and first junction box located in a cooler area. Supply wires (conductors) are brought into the switch housing, wrapped around the enclosing tube under the baffle plate and then brought up to the proper terminals. Excess wire should be positioned so as not to interfere with switch mechanism or housing cover.

Some controls are furnished with an explosion proof (cast) switch housing or a vapor tight (gasketed) type. These housings are used in hazardous locations or when liquid temperature is so low that excessive condensation and frosting of switch parts is likely. After wiring connections have been completed, explosion proof housings must be "sealed" at the conduit outlet with suitable compound or "dope" to prevent entrance of air. Check cover to base fit on explosion proof and vapor tight housings to be certain gasketed joint is tight. A positive seal is necessary to prevent infiltration of moisture laden air or corrosive gases into switch housing.

Connect power supply to control and test switch action by varying liquid level. If switch mechanism fails to function, check verticle alignment of control and consult installation bulletin on mechanism furnished.

PREVENTIVE MAINTENANCE

Periodic inspections are a necessary means to keep your Magnetrol level control in good working order. This control is, in reality a safety device to protect the valuable equipment it serves. Should the control fail, the resultant damage to equipment dependent upon its performance could very well cost far in excess of the control itself. Therefore, a systematic program of "Preventive Maintenance" should be implemented when control is placed into service. If the following sections on "What to Do" and "What to Avoid" are observed, your control will provide reliable protection of your capital equipment.

WHAT TO DO

1. KEEP CONTROL CLEAN

– NEVER leave switch housing cover off the control. This cover is designed to keep dust and dirt from interfering with switch mechanism operation. In addition, it protects against damaging moisture and acts as a safety feature by keeping bare wires and terminals from being exposed. Should the housing cover become damaged or misplaced, order a replacement immediately.

2. INSPECT SWITCH MECHANISMS, TERMINALS AND CONNECTIONS MONTHLY

– Mercury switches may be visually inspected for short circuit damage. Check for small cracks in the glass tube containing the mercury. Such cracks can allow entrance of air into the tube causing the mercury to "oxidize". This is noticeable as the mercury will appear dirty and have a tendency to "string out" like water, instead of breaking into clean round pools. If these conditions exist, replace the mercury switch immediately.

– Dry contact switches should be inspected for excessive wear on actuating lever or misalignment of adjustment screw at point of contact between screw and lever. Such conditions can cause false switch actuating levels. Adjust switch mechanism to compensate (if possible) or replace switch.

DO NOT operate your control with defective or maladjusted switch mechanisms (refer to bulletin on switch mechanism furnished for service instructions).

– Magnetrol controls may sometimes be exposed to excessive heat or moisture. Under such conditions, insulation on electrical wires may become brittle, eventually breaking or peeling away. The resulting "bare" wires can cause short circuits. Check wiring carefully and replace at first sign of brittle insulation.

– Vibration may sometimes cause terminal screws to work loose. Check all terminal connections to be certain that screws are tight. Air (or gas) operating medium lines, subjected to vibration, may eventually crack or become loose at connections causing leakage. Check lines and connections carefully and repair or replace, if necessary.

WHAT TO AVOID

1. **NEVER** leave switch housing cover off the control longer than necessary to make routine inspections.
2. **NEVER** use lubricants on pivots of switch mechanisms. A sufficient amount of lubricant has been applied at the factory to insure a lifetime of service. Further oiling is unnecessary and will only tend to attract dust and dirt which can interfere with mechanism operation.
3. **NEVER** place a jumper wire across terminals to "cut-out" the control. If a "jumper" is necessary for test purposes, be certain it is removed before placing control into service.
4. **NEVER** attempt to readjust magnetic attraction sleeves which are factory set. Tampering may cause failure of control while in service even though manual operation actuates switches.
5. **NEVER** attempt to make adjustments or replace switches without reading instructions carefully. Certain adjustments provided for in Magnetrol controls should not be attempted in the field. When in doubt, consult the factory or your local Magnetrol representative.

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TROUBLE SHOOTING

Usually the first indication of improper operation is failure of the controlled equipment to function – pump will not start (or stop), signal lamps fail to light, etc. When these symptoms occur, whether at time of installation or during routine service thereafter, check the following external causes first.

- Fuses may be blown.
- Reset button(s) may need resetting.
- Power switch may be open.
- Controlled equipment may be faulty.
- Wiring (or medium lines) leading to control may be defective.

If a thorough inspection of these possible conditions fails to locate the trouble, proceed next to a check of the control's switch mechanism.

1. Pull disconnect switch or otherwise assure that electrical circuit(s) through the control is deactivated.
2. Remove switch housing cover.
3. Swing magnet assembly in and out by hand, checking carefully for any sign of binding. Assembly should require no force, however slight, to move it through its full swing.
4. If binding exists, magnet may be rubbing enclosing tube or pivot sockets may be overly tight. Readjust pivot sockets as required until a slight amount of side play is evident. If magnet is rubbing, loosen magnet clamp screw and shift magnet position.
5. If switch magnet assembly swings freely and mechanism still fails to actuate, check installation of control to be certain it is within the specified three (3°) degrees of vertical (use spirit level on side of enclosing tube in two places, 90° apart).
6. If mechanism is equipped with a mercury switch, examine glass tube closely, as previously described in preventive maintenance section. If switch is damaged, replace it immediately.

NOTE: As a matter of good practice, spare switches should be kept on hand at all times.

If switch mechanism is operating satisfactorily, a test of the complete control's performance is the next likely step.

1. Reconnect power supply and carefully actuate switch mechanism manually (using a non-conductive tool on electrical switch mechanism) to determine whether controlled equipment will operate.

CAUTION: With electrical power "on" care should be taken to avoid contact with switch leads and connections at terminal block.

2. If controlled equipment responds to manual actuation test, trouble may be located in level sensing portion of the control (displacers, spring, stem and magnetic attracting sleeve).

NOTE: Check first to be certain liquid is entering tank or vessel. A valve may be closed or pipe line plugged.

3. With liquid in tank or vessel, proceed to check level sensing action by removing switch housing assembly.

CAUTION: Be certain to pull disconnect switch or otherwise assure that electrical circuit(s) through control is deactivated. Close operating medium supply valve on controls equipped with pneumatic switch mechanisms.

   A. Disconnect wiring from supply side of switch mechanism(s) and remove electrical conduit or operating medium line connections to switch housing.
   B. Relieve pressure from tank or vessel and allow unit to cool.
   C. Remove switch housing assembly by loosening hex nut located immediately below housing base.

4. With switch housing assembly removed, inspect attracting sleeve and inside of enclosing tube for excessive corrosion or solids build-up which could restrict movement, preventing sleeve from reaching field of switch magnet.
5. If trouble still is not located, proceed to remove the entire sensing unit from the tank or vessel by unbolting head flange or unscrewing mounting bushing. Inspect displacer assembly and all internal parts for any signs of damage. Check assembly for binding by supporting head flange or mounting bushing over the edge of a bench and move displacer assembly by hand.

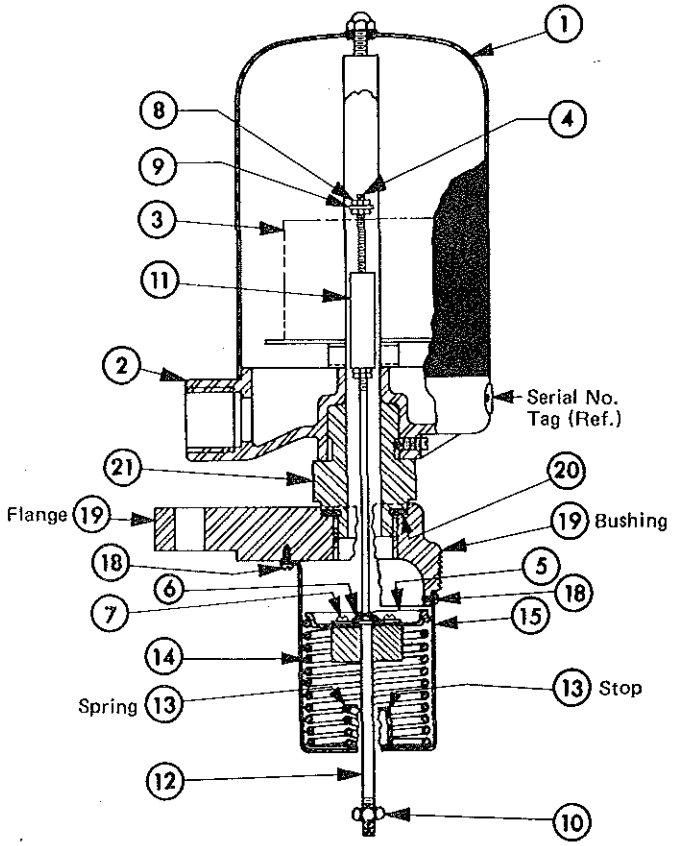
NOTE: When in doubt about the condition or performance of a Magnetrol control, return it to the factory. See "Our Service Policy" on back page.

The instructions contained in this bulletin are general and can be applied to most any Magnetrol displacement type control. If difficulties are encountered which can not be identified, consult with the factory or your local representative for assistance. A complete description of the trouble should be provided along with information concerning your piping and mounting arrangement, and a description of your operation sequence. Sketches or photographs showing the installation are also beneficial.

When communicating about your control, be certain always to specify the complete Model and Serial numbers.

STANDARD MODEL REPLACEMENT PARTS

TYPICAL MODEL A-103 or A-103-F
(Composite Section)



DISPLACER SETS

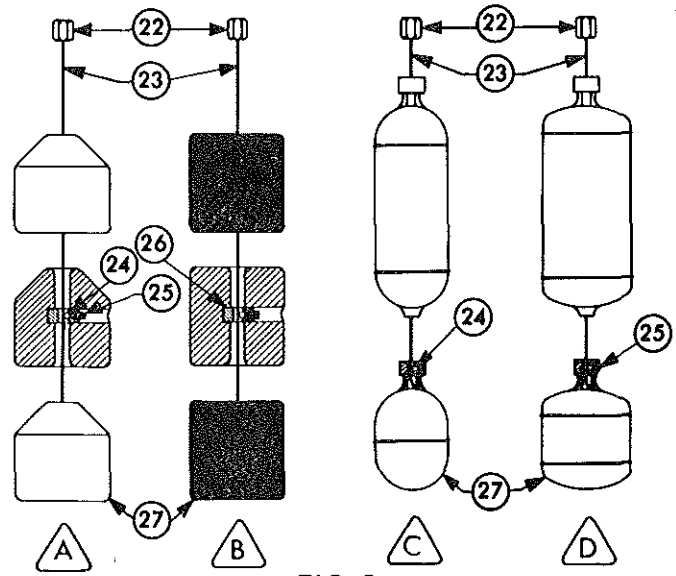
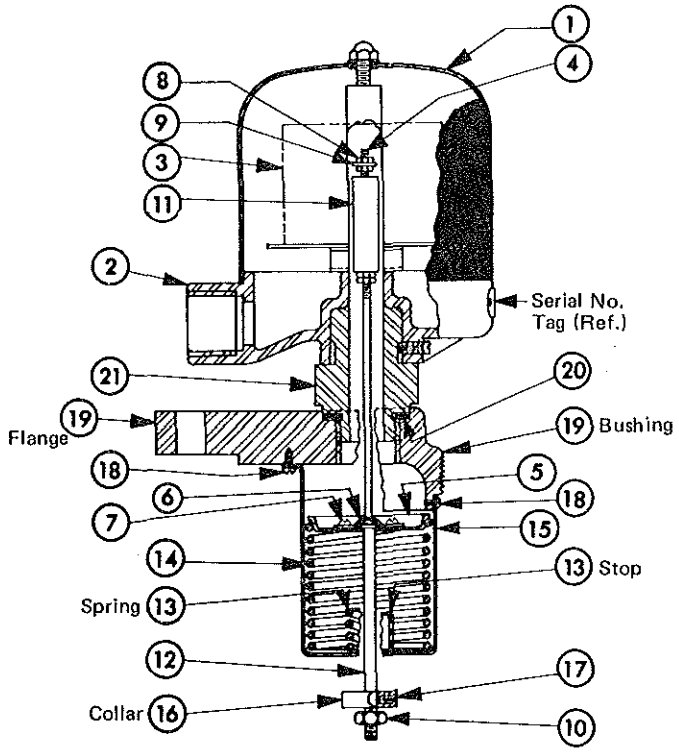


FIG. 2

TYPICAL MODEL A-153 or A-153-F
(Composite Section)



DISPLACER SETS

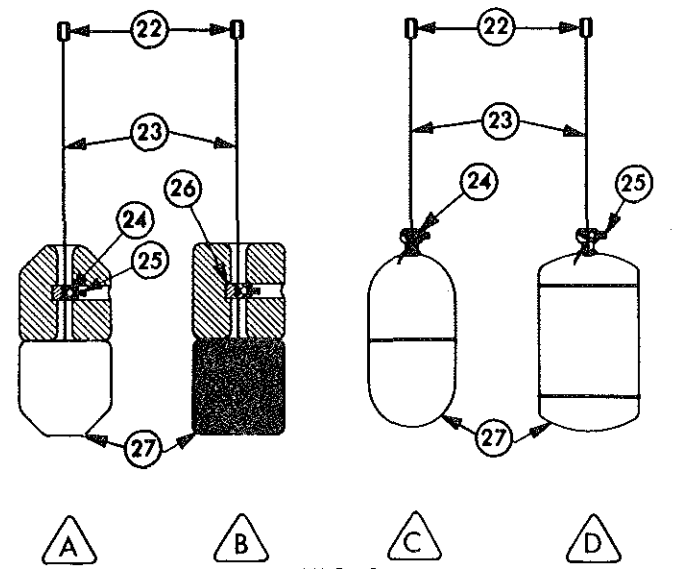


FIG. 3

CAUTION:

Location of jam nuts (item 9) on stem (item 4) must be maintained for proper switch actuation. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

STANDARD MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION	REPLACEMENT ASSEMBLIES ①				
			MODEL			
			A-103	A-103-F	A-153-F	A-153
1	Switch Housing Cover	Housing Kits	See Bulletin 42-680 for Ref. Type S-1 Housing Replacement Assemblies. Consult Local Representative on Types J-1, J-2 and M-1 Housings.			
2	Switch Housing Base					
3	Switch Mechanism	–	See Bulletin on Switch Mechanism Furnished (Listed on Page 11).			
4	Stem ②	Stem Kits ③	89-5523-001 Standard Sleeve 89-5524-001 Sheathed Sleeve			
5	Spring Guide					
6	Retaining Bracket					
7	Bracket Mtg. Screws					
8	Jam Nuts					
9	Guide Washer(s)					
10	Lock Nut					
11	Attraction Sleeve					
12	Connecting Link Ass'y.	Spring Kits ④	89-5303-001 Standard 89-5304-001 W/Karbate Displacers	89-5305-001 Standard 89-5306-001 W/Karbate Displacers	89-5307-001 Standard 89-5308-001 W/Karbate Displacers	89-5309-001 Standard 89-5310-001 W/Karbate Displacers
13	Spacer Spring or Stop					
14	Range Spring					
15	Spring Cup					
16	Stop Collar					
17	Set Screw					
18	Cup Mtg. Screws					
18	Cup Mtg. Screws	Mounting Kits	NOTE: Mounting Components Directly Affect Calibration of Displacement Type Controls. Should Replacement Kit Be Required, Control Should Be Returned to the Factory for Fitting of New Components and Recalibration. See Return Material Procedure on Back Page.			
19	Mounting Bushing					
	Mounting Flange					
20	E-Tube Gasket					
20	E-Tube Gasket	E-Tube Kits	89-5908-001 (Short) 89-5903-001 (Tall)		89-5908-001 (Short)	
21	Enclosing Tube					

ITEM	DESCRIPTION	REPLACEMENT DISPLACER SETS ⑤							
		MODELS A-103 and A-103-F				MODELS A-153 and A-153-F			
		Porcelain A	Karbate B	Stainless Steel C	Stainless Steel D	Porcelain A	Karbate B	Stainless Steel C	Stainless Steel D
22	Connector Nut	89-6110-001	89-6111-001	89-6112-001	89-6113-001	89-6114-001	89-6115-001	89-6116-001	89-6117-001
23	Displacer Cable								
24	Clamp Balls								
25	Set Screws								
26	Displacer Clamps								
27	Displacers								

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard base models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in above listing.

② Stem furnished must be cut to match length of old stem before assembly.

③ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeve is type 400 series stainless steel.

④ All spring Kits listed use standard inconel range springs. Consult local representative on Kits for optional models using stainless steel range springs.

⑤ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers. Displacer sets can not be interchanged without special control modifications and recalibration.

TANDEM STYLE CONTROLS

TWO LEVEL STAGE TANDEM CONTROLS

The Magnetrol two level stage tandem control combines the functions of two separate controls into a single unit – requiring only one opening into the tank or vessel upon which it is to be mounted. Two separate switch mechanisms are employed – each operated independently. There are two general types of controls – those with a "wide" differential at each level stage, and those with a "narrow" differential at each level stage.

A-103 SERIES (Wide Differential)

These controls were designed for a variety of functions, of which five of the most common switch and displacer arrangements are described in Figure 4 below.

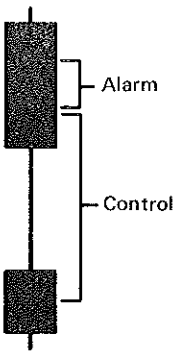
The A-103 Model is mounted by means of a 3" NPT cast iron mounting bushing. The A-103-F Model is furnished with a 4" cast iron mounting flange as standard and is available with larger flanges and/or flanges of other materials.

A-153 SERIES (Narrow Differential)

These units were designed principally for applications requiring both high and low level alarm functions in a single control, as described in Figure 5 below.

The A-153 Model is installed with a mounting bushing while the A-153-F Model is flange mounted version.

TYPICAL A-103 SERIES TANDEM CONTROL ARRANGEMENTS

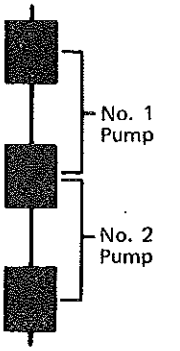


Arrangement No. 1

PUMP CONTROL PLUS ALARM

Arrangement No. 1 (illustrated): At the lowest level the pump starts. When the level rises to the middle displacer, the pump stops. If the level continues to rise, the upper displacer actuates the alarm switch which remains actuated until the level drops to the middle displacer.

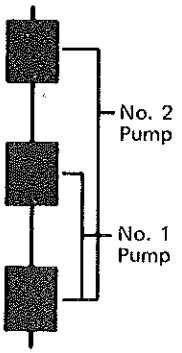
Arrangement No. 2: The sequence of Arrangement No. 1 can be reversed to provide pump start at high level and pump stop at low level followed by low level alarm operation.



Arrangement No. 3

CONTROL OF TWO PUMPS OF DIFFERENT CAPACITY

Arrangement No. 3 (illustrated): Two pumps are used to keep a tank filled. When the level falls to the middle displacer, a small No. 1 pump starts. A second larger pump is started should the level continue to fall to the bottom displacer.



Arrangement No. 4

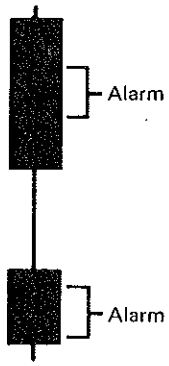
CONTROL OF TWO PUMPS

Arrangement No. 4 (illustrated): In this sequence No. 1 pump starts as the level rises to the middle displacer. Should the level continue to rise to the upper displacer, No. 2 pump is actuated. Both pumps operate until the level is dropped to the lower displacer.

Arrangement No. 5: The pumping sequence of Arrangement No. 4 can be reversed for a pump "fill" application.

FIG. 4

TYPICAL A-153 SERIES TANDEM CONTROL ARRANGEMENT



When properly installed, the normal level would be somewhere between the two displacers. Should the level rise to the upper displacer, the high level alarm switch will actuate and remain actuated until the level recedes. Conversely, should the level drop to the lower displacer, the low level alarm switch actuates and remains actuated until the level rises.

FIG. 5

CAUTION: Tandem style level controls are factory calibrated to function in one arrangement only to meet original customer specifications. Any variation in actual conditions from design conditions usually requires special control modifications. Consult with factory or local representative for assistance.

TANDEM STYLE CONTROLS – continued

THREE LEVEL STAGE TANDEM CONTROLS

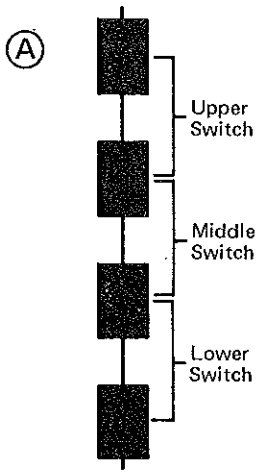
A-103-3X SERIES (Wide Differential)

Magnetrol three level stage tandem controls are designed for applications where a single instrument is required to provide three electrically separate control signals in sequence. Three independent switch mechanisms are employed – operating in a special extended switch housing. Seven factory set switch and displacer arrangements are described in Figure 6 below.

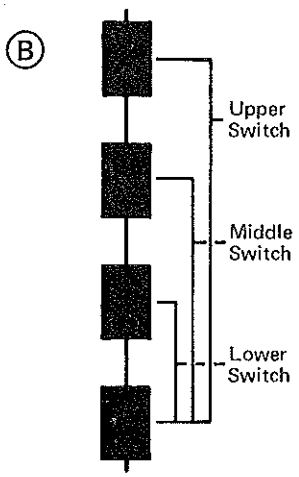
The A-103-3X Model is mounted by means of a 3" NPT cast iron mounting bushing. The A-103-F-3X Model is furnished with a 4" cast iron mounting flange as standard and is available with larger flanges and/or flanges of other materials.

TYPICAL A-103-3X SERIES TANDEM CONTROL ARRANGEMENTS

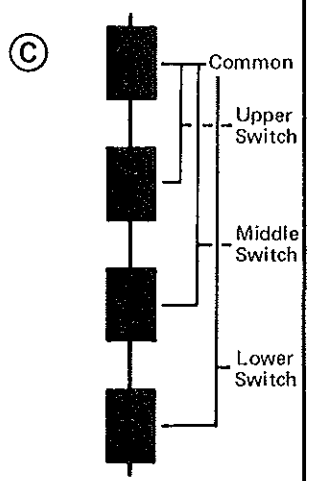
Control of three separate devices employing two common displacers.



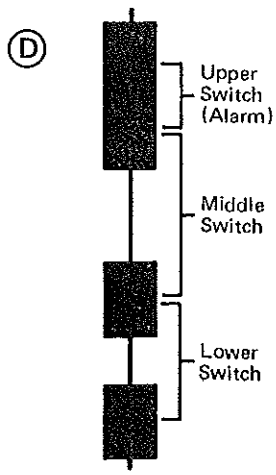
Control of three separate pumps on rising level. Pumps cut-in individually; stop simultaneously at lower displacer.



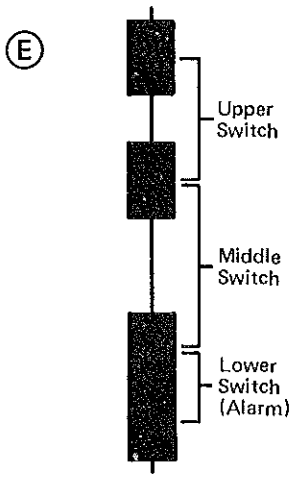
Control of three separate pumps on falling level. Pumps cut-in individually; stop simultaneously at upper displacer.



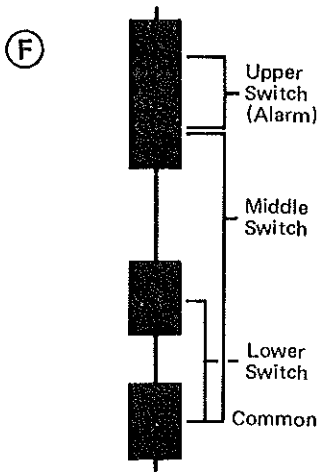
Control of two pumps of different capacity, plus high level alarm.



Control of two pumps of different capacity, plus low level alarm.



Control of two pumps on rising level plus high level alarm. Pumps cut-in individually; stop simultaneously at lower displacer.



Control of two pumps on falling level plus low level alarm. Pumps cut-in individually; stop simultaneously at upper displacer.

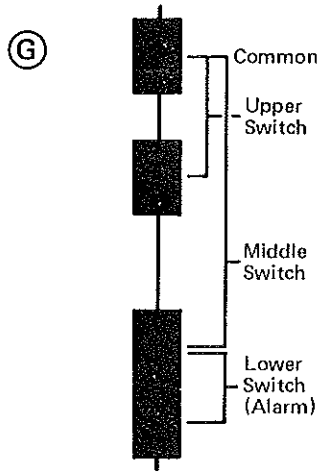
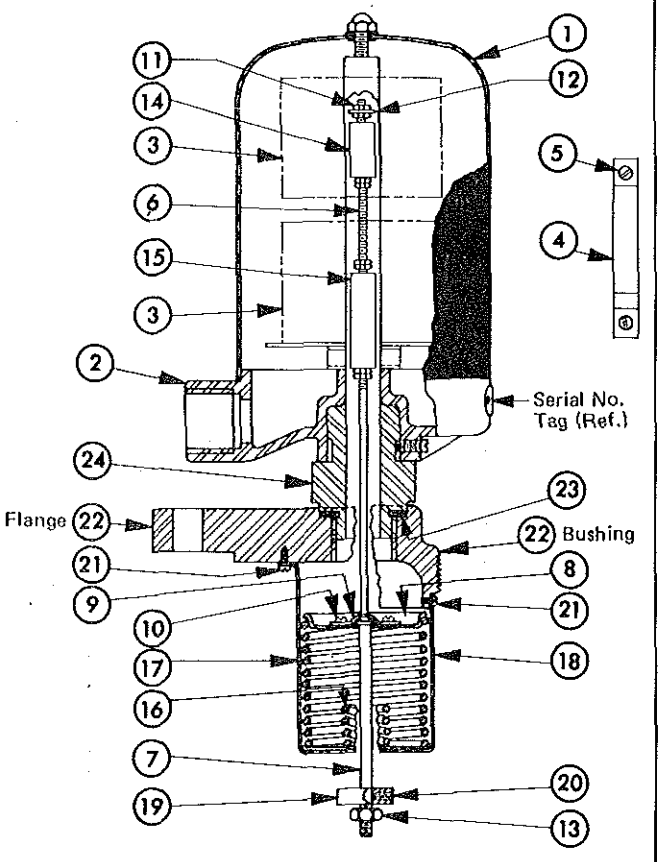


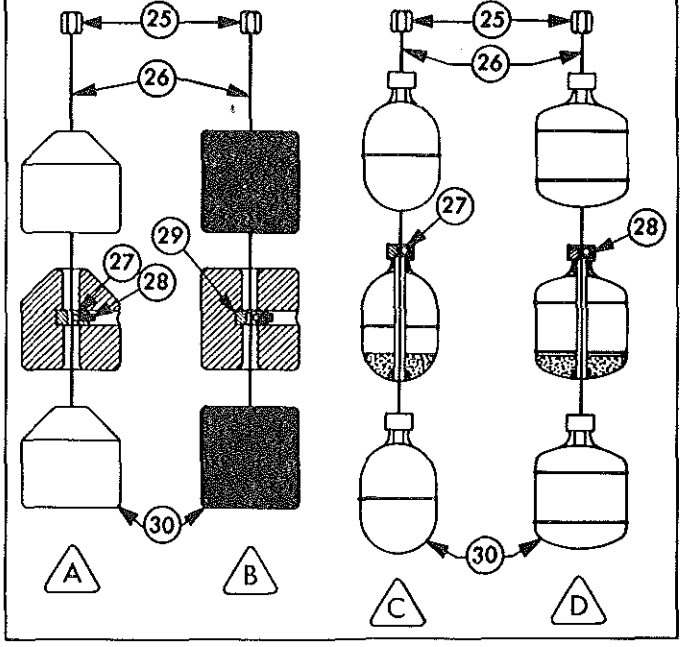
FIG. 6

TANDEM MODEL REPLACEMENT PARTS

TYPICAL A-103-TDM and A-103-F-TDM
A-153-TDM and A-153-F-TDM UNITS
(Composite Section)



A-103-TDM and A-103-F-TDM
DISPLACER SETS



IMPORTANT: Many control models are specially tailored to meet specific customer specifications and therefore may contain special parts. When ordering replacement parts, always give serial number of control.

CAUTION:

Location of jam nuts (item 11) on stem (item 6) must be maintained for proper switch actuations. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

⊛ IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

A-153-TDM and A-153-F-TDM
DISPLACER SETS

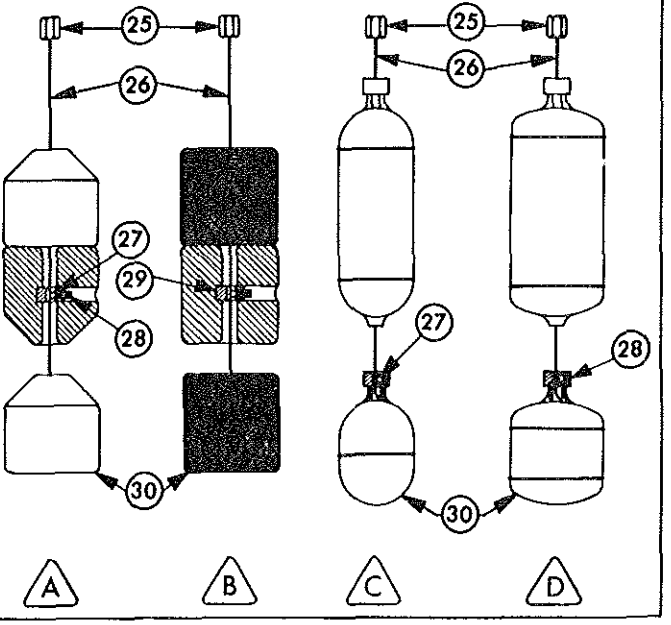


FIG. 7

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard tandem models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in listing, page 9.

② Stem furnished must be cut to match length of old stem before assembly.

TANDEM MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION		REPLACEMENT ASSEMBLIES ①			
			MODEL			
			A-103-TDM	A-103-F-TDM	A-153-F-TDM	A-153-TDM
1	Switch Housing Cover	Housing Kits	See Bulletin 42-680 For Ref. Type S-1 Switch Housing Replacement Assemblies. Consult Local Representative on Types J-1, J-2 and M-1 Housings.			
2	Switch Housing Base					
3	Switch Mechanisms	—	See Bulletin on Switch Mechanisms Furnished (Listed on Page 11).			
4	Spacer Bracket	Spacer Kit	89-6919-001			
5	Rd. Hd. Screws					
6	Stem ②	Stem Kits ③	89-5525-001 Standard Sleeves 89-5526-001 Sheathed Sleeves	89-5527-001 Standard Sleeves 89-5528-001 Sheathed Sleeves	89-5525-001 Standard Sleeves 89-5526-001 Sheathed Sleeves	
7	Connecting Link					
8	Spring Guide					
9	Retaining Bracket					
10	Bracket Mtg. Screws					
11	Jam Nuts					
12	Guide Washer(s)					
13	Lock Nut					
14	Attraction Sleeve (upper)					
15	Attraction Sleeve (lower)					
16	Spacer Spring	Spring Kits ④	89-5311-001	89-5312-001	89-5311-001	
17	Range Spring					
18	Spring Cup					
19	Stop Collar					
20	Set Screw					
21	Cup Mtg. Screws					
21	Cup Mtg. Screws	Mounting Kits	NOTE: Mounting Components Directly Affect Calibration of Displacement Type Controls. Should Replacement Kit Be Required, Control Should Be Returned to the Factory for Fitting of New Components and Recalibration. See Return Material Procedure on Back Page.			
22	Mounting Bushing					
	Mounting Flange					
23	E-Tube Gasket					
23	E-Tube Gasket	E-Tube Kits	89-5903-001			
24	Enclosing Tube					

ITEM	DESCRIPTION	REPLACEMENT DISPLACER SETS ⑤							
		MODELS A-103-TDM and A-103-F-TDM				MODELS A-153-TDM and A-153-F-TDM			
		Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)	Porcelain (A)	Karbate (B)	Stainless Steel (C)	Stainless Steel (D)
25	Connector Nut	89-6118-001	89-6119-001	89-6120-001	⊛ Special Order Item. See Important Order Note on Page 8.	89-6118-001	89-6119-001	89-6121-001	⊛ Special Order Item. See Important Order Note on Page 8.
26	Displacer Cable								
27	Clamp Balls								
28	Set Screws								
29	Displacer Clamps								
30	Displacers								

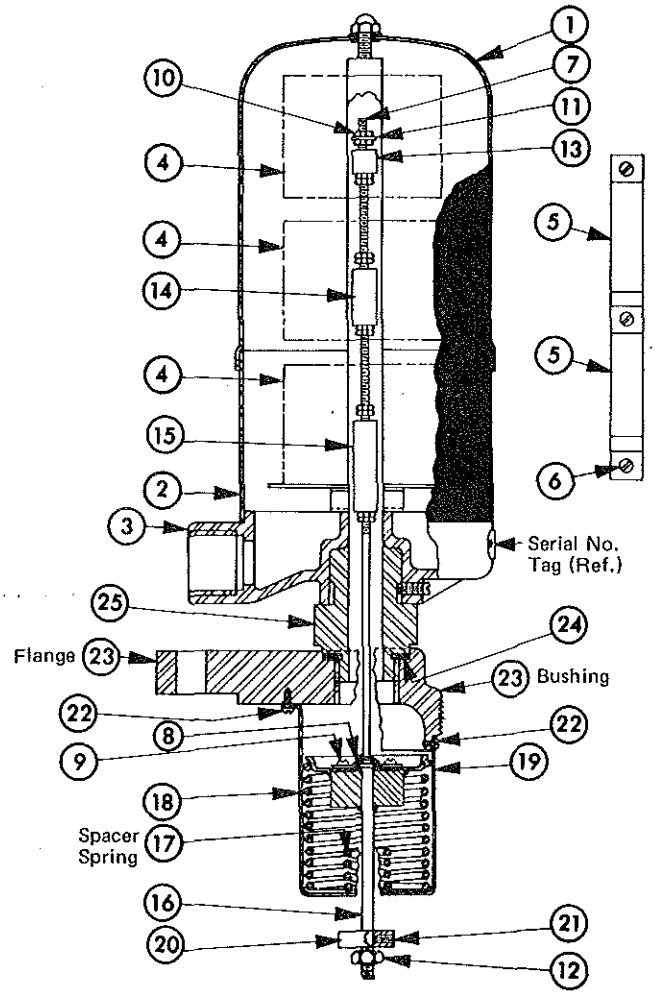
③ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeves are type 400 series stainless steel.

④ Spring kits listed use inconel range springs. Consult local representative on kits for optional models using stainless steel range springs.

⑤ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers. Displacer sets can not be interchanged without special control modifications and recalibration.

TRIPLEX TANDEM MODEL REPLACEMENT PARTS

TYPICAL A-103-3X-TDM and
A-103-F-3X-TDM UNITS
(Composite Section)



IMPORTANT: Many control models are specially tailored to meet specific customer specifications and therefore may contain special parts. When ordering replacement parts, always give Serial number of control.

CAUTION:

Location of jam nuts (item 10) on stem (item 7) must be maintained for proper switch actuations. Do NOT attempt to alter differential of control by repositioning jam nuts. When disassembling control for maintenance, be certain to measure position of jam nuts on stem and record for reference use during reassembly.

⊛ IMPORTANT:

When ordering, please specify:

A. Model and Serial number of control.

B. Name and Number of replacement assembly (Kit).

A-103-3X-TDM and A-103-F-3X-TDM
DISPLACER SETS

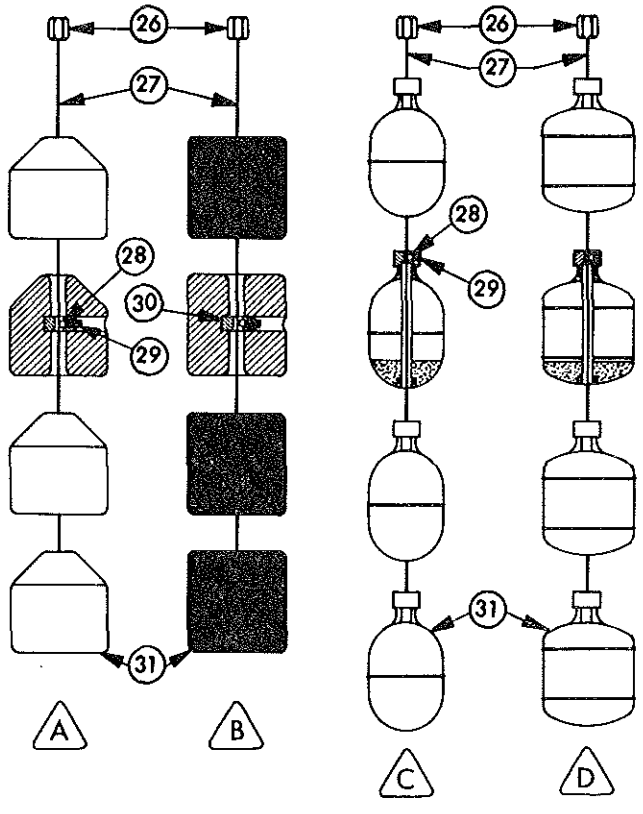


FIG. 8

TRIPLEX TANDEM MODEL REPLACEMENT PARTS – continued

ITEM	DESCRIPTION	REPLACEMENT ASSEMBLIES ① MODEL A-103-3X-TDM	REPLACEMENT ASSEMBLIES ① MODEL A-103-F-3X-TDM
1	Switch Housing Cover	89-6528-001 Standard Housing ② 89-6529-001 Explosion Proof Housing	
2	Cover Extension		
3	Switch Housing Base		
4	Switch Mechanisms	See Bulletin on Mechanism Furnished.	
5	Spacer Brackets	89-6920-001 Spacer Kit	
6	Rd. Hd. Screws		
7	Stem ③	89-5529-001 Stem Kit w/Standard Sleeves 89-5530-001 Stem Kit w/Sheathed Sleeves ④ ⑤	
8	Retaining Bracket		
9	Bracket Mtg. Screws		
10	Jam Nuts		
11	Guide Washer(s)		
12	Lock Nut		
13	Attraction Sleeve (upper)		
14	Attraction Sleeve (middle)		
15	Attraction Sleeve (lower)		
16	Connecting Link Ass'y.	89-5313-001 Spring Kit ⑤ ⑥	89-5314-001 Spring Kit ⑤ ⑥
17	Spacer Spring		
18	Range Spring		
19	Spring Cup		
20	Stop Collar		
21	Set Screw		
22	Cup Mtg. Screws		
22	Cup Mtg. Screws	Mounting Kits (See Note ⑤ Below)	
23	Mounting Bushing		
	Mounting Flange		
24	E-Tube Gasket		
24	E-Tube Gasket	89-5902-001 E-Tube Kit	
25	Enclosing Tube		

ITEM	DESCRIPTION	DISPLACER SETS ⑦ Porcelain (A)	Karbate (B)	SST (C)	SST (D)
26	Connector Nut	89-6122-001	89-6123-001	⊛ Special Order Items. See Important Order Note on Page 10.	
27	Displacer Cable				
28	Clamp Balls				
29	Set Screws				
30	Displacer Clamps				
31	Displacers				

NOTE:

① All replacement assemblies listed are furnished in Kit form for standard triplex tandem models which use Ref. type S-1 switch mechanisms only. Consult local representative for ordering assistance on all special model replacement parts not included in above listings.

② Replacement standard housing kits are furnished with moisture proof epoxy coated housing covers only for NEMA classifications 1 through 5 and 12.

③ Stem furnished must be cut to match length of old stem before assembly.

④ Sheathed attraction sleeves are used on models specified for corrosive service. Standard sleeves are type 400 series stainless steel.

⑤ Stem, spring, and mounting kit components directly affect calibration of triplex tandem model displacement controls. Should any of these replacement kits be required, control should be returned to the factory for fitting of new components and recalibration. See return material procedure on back page.

⑥ Spring kits listed use inconel range springs. Consult local representative on kits for optional models using stainless steel range springs.

⑦ When ordering replacement displacer sets, be certain to specify set which duplicates original set furnished both in type and number of displacers.

NOTE: Refer to one of the following bulletins furnished with your control for switch mechanism replacement parts.

SWITCH MECHANISM (Model Suffix Number)	BULLETIN	REF. TYPE
S-1 & DPS-1 Mercury Switches	42-608	S-1
J-1 Bleed Type Pneumatic Valve	42-617	J-1
J-2 Non-Bleed Type Pneumatic Valve	42-621	J-2
S-1M & DPS-1M Dry Contact Switches	42-657	S-1
M-1 & M-4 Anti-Vibration Dry Contact Switches	42-670	M-1
SPS-1 & SPDPS-1 Anti-Vibration Mercury Switches	42-675	S-1

Guarantee

We guarantee to repair or to replace, at our option, any MAGNETROL Level or Flow Control which, within one year from date of shipment, exhibits any defect in material or workmanship, provided that: (1) the unit has been properly installed; and (2) it has been operated with the liquid and within the pressure, temperature, specific gravity and electric current or pneumatic supply limitations specified on the original purchase order or as stamped on the MAGNETROL instrument nameplate.

Important

OUR SERVICE POLICY

Owners of Magnetrol controls may request to return a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. If, once returned, the underlying cause of the trouble is found to be defective material or workmanship (within the guarantee period), the item will be either rebuilt, or replaced completely, without charge on an F.O.B. factory basis. If the trouble is the result of conditions beyond our control or is not covered by the guarantee, there will be a charge for labor and a charge for parts required to rebuild or replace the item.

In some cases it may be expedient to ship new parts or in extreme cases, a complete new control to replace the original before it is returned. If this is desired, inform us as to what parts are needed, the model number and the serial number of the control and repair part number. Credit for materials returned in such cases will be determined on the basis of the applicability of our guarantee.

No claims for labor or consequential damage will be allowed.

RETURN MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" tag be obtained from the factory for attachment to the goods. This is available through Magnetrol's local representative or by writing directly to the factory supplying the following information:

1. Installation Name
2. Description of Material
3. Production Number
4. Serial Number
5. Reason for Return
6. Desired Action

All shipments returned to the factory must be by Prepaid transportation.

All replacements will be shipped F.O.B. factory.

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Phone: 052-445901
Telex: 846-25944

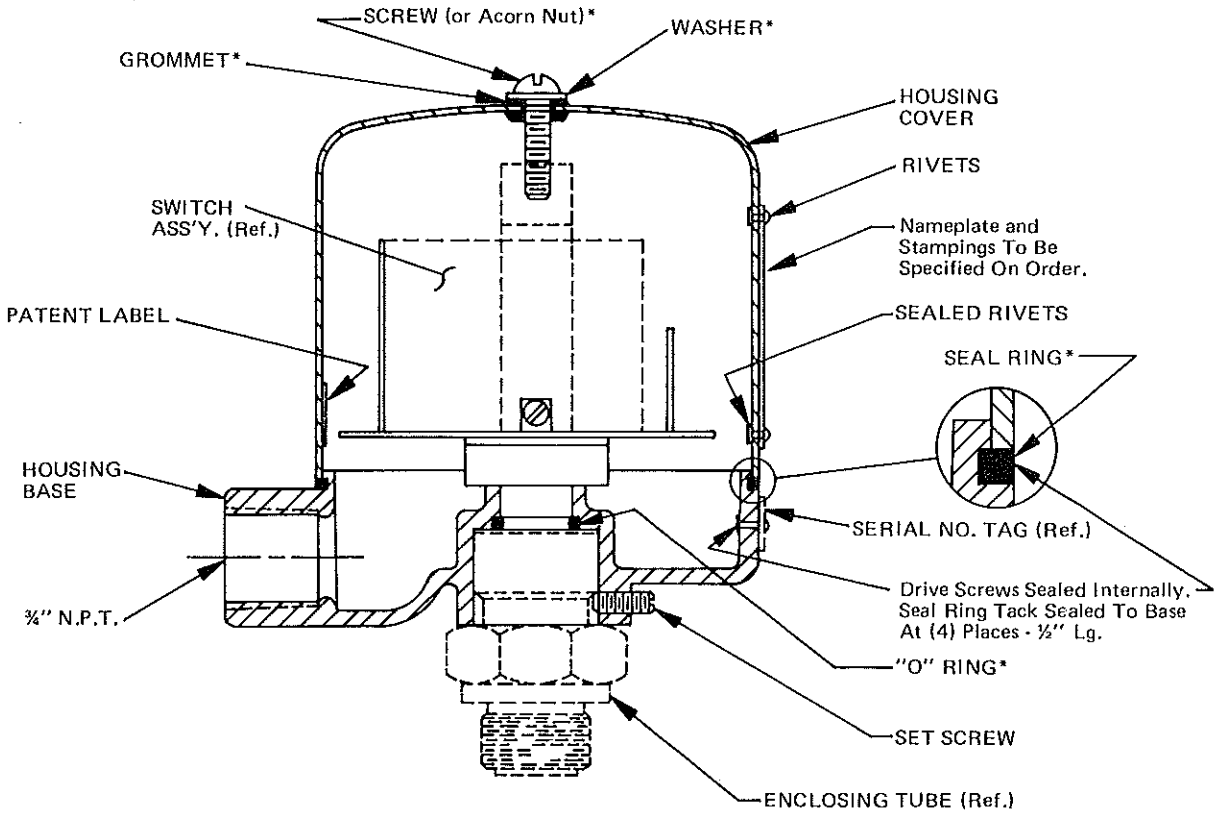
REPRESENTATIVES IN PRINCIPAL CITIES.

Printed in USA

MAGNETROL INTERNATIONAL

BULLETIN: 42-680.4
EFFECTIVE: October 1977
SUPERSEDES: November 1975

MAGNETROL TYPE S-1 SWITCH HOUSING REPLACEMENT ASSEMBLIES



TYPICAL STANDARD HOUSING ASSEMBLY

DESCRIPTION

Standard housing replacement assemblies are designed for applications ranging from general purpose indoor use to non-hazardous installations requiring a dust, water, lint, fiber and oil tight enclosure.

The manual reset (M.R.) assemblies utilize the same basic components as the standard units, but are limited to general purpose indoor applications where unit is not exposed to unusual conditions.

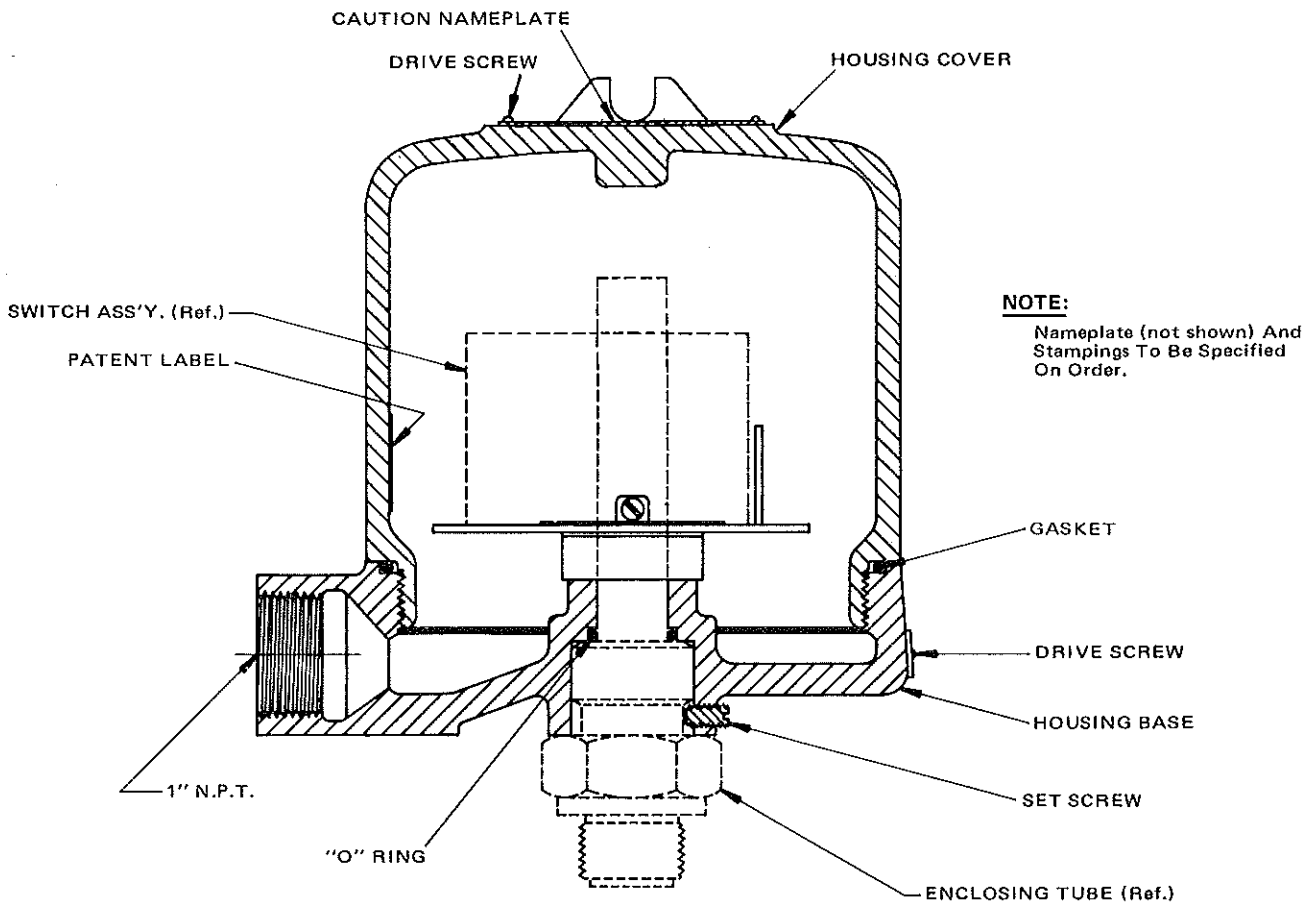
NOTE: Manual reset mechanism requires a hole in the side of the cover to accommodate the reset actuating plunger.

DESCRIPTION		NEMA ① TYPE	REPLACEMENT PART KIT NO.
Standard Housing Cover	Short (4")	NEMA 1 thru 5 & 12	89-6509-001 ②
	Tall (6")		89-6510-001 ②
Manual Reset Housing Cover	Short (4")	NEMA 1 (only)	89-6511-001 ②
	Tall (6")		89-6512-001 ②
Transparent "Lexan" Housing Cover Tall (6") Only		NEMA 1 thru 5 & 12	89-6522-001 ②
Housing Base (Std. & M.R.)		NEMA 1 thru 5 & 12	89-6505-001 ③
Cover Assembly Hardware *		NEMA 1 thru 5 & 12	89-6508-001

① National Electrical Manufacturers Association.
② Includes assembly hardware kit (89-6508-001).
③ Includes base assembly hardware.

(continued)

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TYPICAL EXPLOSION PROOF (E.P.) HOUSING ASSEMBLY

DESCRIPTION

Explosion proof housing replacement assemblies are designed for applications in hazardous atmospheric locations, as classified under types NEMA 7 and 9 of the National Electrical Code.

Housings equipped with submersible base are suitable for submersion under water, as classified under NEMA type 6 of the code.

IMPORTANT:

When ordering, please specify:

1. Model and Serial number of control.
2. Name and Number of replacement kit.

NOTE:

Consult your local representative on applications to meet NEMA and other codes not covered in this bulletin.

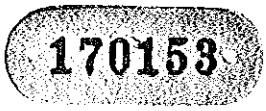
DESCRIPTION	NEMA ① TYPE	REPLACEMENT KIT PART NO.
Explosion Proof Housing Cover (4")	NEMA 6, 7 & 9	89-6513-001 ②
Explosion Proof Housing Cover (6")	NEMA 6, 7 & 9	89-6514-001 ②
Standard Explosion Proof Housing Base	NEMA 7 & 9	89-6515-001 ③
Explosion Proof Housing Base W/Drain	NEMA 7 & 9	89-6516-001 ③
Submersible Explosion Proof Housing Base	NEMA 6, 7 & 9	89-6517-001 ③

① National Electrical Manufacturers Association
② Includes cover assembly hardware.
③ Includes base assembly hardware.

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PRINTED IN U.S.A.

MAGNETROL INTERNATIONAL
5300 BELMONT ROAD / DOWNERS GROVE, IL 60515 / AREA 312/969-4000



THIS IS A MAGNETROL® SERIAL NUMBER TAG

SERIAL NUMBERS — YOUR GUIDE TO PROMPT, ACCURATE SERVICE

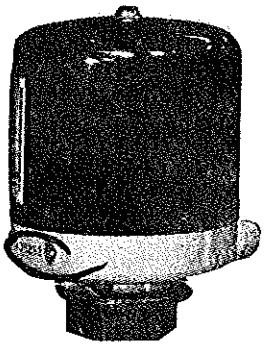
Should an electrical short circuit damage or physical damage make parts replacement necessary, be sure your purchase order includes the SERIAL NUMBER of your Magnetrol control. This will insure prompt delivery of the proper parts.

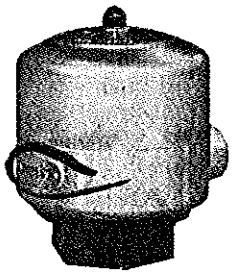
WHY SERIAL NUMBER?

The serial number of each Magnetrol control is recorded and cross-indexed with the production records. These records are then kept on micro film to provide a quick access "key" to the complete engineering of any given control. This file contains full information on the mechanism furnished, exact control action, the liquid or material for which the control was intended, its specific gravity, dielectric constant, pressure and temperature, etc. In addition, all drawings and specifications are included for any special parts used in the construction of non-standard model controls.

On the Type S-1 Moisture Proof Housings . . .

The Serial Number will be located at a point 180° from the conduit opening. This housing is distinguished by the black sheet-steel cover. Whether the cover is the standard "short" (illustrated), standard "tall" or "extended", the Type S-1 standard cover serial number will be in this location.

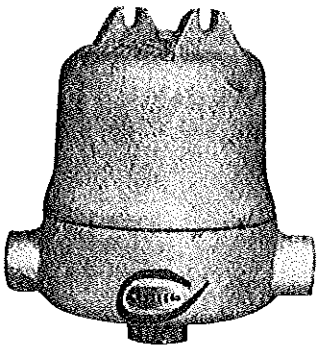




On the Type S-5 Splash-Proof Housings . . .

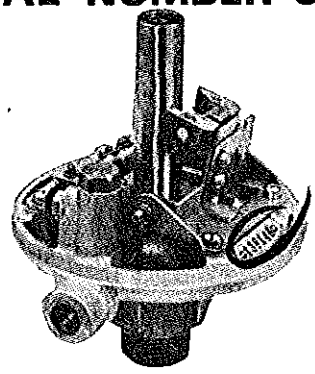
The Serial Number is also located at a point 180° from the conduit opening.

RECORD THE SERIAL NUMBER OF YOUR CONTROL



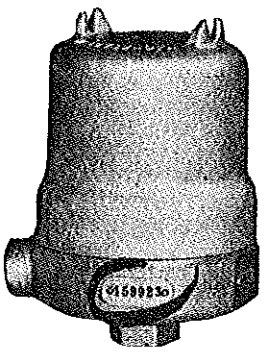
On the Type S-1 Double-tap Explosion- or Vapor-Proof Housing . . .

The Serial Number will be located at a point 90° from either of the conduit openings (one will be "plugged"). Whether the cover is the EP or VP short, tall or "extended", the Serial Number tag will be in this position.



On the Type J-1 Pneumatic Pilot Mechanism . . .

The Serial Number is located *inside* the housing. After the housing is removed, the Serial Number will be found riveted to the housing base.



On the Type S-1 or S-5 Explosion- or Vapor-Proof Housing . . .

The Serial Number will be located at a point 90° from the conduit opening, or 90° from the nameplate.

FORM: 41-310.2
November 1977

PRINTED IN U.S.A.

BULLETIN: 42-657.3
EFFECTIVE: August, 1975
SUPERSEDES: May, 1974

GENERAL INSTRUCTIONS FOR TYPE "S-1M" and TYPE "DPS-1M" SWITCH MECHANISMS

DESCRIPTION

TYPE S-1M SWITCH MECHANISM

The type S-1M switch mechanism uses a single SPDT dry contact switch and is designed to be interchangeable with the type S-1 Mercury switch mechanism used in most Magnetrol® liquid level controls and flow switches. It is completely self contained with numbered terminal strip and removeable dry contact switch. See bulletin 42-110 for further details and rating information.

TYPE DPS-1M SWITCH MECHANISM

The type DPS-1M mechanism uses two SPDT dry contact switches actuated by the same magnet, to obtain double pole action. This arrangement provides the capability to "break" both sides of a control circuit simultaneously or control two circuits of different voltage and current characteristics. A high temperature porcelain terminal block is featured as standard. Also see bulletin 42-110 for complete specifications.

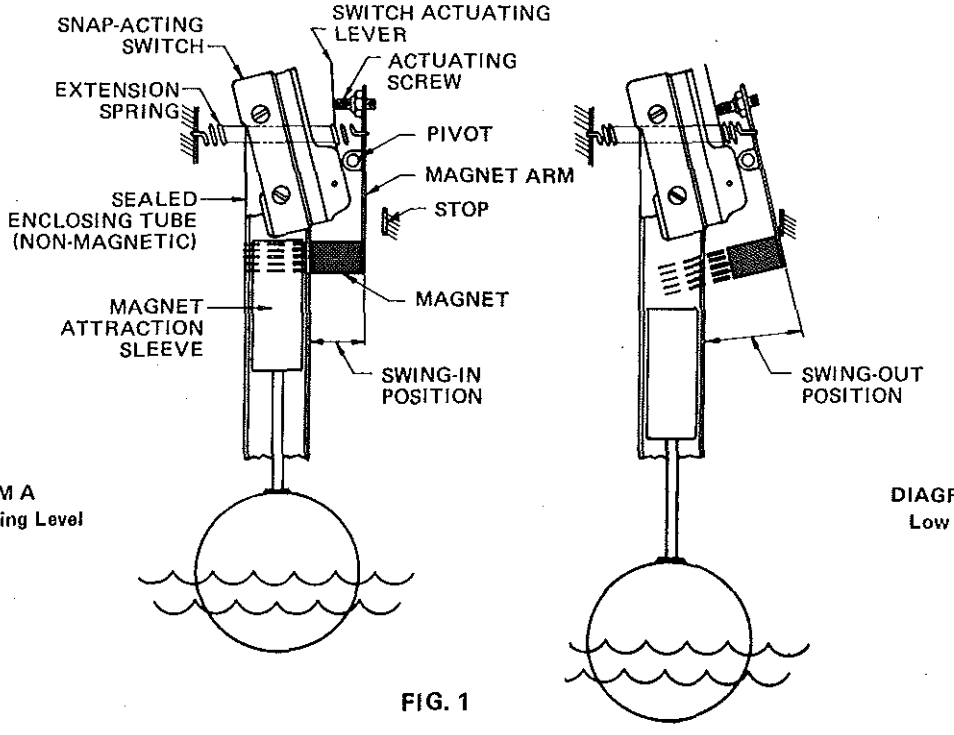


FIG. 1

OPERATING PRINCIPLE

Diagrams A and B illustrate the simple and foolproof Magnetrol operating principle. Switching action is obtained through the use of a magnetic sleeve actuated by a float (or flow sensing device) and a switching mechanism. These two basic component assemblies are separated by a non-magnetic, pressure-tight enclosing tube. A swinging magnet carriage, operating on precision stainless steel pivots, activates the switch.

OPERATING CYCLE

At "Normal Operating Level" of liquid in a storage vessel (diagram "A"), the float moves the magnetic sleeve up within the field of a switch magnet, drawing it in tightly to the enclosing tube. This causes the switch lever to release, "making" or "breaking" an electrical circuit. As liquid level recedes, the float pulls the magnetic sleeve downward until, at a pre-determined "Low Level", the switch magnet releases and swings outward away from the enclosing tube. This in turn re-actuates the switch lever, thus reversing switch action.

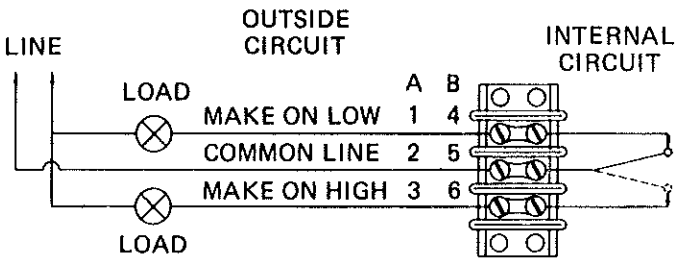
When liquid level returns to normal, the float once again moves the magnetic sleeve up the enclosing tube, causing the switch mechanism to assume its original position.

Switch mechanisms can be used singly or in multiples depending on operational requirements and switching action desired.

WIRING INSTRUCTIONS

S-1M MECHANISM

WIRING DIAGRAM

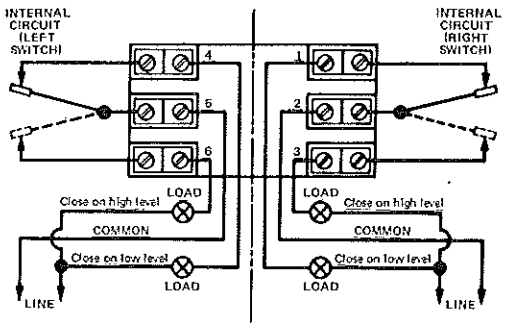


NOTE: When used on side mounted float-in-tank switches, the wiring diagram is reversed. (Make on Low becomes Make on High, etc.)

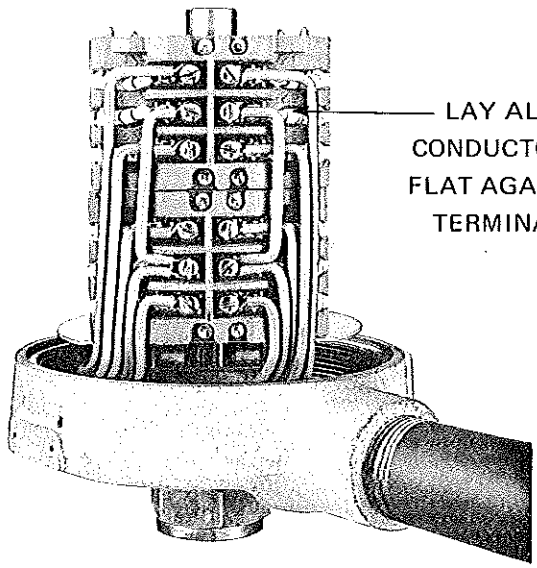
FIG. 2

DPS-1M MECHANISM

WIRING DIAGRAM



NOTE: – Double pole action is obtained by simultaneous operation of R.H. and L.H. single pole switches.
– When used on side mounted float-in-tank switches, the wiring diagram is reversed. (Make on High becomes Make on Low, etc.)



DPS-1M WIRING

Care must be exercised in positioning the incoming conductors to insure clearance between the conductors and the housing cover. Figure at right shows a recommended wiring practice for two DPS-1M mechanisms. All conductors are brought into the housing, wrapped around the enclosing tube under the baffle plate and then brought up to the proper terminal. Excess wire must be cut off before stripping ends. Use asbestos insulated wire suitable for at least 90°C if a high ambient temperature exists at the control or conduit. These wires need not extend beyond the first junction box.

FIG. 3

©MAGNETROL INTERNATIONAL 1974

REMOVING THE SWITCH MECHANISM

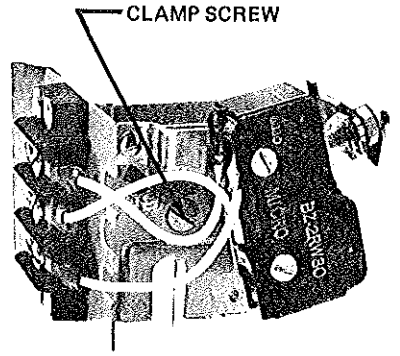


FIG. 4

All type S-1M and DPS-1M switch mechanisms can be easily removed from a Magnetrol control without disturbing piping connections or the rest of the control. Switch mechanisms are secured in the controls by means of a split clamp screw.

CAUTION: Before attempting to remove a switch mechanism, be certain to pull disconnect switch or otherwise assure that electrical circuit through control is deenergized.

1. Disconnect wiring from supply side of terminal block on switch mechanism(s). Note and record lead wire terminal locations.

NOTE: Measure location of switch mechanism(s) on enclosing tube and record for reference use during reassembly. Measure from top of enclosing tube to top of split mounting clamp on switch mechanism.

2. Loosen screw in split mounting clamp until mechanism slides freely on enclosing tube.
3. Remove small round head screw securing lower switch mechanism to baffle plate.
4. Carefully lift off switch mechanism(s) and place on clean surface, free of metal particles which may be attracted to switch magnet(s).
5. Replace switch mechanism(s) in reverse of steps 1 thru 4 above. Be certain, in the case of S-1M mechanisms, that assemblies are stacked in proper order on controls with multiple mechanisms.
   - "B" mechanism must be replaced first and attached to baffle plate, then followed by an "A" mechanism.
   - On controls with three or more mechanisms, an "A" mechanism must be positioned between two "B" mechanisms.

NOTE: All S-1M mechanisms have "A" or "B" identification markings placed next to terminal blocks.

REPLACING THE TYPE S-1M SWITCH

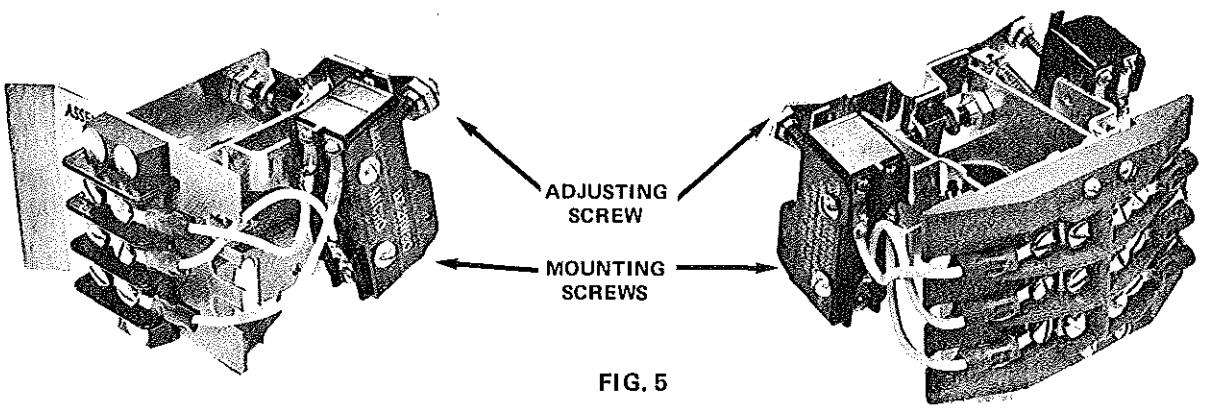


FIG. 5

Dry contact switches used in Magnetrol S-1M and DPS-1M switch mechanisms are easily removed and replaced when damaged or broken.

1. Disconnect Magnetrol control from power supply.
2. Disconnect switch leads from terminal block. Note and record terminal connections of switch to be replaced.
3. Remove two mounting screws holding existing switch.
4. Remove existing switch and install replacement switch in the same position, tightening mounting screws securely.

NOTE: For proper operation of the replacement switch, it must actuate in the middle portion of the pivoted magnet's swing.

5. Check switch action and adjust as follows:
   A. Slowly rotate the pivoted magnet by hand, back and forth through its angle of swing, listening closely for the actuating "click" of the switch in each direction.
   B. Check to see if there is equal additional over-travel of magnet in its swing after the switch "click" in either direction.
   C. If switch actuation is not correct, change adjustment of actuating screw using a 1/16" hexagon key wrench.

NOTE: If a single switch is being replaced on a DPS-1M mechanism, lever of second switch must be depressed and held to allow for the audible adjustment of new switch, as described above.

   D. With new switch in adjustment, release lever of second switch and perform "fine-tuning" of both switches to provide simultaneous actuation (clicks).
6. Re-connect power supply and test switch action by varying liquid level in the vessel or by "blowing down" float chamber.

REPLACEMENT PARTS

PART NUMBERS FOR TYPE S-1M and DPS-1M SWITCH MECHANISMS (W/SWITCHES)									
DESCRIPTION		MAXIMUM LIQUID TEMPERATURE							
		250°F				450°F			
CONTACTS	Elec. Current	Red Dot Magnet		Yellow Dot Magnet		Red Dot Magnet		Yellow Dot Magnet	
		"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism	"A" Mechanism	"B" Mechanism
SPDT (S-1M)	AC	89-7401-101	89-7401-102	89-7401-103	89-7401-104	89-7401-107	89-7401-108	89-7401-109	89-7401-110
	DC	–	–	89-7401-105	89-7401-106	–	–	–	–
Baffle Plate Ass'y.		36-5303-001 (RP-1011)							
DPDT (DPS-1M)	AC	89-7401-121		89-7401-122		89-7401-124		89-7401-125	
	DC	–		89-7401-123		–		–	
Baffle Plate Ass'y.		36-5305-001 (RP-6206)							

CAUTION: **When ordering replacement switch mechanisms, be certain to determine color dot on magnet. NEVER replace a mechanism having a red dot magnet with one having a yellow dot magnet, and vice versa.**

PART NUMBERS FOR DRY CONTACT SWITCHES ONLY									
For L.H. or "B" Mechanisms ①	MAXIMUM LIQUID TEMPERATURE				MAXIMUM LIQUID TEMPERATURE				For R.H. or "A" Mechanisms ①
	250°F		450°F		250°F		450°F		
	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	Red Dot Magnet	Yellow Dot Magnet	
AC CURRENT	89-7101-021		89-7101-023		89-7101-020		89-7101-022		AC CURRENT
DC CURRENT	–	89-7101-025	–	–	–	89-7101-024	–	–	DC CURRENT

NOTE:
1. "LEFT HAND" (L.H.) or "RIGHT HAND" (R.H.) designations, used to identify switches on DPS-1M mechanisms only, determined by viewing switch mechanism facing terminal block.

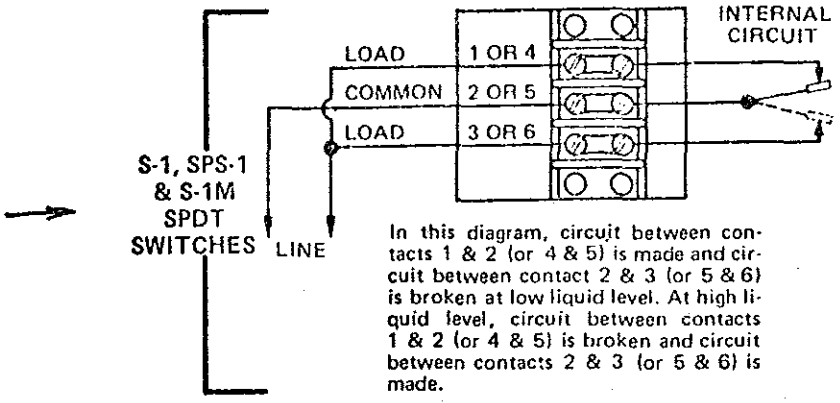
IMPORTANT:
When ordering, please specify:
1. Model and Serial number of control.
2. Name and Number of part.

MAGNETROL
INTERNATIONAL, INCORPORATED
5300 Belmont Road • Downers Grove, Illinois 60515 • (312) 969-4000 • Telex 25-3085

PRINTED IN U.S.A.

11908552

TERMINAL CONNECTIONS
SINGLE POLE SWITCH MECHANISMS



In this diagram, circuit between contacts 1 & 2 (or 4 & 5) is made and circuit between contact 2 & 3 (or 5 & 6) is broken at low liquid level. At high liquid level, circuit between contacts 1 & 2 (or 4 & 5) is broken and circuit between contacts 2 & 3 (or 5 & 6) is made.

LIMERICK GENERATING STATIONS UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
P.O. NO. LX 239585
COLT/FMED ORDER NO. 11-700000

NOTE: WIRING DIAGRAM IS REVERSED (HIGH LEVEL ACTUATION BECOMES LOW LEVEL ACTUATION, ETC.) WHEN THIS SWITCH MECHANISM IS USED ON SIDE MOUNTED, FLOAT IN TANK SWITCHES, EMPLOYING A REVERSING PIVOT (MODELS TF-52, TF-62, TF-63, TF-64, ETC.)

MODIFIED BY ECO 12221
MAGNETROL order # M134149-101
S.S. DISPLACERS
5-27-82

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

FOR Colt Industries/Fairbanks Morse

CUSTOMER ORDER B458959-0 Rev. 1 MAGNETROL ORDER (original) M471493-101

MODEL A153F-EP/VP-S1M3DC (New # A15-1H3B-DK) QUANTITY 8

SWITCH RATING 2.2 AMPS @ 125 VOLTS DC TEMPERATURE OF PROCESS LIQUID 250 °F MAX.

CERTIFIED BY [signature] DATE 4-25-78

TAG(S)
F.M. P/N
11908552

FORM: 42-603.3
November 1976

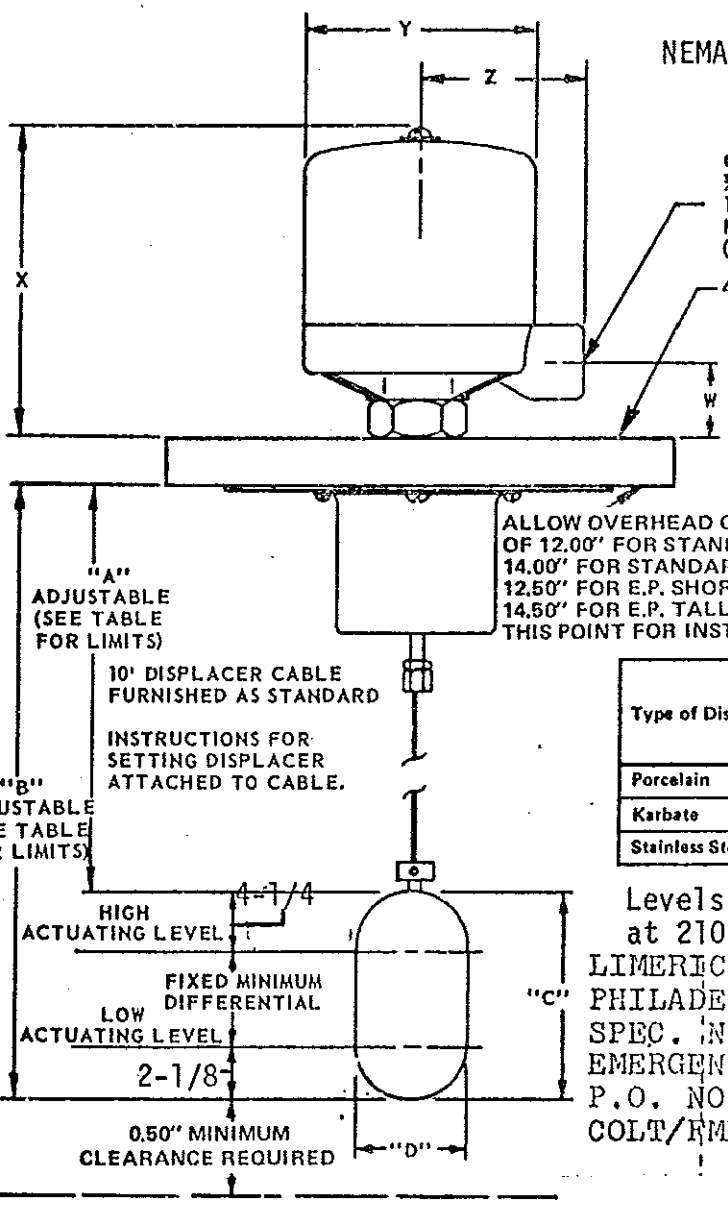
MAGNETROL INTERNATIONAL

5300 BELMONT ROAD / DOWNERS GROVE, IL 60515 / AREA 312/969-4020

Printed in U.S.A.

11908552

INSTALLATION DIMENSIONS
MODEL A-153-F & A-153-F.E.P.



TYPE OF COVER	W	X	Y	Z
STANDARD SHORT	1.50	6.50	4.69	3.25
STANDARD TALL	1.50	8.50	4.69	3.25
EXPLOSION PROOF SHORT	1.62	7.81	5.81	4.00
EXPLOSION PROOF TALL	1.62	9.81	5.81	4.00

NEMA VII Explosion proof/Vapor proof Housing

Type of Displacers	Diameter of Displacer "D"	Diameter of Displacer "C"	Limits of Displacer Adjustment "A" Min.	"A" Max.	"B" Min.	"B" Max.
Porcelain	2.56	7.25	4.50	9'-9.75"	11.75	10'-4.25"
Karbate	2.50	9.00	4.50	9'-7.00"	13.50	10'-4.25"
Stainless Steel	3.00	6.00	6.00	10'-3.00"	11.38	10'-8.25"

Levels given are for .95 sp. gr.
at 210°F

LIMERICK GENERATING STATIONS UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71
EMERGENCY DIESEL GENERATORS
P.O. NO. LX 239585
COLT/FMED ORDER NO. 11-700000

(NOT FOR CONSTRUCTION UNLESS CERTIFIED)

FOR Colt Industries/Fairbanks Morse

TAG(S) F.M. P/N 11908552

CUSTOMER ORDER B458959-0 Rev. 1 MAGNETROL ORDER M471493-101

MODEL A153F-EP/VP-S1M3DC (REV to A16-1H3B-DK) QUANTITY 8

SWITCH ACTION SPDT micro switch per ECO 12271 / MAGNETROL order # M134149-101

DISPLACER TYPE Porcelain (STAINLESS STEEL 5-21-82) SWITCH HOUSING Explosion proof/Vapor proof

MIN. SP. GR. .70 MAX. PRESS. 200 P.S.I. MAX. TEMP. 210 °F. SERVICE LIQUID -

CERTIFIED BY [signature] DATE 4-25-78

FORM: 45-501.2
October 1977

MAGNETROL INTERNATIONAL

Printed in U.S.A.

11908552

RECOMMENDED SPARE PARTS

IMPORTANT: When ordering parts, furnish the serial number of the Magnetrol.

CUSTOMER Colt Industries/Fairbanks Morse

CUST. P.O. NO. B458959-0 Rev. 1 PRODUCTION NO. M471493-101

MAGNETROL MODEL(S)

A153F-EP/VP-S1M3DC

QUANTITY	PART NO.	DESCRIPTION	PRICE EACH F.O.B. FACTORY
		MERCURY SWITCH	
		SPST - Closes on Falling Level	
		Right Side	
		Left Side	
		MERCURY SWITCH	
		SPST - Closes on Rising Level	
		Right Side	
		Left Side	
		MERCURY SWITCH	
		Single Pole, Double Throw	
		Right Side	
		Left Side	
		MICRO-SWITCH	
		Single Pole, Double Throw	
4	89-7101-024	Right Side	$47.00
		Left Side	

MINIMUM INVOICE: A minimum charge will be made on small purchases to cover packing, shipping, order processing, billing and other handling expenses, as follows: $35.00 within the U.S.A. and possessions, $45.00 Canada and Puerto Rico shipments and $50.00 elsewhere.

NOTE: All orders are subject to current prices at time of order placement.

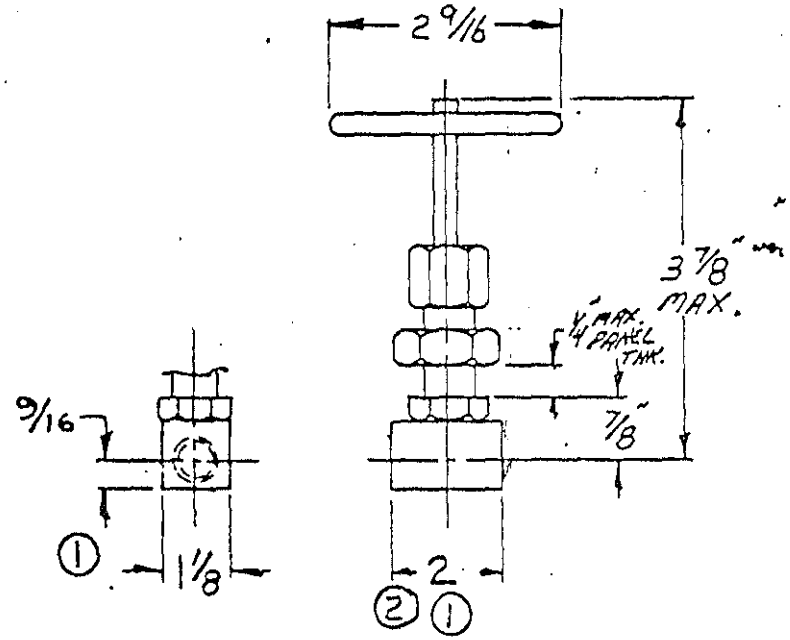
MAGNETROL INTERNATIONAL
6300 BELMONT ROAD/DOWNERS GROVE ILLINOIS 60516 AREA 312/969 4000

11 908 650

DESCRIPTION: INSTRUMENT SHUT-OFF VALVE

VENDOR NO: 6701053D (3)

VENDOR: DRAGON VALVES, INC.
13457 EXCELSIOR DR.
NORWALK, CAL. 90650



APPROVED Rev.3 AUG 18 1977 QUALITY CONTROL

APPROVED Rev.2 APR 21 1977 QUALITY CONTROL

APPROVED Rev.1 APR 6 1977 QUALITY CONTROL

APPROVED Rev.0 MAR 10 1977 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS (5)	WLS MHP
3	10437	8-30 77	SEE SH. 2 (4)	
2	10289	4-27 77	ADDED SEAT TYPE "D" (3)	RHH KO
1	"	"	REVISED DIM WAS 1/8 (2)	RHH KO
—	10276	4-15 77	DIM'S ADDED (1)	RHH KO

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III, CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16/77	ASSY. OR LO.	
DR. BY HERTENSTEIN	2/23/77	SCALE	AL
CHK'D. BY R. NORMALI	3/1/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. R.D. YAI	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 1 OF 4

BF3009-2

I. GENERAL REQUIREMENTS:

A. CONNECTIONS: 1/4" NPT (F)
B. ORIFICE: .180" FULL OPEN (4)
C. MEDIA:

1. FUEL OIL (#2 DIESEL) AT 50 PSIG MEAN W/PULSATIONS TO 200 PSIG & 150°F.
2. COMPRESSED AIR @ 250 PSIG & 130°F.
3. LUBE OIL SERVICE @ 100 PSIG & 200°F.
4. WATER SERVICE @ 50 PSIG & 180°F.

D. FUNCTION: SHUT-OFF.

II. ASME SECTION III REQUIREMENTS:

A. "THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".

B. ASME COMPONENTS QUALITY ASSURANCE REQUIREMENTS DWG. 11 908 456 APPLIES TO THIS ORDER.

C. THE PRESSURE RETAINING AREA DESIGN SHALL CONFORM TO ND-3511.

APPROVED Rev.3 QUALITY CONTROL

APPROVED Rev.2 APR 21 1977 QUALITY CONTROL

APPROVED Rev.1 QUALITY CONTROL

APPROVED Rev.0 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	ORIFICE WAS (4) .214	
2	10289	4-27 77	SEE SH. 1	
1	10276	4-15 77	SEE SH. 1	

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 . ± .060 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16/77	ASSY. OR LO.	
DR. BY R. NORMAN	3/2/77	SCALE	
CHK'D. BY H.R.S.	5/2/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. R.D.M.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 2 OF 4

JUL 31 1978 APP

BF3009-2

II. ASME SECTION III REQUIREMENTS - CONT'D

D. STANDARD PRESSURE CLASS: ANSI 900 LB

E. DESIGN TEMPERATURE: 200°F MAX.

F. DESIGN ALLOWABLE STRESS VALUES: PER ND-3112.4 AND ND-3511. ATTACHED PIPE IS 1/4 SCHED. 80 OR 3/8 TUBE.

G. BOUNDRIES: PER NA-3254.1

H. MATERIALS:

1. MATERIALS SHALL BE NEW, SUITABLE FORTHE APPLICATION AND IN ACCORDANCE WITH ND-2120. BONNET, PACKING GLAND AND PACKING NUT SHALL BE SA-479 TYPE 316 STAINLESS STEEL. STEM AND DISC SHALL BE SA-564 GRADE 630 HIGH ALLOW P.H. STEEL. BODY SHALL BE SA-182 GRADE F-316.
2. IMPACT TESTING NOT REQUIRED.
3. MATERIALS SHALL BE CERTIFIED PER ND-2130 OF ASME SECTION III. CERTIFIED MATERIALS TEST REPORTS AND/OR MATERIAL MFGS. CERTIFICATES OF COMPLIANCE (AS APPLICABLE) SHALL BE FURNISHED TO COLT INDUSTRIES PURCHASING DEPARTMENT.

APPROVED Rev.3 JUL 8 1977 QUALITY CONTROL

APPROVED Rev.2 APR 21 1977 QUALITY CONTROL

APPROVED Rev.1 QUALITY CONTROL

APPROVED Rev.0 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	SEE SHT 2	H.R.S.
2	10289	4-27 77	SEE SH.1	RHN
1	10276	4-15 77	SEE SH. 1	RHN

TITLE
VALVE, INSTRUMENT - 1/4" ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.0 ± .060 0.00 ± .030 0.000 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16 77	ASSY. OR LO.
DR. BY R. NORMAN	3/2 77	SCALE
CHK'D. BY H.R.S.	3/2 77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. R.D.W.
APPV. WELD.		

SHEET SIZE A DWG. NO. 11 908 650 SHEET

JUL 31 1978 QA

II. ASME SECTION III REQUIREMENTS - CONT'D

I. VENDOR TO FURNISH COPY OF DATA REPORT NPV-1 TO COLT INDUSTRIES PURCHASING DEPARTMENT.

J. CERTIFIED DESIGN SPECIFICATIONS AUTHORIZING CLASSIFICATION AND SPECIFYING DESIGN OF THIS COMPONENT ARE COLT DWG. NOS. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM", 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM", 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM".

III. SPECIAL REQUIREMENTS:

A. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBTED.

IV. COLT INDUSTRIES DUTIES:

A. PURCHASING, RECEIVING, INSPECTION, STORING, & DISBURSEMENT SHALL COMPLY WITH SECTION QC-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY CONTROL MANUAL.

B. PURCHASING DEPT. SHALL FORWARD THE FOLLOWING DOCUMENTS TO THE VENDOR AS PAR T OF THE ORDER:

1. COLT DWG. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM" REV. 1 (E) (S)
2. COLT DWG. 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM" REV. 1 (S)
3. COLT DWG. 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM" REV. 1 (S)
4. COLT DWG. 11 908 456 COLT/FMED Q.A. REQUIREMENTS ON VENDOR. REV. 4 (S)

APPROVED Rev. 3 AUG 18 1977 HRN QUALITY CONTROL
APPROVED Rev. 2 APR 21 1977 HRN QUALITY CONTROL
APPROVED Rev. 1 APR 8 1977 HRN QUALITY CONTROL
APPROVED Rev. 0 MAR 31 1977 HRN QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	WLS
3	10437	8-30 77	SEE SH. 2	H.R.S.
2	10289	4-27 77	SEE SH. 1	RMH
1	10276	4-15 77	SEE SH. 1	RMH

TITLE: VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16 77	ASSY. OR LO.	
DR. BY R. NORMAN	3/2 77	SCALE	
CHK'D. BY H.R.S.	3/2 77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. R.O.M.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 4 of 4

QA APP JUL 31 1978

Drawing Not Available In
Original Contract Manual

1. THE FLEXIBLE HOSE ASSEMBLIES USED IN THIS DIESEL POWER GENERATING SET ARE FOR THE AIR START SYSTEM, THE LUBE OIL SYSTEM AND THE JACKET WATER SYSTEM.

2. THE FACTORY ASSEMBLED HOSE ASSEMBLIES SHALL CONSIST OF FC195 AQP (SAE 100 R2A) 2-WIRE BRAID HOSE, #4722 MALE PIPE FITTINGS, #4721 SAE 37° (J.I.C.) SWIVELS, AND #2022 INTERNAL PIPE/37° FLARE ADAPTERS IN SIZES AND LENGTHS SHOWN.

FM PART NO.	HOSE SIZE	HOSE LENGTH	MALE PIPE FITTING	SAE 37°FITTING
11908981	1-1/2"	24"	4722-24-24S	4721-24S
11908982	1-1/2	18	4722-24-24S	4721-24S
11908983	1	12	4722-16-16S	4721-16S
11908984	1/2	12	4722-8-8S	4721-8-8S

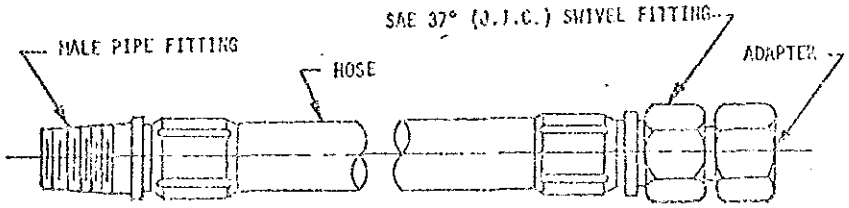
FM PART NO.	ADAPTER	HOSE ASSEMBLY FINISHED LENGTH
11908981	2022-24-24S	31.55
11908982	2022-24-24S	25.55
11908983	2022-16-16S	17.92
11908984	2022-8-8S	16.61

3. CADMIUM PLATED STEEL HOSE FITTINGS AND ADAPTERS.

4. HOSE ASSEMBLY MUST BE TESTED AT 200 PSI WITH WATER FOR (1) HOUR AND CERTIFIED BY VENDOR'S QUALITY CONTROL THAT THEY DO NOT LEAK. ANY LEAKING ASSY. WILL NOT BE REPAIRED OR REWORKED WITHOUT VENDOR'S QUALITY CONTROL APPROVAL. LEAKS IN THE HOSE PORTION WILL NOT BE REPAIRED OR REWORKED.

5. DRAWINGS: VENDOR TO FURNISH (2) REPRODUCIBLE DRAWINGS FOR APPROVAL. DRAWINGS TO INCLUDE THE FOLLOWING:

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.
PURCHASE ORDER NO. LX 239585
FAIRBANKS MORSE ORDER NO. 11-700000



VENDOR PART NO.:

VENDOR DWG. NO.:

VENDOR: AEROQUIP OR EQUIVALENT

11908985

Colt Industries — Fairbanks Morse Engine Division

TITLE: HOSE ASSY. NPT (M) x NPT (F)

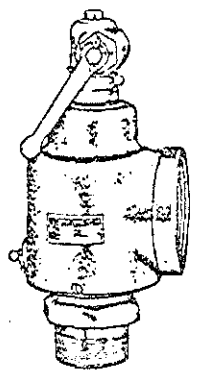
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .005
FLAME CUTTING, SHEARING, MISSING, FORMING AND WELDING ± .030
DECIMAL MACHINING TOLERANCES
0 PL ± .100 .0 ± .01 0.00 ± .010

DRAWN
CHKD. 3/6/84
ENGR.
CHKD.
MATL
CAST
APPV. MACH.
WELD.
SHEET D DWG. NO. 11 500 825
SIZE SHEET 1 OF 1

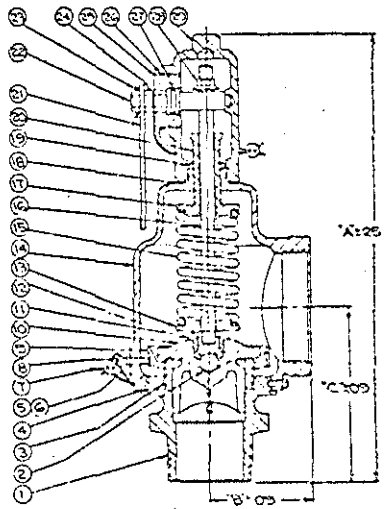
REV NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY

DIMENSIONS

Inlet Male NPT	Outlet Female NPT	A 80-4 & 80-4S Sc'd	A 80-4 & 80-4S Flg'd	A 84-4 & 84-4S Sc'd	A 84-4 & 84-4S Flg'd	B	C Sc'd	C Flg'd	Weight, Lbs. 80-4 Sc'd	Weight, Lbs. 84-4 Sc'd
~~¾"~~	~~¾"~~	~~4¾~~		~~6~~		~~1⅞~~	~~2½~~		~~1~~	~~1¾~~
~~¾"~~	~~1¼"~~	~~6~~		~~7½~~		~~3½~~	~~2⅝~~		~~2~~	~~2½~~
1"	1½"	6⅝		8¼		1⅞	3⅜		2¾	3¼
~~1¼"~~	~~2"~~	~~7⅞~~		~~9½~~		~~2½~~	~~3⅝~~		~~4¾~~	~~5¼~~
~~1¼"~~	~~2½"~~	~~8⅜~~	~~8⅛~~	~~9⅜~~	~~9⅜~~	~~2⅜~~	~~4⅛~~	~~4~~	~~7~~	~~7½~~



FIGURES 84-4, ...



DESCRIPTION: KUNKLE 1" FIGURE 84-4 BRONZE RELIEF VALVE WITH THE FOLLOWING FEATURES:

1. INLET - 1" MALE NPT
2. OUTLET - 1 1/2" FEMALE NPT
3. PRESSURE SETTING 40 PSIG

VENDOR: KUNKLE VALVE CO., INC.
FT. WAYNE, INDIANA

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: VALVE, SAFETY 1"

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 .0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11200	11/13/78	ASSY. OR LO.	
DR. BY L.W.Cooper	11/10/78	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 910 548 | SHEET OF

KUNKLE VALVE COMPANY, INC. 1/910548

121 So. Clinton Street, Fort Wayne 2, Indiana

Maintenance, Service and Adjusting Instructions For Safety & Relief Valves

Maintenance of safety valves consists of: 1. Frequent inspection for clogged drains and dirt buildup in bodies. 2. Pop testing every two to six months (depending on general plant conditions). 3. Yearly removal for testing inspection and overhaul.

If valves are to be popped by hand, pressure should be at least 75% of set pressure to prevent foreign material from becoming caught between seat and disc. The recommended procedure is to pop the valve by running pressure up to set pressure of valve.

Valve failure may be caused by seizing of parts, scored or wire drawn seats and overtightening valve in bushing, heavy discharge piping supported directly by valve, operating pressure too close to set pressure of valve and corroded or eroded springs. The first case may be corrected by careful cleaning followed by light sanding of the seating surfaces. For correction of the second, safety valves are susceptible of re-machining of seating surfaces to angles shown on part drawings, or careful hand lapping if damage is less severe. Springs rarely require replacement, but may be purchased from manufacturer as a unit of spare parts should replacement be necessary.

DISMANTLING

1. Remove lifting gear and/or hood and mark relative positions of pressure screw, locknut and cap.
2. Loosen pressure screw locknut and pressure screw to release pressure on spring.
3. Remove cap.
4. Remove spindle, disc and guide.
5. Mark location of regulator ring(s) if used and remove it.

To reassemble, reverse the above procedure, being careful to return parts to their marked positions and replace all gaskets. Re-set valves according to instructions below.

ADJUSTMENT, SETTING and TESTING

Popping Pressure or Cracking Pressure. Make sure of gauge accuracy before beginning. Remove lifting gear and hood exposing pressure screw and locknut. Loosen locknut and raise pressure until valve pops. If opening pressure is too low, turn down on pressure screw. If pressure is too high, reverse pressure screw. After proper pressure has been reached securely tighten locknut.

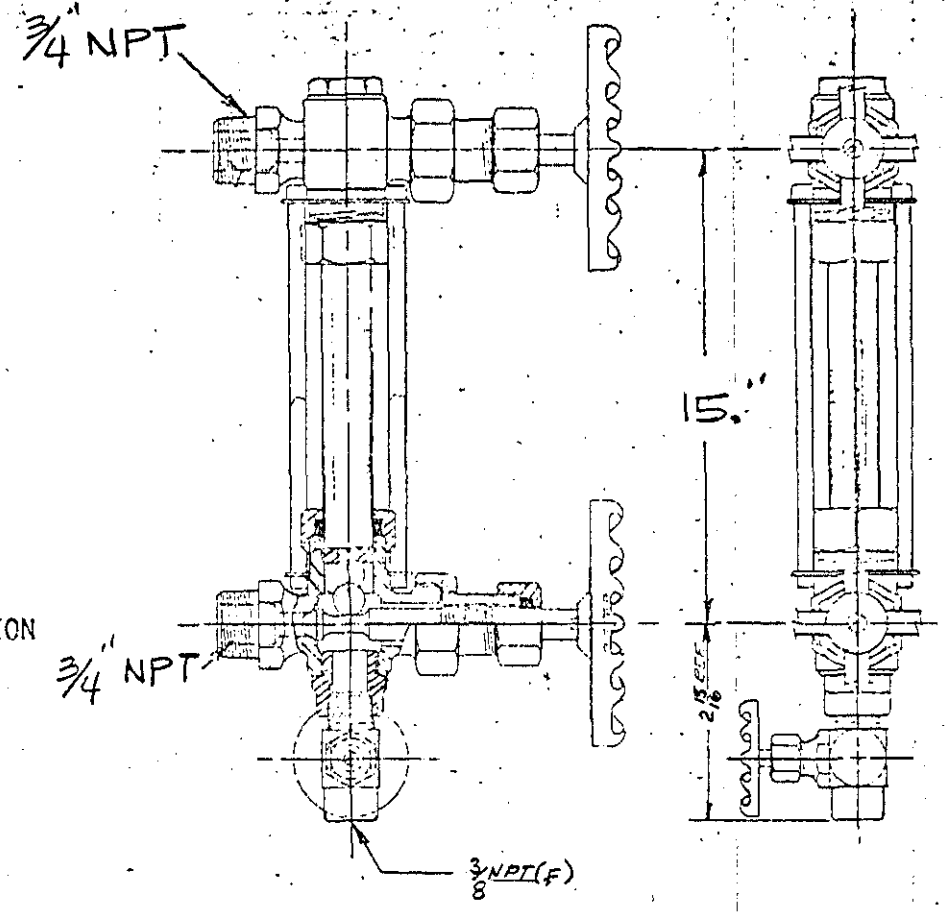
Blowdown Adjustment, Steam, Air, Gas Valves Only. When popping pressure is changed, a slight adjustment in blowdown may be required. Raising the popping pressure lengthens blowdown and lowering the popping pressure shortens blowdown. Raising the regulator ring toward the disc will increase blowdown and lowering the ring will decrease blowdown. Regulator ring adjustments should be made a notch at a time as the adjustment is sensitive. The normal position would be six (6) notches down from touching the disc, but this figure will vary with conditions.

CAUTION: Re-tighten regulator ring set screw being careful that it rests in notches without gouging ring surface. Adjusting regulator ring may cause valve to pop if it is simmering. Keep hands and face clear of outlet.

The factory will be pleased to service valves for you or to give advice should problems arise during reconditioning.

D.R. 119-970

11911663



VENDOR PART NO.: 54A

VENDOR: ESSEX BRASS CORPORATION
P. O. BOX 4607
DETROIT, MI 48234

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE

SIGHT GLASS,
J.W EXPANSION TANK

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	11628	10/24/79 ASSY. OR LO.
DR. BY	K. OSTOIC	10/18/79 SCALE
CHK'D. BY	L.HARSH	10/22/79 HEAT TR.
MAT'L	PURCHASE	
APPV. CAST.		MAT'L
APPV. MACH.		ENG. PE
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11911663 | SHEET 1 OF 2

BF3009 2

D.R. 11908970

11911663

DESCRIPTION: ESSEX BRASS NO. 54A "NAVY" DIRECT READING. LIQUID LEVEL INDICATORS PER THE FOLLOWING:

I. GENERAL REQUIREMENTS:

A. CONNECTIONS - 3/4" NPT INLET AND OUTLET, 3/8" NPT (F) DRAIN

B. MEDIA: WATER

C. VALVE BODIES: CAST BRONZE

D. TYPE 2 AUTOMATIC - HAS AUTOMATIC BALL CHECK, SUITABLE FOR A MAXIMUM WORKING PRESSURE OF 300 PSI

E. CLASS A GENERAL - GUARD ROD PROTECTION FOR GAUGE GLASS

F. 15" CENTER DISTANCE WITH A 3/4" X 3" GLASS TUBE

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
SIGHT GLASS
J.W. EXPANSION TANK

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

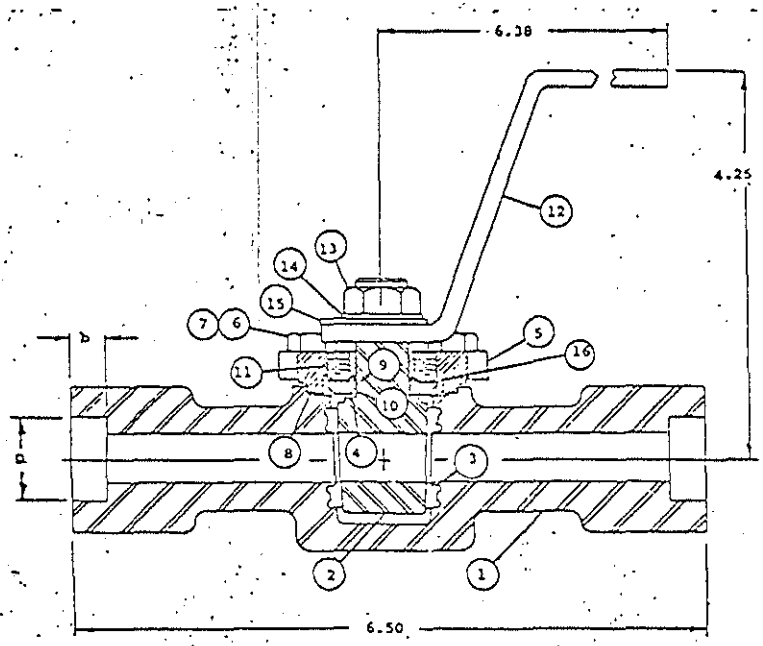
REL. NO.	11628	10/24/79	ASSY. OR LO.
DR. BY	K. OSTOIC	10/18/79	SCALE
CHK'D. BY	J. HARSH	10/22/79	HEAT TR.
MAT'L	PURCH		
APPV.	CAST.		MAT'L
	MACH.		ENGR PE
	WELD.		

SHEET SIZE A | DWG. NO. 11911663 | SHEET 2 OF 2

BF3029 2

11911811

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	b	D
3/4"	.50	1.07

VENDOR NO: 3/4" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP. ELK GROVE, IL 60007

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

See 11908456 for Colt/FMED Q.A. Requirements on Vendor.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
VALVE, PLUG
3/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11464	5/25/79	ASSY. OR LO.	
DR. BY T. RYAN	5/23/79	SCALE	~
CHK'D. BY J. HAKES	5/25/79	HEAT TR.	
MAT'L. PURCHASE			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. PE	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11911811		SHEET 1 OF 3

COL. FM MAY 23 1979 APP

BF3009-2

DESCRIPTION: TUFLINE FIG. 0366SW TEFLON SLEEVE NON-LUBRICATED SOCKET WELD PLUG VALVE WITH THE FOLLOWING FEATURES:

I. GENERAL REQUIREMENTS:

STANDARD DESIGN RATING: 300 LB.
DESIGN CONDITIONS: MAXIMUM PRESSURE ALLOWED AT 200°F

II. ASME SECTION III REQUIREMENTS:

A. "THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".

B. ALL MATERIALS SHALL COMPLY WITH REQUIREMENTS OF ND-2121 OF ASME SECT. III. SPECIFIC MATERIALS AS FOLLOWS:

1. BODY & BONNET MATERIAL TO BE ASME SA-216 GRADE WCB.
2. PLUG MATERIAL TO BE ASME SA-479 TYPE 316.

C. DESIGN ALLOWABLE STRESS VALUES SHALL COMPLY WITH ND-3112-4 OF ASME SECTION III.

D. MATERIAL TO BE CERTIFIED IN ACCORDANCE WITH ND-2130 OF ASME SECTION III. COPIES OF CERTIFIED MATERIALS, TEST REPORTS AND MATERIAL MANUFACTURER'S CERTIFICATES OF COMPLIANCE (AS APPLICABLE) SHALL BE FURNISHED TO COLT INDUSTRIES PURCHASING DEPT.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
VALVE, PLUG
3/4
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11464	5/2579	ASSY. OR LO.	
DR. BY T. RYAN	5/23/79	SCALE	
CHK'D. BY J. HARSH	5/23/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. PE	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 911 811 | SHEET 2 OF 3

COLT FM MAY 23 1979 APP

E. VALVE DESIGN TO CONFORM TO ND-3511 OF ASME SECT. III (PRESSURE TEMPERATURE RATING AND WALL THICKNESS). ATTACHED PIPE IS 3/4" SCHEDULE 80 PIPE.

F. VENDOR TO FURNISH COPY OF DATA REPORT NPV-1 TO COLT INDUSTRIES PURCHASING DEPARTMENT.

G. CERTIFIED DESIGN SPECIFICATIONS AUTHORIZING CLASSIFICATION AND SPECIFYING DESIGN OF THIS COMPONENT IS COLT DWG. NO. 11871105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM".

III. SPECIAL REQUIREMENTS:

A. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBITED.

IV. COLT INDUSTRIES DUTIES;

A. PURCHASING, RECEIVING, INSPECTION, STORING, & DISBURSEMENT SHALL COMPLY WITH SECTION QA-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY ASSURANCE MANUAL.

B. PURCHASING DEPT. SHALL FORWARD THE FOLLOWING DOCUMENTS TO THE VENDOR AS PART OF THE ORDER:

1. COLT DWG. 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM:

2. COLT DWG. 11908456 COLT/FMED Q.A. REQUIREMENTS ON VENDOR.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
VALVE, PLUG
3/4
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	11464	5/25/79	ASSY. OR LO.
DR. BY	T. RYAN	5/23/79	SCALE
CHK'D. BY	J. WALSH	5/23/79	HEAT TR.
MAT'L			
APPV. CAST.			MAT'L.
APPV. MACH.			ENGR. PE
APPV. WELD.			

SHEET SIZE	DWG. NO.	SHEET
A	11 911 811	3 OF 3

MAY 23 1979

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	P6341	6/17/76	ADDED PICTURE	SJV JMW
2	"	"	④ADD VENDOR PART NO. SERIES 50	
2	"	"	④ADD NOTES ON BLUE BAND FOR INSP. PURPOSES	
2	10875	5-19-78	③ WAS VENDOR BULLETIN AD 257-9	

DESCRIPTION: "Garflex" nitrile/neoprene molded bellows with two ASA 150 FF loose flanges.

Free length, face to face over molded bellows - 5".
Allowable compression -- 1-1/4" max.
Allowable elongation -- 3/4" max.
Allowable transverse deflection (parallel misalignment +: 3/4" max.
Ratings for all sizes, continuous duty -
Working pressure - 250 PSI
Test pressure - 350 PSI
Burst pressure - 850 PSI min.
Vacuum - 10" Hg.
Temperature - -22°F to 212°F.

VENDOR BULLETIN NO.: AD-330

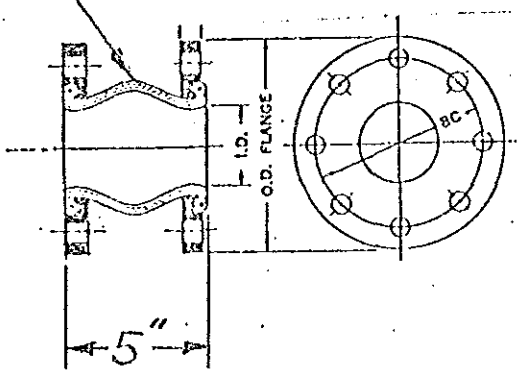
①VENDOR PART NO: SERIES 50 (NITRILE LINER)

PART NO.		PIPE SIZE (INS.)	ALLOWABLE ANGULAR DEFLECTION°, MAX.
12 994 172		2	35
12 994 173		2-1/2	30
12 994 174		3	30
12 994 130		4	25
12 994 150		5	20
12 994 129		6	20
12 994 175		8	15

②FLEXIBLE CONNECTORS MUST HAVE SOLID BLUE BAND INDICATING NITRILE LINER
Use for water and lubricating oil only.

VENDOR: Garlock Inc.
Palmyra, N.Y. 14522

③INSPECT FOR SOLID BLUE BAND REJECT IF DOTS OR OTHER COLOR CODING ARE ON THE COLOR BAND.



TITLE: FLEXIBLE PIPE CONNECTORS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries
Fairbanks Morse Power Systems Division

REL. NO. P.V. 656 | P.O. P125172 ASSY. OR LO.
DR. BY J.G.Wood 11/9/71 SCALE
CHK'D. BY [illegible] 11/12/71 HEAT TR.
MAT'L V
APPV. CAST. MACH. WELD. MATL ENGR.

SIZE A | DWG. NO. 12 994 171 | SHEET 1 OF 1

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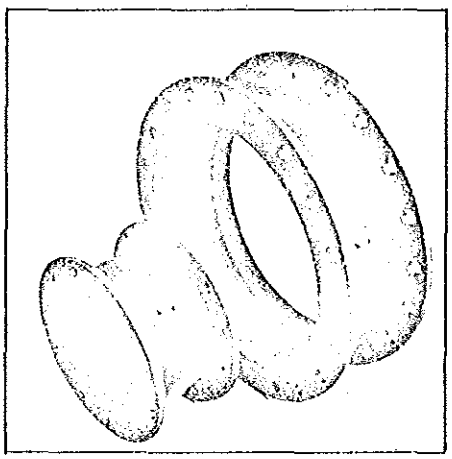
12 994 171

ORIGINAL

12994129

15.12/Gar

Garlock EZ-FLO™ Design Flowing Arch Expansion Joints



The Style 204 EZ-FLO design is interchangeable with GARLOCK Style 204 or equivalent design yet provides a streamlined arch configuration, higher pressure rating, more capability to absorb compression movement and is rated for 250°F continuous operating temperature. The vacuum rating for EZ-FLO design depends on the face to face length (distance between flanges) as shown in the table.

The expansion joint has an integral rubber and fabric flange and 1/2" thick retaining rings must be used.

The standard pressure ratings have been increased by as much as 69% over standard expansion joint ratings, providing greater safety factor. Standard Style 204 EZ-FLO design joints have "HP" ratings at no extra cost!

Ability to absorb compression movement is increased by more than 20% over previous Style 204 designs. Compression of 1" or more for all sizes frequently eliminates the need for multiple arch joints.

A totally new concept in arch design, for these sizes, provides a smooth quiet fluid flow with no possibility of trapped slurry materials. The arch is no longer deep with straight sides, but long and shallow - it is actually self flushing and no contaminate can get lodged in this arch. More movement and less force to deflect are also benefits from the improved design.

The standard Style 204 EZ-FLO design is rated for 250°F continuous service. No more worry about whether to stock Class I or Class II joints, as GARLOCK standard design handles both temperatures. Chlorobutyl is the standard tube and cover material.

If other materials such as Neoprene or natural rubber are selected for the tube, the temperature rating of the expansion joint will be adjusted accordingly.

Temperature Rating For All Sizes -- 250°F (Special Class II (FSA Standard)
The above temperature rating applies when standard Chlorobutyl construction is furnished. The EZ-FLO design can also be furnished with Neoprene, FDA approved liner or other elastomers which may change the temperature rating. Consult your GARLOCK representative.

The new Style 204 EZ-FLO design joints weigh about half as much as conventional spool-type joints, thus reducing freight charges. Handling and installation is also much easier as a result. Example, a typical 16" spool-type joint weighs about 48 lbs. vs. 22 lbs. for the EZ-FLO design.

Allowable Movements		
Type Movement	Pipe Size I.D. (inches)	Maximum Movement
Compression	10 - 18" I.D.	1"
	20 - 24" I.D.	1-1/8"
	26 - 40" I.D.	1-1/4"
	42" Up	1-3/8"
Elongation	10 - 18" I.D.	3/8"
	20 - 24" I.D.	7/16"
	26" Up	1/2
Transverse	All Sizes	1/2"

Vacuum Ratings For All Sizes	
Face to Face	Rating
8"	15" Hg
10"	12" Hg
12"	10" Hg

Pressure Ratings	
Pipe Size I.D. (inches)	Max. Allowable Working Pressure (PSIG)
10 - 12"	190
14"	130
16 - 20"	110
22 - 24"	100
26 - 40"	90
42 - 66"	55
68" Up	45

GARLOCK MOLDED ALL-TFE EXPANSION JOINTS AND FLEXIBLE COUPLINGS

GYLON®

PP/PRODUCT PRESENTATION

For Chemical Processing, Air Conditioning, and Heating Piping Systems

GYLON®
STYLE 214
Concentric Spool-Type Coupling, Single Arch.
Service Range to:
450°F., 185 psig, 29.9 in. Hg

GYLON
STYLE 215
Concentric Spool-Type Expansion Joint, Double Arch.
Service Range to:
450°F., 145 psig, 29.9 in. Hg

GYLON expansion joints and couplings were developed especially to reduce noise and vibration in chemical processing, air conditioning, and heating piping systems while compensating for expansion, contraction, and minor misalignment.



Features

They are contour-molded by a proprietary Garlock process and provide the following important advantages:

- White corrosion-resistant GYLON TFE fluorocarbon resin body
- Higher pressure ratings for modern piping systems
- Non-aging with long flex life
- Low force to deflect
- Complete assembly includes nickel-plated ductile-iron flanges, preinstalled asbestos gaskets, polyethylene-covered restriction bolts, and corrosion-resistant reinforcing rings.

Long Life

Our special molding process results in a bellows with a controlled wall thickness, and the contour and shape of each convolution have been calculated to provide extra-long flex life at high temperatures and pressures.

Superior Service

GYLON has a general service range of from −100°F. to +450°F., and it is completely resistant to water, steam, and almost all chemicals and gases. Its thermal stability, resistance to age, cracking, and anti-stick properties all combine to produce a superior bellows for couplings and expansion joints.

High Pressure Rating

GYLON expansion joints and couplings have pressure ratings high enough to handle most applications. As the pipe size gets larger, Garlock increases the bellows thickness and the strength of the reinforcing rings to compensate for the change in internal forces. This permits the same high pressure rating for large diameter sizes as for small ones.

Low Force to Deflect

A major advantage of GYLON couplings and expansion joints is the relatively low force needed to deflect or move the bellows, which makes them ideal for use in glass piping systems.

Positive Protection

GYLON expansion joints and couplings are supplied with ductile-iron flanges and corrosion-resistant reinforcing rings. The cadmium-plated restriction bolts are covered with a polyethylene sleeve with polyethylene washers on each end. A locknut "factory sets" the entire unit so that bellows cannot be extended beyond its limit. As a result, all metal parts are protected against corrosion and isolated from noise. In addition, all GYLON couplings and expansion joints are electrically isolated so that electrolysis is prevented. They can even be used as electrical insulators between pipe sections or connected equipment.

A Sure Seal

An asbestos gasket behind the GYLON material at the face of the flange, combined with an exclusive concentric serrated surface on the GYLON face, insures a positive seal without excessive tightening of flange bolts.

TFE

The basic TFE materials are made to conform to USA Department of Commerce, Standard PS3-66, Grade A, having the following properties: Tensile —4000 psi min./ Elongation—300% min.

GYLON expansion joints and couplings are available in standard sizes from 1" through 8" pipe I.

Contact factory for details on 10" and 12" I.D. sizes.

Garlock® CONSTRUCTION PRODUCTS DIVISION
PALMYRA, NEW YORK 14522
INTERNATIONAL DIVISION, PALMYRA, N.Y.
GARLOCK OF CANADA LTD. TORONTO, ONT.

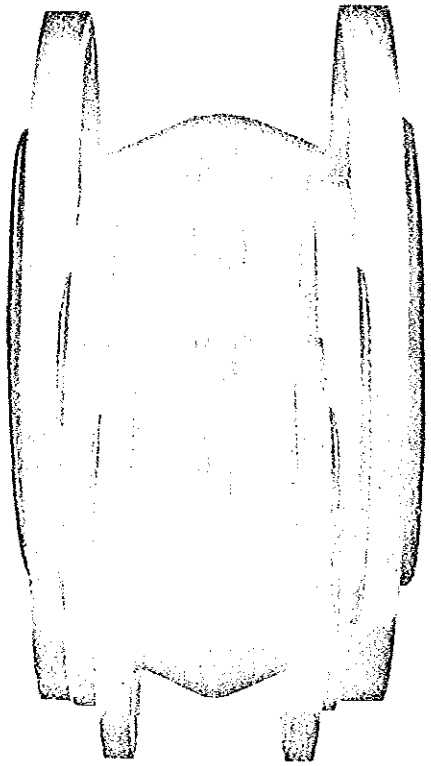
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Garlock/GARFLEX®

fully molded, flowing arch

EXPANSION JOINTS



PRODUCT PRESENTATION

GARFLEX
Style 8100

Concentric Single Flowing Arch. Service Range to: 250°F, 250 psig, 16 In. Hg Series 50 and 60; 10" Hg for Series 80.

Available with 3 Different Face-To-Face Lengths

Series 50: 5"FF Dimension - 2" through 12" I.D.
Series 60: 6"FF Dimension - 2" through 8" I.D.
Series 80: 8"FF Dimension - 10" and 12" I.D.

Series 50 is ideal for new jobs where close coupled piping is desirable. Series 60 and 80 are recommended both for new construction and for the replacement of conventional 6" and 8" face-to-face spool-type expansion joints. As replacements, they can upgrade a system at no extra cost.

Stronger, More Efficient Design

GARFLEX expansion joints feature a molded, elastomeric bellows having a ball-shaped design that is inherently stronger than other configurations. Coupled with tough, nylon tire cord reinforcement, this produces a unit with an exceptional burst pressure rating and a high safety factor.

This streamlined, flowing arch reduces turbulence and allows smooth, quiet flow. There is no possibility of sediment build-up and no need to fill the arch and thus restrict its movements.

Greater Service Range, Greater Safety

All GARFLEX expansion joints can operate at 250 psig up to 212°F or 175 psig up to 250°F - continuously. This makes them suitable for use in a broad range of modern high pressure, high temperature systems and with capability to spare.

Because of their wide service limits and reasonable cost, they can be considered as all-purpose expansion joints leading to lower replacement inventory requirements.

More Movement Capability in Every Direction

The GARFLEX expansion joint bellows can absorb up to three times more movement than competitive products. It will compress 1¼", elongate ¾", absorb transverse deflection of ±¾" and angular deflection from 10° to 35° This minimizes system hammer and noise, and provides excellent shock and vibration control.

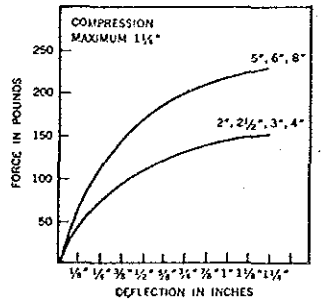
NOTE: When GARFLEX expansion joints are mated to slip on, or similar type flanges having a larger I.D. than the nominal pipe size, full face gaskets should be used to assure a seal.

GARFLEX expansion joints are also ideal for solving problems caused by stresses and strains in a piping system because the "force to deflect" or move the joint is so low. For example, only 150 lbs. of force is required to compress a GARFLEX joint one full inch in pipe sizes through 4" I.D.

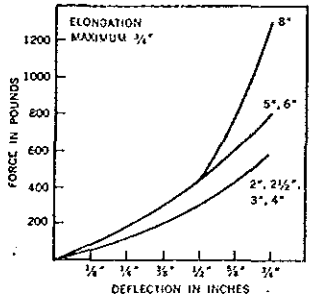
The extent and ease of movement of GARFLEX joints prevents flange breakage and pipe damage and permits the use of a minimum number of expansion joints in any given piping system. They are ideal for use with plastic piping where these low forces are desirable.

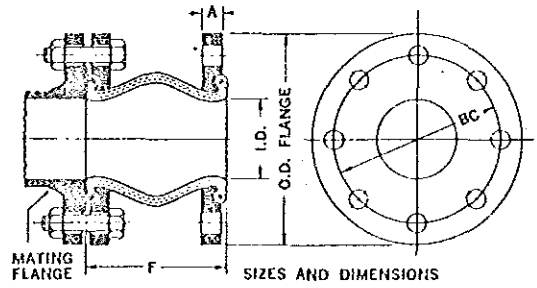
GRAPHS SHOWING FORCE TO DEFLECT

COMPRESSION



ELONGATION





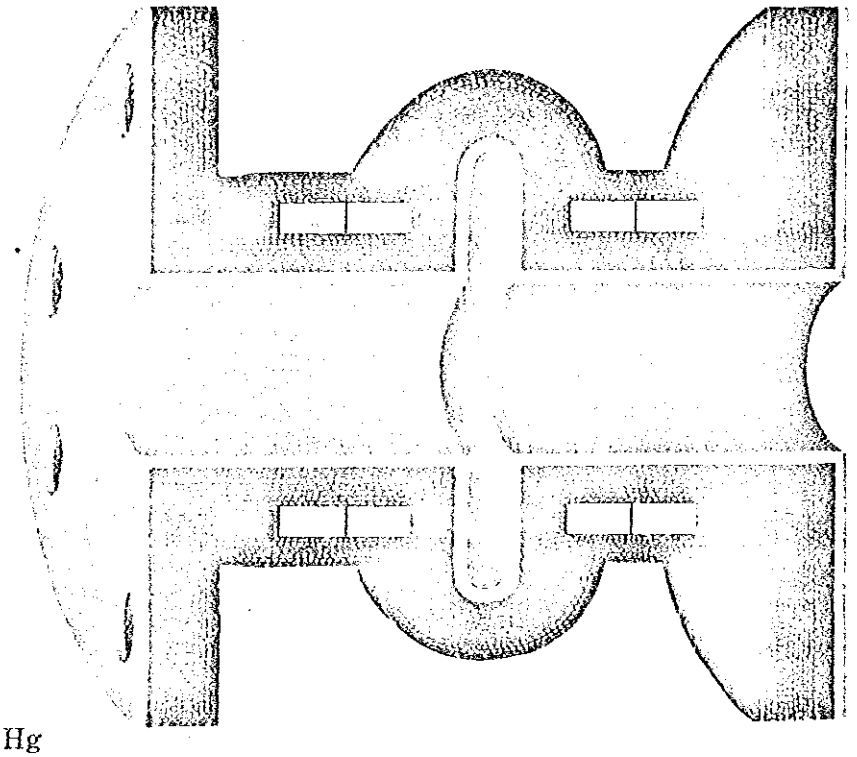
SIZES AND DIMENSIONS

DIMENSIONS FOR 125/150-lb. ANSI DRILLING*

Joint Size (I.D.), Inches	2	2½	3	4	5	6	8	10	12
Joint F Dimension, Inches									
Series 50	5	5	5	5	5	5	5	5	5
Series 60	6	6	6	6	6	6	6		
Series 80								8	8
Flange Dimension, Inches									
O.D. Flange	6	7	7½	9	10	11	13½	16	19
Bolt Circle (BC)	4¾	5½	6	7½	8½	9½	11¾	14½	17
Number of Bolt Holes	4	4	4	8	8	8	8	12	12
Diameter of Bolt Holes	¾	¾	¾	¾	⅞	⅞	⅞	1	1
Thickness (A)	⅝	⅝	¾	¾	¾	¾	⅞	1	1

*Control rods required unless piping is properly anchored. Control units furnished as standard in 10" and 12" sizes.

Garlock GUARDIAN®"200" FEP*-Lined, Rubber and Fabric Expansion Joints



Concentric Spool-Type
Expansion Joints
With or Without Single Arch.
Service Range to:
204°C (400°F), 200 psig, 30 in. Hg

FEP possesses unusual characteristics of corrosion resistance, thermal stability, and non-stick surface, making this fluorocarbon ideally suited for expansion joints and flexible couplings.

GUARDIAN "200" FEP-lined rubber joints are frequently adopted by designers, architects, and installers as standard equipment in free-movement piping systems conveying water, steam, gas sludge, slurries, and petroleum. Their greatest use, however, is in the chemical and pulp-and-paper industries, where their ability to resist corrosive attack at normal or elevated temperatures and pressures is unmatched.

GUARDIAN "200" joints, a GARLOCK specialty, provide chemical resistance against almost all corrosive fluids and gases. The FEP lining is seamless and extends through the bore to the outer edge of both flanges. These joints are manufactured using a GARLOCK proprietary process that results in a homogeneous, durable FEP lining integrally fused to the body of the joint. The result is far superior to that obtained with conventionally attached liners, since the FEP cannot separate from the joint body in service.

The result is an expansion joint combining the best features of FEP fluorocarbon--chemical resistance, anti-stick properties, thermal stability, resistance to age-cracking--with the best features of elastomeric expansion joints - good noise and vibration dampening, high flexibility, high pressure ratings, and standard face-to-face dimensions. Temperature ratings as high as 204°C (400°F) are possible with FEP, depending on construction of the elastomeric portion of the joint.

GUARDIAN "200" joints are available in single-arch construction in standard sizes from 2" through 30" nominal pipe diameter. Joints without arches are available in the same sizes.

*Flourinated Ethylene Propylene Copolymer (Teflon)

GARLOCK INC manufactures a complete line of rubber expansion joints in sizes thru 122" I.D., all TFE, joints and couplings thru 12" I.D. and gas ductwork joints of all sizes. Contact Construction Products Div., Palmyra, N.Y. at 315-597-4811 for full information and detailed brochures.

4. INTERCOOLER COOLANT SYSTEM

Part No.	Description
11 907 843	Controller - Reverse Acting
11 908 163	Temperature Control Valve 4"
11 908 180	Plug Valve 1/2
11 908 181	Plug Valve 3/4
11 908 183	Plug Valve 1-1/2
11 908 187	Heat Exchanger
11 908 191	Check Valve
11 908 650	Isolation Valve
11 908 790	Temperature Transmitter
11 908 984	Flexible Connector 1/2"
12 994 129	Flexible Connector 6"

DESCRIPTION: MOORE Series 55 Intergral setting controller with the following features:

1. With proportional & reset adjustments:

   Proportional band 2 to 200%

   reset action 0.1 to 50 minutes per repeat.

2. with control point and process gauges calibrated to read 100° to 200°F

3. With mounting bracket (not manifold)

4. Relay action - increasing adjustment decreases air output pressure.

VENDOR'S MOD. NO: No. 55

VENDOR: Moore Products Co.
72 North Broadway
Des Plaines, Ill 60016

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REV. NO.	CHANGE NOTE	DATE	DESCRIPTION	CHK'D. BY

TITLE: CONTROLLER

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

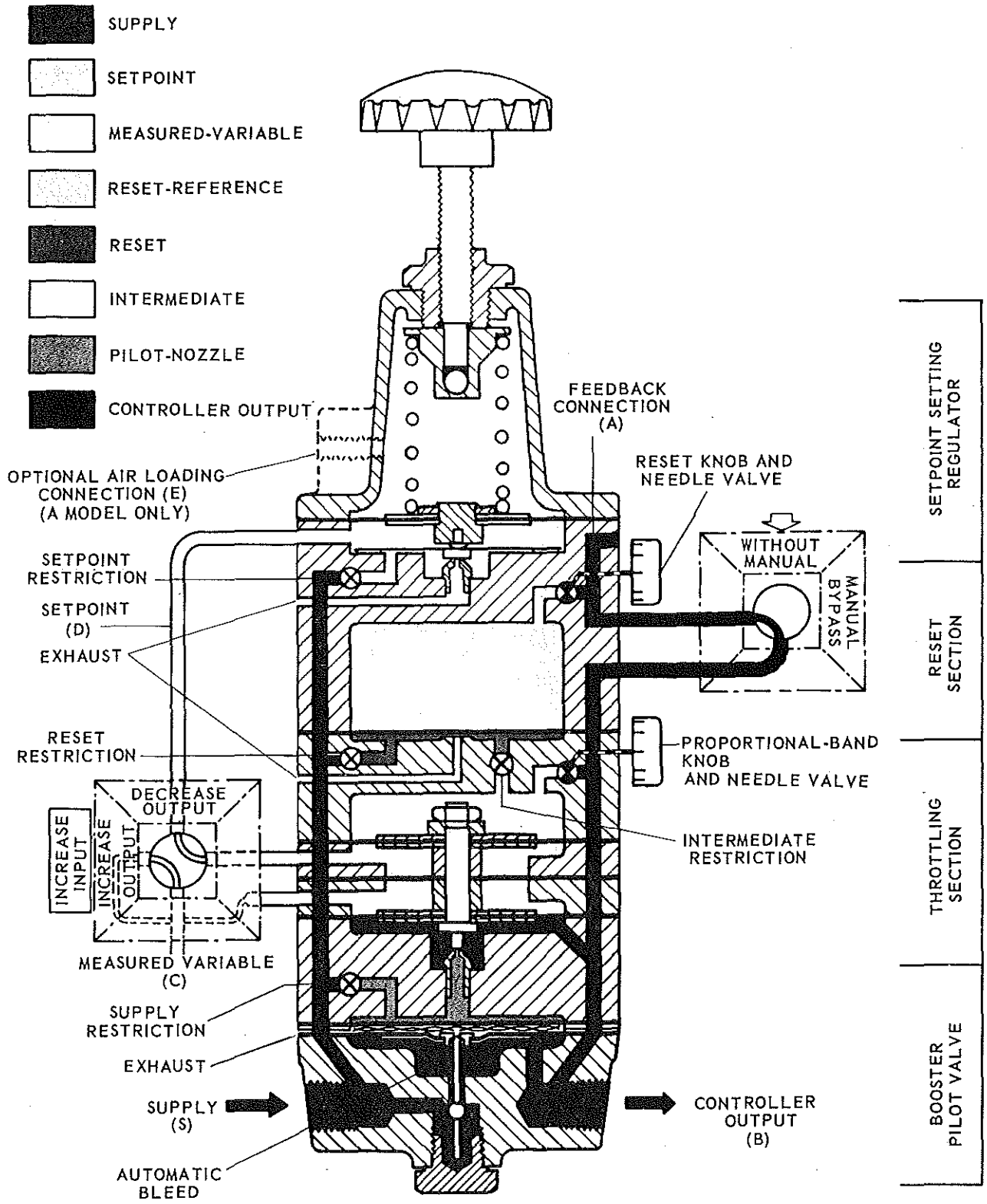
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	11/12/75	ASSY. OR LO.	
DR. BY L.W. Cooper	11/7/75	SCALE	
CHK'D. BY L.W.C	11/7/75	REAT YR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 907 843 | SHEET 1 OF 1

MOORE

NULLMATIC CONTROLLER MODEL 55



MODEL DESIGNATION

CONTROL FUNCTION	PIPE CONNECTION	PLUG-IN MANIFOLD	% PROPORTIONAL BAND	RESET MINUTES REPEAT
Std. Proportional Band and Reset	55	55M	2–200	.1–50
Std. Proportional Band and Fast Reset	55F	55MF	2–200	.01–5
Wide Proportional Band and Reset	55W	55MW	5–500	.1–50
Wide Proportional Band and Fast Reset	55FW	55MFW	5–500	.01–5
Fast Reset – No Proportional Adjustment	55FY	55MFY	200	.01–5

Fast Reset (Suffix "F")

The operating principle of the fast reset controller is identical to that of the conventional controller except that it provides a reset rate 10 times faster than standard. This control action is useful on applications and processes with very short time constants, such as flow.

Wide Band Controller (Suffix "W")

The operating principle of the wide proportional band controller is identical to that of the conventional controller. In the wide band controller, however, the effective preformed diaphragm relationship is 5 to 1. This establishes the maximum proportional band at 500%.

PRINCIPLE OF OPERATION

PROPORTIONAL ACTION (See Schematic)

Assume the reset reference pressure remains fixed at mid-scale and the reset needle valve is closed. The reset reference pressure acts on the reset diaphragm which is part of a 1:1 reproducing relay. Supply air passes through a restriction and out the exhaust nozzle to make the reset pressure equal the reset reference pressure.

If the proportional-band needle valve is closed, the intermediate chamber pressure will equal the reset pressure since they are connected via the intermediate restriction.

The controlled-variable pressure pushes upward on the small center diaphragm and downward on the large diaphragm. The effective area of the large diaphragm is twice that of the small diaphragm. Therefore, controlled variable pressure produces a net force downward. Likewise, the setpoint pressure gives a net force upward.

If the controller variable pressure equals the set-point, the resultant forces from these two sources cancel each other; and the output will match the reset or intermediate chamber pressure, bringing all forces on the detector stack to balance. If the controlled variable pressure increases 1 psi, the output will increase 1/2 psi. This is because the output acts on the full area of the bottom diaphragm -- whereas the controlled variable acts downward on a net effective area equal to one-half that amount. Thus, with the needle valve closed, the widest proportional band (minimum gain) is established, this proportional band being 200% on standard controllers.

If the proportional band needle valve is wide open and the controlled variable increases above set-point, the output will increase instantly -- because of the imbalance of forces. The increase in output will directly affect the intermediate pressure, which will further require the output to increase. This regenerating action will continue so that a very small error will produce a large change in output. The wide-open needle valve position, therefore, establishes the minimum band, this minimum band being 2% on standard controllers.

If the proportional band needle valve is open to a setting where its resistance equals that of the intermediate restriction, the following will occur: When controlled-variable pressure increases by 1 psi, the output (by design) will instantly increase by ½ psi. The ½ psi increase will cause a flow from output through the proportional band valve into the intermediate chamber and through the intermediate restriction to the reset reproducer. Since the restriction and needle valve resistances are equal, the pressure drops will divide equally, resulting in a ¼ psi increase in the intermediate chamber pressure. This ¼ psi increase directly increases controller output an additional ¼ psi; which divides again into a 1/8 psi increase in the intermediate chamber pressure. This action continues until equilibrium is reached – with

the output changing a total of 1 psi, and intermediate chamber pressure increasing ½ psi. In this instance, a 1 psi change in the controlled variable resulted in a 1 psi change in output. Therefore, this needle-valve opening provides a 100% proportional band. To reverse the action of the controller, the reversing plate may be rotated to interchange the signals.

RESET ACTION

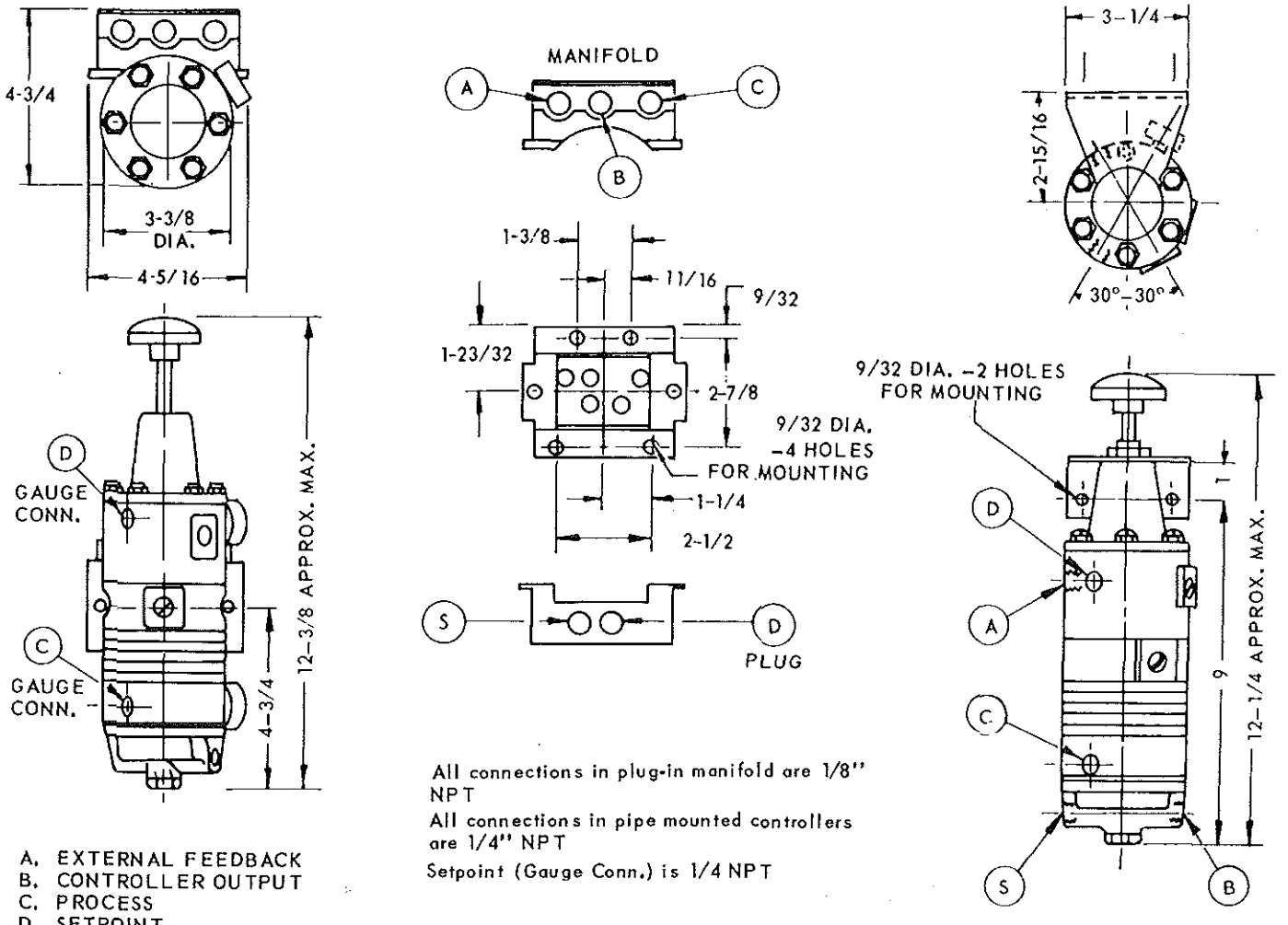
If every process could be controlled with a 2% proportional band (practically on-off), there would be no need for reset action. In practice, however, there is always a limit to how narrow a band may be used without incurring instability. For fast or noisy processes, the band may have to be very wide to avoid instability. With proportional action, if any change in valve pressure is required because of a change in load, the change can be produced only when an error develops between controlled variable and setpoint. Therefore, instead of controlling at setpoint, a control offset will result. In most cases, this is intolerable and reset action is used to eliminate offset.

If the reset needle valve is open, the controller output will continue to change in the corrective direction, ad infinitum if necessary, until the controlled variable is brought exactly on setpoint. When reset is active, the controller comes to equilibrium only when the controlled variable equals the setpoint and when the output, reset, and intermediate pressures are equal to each other (but not necessarily equal to setpoint and controlled variable). If any difference exists between measured variable and setpoint, then because of proportional action, the output will differ from the reset-reference pressure. Due to the resulting flow through *the reset valve, the reset pressure will continue to* change; thus providing a continuous reinforcing action – until equilibrium ultimately results.

INSTALLATION

GENERAL

Reversing Plate -Controllers are shipped for reverse action (Inc/Dec.); i.e., an increasing process causes a decreasing controller output. The controller can be changed to direct action (Inc./Inc.) by rotating the reversing plate. The correct controller action for a given installation depends upon the action of the control valve and its effect on the process.



A. EXTERNAL FEEDBACK
B. CONTROLLER OUTPUT
C. PROCESS
D. SETPOINT
S. SUPPLY

All connections in plug-in manifold are 1/8" NPT
All connections in pipe mounted controllers are 1/4" NPT
Setpoint (Gauge Conn.) is 1/4 NPT

FIGURE 2
Installation Dimensions & Piping Connections

External Feedback Controllers are shipped set for internal feedback (without Man. Bypass). To alter the controller for external feedback, remove the EXT. FEEDBACK sealing screw and turn the feedback switching plate to "With Man. Bypass". Pipe the external feedback signal into the "A" port of the control station manifold block or field mounting block, whichever applies.
IMPORTANT: When the EXTERNAL FEEDBACK is not used, the "A" port on the control station or field mounting block MUST be plugged.

MOUNTING

Dimensions Fig. 2 gives mounting dimensions for field mounted controllers.

Location The controller should be mounted in a reasonably vibration-free location. It can be mounted indoors or outdoors provided the ambient temperature limits of -40° F. and +180° F. are not exceeded.

Position The controller can be mounted in any position. It should, however, be calibrated in the same position in which it is to be mounted.

PIPING

Figs. 2 and 3 give the piping connections. Any scale-free piping may be used for connecting the controller; 1/4" O.D. tubing is recommended.

Before connecting the lines, blow them out to prevent foreign material from entering the controller. The connecting lines must be leak-tight. Leak test the lines with a soapless lather.

The length of transmission lines has no effect on operation of the controller other than increasing the lag between controlled variable change and controller action.

SUPPLY AIR

The recommended supply pressure for the conventional 3–15 psig instrument signals is as follows:

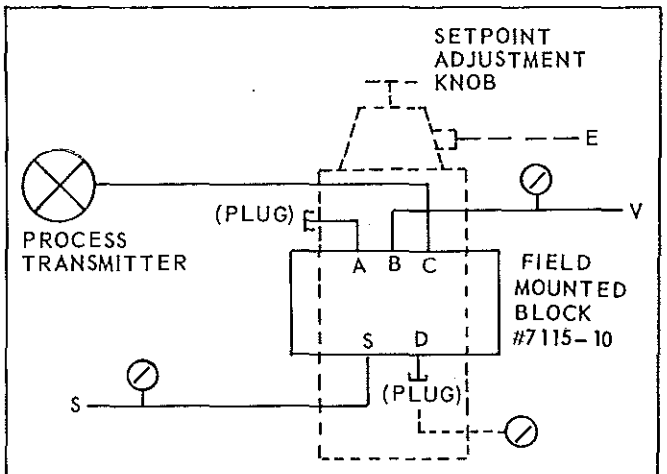
Recommended	20 psig
Minimum	18 psig
Maximum Recommended	25 psig

Although the controller is intended to operate in the 3–15 psig range, the process, setpoint, supply and output pressures can be as high as 50 psig.

Air consumption, when the controller is in a balanced condition, is approximately 0.15 scfm. In figuring compressor and filter capacities, follow the general practice of allowing 0.5 scfm for each instrument of any make.

A clean, dry and oil-free air supply should be provided for the controller. A Moore Model 91F60 Filter Regulator will reduce problems associated with dirty instrument air.

When the instrument and its air lines are exposed to freezing temperatures, an air dryer must be installed at the take-off point from the main plant air stream.



Setpoint gauge and process gauge are mounted in pipe connections on controller

When connection "A" is not used (plugged), the switch plate must be without MAN. BYPASS

A. EXTERNAL FEEDBACK
B. CONTROLLER OUTPUT
C. PROCESS
D. SETPOINT (PLUG)
E AIRLOADING CONNECTION (OPTIONAL)
S. SUPPLY

FIGURE 3
Installation Piping Drawing

CALIBRATION

When calibrating the Model 55 controller, it should be mounted in the same position as it will be used.

1. Set up the controller as per Fig. 4.

2. Set the reversing plate to Inc./Dec. The controller bypass plate can be in either position.

3. Open the reset knob (0.1 on standard controllers; 0.01 on fast reset models).

4. Open the proportional band knob to 30% on standard controllers; 75% on wide-band models.

5. Adjust the controller's regulator to 10% of span.

   NOTE: After each change of the regulator setting, allow ample time for the controller reset action to balance out. This will be longer for the standard reset controllers.

6. Adjust the controller's zero screw until the pointers match.

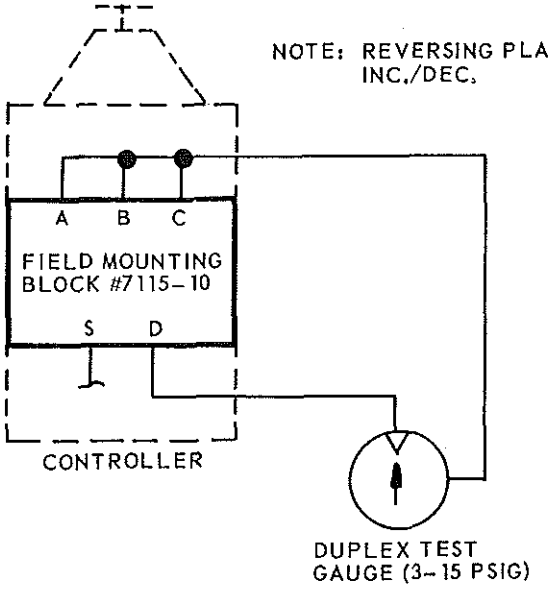


FIGURE 4
Calibration Set-Up

7. Adjust the controller's regulator until the setpoint is 90% of span.

8. If the controller output (black pointer) does not match the red pointer, note the deviation and adjust the controller's tracking screw. Make a three-fold overcorrection.

   EXAMPLE: If the red pointer is at 90% and the black pointer is at 91%, adjust the tracking screw to move the black pointer to 87%. The amount of overcorrection is approximate and may vary a little between controllers.

9. Adjust the controller's zero screw until the pointers match.

10. Repeat steps 5 through 9 until the pointers match when the controller's regulator is changed from 10% to 90% of span.

11. Set the reversing plate to the original position.

TUNING

The following method is only one of many methods of tuning a two-mode controller in a control system.

1. Place station in manual.

2. Open the controller reset needle valve (lowest numerical setting).

3. Bring the process to the desired control point using manual control.

4. Close the controller reset needle valve, trapping the valve pressure in the reset chamber.

5. Close the proportional band needle valve (highest setting).

6. Switch to automatic control.

7. Simulate process upset by making a small change in the control point. Look for a sustained process cycle. Continue to decrease proportional band in increments of ½, introducing setpoint changes after each adjustment, until a sustained cycle of constant amplitude first appears.

8. Note the lowest proportional band setting at which the sustained cycling occurs. This is the ultimate proportional band (PBu).

9. Time the process cycle peak to peak in minutes. This is the ultimate period (Tu).

10. The following settings are recommended as a starting point. Fine tuning will be necessary to obtain the response best suited to a particular process.

    Proportional Band = PBu x 2.2
    Reset Time = Tu x .833 minutes

MAINTENANCE

GENERAL

Most problems associated with pneumatic instruments can be prevented by using a clean, dry and oil-free air supply. An instrument air filter should be provided for the supply air system. Daily blow-down of the filter dripwell and a periodic check of the filter element are recommended.

Plug-in controllers have additional filtering protection. The plug-in manifold block, either station or field-mounted, has filter screens in the "supply" and "valve" ports. These are 100 mesh screens which stop particles .010" or larger. This protects the controller restrictions which are nominally .0115" to .012".

SERVICING

Figs. 5 to 7 show the items to be serviced.

Cleaning The items that can be cleaned are the filter screens, valve plunger restrictions, and needle valves.

FILTER SCREENS – The screens are located in the ports of the plug-in manifold or connection block. If a screen is clogged, blow it down in a reverse direction. If the dirt is still not dislodged, loosen it mechanically or chemically and again blow the screen down in a reverse direction.

If the mesh of a screen is damaged, it should be replaced. Use a pointed tool to remove the retaining washer and the screen. When installing a screen, use a new fiber washer to retain the screen at the bottom of its port.

VALVE PLUNGER – Fig. 5 shows removal of the valve plunger. The large spherical surface is the supply face; the tip is the exhaust face. Use non-abrasives for cleaning. The supply and exhaust seats in the controller should also be cleaned. The supply seat is readily accessible; the exhaust seat can be reached with a tobacco pipe cleaner.

RESTRICTIONS – Fig. 6 shows removal of a restriction screw. There are (4) such restrictions in the controller: pilot supply, reset supply, setpoint supply, and intermediate. All (4) are identical and are interchangeable. The Allen wrench stored in the base of the controller is used to remove the restriction screws. They are cleaned with a .010" cleaning wire which is also in the base of the controller. Stubborn deposits may require solvent softening before the wire can be passed through the orifice. When reinstalling, be sure both the restriction and sealing screws are screwed in tightly.

NEEDLE VALVES – Fig. 7 shows removal of a needle valve. There are (2) such valves in the controller: reset and proportional band. These are not interchangeable. The needle valves and valve bodies have matching identification letters stamped on them. Reset has either an "R" or an "RF". Proportional band has either a "T" or a "TW".

Use non-abrasives for cleaning. Lubricate the "O" ring on the needle valve before reinstalling it. If the valve body was removed, inspect the "O" rings on it, especially the small one at the tip. Lubricate the large "O" ring before reinstalling the valve body.

Lubrication

Fig. 7 shows the "O" ring that may require lubrication. There is one of these on each of two needle valves. If a needle valve has been removed, its "O" ring should be relubricated. Or, if a needle valve knob moves away from a setting immediately after making the setting, the "O" ring should be relubricated. Otherwise, these "O" rings require no periodic servicing. Vaseline or a Silicone "O" ring lube is recommended.

Other "O" Rings in the controller can only be reached by disassembly. Normally, they only require attention at a major overhaul.

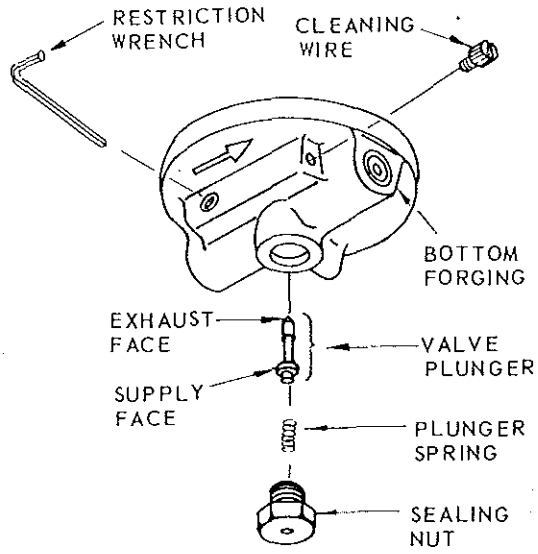
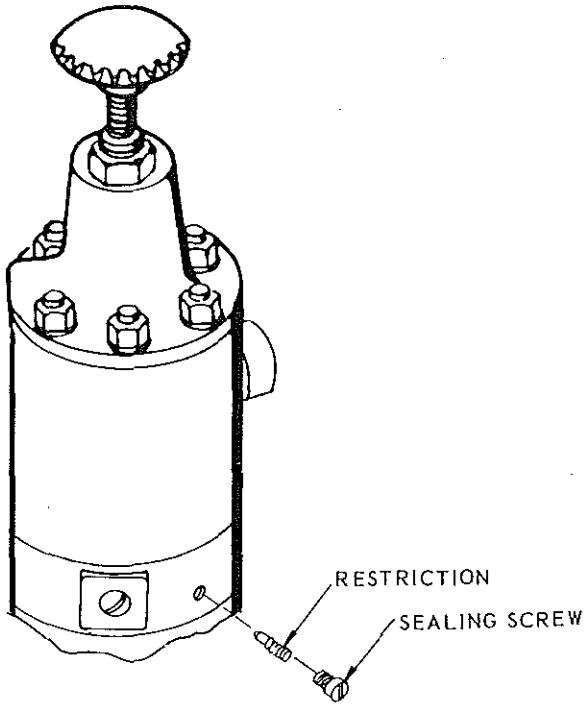


FIGURE 5
Valve Plunger



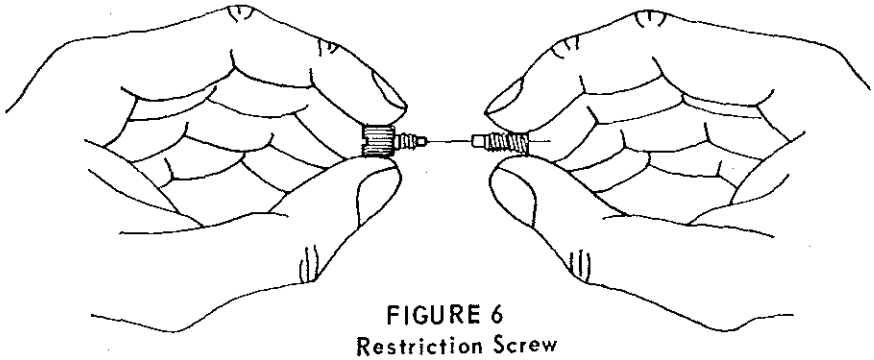


FIGURE 6
Restriction Screw

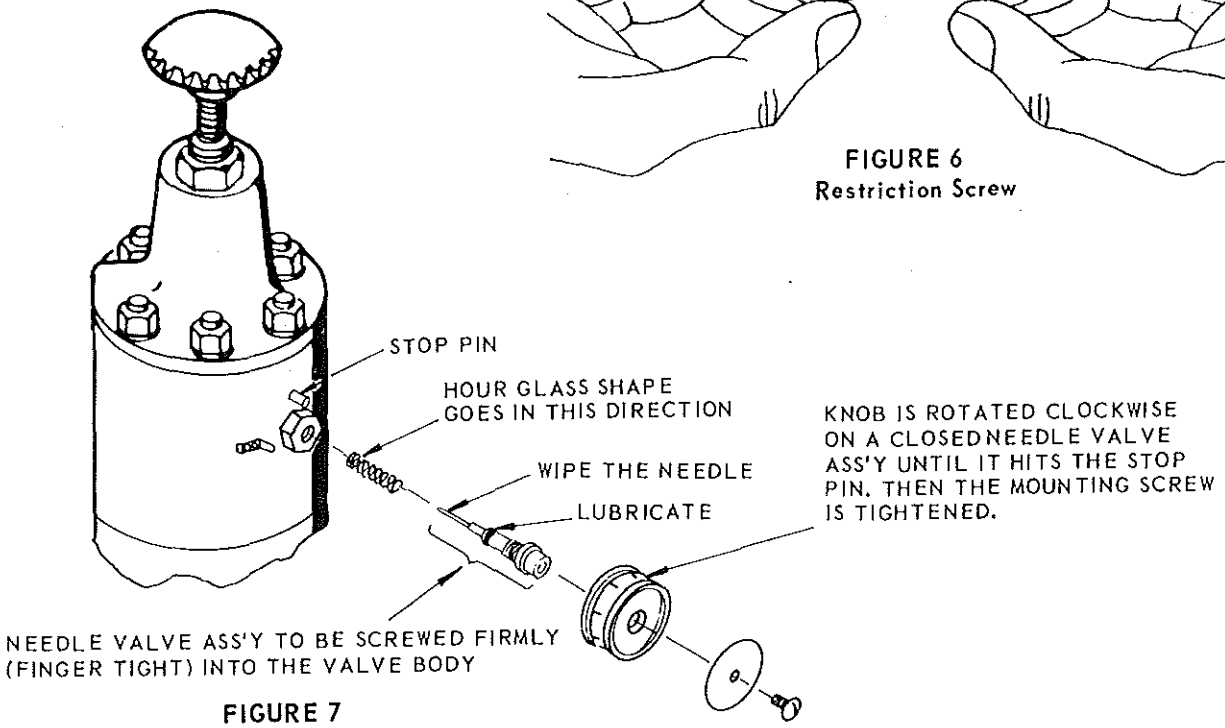


FIGURE 7
Needle Valve

TROUBLE ANALYSIS

The probable causes in the following table are in the order of most to least likely. Most symptoms are difficult to analyze while the controller is operating. They are most readily seen in a test set-up.

SYMPTOM	PROBABLE CAUSE	REMEDY
No output.	No supply.	Turn on supply air.
	Controller reversing plate incorrectly set.	Set according to control valve action and its effect on the process.
	Clogged supply restriction.	Clean the restriction.
	Clogged setpoint restriction.	Clean the restriction.
	Motion stop not properly positioned when controller is assembled.	Insert motion stop properly (check top control diaphragm for damage).
Output will not increase to full-scale value.	Supply pressure too low.	Raise supply pressure to recommended value.
	Controller zero or tracking adjustment.	Calibrate the controller.
	Pilot plunger being held off of exhaust seat by a thread shaving, a piece of pipe dope or a shred of Teflon tape.	Remove plunger and clean it and the exhaust seat.
	Bent pilot nozzle.	Replace.
Output will not decrease to a minimum-scale value.	Loose supply or reset restriction screws.	Tighten the restrictions.
	Zero or tracking adjustment.	Calibrate the controller.
On-off controller action.	Clogged intermediate restriction.	Clean the restriction.
	Misadjusted needle valve.	Readjust.
Proportional action radically disagrees with indicated setting.	Misadjusted proportional band knob and needle valve.	Tighten needle valve finger-tight and mount knob against stop with index pointing to the highest number (200% or 500%).
	Clogging intermediate restriction.	Clean the restriction.
	Coated proportional band needle valve (carbon, etc.)	Clean the needle valve and its seat.
	Loose proportional band needle valve body.	Tighten the body into the controller.
	Damaged "O" ring at tip of proportional band needle valve body.	Replace "O" ring.

No reset action.	Clogged reset restrictions.	Clean the restriction.
Reset action radically disagrees with indicated setting.	Misadjusted reset knob and needle valve.	Tighten needle valve finger-tight and mount knob against stop with index pointing to the highest number (5 min. or 50 min.).
	Clogging reset restriction.	Clean the restriction.
	Coated reset needle valve (carbon, etc.).	Clean the needle valve and its seat.
	Loose reset needle valve body.	Tighten the body into the controller.
	Damaged "O" ring at tip of reset needle valve body.	Replace "O" ring.

DISASSEMBLY

The controller uses a convenient "stack" construction that allows easy and complete disassembly for inspection, cleaning or replacement of parts. Remove the six nuts, separate the diaphragms and rings, and lift the parts off the studs. Experience has shown that a dull table knife works best to separate the diaphragms and rings.

IMPORTANT: Because of an internal motion stop arrangement, shown in Figure 8, the "control diaphragm assembly" and the "pilot ring assembly" must be lifted off the studs before they can be separated from each other. These two assemblies must be slid apart in a certain direction. Otherwise, the pilot nozzle, and possibly the pilot nozzle seat, will be damaged. Use the procedure that follows:

To disengage the control diaphragm and pilot ring assemblies from each other:

1. Hold the pilot ring assembly so the "zero" adjustment screw faces you.
2. Position the control diaphragm assembly above and behind the pilot ring assembly. Line up the dot on the bottom ring of the control diaphragm assembly with the "zero" adjustment screw on the pilot ring assembly.
3. Slide these two assemblies together. While doing so, guide the zero adjustment leaf spring into the opening formed by the motion stop, and make sure the "U" shaped plate engages under the head of the pilot nozzle.

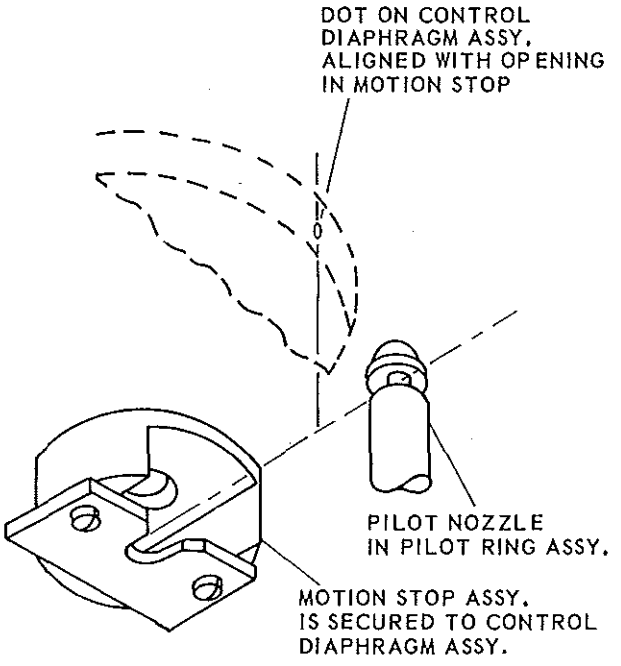
ASSEMBLY

To reassemble the controller, use the parts drawing for the sequence of parts, and align the rings by the locating grooves on their periphery.

The control diaphragm and pilot ring assemblies must be assembled to each other before being placed on the studs. Use the following procedure:

1. Loosen the control diaphragm assembly from the pilot ring assembly. Do not pry! The diaphragm between these two assemblies must not adhere to the pilot ring assembly.
2. Hold the two parts with their locating grooves aligned and with the dot on the control diaphragm assembly facing you.
3. Hold the pilot ring assembly and push the control diaphragm assembly away from you.
4. Hold the two assemblies together, align their locating grooves and place them on the studs.

If the control diaphragm assembly was disassembled, the "U" plate portion of the motion stop must be put back in the correct position. Align the open end of the "U" with the dot on the periphery of the bottom control diaphragm assembly ring.



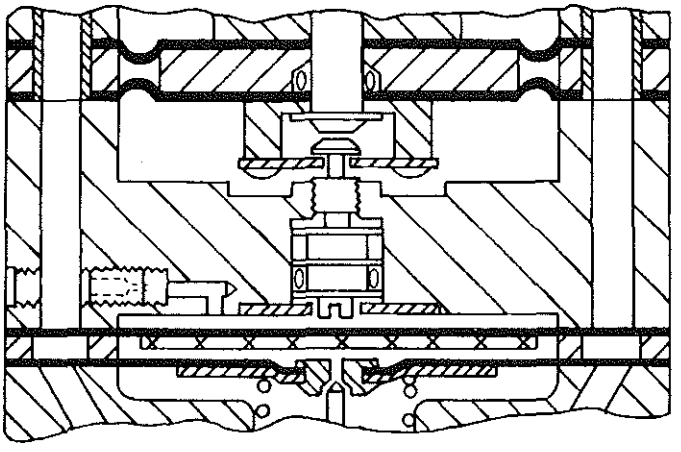


FIGURE 8
Control Diaphragm Motion Stop

CONVERSIONS

Controllers can be converted from standard to wide proportional band, from standard to fast reset, and vice versa. See the table under "Model Designation" for the various two-mode controller configurations.

Use the parts list drawings as an aid while making the conversions and re-calibrate the controller when finished.

The following tabulations list the parts required for conversion.

STANDARD TO WIDE PROPORTIONAL BAND

Qty.	Description	Part No.
1	Control Diaphragm Ass'y.	14278–31
1	Throttling Knob Ass'y.	10880–50

WIDE TO STANDARD PROPORTIONAL BAND

Qty.	Description	Part No.
1	Control Diaphragm Ass'y.	14278–11
1	Throttling Knob Ass'y.	10880–45

STANDARD TO FAST RESET

Qty.	Description	Part No.
1	Reset Valve Ass'y.	10880–2
1	Reset Knob Ass'y.	10880–42

FAST TO STANDARD RESET

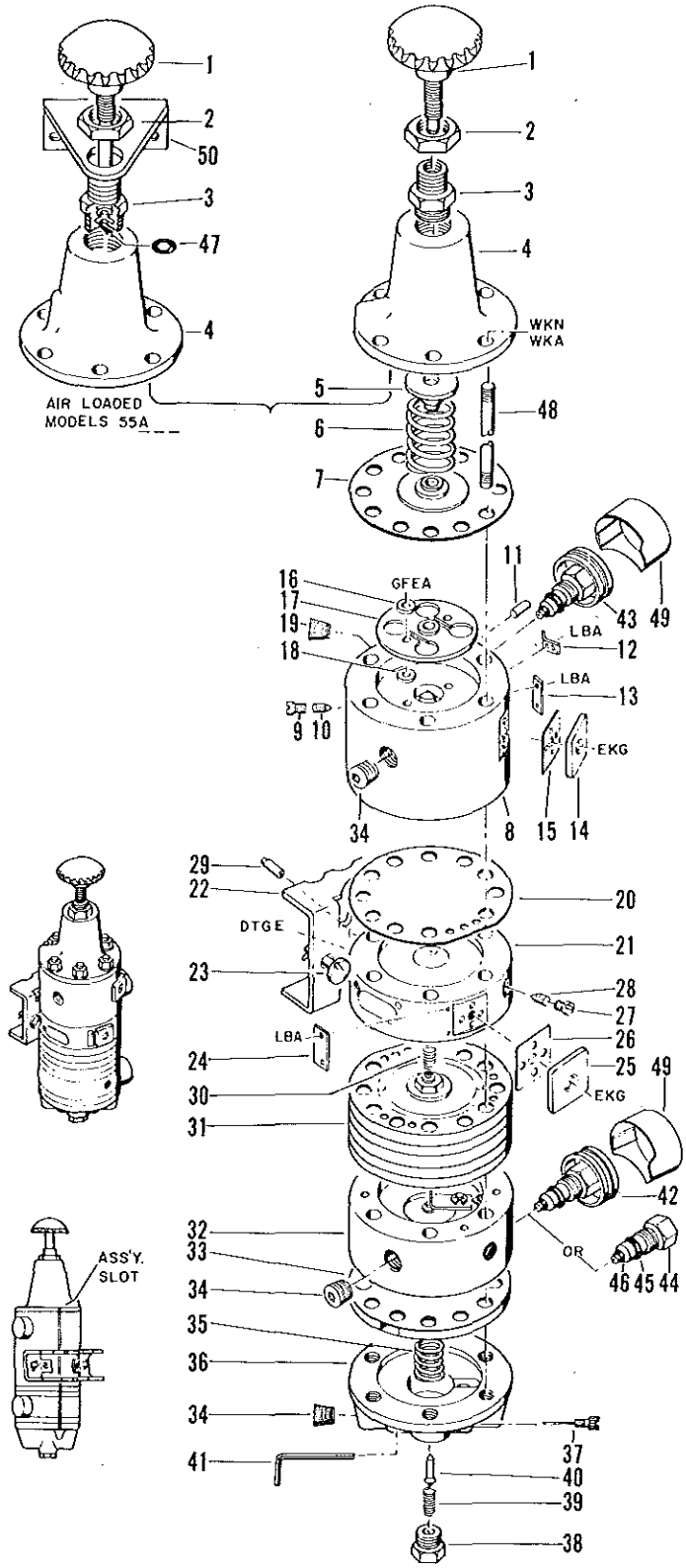
Qty.	Description	Part No.
1	Reset Valve Ass'y.	10880–1
1	Reset Knob Ass'y.	10880–41

MOORE PRODUCTS CO.
SPRING HOUSE, PA.

PARTS LIST
PIPED & MANIFOLD MOUNTED NULLMATIC CONTROLLER

From Drawing
No. 14281-60

MODELS	B/M
55	14281-111S2
55F	14281-112S2
55W	14281-113S3
55FW	14281-114N3
55FY	14281-112S2 (M3)
55A	14281-121S2
55AF	14281-121S2 (MS)
55AW	14281-122N3
55M	14281-115S2
55MF	14281-116S2
55MW	14281-117N3
55MFW	14281-118N3
55MFY	14281-116S2 (M3)



*Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

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PARTS LIST
PIPED & MANIFOLD MOUNTED NULLMATIC CONTROLLERS

From Drawing No. 14281–60

Item No.	Part No.	Description	Req'd.
		COMMON PARTS	
1a	1447–22	Adjusting Screw (except "A" models)	1
1b	3179–4	Adjusting Screw ("A" models)	1
2	3603–14	Mounting Nut (except "M" models)	1
3a	2155–165	Bushing (except "A" models)	1
3b	3494–4	Bushing ("A" models)	1
4a	2155–13	Top Housing (except "A" models)	1
4b	4557–11	Top Housing ("A" models)	1
5	1447–24	Spring Seat	1
6	572–36	Spring	1
7a	2932–10	Diaphragm (except "A" Models)	1
7b	3495–3	Diaphragm ("A" models)	1
8	8855–4	Upper Housing (Incl. Items 9–19, EKG, GFEA & LBA)	1
9	2900–23	Sealing Screw	1
10	2900–22	Restriction	1
11	3035–1	Pin	1
12	3092–31	Pointer	1
13	3850–12	Nameplate	1
14	3850–13	Switching Plate	1
15	3092–3	Gasket	1
16	3092–17	Spacer	2
17	1447–11	Spring Plate	1
18	3850–7	Spacer	2
19	3092–35	Pipe Plug	1
20	2900–25	Diaphragm	1
30	8106–32	Spring	1
31a	14278–11	Control Diaphragm (except "W" models) (See Spare Parts Dwg. 14278–50)	1
31b	14278–31	Control Diaphragm ("W" Models) (See Spare Parts Dwg. 14278–50)	1
32	14281–9	Pilot Ring (See Spare Parts Dwg. 14281–51)	1
33	8003–8	Exhaust Diaphragm	1
35	1447–13	Differential Spring	1
36	8855–1	Bottom Forging (Incl. Items 37–41)	1
37	1518–4	Cleaning Wire	1
38	8003–2	Retaining Nut	1
39	2155–7	Spring	1
40	8003–5	Plunger	1
41	3092–33	Restriction Wrench	1
42a	10880–62	Throttling Knob & Needle Valve (except "W" models) (See Spare Parts Dwg. 10880–76)	1
42b	10880–69P	Throttling Knob & Needle Valve ("W" models) (See Spare Parts Dwg. 10880–76)	1
43a	10880–60	Reset Knob & Needle Valve (except "F" models) (See Spare Parts Dwg. 10880–76)	1
43b	10880–61	Fast Reset Knob & Needle Valve ("F" models) (See Spare Parts Dwg. 10880–76)	1

Item No.	Part No.	Description	Req'd.
44	4675–7	Plug ("Y" Model Only)	1
45	2938–3	"O" Ring ("Y" Model Only)	1
46	2938–15	"O" Ring ("Y" Model Only)	1
47	2938–1	"O" Ring ("A" Models Only)	1
48	7307–7	Stud	6
49	3092–47	Knob Cover	2
50	2932–19	Mounting Bracket (When Required)	1
		PIPED MODELS (55, 55F, 55W, 55FW, 55FY, 55A, 55AF 55AW)	
21a	8855–64	Center Housing (Incl. Items 21b, 24–28, EKG & LBA)	1
21b	14278–47	Center Housing	1
24	3850–43	Nameplate	1
25	3850–13	Switching Plate	1
26	3092–3	Gasket	1
27	2900–23	Sealing Screw	2
28	2900–22	Restriction	2
		MANIFOLD MOUNTED (55M, 55MF, 55MW, 55MFW, & 55MFY)	
21	8855–66	Center Housing (Incl. Items 22–29, DTGE, EKG & LBA)	1
22	7115–40	Mounting Bracket	1
23	7115–41	Stud	2
24	3850–43	Nameplate	1
25	3850–13	Switching Plate	1
26	3092–3	Gasket	1
27	2900–23	Sealing Screw	2
28	2900–22	Restriction	2
29a	7115–37	Tube (Short)	3
29b	7115–38	Tube (Long)	2
34	3092–35	Pipe Plugs	4

– CODE –	– HARDWARE –	Req'd.
DTGE	#10–32 x 1/2" Lg. Undercut Flat Hd. Screw("MS")	2
EKG	1/4–20 x 1/2" Lg. Oval Hd. Screw	2
GFEA	#4–40 x 3/8" Lg. Bind. Hd. Self Tap Screw	2
LBA	#0 x 1/8" Lg. Type " U " Drive Screw	6
WKA	1/4 Lockwasher	6
WKN	1/4–20 Hex Nut	6

*Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

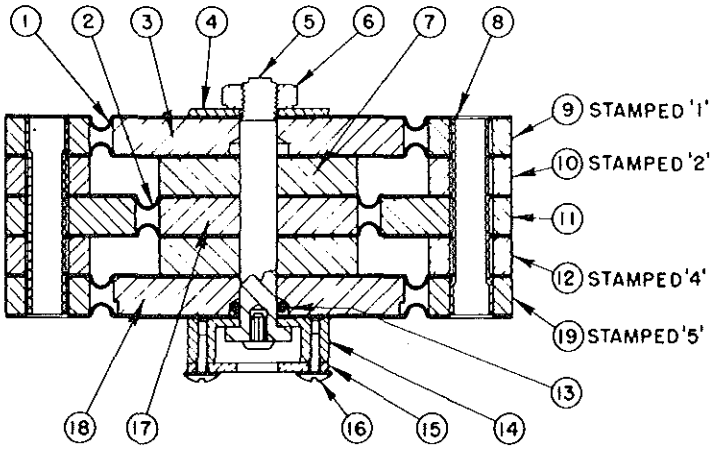
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SPRING HOUSE, PA.

PARTS LIST
CONTROL DIAPHRAGM

From Drawing
14278–50

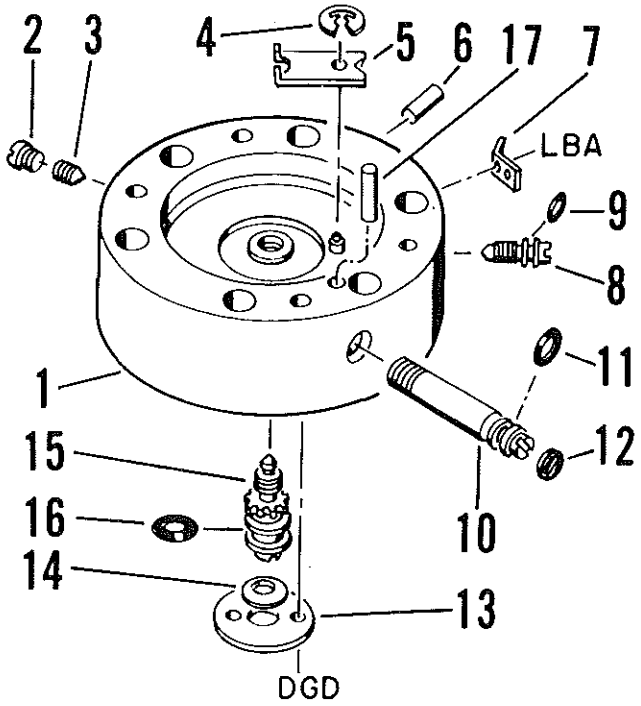
P/N 14278–11
14278–31



Item No.	Part No.	Description	Req'd. 200%	Req'd. 500%
*1	8648–5	Diaphragm	4	4
*2a	8648–4	Diaphragm	2	–
*2b	8648–13	Diaphragm	–	2
3	4551–5	Upper Spacer	1	1
4	3092–40	End Plate	1	1
5	4551–22	Rod Assy.	1	1
6	3821–32	Jam Nut	1	1
7	4551–6	Center Spacer	3	2
8	4551–10	Dowel Tube	2	2
9	4551–1	Vent Ring – Upper	1	1
10	4551–2	Spacer Ring – Upper	1	1
11a	4551–3	Vent Ring – Center	1	–
11b	4551–50	Vent Ring – Center	–	1
12	4551–4	Spacer Ring – Lower	1	1
*13	2938–1	"O" Ring	1	1
14	14278–12	Stop Bracket	1	1
15	14278–14	Stop Plate	1	1
16	Screw	#4–40 x 1/4 Lg. Truss Hd.	2	2
17	4551–51	Center Spacer	–	1
18	4551–12	Lower Spacer	1	1
19	4551–81	Vent Ring-Lower	1	1

PARTS LIST
PILOT RING ASSEMBLY

No. 14281–51



P/N 14281-9
14281-10

Item No.	Part No.	Description	Required
1a	14278–5	Pilot Ring (For Ass'y. 14281–9)	1
1b	14278–34	Pilot Ring (For Ass'y. 14281–10)	1
*2	2900–23	Sealing Screw	1
*3	2900–22	Restriction	1
4	7044–1	Retainer Ring	1
5	8051–42	Leaf Spring	1
6	3035–1	Pin	1
7	3092–31	Pointer	1
8	8051–41	Zero Screw	1
9	2938–5	"O" Ring	1
10	14568–4	Tracking Screw	1
11	2938–4	"O" Ring	1
12	8051–56	Plug	1
13	14278–43	Stop	1
14	14278–40	Curved Washer	1
15	14278–13	Nozzle	1
16	2938–2	"O" Ring	1
17	8179–2	Pin	1

– CODE –	– HARDWARE –	Required
DGD	#5–40 x 5/16" Lg. Flat Hd. Screw	2
LBA	#0 x 1/8" Lg. Type "U" Drive Screw	2

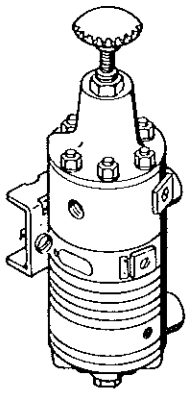
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MOORE

SD55
Issue: 1
Date: 4/30/73

SERVICE INSTRUCTIONS



MODEL 55
TWO-MODE
NULLMATIC CONTROLLER

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DESCRIPTION

GENERAL INFORMATION

The Series 55 Nullmatic Controller is a two-mode controller which operates on the pneumatic "Null" balance principle. It controls the process variable in response to an air pressure signal from the process transmitter. The Model 55 controller incorporates adjustable proportional band (gain) reset action and an integral setpoint regulator.

The controller is intended to operate on an output of 3-15 psig from a pneumatic transmitter. However, it is capable of operating at any range under 50 psig. The controller output is normally 3 to 15 psig, but it may be as much as 50 psig for special purposes.

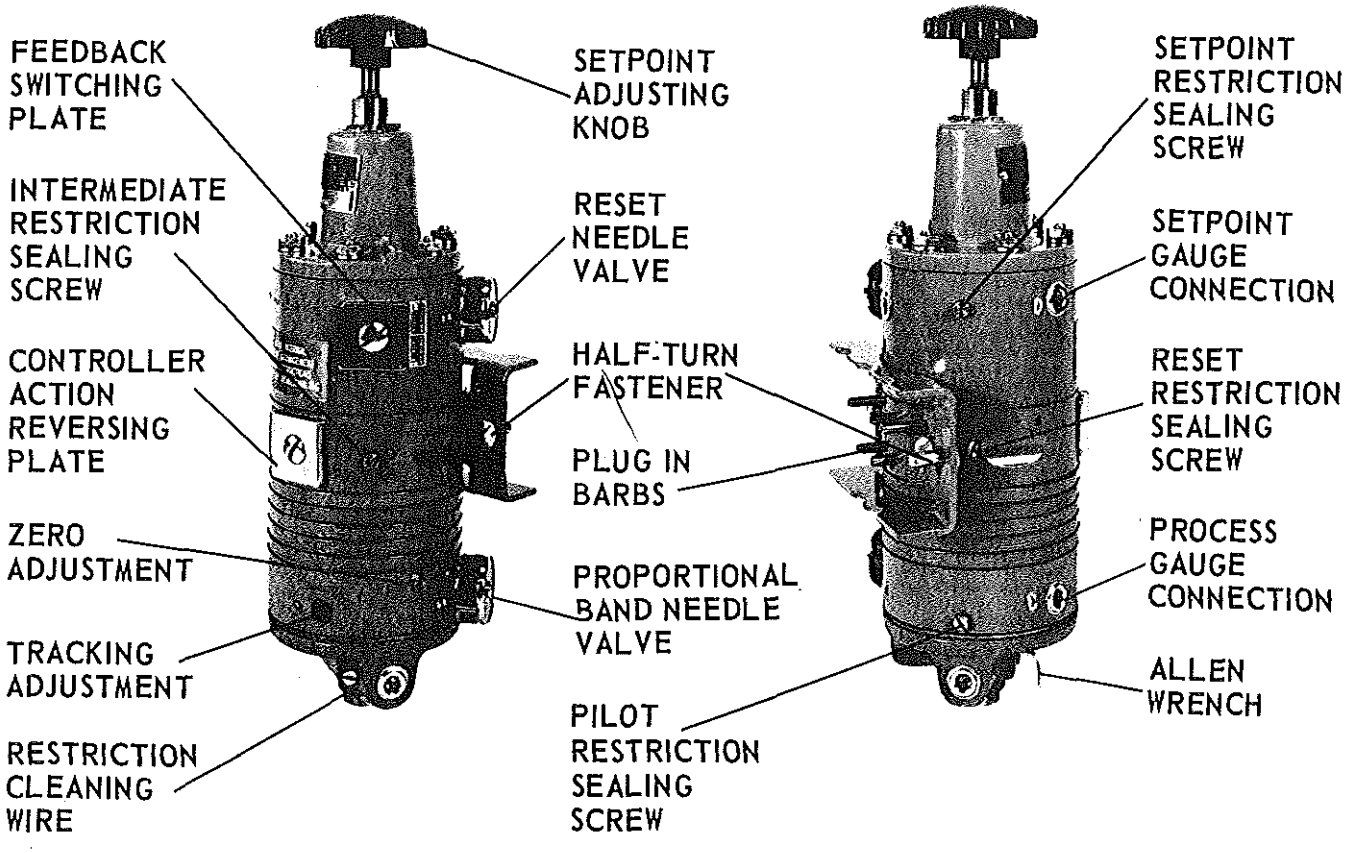
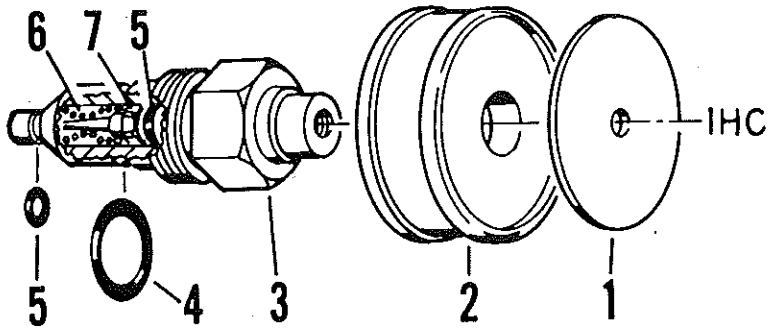


FIGURE 1
Model 55 Controller

MOORE PRODUCTS CO.
SPRING HOUSE, PA.

PARTS LIST
PIPE & MANIFOLD MOUNTED NULLMATIC CONTROLLER

From Drawing
10880-76



RESET KNOB & NEEDLE VALVE — P/N 10880-60

Item No.	Part No.	Description	Required
1	3850-8	Reset Knob Disc	1
2	10880-41	Reset Knob	1
3	10880-1	Reset Needle Valve Assy. (Includes 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-8	Reset Valve Spring	1
7	10852-59	Friction Washer	1

Code	Hardware	Required
IHC	#6-32 x 1/4 Lg. Truss Hd. Scr.	1

FAST RESET KNOB & NEEDLE VALVE — P/N 10880-61

Item No	Part No.	Description	Required
1	3850-8	Reset Knob Disc	1
2	10880-42	Reset Knob	1
3	10880-2	Fast Reset Needle Valve Assy. (Includes 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-8	Reset Valve Spring	1
7	10852-59	Friction Washer	1

Code	Hardware	Required
IHC	#6-32 x 1 4 Lg. Truss Hd. Screw	1

THROTTLING KNOB & NEEDLE VALVE — P/N 10880-62

Item No.	Part No.	Description	Required
1	3092-26	Throttling Knob Disc	1
2	10880-45	Throttling Knob	1
3	10880-3	Throttling Needle Valve Assy. (Includes 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-46	Throttling Valve Spring	1
7	10852-59	Friction Washer	1

Code	Hardware	Required
IHC	#6-32 x 1 4 Lg. Truss Hd. Screw	1

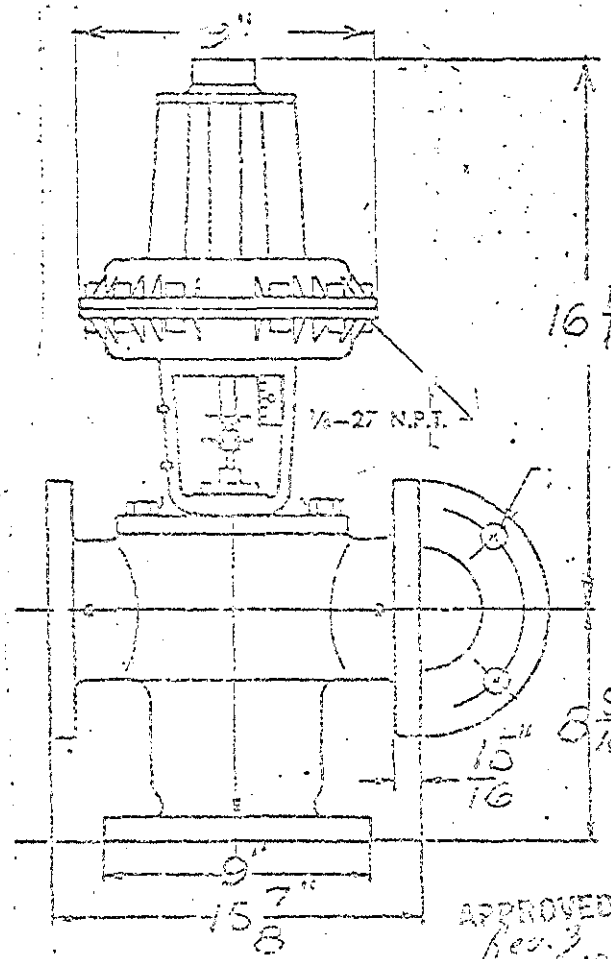
THROTTLING KNOB & NEEDLE VALVE — P/N 10880-69P

Item No.	Part No.	Description	Required
1	3092-26	Throttling Knob Disc	1
2	10880-50	Throttling Knob	1
3	10880-3	Throttling Needle Valve Assy. (Includes 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-46	Throttling Valve Spring	1
7	10852-59	Friction Washer	1

Code	Hardware	Required
IHC	#6-32 x 1/4 Lg. Truss Hd Screw	1

*Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

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VENDOR NO:

VENDOR: ROBERTSHAW CONTROLS CO.
190 GORDON ST.
ELK GROVE, ILL
60007

① SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR.

② LIMERICK GENERATING STAT. UNITS 1 & 2 PHILADELPHIA ELECTRIC CO.

APPROVED Rev. 2 NOV 18 1976 QUALITY CONTROL

APPROVED Rev. 3 OCT 28 1977 QUALITY CONTROL

APPROVED Rev. 2 MAR 10 1977 QUALITY CONTROL

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REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	10230	5-17-77	See Sheet 5	
2	10128	3-10-76	See Shts 3 & 4	
2	"	"	Added Limerick Gen. Station --- ②	
1	10077	2-27-76	ADDED SEE 11 908 456 Sht No. ①	
1	[illegible]	"	SEE SHEETS 1 & 4	

TITLE
VALVE, 4" THREE WAY DIAPHRAGM OPR.
ASME SECT. III CL 3

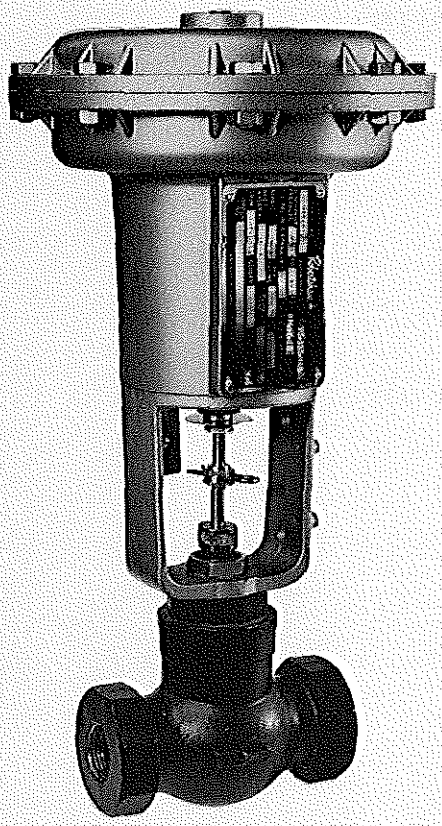
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

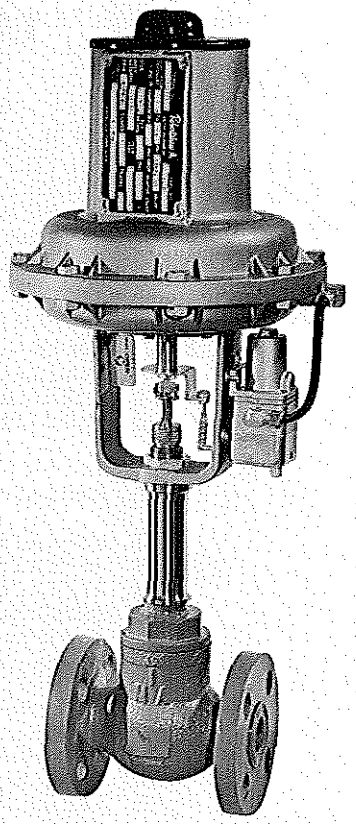
REL. NO. PO1494	8/27/76	ASSY. OR LO.	
DR. BY L.H. COOPER	8/19/76	SCALE	
CHK'D. BY [illegible]	8/19/76	HEAT TR.	
MAT'L. PURCHASE			

APPV.		MAT'L.
	CAST.	
	MACH.	ENGR.
	WELD.	

SHEET SIZE A | DWG. NO. 11 908 163 | SHEET 1 OF 5



VC-230



VC-231

INSTRUCTIONS

FOR

INSTALLATION AND OPERATION

Models VC-230 & VC-231
DIAPHRAGM CONTROL VALVES

Note To Installer: After installing the Control Valve give this instruction folder to operating personnel or see that it is filed for future reference.

Robertshaw

ROBERTSHAW CONTROLS COMPANY
FULTON SYLPHON DIVISION • KNOXVILLE 1, TENNESSEE

Printed in U.S.A.

Form No. P 2181

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SECTION I — OPERATION

These Diaphragm Control Valves are designed to control the flow of the medium passing through its valve by responding to a signal from an instrument or pilot controller which utilizes air or gas as the operating medium. The opening, closing or throttling action of the valve is controlled by changes of the instrument pressure in response to changes in the controlled system. The variable being controlled may be pressure, temperature, liquid level, flow, etc.

SECTION II — INSTALLATION

These instructions apply for all the VC-230 & VC-231 Series control valves. All operate in the same manner and differ only in the body style, valve plug construction and actuator operation (direct or reverse action).

A. VALVE PLUG REMOVAL CLEARANCES

Tabulation shows clearances above the valve centerline for removal of the actuator and below the valve body centerline for removal of the valve plug or disc.

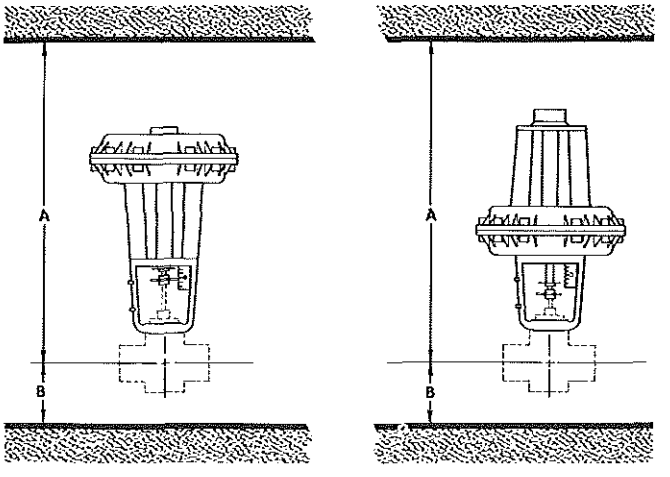


Figure 1 - DIMENSIONS

VC-230 (Direct-Acting)

VALVE SIZE (Inches)	SINGLE-SEATED VALVES																			
	A, A-O Direct Acting		AR Reverse Acting		A-OR Reverse Acting		C, CS, CSS Direct Acting		CR,CSR,CSSR Reverse Acting		MA, MAS Direct Only		BB, BC Direct Acting		BBR, BCR Reverse Acting		BF, BG Direct Acting		BFR, BGR Reverse Acting	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
½	18 1/16	1 15/16	18 7/16	7 5/16	18 7/16	7 11/16	18 7/16	1 13/16	18 7/16	7 5/16			17 7/8	2	17 ½	8	18 ¼	2 7/8	18 ¼	7 7/8
¾	18 11/16	2 ¼	18 15/16	8 ¾6	18 15/16	8 5/16	18 ¾	3 5/16	18 ¾	8 5/16	20 5/16	2 ½	17 9/16	2 5/16	17 13/16	9	18 7/8	2 15/16	18 7/8	8 15/16
1	18 15/16	2 ¼	18 15/16	8 ¾6	18 15/16	8 5/16	18 ¾	3 5/16	18 ¾	8 5/16	20 5/16	2 ½	18 11/16	2 7/8	18 ⅜	10 5/8	19 15/16	3 ¾	19 15/16	10 ¾
1¼	19 ½	3	19 ½	9 7/8	19 ½	9 7/16					20 ½	2 7/8	18 11/16	2 7/8	18 ⅜	10 5/8	19 13/16	3 ¾	19 13/16	10 ¾
1½	19 15/16	3 ¾6	19 15/16	10 ¾	19 15/16	10 9/16					21	2 15/16	18 11/16	2 7/8	18 ⅜	10 5/8	19 13/16	3 ¾	19 13/16	10 ¾
2							19 5/8	6 ¾	19 5/8	9 7/8	21 7/8	6 ¾	18 ¾	3 ¼	18 11/16	11 13/16				
2½													22 13/16	4 5/8	24 ½	16 15/16				
3													23 5/8	4 13/16	22 13/16	18 ¾				
4													24 5/8	5 7/8	23 ¾	20 ¾				

VALVE SIZE (Inches)	DOUBLE-SEATED VALVES								THREE-WAY VALVES											
	F Direct Acting		FR Reverse Acting		FA, FB, FC Direct Acting		FAR,FBR,FCR Reverse Acting		WA-O		WA		WB		WC,WCS,WCSS		WD		WE	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
½									18 1/16	8 1/8	18 1/16	8 ¼			18 1/16	8 5/16			18 11/16	7 15/16
¾	18 7/8	3	18 7/8	9	18 15/16	3 1/16	18 15/16	9 1/16	18 ¾	8 7/8	18 15/16	9 1/16			18 ¾	9 ½			18 13/16	8 ¼
1	19 ⅜	3 ¼	19 ⅜	10 ¼	19 11/16	3 13/16	19 11/16	10 13/16	18 ¾	8 ¾	18 15/16	9 1/16			18 ¾	9 ½			19 ⅜	10 ½
1¼	19 ½	3 ⅝	19 ½	10 ⅝	19 11/16	3 13/16	19 11/16	10 13/16	19 5/16	10 ⅜6	19 ½	9 13/16							19 ⅝	11 ½
1½	19 15/16	4 1/16	19 15/16	12 1/16	20	4 1/8	20	12 ⅛	19 15/16	10 25/16	19 13/16	10 15/16							19 ⅝	11 ½
2	21	5 ¼	20 ⅜	11 ½	20 11/16	4 1/16	20	12 13/16					22 9/16	9 3/16	19 ⅝	11	21 1/16	9 3/16	19 ⅝	13 ⅞
2½	21 ⅝	5 13/16	20 ½	13 ⅛	21 ¼	4 ¼	20 ½	14 ⅜					22 ⅞	10 ½			20 ⅞	10 ½	21 ⅝	18 ½
3	21 ⅝	6 ¼	20 ¾	15 ⅛	21 ⅝	4 15/16	20 13/16	16 ¾					25 3/16	11 ¾			20 ⅞	10 ¾	23 ¼	19 ⅞
4	22 ⅝	7 ⅛	21 ½	17 ⅜	22 11/16	6	21 ⅞	18 13/16					28 ½	14 9/16			20 7/16	12 9/16	24	23
5													34 7/16	18 ⅝			25 ⅞	15 ⅝		
6													39 ¼	26 7/16			27 ⅞	17 ¾		

VC-231 (Reverse-Acting)

VALVE SIZE (Inches)	SINGLE-SEATED VALVES																			
	A, A-O Direct Acting		AR Reverse Acting		A-OR Reverse Acting		C, CS, CSS Direct Acting		CR,CSR,CSSR Reverse Acting		MA, MAS Direct only		BB, BC Direct Acting		BBR, BCR Reverse Acting		BF, BG Direct Acting		BFR, BGR Reverse Acting	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
½	19 1/16	1 15/16	19 1/16	7 5/16	19 1/16	7 11/16	19 1/16	1 13/16	19 1/16	7 5/16			18 ½	2	18 ⅛	8	19 ⅛	2 7/8	19 ⅛	7 7/8
¾	19 9/16	2 ¼	19 9/16	8 3/16	19 9/16	8 5/16	19 ⅜	3 5/16	19 ⅜	8 5/16	20 15/16	2 ½	18 13/16	2 5/16	18 7/16	9	19 ½	2 15/16	19 ½	8 15/16
1	19 9/16	2 ¼	19 9/16	8 3/16	19 9/16	8 5/16	19 ⅜	3 5/16	19 ⅜	8 5/16	20 15/16	2 ½	19 5/16	2 7/8	19 ¼	10 ⅝	20 1/16	3 ¾	20 1/16	10 ¾
1¼	20 ⅛	3	20 ⅛	9 ⅜	20 1/16	9 7/16					21 ⅛	2 7/8	19 5/16	2 7/8	19 ¼	10 ⅝	20 1/16	3 ¾	20 1/16	10 ¾
1½	20 5/16	3 3/16	20 5/16	10 ⅜	20 5/16	10 9/16					21 ⅜	2 15/16	19 5/16	2 7/8	19 ¼	10 ⅝	20 1/16	3 ¾	20 1/16	10 ¾
2							20 ⅛	6 ¾	20 ⅛	9 ⅞	22 ½	6 ¾	19 ⅜	3 ⅛	19 5/16	11 13/16				
2½													23 1/16	4 5/8	25 ⅛	16 15/16				
3													24 ¾	4 15/16	23 1/16	18 ¾				
4													25 ⅛	5 7/8	24 ⅜	20 ¾				

VALVE SIZE (Inches)	DOUBLE-SEATED VALVES								THREE-WAY VALVES											
	F Direct Acting		FR Reverse Acting		FA, FB, FC Direct Acting		FAR,FBR,FCR Reverse Acting		WA-O		WA		WB		WC,WCS,WCSS		WD		WE	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
½									19 1/16	8 1/8	19 1/16	8 ¼			19 1/16	8 5/16			19 5/16	7 15/16
¾	19 ½	3	19 ½	9	19 9/16	3 1/16	19 9/16	9 1/16	19 ⅜	8 7/8	19 9/16	9 1/16			19 ⅜	9 5/16			19 7/16	8 ¼
1	20	3 ¼	20	10 ¼	20 5/16	3 13/16	20 5/16	10 13/16	19 ⅜	8 7/8	19 9/16	9 1/16			19 ⅜	9 5/16			20 ¼	10 ½
1¼	20 ⅛	3 ⅜	20 ⅛	10 ⅜	20 5/16	3 13/16	20 5/16	10 13/16	20 5/16	10 5/16	20 ¼	9 13/16							20 ¼	11 ½
1½	20 9/16	4 3/16	20 9/16	12 1/16	20 ⅜	4 1/8	20 ⅝	12 ⅛	20 9/16	10 15/16	20 9/16	10 15/16							20 ¼	11 ½
2	21 ⅜	5 ¼	21	11 ½	21 5/16	4 1/8	20 ⅝	12 13/16					23 1/16	9 3/16	20 ¼	11	21 11/16	9 3/16	20 ¼	13 ⅞
2½	22 ¼	5 13/16	21 ⅛	13 ⅞	21 ⅞	4 ¼	21 ⅛	14 ⅜					23 ½	10 ½			21 ½	10 ½	22 ¼	18 ½
3	22 ¼	6 ¼	21 ⅛	15 ⅛	22 ¼	4 15/16	21 ½	16 ¾					25 ⅛	11 ¼			21 ½	10 ¾	23 ¼	19 ⅛
4	23 ¼	7 ⅛	22 ⅛	17 ⅛	23 5/16	6	22 ½	18 13/16					29 ⅛	14 9/16			21 1/16	12 9/16	24 ⅝	23
5													35 1/16	18 ⅝			26 ½	15 ⅝		
6													39 ¼	26 7/16			28 ½	17 7/16		

Table I • DIMENSIONS

B. VALVE PIPING

The size of a Diaphragm Control Valve is computed to give full throttling action under certain specific conditions of flow and pressure drop. To insure obtaining maximum performance, the control valve should not be placed in the main line adjacent to elbows, bends or plug cocks where abnormal velocities may occur. The size of the main line is usually one or two nominal sizes larger than the size of the control valve. When it is desired to use plug cocks for shutoff valves, they should be the same size as the main line and not the size of the control valve.

Inspect all parts of the control valve for any foreign material that may have collected during shipment. Clean and blow out all pipe lines to remove pipe scale and chips.

If it is desirable to have continuous system operation when necessary to inspect or replace any control valve parts, install a conventional three-valve bypass around the control valve.

When installing the body in the line, observe the following precautions: If the body has screwed connections, make sure the male threads are sharp. Use a good grade of pipe compound, apply only above the second or third male thread in moderate amounts. If the body is of flanged construction, be careful to draw the bolts up evenly to prevent placing a strain on the valve body and to avoid the possibility of cracking a flange. Make sure the flow through the valve body is in the direction indicated by the arrow cast on side of body.

The control valve may be installed with the diaphragm in any position. Table I lists the clearances necessary to remove and remove and replace valve plugs when inspection or replacement of parts is necessary.

It is recommended that pressure taps be installed upstream and downstream of the control valve for use when it is desirable to check the flow capacity or pressure drop across the control valve.

C. AIR PIPING TO VALVE

Run 1/4" or 3/8" tube or pipe from the connection on the upper housing of the diaphragm (lower casing for reverse-acting actuator) to the outlet fitting of the instrument or pilot controller. To avoid excessive delay in response, it is recommended that the distance should be less than 150 ft. from the instrument to valve. If excessive distances are necessary, one or more booster relays, Robertshaw CR-100-A1, may be used to speed the response. If control valve is equipped with a positive positioner, connection from the controller is made at the positioner (See E. Control Valve with positioner).

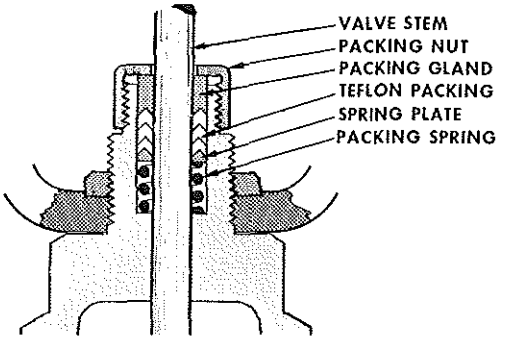


Figure 2 - PACKING BOX

D. PACKING

Teflon packing is standard on all Robertshaw control valves.

Proper compression of the packing to prevent leakage is provided by a spring within the packing box. (Tightening the packing nut "finger tight" is usually sufficient to obtain the required compression.) To make certain there is no leakage from the packing box in starting up, check the valve stem to see that there are no cuts or abrasions where it goes into the packing box.

O-ring packing is available for gas, air or cold service when specified on order or when Teflon V-rings prove ineffective.

E. CONTROL VALVE WITH POSITIONER

The purpose of a valve positioner is to provide additional force to the diaphragm when required to insure accurate positioning of the valve in response to the dictates of the controller or instrument output pressure change; also, to handle higher close-off pressure drops and for split-range operation.

The positioner, when ordered, will come attached and with all necessary piping installed. Connect clean, reduced air supply to the positioner supply port and connect a line from the instrument or controller to the instrument tap on the positioner connection block. 1/4" or 3/8" tubing or pipe should be used. See Instruction Bulletin P-2108 for P-2 positioner.

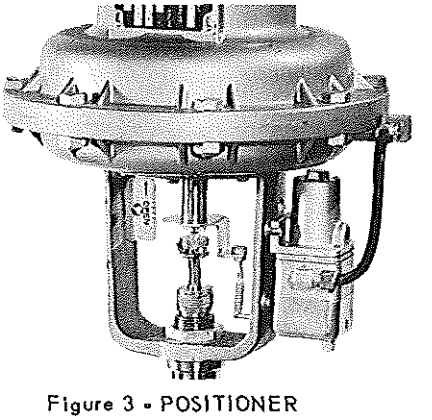


Figure 3 - POSITIONER

F. HIGH OR LOW TEMPERATURE VALVES

A plain extension bonnet (See Figure 4) is recommended for control valve service handling cold fluid maximum temperatures as low as minus 150° F; or hot fluids at temperatures between 450° and 850° F. This type of construction is recommended for low or high temperature service because it is more adaptable to any necessary insulation.

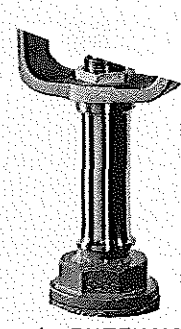


Figure 4 - EXTENSION BONNET

SECTION III — ADJUSTMENTS

The size of the Diaphragm Control Valve is computed to give full throttling action.

The Diaphragm Control Valve is shipped from the factory with the range spring adjustment properly set for the operating conditions specified on your order.

Under actual service conditions, pressure drops can differ. This is particularly noticeable on single-ported bodies, but is usually of little consequence on double-ported bodies. For this reason the spring may have to be adjusted in order to compensate for the pressure drop so that full valve travel may be obtained over the diaphragm pressure range.

Direct-Acting: Load spring adjustment is accomplished by turning the adjustment screw to the left to increase spring compression and to the right to decrease spring compression (See Figure 5A).

Reverse-Acting: Load spring adjustment is accomplished by lifting off the black plastic cap from the top of the actuator and then turning the adjusting screw to the right (counter clockwise, looking at top of actuator) to increase spring compression and to the left to decrease spring compression (See Figure 5B).

When valve is completely installed and connected to the instrument or controller, open the manual downstream valve and close the bypass valve. Slowly open the upstream manual control valve. Allow the controller sufficient time to assume normal operation before checking for proper control action.

Every valve should be checked on or before startup for correct stroke, free movement, correct location, and proper flow direction through the body.

In all cases of trouble, always check first the air lines and fittings for leaks and make sure you have the correct assembly for the desired action.

For successful performance of this equipment, the valve stem must move freely in response to air pressure change on the diaphragm. If this type of action is not being obtained, check the following:

1. **Valve Plug.** Examine the valve guides for "scoring" as a result of foreign material or misalignment.
2. **Packing Box.** Teflon packing will not usually cause trouble unless it is damaged by burrs on the stem during stem insertion or removal through packing. Prior to removing stem through packing, loosen Packing Nut sufficiently to relieve spring load on V-rings, thereby increasing internal diameter, thus avoiding damage to Teflon V-rings.
3. **Diaphragm.** A diaphragm that is no longer pliable or is ruptured must be replaced.

Refer to "Maintenance" section for procedure on checking and replacing these parts. If the above three parts are performing correctly, any trouble that may be encountered will likely be found in the controller.

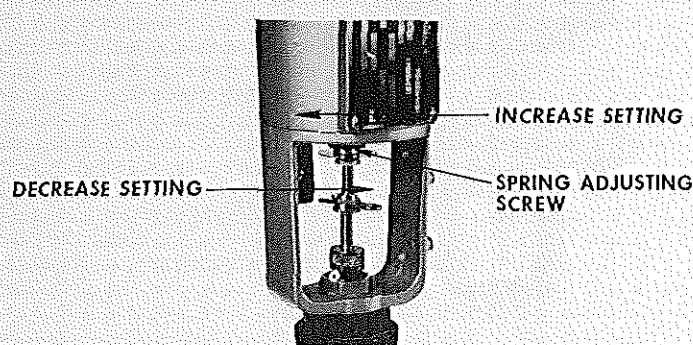


Figure 5A - ADJUSTMENT (Direct-Acting)

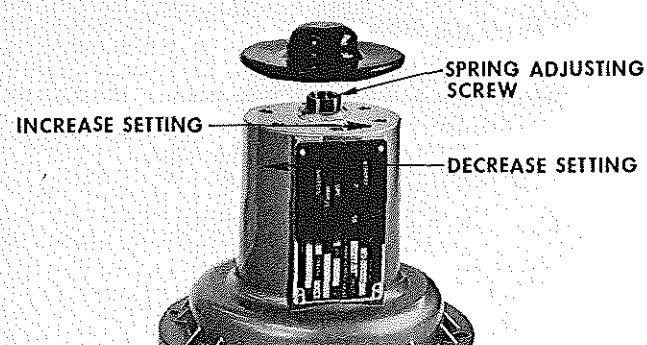


Figure 5B - ADJUSTMENT (Reverse-Acting)

SECTION IV — MAINTENANCE

A. GENERAL

The actuator and valve are shipped completely assembled with all adjustments made. However, step-by-step procedures are given in the following paragraphs should it be necessary to disassemble the unit for maintenance or inspection.

B. DISASSEMBLING THE ACTUATOR FROM VALVE (FIG. 6)

The stem connection is easily disengaged by removing the Hairpin Connector.

The Valve is secured to the frame by means of a Locknut. To remove the actuator from the valve, disengage the Hairpin Connector, Locknut and air line.

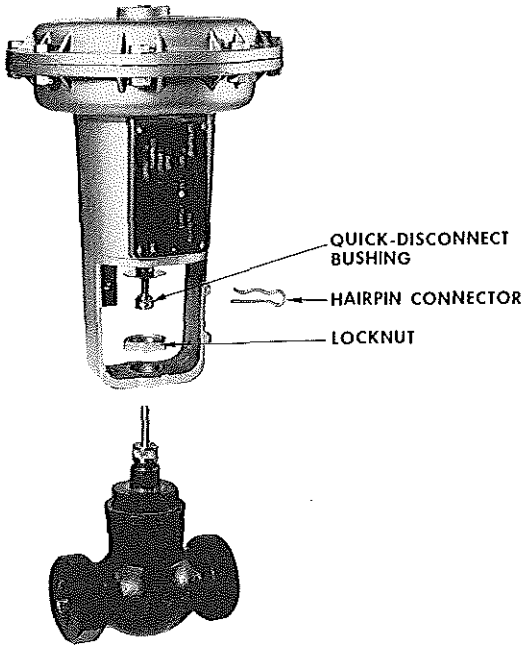


Figure 6 • ACTUATOR AND VALVE

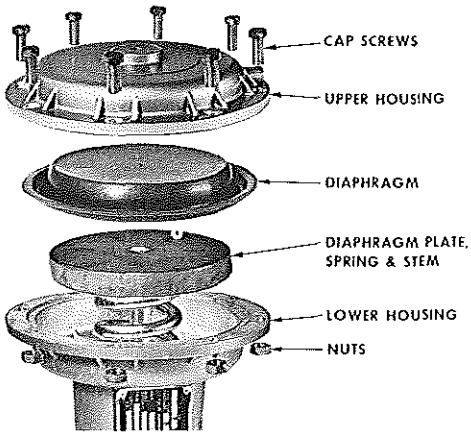


Figure 7 • DIAPHRAGM REMOVAL (Direct-Acting)

C. REPLACEMENT OF DIAPHRAGM

Direct-Acting: (Fig. 7)

1. Remove air pressure.
2. Turn the Adjustment Screw to the right to relieve spring compression.
3. Remove Cap Screws and nuts holding the Upper Housing to the Lower Housing which then allows the Diaphragm to be removed.

Reverse-Acting: (Fig. 8)

1. Remove air pressure.
2. Lift off plastic Cap and turn Adjusting Screw to the left (clockwise, looking at top of actuator) to relieve spring compression.
3. Remove Cap Screws and Nuts holding Upper Housing to the Lower Housing and remove Upper Housing.
4. Lift off Spring, Spring Seat, Adjusting Screw and Thrust Bearing as a unit.
5. Unscrew Upper Actuator Stem from Lower Actuator Stem to remove Diaphragm. It is not necessary to remove Lower Actuator Stem from the Lower Housing for Diaphragm removal.

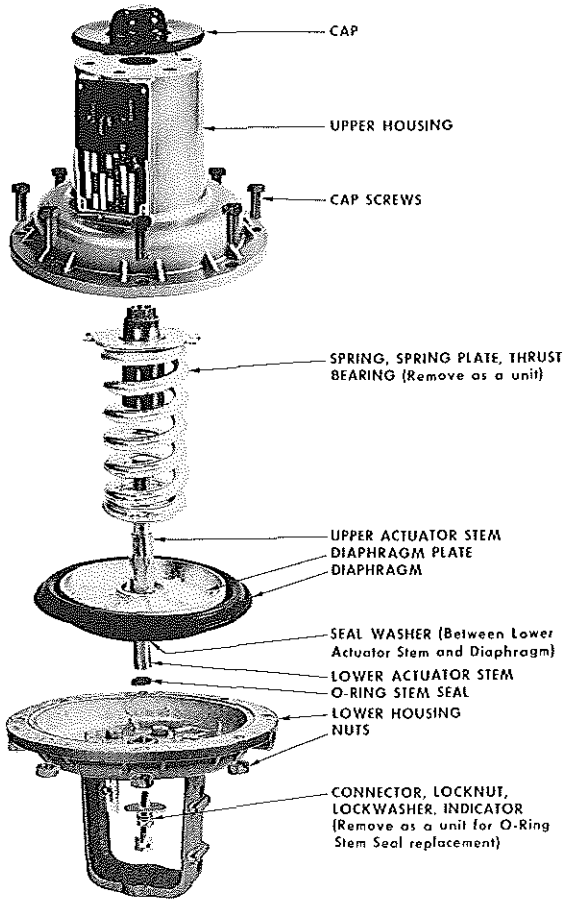


Figure 8 • DIAPHRAGM REMOVAL (Reverse-Acting); O-RING STEM SEAL REMOVAL

D. REPLACEMENT OF O-RING STEM SEAL (REVERSE-ACTING ONLY) FIG. 8

In rare instances the O-Ring Stem Seal may be worn or mutilated, which will result in loss of diaphragm pressure. If O-Ring Stem Seal is to be replaced, follow these steps:

1. Remove air pressure.
2. Remove Hairpin Connector.
3. Remove Locknut and separate actuator from valve.
4. Remove Connector, Locknut, Lock Washer, and Indicator from Actuator Stem.
5. Lift off plastic Cap and turn Adjusting Screw to the left (clockwise, looking at top of actuator) to relieve spring compression.
6. Remove Cap Screws and Nuts holding Upper Housing to the Lower Housing and remove Upper Housing.
7. Lift off Spring, Adjusting Screw, Spring Seat and Thrust Bearing as a unit.
8. Remove Upper and Lower Actuator Stem, Lock Washer, Diaphragm Plate, Diaphragm and Seal Washer as a unit.
9. Remove O-Ring from Stem Guide. No need to separate Stem Guide from Lower Housing for this.
10. Clean out O-Ring groove.
11. Lubricate new O-Ring with Parker O-Lube, or equivalent, before inserting.
12. Wipe off Lower Actuator Stem with clean, dry cloth. DO NOT attempt to polish. If Stem is scratched or nicked around O-Ring area, it should be replaced.
13. Reassemble in reverse order.

E. REPLACEMENT OF PACKING (FIG. 9)

Valve stem Packing Nut should be kept only finger-tight. If valve stem packing must be replaced, follow steps below.

1. Remove Hairpin Connector.
2. Remove Locknut and separate actuator from valve.
3. Remove Packing Nut and Packing Gland.
4. Remove Bonnet from valve.
5. Remove Packing Spring Plate and Spring.
6. Clean out packing box with a clean rag or soft paper.
7. Wipe off stem with clean rag. DO NOT attempt to polish. If stem is scratched or nicked around packing area, it should be replaced.

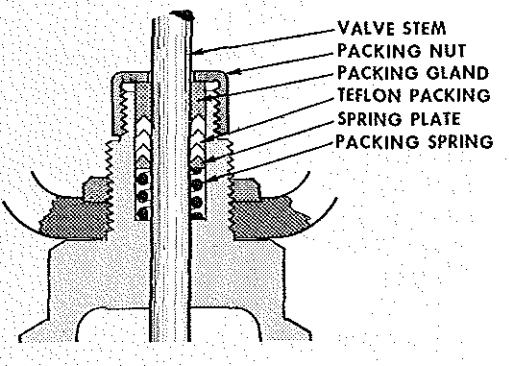


Figure 9 - PACKING BOX

8. Replace Bonnet on valve.
9. Carefully place new packing in packing box. In an emergency, if chevron packing is not available, repack with a good grade of graphited string packing. Put a small amount of good packing lubricant in the packing box while repacking. This packing, however, should be replaced with Teflon chevron packing as soon as possible. Lubricate Teflon rings by dipping in Dow Corning 710.
10. Replace Packing Gland.
11. Replace Packing Nut and tighten.
12. Connect valve to actuator and tighten Locknut.
13. Insert Hairpin Connector.

F. REPLACEMENT OF VALVE PLUG

1. Detach actuator from valve (See Fig. 6).
2. Loosen Packing Nut.
3. On direct-acting valves, unscrew Bonnet (Fig. 10) or remove Cap Screws and Bonnet.

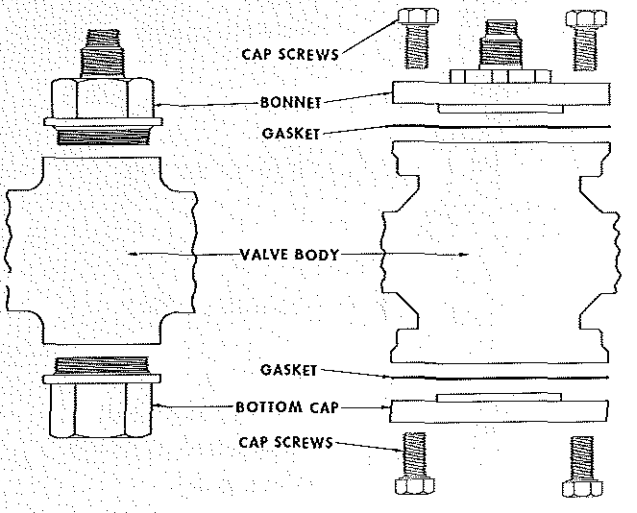


Figure 10 - BONNET AND CAP

4. On reverse-acting valves, unscrew Bottom Cap (Fig. 10) or remove Cap Screws and Bottom Cap.
5. Remove Stem and Poppet assembly from valve except for WB valve (See Fig. 12).
6. On the A, C, F, BB, BC, BF, BG, WA, WC, WD, and WE valves, we recommend that the Stem and Poppet be replaced as one unit. On MA valves (Fig. 11), remove Snap Ring and separate Stem and Poppet.

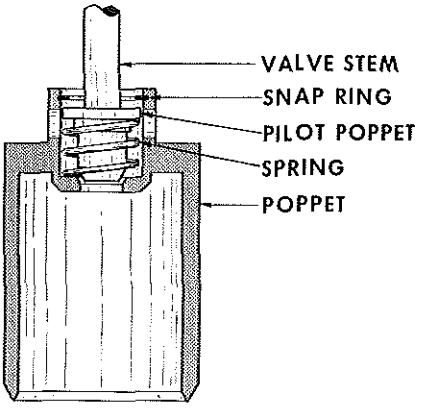


Figure 11 - SNAP RING REMOVAL

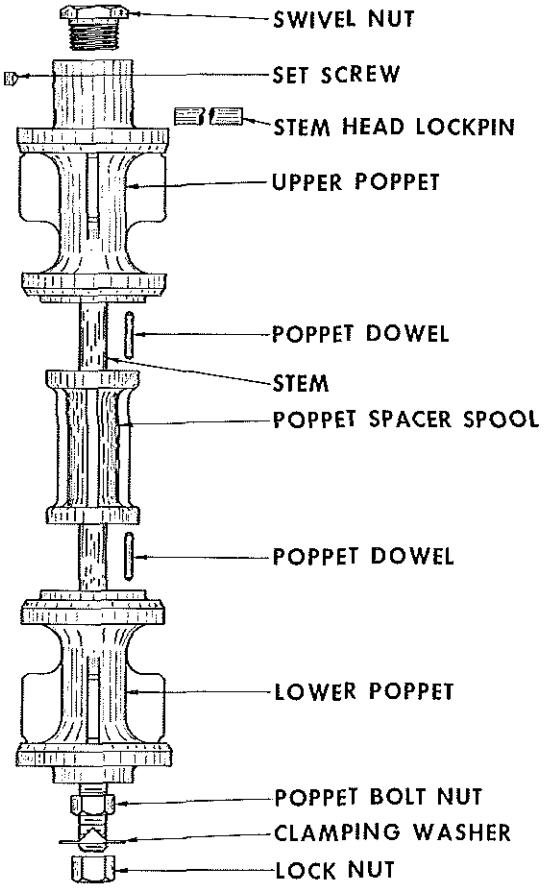


Figure 12 - WB VALVE

G. REPLACEMENT OF SEAT RINGS

1. Detach actuator from valve (See Fig. 6).
2. For removal of valve plug, see "Replacement of Valve Plug."
3. The seat ring may be found "frozen" in the body. A lathe or boring mill can be used to good advantage in loosening them. However, where it is not desired to remove the body from the line, or heavy machine shop tools are not available, a seat ring puller as shown in Fig. 13 may be fabricated in your own shop.
   Use of penetrating oil on an extended "cheater" arm on the seat ring puller may be needed to free tight rings. When this procedure doesn't work, however, heat the body with a torch or cover the ring with a cold material such as dry ice. In a short time the rings will loosen and may be removed. After the rings have been removed, thoroughly clean the body and port threads.
4. To install new rings: Apply a moderate amount of pipe joint compound to the male seat ring threads. In double-port bodies, note that one of the seat rings is smaller than the other. This ring should be installed first in the bottom port of push-down-to-close valves. On push-down-to-open valves, the smaller ring should be inserted first, from the bottom of the body into the upper port. The seat ring puller, lathe or boring mill can be used to tighten the rings in the body. Remove all excess pipe joint compound after drawing the rings tight.

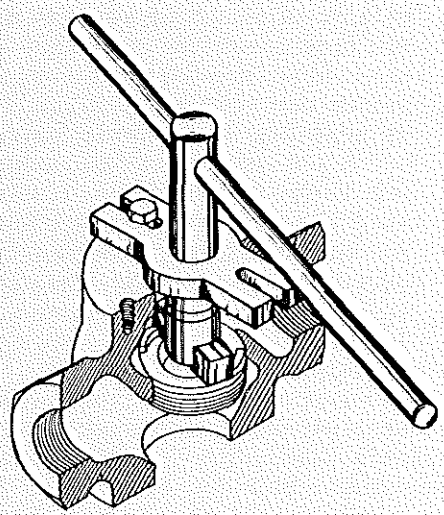
H. GRINDING-IN SEAT RINGS

Following is the procedure found most effective for grinding-in seats on double-port valves with stainless steel trim.

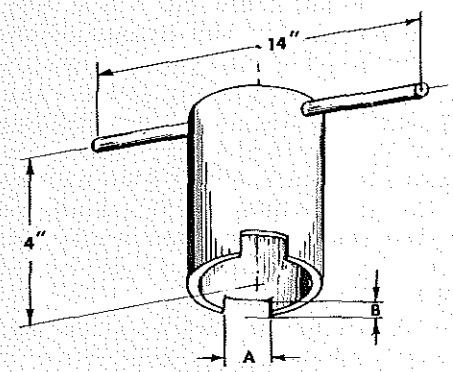
Grinding Compound – Use one measure of No. 280 grain emery flour and one measure of rottenstone, mixed with machine oil to produce a medium texture compound. To prevent galling, when grinding-in seats, be sure to apply white lead to seating surfaces and then apply grinding compound. Do not mix white lead with grinding compound. It is known from experience that the top seat generally grinds faster. Under these circumstances, continue to use the grinding compound with white lead on the bottom seat, but simply use a polishing mixture of rottenstone and machine oil for the top port. When grinding-in seats, the bonnet should be placed on body to insure proper alignment.

After both seats have been fully ground, polish with the mixture of rottenstone and machine oil.

If either of the ports continues to leak,



Typical Seat Ring Puller



VALVE SIZE	PIPE SIZE	DIM.A	DIM.B
3/4 & 1	1-1/2	7/16	1/4
1-1/4	1-1/2	7/16	1/4
1-1/2	2	1/2	1/4
2	2-1/2	1/2	1/4

Used on MA Valve Only

Figure 13 - SEAT RING PULLERS

use more grinding compound on the seat that *is not leaking* and use polishing compound on the other until both seats touch the surface at the same time.

It is possible and generally is preferred to grind the valve while in the line. By doing this, the problem of leakage due to line stresses and distortion when installing valve in line will be minimized. If tight seating is required, it is advisable to heat the body if the control valve is being used on high temperature service.

To grind-in single-port valves with stainless steel trim, use similar procedure by first applying white lead to seat and then applying grinding compound as outlined above. However, single-port valves require less grinding. It is generally found that finer emery flour, taking a smaller bite, will do a smoother job. The use of No. 400 or No. 600 emery flour on single-port valves is recommended. If a large nick is present on the seat ring, it should be machined out rather than ground.

To grind-in single- or double-port valves furnished with stellite or bronze trim, use same procedure as outlined above, except that white lead is not required, since galling is not a problem on these materials.

I. REASSEMBLY

DIRECT-ACTING ACTUATOR

Direct-Acting Valve:

1. Set Valve Plug on Its seat.
2. Screw the Bonnet into the Valve Body or place the Gasket and Bonnet on the Valve Body. On larger valves, tighten the Cap Screws evenly since undue strain could crack the flange or cause binding between the valve plug and seat rings.
3. Assemble the inner parts of the packing box. Do not tighten the Packing Nut since the resulting friction would prevent turning the Valve Stem in the Quick-Disconnect Bushing.
4. Place the actuator assembly on the valve and tighten the Locknut.
5. With no pressure on the actuator, raise Valve Stem until hole in Stem is aligned with hole in Quick-Disconnect Bushing and insert Hairpin Connector.
6. Now apply pressure to the Diaphragm to check operation.
7. Tighten Packing Nut.

Reverse-Acting or Three-Way Valve:

1. Insert the valve plug and stem, *stem* first, into the body.
2. Screw the Bottom Cap into the valve or place the Gasket and Bottom Cap on the valve. Tighten Cap Screws evenly since undue strain could crack the Bottom Cap or cause binding between the valve plug and seat rings.
3. Assemble the inner parts of the packing box. Do not tighten the Packing Nut, since the resulting friction would prevent turning the Valve Stem in the Quick-Disconnect Bushing.
4. Place the actuator assembly on the valve and tighten Locknut.
5. With no pressure on actuator, raise Valve Stem until valve plug assembly moves against seat.
6. Apply air pressure to diaphragm until the holes in the Stem and Quick-Disconnect Bushing are aligned. Insert Hairpin Connector.
7. Check actuator for operation.
8. Tighten Packing Nut.

REVERSE-ACTING ACTUATOR

Direct-Acting Valve:

1. Set Valve Plug on its seat.

2. Screw the Bonnet into the Valve Body or place the Gasket and Bonnet on the Valve Body. Tighten Cap Screws on larger valves evenly since undue strain could crack the flange or cause binding between the valve plug and seat rings.
3. Assemble the inner parts of the packing box. Do not tighten the Packing Nut since the resulting friction would prevent turning the Valve Stem in the Quick-Disconnect Bushing.
4. Place the actuator assembly on the valve and tighten the Locknut.
5. With no pressure on the actuator, align the hole in the Valve Stem with hole in Quick-Disconnect Bushing and insert Hairpin Connector.
6. Now apply pressure to the Diaphragm to check operation.
7. Tighten Packing Nut.

Reverse-Acting or Three-Way Valve:

1. Insert the Valve Plug and Stem, Stem first, into the Body.
2. Screw the Bottom Cap into the valve or place the Gasket and Bottom Cap on the valve. Tighten Cap Screws evenly since undue strain could crack the Bottom Cap or cause binding between the Valve Plug and Seat Rings.
3. Assemble the inner parts of the packing box. Do not tighten the Packing Nut, since the resulting friction would prevent turning the Valve Stem in the Quick-Disconnect Bushing.
4. Place the actuator assembly on the valve and tighten Locknut.
5. With no pressure on the actuator, align the hole in the Valve Stem with hole in Quick-Disconnect Bushing and insert Hairpin Connector.
6. Now apply pressure to the Diaphragm to check operation.
7. Tighten Packing Nut.

J. VALVE STEM STROKE ADJUSTMENT

DIRECT-ACTING ACTUATOR

Direct-Acting Valve:

These valves close with a downward stem motion which is produced with increasing air pressure on the VC-230 actuator. (See Fig. 14)

1. With valve installed, insert end of Valve Stem 7 into Quick-Disconnect Bushing 5 and fasten with Hairpin Connector 4.
2. Increase air pressure on the diaphragm until the valve is fully closed. Set Valve Stroke Indicator 2 opposite the bottom mark on Indicator Plate 6. Be sure the indicator plate for a new valve is graduated to correspond with the proper valve stroke. New indicator plates may be obtained from the factory.
3. Remove air pressure from actuator diaphragm, allowing the valve to move to a full-open position. Measure distance stem has traveled and compare with proper valve stroke found in Table II. To get longer valve stroke, loosen Locknut 3 and turn Quick-Disconnect Bushing 5 into Actuator Stem 1 until proper stroke is obtained. Tighten Locknut 3. To shorten stroke, turn Quick-Disconnect Bushing 5 out of Actuator Stem 1 until valve stroke is obtained. Tighten Locknut 3.

Reverse-Acting, Three-Way Valve:

Reverse-acting valves close with an upward stem movement produced with decreasing air pressure on the VC-230 actuator. Since spring thrust provides the closing force on reverse-acting valves, care must be taken to be sure diaphragm is just free of upward stop when the valve is closed. (See Fig. 14)

1. With valve installed, insert end of Valve Stem 7 into Quick-Disconnect Bushing 5 and fasten with Hairpin Connector 4.
2. Loosen Locknut 3 and turn Quick-Disconnect Bushing 5 out of Actuator Stem 1 a sufficient distance to allow diaphragm to move upward against stop.
3. Turn Quick-Disconnect Bushing 5 into Actuator Stem 1 until the resistance of the valve poppet reaching seat can be felt. On a three-way valve this is obviously the upper seat. Turn Quick-Disconnect Bushing 5 into Actuator Stem 1 one more full turn to pull diaphragm slightly away from stop. Tighten Locknut 3.
4. Set Valve Stroke Indicator 2 opposite first mark at top of Indicator Plate 6.
5. Apply pressure on diaphragm sufficient to move valve through downward stroke to be sure valve can move a distance equal to that specified in Table II for the valve being installed. For reverse-acting valves, this would represent the full-open position, while on three-way valves, it is the distance to the lower seat.
6. Remove pressure from diaphragm and check to see that Valve Stroke Indicator 2 returns to fully closed position on reverse-acting valves (upper seat on three-way valves).

REVERSE-ACTING ACTUATORS

Direct-Acting, Three-Way Valve:

These valves close with a downward stem movement which is provided with decreased air pressure on the VC-231 actuator (See Fig. 14). Since spring thrust provides the closing force on direct-acting valves, care must be

taken to be sure diaphragm is just free of downward stop when the valve is closed.

1. With valve installed, insert end of Valve Stem 7 into Quick-Disconnect Bushing 5 and fasten with Hairpin Connector 4.
2. With no air pressure on the diaphragm valve, and with adjusting spring compressed to hold diaphragm against stop, poppet should be on seat. If not, turn Quick-Disconnect Bushing 5 out of the actuator stem until the resistance of the valve poppet reaching the seat can be felt. Turn quick-disconnect bushing one more full turn to make sure poppet is properly seated and raise diaphragm slightly off stop. Set valve stroke indicator 2 opposite the bottom mark on Indicator Plate 6. Be sure that Indicator Plate for a new valve is graduated to correspond with the proper valve stroke. New Indicator Plates may be obtained from the factory.
3. Apply air pressure to the actuator diaphragm, allowing the valve to move to full-open position – (upper seat on three-way valves). Measure distance stem has traveled and compare with proper valve stroke found in Table II. To get longer valve strokes, loosen Locknut 3 and turn Quick-Disconnect Bushing 5 into Actuator Stem 1 until proper stroke is obtained. Tighten Locknut 3.

   To shorten stroke, turn Quick-Disconnect 5 out of Actuator Stem 1 until valve stroke is obtained. Tighten Locknut 3.

Reverse-Acting Valve:

The reverse-acting valve closes with an upward stem movement produced with increased air pressure on the VC-231 (See Fig. 14).

1. With valve installed, insert end of Valve Stem 7 into Quick-Disconnect Bushing 5 and fasten with Hairpin Connector 4.
2. Increase air pressure on the diaphragm until the valve is fully closed. Set Valve Stroke Indicator 2 opposite the top mark on Indicator Plate 6. Be sure the Indicator Plate for a new valve is graduated to correspond with the proper valve stroke. New Indicator Plates may be obtained from the factory.
3. Remove pressure from diaphragm and check to see that Valve Stroke Indicator 2 returns to full-open position.

NOTE: In actual operation, system pressure acting on the unbalanced area of single-seated valves, valve stroke and diaphragm area for a specified control valve, and controller signal are used to determine the actuator spring. Hence, it is not practical to stipulate diaphragm pressures for checking reverse-acting and three-way valve strokes on bench tests. Therefore, these instructions are limited to assuring that the valve is on seat and that the actuator can move the required distance for full-open, reverse-acting valve position and seat-to-seat distance on three-way valves.

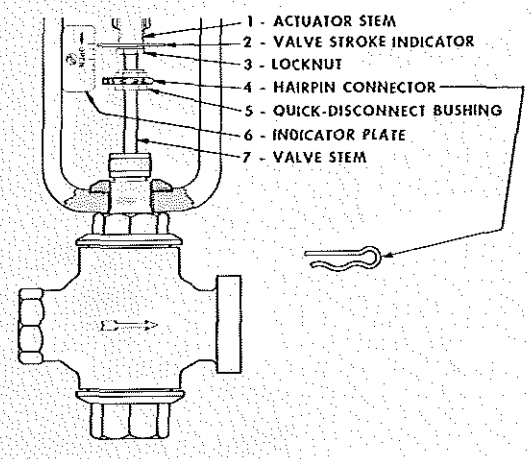
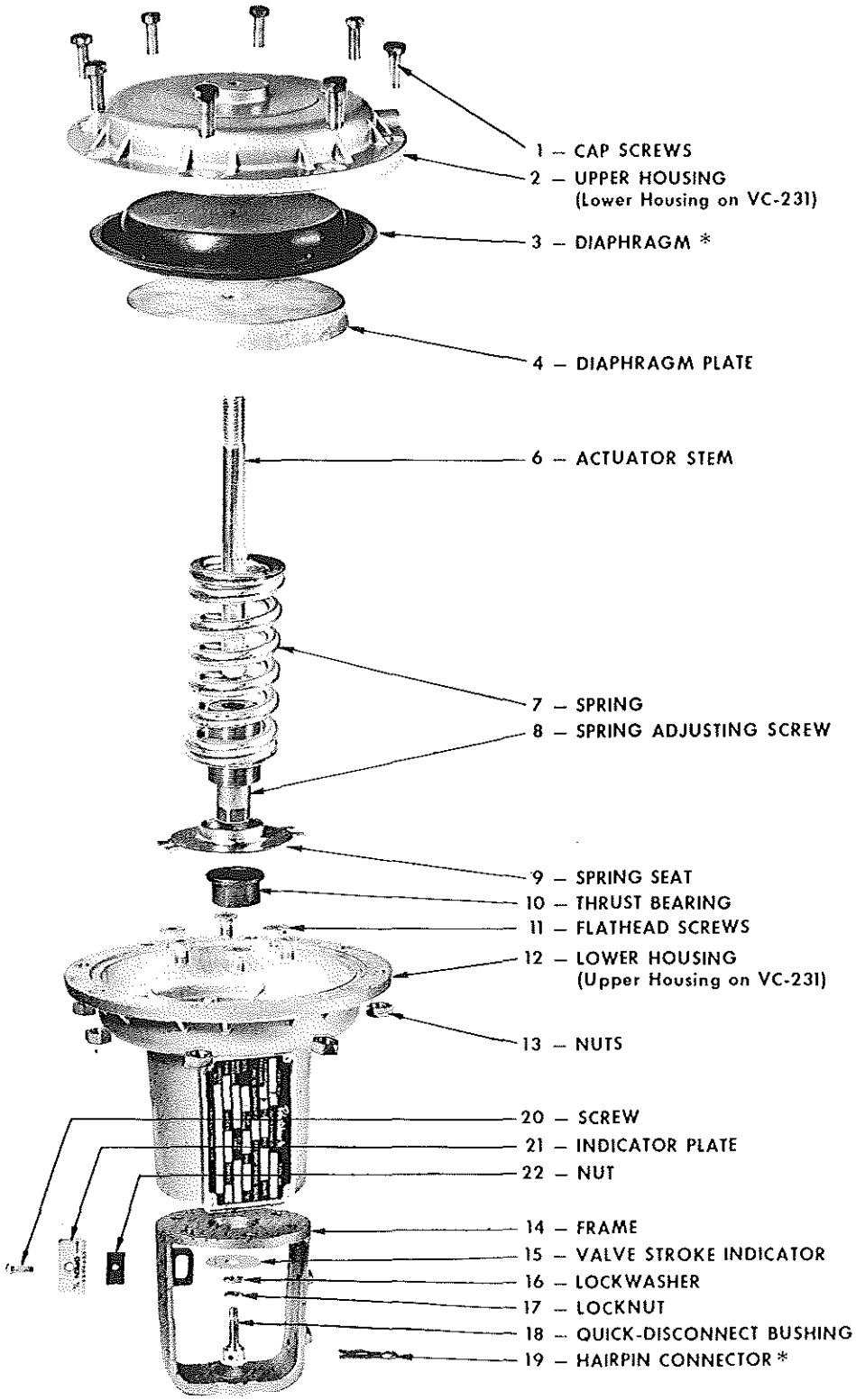


Figure 14 - VALVE STEM STROKE ADJUSTMENT

VALVE TYPE	VALVE SIZE														
	1/8	3/16	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
A, AR, A-O, A-OR, C, CR, CS, CSR, MA, MAS, WA, WA-O, WC	3/32	7/64	1/8	5/32	3/16	1/4	5/16	3/8	7/16	9/16					
BB, BBR, BC, BCR, BF, BFR, BG, BGR, WE					3/8	3/8	5/8	5/8	5/8	5/8	1	1	1		
FA, FAR						5/32	3/16	7/32	1/4	5/16	3/8	7/16	9/16		
FB, FBR, FC, FCR						1/4	5/8	5/8	5/8	5/8	5/8	3/4	1		
WB										3/8	7/16	1/2	11/16	13/16	7/8
WD										5/16	7/16	5/8	5/8	23/32	1 1/32

Table II - VALVE STEM STROKE ADJUSTMENT

SECTION V — PARTS LIST



* Indicates recommended spare parts.

** Always specify part reference number, name and Figure 15 when ordering replacement parts from this page.

Figure 15 - ACTUATOR PARTS, VC-230 (Direct-Acting)

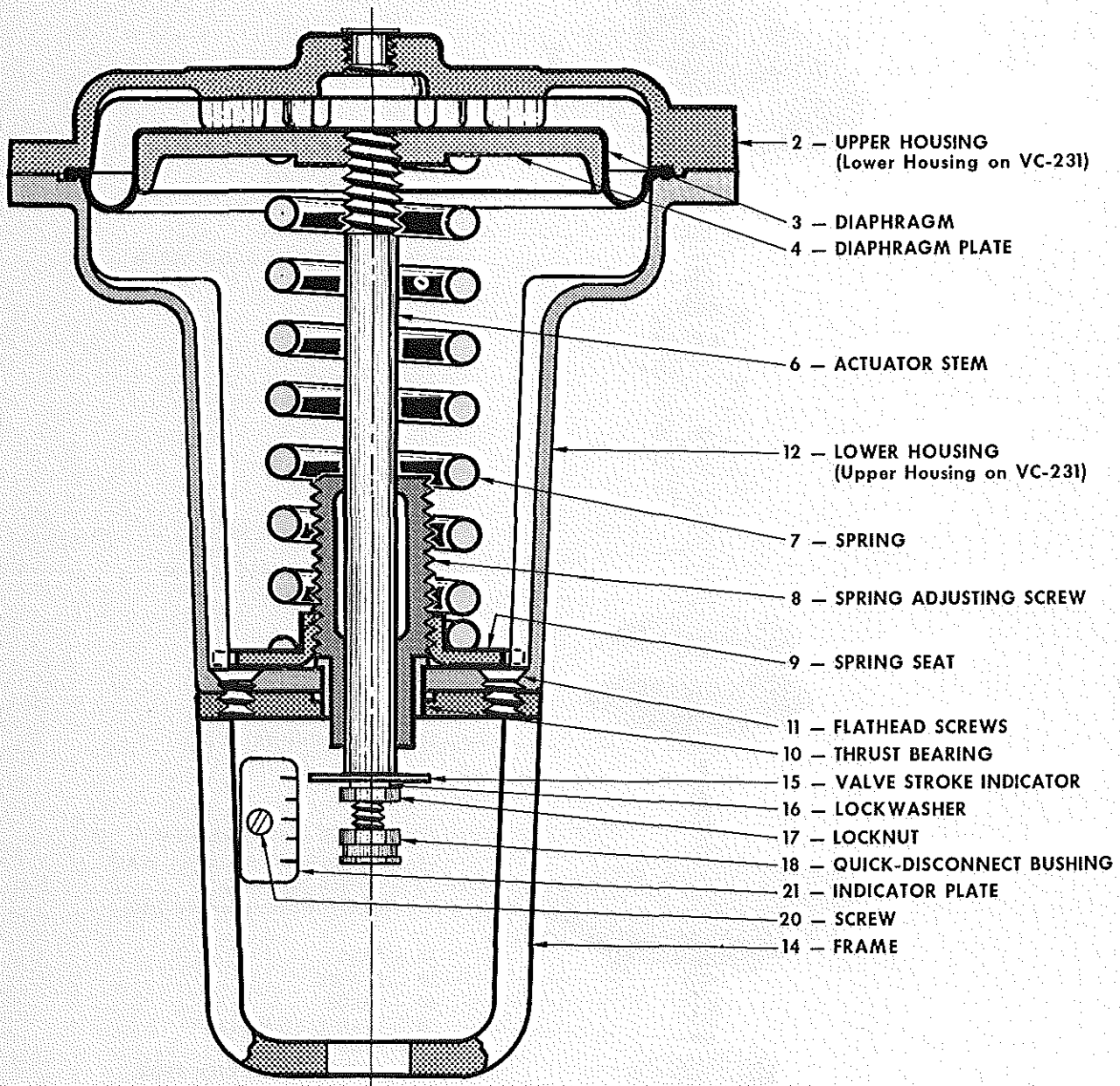
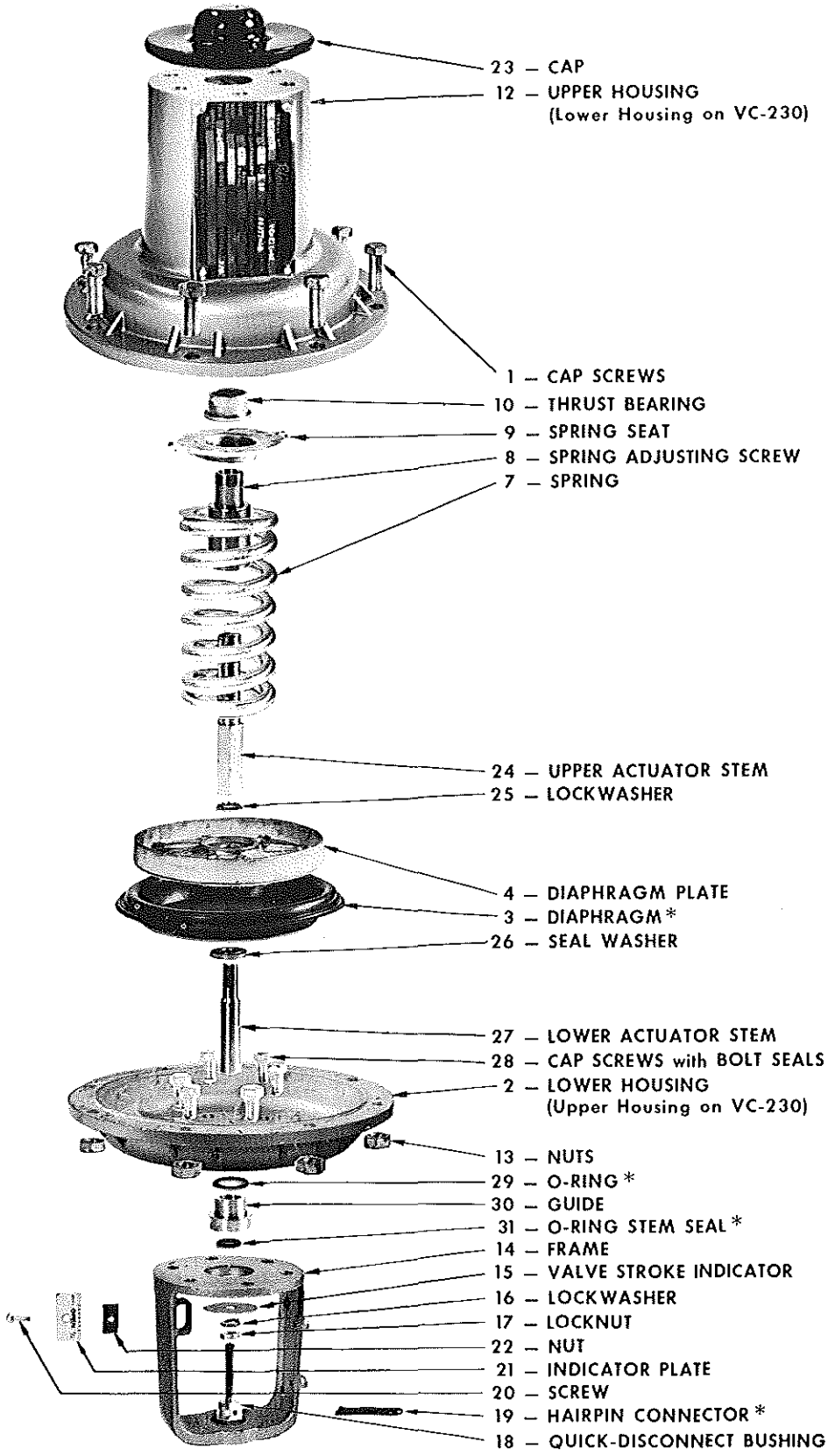


Figure 16 - ACTUATOR ASSEMBLY, VC-230 (Direct-Acting)



* Indicates recommended spare parts.

** Always specify part reference number, name and Figure 17 when ordering replacement parts from this page.

Figure 17 - ACTUATOR PARTS, VC-231 (Reverse-Acting)

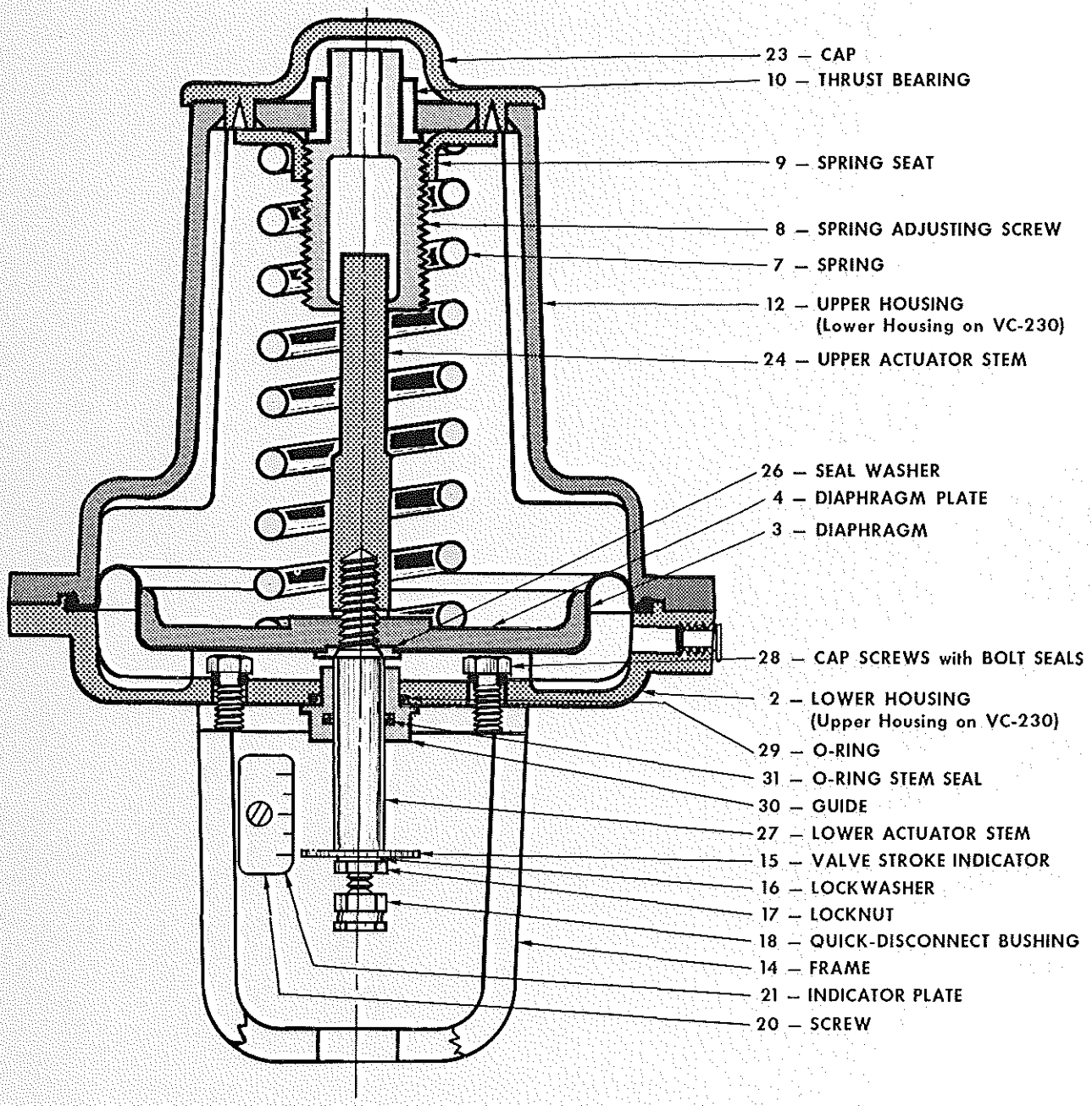
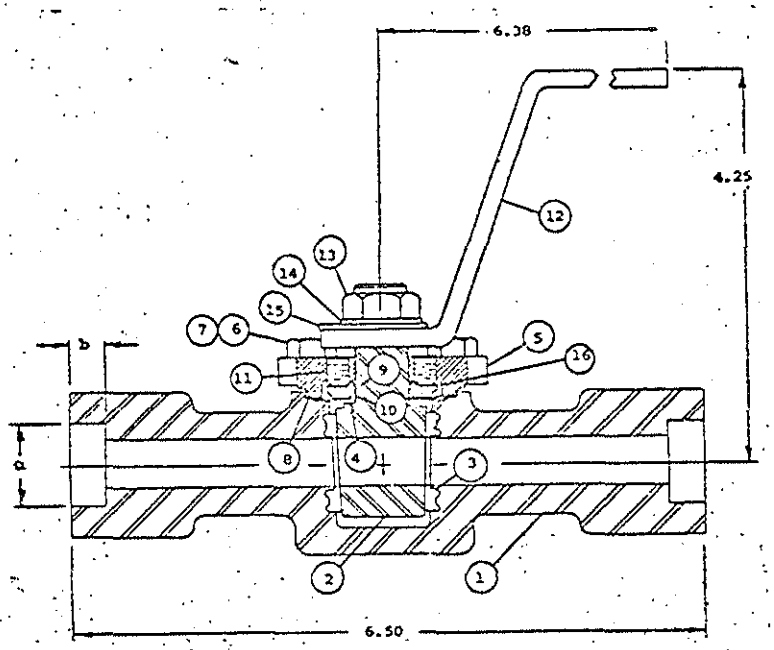


Figure 18 - ACTUATOR ASSEMBLY, VC-231 (Reverse-Acting)

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	b	D
1/2"	.38	.86
3/4"	.50	1.07

VENDOR NO: 1/2" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP. ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FIMED Q.A. REQUIREMENTS ON VENDOR. ①

LIMERICK GENERATING STATION UNITS 1 & 2 PHILADELPHIA ELECTRIC CO.

APPROVED Rev 2 NOV 3 1975 QUALITY CONTROL

APPROVED REV. 1 OCT 12 1976 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10998	6-26 78	SEE SH. 2	
4	10644C	1-27 78	SEE SHEETS 2,3,4	LM PE
3	10629	1-13 78	SEE SHEET #2	LM PE
2	10128	11-10- 76	See Shts 3 & 4	
1	10102	10-27 76	SEE SHEETS 3 & 4	
1	"	"	①ADDED "SEE 11908 456..." NOTE	

TITLE
VALVE, PLUG
1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

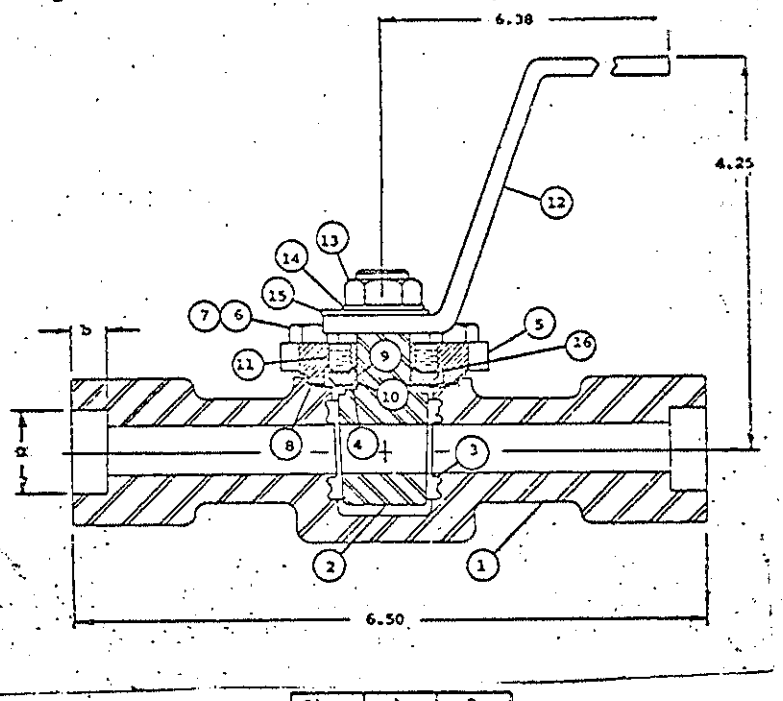
REL. NO. PC 1503 | 9/ 3/76 ASSY. OR LO.
DR. BY P. ESTRADA | 8/30/76
CHK'D. BY L.W. Cox
MAT'L PUR
APPV. CAST. MACH. WELD. ENGR.

FOR VENDORS LITERATURE SEE TAB 2

SHEET SIZE A | DWG. NO. 11 908 180 | SHEET 1 OF 4

COLT FM JUN 14 1978 QA APP Rev. 5
COLT FM JAN 2 1978 QA APP Rev. 4
COLT FM JAN 6 1978 QA APP

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Size	b	D
1/2"	.38	.84
3/4"	.50	1.07

VENDOR NO: 3/4" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF
XOMOX CORP.
ELK GROVE, IL 60007

LIMERICK, GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED
REV. 2
JAN 25 1977
QUALITY CONTROL

APPROVED
Rev. 1
QUALITY CONTROL

APPROVED
Rev. 3
1977
QUALITY CONTROL

COLT FM Rev. 5 JUN 14 1978 QA APP

(1) See 11908456 for Colt/FMED Q.A. Requirements on Vendor.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10978	6-20-78	SEE SH 2	R.H.
4	10629	1-13-78	SEE SHEET 2	LM
3	10556	11-14-77	SEE SHEET 2	PE EDJ
2	10128A	1/28/77	See sheet 3	RAN
1	10128	11-10-76	See Shts 3 & 4	R.H.
1	"	11-10-76	-Added "See 11908456 ...."Note (1)	R.H.

TITLE
VALVE, PLUG
3/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	PC 1503	9/3/76	ASSY. OR I.C.
DR. BY	P. ESTRADA	8/30/76	
CHK'D. BY	L.W. Cooper		
MAT'L	PURC.		
APPV.	CAST.		
	MACH.		
	WELD.		
	ENGR.		

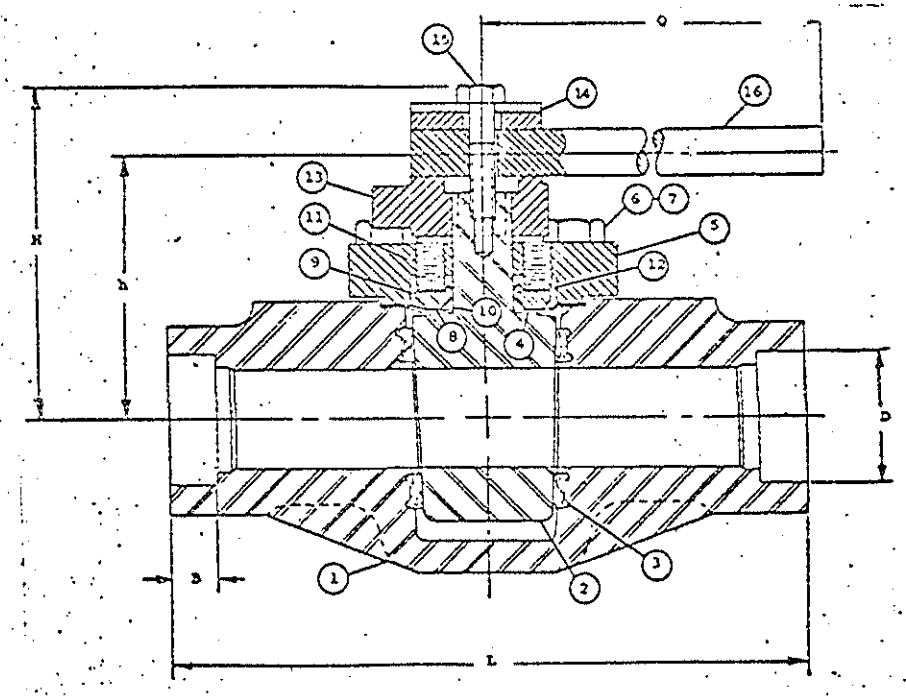
FOR VENDORS LITERATURE
SEE TAB 2

SHEET SIZE	DWG. NO.	SHEET
A	11 908 181	1 OF 4

COLT FM Rev. 4 JAN 16 1978 QA APP

BF3009-2

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	L	D	B	h	H	Q
1"	6.50	1.33	.50	3.81	2.83	7.38
1½"	7.50	1.92	.50	4.56	3.63	11.25
2"	8.50	2.41	.63	5.13	4.00	17.00

VENDOR NO: 1-1/2" FIG. 0366SW

VENDOR: TUFLINE DIVISION OF XOMOX CORP. ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR. ①

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

APPROVED Rev 2 PWR
APPROVED REV. 1 OCT 29 1976 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	10128	11-10-76	See Shts 3 & 4	R.H.
1	10102	10-29-76	SEE SHEETS 3 & 4	R.H.
1	"	"	①ADDED "SEE 11908456..." "NOTE	

TITLE
VALVE, PLUG
1-1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

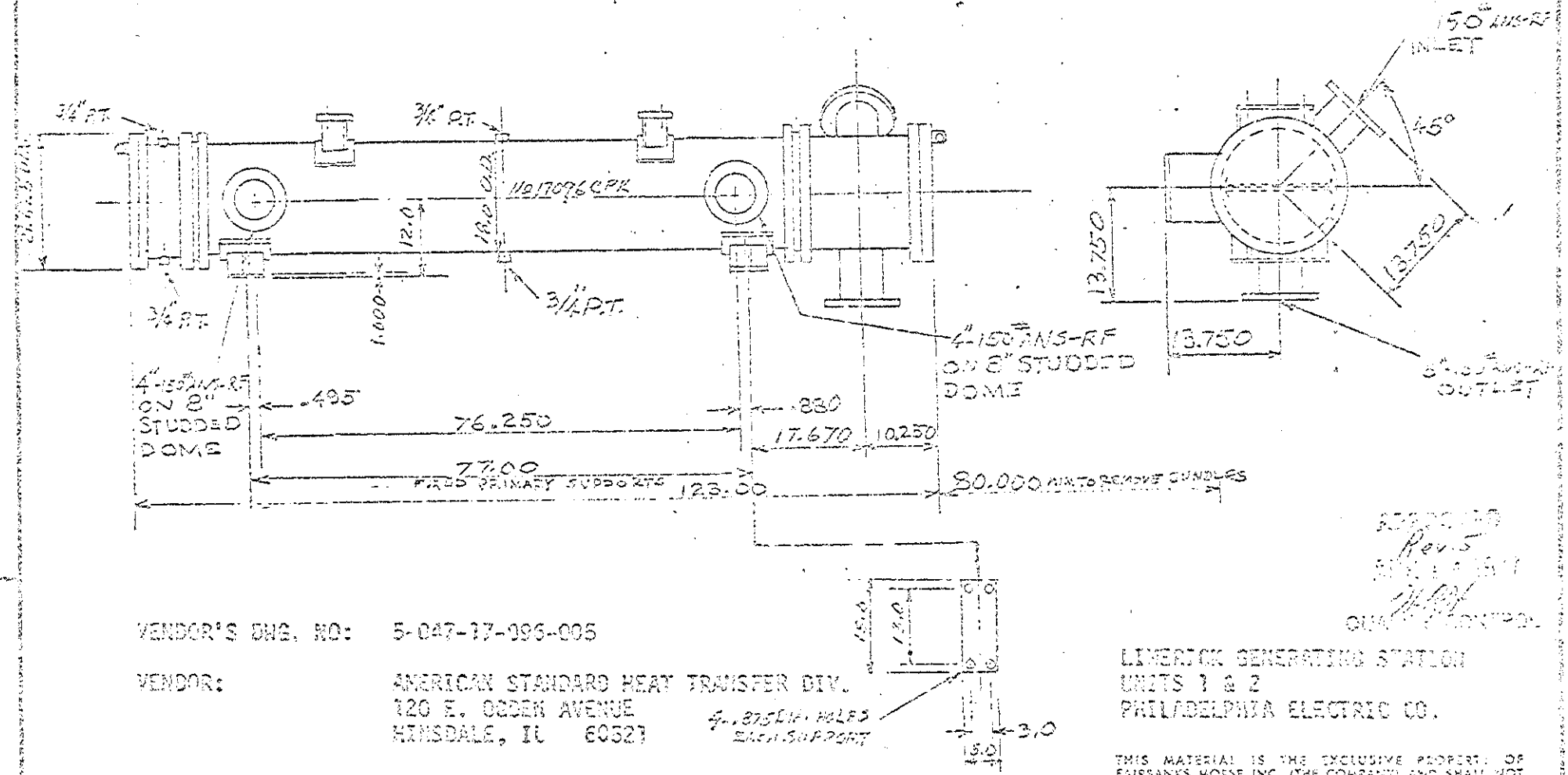
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC1503 9/3 /76 ASSY. OF
DR. BY P. ESTRADA 8/30 /76
CHK'D. BY L.W. Cooper
MAT'L PURC
APPV. CAST. MACH. WELD. ENGR.

FOR VENDORS LITERATURE SEE TAB 2

SHEET SIZE A | DWG. NO. 11 908 183 | SHEET 1 OF 4

DF2009-2



VENDOR'S DWG. NO: 5-047-17-096-005

VENDOR: AMERICAN STANDARD HEAT TRANSFER DIV.
320 E. OGDEN AVENUE
HINSDALE, IL 60521

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	10283	4-21-77	Redrawn	PHL PG

TITLE
HEAT EXCHANGER
INTERCOOLER WATER
ASME SECT. III, CL. 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY R. NORMAN	4/13/77	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 187 | SHEET 1 OF 1

TYPE CPS, CP & CPK EXCHANGERS

INSTALLATION

1. Provide sufficient clearance at the channel or bonnet end of unit to permit removal of tube bundles from shells. On the floating head end, a space of 3 or 4 feet should be provided to permit the removal of the floating head.
2. Provide valves and by-passes in the piping system so that both the shells and tube bundles may be by-passed to permit cutting out the unit for inspection or repairs.
3. Provide convenient means for frequent cleaning of the unit as suggested under "Maintenance."
4. Provide thermometer wells and pressure gage connections in all piping to and from the unit, as near the unit as possible.
5. Provide necessary air vent cocks so that the unit can be purged to prevent or relieve vapor or gas binding of either the tube bundles or the shell.
6. Foundations must be adequate so that exchangers will not settle and cause piping strains. Foundation bolts should be set to allow for setting inaccuracies. In concrete footings, pipe sleeves at least one size larger than bolt diameter slipped over the bolt and cast in place are best for this purpose, as they allow the bolt center to be adjusted after the foundation has set.
7. Loosen foundation bolts at one end of unit to allow free expansion of shells. Oval holes in foundation brackets are provided for this purpose.
8. Set exchangers level and square so that pipe connections may be made without forcing.
9. Inspect all openings in exchanger for foreign material. Remove all wooden plugs and shipping pads just before installing. Do not expose units to the elements with pads or other covers removed from nozzles or other openings since rain water may enter the unit and cause severe damage due to freezing.
10. Be sure entire system is clean before starting operation to prevent plugging of tubes with sand or refuse. The use of strainers or settling tanks in pipe lines leading to the unit is recommended.
11. Drain connections should not be piped to a common closed manifold.
12. To guard against pulsation of fluids caused by reciprocating pumps, compressors or other equipment a surge drum should be installed.

OPERATION

A heat exchanger is a pressure vessel designed for operation at certain specific limits of pressure and temperature, and the system must be safeguarded with safety valves and controls so that these design conditions are not exceeded and that all operating personnel are alerted.

1. When placing a unit in operation, open the vent connections and start to circulate the cold medium only. Be sure that the passages in the exchanger are entirely filled with the cold fluid before closing the vents. The hot medium should then be introduced gradually until all passages are filled with liquid. Then, close vents and slowly bring the unit up to temperature.
2. Start operation gradually. Do not admit hot fluid to the unit suddenly when it is empty or cold. Do not shock unit with cold fluid when it is hot.
3. In shutting down, flow of hot medium should be shut off first. If it is necessary to stop circulation of cooling medium, the circulation of hot medium should also be stopped by by-passing or otherwise.
4. Do not operate equipment under conditions in excess of those specified on nameplate.
5. In all installations, there should be no pulsation of fluids since this causes vibration and strain with resulting leaks.
6. All gasketed joints should be rechecked for tightness after the unit has been heated to prevent leaks and blowing out gaskets.
7. The packed end joints on Lube Oil Coolers may require adjustment from time to time to eliminate slight leakage. This joint contains Neoprene packing rings which require only a small amount of bolting pressure to seal tight.

Many heat exchangers handle fluids which are irritating or dangerous to the human system and could cause problems if bolted and packed joints are not maintained in a leak tight condition both at operating pressures and temperatures, and also at no flow, ambient conditions.

If fluids are not irritating or dangerous a leak will at least cause a slippery situation on the floor below.

Since one fluid in the heat exchanger is at higher temperatures, any leaks might cause burns.

If leakage should appear at the packed end joint after the cooler is placed in operation, the bolting should be pulled up only enough to stop it. This can be accomplished by taking a one-half turn on each successive bolt starting at one point and continuing around the cooler until all leakage has been eliminated. Do not tighten this joint any more than is required to stop the initial leakage.

When the packing has been repeatedly tightened to the point where there is almost a metal-to-metal contact between the bonnet (or channel) and shell flanges, the two packing rings should be replaced. To accomplish this, proceed as follows:

(A) Remove the bonnet (or channel), lantern ring, and all packing rings from the cooler.
(B) Clean the packing ring recess in both the bonnet (or channel) and shell flanges and the latern ring, if necessary.
(C) Place one of the new packing rings over the floating tube sheet and slide it, into the recess in the shell flange. Be sure the packing ring is not twisted and fits squarely into this recess.
(D) Place the lantern ring over the floating tube sheet and slide it against the first packing ring.
(E) Place the second new packing ring over the floating tube sheet and slide it against the lantern ring, making sure the packing ring is not twisted.
(F) With the studbolts pulled up only finger tight, the bonnet (or channel) should be positioned so that the second packing ring is secure in the recess of the bonnet (or channel) flange.
(G) Each bolt should now be pulled up only one or two turns.
(H) When the cooler is either hydrostatically tested or placed in operation, any final adjustment should be made as previously described.

8. Be sure that all parts of the system are clean and in proper operating condition. An exchanger cannot perform properly unless all connected equipment is functioning properly, yet, the exchanger is frequently blamed for non-performance when the actual trouble is elsewhere in the system.

Observe the following precautions to obtain maximum performance:

(A) Exchanger must be full of fluid in both shell and tube sides.
(B) Provide periodic venting if air tends to accumulate in system.
(C) Maintain rated flow of both mediums.
(D) Avoid excessive flow of cooling water in exchangers used as coolers. It is a frequent cause of tube failure through erosion, and may decrease cooling efficiency, especially with heavy oils.
(E) Inspect exchanger periodically and clean thoroughly when necessary, especially inside of the tubes.

MAINTENANCE

1. Provide convenient means for frequent cleaning of heat exchangers as suggested below:

(A) Circulating hot wash oil or light distillate through tubes or shell at good velocity will effectually remove sludge or other similar soft deposits.
(B) Soft salt deposits may be washed out by circulating hot fresh water.
(C) Some cleaning compounds on the market, such as "Oakite" may be used to advantage for removing sludge or coke, provided hot wash oil or water, as described above, does not give satisfactory results.
(D) If none of the above described methods are effective for the removal of hard scale or coke a mechanical means may be used.

When the heat exchanger is cleaned, it is important that full characteristics of the fouling material and the cleaning agent be known and care exercised in handling them according to instructions.

2. Frequently and at regular intervals, observe interior and exterior condition of all tubes and keep them clean. Neglect in keeping all tubes clean may result in complete stoppage of flow through some tubes, with consequent overheating of these tubes as compared to surrounding tubes, resulting in severe expansion strains and leaking tube joints.

When shutting down for repairs it is imperative that all fluids be drained from the heat exchanger and that no bolting be loosened until the pressures are down to atmospheric and the temperatures of the parts are down to ambient.

3. Do not attempt to clean tubes by blowing steam through individual tubes. This overheats the tube and results in the same severe expansion strains and leaks as in plugged tubes.
4. Do not blow out heat exchangers with air when fluids normally handled are of an inflammable nature.
5. Do not open heads until all pressure is off equipment and the unit drained.
6. Do not handle tube bundles with hooks or other tools which might damage tubes. Bundles should be moved about on cradles or skids.
7. Do not tighten bolts until gasket is positioned properly. This precaution will eliminate one cause for taking down units because of leaks.

Since many of the removeable components or the heat exchanger, particularly in the larger sizes are too heavy for men to handle care must be used to take this weight with proper rigging to avoid injury.

When a heat exchanger is dismantled for any cause, it is recommended that new gaskets be used in reassembly. This will tend to lessen the possibility of future leaks. Because composition gaskets become brittle and dry out, they do not provide an effective seal when reused. Metal or metal jacketed gaskets when compressed initially tend to match their gasket contact surfaces. In so doing, they are work hardened to the point that their reuse provides an imperfect seal and possible damage to the gasket contact surfaces of the heat exchanger.

8. To tighten a loose tube joint, use a suitable roller type tube expander. Do not roll tubes that are not leaking as it needlessly thins the tube wall.
9. Exchangers subject to fouling or scaling should be cleaned periodically. A light sludge or scale coating on the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicates cleaning is necessary, If the unit has been checked for air or vapor binding and this has been found not to be the cause. Since the difficulty of cleaning increases rapidly as the scale thickens or deposit increases, the intervals between cleanings should not be excessive.
10. To clean or inspect inside of tubes, remove channel covers (or bonnets). Do not remove channels.

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP
BUFFALO, N.Y. 14240

TYPE CPS, CP & CPK EXCHANGERS

11. To locate leaking joints between tube and tube sheet or a split tube, proceed as follows:

Channel Type
(a) Remove channel covers.
(b) Apply hydrostatic pressure in shell.

Bonnet Type
(a) Remove bonnets.
(b) Bolt test rings in place with gaskets and packing.
(c) Apply hydrostatic pressure in shell.

Use only cold liquid for hydrostatic test. The point where the water escapes indicates the defective tube or joint.

12. When removing tube bundles from exchangers for inspection or cleaning, care should be exercised to avoid damage by improper handling. Although tube bundles are often of great weight, the tubes are small and of relatively thin metal. The dead weight of the bundle, therefore, should never be supported on individual tubes, but should rest on those parts that are designed to carry it, i.e., the tube sheets, support plates or wood blocks, cut to fit the periphery of the bundle. In withdrawing tube bundles, it is recommended that rods or steel cables be passed through two or more of the tubes and the load taken on the floating tube sheet. Rods should be threaded and provided with nuts and should pass through a bearing plate at either end of the bundle. A soft wood filler board should be inserted between bearing plates and tube sheets, in order to prevent damage to tube ends. A forged steel eye bolt which may be screwed into either plate is used for pulling and lifting.

When steel cables are used for lifting, the cable is threaded through one tube and returned through another. Loops are formed in the ends of the cable by use of thimbles and wire rope clips. A hard wood spreader block is inserted between the cable and the floating tube sheet to prevent crushing of tube end.

If the tube bundle has been in service for a considerable length of time without being removed it may be necessary to use a hydraulic jack on the floating tube sheet to get it started. A good sized steel bearing plate should be inserted between jack and tube sheet and the tube ends protected by means of a filler board.

Tube bundles may be raised horizontally by means of slings formed by bending light plates into a U-Form and attaching lifting lugs to the ends of the sheets. Baffles can be easily bent and damaged by dragging a bundle over a rough surface. Diameter of the baffles is practically the same as the inside of the shell and a close fit must be maintained for the apparatus to function properly. Any damage to baffles should, therefore, be carefully avoided.

In cleaning a tube bundle, tubes should not be hammered on with any metallic tool. In case it is necessary to use scrapers, care should be exercised to see that the scraper is not sharp enough to cut the metal of the tubes.

The following are safe loads for rods and eye bolts:

RODS

Size Tubes	Size Rods	Safe Load per Rod
5/8"	3/8"	1000 lbs.
3/4"	1/2"	2000 lbs.
1"	5/8"	3000 lbs.

EYE BOLTS

Size	Safe Load
3/4"	4000 lbs.
1"	6000 lbs.
1 1/4"	10000 lbs.
1 1/2"	15000 lbs.

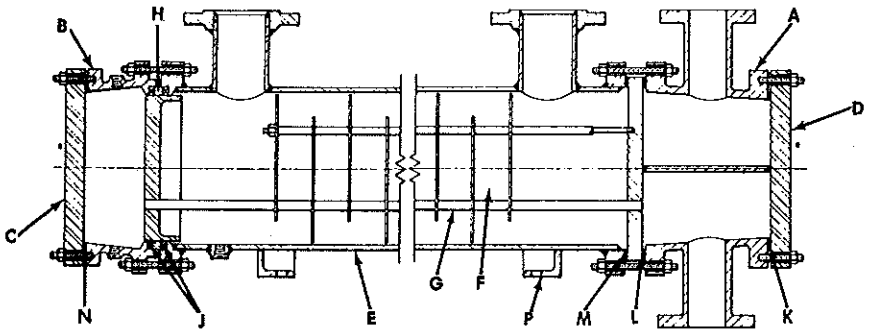
PARTS LIST

Any parts listed below and indicated alphabetically on the typical cross sectional drawings can be furnished.

When ordering parts, use part name indicated in parts list. Give cooler size and serial number as stamped on name plate of cooler. Special care in following above instructions will facilitate quick shipment.

If parts are required in materials of construction differing from those originally furnished, specify the desired changes and reason for changing.

CHANNEL TYPE



A. CHANNEL, STATIONARY END
B. CHANNEL, PACKED END.
C. CHANNEL COVER, PACKED END
D. CHANNEL COVER, STATIONARY END
E. SHELL ASSEMBLY
F. BUNDLE ASSEMBLY, Consisting of:
   1. Stationary Tube Sheet
   2. Floating Tube Sheet
   3. Tubes
   4. Baffle Plates
G. TUBE
H. LANTERN RING
J. PACKING RINGS
K. GASKET, STATIONARY CHANNEL COVER
L. GASKET, TUBE SHEET TO CHANNEL
M. GASKET, TUBE SHEET TO SHELL
N. GASKET, PACKED CHANNEL COVER
P. CRADLE ASSEMBLY

WARRANTY

WARRANTY OF SELLER'S PRODUCTS—Except where a different express written warranty has been issued with respect to a particular product, no warranty of any kind, express or implied, is extended by the Seller to any person or persons other than its direct Buyers. To direct Buyers, the Seller warrants only that it will furnish by freight a replacment for, or at its option repair any product of its manufacture or part or portion thereof, proved to its satisfaction to be defective in material or workmanship under normal use and service within one year from the date the equipment is first placed in use, or two years from the date of shipment, whichever shall be less.

The Seller shall have no responsibility for the performance of any product sold by it under conditions varying materially from those under which such product is usually tested under existing industry standards, nor for any damage to the product from abrasion, erosion, corrosion, deterioration or the like due to abnormal temperatures or the influence of foreign matter or energy, nor for the design or operation of any system of which any such product may be made a part or for the suitability of any such product for any particular application.

The Seller shall not be liable for any cost or expense, including, without limitation, labor expense, in connection with the removal or replacement of alleged defective equipment or any part or portion thereof, nor for incidental or consequential damages of any kind, nor under any circumstances for any damage beyond the price of the goods sold. Any freight allowance in connection with a replacement will be on the same terms as were applicable to the original sale, except that a replacement for a product or part or portion thereof which is proved to the Seller's satisfaction to be defective in material or workmanship as provided herein above, will in any event be furnished with freight (but not local cartage) allowed, inside the continental United States (excluding Alaska and Hawaii), to the first destination.

OTHER WARRANTIES—The foregoing warranty is in lieu of all other warranties of any kind, express or implied, and of all other obligations or liabilities, on the part of the Seller. The Seller neither assumes, nor does it authorize any other person to assume on its behalf, any other liability in connection with the sale of its products.

GOODS OF OTHER MANUFACTURERS—Goods of other manufacturers sold by the Seller are not warranted except by express warranties which may be issued in writing from time to time with respect to a particular product or a particular sale; but the Seller will endeavor to secure for its direct Buyers the benefits of warranties extended by the manufacturers of such goods sold but not manufactured by the Seller.

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(a Delaware corporation)
Prices and Other Data Subject
to Change Without Notice

RP _____

RECOMMENDED SPARE PARTS LIST

EXCHANGER P/N 5-047-17-096-005
(4-750-17-096-001)
S/N 9-20008-02

COLT 11908187
INTERCOOLER WATER COOLER

NUMBER REQUIRED/ EXCHANGER	DESCRIPTION	PART NUMBER
2	Gaskets	3-298-8-00-901-17
2	Gaskets	3-299-8-00-901-17
2	Packing Rings	3-359-8-00-905-17

P/N 5-047-17-096-005
(4-750-15-096-004)
S/N 9-20008-03
Colt 11908186
Jacket Water Cooler

2	Gaskets	3-298-8-00-901-15
2	Gaskets	3-299-8-00-901-15
2	Packing Rings	3-359-8-00-905-15

P/N 5-046-15-096-021
S/N 9-20008-04
Colt 11908185
Lube Oil Cooler

4	Gaskets	3-299-8-00-901-15
2	Packing Rings	3-359-8-00-905-15

Item No.	Matl. Stat.	From Dept	Quan. Reqd.	Total Quan.	Description	Matl & Spec.	Sizes/Pattern No.	Part Number	Dwg. Size
24									
23									
22					FOR ELEVATION DWG SEE			5-047-17-096-005	C
21									
20									
19									
18									
17		CERT	16		HEX NUT DOME	STEEL SA 152-2H	.625-11TPI	2-122-5-00-902-07	A
16		CERT	16		STUD DOME	ALLOY STL SA193-B7	.625-11TPI-TFL 3.000 LG	2-012-5-10-901-12	A
15		CERT	128		HEX NUT	STEEL SA194-2H	.625 D-11 TPI	2-122-5-00-902-07	A
14			16		STUDBOLT STA.	ALLOY ST SA193-B7	.625 D-11 TPI-TFL-6.25 LG	2-012-5-10-901-25	A
13			16		STUDBOLT FLO.	ALLOY STL SA193-B7	.625 D-11 TPI-TFL-5.25 LG	2-012-5-10-901-21	A
12			32		STUDBOLT COVS.	ALLOY STL SA193-B7	.625 D-11 TPI-TFL-4.75 LG	2-012-5-10-901-19	A
11		CERT	4		PIPE PLUG	STEEL SPACER	3/4 P.T. SIZE	2-135-5-96-901-05	A
10			2		GASKET	ASBESTOS		3-299-8-00-901-17	A
9			2		GASKET	ASBESTOS		3-298-8-00-901-17	A
8			2		PACKING RING	NEOPRENE		3-359-8-00-905-17	A
7			1		LANTERN RING	CAST IRON		3-338-7-00-902-17	A
6									
5		PEC	2		COVER	STEEL		4-500-17-115-005	A
4			1		CHANNEL FLO.	STEEL		4-321-17-815-008	A
3			1		CHANNEL STA.	STEEL		4-305-17-215-027	B
2			1		BUNDLE			4-109-17-096-001	B
1		PEC	1		SHELL	STEEL		4-605-17-096-002	B

REV #	REVISIONS	DATE

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MA Sello DATE 5/24/77

CHECK TJU DATE

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP BUFFALO, N.Y. 14240

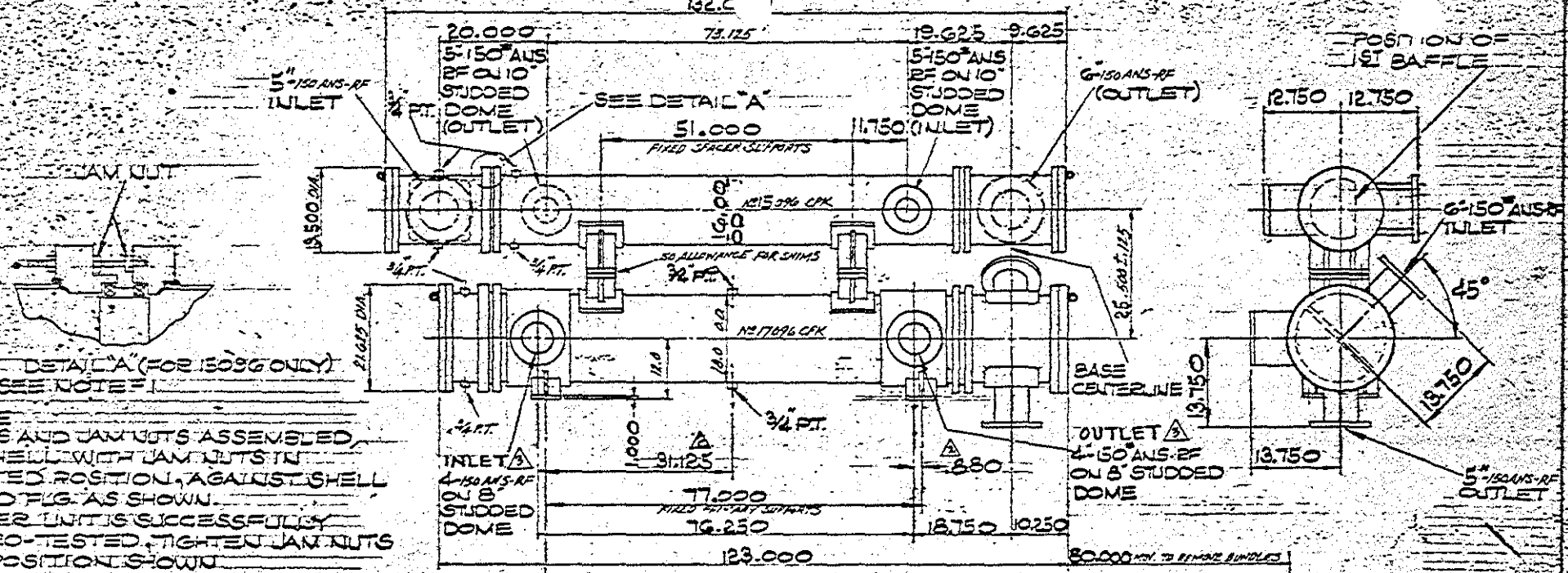
TITLE BILL OF MATERIAL CPK

SIZE	PART NUMBER	REV
A	4-750-17-096-001	7

FACTORY ORDER NO. 9-20008-02

A 01-03-01-0 TPC

11/28/77



THIS UNIT CONFORMS TO ASME SECT. III, CLASS 3 '74 SUMMER ADDENDUM 1976

PART	MATERIAL	A.S.M.E.	CORR.
SHELL PIPE	CARBON STL.	SA106-B	1/32
SHELL FLANGES	CARBON STL.	SA105-II	
COVE PIPE	CARBON STL.	SA106-B	1/32
COVE FLANGES	CARBON STL.	SA105-II	1/32
COUPLINGS	CARBON STL.	SA105	
CRADLES	CARBON STL.	SA285-C	
REINF. PAD	CARBON STL.	SA285-C	
CHANNEL PIPE	CARBON STL.	SA106-B	1/32
CHANNEL FLANGES	CARBON STL.	SA105-II	
NOZZLE PIPE	CARBON STL.	SA106-B	1/32
NOZZLE FLANGES	CARBON STL.	SA105-II	
COUPLINGS	CARBON STL.	SA105	
REINF. PAD	CARBON STL.	SA285-C	
COVE "A" PLATE	CARBON STL.	SA515-70	1/32
CHANNEL COVERS	CARBON STL.	SA285-C	
TUBESHEET	MONEL	SB127 SA265	
BAFFLE PLATE	STEEL		
TUBES	90/10 CU-NI	SB111	
BOLTS	ALLOY STL.	SA193-B7	
NUTS	STL.	SA194-2H	
GASKETS	ASB		
PACKING	NEOPRENE		
PIPE PLUGS	CARBON STL.	SA105	

	DESIGN PRESSURE	TEST PRESSURE	DESIGN TEMP.
SHELL	150 P.S.I.	225 P.S.I.	300 °F.
TUBE SIDE	150 P.S.I.	225 P.S.I.	500 °F.

4		16	HEX NUT	STL.	.750-10TPI	2-122-5-00-902-06	A
3		8	STUDBOLT 4.00 LG	ALLOY STL.	.750-10TPI-TFL	12-012-5-12-901-16	A
2		1	15096 CFK EXCH. ASSY.			4750-5-096-004	A
1		1	17096 CFK EXCH. ASSY.			4750-5-096-001	A
REV #			DESCRIPTION			PART NUMBER	REV

2 REVERSED INLET & OUTLET 3-13-78

TOLERANCE UNLESS OTHERWISE SPECIFIED: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1°

HEAT TRANSFER DIVISION
AMERICAN-STANDARD
POWER & CONTROLS GROUP BUFFALO, NY 14240

TITLE: STRUCTURAL ASSEMBLY OF 15096 AND №17096 CFK EXCHANGERS

SIZE C | PART NUMBER 5-047-17096-005 | REV 3

DRAWN | CHECKED | DATE

FACTORY ORDER NO. 9-20008-01

11/08/1977

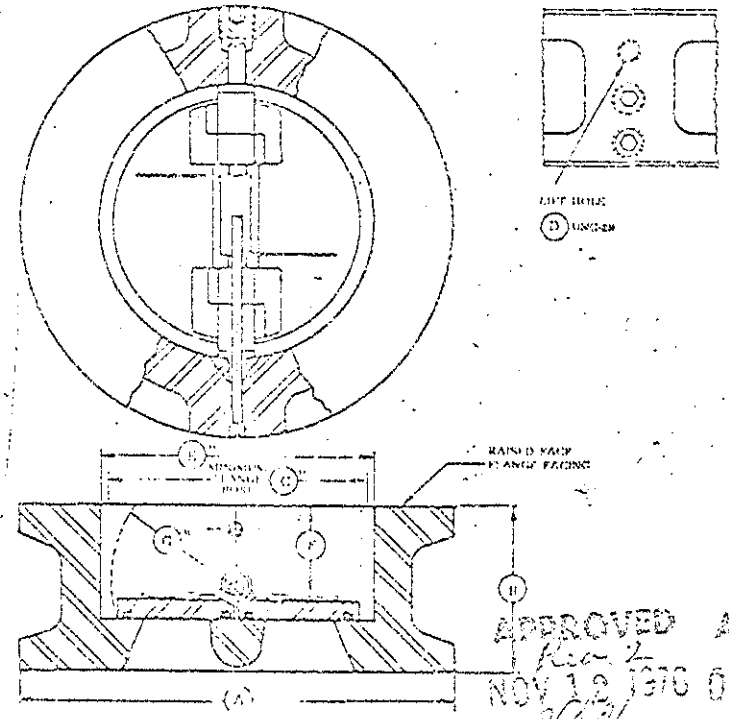
VENDOR PART NO:

VENDOR: MISSION MFG. CO.
HOUSTON, TEXAS

REPR: WALTER B. ROM & SON, INC.
1060 N. 115TH ST.
WAUWATOSA, WI

(1) SEE 11908456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.



APPROVED Rev 2 NOV 12 1976 APPROVED Rev 3 OCT 12 1976
QUALITY CONTROL/QUALITY CONTROL

SIZE	SERIES	TYPE FACING	(A) D	(B)	(C) D	(D)	(E) D	(F)	(G) R
4"	150	RF	6 7/8	2 7/8	3 53/64	NONE	4 1/2	1 3/16	2 1/8

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D.
2	10123	11-10-76	See Shts 2, 3, & 4	
1	10097	10-29-76	Added "See 11908456.." Note	
1	A	"	See Sheet 1 & 4	

TITLE
VALVE, CHECK
4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1503	9/3/76	ASSY. OR LO.
DR. BY P. ESTRADA	8/30/76	SCALE
CHK'D. BY L.W. Cooper	9/2/76	HEAT TR.
MAT'L PURCHASE		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 191 | SHEET 1 OF 4

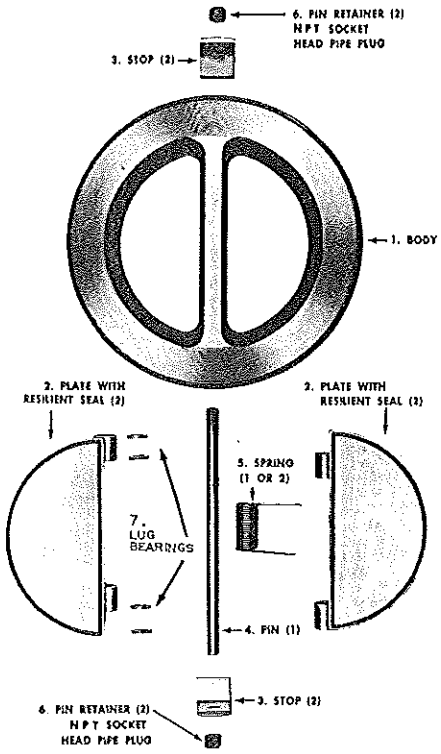
MISSION*
VALVE AND PUMP CO.
A DIVISION OF MISSION MANUFACTURING COMPANY
P. O. BOX 4209 • HOUSTON, TEXAS 77014
(713) 462-3461
Shipping Address — 8760 Clay Road
Cable Address — "Missoman"

EXPORT OFFICE
30 Rockefeller Plaza — New York 10020
Cable Address — "Missoman"

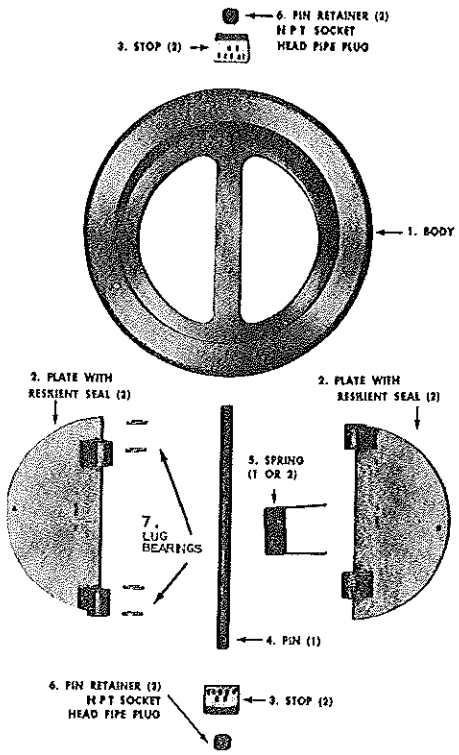
MISSION MANUFACTURING CO., LTD.
Berkeley Square House, Berkeley Square, London, W1, England
Cable Address — "Missoman"

Printed in U.S.A.

*AN OPERATING UNIT OF TRW INC.



Upstream Side



Downstream Side

Duo-Chek Check Valve Assembly

1. Clean all parts with a suitable solvent.
2. Position the Plates (2) within the Body (1), aligning the lugs with the pin retainer holes.
3. Install the Stops (3), one at each end of the Plates, between the plate and the body.
4. Align these parts by temporarily installing the Pin (4).
5. Withdraw the Pin (4) part way, far enough to permit installation of the Spring (5), and lug bearings (7).
6. Wind up the Spring one-half turn to obtain initial torsion. Install the spring with spring arms flat on the plates. These spring arms will extend from underneath the Pin (4).
7. Push the Pin (4) through, holding the spring in position so that the pin passes through the coils. Thread lug bearings (7) on pin at the same time.
8. Install Pin Retainer (6). The pin retainers are assembled at our plant and wrapped with Teflon tape to facilitate removal in the field and to insure a positive thread seal. Some similar tape or thread compound should be used during re-assembly.

Duo-Chek Check Valve Disassembly

1. Remove the two Pin Retainers (6).
2. Depress the Spring (5) to free the Pin (4).
3. Push the Pin (4) out of the Body (1) while holding the spring firmly, since it is preloaded and may snap out of the valve as the pin is withdrawn.
4. Remove the Spring (5), Stops (3), Plates (2) and lug bearings (7).

RECOMMENDED SPARE PARTS

1 yr. Service: 1 pin, 1 spring, 4 lug bearings.
2 yr. Service: 1 complete set spare parts.

NOTE: Specify Valve Size, Figure Number, Model Number, Quantity and Part Name of Parts desired when placing Spare Parts Orders.

MISSION*
VALVE AND PUMP CO.
A DIVISION OF MISSION MANUFACTURING COMPANY

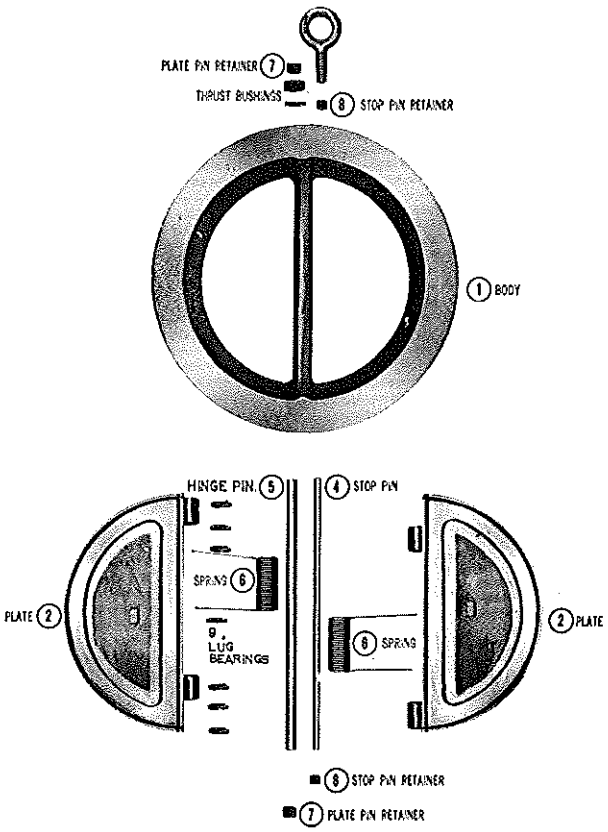
P. O. BOX 4209 • HOUSTON, TEXAS 77014
(713) 462-3461
Shipping Address — 8760 Clay Road
Cable Address — "Missoman"

EXPORT OFFICE
30 Rockefeller Plaza — New York 10020
Cable Address — "Missoman"

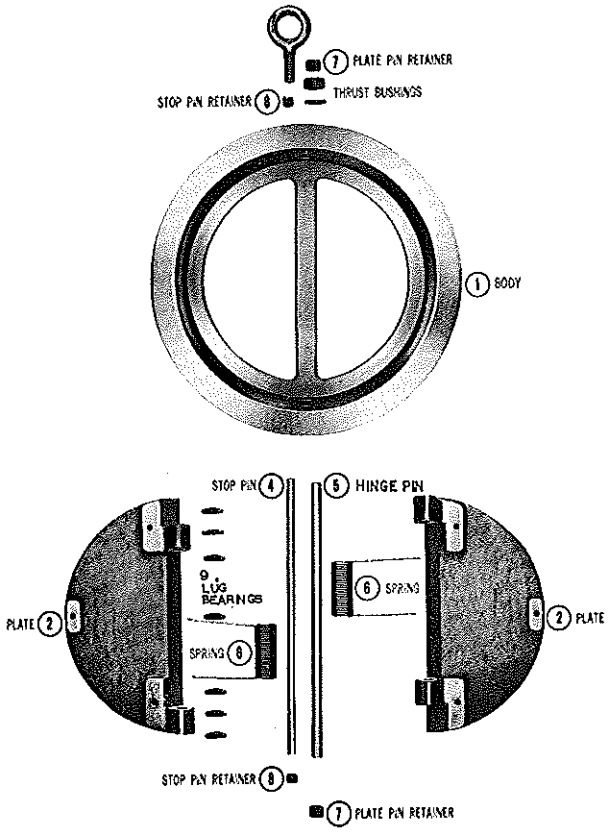
MISSION MANUFACTURING CO., LTD.
Berkeley Square House, Berkeley Square, London, W1, England
Cable Address — "Missoman"

Printed in U.S.A.

*AN OPERATING UNIT OF TRW INC.



Upstream Side



Downstream Side

Duo-Chek Check Valve Assembly

1. Clean all parts with a suitable solvent.
2. Position the Plates (2) within the Body (1), aligning the lugs with the pin retainer holes.
3. Align these parts by temporarily installing the Hinge Pin (5).
4. Withdraw the Hinge Pin (5) part way, far enough to permit installation of the Spring (6), and lug bearings (9).
5. Wind up the spring one-half turn to obtain initial torsion. Install the spring with spring arms flat on the plates. These spring arms will extend from underneath the Hinge Pin (5).
6. Push the Hinge Pin (5) through, holding the spring in position so that the pin passes through the coils. Thread lug bearings (9) on pin at same time.
7. Install Hinge Pin Retainer (7). The pin retainers are assembled at our plant and wrapped with Teflon tape to facilitate removal in the field and to insure a positive thread seal. Some similar tape or thread compound should be used during re-assembly.
8. Install Stop Pin (4) and Pin Retainer (8).

Duo-Chek Check Valve Disassembly

1. Remove Stop Pin Retainers (8) and Stop Pin (4).
2. Remove the two Hinge Pin Retainers (7).
3. Depress the Spring (6) to free the Hinge Pin (5).
4. Push the Hinge Pin (5) out of the Body (1) while holding the spring firmly, since it is preloaded and may snap out of the valve as the pin is withdrawn.
5. Remove the Spring (6), Plates (2), and lug bearings (9).

NOTE: Specify Valve Size, Figure Number, Model Number, Quantity and Part Name of Parts desired when placing Spare Parts Orders.

RECOMMENDED SPARE PARTS

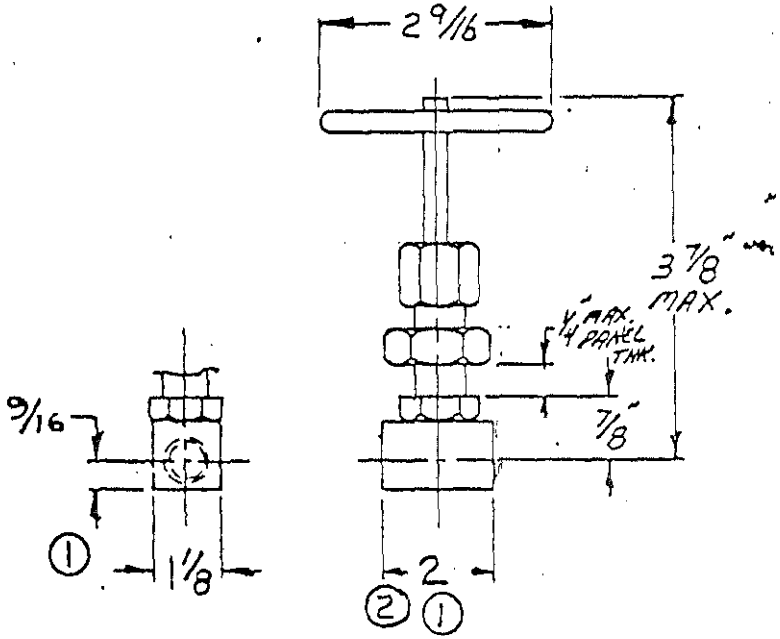
1 yr. Service: 1 pin, 1 spring, set of lug bearings.
2 yr. Service: 1 complete set spare parts.

11 908 650

DESCRIPTION: INSTRUMENT SHUT-OFF VALVE

VENDOR NO: 6701053D (3)

VENDOR: DRAGON VALVES, INC.
13457 EXCELSIOR DR.
NORWALK, CAL. 90650



APPROVED Rev.3 AUG 18 1977 QUALITY CONTROL

APPROVED Rev.2 APR 21 1977 QUALITY CONTROL

APPROVED Rev.1 APR 6 1977 QUALITY CONTROL

APPROVED Rev.0 MAR 10 1977 QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS (5)	WLS JMSP
3	10457	8-30 77	SEE SH. 2 (4)	APS
2	10289	4-27 77	ADDED SEAT TYPE D (3)	RH KO
1	"	"	REVISED DIM WAS 1/8 (2)	RH KO
—	10276	4-15 77	DIM'S ADDED (1)	RH PS

TITLE: VALVE, INSTRUMENT - 1/4" ASME SECT. III, CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236 | 3/16/77 | ASSY. OR LO.
DR. BY HERTENSTEIN | 2/23/77 | SCALE
CHK'D. BY R. NORMAN | 3/1/77 | HEAT TR.
MAT'L

APPV. CAST. MATL.
MACH. ENGR. R.D. YAI
WELD.

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 1 OF 4

BF3008-2

I. GENERAL REQUIREMENTS:

A. CONNECTIONS: 1/4" NPT (F)
B. ORIFICE: .180" FULL OPEN (4)
C. MEDIA:

1. FUEL OIL (#2 DIESEL) AT 50 PSIG MEAN W/PULSATIONS TO 200 PSIG & 150°F.
2. COMPRESSED AIR @ 250 PSIG & 130°F.
3. LUBE OIL SERVICE @ 100 PSIG & 200°F.
4. WATER SERVICE @ 50 PSIG & 180°F.

D. FUNCTION: SHUT-OFF.

II. ASME SECTION III REQUIREMENTS:

A. "THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".

B. ASME COMPONENTS QUALITY ASSURANCE REQUIREMENTS DWG. 11 908 456 APPLIES TO THIS ORDER.

C. THE PRESSURE RETAINING AREA DESIGN SHALL CONFORM TO ND-3511.

APPROVED Rev. 3 JUL 31 1978 QUALITY CONTROL
APPROVED Rev. 2 APR 21 1977 QUALITY CONTROL
APPROVED Rev. 1 QUALITY CONTROL
APPROVED Rev. 0 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
4	11014	8-7-78	See Sht. 1	NLS
3	10437	8-30-77	ORIFICE WAS (4) .214	
2	10289	4-27-77	SEE SH. 1	
1	10276	4-15-77	SEE SH. 1	

TITLE: VALVE, INSTRUMENT - 1/4" ASME SECT. III CL 3

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES 0.0 ± .060 0.00 ± .030 0.000 ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	10236	3/16/77	ASSY. OR LO.
DR. BY	R. NORMAN	3/2/77	SCALE
CHK'D. BY	H. R. S.	5/2/77	HEAT TR.
MAT'L			

APPV. CAST. MAT'L. MACH. ENGR. R.D.M. WELD.

SHEET SIZE A DWG. NO. 11 908 650 SHEET 2 OF 4

FM JUL 31 1978 APP

BF3009 2

II. ASME SECTION III REQUIREMENTS - CONT'D

D. STANDARD PRESSURE CLASS: ANSI 900 LB

E. DESIGN TEMPERATURE: 200°F MAX.

F. DESIGN ALLOWABLE STRESS VALUES: PER ND-3112.4 AND ND-3511. ATTACHED PIPE IS 1/4 SCHED. 80 OR 3/8 TUBE.

G. BOUNDRIES: PER NA-3254.1

H. MATERIALS:

1. MATERIALS SHALL BE NEW, SUITABLE FORTHE APPLICATION AND IN ACCORDANCE WITH ND-2120. BONNET, PACKING GLAND AND PACKING NUT SHALL BE SA-479 TYPE 316 STAINLESS STEEL. STEM AND DISC SHALL BE SA-564 GRADE 630 HIGH ALLOY P.H. STEEL. BODY SHALL BE SA-182 GRADE F-316.
2. IMPACT TESTING NOT REQUIRED.
3. MATERIALS SHALL BE CERTIFIED PER ND-2130 OF ASME SECTION III. CERTIFIED MATERIALS TEST REPORTS AND/OR MATERIAL MFGS. CERTIFICATES OF COMPLIANCE (AS APPLICABLE) SHALL BE FURNISHED TO COLT INDUSTRIES PURCHASING DEPARTMENT.

APPROVED Rev.3 JUL 8 1977 RAH QUALITY CONTROL

APPROVED Rev.2 APR 21 1977 RAH QUALITY CONTROL

APPROVED Rev.1 AT [illegible] RAH QUALITY CONTROL

APPROVED Rev 0 [illegible] RAH QUALITY CONTROL

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REV.	CHANGE	DATE	DESCRIPTION	CHK'D.
4	11014	8-7 78	See Sht. 1	NLS
3	10437	8-30 77	SEE SHT 2	H.R.S.
2	10289	4-27 77	SEE SH.1	RAH
1	10276	4-15 77	SEE SH. 1	RAH HPS

TITLE
VALVE,
INSTRUMENT - 1/4"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES

Colt Industries — Fairbanks Morse Engine Division

REL NO. 10236	3/16 77	ASSY. OR LO.	
DR. BY R. NORMAN	3/2 77	SCALE	
CHK'D. BY H.R.S.	3/2 77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. R.D.M	
APPV. WELD.			

SHEET A | DWG. | SHEET

JUL 31 1978 QA AP4

II. ASME SECTION III REQUIREMENTS - CONT'D

I. VENDOR TO FURNISH COPY OF DATA REPORT NPV-1 TO COLT INDUSTRIES PURCHASING DEPARTMENT.

J. CERTIFIED DESIGN SPECIFICATIONS AUTHORIZING CLASSIFICATION AND SPECIFYING DESIGN OF THIS COMPONENT ARE COLT DWG. NOS. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM", 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM", 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM".

III. SPECIAL REQUIREMENTS:

A. EXPOSURE TO MERCURY, OR ITS COMPOUNDS, CONTAMINATION DURING MANUFACTURING IS PROHIBTED.

IV. COLT INDUSTRIES DUTIES:

A. PURCHASING, RECEIVING, INSPECTION, STORING, & DISBURSEMENT SHALL COMPLY WITH SECTION QC-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY CONTROL MANUAL.

B. PURCHASING DEPT. SHALL FORWARD THE FOLLOWING DOCUMENTS TO THE VENDOR AS PART OF THE ORDER:

1. COLT DWG. 11 871 106 "DESIGN SPECIFICATION FOR FUEL OIL SYSTEM" REV. 1 (E) (S)
2. COLT DWG. 11 871 104 "DESIGN SPECIFICATION FOR LUBE OIL SYSTEM" REV. 1
3. COLT DWG. 11 871 105 "DESIGN SPECIFICATION FOR COOLING WATER SYSTEM" REV. 1 (S)
4. COLT DWG. 11 908 456 COLT/FMED Q.A. REQUIREMENTS ON VENDOR. REV. 4 (S)

APPROVED Rev. 3 AUG 12 1977 QUALITY CONTROL

APPROVED Rev 2 APR 21 1977 QUALITY CONTROL

APPROVED Rev. 1 APR 6 1977 QUALITY CONTROL

APPROVED Rev. 0 MAR 1 1977 QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11014	8-7 78	See Sht. 1	LLS
3	10437	8-30 77	SEE SH. 2	A.R.S.
2	10289	4-27 77	SEE SH. 1	RMN
1	10276	4-15 77	SEE SH. 1	RMN

TITLE
VALVE,
INSTRUMENT - 1/4"
ASME SECT. III CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10236	3/16 77	ASSY. OR LO.
DR. BY R. NORMAN	3/2 77	SCALE
CHK'D. BY H.R.S.	3/2 77	HEAT TR.
MAT'L		

APPV.		
	CAST.	MAT'L
	MACH.	ENGR. R.O. Mc.
	WELD.	

SHEET SIZE A | DWG. NO. 11 908 650 | SHEET 4 OF 4

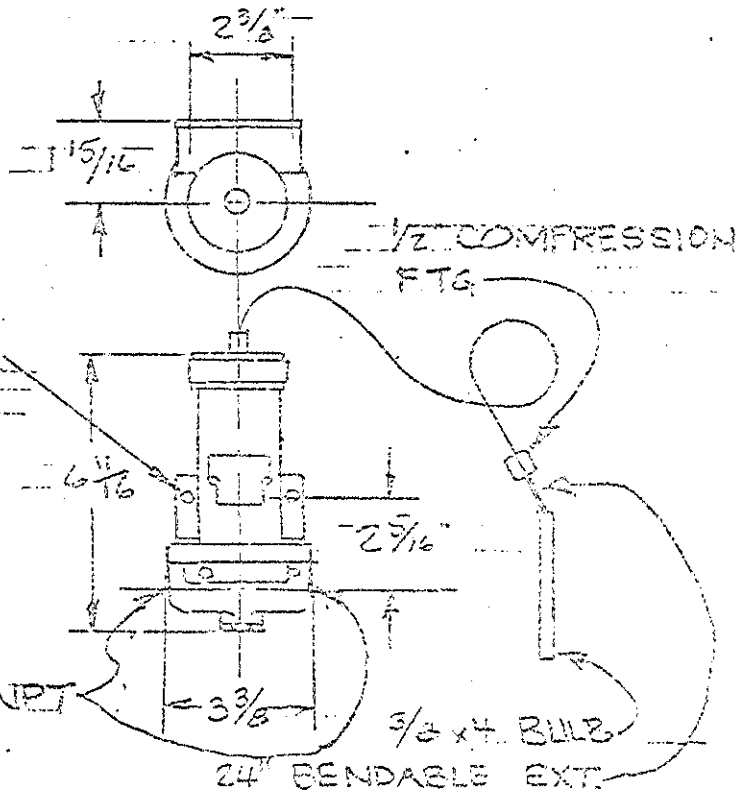
QA APP JUL 31 1978

DESCRIPTION: MOORE MODEL 33 NULLMATIC TEMPERATURE TRANSMITTER WITH THE FOLLOWING FEATURES:

1. RANGE 100° -200°F
2. OUTPUT 3-15 PSIG
3. THERMAL SYSTEM HELIUM FILLED
   (a) 3/8" x 4" NON RIGID BULB
   (b) 26 FT. OF 316 ARMORED CAPILLARY

VENDOR'S PART NO: 3305475 (E26F) TRANSMITTER WITH
12140-3 COMPRESSION FITTING (1/2 NPT THREAD)

VENDOR: MOORE PRODUCTS
477 E. WATERFILED RD.
LOMBARD, ILL



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: TRANSMITTER, TEMPERTURE 3-15 PSI 100-200°F

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10282	4/21/77	ASSY. OR LO.	
DR. BY P. LANSING	4/7/77	SCALE	
CHK'D. BY H.R.S.	4/12/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 790 | SHEET 1 OF 1

1190879O

SD33
Issue: 7
Date: 1/80

SERVICE INSTRUCTIONS

MODEL SERIES 33
NULLMATIC® TEMPERATURE TRANSMITTER

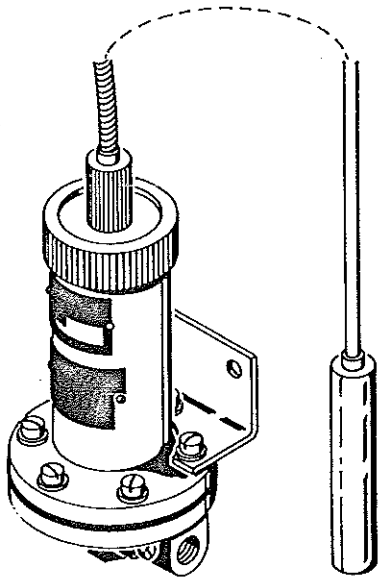


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THERMAL SYSTEM INSTALLATION	5
MAINTENANCE	9
CALIBRATION	10
TRANSMITTER AND THERMAL SYSTEM SELECTION	11
PARTS LIST	

MOORE PRODUCTS CO., Spring House, Pa. 19477

GENERAL DESCRIPTION

The Model Series 33 Nullmatic Temperature Transmitters are used to measure temperature in vessels, reactors, fractionating columns, heat exchangers, pipelines, air ducts, flues, etc., and transmit a pneumatic output proportional to the measured temperature range.

Each Model Series 33 Nullmatic Temperature Transmitter consists of two portions: a helium-filled Thermal System and a Nullmatic force-balance Transmitter. The Nullmatic force-balance Transmitter converts pressure changes in the Thermal System, caused by changes in temperature, to 3-15 psig output signals proportional to the measured temperature range.

Thermal Systems consist of a bulb, with a bendable extension (except Rigid Bulbs), a flexible armored capillary, and a bellows. Three kinds of Bulbs are available for use with a Thermal System: 3/8" O.D., 3/4" O.D. and Averaging. The 3/8" O.D. Bulbs are either Plain Bulbs or Rigid Bulbs. The 3/4" O.D. Bulbs are either Plain Bulbs, Non-Rigid Bulbs or Rigid Bulbs. The Averaging bulb has a 3/16" O.D. and is extendable. All thermal systems are made of either 316 Stainless Steel or Copper.

The Nullmatic force-balance Transmitter employs a pilot-operated null-balance principle of operation. This maintains the output pressure regardless of wide changes in flow or supply pressure.

GENERAL SPECIFICATIONS

Temperature Span..... 3/4" O.D. and Averaging Bulbs -
Minimum: 50°F (30°C);
Maximum: 1000°F (540°C)
3/8" O.D. Bulbs -
Minimum: 70°F (40°C);
Maximum: 1000°F (540°C)

Operating Temp. Limits.... 3/4" O.D. and Averaging Bulbs -
Minimum: –450°F (–270°C);
Maximum: 1400°F (760°C)
Minimum: –450°F
(–270°C); Maximum:
1000°F (540°C)

Supply Pressure..... Normal — 20 psig
Maximum — 35 psig
Minimum — 19 psig

Output Range..... 3-15 psig
3-27 psig and 0-30 psig
output ranges are available.

Connections..... 1/4" NPT for Supply and Output

Ambient Temp. Limits..... –40° to 180°F

MODEL DESIGNATION

33 C 5012 (C7C)

Basic Model Series Designation

Transmitter Model Number

Designator for Mating Transmitters and Thermal Systems

- A — Spans of 250°F to 1000°F
- C — Spans of 150°F to 800°F
- D — Spans of 100°F to 475°F
- E — Spans of 70°F to 250°F
- SE — Spans of 50°F to 70°F

Thermal System Number

THERMAL SYSTEM NUMBER	THERMAL SYSTEM MATERIAL	BULB DIAMETER	BULB TYPE	BULB OVERALL LENGTH	BULB ACTIVE LENGTH	BENDABLE EXTENSION LENGTH	ARMORED CAPILLARY LENGTH
5012	Copper	3/4"	Plain	4"	4"	20"	36"
5048	Copper	3/4"	Rigid	6"	4"	None	36"
5072	316 S.S.	3/4"	Plain	4"	4"	20"	36"
5079	316 S.S.	3/4"	Rigid	6"	4"	None	36"
5081	316 S.S.	3/4"	Plain	4"	4"	20"	36" PVC*
5098	316 S.S.	3/4"	Non-Rigid	4"	4"	20"	36"
5142	316 S.S.	3/4"	Plain	4"	4"	20"	120"
5257	316 S.S.	3/4"	Rigid	6"	4"	None	120"
5287	Copper	3/4"	Non-Rigid	4"	4"	20"	36"
5341	316 S.S.	3/16"	Extendable	14'	14'	20"	36"
5475	316 S.S.	3/8"	Plain	4"	4"	24"	36"
5476	Copper	3/8"	Plain	4"	4"	24"	36"
5477	316 S.S.	3/8"	Rigid	11-1/4"	4"	None	36"
5478	Copper	3/8"	Rigid	11-1/4"	4"	None	36"
5479	316 S.S.	3/8"	Plain	4"	4"	24"	36" PVC*
5580	316 S.S.	3/8"	Plain	4"	4"	24"	120"

*Polyvinyl Chloride Coating

Factory Code

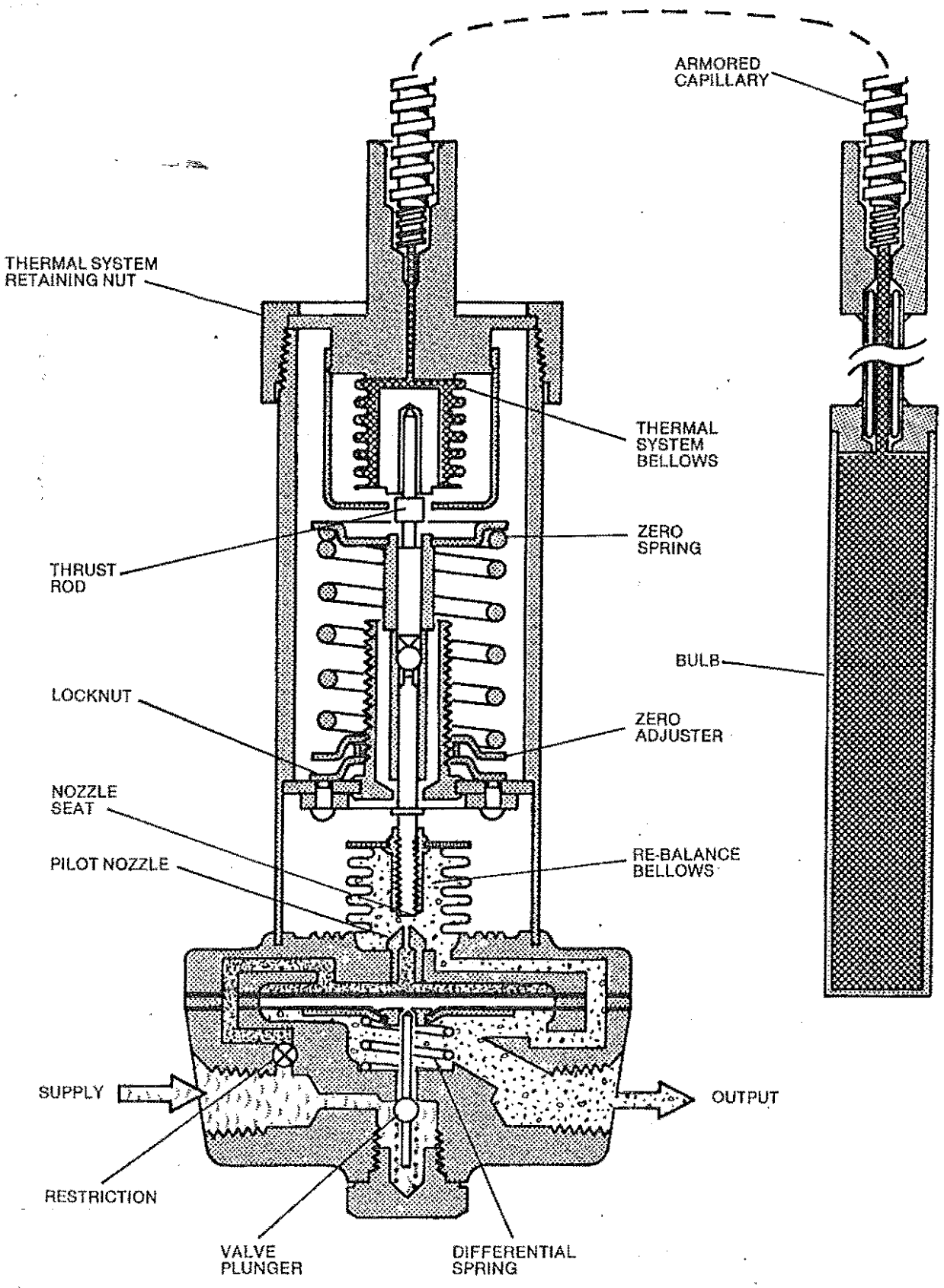


FIGURE 1 Schematic

PRINCIPLE OF OPERATION

Refer to Figure 1 and the following text.

As the measured temperature increases, the pressure of the gas in the Thermal System increases, increasing the force exerted by the Thermal System bellows. This increased force is applied to the rebalance bellows, via the thrust rod, decreasing the clearance between the pilot nozzle and nozzle seat. The decreased clearance restricts air flow from the pilot nozzle, increasing the pressure in the chamber above the booster diaphragm.

As the pressure above the booster diaphragm increases, the diaphragm is forced down. It contacts the valve plunger, closing the exhaust port, and moves the plunger down, opening the supply port. The output pressure increases, increasing the force exerted by the rebalance bellows. When the force exerted by the rebalance bellows equals the force exerted by the Thermal System bellows, the Transmitter output will have increased an amount proportional to the temperature increase. At this point, the exhaust diaphragm moves upward, allowing the valve plunger to move up and close the supply port, thus preventing any further increase of the Transmitter output.

The booster section consists of a booster diaphragm assembly, a valve plunger, a differential spring, a pilot nozzle, and a supply restriction. This 1:1 volume booster increases the output capacity of the Transmitter. A very small flow of supply air passes through the restriction and into the chamber on top of the booster diaphragm. It exits this chamber through the pilot nozzle and into the output. This small flow into the output is exhausted to atmosphere via the booster diaphragm. The differential spring acts on the bottom of the booster diaphragm and exerts a force equivalent to 3 psi. Therefore, the pressure in the chamber above the booster diaphragm will always be higher than the output (i.e., pressure on top = output + differential spring). The differential spring, therefore, maintains a constant pressure drop across the pilot nozzle. This constant drop minimizes movement of the rebalance bellows (i.e., extremely small clearance changes between the nozzle seat and pilot nozzle) to provide a high degree of accuracy.

TRANSMITTER INSTALLATION

MOUNTING

The Model 33 Nullmatic Temperature Transmitter includes a standard mounting bracket.

Two optional mounting brackets are available (see Fig. 2) and are bolted to the standard bracket for use. The P/N 3351-101 kit is used for pipe mounting, either horizontal or vertical. The P/N 859-89 mounting bracket is used for thermal well mounting.

Mounting dimensions are shown in Figure 2.

The Model 33 may be mounted in any reasonably vibration-free location. It is recommended to mount the Transmitter in a vertical position, although it may be mounted in any position. Mounting the Transmitter in positions other than vertical requires that the zero adjustment be reset.

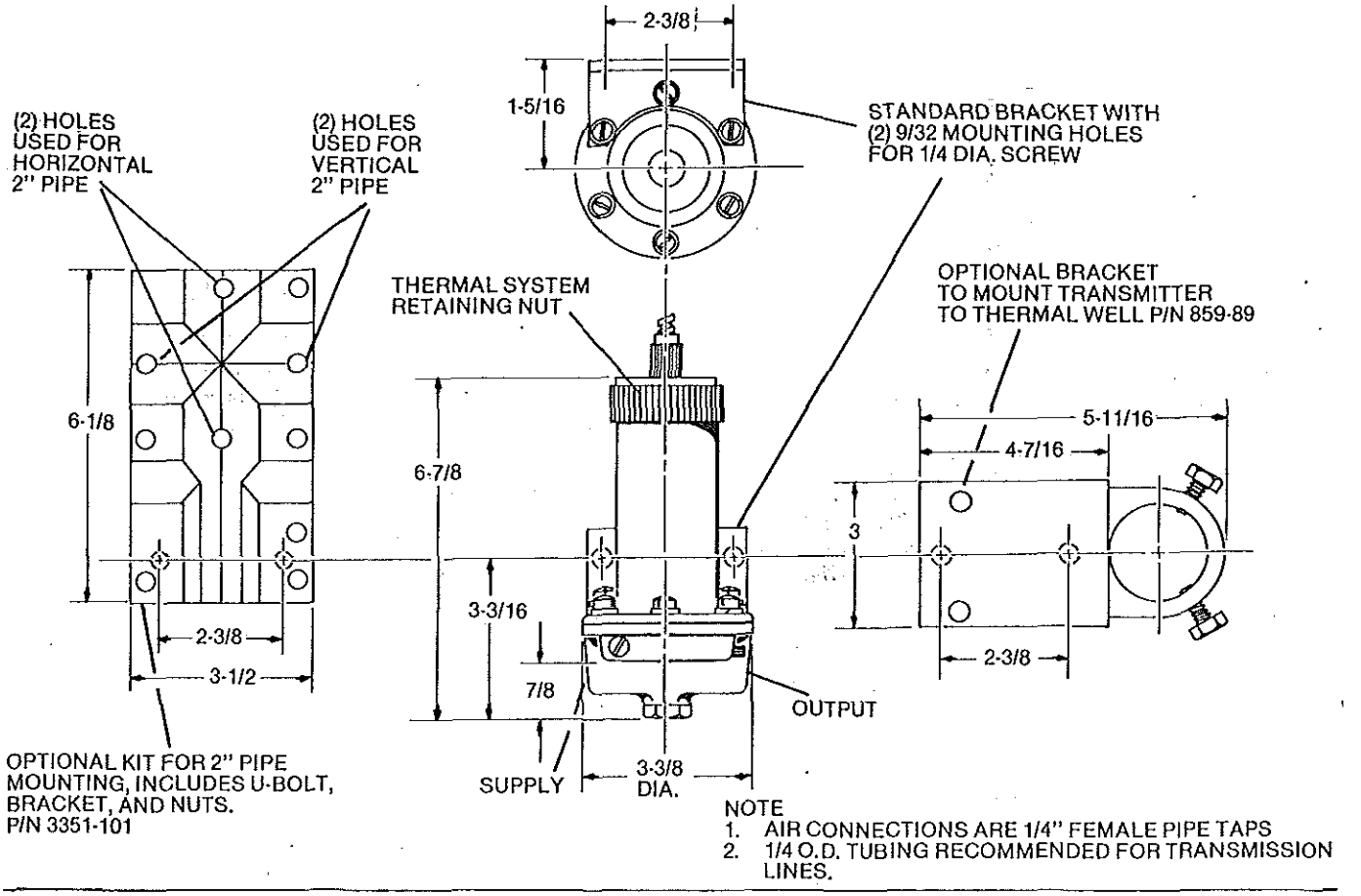


FIGURE 2 Transmitter Installation

Caution

Exceeding the specified ambient temperature limits can adversely affect performance and may cause damage.

PNEUMATIC CONNECTIONS (Refer to Figure 2)

The supply and output connections are 1/4" N.P.T.

1/4" O.D. tubing is recommended for piping to the Transmitter, however, any scale-free piping may be used.

Blow out all piping before connections are made to prevent the possibility of dirt or chips entering the Transmitter.

Use pipe sealant sparingly, and then only on the male threads. A non-hardening sealant is strongly recommended.

Connect the Transmitter to a 20 psig (19 psig min.; 35 psig max.) source of clean, dry, oil-free instrument air. See SUPPLY AIR REQUIREMENTS.

Caution

Supply pressure in excess of 35 psig may cause damage.

SUPPLY AIR REQUIREMENTS

Connect the Transmitter to a source of clean, dry, oil-free supply air. Failure to do so will increase the possibility of a malfunction or a deviation from specified performance.

Caution

Synthetic compressor lubricants in the air stream at the instrument may cause the Transmitter to fail.

There are different types of synthetic compressor lubricants. Some may not be compatible with the neoprene diaphragm assembly or the Buna-N "O"-ring used in the Transmitter. Wetting of these parts by such an oil mist or oil vapor, etc., may cause them to deteriorate. This may ultimately result in failure of the Transmitter.

The requirements for a quality air supply can be found in the Instrument Society of America's "Quality Standard For Instrument Air" (ISA-S7.3). Basically this standard calls for the following:

Particle Size — The maximum particle size in the air stream at the instrument should be no larger than 3 microns.

Dew Point — The dew point - at line pressure - should be at least 10°C (18°F) below the minimum temperature to which any part of the instrument air system is exposed at any season of the year. Under no circumstances should the dew point - at line pressure - exceed 2°C (35.5°F).

Oil Content — The maximum total oil or hydrocarbon content, exclusive of noncondensibles, should not exceed 1 ppm under normal operating conditions.

THERMAL SYSTEM INSTALLATION

MOUNTING CONSIDERATIONS

Plain bulbs are generally used on open kettles, shallow pots, and tanks; where threaded support is not required. By adding a compression fitting to a 3/8" Plain Bulb, or a compression fitting and union screw to a 3/4" Plain Bulb, a fixed position can be obtained. The 3/4" Plain Bulbs with a compression fitting and union screw cannot be used for pressure-tight installations.

For vessels under pressure or whenever strong lateral forces are present, rigid bulbs or plain bulbs in thermal wells are used. Rigid bulbs are not used in thermal wells.

The speed of response depends primarily upon the degree of contact between the bulb and the measured process medium. Bare bulbs provide the fastest response. Response speed will also depend upon the circulation present in the processing vessel.

The Nullmatic Transmitter and Thermal System are calibrated together at the factory. On multiple unit installations, if the Thermal Systems are separated from their Transmitters, they must be remated with the original Transmitter - otherwise the calibration will be incorrect.

All bulbs, except averaging, have a 4 inch active portion. Consideration must be given to wall thickness, mounting hardware, etc., so that the 4 inch active portion is immersed in the medium to be measured.

To improve heat transfer between a thermal well and a bulb, copper contact strips may be employed. These .005" thick sheets are placed along side the bulb before it is inserted into the thermal well. The sheet must make positive contact against the thermal well walls.

Caution

Do not expose the Thermal System to process temperatures beyond the limits in Table 1 or Table 2. Exceeding the maximum operating temperatures may adversely affect performance. Exceeding the overrange limits can cause damage.

MOUNTING INSTRUCTIONS

3/8" O.D. Plain Bulbs

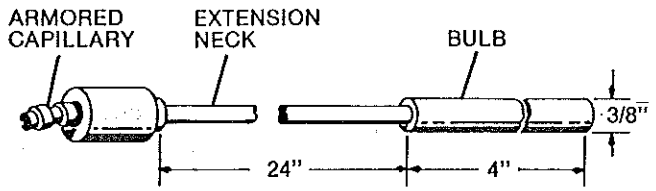
GENERAL

Figure 3 shows the 3/8" O.D. Plain Bulb dimensions, the compression fitting used and the thermal well dimensions.

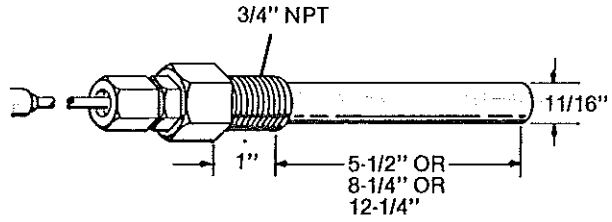
Thermal wells are available in either 304 S.S. or 316 S.S. They have either a 2-1/8" lag or no lag. Three immersion lengths are available: 5-1/2", 8-1/4" and 12-1/4".

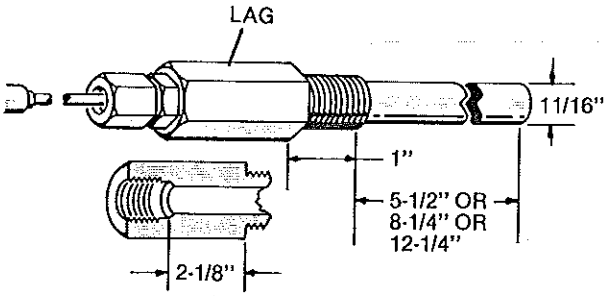
The compression fitting is used to mount the 3/8" O.D. Plain Bulb to the customer's connection or thermal well. It consists of a nut, a split packing follower with a retaining spring, (4) split asbestos packing rings, a split packing gland with a retaining spring, and a 1/2"

NPT male pipe fitting. This compression fitting can be used for pressure installations to 1000 psig. The P/N 12140-3 compression fitting is used on stainless steel Thermal Systems; the P/N 12141-15 compression fitting is used on copper Thermal Systems.

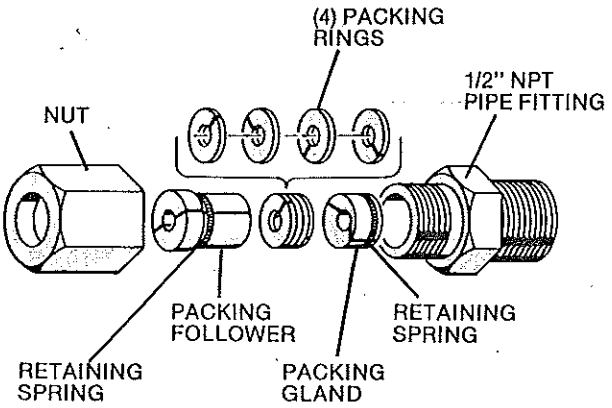


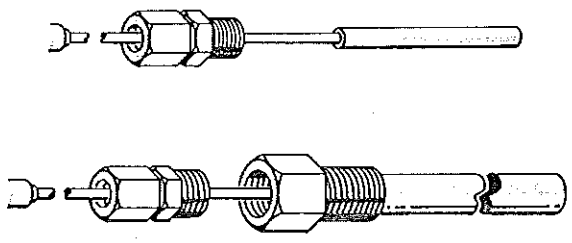
BULB DIMENSIONS





THERMAL WELL DIMENSIONS





COMPRESSION FITTING

FIGURE 3 3/8'' Plain Bulb Installation

PROCEDURE

Refer to Figure 3.

The following procedure is recommended for assembling the compression fitting on the extension neck and mounting the bulb. All parts of the compression fitting, except the packing rings, will pass over the bulb.

1. Determine where, on the extension neck, the fitting is to be made-up.
2. Pass the nut, packing follower, packing gland and the pipe fitting over the bulb onto the extension neck.
3. Place one split packing ring on the extension neck, between the packing follower and packing gland.
4. Put the packing gland into the pipe fitting.
5. Note where the split is, on the packing ring, and using the packing follower, push the packing ring into the pipe fitting until it bottoms.
6. Repeat step 5 for each of the remaining (3) packing rings. Place each successive packing ring split 90° away from the last.
7. Put the packing follower into the pipe fitting.
8. Screw the nut onto the pipe fitting, but do not tighten.
9. Position the bulb into the vessel or installed thermal well, to the depth determined in step 1.

NOTE

If a P/N 4454-1105 contact strip is used, it must be placed along side the bulb before it is inserted into the thermal well.

10. Tighten the pipe fitting.
11. Tighten the nut.

To install a thermal well, simply tighten it into the vessel connection.

NOTE

The thermal well must be installed before installing the bulb into it.

3/8'' O. D. Rigid Bulbs

GENERAL

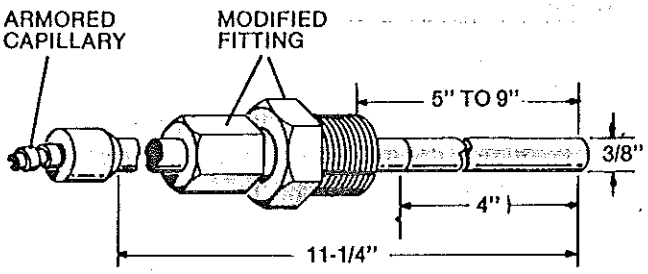
Figure 4 shows the 3/8" O.D. Rigid Bulb dimensions and the modified fitting used.

The 3/8" O.D. Rigid Bulbs have a 7-1/4" lag. This lag enables the bulb to have a 5" to 9" insertion length.

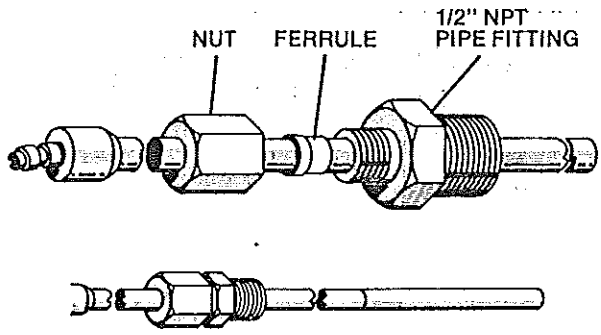
The modified fitting is used to mount the 3/8" Rigid Bulb to the customer's connection. It consists of a nut, a ferrule and a 1/2" NPT male pipe fitting. This fitting can be used for pressure installations to 1500 psig for stainless steel bulbs; 1000 psig for copper bulbs. The P/N 12142-3 fitting is used on stainless steel Thermal Systems; the P/N 12143-4 fitting is used on copper Thermal Systems.

IMPORTANT

Once the modified fitting is made-up and tightened, the ferrule becomes permanently fixed in place. This is a one-time setting and cannot be changed.



BULB DIMENSIONS



MODIFIED FITTING

FIGURE 4 3/8'' Rigid Bulb Installation

PROCEDURE

Refer to Figure 4.

The following procedure is recommended for assembling the modified fitting on the bulb and mounting the bulb. All parts of the fitting will pass over the bulb.

1. Determine where, on the bulb, the fitting is to be made-up.
2. Pass the nut, ferrule and 1/2" NPT pipe fitting onto the bulb.
3. Position the bulb, into the vessel, to the depth determined in Step 1.
4. Tighten the 1/2" NPT male pipe fitting.
5. Place the nut over the ferrule and tighten it on the fitting.

3/4'' O.D. Plain Bulbs

GENERAL

Figure 5 shows the 3/4" O.D. Plain Bulb dimensions, the compression fitting used and thermal well dimensions.

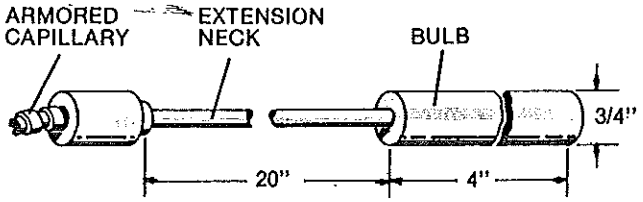
Thermal wells are available in either 304 S.S. or 316 S.S. They have either a 2-1/8" lag or no lag. Three immersion lengths are available: 5-1/2", 8-1/4" and 12-1/4".

The compression fitting is used to mount the 3/4" O.D. Plain Bulb to the customer's connection or thermal well.

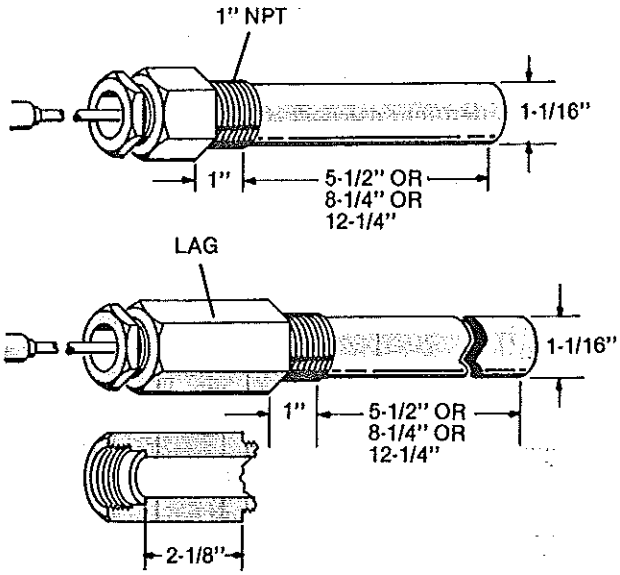
IMPORTANT

This compression fitting is used with a union screw or on a thermal well. It is not used alone.

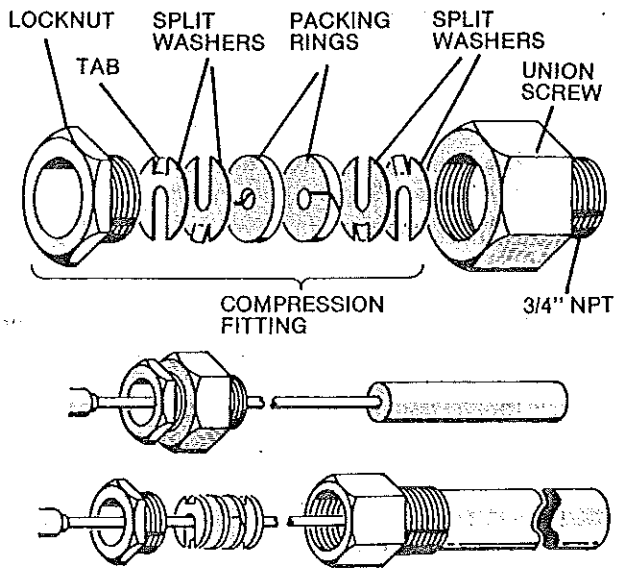
The compression fitting consists of a union locknut, (4) 316 S.S. split washers, and (2) split asbestos packing rings. This compression fitting when used with a union screw, is used on non-pressure installations only. The P/N 1551-31 compression fitting is used on stainless steel Thermal Systems; the P/N 1551-30 compression fitting is used on copper Thermal Systems. The P/N 1551-31 compression fitting and the P/N 859-112 union screw are available together under P/N 1551-22 for stainless steel Thermal Systems. The P/N 1551-30 compression fitting and the 1551-5 union screw are available together under P/N 1551-9 for copper Thermal Systems.



BULB DIMENSIONS



THERMAL WELL DIMENSIONS



COMPRESSION FITTING AND UNION SCREW

FIGURE 5 3/4'' Plain Bulb Installation

PROCEDURE

Refer to Figure 5.

The following procedure is recommended for assembling the compression fitting on the extension neck and mounting the bulb.

1. Determine where, on the extension neck, the fitting is to be made-up.
2. Pass the union locknut (and union screw - if not to be installed in a thermal well) over the bulb onto the extension neck.
3. Position the bulb into the vessel or installed thermal well, to the depth determined in step 1.

NOTE

If a P/N 4454-0105 contact strip is used, it must be placed along side the bulb before it is inserted into the thermal well.

4. Tighten the union screw into the vessel connection, if a thermal well is not being used.
5. Place one split washer on the extension neck with the tab facing inward. Slide this washer into the installed thermal well or union screw until it bottoms.
6. Place the second split washer on the extension neck, rotated 180°, with the tab facing outward. Slide this washer into the installed thermal well or union screw to mate with the first split washer.
7. Place one split packing ring on the extension neck.
8. Note where the split is, on the packing ring, and push the packing ring in until it bottoms.
9. Place the other packing ring on the extension neck. Push this packing ring in, with the split 90° away from the other, until it bottoms.
10. Place the last two split washers on the extension neck as shown in Figure 5, and slide them in against the last packing ring.
11. Position and tighten the union locknut.

To install a thermal well, simply tighten it into the vessel connection.

NOTE

The thermal well must be installed before installing the bulb into it.

3/4'' O.D. Rigid Bulbs

GENERAL

Figure 6 shows the 3/4" O.D. Rigid Bulb dimensions and the union locknut and union screw used.

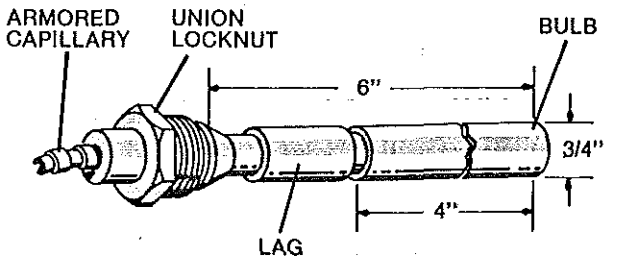
The union locknut and union screw are used to mount the 3/4" Rigid Bulb to the customer's connection. The tapered metal seat of the bulb seats in the union screw. This fitting, union locknut and union screw, can be used for pressure installations to 1500 psig for stainless steel bulbs; 1000 psig for copper bulbs.

The union locknut is included on the Thermal System and is a permanent part of it.

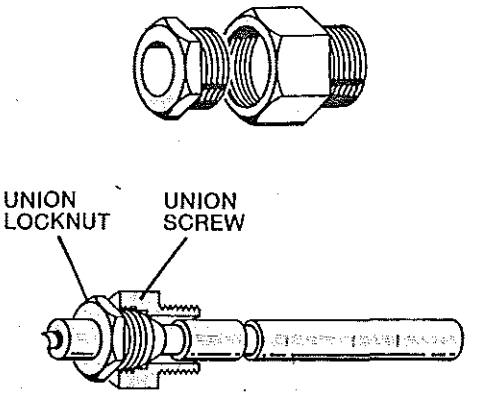
The P/N 859-112 union screw is used on stainless steel bulbs, the P/N 1551-5 union screw is used on copper bulbs.

PROCEDURE

1. Tighten the union screw into the vessel connection.
2. Position the bulb into the vessel.
3. Tighten the union locknut.



BULB DIMENSIONS



FITTING

FIGURE 6 3/4'' Rigid Bulb Installation

3/4'' O.D. Non-Rigid Bulbs

GENERAL

Figure 7 shows the 3/4" O.D. Non-Rigid Bulb dimensions and the union locknut and union screw used.

The union screw and union locknut are used to mount the 3/4" Non-Rigid Bulb to the customer's connection. A tapered metal seat is permanently welded (316 S.S. units) or silver soldered (copper units) to the extension neck. The purpose of the seat is to obtain pressure vessel connections for bare bulbs, by eliminating the asbestos packing used in compression fittings. The seat may be located anywhere on the neck, but must be specified on the order.

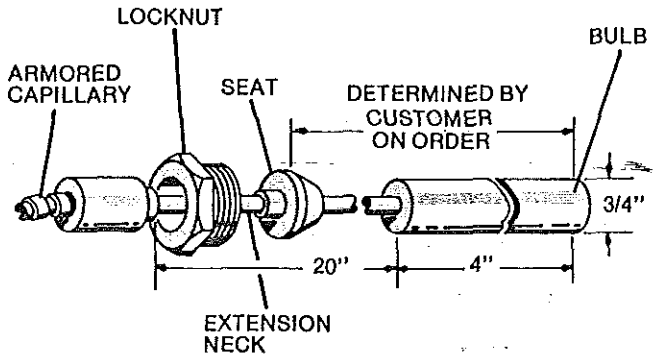
The union locknut and union screw, as a fitting, can be used for pressure ratings to 1500 psig for stainless steel bulbs; 1000 psig for copper bulbs.

The union locknut is included on the Thermal System and is a permanent part of it.

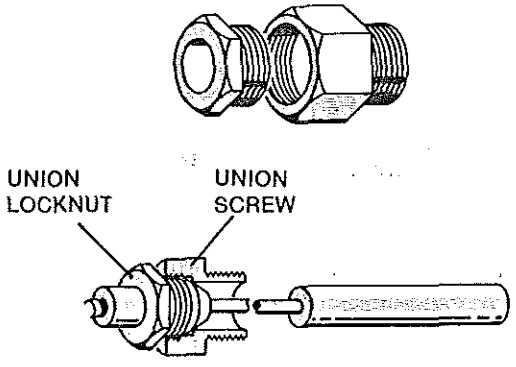
The P/N 859-112 union screw is used on stainless steel bulbs; the P/N 1551-5 union screw is used on copper bulbs.

PROCEDURE

1. Tighten the union screw into the vessel connection.
2. Position the bulb into the vessel.
3. Tighten the union locknut.



BULB DIMENSIONS



FITTING

FIGURE 7 3/4" Non-Rigid Bulb Installation

Averaging Bulbs

GENERAL

Figure 8 shows the Averaging Bulb dimensions.

Averaging Bulbs have a 3/16" diameter bulb, 14' long, coiled into a 6" diameter for shipment. The end of the bulb includes a ring for anchoring the bulb after it has been stretched to its installation length.

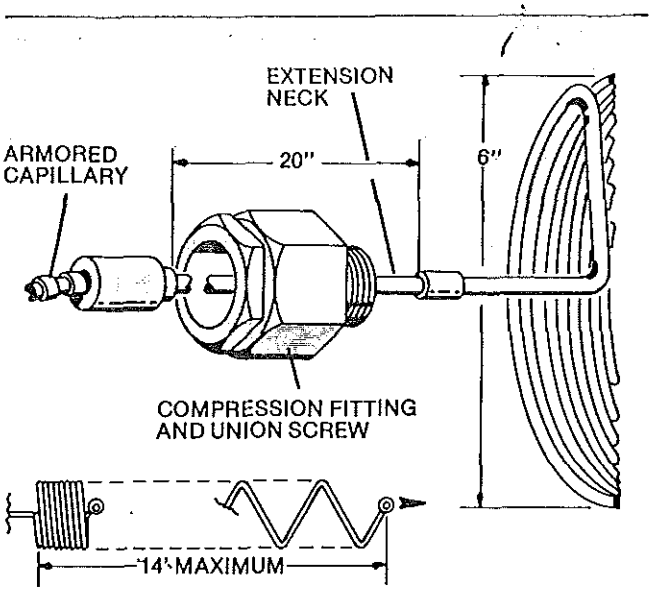
The compression fitting is used to mount the Averaging Bulb to the duct or vessel. It is the same one that is used to mount 3/4" O.D. Plain Bulbs. See Figure 5.

The Averaging Bulb is available in 316 S.S. only. It uses the P/N 1551-31 stainless steel compression fitting and the P/N 1551-22 union screw. These are available under P/N 1551-22.

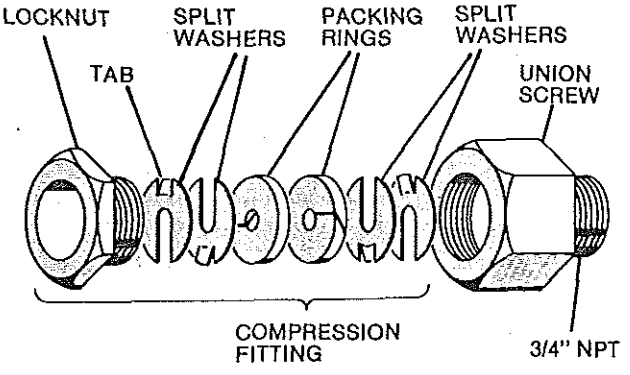
The compression fitting and union screw (P/N 1551-22) are assembled on the extension neck before shipment.

PROCEDURE

1. Install the bulb into the duct or vessel and anchor it.
2. Tighten the union screw into the duct or vessel connection.
3. Tighten the union locknut.



BULB DIMENSIONS



COMPRESSION FITTING AND UNION SCREW

FIGURE 8 Averaging Bulb Installation

MAINTENANCE

GENERAL

The Model 33 Nullmatic Temperature Transmitter has no recommended routine maintenance. The only item to check on a periodic basis is the Transmitter's zero adjustment.

In installations where the process medium is dirty or coats the bulb (or thermal well), the bulb (or thermal well) should be removed periodically for cleaning.

CLEANING (See Figure 9)

The restriction screw, screen and valve plunger are the only items that require maintenance under ordinary conditions.

Restriction Screw

The small orifice and/or the filter screen may become clogged if the air supply is not clean.

1. Turn off supply air.
2. Remove the restriction screw.
3. Remove the filter screen from the restriction screw.

4. Using the knurled cleaning wire, located in the base of the transmitter, clear the small orifice in the end of the restriction screw.
5. If the orifice is blocked and the cleaning wire cannot clear, soak the restriction screw in solvent to dissolve the blockage.
6. The filter screen can be cleaned by soaking it in solvent, and then blowing it through with air.
7. Make certain that the "O" ring is not cut or gouged.

Valve Plunger

In cases of dirty supply air, a deposit may build up on the supply and/or exhaust seats.

1. Turn off supply air.
2. Remove the retaining nut in the base of the transmitter. The valve plunger and spring will drop out.
3. Clean the supply and exhaust seats in the transmitter. The supply seat is readily accessible; the exhaust seat can be reached with a tobacco pipe cleaner.
4. Replace the valve plunger and spring.
5. Replace and tighten the retaining nut.

TROUBLE ANALYSIS

The following table lists symptoms, probable causes and remedies. The symptoms and probable causes listed in order from most to least likely.

SYMPTOM	PROBABLE CAUSE	REMEDY
High Indication	Valve Plunger	Clean valve plunger
	Restriction screw loose	Tighten retaining screw
	Zero setting shifted	Reset zero setting
	Exhaust holes clogged	Clear exhaust holes
Low or No Indication	Restriction clogged	Clean restriction
	Valve plunger retaining nut loose	Tighten retaining nut
	Zero setting shifted	Reset zero setting
	Low or No air supply	Adjust to recommended supply pressure
	Partial or complete loss of thermal system fill	Replace thermal system
	Thermal system retaining nut not tight	Tighten retaining nut

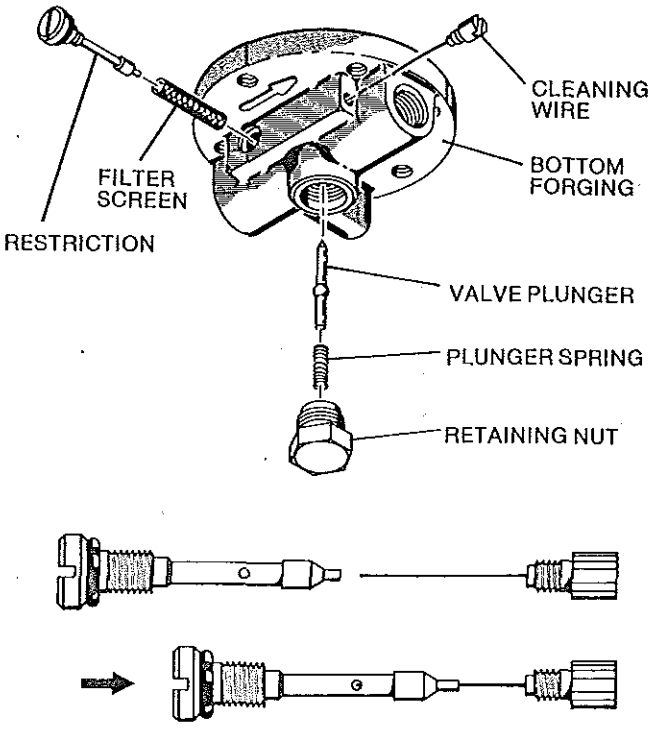


FIGURE 9 Cleaning

CALIBRATION

GENERAL

The only calibration adjustment is the zero adjustment. The span of the Instrument is determined by the Thermal System fill pressure. The System is inherently linear.

TEST EQUIPMENT

The following equipment is necessary to affect proper calibration of the Nullmatic Temperature Transmitter.

1. A controlled temperature bath.
2. A temperature measuring device accurate to 1/4%.
3. A 0-30 psig output test gauge accurate to 1/4%.
4. A supply air source set at 20 psig.

PROCEDURE

1. Immerse the bulb in a bath of known temperature within the range of the Instrument. The bath should be agitated and the temperature measured.
2. Allow a few minutes for the Thermal System to come to the bath temperature.
3. The output may be calculated for any temperature within the range of the Instrument. Calculate the output for the temperature of the bath.
4. Remove the zero adjuster cover plate.

5. Loosen the (lower) locknut and adjust the adjusting nut (next to the spring) until the output test gauge reads the calculated output.
6. Tighten the locknut against the adjusting nut to avoid a shift due to vibration.
7. Replace the zero adjuster cover.

TRANSMITTER AND THERMAL SYSTEM SELECTION

GENERAL

Tables 1 and 2 indicate the spans and maximum operating temperatures against which the proper Model 33 should be selected. Table 1 is used for Fahrenheit selection; Table 2 is used for Celsius selection.

NEW TRANSMITTER AND THERMAL SYSTEM

1. From the column marked common SPANS, select the desired span value. If the desired span is between the listed values, base the span selection on the next higher span shown.
2. Read from left to right along the selected span value to the first column listing a MAXIMUM OPERATING TEMPERATURE equal to or greater than the high end of the desired range. The MAXIMUM OPERATING TEMPERATURES for 3/8" bulbs and the 3/4" and averaging bulbs are listed separately. Use the Transmitter shown at the top of that column (e.g., 33D).
3. If the Thermal System may be subjected to a significant overrange in temperature, check the columns under MAXIMUM OVERRANGE to insure that the excess temperature is within limits.
4. Consult the factory to determine the type of Thermal System desired (according to location, mounting, etc.).

DIRECT REPLACEMENT

Direct replacement for either the Thermal System or the entire Transmitter — Thermal System can be made from the information stamped on the neck of the Thermal System bellows or on the Transmitter. For example:

TRANSMITTER	THERMAL SYSTEM
MODEL - 33C5072	PART - 5072-C8F
SERIAL - 14033-5072C8F	RANGE - 0-150°F
RANGE - 0-150°F	TRANS. - 33C

NEW THERMAL SYSTEM FOR EXISTING TRANSMITTER

An existing Transmitter may be used only if the new selection data for a new Thermal System dictates that the same Transmitter can be used. The factory must be consulted to make this determination.

TABLE 1 FAHRENHEIT SELECTION

	MAXIMUM OPERATING TEMPERATURE °F (1. 2. 3.)										MAXIMUM OVERRANGE °F*			
MODEL	33A		33C		33D		33E		33SE		3/8" BULBS (COPPER BULB LIMIT — 800°F)			
BULB DIA. / COM. SPANS °F	3/8"	3/4" AVER	3/8"	3/4" AVER	3/8"	3/4" AVER	3/8"	3/4" AVER		3/4" AVER	33A	33C	33D	33E
50	—	—	—	—	—	—	—	—	—	100	—	—	—	—
60	—	—	—	—	—	—	—	—	—	250	—	—	—	—
70	—	—	—	—	—	—	150	—	—	370	—	—	—	650
80	—	—	—	—	—	—	200	200	—	—	—	—	—	825
90	—	—	—	—	—	—	230	286	—	—	—	—	—	975
100	—	—	—	—	100	100	270	370	—	—	—	—	625	1000
110	—	—	—	—	150	165	290	465	—	—	—	—	900	1000
120	—	—	—	—	200	220	320	550	—	—	—	—	1000	1000
125	—	—	—	—	225	250	330	590	—	—	—	—	1000	1000
130	—	—	—	—	250	280	360	635	—	—	—	—	1000	1000
140	—	—	—	—	300	335	390	720	—	—	—	—	1000	1000
150	—	—	150	150	350	395	430	805	—	—	—	650	1000	1000
160	—	—	190	190	400	450	450	890	—	—	—	710	1000	1000
170	—	—	230	230	440	510	480	975	—	—	—	770	1000	1000
175	—	—	250	250	460	540	500	1000	—	—	—	800	1000	1000
180	—	—	270	270	470	565	520	1000	—	—	—	830	1000	1000
190	—	—	305	310	500	620	540	1000	—	—	—	890	1000	1000
200	—	—	340	350	520	680	570	1000	—	—	—	950	1000	1000
225	—	—	440	450	580	825	640	1000	—	—	—	1000	1000	1000
250	260	255	500	550	640	970	700	1000	—	—	650	1000	1000	1000
275	330	325	550	650	700	1000	—	—	—	—	750	1000	1000	—
300	400	400	610	750	750	1000	—	—	—	—	850	1000	1000	—
325	480	470	665	850	810	1000	—	—	—	—	1000	1000	1000	—
350	550	540	715	950	870	1000	—	—	—	—	1000	1000	1000	—
375	620	610	765	1000	920	1000	—	—	—	—	1000	1000	1000	—
400	700	680	820	1125	980	1400	—	—	—	—	1000	1000	1000	—
425	770	750	870	1215	—	1400	—	—	—	—	1000	1000	—	—
450	840	820	920	1285	—	1400	—	—	—	—	1000	1000	—	—
475	890	890	970	1380	—	1400	—	—	—	—	1000	1000	—	—
500	940	960	1000	1400	—	—	—	—	—	—	1000	1000	—	—
600	1000	1230	—	1400	—	—	—	—	—	—	1000			
700	1000	1300	—	1400	—	—	—	—	—	—	1000	*ALL 316 S.S. 3/4", AVER — 1400°F ALL CU. 3/4" — 800°F		
800	1000	1400	—	1400	—	—	—	—	—	—	1000			
900	1000	1400	—	—	—	—	—	—	—	—	1000			
1000	1000	—	—	—	—	—	—	—	—	—	1000			

1. Max. operating temperature for Copper Bulbs is 800°F.
2. Transmitter must be selected from first column (read left to right) of max. oper. temps. which satisfy range req.
3. Thermal systems are not interchangeable between different lettered transmitters.

TABLE 2 CELSIUS SELECTION

MODEL	MAXIMUM OPERATING TEMPERATURE °C (1. 2. 3)										MAXIMUM OVERRANGE °C*			
	33A		33C		33D		33E		33SE		3/8" BULBS (COPPER BULB LIMIT - 425°C)			
BULB DIA. / COM. SPANS °C	3/8"	3/4" AVER	3/8"	3/4" AVER	3/8"	3/4" AVER	3/8"	3/4" AVER	3/8"	3/4" AVER	33A	33C	33D	33E
28	—	—	—	—	—	—	—	—	—	35	—	—	—	—
30	—	—	—	—	—	—	—	—	—	40	—	—	—	—
35	—	—	—	—	—	—	—	—	—	120	—	—	—	—
40	—	—	—	—	—	—	70	—	—	190	—	—	—	380
45	—	—	—	—	—	—	90	90	—	—	—	—	—	450
50	—	—	—	—	—	—	110	140	—	—	—	—	—	525
60	—	—	—	—	60	65	140	225	—	—	—	—	380	540
70	—	—	—	—	105	125	170	310	—	—	—	—	480	540
80	—	—	—	—	155	185	205	395	—	—	—	—	540	540
90	—	—	95	95	200	240	240	480	—	—	—	385	540	540
100	—	—	130	135	245	300	270	540	—	—	—	445	540	540
110	—	—	165	175	265	355	—	540	—	—	—	510	540	—
120	—	—	205	215	295	415	—	540	—	—	—	540	540	—
130	—	—	240	255	315	470	—	540	—	—	—	540	540	—
140	—	125	265	295	335	530	—	540	—	—	—	540	540	—
150	155	155	285	335	360	540	—	—	—	—	390	540	540	—
160	185	185	305	375	385	540	—	—	—	—	455	540	540	—
170	210	210	325	415	405	540	—	—	—	—	540	540	540	—
180	240	240	345	455	430	540	—	—	—	—	540	540	540	—
190	265	265	365	495	455	540	—	—	—	—	540	540	540	—
200	320	295	400	535	475	540	—	—	—	—	540	540	540	—
225	390	365	450	600	—	760	—	—	—	—	540	540	—	—
250	450	435	495	700	—	760	—	—	—	—	540	540	—	—
275	500	505	535	750	—	760	—	—	—	—	540	540	—	—
300	540	535	—	760	—	—	—	—	—	—	540	—	—	—
350	540	680	—	760	—	—	—	—	—	—	540	—	—	—
400	540	700	—	760	—	—	—	—	—	—	540	—	—	—
500	540	760	—	—	—	—	—	—	—	—	540	—	—	—
556	540	—	—	—	—	—	—	—	—	—	540			
												*ALL 316 S.S. 3/4", AVER - 760°C ALL CU. 3/4" - 425°C		

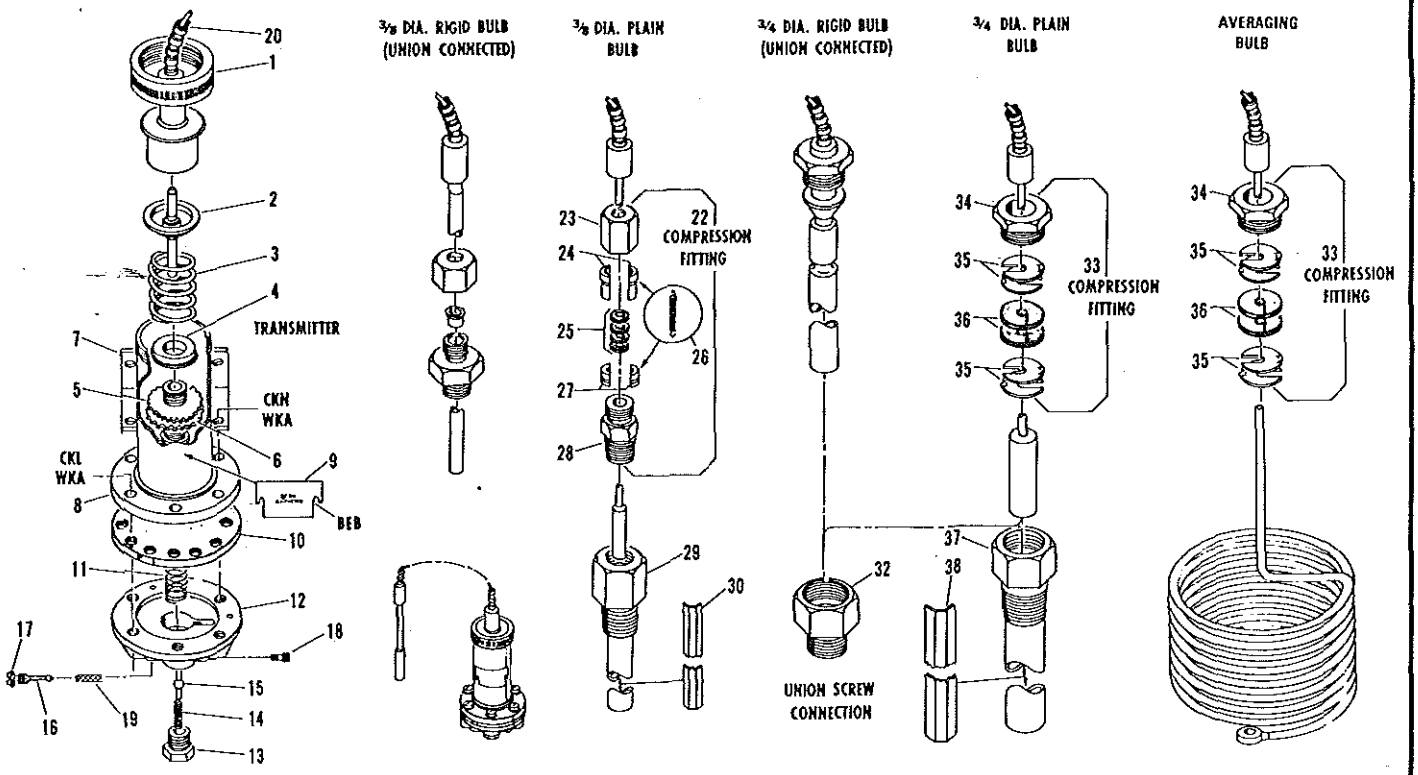
1. Max. Operating Temperature for Copper Bulbs Limited to 425°C.
2. Transmitter must be selected from first column (read left to right) of max. oper. temps. which satisfies range req.
3. Thermal systems are not interchangeable between different lettered transmitters.

PARTS LIST

MOORE PRODUCTS CO.
SPRING HOUSE, PA. 19477

MODEL 33 NULLMATIC TEMPERATURE TRANSMITTER

Drawing No. 3351PL



Item No.	Part No.	Description	Req'd.
		TRANSMITTER	
1	859-5	Cover Nut	1
2	3351-28	Spring Seat	1
3a	3351-41	Zero Spring (Mod. 33SE only)	1
3b	3351-40	Zero Spring (All Other Models)	1
4	10430-155	Spring Seat	1
5	10430-154	Zero Adjusting Nut	1
6	3351-43	Zero Locknut	1
7	1145-19	Mounting Bracket	1
8		Not Available For Field Use	-
9	859-37	Cover Plate	1
*10	1447-3	Diaphragm Assy.	1
11	4771-55	Differential Spring	1
12	2155-14	Bottom Housing	1
*13	2155-6	Retaining Nut	1
*14	2155-7	Valve Spring	1
*15	2155-3	Valve Plunger	1
*16	10792-12	Restriction Screw (Incl. Item 17 & 19)	1
*17	2938-154	"O" Ring	1
*18	1518-4	Cleaning Wire	1
19	111-20	Filter Screen	1
20		Thermal System - Specify Range & B/M Number	1
		3/8 DIA. PLAIN BULB	
22a	12140-3	Compression Fitting - Stain. Stl. (Incl. Items 23a, 24a, 25, 26 27a & 28a)	1
22b	12141-15	Compression Fitting - Brass (Incl. Items 23b, 24b, 25, 26 27b, 28b)	
23a	12140-7	Packing Nut - Stain. Stl.	1
23b	12141-13	Packing Nut - Brass	1
24a	12140-9	Packing Follower - Stain. Stl.	2
24b	12141-17	Packing Follower - Brass	2
25	12141-10	Packing Ring	4
26	12141-18	Spring	2
27a	12140-10	Split Gland - Stain. Stl.	2
27b	12141-16	Split Gland - Brass	2
28a	12140-4	Tube Fitting Stain. Stl.	1
28b	12141-6	Tube Fitting - Brass	1
29		Socket - Specify As Required	1
30	4454-1105	Contact Strip	1
		3/4 DIA. RIGID BULB (UNION CONNECTED)	
32a	859-112	Bushing - Stain. Stl.	1
32b	1551-5	Bushing - Brass	1
		3/4 DIA. PLAIN BULB	
33a	1551-31	Compression Fitting - Stain. Stl. (For use with Socket - Incl. Items 34a, 35a, 36)	1
33b	1551-30	Compression Fitting - Brass (For use with Socket - Incl. Items 34b, 35b, 36)	1
33c	1551-22	Compression Fitting - Stain. Stl. (For Bare Bulb - Incl. Items 34a, 35a, 36 & 32a)	1
33d	1551-9	Compression Fitting - Brass (For Bare Bulb - Incl. Items 34b, 35b, 36 & 32b)	1
34a	1551-24	Packing Nut - Stain. Stl.	1
34b	859-105	Packing Nut - Brass	1
35a	1551-23	Split Washer - Stain. Stl.	4
35b	1551-8	Split Washer - Brass	4
36	1551-7	Packing Ring	2
37		Socket-Specify As Required	1
38	4454-0105	Contact Strip	1

Code	Hardware	Req'd.
BEB	#3-48 x 3/16 Lg. Rd. Hd. Screw	2
CKL	1/4-20 x 7/8" Lg. Fil. Hd. Screw	3
CKN	1/4-20 x 1" Lg. Fil. Hd. Screw	3
WKA	1/4 Lockwasher	6

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

Printed in U.S.A. 1/80 Supersedes 11/73

1. THE FLEXIBLE HOSE ASSEMBLIES USED IN THIS DIESEL POWER GENERATING SET ARE FOR THE AIR START SYSTEM, THE LUBE OIL SYSTEM AND THE JACKET WATER SYSTEM.

2. THE FACTORY ASSEMBLED HOSE ASSEMBLIES SHALL CONSIST OF FC195 AQP (SAE 100 R2A) 2-WIRE BRAID HOSE, #4722 MALE PIPE FITTINGS, #4721 SAE 37° (J.I.C.) SWIVELS, AND #2022 INTERNAL PIPE/37° FLARE ADAPTERS IN SIZES AND LENGTHS SHOWN.

FM PART NO.	HOSE SIZE	HOSE LENGTH	MALE PIPE FITTING	SAE 37° FITTING
11908981	1-1/2"	24"	4722-24-24S	4721-24S
11908982	1-1/2	18	4722-24-24S	4721-24S
11908983	1	12	4722-16-16S	4721-16S
11908984	1/2	12	4722-8-8S	4721-8-8S

FM PART NO.	ADAPTER	HOSE ASSEMBLY FINISHED LENGTH
11908981	2022-24-24S	31.55
11908982	2022-24-24S	25.55
11908983	2022-16-16S	17.92
11908984	2022-8-8S	16.61

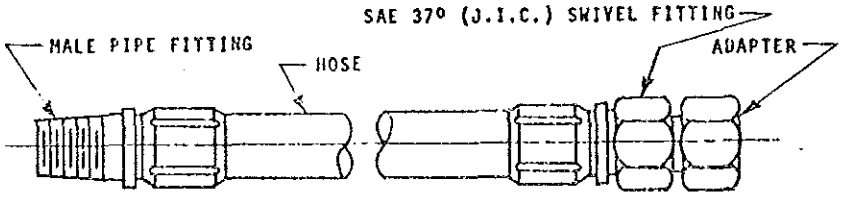
3. CADMIUM PLATED STEEL HOSE FITTINGS AND ADAPTERS.

4.a. HOSE ASSEMBLY, FM PART NO. 11908981, MUST BE TESTED ① AT 900 PSI WITH WATER FOR (1) HOUR AND CERTIFIED BY VENDOR'S QUALITY CONTROL THAT THEY DO NOT LEAK. ANY LEAKING ASSY. WILL NOT BE REPAIRED OR REWORKED WITHOUT VENDOR'S QUALITY CONTROL APPROVAL. LEAKS IN THE HOSE PORTION WILL NOT BE REPAIRED OR REWORKED.

② b. HOSE ASSEMBLY, FM PART NO. 11908982, 11908983, AND 11908984, MUST BE TESTED AT 200 PSI WITH WATER FOR (1) HOUR AND CERTIFIED BY VENDOR'S QUALITY CONTROL THAT THEY DO NOT LEAK. ANY LEAKING ASSY. WILL NOT BE REPAIRED OR REWORKED WITHOUT VENDOR'S QUALITY CONTROL APPROVAL. LEAKS IN THE HOSE PORTION WILL NOT BE REPAIRED OR REWORKED.

5. DRAWINGS: VENDOR TO FURNISH (2) REPRODUCIBLE DRAWINGS FOR APPROVAL. DRAWINGS TO INCLUDE THE FOLLOWING:

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER NO. LX 239585
FAIRBANKS MORSE ORDER NO. 11-700000



VENDOR PART NO.:

VENDOR DWG. NO.:

VENDOR: AEROQUIP OR EQUIVALENT

APPROVED
QUALITY CONTROL

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	104444	9/1/82	ADD ② 200 PSI TEST	

TITLE: HOSE ASSY. NPT(M) X NPT(F)

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .005
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES 0. ± .010 .00 ± .005 .000 ± .010

Colt Industries — Fairbanks Morse Power Systems

REL. NO. PO 18866 6/30/82
DR. BY J. ROTH 6/21/82 — ASSY. CR LO.
CHK'D. BY G. BLUE 6/22/82 — SCALE
MAT'L — HEAT TR.

SIZE B — DWG. NO. 11908985 — SHEET — OF

CAST. MACH. WELD. APP'V. MAT'L ENGR.

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11908985

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	P6341	6/17/76	ADDED PICTURE	SJV JMW
2	"	"	④ADD VENDOR PART NO. SERIES 50	
2	"	"	③ADD NOTES ON BLUE BAND FOR INSP. PURPOSES	
2	10875	5-19-78	③ WAS VENDOR BULLETIN AD 287-9	

DESCRIPTION: "Garflex" nitrile/neoprene molded bellows with two ASA 150 FF loose flanges.

Free length, face to face over molded bellows - 5".
Allowable compression -- 1-1/4" max.
Allowable elongation -- 3/4" max.
Allowable transverse deflection (parallel misalignment + 3/4" max.
Ratings for all sizes, continuous duty -
Working pressure - 250 PSI
Test pressure - 350 PSI
Burst pressure - 850 PSI min.
Vacuum - 10" Hg.
Temperature - -22°F to 212°F.

VENDOR BULLETIN NO.: AD-330

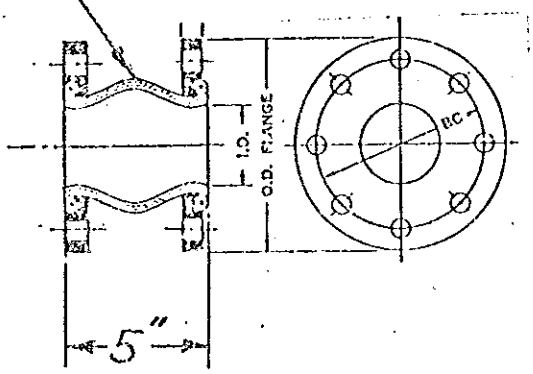
① VENDOR PART NO: SERIES 50 (NITRILE LINER)

PART NO.		PIPE SIZE (INS.)	ALLOWABLE ANGULAR DEFLECTION°, MAX.
12 994 172		2	35
12 994 173		2-1/2	30
12 994 174		3	30
12 994 130		4	25
12 994 150		5	20
12 994 129		6	20
12 994 175		8	15

② FLEXIBLE CONNECTORS MUST HAVE SOLID BLUE BAND INDICATING NITRILE LINER
Use for water and lubricating oil only.

VENDOR: Garlock Inc.
Palmyra, N.Y. 14522

③ INSPECT FOR SOLID BLUE BAND REJECT IF DOTS OR OTHER COLOR CODING ARE ON THE COLOR BAND.



TITLE: FLEXIBLE PIPE CONNECTORS

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries
Fairbanks Morse Power Systems Division

REL. NO. P.V. 656 P.125 P.L. ASSY. OR LO.
DR. BY J.G.Wood 11/9/71 SCALE
CHK'D. BY [illegible] 1/12/72 HEAT TR.
MAT'L V
APPV. MACH. CAST.
WELD. MAT'L
ENG.

SIZE A DWG. NO. 12 994 171 SHEET 1 OF 1

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12 994 171

ORIGINAL

CHAPTER 8 - SUPPORT SYSTEMS EQUIPMENT

#5 EXHAUST AND VACUUM SYSTEMS

Part No.	Description
11 905 056	"U" Tube Manometer
11 908 400	Pressure Switch (CCP)
11 908 511	Exhaust Silencer
11 908 512	Exhaust Expansion Joint

11 905 056

DESCRIPTION: Meriam flush mounted U tube manometer
with 10" scale
with Brass wetted parts

VENDOR'S PC NO: 10AA25FF

VENDOR'S DWG NO: B-2249

VENDOR: Meriam Instrument Company
Cleveland, Ohio

Representative: Simone Engineering Inc.
4962 N. Hopkins Avenue
Milwaukee, Wisconsin

NOTE: Substitutes Not Permitted.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: MANOMETER, "U" TUBE

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Dole Engineering — Nishimbe Meriam Power Systems Division

SEL. NO. [illegible]	2/14/67	ASSY. OR I.O.	
DR. BY L. M. Cooper	6/9/67	SCALE	
CHK'D. BY L.J.C.	6/13/67	APPV. [illegible]	2/12/70
MAT'L		HEAT TR.	

SHEET SIZE A | DWG. NO. 11 905 056 | SHEET OF

Installation, Operation and Maintenance Instructions

MERIAM U-TYPE MANOMETERS

The U-Type Manometer is a Primary Standard for measurement of pressure. No other device offers higher accuracy of result. The vertical distance between the two levels in the U-tube is a true measurement of the difference in pressure between the two sides of the manometer. This difference may be expressed in linear units of the indicating fluid used such as Inches of Mercury or easily converted to other convenient terms of measurement such as Pounds Per Square Inch etc. With a wide variety of stable indicating fluids available, exceedingly accurate measurements can be made.

INSTALLATION and OPERATION

Mount the instrument vertically and connect lines from the point of measurement to the convenient ¼" NPT connections at the manometer.

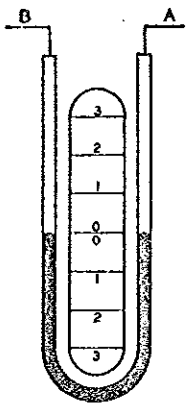


Figure 1

In Figure 1, Connections A and B are the tube leg connections. In measuring a pressure or a vacuum, connection may be made to either A or to B with the remaining leg open to the atmosphere. In measuring a differential pressure, or difference in pressure, the higher pressure is connected to one tube leg, A, and the lower pressure is connected to the other tube leg, B.

With both legs open to atmosphere, as shown in Figure 1, indicating fluid is placed in the U-tube until the level is at the center zero graduation on the scale. Applying a pressure above atmosphere to the leg A as shown in Figure 2, the indicating fluid will immediately respond causing the fluid column to lower in leg A and rise in leg B. The indicating fluid in the U-tube will continue to move until the head of fluid, H, balances the pressure measured. The height of indicating fluid or head will then be the sum of the liquid deflection downward from zero plus the liquid deflection upward from zero. In Figure 2, the fluid in leg A lowered to the 1.5" scale graduation and the fluid level in leg B raised to the 1.5" scale graduation. Under a state of balance the head, H, will then be 1.5" plus 1.5" or 3". The pressure applied to A is then equivalent to 3" of fluid head of whatever indicating liquid is used in the U-tube. As each inch of mercury, water or oil represents a definite pressure equivalent, the head reading, H, can be converted to other units of pressure. With a manometer scale graduated in known pressure units such as pounds or ounces, manometer readings can be taken directly in pressure units. Using a scale graduated in linear inches and tenths readings can be converted to pressure units for any manometer indicating fluid used by referring directly to a Meriam manometer fluid conversion table.

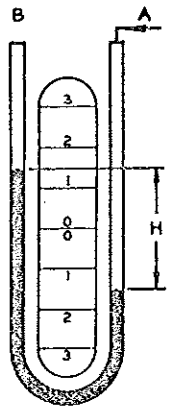


Figure 2

CONVERSION TABLES FOR MERIAM MANOMETER FLUIDS

(All fluids at a temperature of 70° F.)

1 In. Water	= .0361 lbs./sq. in.	1 In. Red Oil	= .0297 lbs./sq. in.
	.5768 oz./sq. in.		.4758 oz./sq. in.
	.0737 in. mercury		.0608 in. mercury
	.3373 in. #3 fluid		.2782 in. #3 fluid
	1.2123 in. Red Oil		.8248 in. water
		1 in. #3 Fluid	= .1067 lbs./sq. in.
1 ft. Water	= .4326 lbs./sq. in.		1.7067 oz./sq. in.
	6.9221 oz./sq. in.		.2185 in. mercury
	.8843 in. mercury		2.9649 in. water
	4.0472 in. #3 fluid		3.5945 in. Red Oil
	14.5481 in. Red Oil	1 oz./sq. in.	= .1277 in. mercury
	62.2987 lbs./sq. ft.		.5847 in. #3 fluid
			2.1017 in. Red Oil
			1.7336 in. water
1 In. Mercury	= .4893 lbs./sq. in.		
	7.8285 oz./sq. in.	1 lb./sq. in.	= 2.0438 in. mercury
	4.5771 in. #3 fluid		27.7369 in. water
	13.5707 in. water		9.3738 in. #3 fluid
	1.1309 ft. water		2.3114 ft. water
	16.4523 in. Red Oil		33.6950 in. Red Oil

MAINTENANCE

Maintenance of the U-type manometer is simple and consists primarily of keeping the indicating fluid and indicating tube clean. Should the fluid become contaminated it is recommended that in the case of mercury, it be cleaned by washing and squeezing thru wet chamois, mechanically agitated and filtered, or replaced by clean instrument grade mercury. Other fluids should be discarded and a fresh filling supplied. Should the connecting lines become plugged disconnect and clean in a suitable manner.

Indicating tubes can be cleaned by swabbing with warm water and detergents followed by a thorough rinse, or by use of suitable solvents such as acetone, naptha or potassium bicromate solution (1 qt. water, 3 oz. potassium bicromate and 3 oz. sulphuric acid). CAUTION: Always pour acid into the water. DO NOT ADD water to the acid. Avoid the use of strong acids or corrosive cleaning agents in contact with metal parts, painted parts or instrument scales. Wipe instrument scales with a damp cloth. After drying the instrument it can be returned to service.

THE MERIAM Instrument CO.

10920 MADISON AVENUE SINCE 1911 CLEVELAND, OHIO - 44102

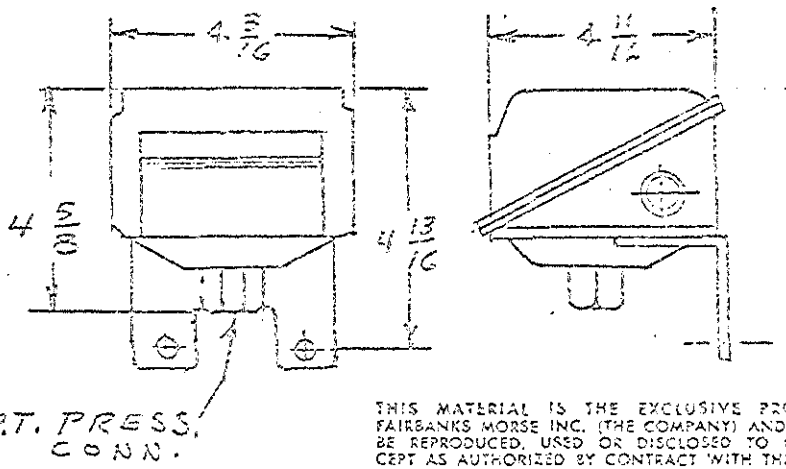
Form 63 *REPRESENTATIVES IN PRINCIPAL CITIES* Printed in U.S.A.

DESCRIPTION: UNITED ELECTRIC J300 MODEL 440 PRESSURE SWITCH WITH THE FOLLOWING FEATURES:

1. RANGE 0 TO 2" WC PRESSURE.
2. TO BE FACTORY SET TO CLOSE NORMALLY OPEN CONTACTS AT 0.6" W.C. ON INCREASING PRESSURE AND RE-OPEN NORMALLY OPEN CONTACTS @ 0.35 TO 0.53" W.C. ON DECREASING PRESSURE.
3. NEMA 4 HOUSING (TO INCLUDE 1/2" FPT WATER TIGHT CONDUIT FITTING).
4. PROOF PRESSURE 50 PSI.
5. VIBRATION RESISTANT.
6. SWITCH TO HAVE 0.3 AMP INTERRUPTING CAPACITY ON 125 V.D.C. INDUCTIVE CIRCUIT.

VENDOR: UNITED ELECTRIC CONTROLS CO.
WATERTOWN, MASS.

REPR: A-A ELECTRIC, INC.
CEDARBURGH, WISCONSIN 53021



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REV NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

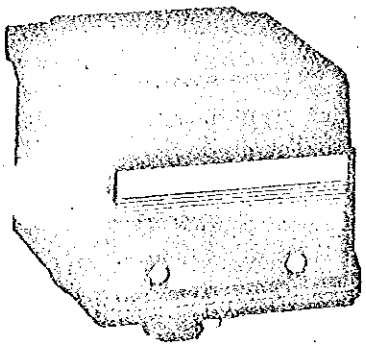
TITLE: SWITCH, PRESS. 0-2" W.C.

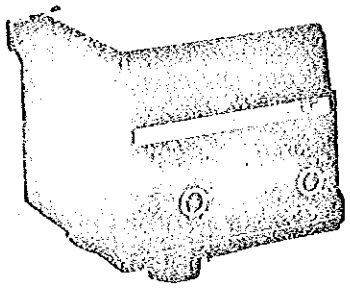
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. P6501	10/10/76	ASSY. OR LO.	
DR. BY L.W. COOPER	9/16/76	SCALE	
CHK'D. BY R. Estrada	9/17/76	HEAT TR.	
MAT'L PURCH.			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. R.E.K.S.E.	
APPV. WELD.			

SHEET SIZE A — DWG. NO. 1190B400 — SHEET 1 OF 1





300 SERIES PRESSURE CONTROLLERS

ON-OFF TYPES H300, H302, H303, J300, J302, J303

PROPORTIONING TYPES SH300, SH302, SH303, SJ300, SJ302, SJ303, SSH302, SSH303, SSJ302, SSJ303

INSTALLATION AND MAINTENANCE INSTRUCTIONS

IM-300
Rev. C

OPERATION

As pressure changes, a diaphragm, bellows, or piston sensor actuates 1, 2, or 3 snap switches or positions the wiper of a proportioning potentiometer. The controller settings are determined by positioning the switches or potentiometer by means of internally located adjustment screws (J types) or external knobs (H types).

PART I—INSTALLATION—ALL TYPES

1. Remove Cover
   — Cover is held on by two captive screws located below the blue panel.
   — On calibrated controls first pull off the knob (s).

2. Knockout Electrical Entrance
   Three cast-in knockouts for ½" conduit are located in the sides and back of the enclosure. These can be easily knocked out with a screwdriver. Place the end in groove and rap it sharply with a hammer.

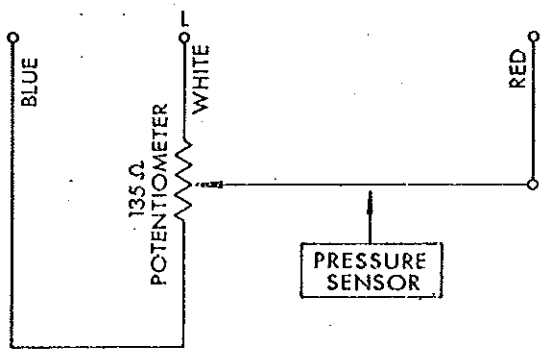
3. Mount the Controller
   Mount the case in any position. Locate it where vibration, shock and ambient temperature fluctuations are minimal. Mount it directly to a pipe via the pressure connection or to panel as follows (See mounting diagrams—Fig. 1.):

   To Surface Mount: Use the two holes in the mounting bracket supplied. For front side or top mounting, the bracket may be removed and repositioned on the base casting. In lieu of the bracket the case may be used. Knock them out in accordance with step 2.
   To Panel Mount: Position the bracket for front mounting, prepare a rectangular cutout in the panel to reveal the knob and scale, and drill two holes to clear #¼ screws.
   To Pipe Mount: Mount via the NPT pressure connection. Always hold a wrench on the hex or flat portion of the diaphragm piston or bellows housing when tightening.

4. Make Wiring Connections
   A. On-Off Switch Types
      Connect conduit to the case and wire directly to the switch terminals in accordance with the job wiring requirements. Bring the wires up to the terminals from the rear of the case allowing enough slack so as not to retard switch movement when making setting adjustments. See Fig. 2.
      If manual reset switch is used lead wires are supplied, color coded as follows:

Common	White
Normally Closed	Blue
Normally Open	Black

   B. Proportioning Potentiometer Types
      Follow same procedure and caution as paragraph 4A above, except utilize wire nuts to connect wiring to leads of potentiometer. Wiring as follows:



   C. Combination Switch & Potentiometer Types
      Follow procedure of paragraph 4A & 4B above.

5. Adjust Settings for Internal Adjustment Types
   See adjustment procedure Part II

6. Replace Cover (and knobs if supplied)

PART II—ADJUSTMENTS—ON-OFF TYPES ONLY

SEE FIGURE 2

1. Non-Calibrated J300 Only
   Remove cover. Switch has screw adjustment inside enclosure. To raise the pressure setting turn the screw in (clockwise), one full turn corresponds to 10% of range on diaphragm and piston models, and 20% of range on bellow models. When making adjustments do not exceed the proof pressure rating on the nameplate.

2. Types—J302,J303
   Remove cover. Follow same procedure as paragraph above. Switches may be set together or apart up to 100% of scale range. On dual switch models either switch may be set high. On 3-switch models, the third (or middle) switch has no over-travel mechanism and must always be set at the highest pressure when the switches are set apart. Altering the setting of one switch will usually have negligible effect on the other(s), however it's recommended that all settings be checked after each adjustment.

3. Calibrated Types—H300, H302, H303
   Dials are factory calibrated for maximum accuracy at the scale midpoint. Recalibration of knob zero point may be desired at a critical pressure setting or after changing a switch or diaphragm, etc. Proceed as follows:

UNITED ELECTRIC CONTROLS COMPANY
85 SCHOOL STREET • WATERTOWN • MASS. 02172 • U.S.A. • 617/926-1000
TELEX: 092-2445

a) Turn the knob (s) to the desired calibration pressure.
b) Remove the knob (s) and cover.
c) Adjust screws per paragraph (1) until switch (es) trips at the knob setting.
d) Replace cover and knob (s).

4. Types With Adjustable On-Off Differential Switches
   a) Types J300D, J302D, J303D.
   Differentials are varied by rotating the wheel using the switch mounting screw as an index. Increasing letters correspond to a wider differential. See Fig. 3A.
   b) Types H300D, H302D, H303D.

   Differentials are varied by rotating the wheel. Clockwise turning corresponds to a wider differential. See Fig. 3B.

5. Types With Extra Wide On-Off Differential Switches
   Types J300F, J302F, J303F (1 and 2 switch only)—same procedure as paragraph 4a. above, adjust differentials up to appx. 70% of range.

6. Types With Manual Reset
   Some models (suffix "G") incorporate a snap switch that, when actuated, remains tripped until pressure changes, and the reset button is depressed to reset position manually. On multi-switch controls, this switch must be set highest.

PART III—ADJUSTMENTS—PROPORTIONING TYPES ONLY

Potentiometers register 35% coil resistance at set point

SEE FIGURES 2 & 3C

1. General—Internal Adjustment Types SJ300 Only
   Remove cover. Potentiometer has hex screw adjustment inside cover. To raise the pressure setting turn the screw in (clockwise), one full turn corresponds to 20% of range on bellows models. When making adjustments do not exceed the proof pressure rating on the nameplate.

2. Dual Potentiometer Internal Adjustment Type SSJ300 Only
   Remove cover and follow procedure in above paragraph. Potentiometers may be set together or apart up to 100% of scale range; either potentiometer may be set high. Altering the setting of one potentiometer will usually have negligible effect on the other, however, it's recommended that all settings be checked after each adjustment.

3. Calibrated Proportioning—Types SH300 & SSH302
   Dials are factory calibrated for maximum accuracy at the scale midpoint. Recalibration of the knob zero point may be desired at a critical pressure setting or after changing a potentiometer or sensor, etc. Proceed as follows:

a) Turn the knob (s) to the desired calibration pressure.
b) Remove the knob (s) and cover.
c) Adjust screws per paragraph (1) until potentiometer (s) matches the knob setting.
d) Replace cover and knob (s).

PART IV—ADJUSTMENTS—COMBINATION ON-OFF/PROPORTIONING TYPES

1. Internal Adjustment Types SJ302, SSJ303, SJ303—follow procedure for Internal Switch (Part II) and Internal Potentiometer (Part III) adjustments above.

2. External Adjustment—Types SH302, SSH303, SH303—follow procedure for External Calibrated Switch (Part II) and External Calibrated Potentiometer (Part III) adjustments above.

PART V—REPLACEMENT PARTS

Components most likely to require replacement are the diaphragm, piston or bellows sensors and the switches or potentiometers. Replace as follows:

Switch Replacement
1. Disconnect Leadwires.
2. Remove the two mounting screws. On multi-switch controls first remove switch bias spring. See Fig. 2.
3. Insert replacement switch and replace screws.
4. Check switch set point and recalibrate if required. See Adjustments Part II.

Potentiometer Replacement
1. Disconnect Leadwires wire nuts.
2. Remove potentiometer mounting screws on multi-potentiometer controls, first remove potentiometer bias spring just as switch replacement above (Fig. 2).
3. Insert replacement potentiometer, replace mounting screws, reconnect wires with wire nuts.
4. Check control set points and recalibrate if required, following Adjustment procedure--Part III.

Diaphragm Replacement
1. Remove the 6 pressure cap screws.
2. Insert new diaphragm as shown in Fig. 4.
3. Replace pressure cap and screws. Make sure they are tight.
4. Check set point (s) and recalibrate if required. See Adjustments Part II, III, or IV.

CAUTION: TO INSURE AGAINST POSSIBLE LEAK, BE SURE O'RING IS PROPERLY SEATED BEFORE TIGHTENING SCREWS.

Bellows and Piston and Assembly Replacement
1. Bellows: Unscrew the bellows housing from the casting. Retain the plunger. Piston: Unscrew tip of pressure connection only.
2. Screw in the new bellows or piston assembly.
3. Check set point (s) and recalibrate if required. See Adjustments Part II, III, or IV.

MOUNTING DIAGRAM

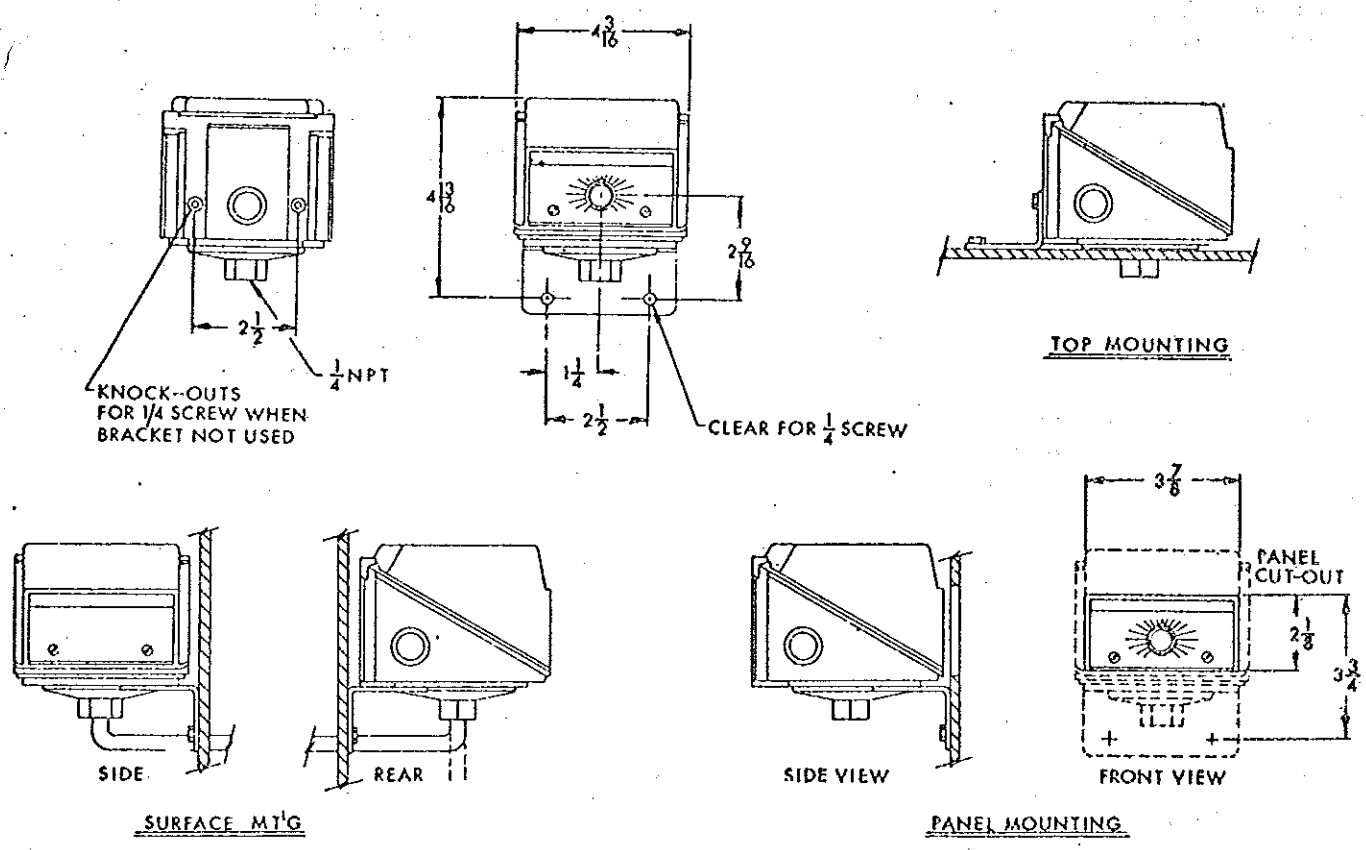


FIG. 2 GENERAL LAYOUT

NOTE: The middle switch assembly is omitted in dual switch controllers. The outer two switch assemblies are omitted in single switch controllers. "J" series controllers have internal screw adjustments. "H" series controllers have cam assemblies for external calibrated adjustment.

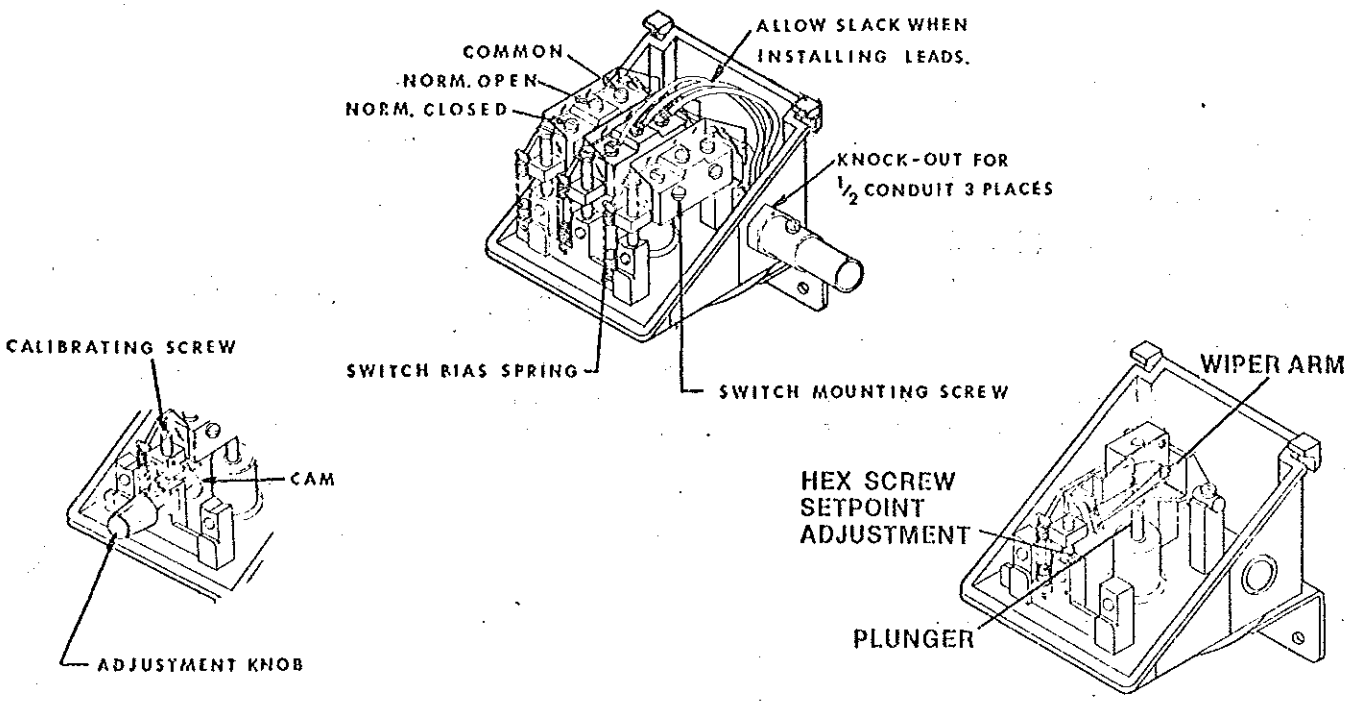


FIG. 3A

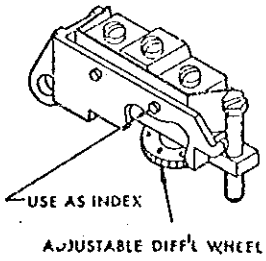


FIG. 3B

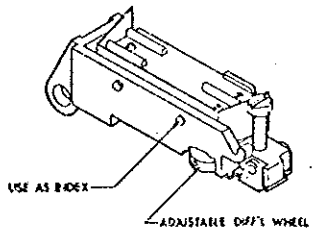


FIG. 3C

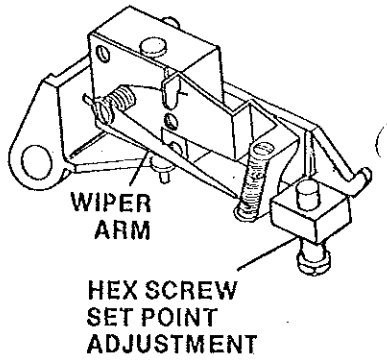
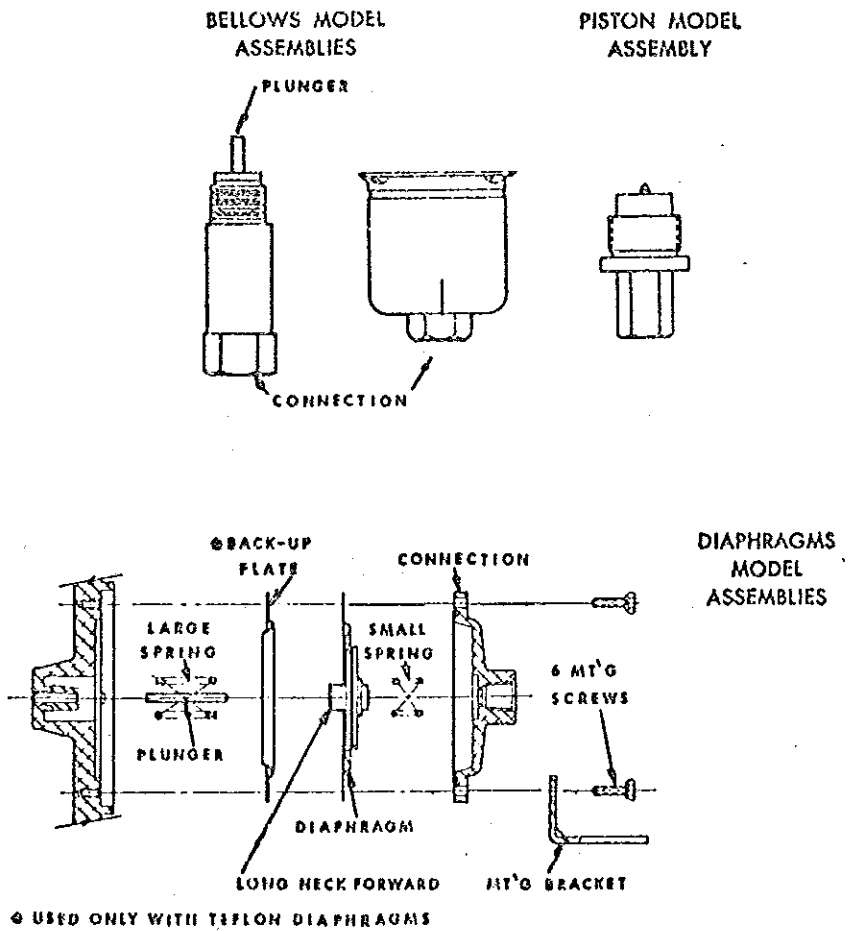
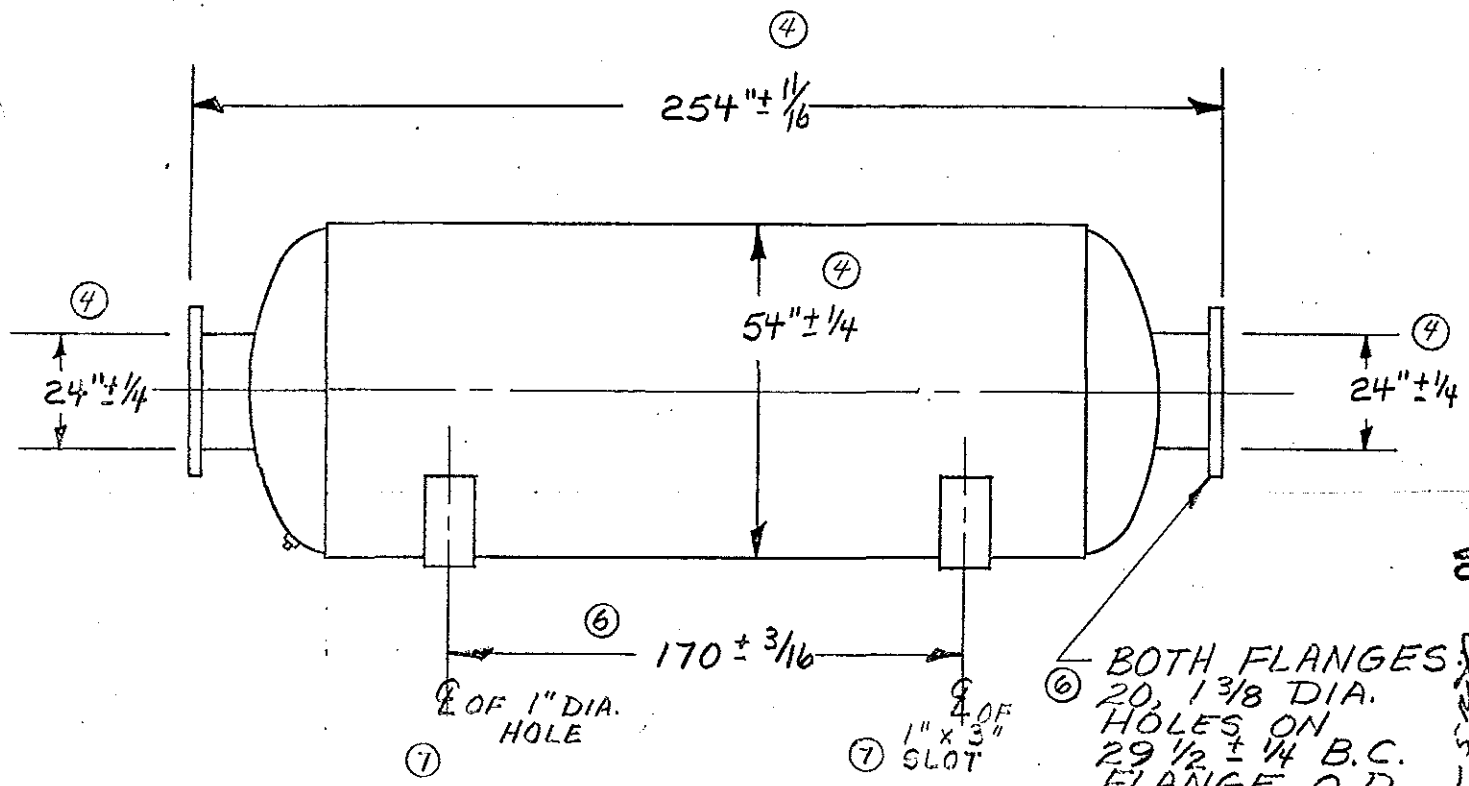


FIG. 4 SENSING ELEMENT





LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER NO. LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: BURGESS-MANNING

①

VENDOR DWG. NO.: 52-2008-3 REV. 1

TITLE: SILENCER, EXHAUST, BMTA-24

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REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D. BY
5	11348	3-21 79	⑦ & NOTES ADDED ⑥ DIMENSION ADDED	
5	"	"	⑤ NOTE ADDED ④ TOLERANCES ADDED	
4	11137	10-12 78	③ DELETE REF TO REV OF SPEC PG. 1/2, & 1/2	VM MISKO
3	11014	8-7-78	② ADD REV STATE TO SUB TIER SPECS	ULS MISKO
2	10587	11-28 77	① ADDED VENDOR, VENDOR DWG. NO. AND PICTURE	SJV
1	10259	3-31 77	GENERAL REVISIONS	J.A.D. JAW

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1700	2/24/77	ASSY. OR LO.	
DR. BY J. Dorn	2/10/77	SCALE	
CHK'D. BY J. WHALEN	2/18/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 511 | SHEET 1 OF 3

ORIGINAL

COLT OCT 17 1978 APP | FM | OA

COLT FEB 26 1979 APP | FM | OA

11 908 511

EXHAUST SILENCER FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL POWER CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY TO THE EXHAUST SILENCER.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 37-38 PARA. 5.0a THRU g - INSPECTION & TESTS

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3a & b - SHIPMENT

1.1.4 PAGE 47 PARA. 8.2f - DOCUMENTATION REQUIREMENTS

1.1.5 APPENDIX "D" - SOUND LEVEL DATA

2. TECHNICAL SPECIFICATIONS

2.1 24" HORIZONTALLY MOUNTED EXHAUST SILENCER AS FOLLOWS:

2.1.1 EXHAUST FLOW - 34,000 CFM AT 730°F

2.1.2 MAXIMUM DESIGN EXHAUST TEMPERATURE - 900°F

2.1.3 MAXIMUM PRESSURE DROP FLANGE TO FLANGE - 5" WATER

2.1.4 SOUND ATTENUATION - SHALL MEET OR EXCEED LEVELS GIVEN IN APPENDIX "D" (SEE PARA. 1.1.5)

2.1.5 MATERIALS OF CONSTRUCTION - WELDED STEEL

2.1.6 SILENCER SHALL BE TREATED WITH VENDOR STANDARD PAINT TO PREVENT RUST. ENDS SHALL BE SEALED TO PREVENT ENTRANCE OF DIRT.

2.1.7 SILENCER SHALL BE EQUIPPED WITH SADDLES OR MOUNTING BRACKETS SUITABLE FOR HORIZONTAL MOUNTING

2.1.8 THE MOUNTING OF THE SILENCER TO FOUNDATION (FOUNDATION BY OTHERS) AND THE COMPONENT INTEGRITY MUST BE ADEQUATE AND DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.1.9 VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

ORIGINAL

REV. 4 REV. 5

11 908 511
COLT FEB 26 1979 QA
COLT OCT 17 1978 QA APP
TTC 906 TT

2.1.10 ANCHOR BOLT LOADINGS - THE MANUFACTURER'S SETTING PLAN DRAWING OF THE COMPONENT SHALL INDICATE THE ANCHOR BOLT LOADINGS IN THE FORMAT OF A NOTE. "THE SEISMIC AND OPERATING ANCHOR BOLT LOADINGS, EACH BOLT AT THE _____LOCATIONS, _____LBS TENSION AND _____LBS SHEAR.

2.1.11 THE MANUFACTURER'S ARRANGEMENT PLAN FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS, DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE AND ANCHOR BOLT LOADINGS.

2.1.12 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

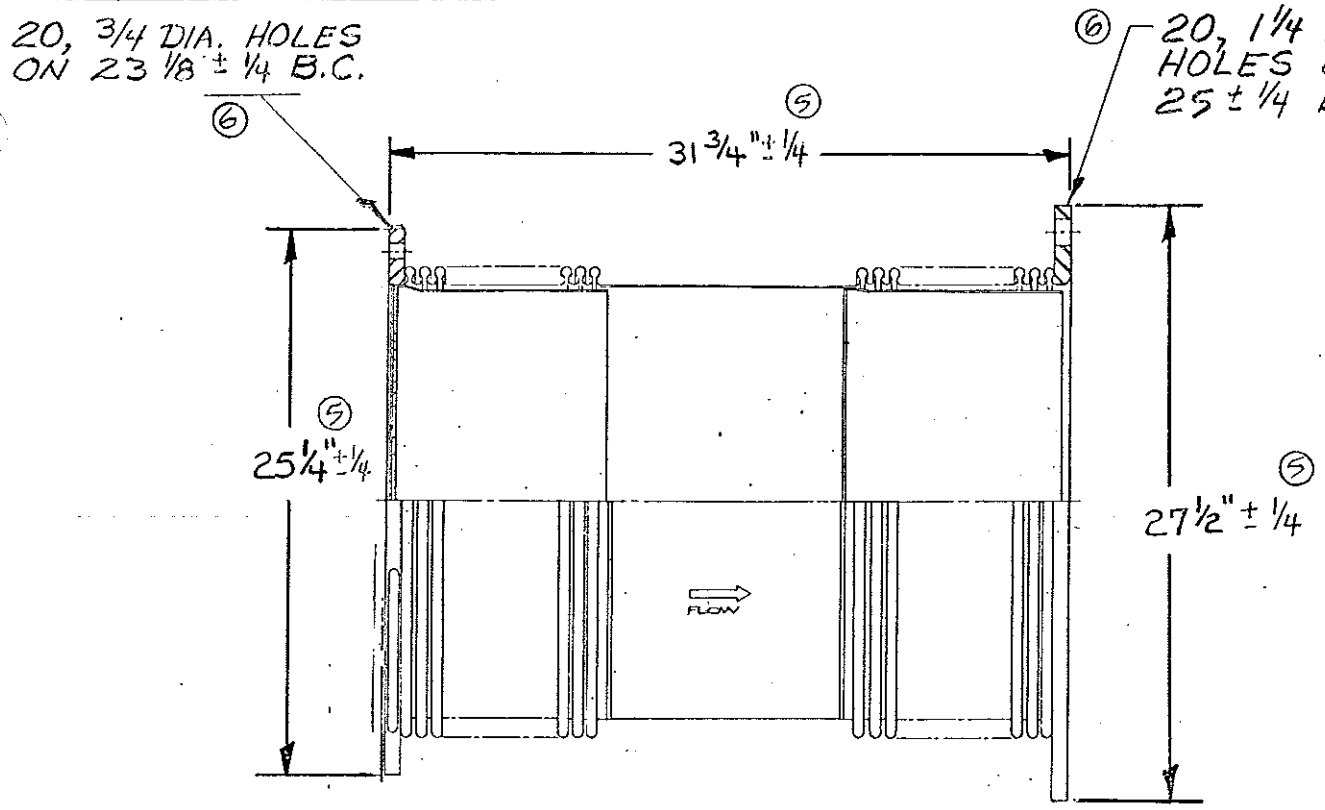
11 908 511

COLT FM OCT 17 1978 COLT QA FEB 26 1979 APP FM QA

ORIGINAL

Colt Industries / Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 511 REV 3 REV 2	SHEET 3 OF 3

REV 4 REV 5



1 908 512

COLT FEB 2 1978 QA

COLT OCT 12 1978 QA

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: FLEXONICS

②

VENDOR DWG. NO.: 310-379-5005

TITLE: EXPANSION JOINT, EXHAUST, 20"

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	11348	3-21 79	⑥ NOTES ADDED ⑤ TOLERANCES ADDED	LSD
4	11137	10-12 78	④ DELETE REF TO REV OF SPEC PG. 42 & 43	
3	11014	8-7 78	ADD REV STATE TO SUBMITTED SPEC. ③	DLS
2	10575	11-28 77	② ADDED PICTURE, VENDOR, & VEN. DWG. NO.	SJV
2	10575	11-28 77	① ADDED PARA. 2.1.17	SJV
1	10259	3-31 77	GENERAL REVISIONS	JLD

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1700	2/24/77	ASSY. OR LO.	
DR. BY J. Dorn	2/11/77	SCALE	
CHK'D. BY J. WHALEN	2/18/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 512 | SHEET 1 OF 3

ORIGINAL

EXHAUST EXPANSION JOINT FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY TO THE EXPANSION JOINT.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 37-38, PARA. 5.0a THRU g - INSPECTION & TESTS

1.1.2 PAGE 42, PARA 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA 6.3a & b - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - DOCUMENTATION REQUIREMENTS

2. TECHNICAL SPECIFICATIONS

2.1 20" EXHAUST EXPANSION JOINT VERTICALLY MOUNTED AND AS FOLLOWS:

2.1.1 OPERATING TEMPERATURE - 750°F

2.1.2 DESIGN TEMPERATURE - 900°F

2.1.3 OPERATING PRESSURE, MAX. - 15 PSI

2.1.4 DESIGN PRESSURE - 30 PSI

2.1.5 AXIAL MOVEMENT - COMPRESSION - .5"

2.1.6 MAX. ALLOWABLE AXIAL FORCE - 400 LBS - LESS ONE-HALF THE WEIGHT OF THE EXPANSION JOINT

2.1.7 LATERAL MOVEMENT - .5"

2.1.8 MAX. LATERAL FORCE WHEN OFFSET .5" - 100 LBS - MAX. MOMENT - 150 FT. LBS

2.1.9 MATERIALS OF CONSTRUCTION
BELLOWS - STAINLESS STEEL
LINER - STAINLESS STEEL
FLANGES - CARBON STEEL

2.1.10 FLANGES SHALL BE SPS FLAT FACE FLANGE FIXED END, 125 LB LIGHT WEIGHT ASA FLAT FACE VAN STONED FLANGE OTHER END. SPS FLANGE DIMENSIONS - 25-1/4" O.D. (20) 3/4" DIA. BOLT HOLES ON 23-1/8" DIA. BOLT CIRCLE. INLET AT FIXED END.

2.1.11 EXPANSION JOINT SHALL BE TREATED TO PREVENT RUST.

ORIGINAL

M/F REV. 4 REV. 5

908 512
COLT OCT 17 1978 FM
QA APP FEB 26 1979

11 908 512

2.1.12 THE INTERIOR OF THE COMPONENT MUST BE FREE OF ALL DIRT, WELD BERRIES AND ANY OTHER FOREIGN MATERIAL AND THE ENDS SEALED TO PREVENT ENTRANCE OF DIRT.

2.1.13 THE EXPANSION JOINT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONATAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.1.14 VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

2.1.15 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.1.16 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS.

① 2.1.17 EXHAUST FLOW - 34,000 CFM AT 730°F.

QA COLT FEB 26 1979 APP

COLT QA OCT 17 1978 APP

M/F ORIGINAL

Colt Industries / Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 512 REV. 3 REV. 2	SHEET 3 OF 3

M/F REV. 4 REV. 5

CHAPTER 8 - ENGINE-GENERATOR SUPPORT SYSTEMS

6. AIR INTAKE SYSTEM

Part No.	Item
11 908 389	Filter/Silencer, Air Intake
11 908 513	Joint, Air Intake Expansion
11 908 785	Manometer, "U" Tube

BURGESS-MANNING, INC.
227 THORN AVENUE, ORCHARD PARK, NY 14127
VOICE: (716) 662-6540 FAX: (716) 662-6548

FAX Transmission **NUMBER OF PAGES: One (1)**

From:	**DAVID J. BREINDEL**	**Date:**	**May 19, 1993**
To:	**MR. DAVE NELSON**	**FAX #:**	
Company:	**COLTEC**		

REFERENCE: Coltec #431282-H
Burgess-Manning Shop Order 72960

The quote you received referencing 000-0111-00-020 is infact the same door latch shown on our acknowledgment as 11265-111.

The part number quoted is obsolete. The shipping papers referenced Part Number 11265-111.

Yours very truly,

BURGESS-MANNING, INC.

Judy Goodwin

Judith Goodwin

cc: T. Stevenson
F. Chase

JG/djd

BURGESS-MANNING, INC.

227 Thorn Avenue • Orchard Park, New York 14127
(716) 662-6540 TELEFAX: (716) 662-6548 EASYLINK: 62886281

Burgess-Manning, Inc. | Bos-Hatten, Inc. | Nitram Energy Systems Division | Alco Products Division

PROPOSAL

TO: COLTEC INDUSTRIES

ATTENTION: MR. DAVE NELSON

DATE April 30, 1993

CUSTOMER REFERENCE NO.

PROPOSAL NO.

JOB/LOCATION

Item	Quantity	Description	Est. Wgt.	Price
A	6	Door Latches for Drawing 20-1783-0 Part Number 000-0111-00-020	6 Lbs.	$27.00 Each

cc: Ted Stavanson
[redacted]
LIMERICK

Filter
Silencer
air inlet

(1190838 9)

PAGE 1 OF 1

DRAWINGS --

DELIVERY Stock

F.O.B. Cisco, Texas

TERMS Net 30 Days

PROPOSAL EXPIRATION DATE 90 Days

PROPOSAL SUBJECT TO TERMS AND CONDITIONS ON REVERSE SIDE HEREOF.

SK/djd

FOR FURTHER INFORMATION CONTACT THE UNDERSIGNED OR:

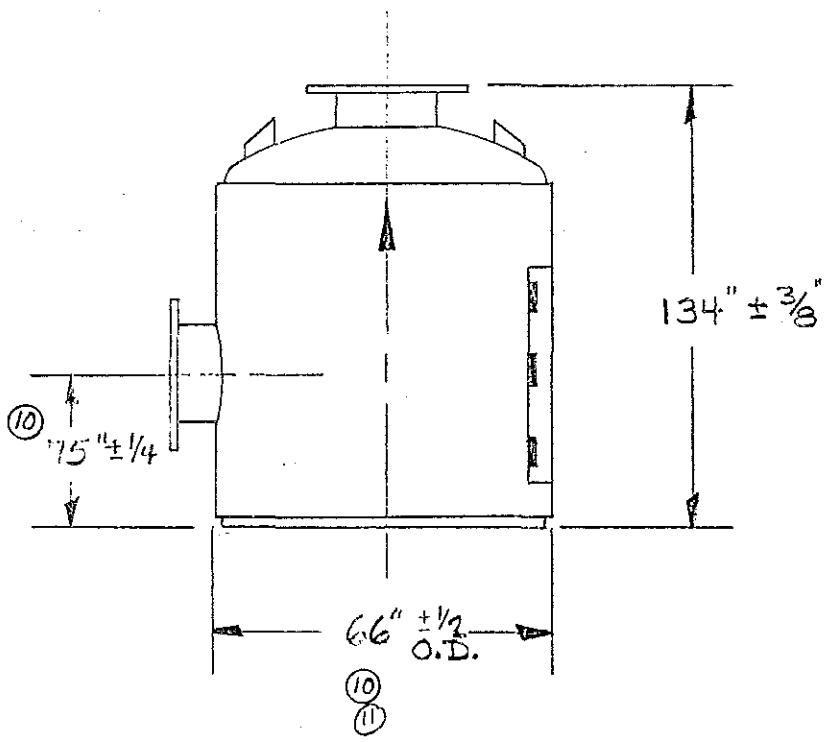
SIGNED Sharon Konieczko Sharon Konieczko

TITLE Sales Coordinator

908 389

SDLF 160 FILTER SILENCER

⑨ BOTH FLANGES: 24, 1 3/8 DIA. HOLES ON 31 3/4 ± 1/4 B.C. FLANGE O.D. 34 1/4 ± 1/4



LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER NO. LX239585
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: BURGESS-MANNING

VENDOR DWG. NO.: 20-1783-0

APPROVED Rev. 2 AUG 5 1977 QUALITY CONTROL

APPROVED Rev. 1 1977 QUALITY CONTROL

APPROVED Rev. 0 FEB 21 1977 QUALITY CONTROL

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TITLE: FILTER/SILENCER, AIR INLET

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
5	11348	3-21-79	⑩ TOLERANCES ADDED NOTE ADDED	
4	11137	10-12-78	⑧ DELETE REF TO REV OF SPEC PB 42413	
3	11014	8-7-78	ADD REV. STATE TO SUB TIER SPECS (7)	
2	10412	7/1/77	⑥ ADDED PICTURE ⑤ ADDED VENDOR DWG NO ④ PARA 2.5 & 2.6 (SH. 2) WERE 2nd SIZE	SJV ITC SJV
2	10412	[illegible]		
1	10384	7/27/77	SEE SHT. 2 FOR ① ② SHT 3 FOR ③ ③ CHNGD. WELD. SPEC. ② CHNGD. TO LIQ. PENETRANT ① CHANGED WELD. SPEC.	J.K.
1	10384	[illegible]		

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1700	2/24/77	ASSY. OR LO.	
DR. BY J. Dorn	2/10/77	SCALE	
CHK'D. BY J. WHALEN	2/18/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 389 | SHEET 1 OF 4

COLT FEB 26 1979 QA
COLT Rev. 5 Mar 1979 QA
COLT OCT 17 1978 QA
COLT JUL 31 1978 QA
Rev. 3 Mar 1979
11 908 389

INLET AIR FILTER FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL POWER CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY," THAT APPLY.

1.1 8031-M-71 REVISION 3 - SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 41 & 42, PARA. 6.1a THRU g - PAINTING

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3e - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - DOCUMENTATION

1.2 8031-G-4 REVISION 6 - PAINTING SPECIFICATION

1.2.1 SHT. 1, PARA. G4.3.2 - ADD TO FIRST SENTENCE..."OR EQUAL, OR THE MANUFACTURER'S STANDARD FOR THE INTENDED SERVICE."

1.2.2 SHT. 2 DELETE PARA. G4.3.3

1.2.3 SHT. 2 ADD TO PARA. G4.5 "PAINT COLOR SAMPLES MUST BE SUBMITTED FOR APPROVAL AND THICKNESS CERTIFIED PRIOR TO RELEASE FOR SHIPMENT."

1.3 QA REQUIREMENTS PER COLT/FM DWG. 11 870 828 REV. 2

1.4 ADDITIONAL SPECIAL QA REQUIREMENTS

(1) 1.4.1 ALL WELDING TO BE CONDUCTED SHALL BE PERFORMED TO THE REQUIREMENTS OF AWS D1.1, REVISION 1-76. WELDING PROCEDURES, PROCEDURE QUALIFICATION AND WELDER QUALIFICATION DATA SHALL BE SUBMITTED TO COLT/FMED FOR APPROVAL.

(2) 1.4.2 LIQUID PENETRANT EXAMINATION IS TO BE PERFORMED ON ALL WELDING WITH THE EXCEPTION OF RESISTANCE SPOT WELDING. ALL TEST PERSONNEL TO BE QUALIFIED IN ACCORDANCE WITH AN/SNT-TC-1A.

1.4.3 RESISTANCE SPOT WELDING: A WELD PROCEDURE MUST BE PREPARED IN ACCORDANCE WITH A NATIONALLY ACCEPTED STANDARD TO EFFECTIVELY CONTROL AND QUALIFY THIS WELDING PROCESS. OPERATORS SHALL ALSO BE SUITABLY QUALIFIED.

APPROVED Rev. 0 FEB 21 1977 QUALITY CONTROL

APPROVED Rev. 1 [illegible] 1977 QUALITY CONTROL

APPROVED Rev. 2 AUG 5 1977 QUALITY CONTROL

1 908 389 ... 11 908 389

WRITTEN PROCEDURES SHALL BE SUBMITTED TO COLT INDUSTRIES FOR APPROVAL.

(3) 1.4.4 REPAIR WELDING SHALL NORMALLY NOT BE CONDUCTED. IF WELD REPAIRS BECOME A NECESSITY, A QUALIFIED PROCEDURE MUST BE WRITTEN TO COMPLY WITH AWS D1.1 REVISION 1-76 AS REQUIRED, AND SUBMITTED TOGETHER WITH THE QUALIFICATION DATA TO COLT INDUSTRIES FOR APPROVAL. REPAIRS MAY NOT BE CONDUCTED WITHOUT PRIOR APPROVAL, AND A CERTIFIED REPAIR REPORT SHALL BE SUBMITTED AFTER ANY SUCH REPAIRS. NON-DESTRUCTIVE TEST SHALL BE PERFORMED ON EACH REPAIR, UTILIZING ONLY APPROVED PROCEDURES AND QUALIFIED PERSONNEL.

1.4.5 COLT INDUSTRIES' QUALITY ASSURANCE DEPARTMENT WILL CONDUCT A FIRST ARTICLE INSPECTION AFTER THE FIRST UNIT IS WELDED, BUT NOT COVERED OR SEALED. AN N.D.E. REPORT MUST BE MAILED TO COLT INDUSTRIES, TRACEABLE TO EACH FILTER. A TEN (10) DAY CUSTOMER NOTIFICATION IS REQUIRED PRIOR TO THIS INSPECTION.

2. TECHNICAL SPECIFICATIONS

2.1 COMBINATION AIR INTAKE FILTER/SILENCER FOR FLOOR MOUNTING AND LOCATED INDOORS.

2.2 RATED CAPACITY - 16000 SCFM

2.3 RATED PRESSURE DROP, CLEAN - 2" WATER MAX.

2.4 FILTRATION CAPACITY - 100 MICRON. FILTER PANELS MAY BE EITHER DISPOSABLE OR CLEANABLE TYPE

(4) 2.5 INLET FLANGE CONNECTION SIZE - 26". FLANGE SHALL BE LOCATED ON THE SIDE OF THE FILTER/SILENCER.

2.6 OUTLET FLANGE CONNECTION SIZE - 26". FLANGE SHALL BE LOCATED ON THE TOP OF THE FILTER.

APPROVED Rev.2 AUG 5 1977 QUALITY CONTROL 2.7 THE INTERIOR OF THE COMPONENT MUST BE FREE OF WELD BERRIES, DIRT AND ANY OTHER FOREIGN MATERIAL, TREATED TO PREVENT RUST AND THE FLANGES SEALED TO PREVENT ENTRANCE OF DIRT.

APPROVED Rev. 1 JUL 13 1977 QUALITY CONTROL 2.8 THE MOUNTING OF THE STRUCTURE TO FOUDATION (FOUNDATION BY OTHERS) AND THE COMPONENT INTEGRITY MUST BE ADEQUATE AND DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAT TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

APPROVED Rev. 0 FEB 21 1977 QUALITY CONTROL 2.9 VENDOR SHALL FURNISH MAXIMUM ALLOWABLE FLANGE LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

2.10 ANCHOR BOLT LOADING - THE MANUFACTURER'S SETTING PLAN DRAWING OF THE

REV. 4 REV. 5

APP QA COLT FM JUL 7 1979 Rev 6 QA COLT FEB 26 1979 Rev 5 QA COLT FM OCT 17 1978 Rev 4 QA COLT FM JUL 31 1978 Rev 3

908 389

COMPONENT SHALL INDICATE THE ANCHOR BOLT LOADINGS IN THE FORMAT OF A NOTE. "THE SEISMIC AND OPERATING ANCHOR BOLT LOADINGS. EACH BOLT AT THE _____ LOCATIONS, _____LBS TENSION AND _____ LBS SHEAR.

2.11 THE MANUFACTURER'S ARRANGEMENT PLAN FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS, DIMENSIONAL CLEARANCES ARE REQUIRED FOR MAINTENANCE AND ANCHOR BOLT LOADINGS.

COLT QA APP JUL 17 1979 Rev 6
COLT FM FEB 26 1979 QA APP Rev 5
COLT QA APP OCT 17 1978 Rev 4
COLT FM JUL 31 1978 QA APP Rev 3
COLT FM JUL 31 1978 QA APP Rev 2

APPROVED
Rev. 2
AUG 5 1977
QUALITY CONTROL

APPROVED
Rev. 1
JUL 18 1977
QUALITY CONTROL

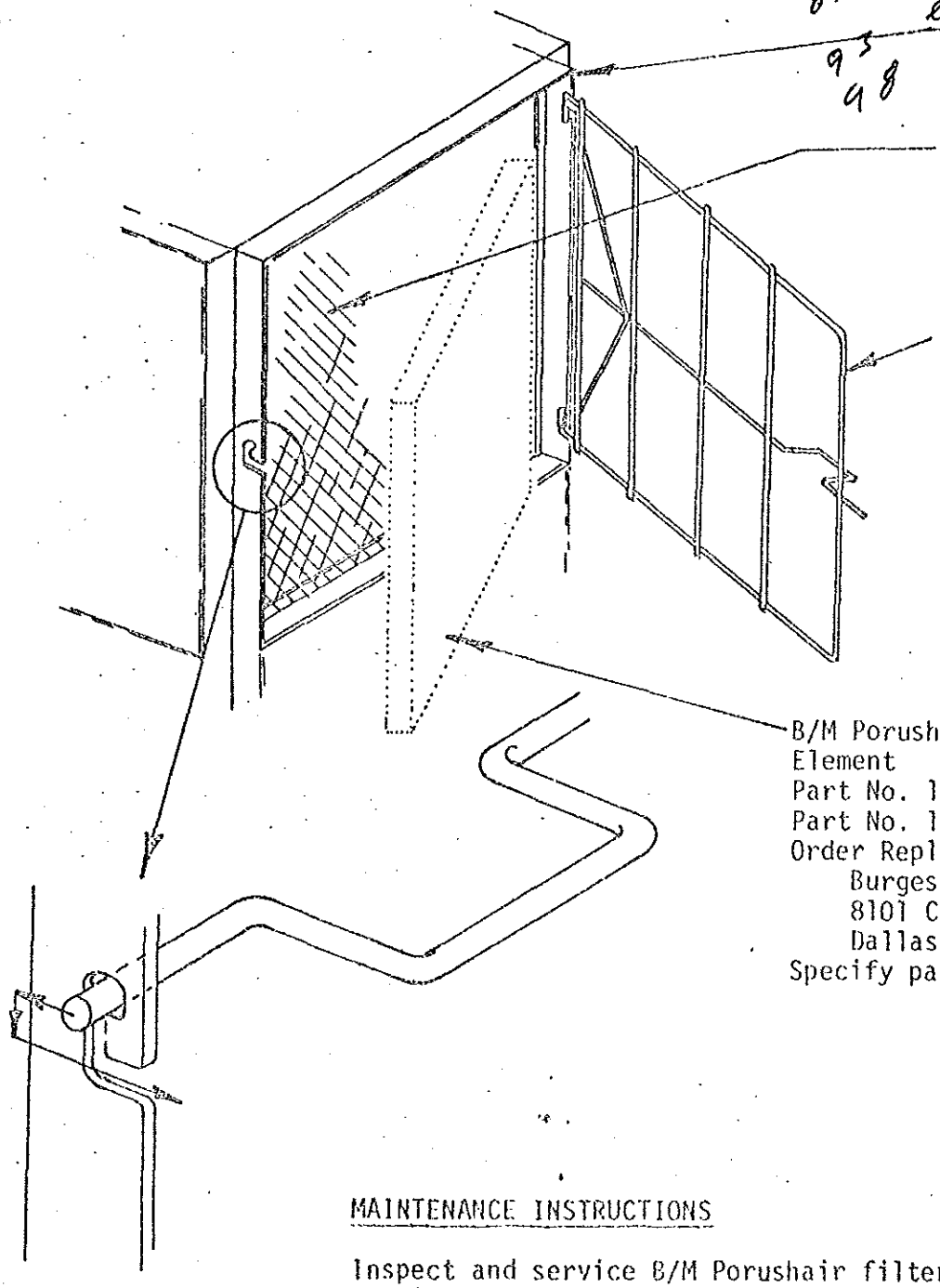
APPROVED
Rev. 0
FEB 21 1977
QUALITY CONTROL

Colt Industries — Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO 11 908 389	REV. 3 REV. 2 REV. 4 REV. 5	SHEET 4 OF 4

11908389

Prepared By		Reference
P.B.	BURGESS INDUSTRIES	10000-483-0
Date		
5-4-79		
	Subject: PARTS LIST AND MAINTENANCE INSTRUCTIONS FOR BURGESS-MANNING POROSHAIR DISPOSAL FILTER ELEMENTS	

71% eff on 5 micron
87% eff on 10 mic.
eff on 15.
on 20
95
98



Filter Frame

Backing Screen, do not remove except for access to inside of filter frame.

Retainer Screen, do not unhinge from filter frame unless replacement of screen is necessary.

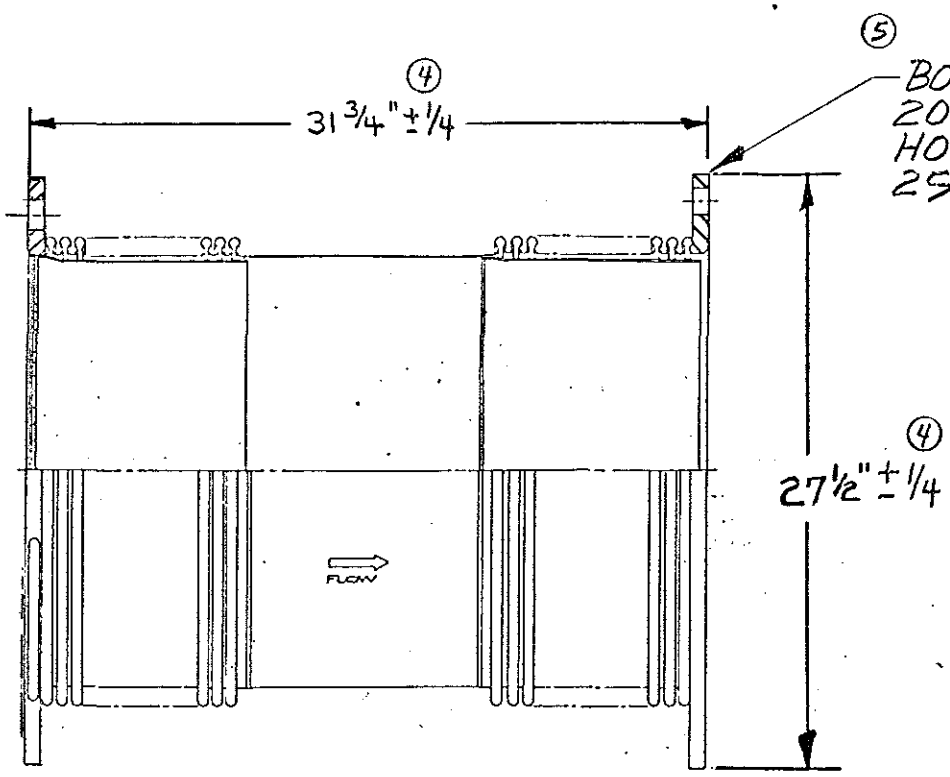
B/M Porushair Disposable Filter Element
Part No. 10500-134: 20" X 20"
Part No. 10500-135: 20" X 25"
Order Replacements From:
Burgess-Manning Division
8101 Carpenter Freeway
Dallas, Texas 75247
Specify part number and quantity.

MAINTENANCE INSTRUCTIONS

Inspect and service B/M Porushair filter elements regularly as required by local dirt conditions or at least annually. Heavy surface dirt concentration and 1" depth penetration indicate filter element should be replaced.

10000-483-0

908 513



LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: FLEXONICS ①

VENDOR DWG. NO.: 310-379-5004

TITLE: EXPANSION JOINT, AIR INLET, 20"

COLT OCT 17 1978 QA
FM FEB 26 1979 QA ADD

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
5	11348	3-21 79	③ NOTE ADDED ④ TOLERANCE ADDED	
4	11137	10-12 78	③ DELETE REF TO REV OF SPEC PQ 42142	
3	11014	8-7 78	② ADD REV. STATE TO SEE THRU SPECS	
2	10575	11-28 77	① ADDED PICTURE, VENDOR, F VEN. DWG. NO.	SJV
1	10259	3-31 77	GENERAL REVISIONS	JLD JMW

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1700	2/24/77	ASSY. OR LO.	
DR. BY J. Dorn	2/11/77	SCALE	
CHK'D. BY J. WHALEN	2/18/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. HDE	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 513 | SHEET 1 OF 3

ORIGINAL

AIR INLET EXPANSION JOINT FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

908 513

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY TO THE EXPANSION JOINT.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGES 37-38, PARA. 5.0a THRU g - INSPECTION & TESTS

1.1.2 PAGE 42, PARA. 6.2a - NAMEPLATES

1.1.3 PAGE 43, PARA. 6.3a - b - SHIPMENT

1.1.4 PAGE 47, PARA. 8.2f - DOCUMENTATION REQUIREMENTS

2. TECHNICAL SPECIFICATIONS

2.1 20" AIR INLET EXPANSION JOINT VERTICALLY MOUNTED AND AS FOLLOWS:

2.1.1 OPERATING TEMPERATURE - 150°F

2.1.2 DESIGN TEMPERATURE - 250°F

2.1.3 OPERATING PRESSURE, MAX.: -6" WATER

2.1.4 DESIGN PRESSURE: -12" WATER

2.1.5 AXIAL MOVEMENT - COMPRESSION - .1"

2.1.6 MAX. ALLOWABLE AXIAL FORCE - 200 LBS. LESS ONE-HALF THE WEIGHT OF THE EXPANSION JOINT

2.1.7 LATERAL MOVEMENT - .15"

2.1.8 MAX. LATERAL FORCE WHEN OFFSET .15" - 100 LBS. MAX. MOMENT - 150 FT. LBS.

2.1.9 MATERIALS OF CONSTRUCTION:
BELLOWS - STAINLESS STEEL
LINER - STAINLESS STEEL
FLANGES - CARBON STEEL

2.1.10 FLANGES SHALL BE 125 LB LIGHT WEIGHT ASA FLAT FACE FLANGE FIXED END, 125 LB LIGHT WEIGHT ASA FLAT FACE VAN STONED FLANGE OTHER END. INLET AT FIXED END.

2.1.11 EXPANSION JOINT SHALL BE TREATED TO PREVENT RUST.

COLT QA FM OCT 17 1978 APP

COLT QA FM FEB 26 1979 APP

ORIGINAL

REV 4 REV. 5

908 513

2.1.12 THE INTERIOR OF THE COMPONENT MUST BE FREE OF WELD BERRIES, DIRT AND ANY OTHER FOREIGN MATERIAL AND THE ENDS SEALED TO PREVENT ENTRANCE OF DIRT.

2.1.13 THE EXPANSION JOINT MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.1.14 VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

2.1.15 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

2.1.16 THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS.

COLT QA FEB 22 1978

COLT QA APP OCT 17 1978

ORIGINAL

Colt Industries — Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 513 REV 3 REV 2	SHEET 3 OF 3

REV 4/5 REV.

DESCRIPTION: Meriam flush mounted U tube manometer with 15" scale (7.5-0-7.5) with Semi-Steel Wetted Parts WITH $\frac{1}{4}$ NPT REAR CONNECTIONS

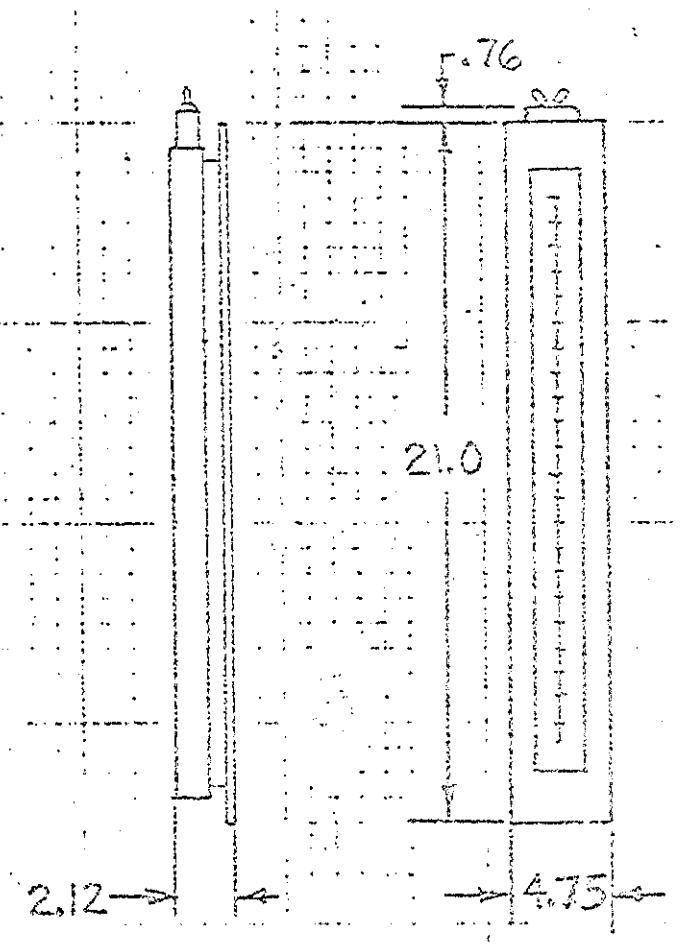
VENDOR'S PC NO: 10AA25FF

VENDOR'S DWG NO: B-2249

VENDOR: Meriam Instrument Company
Cleveland, Ohio

Representative: Simone Engineering Inc.
4962 N. Hopkins Avenue
Milwaukee, Wisconsin

NOTE: Substitutes Not Permitted.



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: MANOMETER, "U" TUBE - 15"

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10282	4/21/77	ASSY. OR LO.	
DR. BY L. McM	3/25/77	SCALE	
CHK'D. BY H. P. S.	4/6/77	HEAT TR.	
MAT'L PURCHASE			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. Y'ELD.			

SHEET SIZE A | DWG. NO. 1190878S | SHEET OF

Installation, Operation and Maintenance Instructions

MERIAM U-TYPE MANOMETERS

The U-Type Manometer is a Primary Standard for measurement of pressure. No other device offers higher accuracy of result. The vertical distance between the two levels in the U-tube is a true measurement of the difference in pressure between the two sides of the manometer. This difference may be expressed in linear units of the indicating fluid used such as Inches of Mercury or easily converted to other convenient terms of measurement such as Pounds Per Square Inch etc. With a wide variety of stable indicating fluids available, exceedingly accurate measurements can be made.

INSTALLATION and OPERATION

Mount the instrument vertically and connect lines from the point of measurement to the convenient ¼" NPT connections at the manometer.

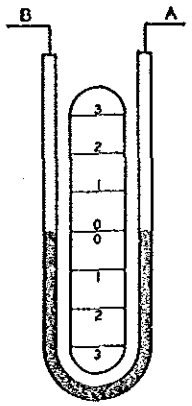


Figure 1

In Figure 1, Connections A and B are the tube leg connections. In measuring a pressure or a vacuum, connection may be made to either A or to B with the remaining leg open to the atmosphere. In measuring a differential pressure, or difference in pressure, the higher pressure is connected to one tube leg, A, and the lower pressure is connected to the other tube leg, B.

With both legs open to atmosphere, as shown in Figure 1, indicating fluid is placed in the U-tube until the level is at the center zero graduation on the scale. Applying a pressure above atmosphere to the leg A as shown in Figure 2, the indicating fluid will immediately respond causing the fluid column to lower in leg A and rise in leg B. The indicating fluid in the U-tube will continue to move until the head of fluid, H, balances the pressure measured. The height of indicating fluid or head will then be the sum of the liquid deflection downward from zero plus the liquid deflection upward from zero. In Figure 2, the fluid in leg A lowered to the 1.5" scale graduation and the fluid level in leg B raised to the 1.5" scale graduation. Under a state of balance the head, H, will then be 1.5" plus 1.5" or 3". The pressure applied to A is then equivalent to 3" of fluid head of whatever indicating liquid is used in the U-tube. As each inch of mercury, water or oil represents a definite pressure equivalent, the head reading, H, can be converted to other units of pressure. With a manometer scale graduated in known pressure units such as pounds or ounces, manometer readings can be taken directly in pressure units. Using a scale graduated in linear inches and tenths readings can be converted to pressure units for any manometer indicating fluid used by referring directly to a Meriam manometer fluid conversion table.

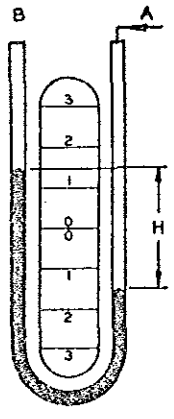


Figure 2

CONVERSION TABLES FOR MERIAM MANOMETER FLUIDS

(All fluids at a temperature of 70° F.)

1 in. Water	= .0361 lbs./sq. in.	1 in. Red Oil	= .0297 lbs./sq. in.
	.5768 oz./sq. in.		.4758 oz./sq. in.
	.0737 in. mercury		.0608 in. mercury
	.3373 in. #3 fluid		.2782 in. #3 fluid
	1.2123 in. Red Oil		.8248 in. water
		1 in. #3 Fluid	= .1067 lbs./sq. in.
1 ft. Water	= .4326 lbs./sq. in.		1.7067 oz./sq. in.
	6.9221 oz./sq. in.		.2185 in. mercury
	.8843 in. mercury		2.9649 in. water
	4.0472 in. #3 fluid		3.5945 in. Red Oil
	14.5481 in. Red Oil	1 oz./sq. in.	= .1277 in. mercury
	62.2987 lbs./sq. ft.		.5847 in. #3 fluid
			2.1017 in. Red Oil
			1.7336 in. water
1 in. Mercury	= .4893 lbs./sq. in.		
	7.8285 oz./sq. in.	1 lb./sq. in.	= 2.0438 in. mercury
	4.5771 in. #3 fluid		27.7369 in. water
	13.5707 in. water		9.3738 in. #3 fluid
	1.1309 ft. water		2.3114 ft. water
	16.4523 in. Red Oil		33.6950 in. Red Oil

MAINTENANCE

Maintenance of the U-type manometer is simple and consists primarily of keeping the indicating fluid and indicating tube clean. Should the fluid become contaminated it is recommended that in the case of mercury, it be cleaned by washing and squeezing thru wet chamois, mechanically agitated and filtered, or replaced by clean instrument grade mercury. Other fluids should be discarded and a fresh filling supplied. Should the connecting lines become plugged disconnect and clean in a suitable manner.

Indicating tubes can be cleaned by swabbing with warm water and detergents followed by a thorough rinse, or by use of suitable solvents such as acetone, naptha or potassium bicromate solution (1 qt. water, 3 oz. potassium bicromate and 3 oz. sulphuric acid). CAUTION: Always pour acid into the water. DO NOT ADD water to the acid. Avoid the use of strong acids or corrosive cleaning agents in contact with metal parts, painted parts or instrument scales. Wipe instrument scales with a damp cloth. After drying the instrument it can be returned to service.

THE MERIAM *Instrument* CO.

10920 MADISON AVENUE — SINCE 1911 — CLEVELAND, OHIO - 44102

Form 63 — *REPRESENTATIVES IN PRINCIPAL CITIES* — Printed in U.S.A.

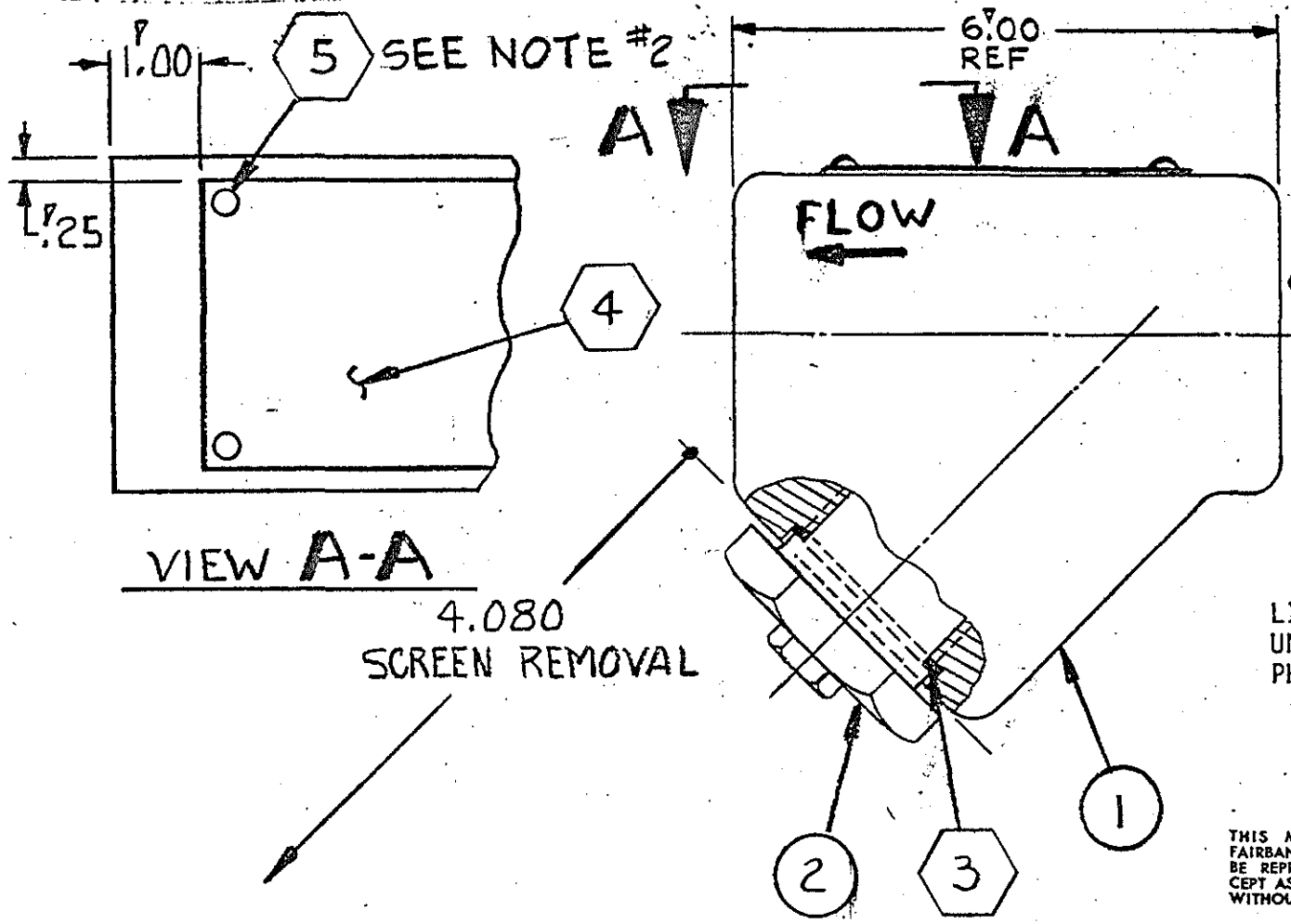
7. AIR START SYSTEM

Part No.	Description
11 872 836	Strainer Assembly 1-1/2"
11 902 079	Pressure Gauge, 0-400 PSI
11 902 174	Control Air Strainer
11 906 077	Pressure Switch
11 906 801	Relief Valve
11 907 020	Solenoid Valve
11 907 495	Plug Valve 1"
11 907 532	Pressure Gauge, 0-600 PSI
11 908 123	Air Start Valve
11 908 370	Air Compressor
11 908 509	Plug Valve 2"
11 908 510	Check Valve 1"
11 908 522	Relief Valve 1/2"
11 908 532	Relief Valve 1/2"
11 908 981	Flexible Connector
11 909 497	Filter/Regulator
11 909 674	Air Filter
11 909 675	Three-Way Manual Override Valve
11 909 676	Three-Way Solenoid Operated Pilot Valve
11 909 677	Two-Way Solenoid Operated Vent Valve
11 909 685	Valve 1-1/2"
11 909 686	Valve 1/2"

11872836

PURCHAS[illegible], RECEIVING, INSPECTION, STORING & DISBURSEMENT ALL COMPLY WITH SECTION QC-6 OF COLT INDUSTRIES, FAIRBANKS MORSE ENGINE DIVISION, NUCLEAR QUALITY CONTROL MANUAL.

TO BE MANUFACTURED IN ACCORDANCE WITH DESIGN SPEC. 11 871 107



② DENOTES ASME III CLASS 3 PART

DENOTES NON-ASME PART

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	11088	9-13 78	SEE SHT 2	CT TRS
2	10992	7-20 78	③ SHT #3 ADDED	RML H.R.S.
2	"	"	② ASM III CL 3 & NON ASME PARTS DENOTED	
1	10689	2-17 78	SEE SHT 2	TRS

TITLE
Y-TYPE STRAINER
1½", S.W., ASSY
ASME

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10621	1/13 78	ASSY. OR LO.	
DR. BY D. BROUSSARD	12/16/77	SCALE 1/2	
CHK'D. BY	/ /	HEAT TR.	
MAT'L SEE B/M			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11872836 | SHEET 1 OF 3

COLT FM JAN 6 1978 QA APP Rev. 0
ULI FM FEB 8 1978 QA APP
COLT FM JUN 29 1978 QA APP Rev. 2
COLT FM SEP 14 1978 QA APP Rev. 3

BF3009-2

A

11872836

GENERAL NOTES:

1. ④ PNEUMATIC TEST TO ①⑤ 345 PSI

2. USING ITEM #4 AS TEMPLATE, DRILL .136 (#29 DRILL) DIA HOLE x .44 DEEP. TYPICAL (4) PLACES.

3. ATTACH NAMEPLATE (ITEM #4) BEFORE PNEUMATIC ④ TEST (SEE NOTE #1).

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	11088	9-13-78	⑤ CHNG'D 425 to 345	UL
3	11	11	④ CHNG'D HYDROSTATIC TEST TO PNEUMATIC	UL
2	10992	7-20-78	③ SEE SHT # 3 ② SEE SHT # 1	BML TRS
1	10689	2-17-78	① WAS 400 PSI	TRS

TITLE: Y-TYPE STRAINER 1 1/2", S.W., ASSY ASME

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10621	1/13/78	ASSY. OR LO.	
DR. BY JACOBSON	12/16/77	SCALE	1/2
CHK'D. BY	/ /	HEAT TR.	
MAT'L SEE B/M			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11872836 | SHEET 2 OF 3

BF3009-2

COLT FM SEP 14 1978 QA
COLT FM JUN 29 1978 QA
COLT FM FEB 8 1978 QA
COLT FM JAN 6 1978 QA

11872836

ASME LEGEND

ITEM NO.	DESCRIPTION	COLT IND QC CHECK	AUTHORIZED INSPECTOR	COLT IND. Q.C. IDENTITY NO.
1	BODY			
2	BONNET ASSY			

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	11088	9-13-78	SEE SHT 2	CLT JRS
2	10992	7-20-78	③ SHT # 3 ADDED ② SEE SHT #1	BM H.R.S.

TITLE: "Y" TYPE STRAINER 1½" S.W ASSY ASME

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY BLINDSEED	6/26/78	SCALE	N
CHK'D. BY	/ /	HEAT TR.	
MAT'L SEE B/M			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11872 836 | SHEET 3 OF 3

BF3009-2

COLT Rev. 3 Engr QA APP FM SEP 14 1978
COLT Rev. 2 Engr QA APP FM JUN 29 1978

11902079

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified)	±1/64
LAYOUT OR ASSEMBLY NUMBER	

Description: Ashcroft, 4-1/2" pressure gauge, phenol turret case, 1/4" NPT.

Back connected, range 0-400 psi at 5 psi intervals and figures at 50 psi intervals.

White face and black markings.

Vendor: Manning, Maxwell & Moore, Inc.
Field Bldg.
135 South LaSalle Street
Chicago, Illinois

Piece/Part No.: 1279A

Drawing No.:

REV. NO.	DATE	CHANGE ORDER NO.	WAS

RELEASE NUMBER AQ-585	DATE OF RELEASE 2-12-62

FAIRBANKS, MORSE & CO.
DIESEL
ENGINEERING DEPARTMENT

DRAWN BY R. Olson	DATE 2-8-62	SCALE
CHECKED BY R. Olson	DATE 2-8-62	

NAME
GAUGE, Pressure

MATERIAL SPECIFICATION

SHEET SIZE A	DWG. NO. 11902079

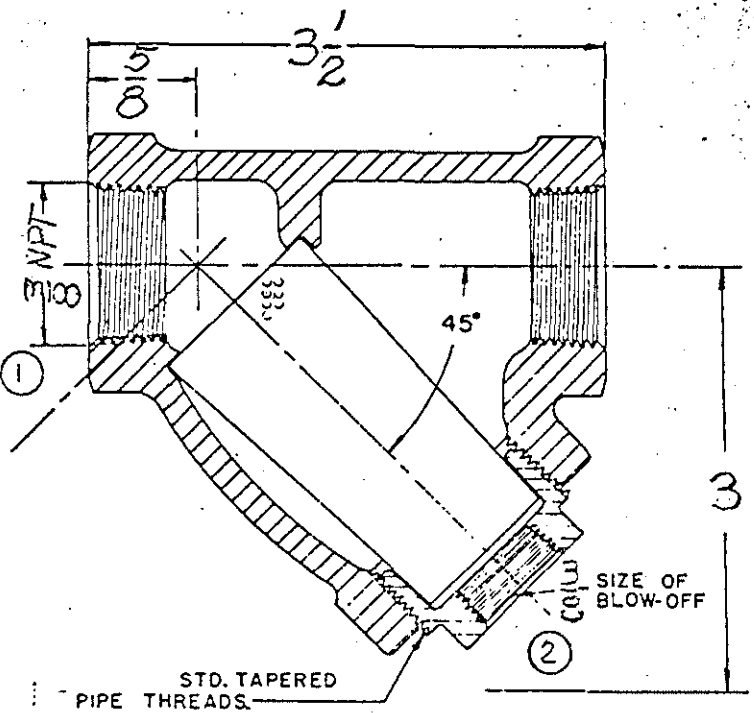
CODE IDENT NO. 82796

APPROVED

BF-3009-25 175-H

SUPERSEDES

SUPERSEDED BY



DESCRIPTION: PAGET 3/8" TYPE B SCREWED "Y"- TYPE STRAINER WITH THE FOLLOWING FEATURES:

1. SEMI-STEEL BODY
2. WITH 100 MESH STAINLESS STEEL SCREEN (.0055 OPENING) BACKED UP WITH 1/8" PERFORATED METAL
3. FOR AIR SERVICE
4. RATING:

   250 PSI - SATURATED STEAM
   400 PSI - W.O.G. @ 100°F. NON-SHOCK

③ VENDOR; SELF CLEANING STRAINER CO. INC.
OR 4545 SOUTHWEST HIGHWAY
APPROVED OAKLAWN, IL 60453
VENDOR:

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	P8832	3/28 79	③ADDED "OR APPROVED VENDOR"	LD
2	10704	2-24 78	② WAS 1/2 SIZE OF BLOW-OFF ① WAS 3/4 NPT	D.C.
1	10488	10-5 77	REDRAWN - WAS LESLIE CATALOG #7000	LMC

TITLE
STRAINER
3/8"

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. AQ-642	5/18/62	ASSY. OR LO.	
DR. BY G. C. CRAIG	5/15/62	SCALE	
CHK'D. BY L.W.COOPER	5/15/62	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. JS	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 902 174 | SHEET OF

DESCRIPTION: ALLEN-BRADLEY BULLETIN 836 OPEN TYPE PRESSURE SWITCH WITH FOLLOWING FEATURES:

1. Adjustable Range 35-375 psi.
2. Adjustable differential 6-55 psi.
3. Maximum Allowable Pressure - 900 psi.
4. Contacts - single pole double throw.

VENDOR'S PART NO: 836-C9

VENDOR: ALLEN-BRADLEY

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH, PRESS. 30-375 PSI.

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL NO 305723	1/21/72	ASSY. OR LO.
DR. BY	/ /	SCALE
CHK'D. BY	/ /	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190607 | SHEET 0

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts
DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC [5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

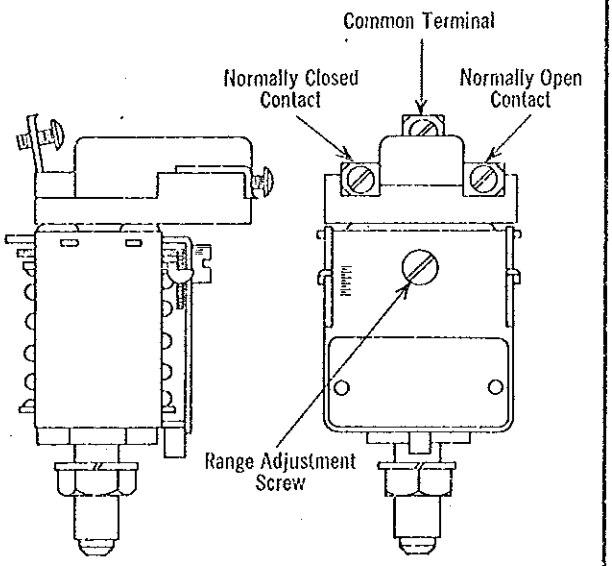
To adjust the controls to suit particular requirements, the following adjustments are to be made; these will apply to both the pressure and temperature controls.

FIXED DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount. It is not possible to change the differential between the cut-in and cut-out settings.

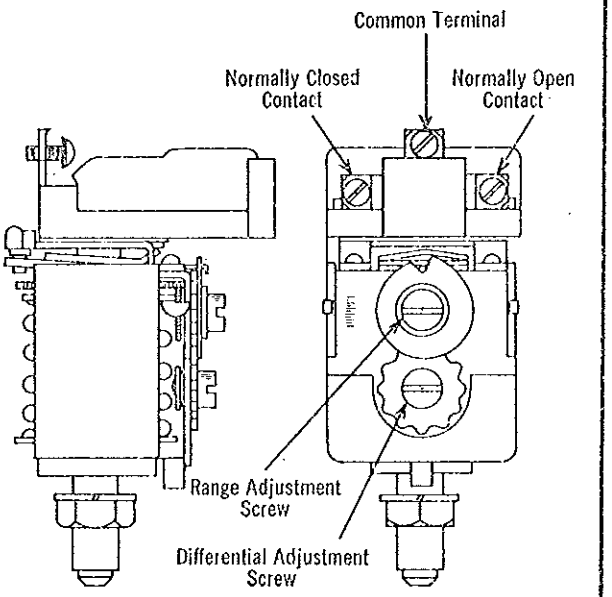
ADJUSTABLE DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount.

When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



Instructions 836-800—November, 1969
Supersedes Instructions 836-800 Dated August 16, 1960

ALLEN-BRADLEY COMPANY

PILOT DUTY RATING —

AC — 125 VA, 24 to 600 Volts
DC — 57.5 VA, 115 to 230 Volts

NON-INDUCTIVE CURRENT RATING —

AC [5 Amperes, 240 Volts
3 Amperes, 600 Volts

CONTACT ARRANGEMENT — Contacts are single pole double throw. Contacts snap to open the normally closed contact and close the normally open contact when pressure or temperature reaches upper setting.

Contacts snap to close the normally closed contact and open the normally open contact when actuating medium falls to lower setting.

REPAIRS — Due to the integral construction of the Bulletin 836 and Bulletin 837 switches, they must be returned to Milwaukee for repair.

ADJUSTMENTS

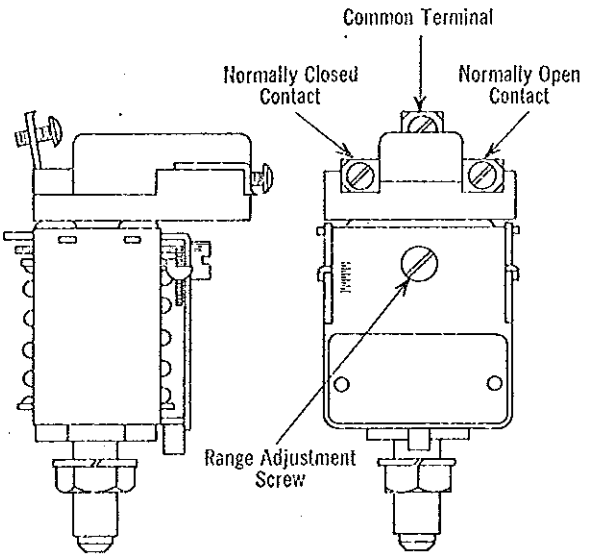
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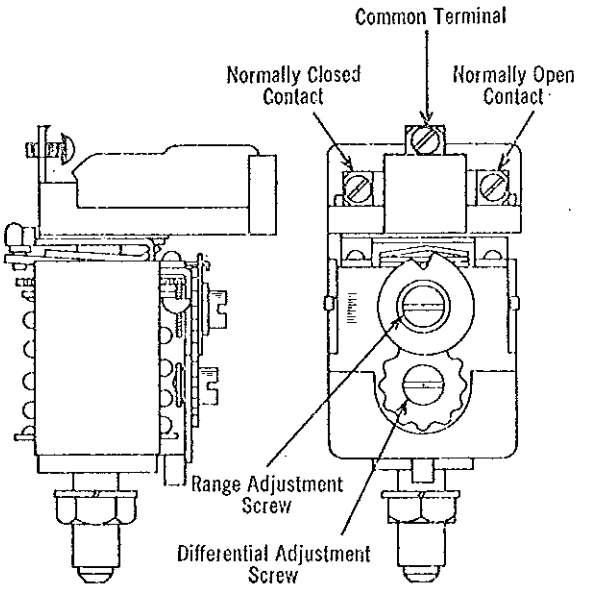
ADJUSTABLE DIFFERENTIAL — When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures or temperatures are raised equally. Turning this range adjustment screw counter-clockwise will lower the cut-in and cut-out settings an equal amount.

When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only, the top setting remains unchanged. Turning the screw counter-clockwise widens the differential by lowering only the lower setting with top setting unchanged.

FIXED DIFFERENTIAL



ADJUSTABLE DIFFERENTIAL



Instructions 836-800—November, 1969
Supersedes Instructions 836-800 Dated August 16, 1960

DESCRIPTION: Brass Air Relief Valve, 1/4" MPT ASME Std.
Manual Lift Ring. Set to 25 psi

VENDOR: Kunkle Valve Co., Inc.
Ft. Wayne, Indiana

③ PIECE/PART NO: MODEL 0548-A-KM0025

② DRAWING NO: ~~[illegible]~~

NOTE: "Substitutes not permitted."

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Colt Industries Fairbanks Morse Engine Division

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	16057	12-13 89	WAS FIG. 48-A 1/4" ③ CAT. 64, PAGE 19 ②	JC
1	11756	2-29 80	REMVD. "ASME" IN TITLE ①	H.A.S.

TITLE: VALVE, RELIEF, 1/4 ① AIR

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries Fairbanks Morse Power Systems Division

REL. NO. PC 312	5/24/73	ASSY. OR LO.	
DR. BY K.S. Ostoic	5/16/73	SCALE	
CHK'D. BY [illegible]	5/17/73	APPV.	1 / 1
MAT'L		HEAT TR.	

SHEET SIZE A | DWG. NO. 11 906 801 | SHEET 1 OF 1

BF3009-2

DESCRIPTION: Brass Air Relief Valve, 1/4" MPT ASME Std.
Manual Lift Ring. Set to 25 psi

VENDOR: Kunkle Valve Co., Inc.
Ft. Wayne, Indiana

PIECE/PART NO: Fig. 48-A 1/4"

DRAWING NO: Cat.64, page 19

NOTE: "Substitutes not permitted."

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: VALVE, RELIEF, 1/4 ASME, AIR

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Bell Helicopter — Fabricated Parts, Plastic Technical Bulletin

REL. NO. PC 312	5/24/72	ASSY. OR INT.
DR. BY K.S. Ostgic	5/16/72	SCALE 1"
CH'K'D. BY [illegible]	5/17/72	APP'V.
MAT'L		HEAT TR.

SHEET SIZE A | DWG. NO. 11 906 807 | SHEET 1 OF 1

KUNKLE VALVE COMPANY, INC.
121 So. Clinton Street, Fort Wayne 2, Indiana

Maintenance, Service and Adjusting Instructions For Safety & Relief Valves

Maintenance of safety valves consists of: 1. Frequent inspection for clogged drains and dirt buildup in bodies. 2. Pop testing every two to six months (depending on general plant conditions). 3. Yearly removal for testing inspection and overhaul.

If valves are to be popped by hand, pressure should be at least 75% of set pressure to prevent foreign material from becoming caught between seat and disc. The recommended procedure is to pop the valve by running pressure up to set pressure of valve.

Valve failure may be caused by seizing of parts, scored or wire drawn seats and overtightening valve in bushing, heavy discharge piping supported directly by valve, operating pressure too close to set pressure of valve and corroded or eroded springs. The first case may be corrected by careful cleaning followed by light sanding of the seating surfaces. For correction of the second, safety valves are susceptible of re-machining of seating surfaces to angles shown on part drawings, or careful hand lapping if damage is less severe. Springs rarely require replacement, but may be purchased from manufacturer as a unit of spare parts should replacement be necessary.

DISMANTLING

1. Remove lifting gear and/or hood and mark relative positions of pressure screw, locknut and cap.
2. Loosen pressure screw locknut and pressure screw to release pressure on spring.
3. Remove cap.
4. Remove spindle, disc and guide.
5. Mark location of regulator ring(s) if used and remove it.

To reassemble, reverse the above procedure, being careful to return parts to their marked positions and replace all gaskets. Re-set valves according to instructions below.

ADJUSTMENT, SETTING and TESTING

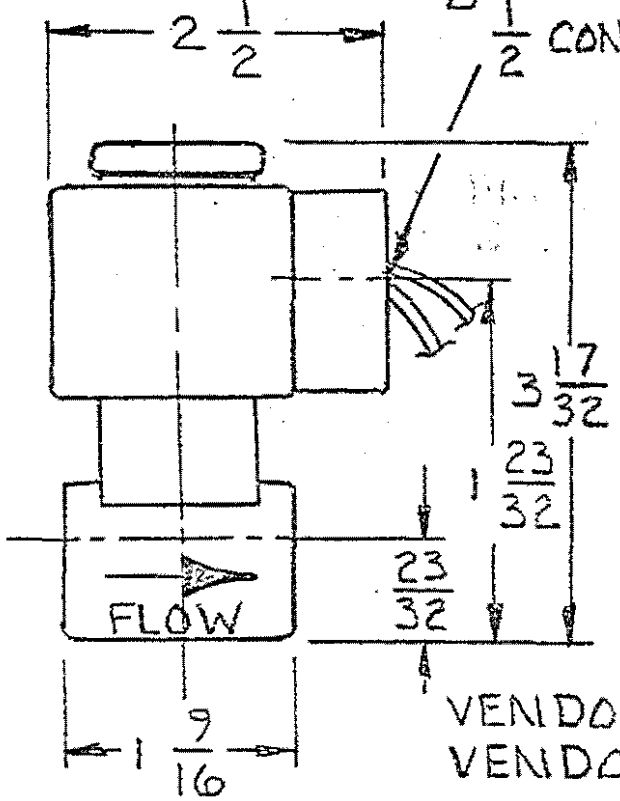
Popping Pressure or Cracking Pressure. Make sure of gauge accuracy before beginning. Remove lifting gear and hood exposing pressure screw and locknut. Loosen locknut and raise pressure until valve pops. If opening pressure is too low, turn down on pressure screw. If pressure is too high, reverse pressure screw. After proper pressure has been reached securely tighten locknut.

Blowdown Adjustment, Steam, Air, Gas Valves Only. When popping pressure is changed, a slight adjustment in blowdown may be required. Raising the popping pressure lengthens blowdown and lowering the popping pressure shortens blowdown. Raising the regulator ring toward the disc will increase blowdown and lowering the ring will decrease blowdown. Regulator ring adjustments should be made a notch at a time as the adjustment is sensitive. The normal position would be six (6) notches down from touching the disc, but this figure will vary with conditions.

CAUTION: Re-tighten regulator ring set screw being careful that it rests in notches without gouging ring surface. Adjusting regulator ring may cause valve to pop if it is simmering. Keep hands and face clear of outlet.

The factory will be pleased to service valves for you or to give advice should problems arise during reconditioning.

11907020



DESCRIPTION:

ASCO TWO WAY DIRECT OPERATED SOLENOID VALVE WITH THE FOLLOWING FEATURES:

1. 1/4" N.P.T.(F) PORTS
2. 5/32" ORFICE.
3. CLASS "F" 120 V.D.C.(OPERABLE ON 102-140 V.D.C.) MOLDED COIL WITH SCREW CONNECTIONS.
4. MAX. PRESSURE 40 PSI
5. NORMALLY CLOSED
6. FOR AIR SERVICE

VENDOR'S PART NO. ④ JKHX8262B202

VENDOR: AUTOMATIC SWITCH CO.
SUITE 220
5856 N. PORT WASHINGTON RD
MILWAUKEE, WISCONSIN 53217

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	11736	2-15 80	④ WAS "FTX8262B202"	JM
2	10634	1-13 78	③ REVISED AND REDRAWN	G.P.J.

TITLE
VALVE SOLENOID 120 V.D.C.

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 8830	1/31/74	ASSY. OR LO.	
DR. BY L.W. COOPER	1/28/74	SCALE	~1
CHK'D. BY LWC	1/28/74	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11907020 | SHEET 1 OF 1

MAINTENANCE INSTRUCTIONS

2-WAY DIRECT ACTING SOLENOID VALVES NORMALLY OPEN AND NORMALLY CLOSED

11/9070.20
8262
8263

DESCRIPTION

Bulletins 8262 and 8263 are 2-way direct acting solenoid valves having bodies of brass or stainless steel. Standard valves have a General Purpose Nema Type I Solenoid Enclosure. Valves that are equipped with a solenoid enclosure, which is designed to meet Nema Type 4–Watertight, Nema Type 7 (C or D) Hazardous Locations – Class I–Group C or D, and Nema Type 9 (E, F or G) Hazardous Locations – Class II Group E, F or G, are shown on separate sheets of Installation and Maintenance Instructions, Form Nos. V-5391, V-5381 and V-5380.

OPERATION

Normally Closed: Open when energized, closed when de-energized.
Normally Open: Closed when energized, open when de-energized.

MANUAL OPERATOR (Optional Ref. Fig. 3)

Valves with suffix "MS" in catalog number, are provided with a screw type manual operator which allows manual operation when desired or during an interruption of electrical power.

FLOW METERING DEVICES (Optional Ref. Fig. 3)

Valves with suffix "M" in catalog number are provided with a metering device for flow control.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

POSITIONING

Valve may be mounted in any position.

PIPING

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening pipe, do not use valve as a lever.

IMPORTANT: For protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required, depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. For valves equipped with an explosion-proof, watertight solenoid enclosure, the electrical fittings must be approved for use in the approved hazardous locations. Housings for all solenoids are made with connections for ½ inch conduit. The general purpose enclosure may be rotated to facilitate wiring by removing the retaining cap.

NOTE: Alternating Current (A-C) and Direct Current (D-C) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the solenoid base sub-assembly and core assembly.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the bare hand for only an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power and line pressure to valve before making repairs. It is not necessary to remove valve from pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on the media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation or excessive leakage will indicate that cleaning is required.

IMPROPER OPERATION

1. Faulty Control Circuit: Check the electrical system by energizing the solenoid. A metallic click signifies solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open-circuited or ground coil, broken lead wires or splice.
2. Burned-Out Coil: Check for open-circuited coil. Replace coil if necessary.
3. Low Voltage: Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. Incorrect Pressure: Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. Excessive Leakage: Disassemble valve and clean all parts. Replace parts that are worn or damaged with a complete Spare Parts Kit for best results.

COIL REPLACEMENT (Ref. Fig. 1)

Turn off electrical power supply and disconnect coil lead wires. Refer to exploded view (Figure 1). Choose Construction 1A or 1B and refer to replacement instructions 1A or 1B.

Coil Replacement, Construction Figure '1A'

1. Remove retaining cap, nameplate and housing.
2. Slip spring washer, insulating washers and coil off solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used.
3. Reassemble in reverse order of disassembly.

Coil Replacement, Construction Figure '1B'

1. Remove retaining cap, nameplate and cover.
2. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly or plugnut/core tube sub-assembly. Insulating washers are omitted when a molded coil is used. In some D-C Construction, a single flux plate over the coil replaces yoke, sleeves and insulating washers.
3. Reassemble in reverse order of disassembly.

CAUTION: Solenoid must be fully reassembled as the housing is part of, and completes the magnetic circuit.

VALVE DISASSEMBLY AND REASSEMBLY

(Refer to Exploded Views)

Depressurize valve and turn of electrical power supply.

1. Remove retaining cap and slip entire solenoid enclosure off the solenoid base sub-assembly or plugnut/core tube sub-assembly.
2. Unscrew bonnet or solenoid base sub-assembly and remove core spring, core assembly and body gasket.
3. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.
4. Reassemble in reverse order of disassembly paying careful attention to Exploded Views provided.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (*) are included in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

ASCO Valves

FORM NO. V-5256R5 PRINTED IN USA 1969 Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932

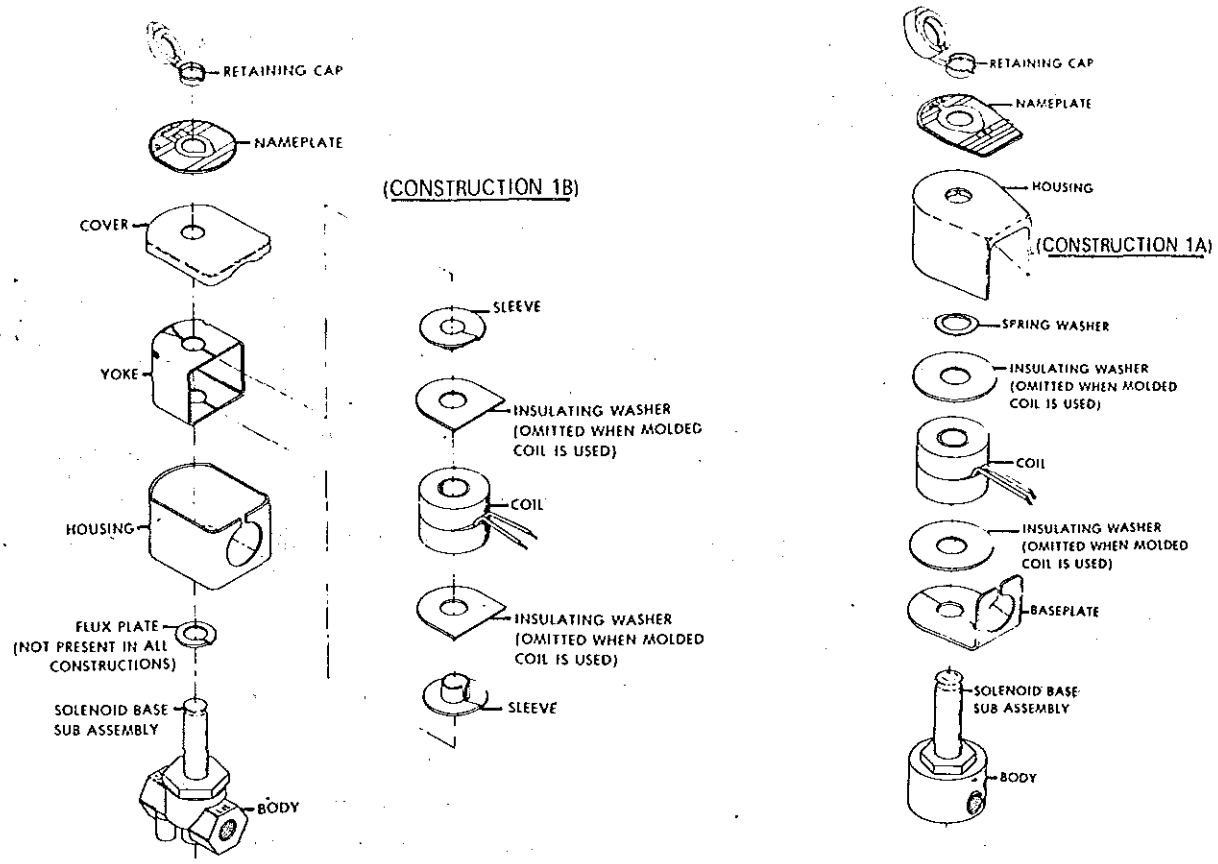
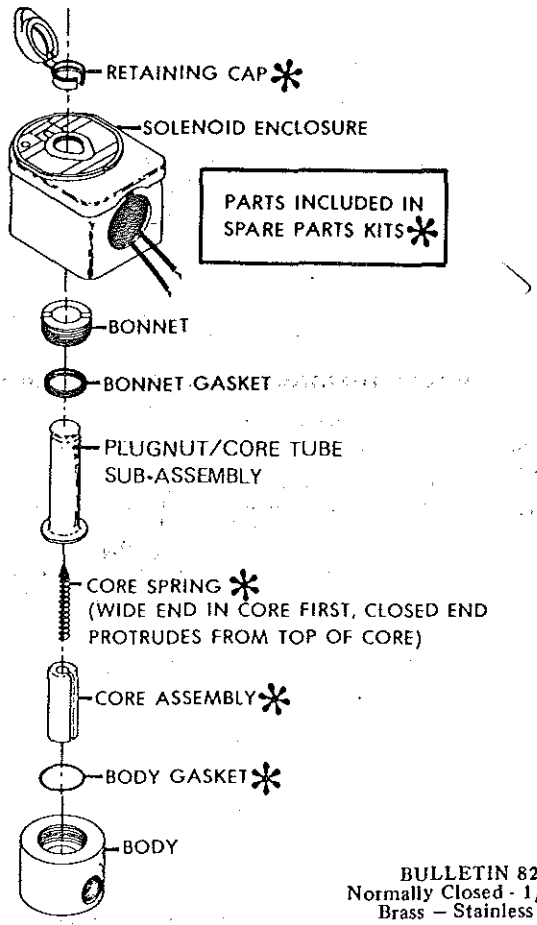
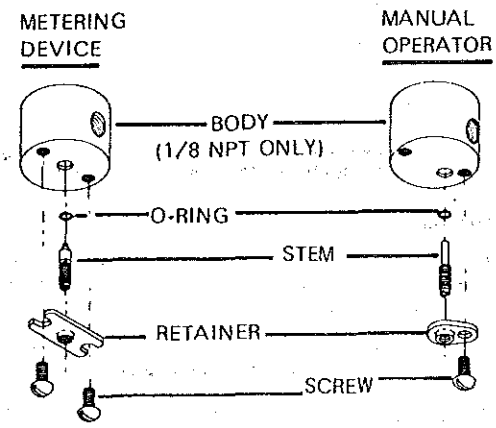


FIGURE 1 COIL REPLACEMENT



BULLETIN 8262
Normally Closed - 1/8" NPT
Brass – Stainless Steel

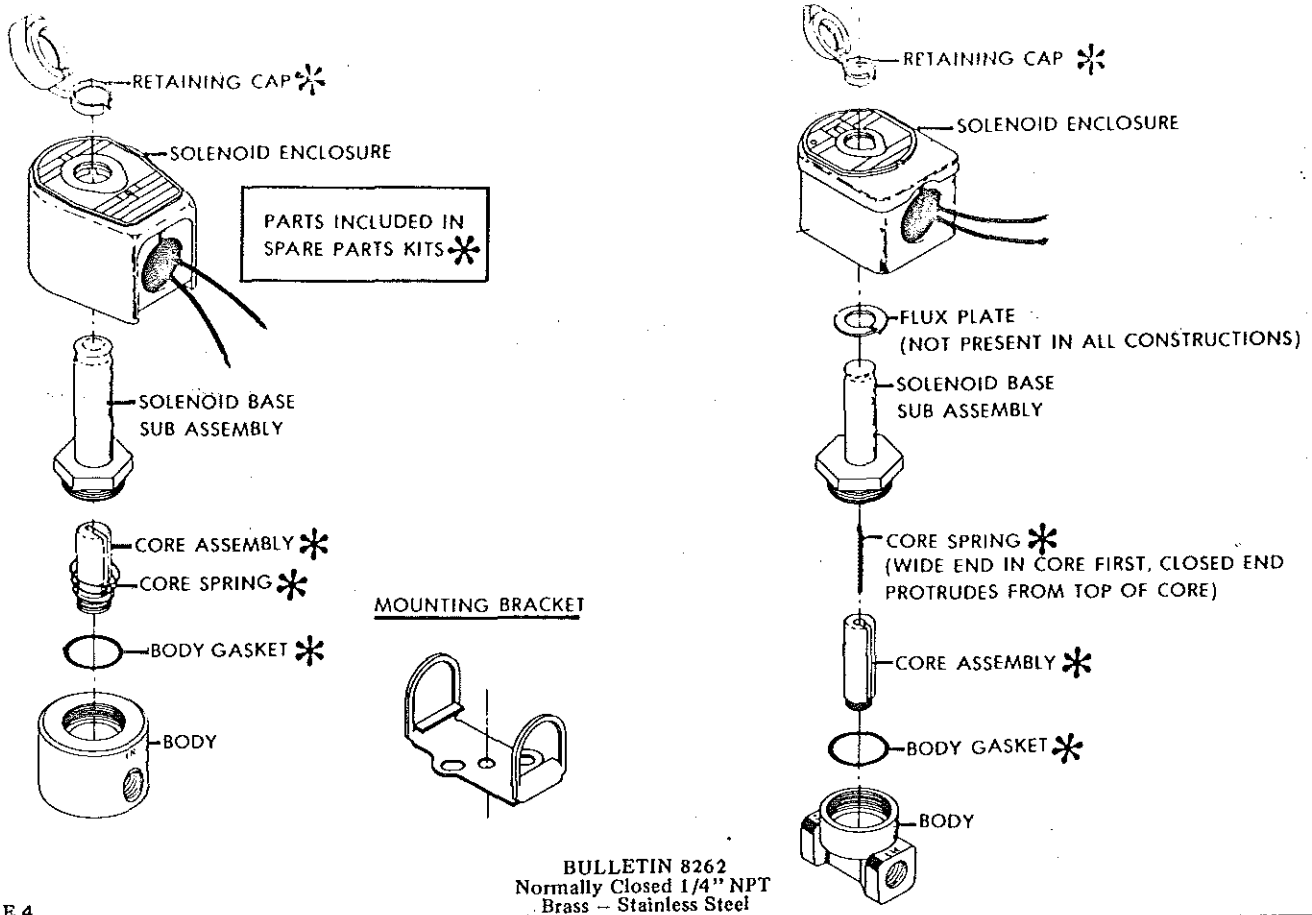
FIGURE 2



FLOW METERING AND MANUAL OPERATOR CONSTRUCTIONS

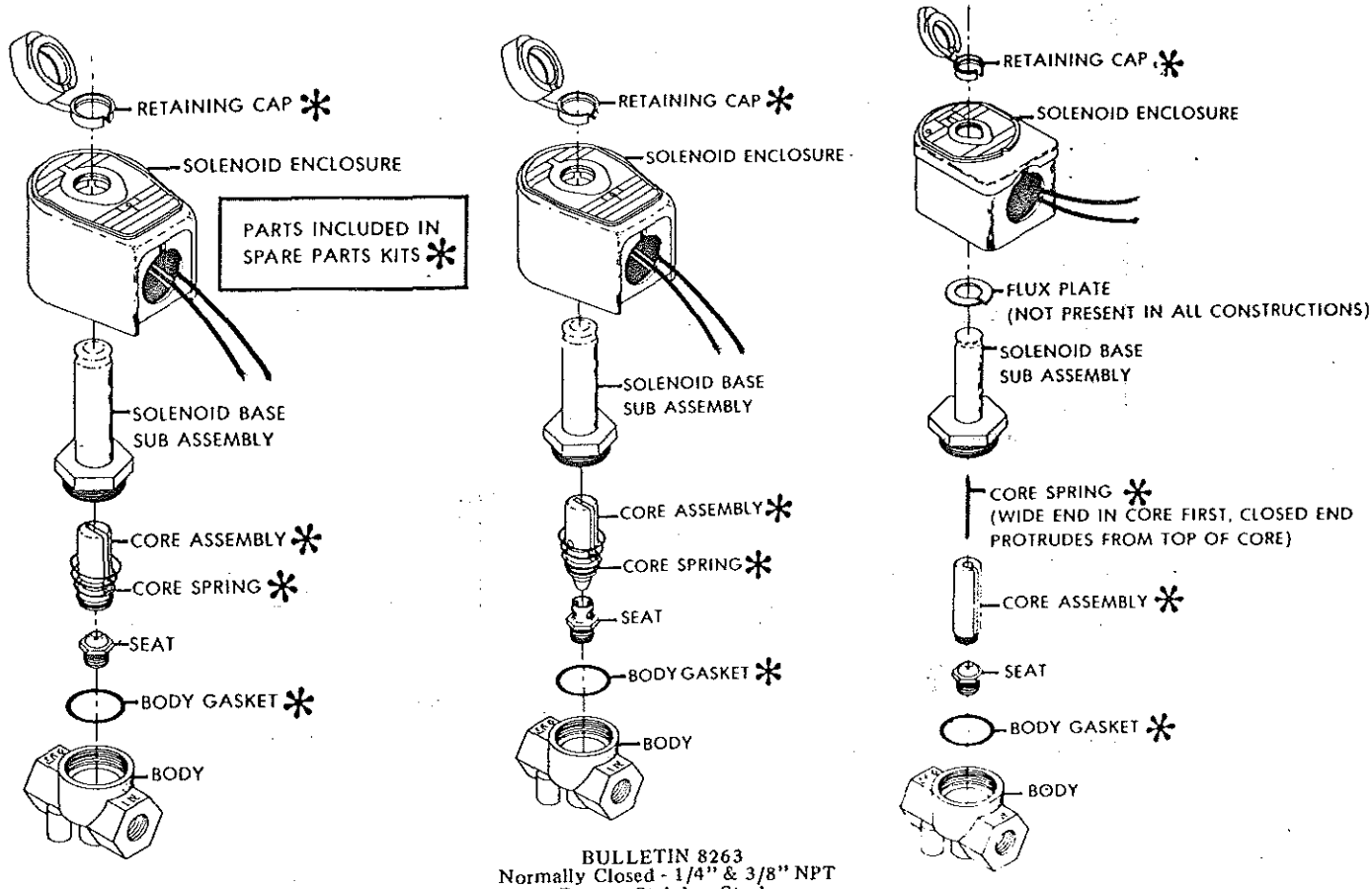
FIGURE 3

ASCO Valves
Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932 FORM NO. V-5256R5 PRINTED IN USA 1969



BULLETIN 8262
Normally Closed 1/4" NPT
Brass – Stainless Steel

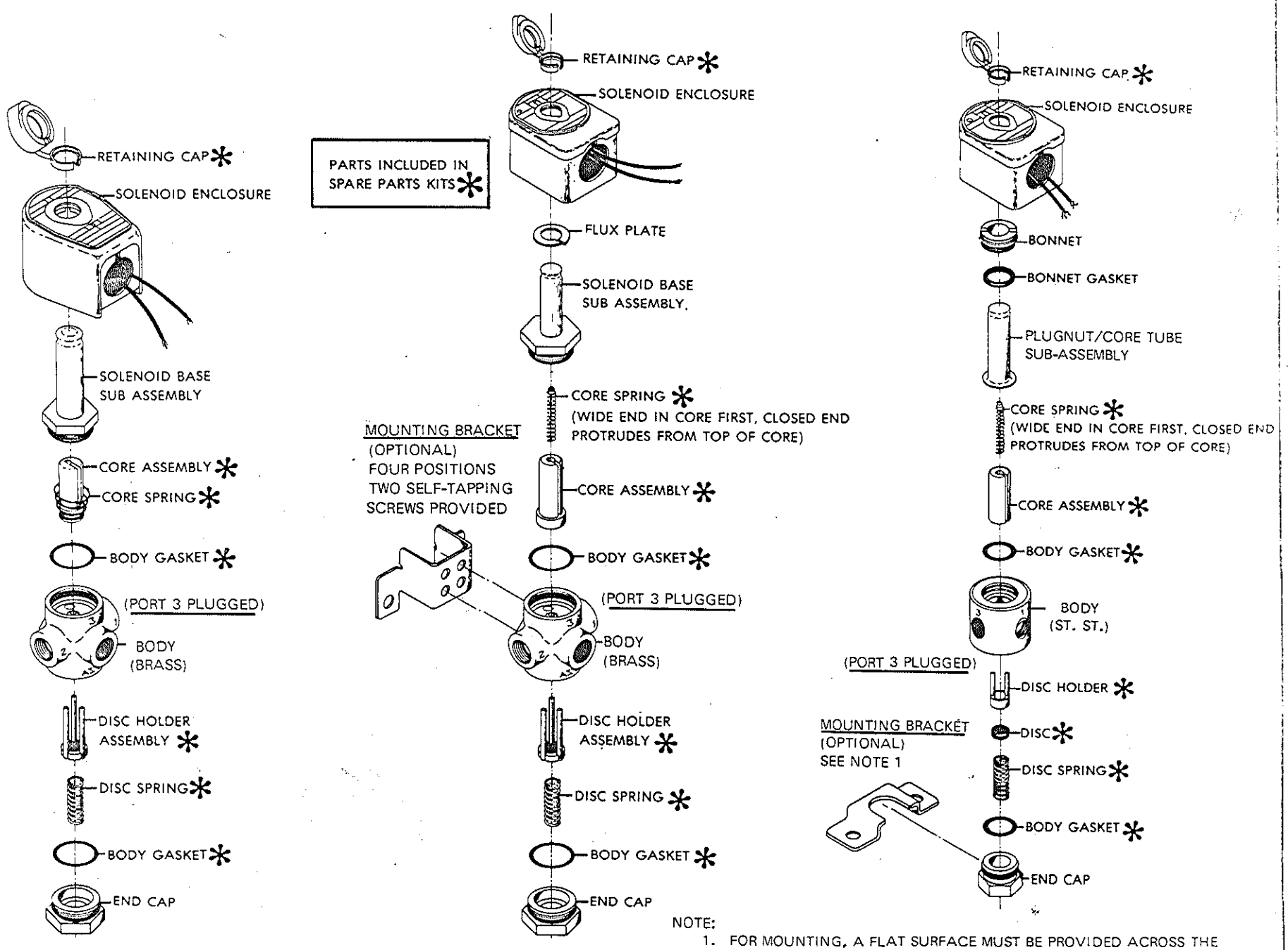
FIGURE 4



BULLETIN 8263
Normally Closed - 1/4" & 3/8" NPT
Brass – Stainless Steel

FIGURE 5

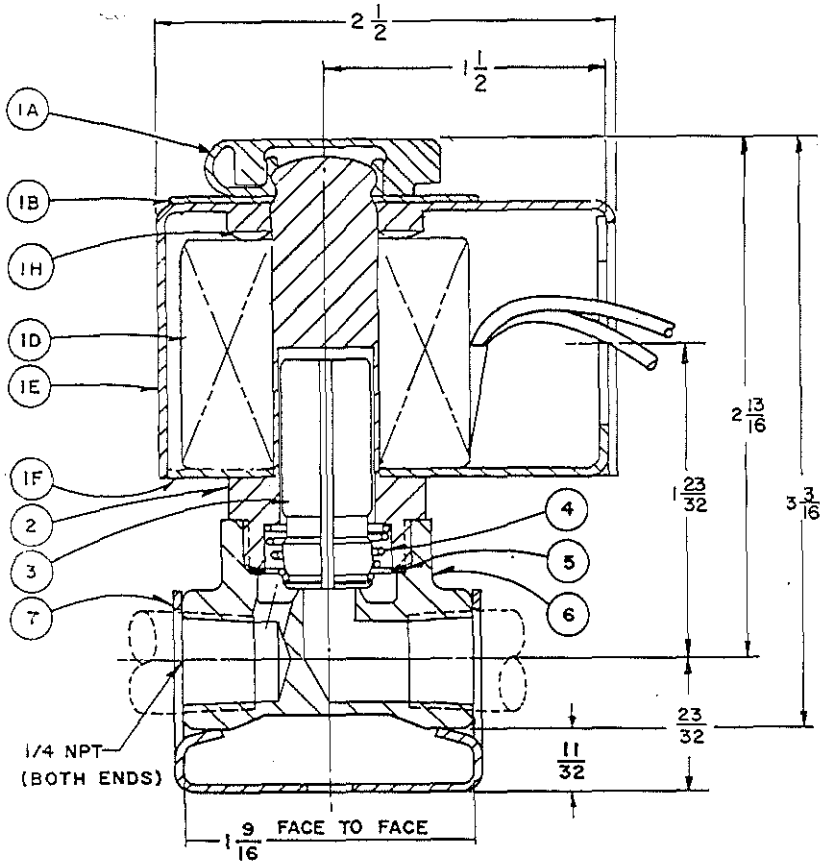
ASCO Valves
Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932 FORM NO. V-5256R5 PRINTED IN U.S.A. 1969



BULLETIN 8263
Normally Open - 1/8" & 1/4" NPT
Brass – Stainless Steel

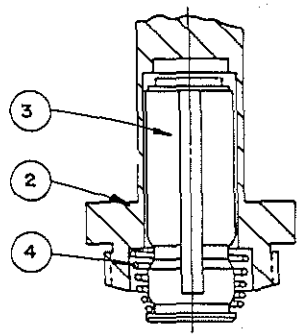
FIGURE

NOTE:
1. FOR MOUNTING, A FLAT SURFACE MUST BE PROVIDED ACROSS THE ENTIRE LENGTH OF THE BRACKET. THE VALVE BODY BECOMES SECURE TO BRACKET, WHEN BRACKET IS TIGHTENED IN TO POSITION.

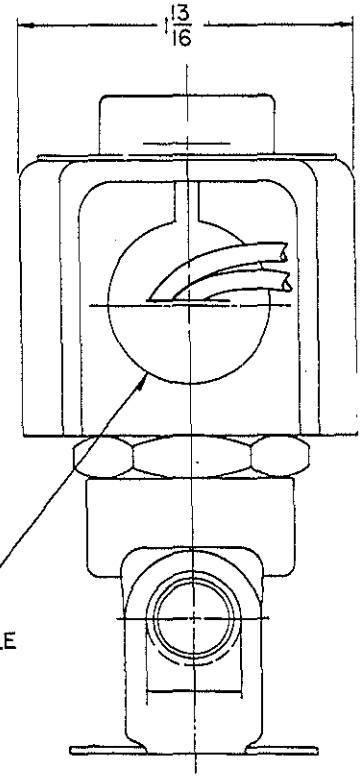


A.C. CONSTRUCTION

FLOW



D.C. CONSTRUCTION

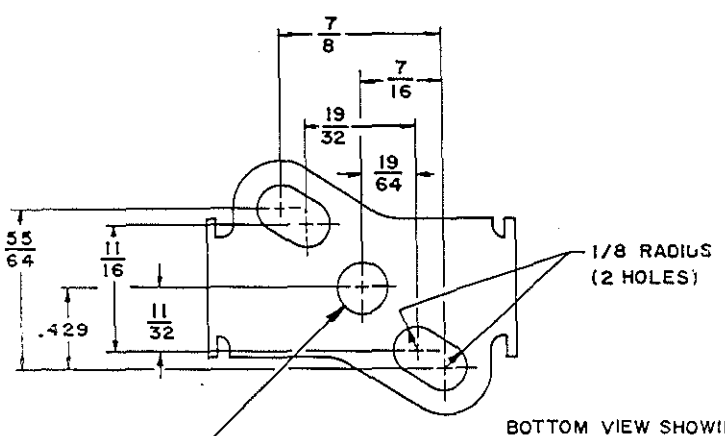


PAR LIST

WHEN ORDERING PARTS GIVE ALL INFORMATION LISTED ON VALVE NAMEPLATE, DWG. NO. BELOW, AND ITEMS DESIRED FROM THIS LIST.

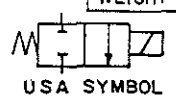
ITEM	NAME	QTY.
1A	RETAINING CAP	1
1B	NAMEPLATE	1
1H	SPRING WASHER	1
1D	COIL	1
1E	HOUSING	1
1F	BASEPLATE	1
2	SOL. BASE SUB-ASSEM.	1
* 3	CORE ASSEMBLY	1
* 4	SPRING, CORE	1
* 5	GASKET, BONNET	1
6	BODY	1
7	MOUNTING BRACKET	1

* PARTS SUPPLIED IN SPARE PARTS KIT.



BOTTOM VIEW SHOWING MOUNTING BRACKET, ITEM 7, ONLY.

1.25 CB	9/32	8262B210	A.C.	'A'	FV-68-038	
	7/32	8262B208	A.C.	'BP'	FV-68-038	
	5/32	8262B202	AC & DC	'A'	FV-68-038	FV-68-039
	1/8	8262B232	A.C.	'BP'	FV-68-038	
	3/64	8262B200	D.C.	'A'		FV-68-039
			A.C	'BP'	FV-68-040	
VALVE WEIGHT	ORF DIA	CATALOG NUMBER	CONST	COIL CLASS	KIT DRAWING NO. AC	KIT DRAWING NO. DC



USA SYMBOL

BULLETIN 8262 , 2 WAY SOLENOID VALVE
NORMALLY CLOSED PACKLESS
ORIFICE DIA 3/64 1/8 5/32 7/32 9/32 BODY MAT'L BRASS
PIPE-PORT CONN. 1/4 NPT SEATING RESILIENT
ENCLOSURE NEMA TYPE 1 GENERAL PURPOSE
WATTS 10.5 AC (CL 'A'), 11 DC (CL 'A'), 16.7 AC ('BP')

VALVE MAY BE MOUNTED IN ANY POSITION

PROPERTY OF AUTOMATIC SWITCH COMPANY. USE PERMITTED FOR OUR WORK ONLY. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

Automatic Switch Co. FLORHAM PARK, NEW JERSEY Printed in U.S.A.

DWN	JR/WH	5-9-67
CH'D	JNS	11-30-67
DFTG	JNS	11-1-67
SCALE		
ENG		

A-103-472

CHANGE LETTER A B C D

D 51824	K.N. 13-17-69 RBD 3-11-69 IN CATA. NOS. B WAS A
C 45520	J.C. 6-15-68 KOD 11-19-68 "INSP." SCREW WAS "SLOT"
B 41700	JNS 9-2-68 JNS 8-26-68 3/64 ORIF. (AC) SPR. WAS CB-1430
A 40203	TA 1-3-68 WGM 1-10-68 K.N. 38200 COIL WAS R.C.D.
— 43502	WM 5-8-67 JNS 11-30-67 ISSUED

K.N. NO.	BY	DATE	APP.	DATE
DEV X	A CONT X	ELECT X		

11/30/67

(THIS SPACE RESERVED FOR VENDOR
DRAWING WHEN IT BECOMES AVAILABLE)

LIMERICK GENERATING STATION UNITS 1&2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR:

VENDOR DWG. NO.:

TITLE: VALVE, PLUG 1"
ASME SECT. III, CL.-3.

APPROVED
Rev. 0
APR 25 1977
QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1679	4/29/77	ASSY. OR I.O.	
DR. BY J. Dorn	1/2577	SCALE	
CHK'D. BY J. [illegible]	3/3/77	HEAT TR.	
MAT'L			
APP'V. CAST.		MAT'L.	
MACH.		ENG'R.	
WELD.			
SHEET SIZE A	DWG. NO. 11 907 495		SHEET 1 OF 3

ORIGINAL

1" HAND OPERATED PLUG VALVE IN AIR START SYSTEM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. ASME BOILER & PRESSURE VESSEL CODE SECTION III

   THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3 REQUIREMENTS. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FM ENGINE DIV. PURCHASE ORDER FOR THE COMPONENT.

2. GENERAL SPECIFICATIONS:

   2.1 FUNCTION - THE FUNCTION OF THE 1" PLUG VALVE IS TO PROVIDE ISOLATION OF THE AIR START TANKS IN THE EVENT THAT THE TANK MUST BE TAKEN OUT OF SERVICE FOR REPAIR.

   2.2 ENVIRONMENTAL CONDITIONS - VALVE WILL BE LOCATED INSIDE A BUILDING WITH MAXIMUM ROOM TEMPERATURE OF 115°F AND MINIMUM ROOM TEMPERATURE OF 65° F AND 50-100% RELATIVE HUMIDITY. THE VALVE WILL NOT BE SUBJECTED TO RADIATION.

   2.3 COMPONENT BOUNDARY DEFINITION - THE VALVE'S SOCKET WELD CONNECTIONS.

   2.4 MATERIAL - STAINLESS STEEL 316. IMPACT TESTING NOT REQUIRED.

   2.5 VALVE SHALL HAVE 1" SOCKET WELD CONNECTIONS.

   2.6 CONNECTIONS LOADS - THE VALVE VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

   2.7 SEISMIC LOADS - THE VALVE SHALL BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

   2.8

MAXIMUM OPERATING AIR PRESSURE:	275 PSI
MAXIMUM OPERATING AIR TEMPERATURE:	400°F
MINIMUM DESIGN PRESSURE:	300 PSI
MINIMUM DESIGN TEMPERATURE:	400°F
MINIMUM STANDARD PRESSURE CLASS:	ANSI 300 LB.

3. VALVE DRAWING - THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

4. QUALITY ASSURANCE REQUIREMENTS:

   4.1 QA REQUIREMENTS PER COLT/FM DWG. 11 908 456.

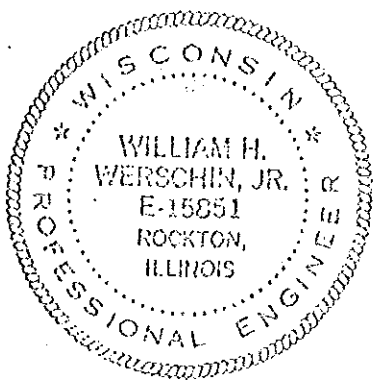
   4.2 THE VENDOR SHALL SUBMIT A COMPLETED BECHTEL STATEMENT OF CONFORMANCE FORM 3295, WITH EACH AND EVERY SHIPMENT.

APPROVED
APR 25 1977
QUALITY CONTROL

ORIGINAL

5. CERTIFICATION:

THIS DESIGN SPECIFICATION IS HEREBY CERTIFIED TO BE CORRECT AND COMPLETE AND TO BE IN COMPLIANCE WITH THE REQUIREMENTS OF ASME SECTION III, CLASS 3, ARTICLES NA-3250 AND ND-3112.



WILLIAM H. WERSCHIN, JR.

DATE: APR 25, 1977

REV.: -

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Rev. 0
APR 25 1977
QUALITY CONTROL

ORIGINAL

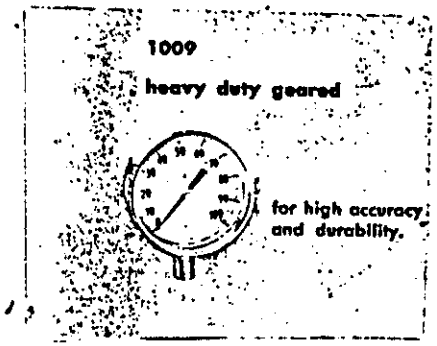
MS

11 907 532

DESCRIPTION: Ashcroft 4 1/2" dia. Model 1009A pressure gauge w/¼" NPT stem mounting, bronze bourdon tube and in accordance with the following:

(A) 0-600 PSI range
(B) 50 PSI figure intervals
(C) 10 PSI interval graduations

(1)



VENDOR'S PIECE NO. Gauge Fig. No. 1009A.

VENDOR: Ashcroft Pressure & Temperature Instruments
Dresser Industrial Valve & Instrument Division
Dresser Industries, Inc.
Stratford, Conn. 06497

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
M/F → 4	12549	10-22-81	(1) WAS 5 FSI	K.O.
M/F 3	PC1421	6/9/76	RELEASED	
2	—	4-14-76	Was No. 1020A.	JMW
1	—	12/12/75	REMOVED COCK & SNUBBER	JMW

TITLE
GAUGE,
PRESSURE 0-600 PSI

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

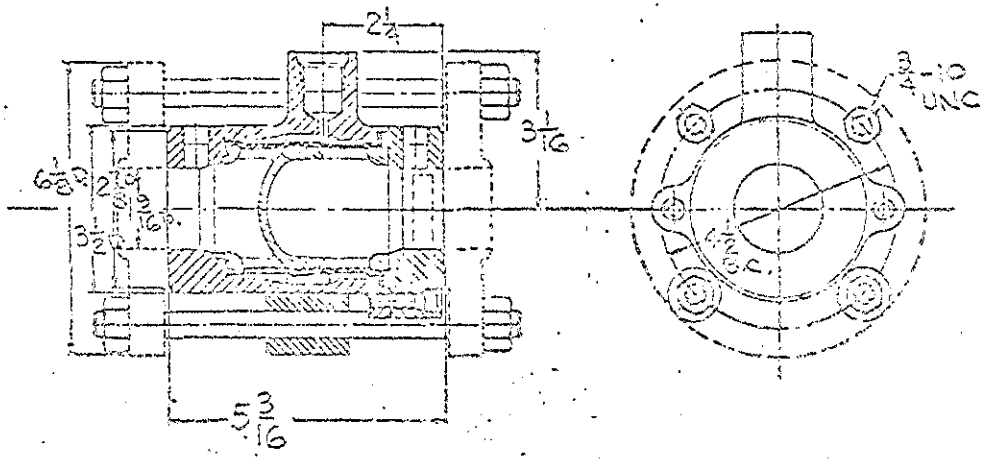
REL. NO. —	/ /	ASSY. OR LO.	
DR. BY J.Whalen	11/13/75	SCALE	
CHK'D. BY HCD	6/3/76	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. HSR	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11 907 532	SHEET 1 OF 1	

BF3009-2

P

DESCRIPTION: GROVE MODEL 80 LIGHT WEIGHT 1-1/2" FLEXFLO VALVE WITH THE FOLLOWING FEATURES:

1. CLASS 300 (MAX. PRESSURE RATING 720 PSI)
2. COMPLETE WITH BOLTS FOR 1-1/2" 300# ANSI FLANGES (WITHOUT FLANGES)
3. FIGURE 11474NK



VENDOR'S DWG. NO: W-80-A35

VENDOR: GROVE VALVE & REGULATOR COMPANY
6529 HALLIS STREET
OAKLAND, CALIFORNIA

REPR: CONTROL ENGINEERING & SUPPLY COMPANY
P.O. BOX 127
MATTESON, ILLINOIS 60443

APPROVED
Rev. 0
FEB 11 1977
QUALITY CONTROL

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV NO	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D. BY

TITLE: VALVE, FLEXFLO 1-1/2"

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10139	2/15/77	ASSY. OR SO.
DR. BY R. NORMAN	1/27/77	SCALE
CHK'D. BY Simmons	1/27/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR. R.J.M.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11 908 123 | SHEET 1 OF 1

W-80-A35

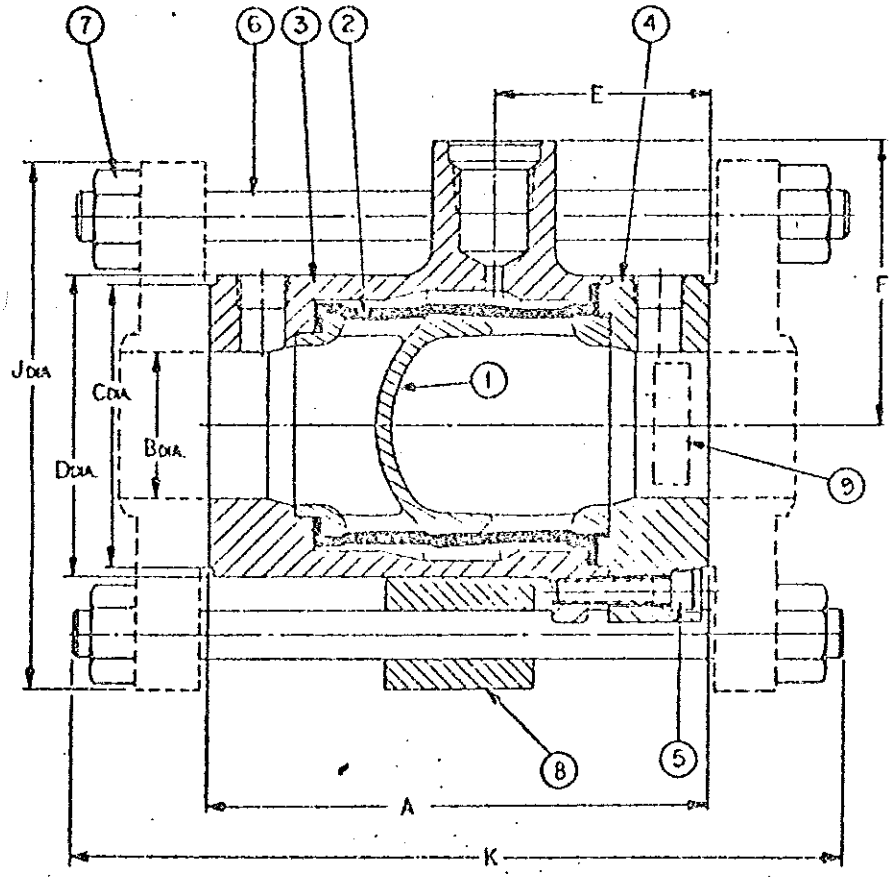
CLASS 150 275 LBS MAX PRESSURE 275 LBS MAX DIFF

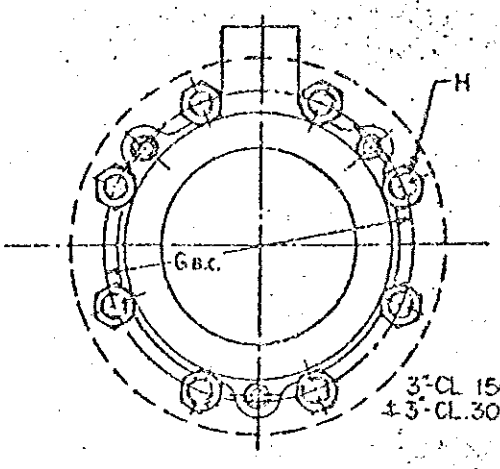
SIZE	A	B	C	D	E	F	G	H	J	K
1½"	5	1 9/16	2 7/8	3 1/16	2 5/16	2 29/32	3 7/8	½"-13 UNC	5	7 3/4
2"	6	2	3 5/8	4	2 7/16	3 1/4	4 3/4	5/8"-11 UNC	6	9
3"	7 3/4	3	5	5 1/2	3 3/16	4 1/8	6 5/8	¾"-10 UNC	8 1/4	11 5/4

CLASS 300 720 LBS MAX PRESSURE 720 LBS MAX DIFF

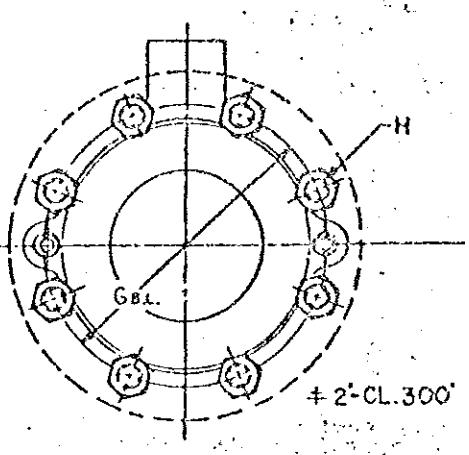
SIZE	A	B	C	D	E	F	G	H	J	K
1½"	5 1/2	1 9/16	2 7/8	3 1/2	2 1/4	3 1/16	4 1/2	¾"-10 UNC	6 1/8	8 5/8
2"	6 1/2	2	3 5/8	4 1/4	2 17/32	3 3/8	5	5/8"-11 UNC	6 1/2	9 1/4
3"	7 1/8	3	5	5 1/8	3 7/32	4 3/16	6 5/8	¾"-10 UNC	8 1/4	12

ITEM	PART NAME	MATERIAL
1	CORE	DUCTILE IRON ELECTROLESS NICKEL COATED
2	TUBE	NITRILE
3	BODY	STEEL
4	COVER PLATE	STEEL
5	CAPSCREW	STEEL CADMIUM PLATED
6	STUD	STEEL CADMIUM PLATED
7	NUT	STEEL CADMIUM PLATED
8	SPACER	NYLON
9	NAMEPLATE	18/8 C.R.E.S.

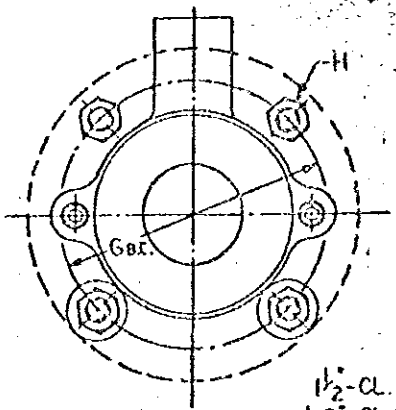




3"-CL. 150
± 3"-CL. 300



± 2"-CL. 300*



1½"-CL. 150
± 2"-CL. 150
1½"-CL. 300

NOTES:
- ± ITEM 8, SPACER, NOT USED ON THESE SIZES.
- * 3" CLASS 150 VALVE ONLY, USE 3" ANSI B 16.5 300 R.F. FLG.

SIZE	MAX. PRESS.	MAX. DIFF.	END CONNECTION	FIGURE NO.
1½", 2", 3"*	275 LBS.	275 LBS.	ANSI B16.5 150 R.F.	[illegible]
1½", 2", 3"	720 LBS.	720 LBS.	ANSI B16.5 300 R.F.	[illegible]

REVISED 1-16-73 [illegible]
REVISED 12-11-72 [illegible]
REVISED 11-15-72 [illegible]

GROVE VALVE & REGULATOR CO.
6529 HOLLIS ST. OAKLAND, CALIF.

DWN BY: ENH	DATE: 8-3-72	CHK'D: [illegible]	APPR'D: [illegible]	DRAWING NO. W-80-A35

MODEL	END CONNECTION	MAX. DIFF.	TITLE
80	SEE TABLE	SEE TABLE	FLEXFLO LIGHT WEIGHT DESIGN

8-18-72 Appr.
Rev. 2-26-73 Appr.
Rev. 10-30-73 Appr.

W-80-A35-1

FIGURE 11473NK

GROVE MODEL 80 PARTS LIST
(Light Weight Design)
Steel, Class 150 Raised Face
275# Maximum Pressure, 275# Maximum Differential Pressure

(Item numbers refer to Drawing W-80-A35)

		1-1/2"		2"		3"	
ITEM	PART NAME	QTY	PART NUMBER	QTY	PART NUMBER	QTY	PART NUMBER
1	Core	1	200-01482	1	200-02084	1	200-03072
2	Tube	1	201-01425	1	201-02025	1	201-03024
3	Body	1	205-02017	1	205-02021	1	205-03016
4	Cover Plate	1	205-02016	1	205-02020	1	205-03015
5	Capscrew	2	N45-54143	2	N45-54163	3	N45-56143
6	Stud	4	N60-58625	4	N60-60725	8	N60-62945
7	Nut	8	N66-58015	8	N66-60015	16	N66-62015
8	Spacer	2	204-02013		—	2	204-03008
9	Nameplate	1	049-00145	1	049-00145	1	049-00145

W-80-A35-1

8-16-72 Appr.
Rev. 10-30-73 Appr.

W-80-A35-2

FIGURE 11474NK

GROVE MODEL 80 PARTS LIST
(Light Weight Design)
Steel, Class 300 Raised Face
720# Maximum Pressure, 720# Maximum Differential Pressure

(Item numbers refer specifically to Drawing W-80-A35)

		1-1/2"		2"		3"	
ITEM	PART NAME	QTY	PART NUMBER	QTY	PART NUMBER	QTY	PART NUMBER
1	Core	1	200-01483	1	200-02085	1	200-03073
2	Tube	1	201-01413	1	201-02009	1	201-03008
3	Body	1	205-02019	1	205-02023	1	205-03018
4	Cover Plate	1	205-02018	1	205-02022	1	205-03017
5	Capscrew	2	N45-54143	2	N45-56143	3	N45-56143
6	Stud	4	N60-62695	8	N60-60745	8	N60-62965
7	Nut	8	N66-62015	16	N66-60015	16	N66-62015
8	Spacer	2	204-02015		----		----
9	Nameplate	1	049-00145	1	049-00145	1	049-00145

W-80-A35-2

V 9-11-73 Appr
Rev. 10-30-73 Appr

W-80-A35-3

FIGURE 11474WH

GROVE MODEL 80 PARTS LIST
(Light Weight Design)
Steel, Class 300 Raised Face
720# Maximum Pressure, 720# Maximum Differential Pressure

(Item numbers refer specifically to Drawing W-80-A35)

		2"	
ITEM	PART NAME	QTY	PART NUMBER
1	Core	1	200-02071
2	Tube	1	201-02009
3	Body	1	205-02029
4	Cover Plate	1	205-02022
5	Capscrew	2	N45-56143
6	Stud	8	N60-60745
7	Nut	16	N66-60015
9	Nameplate	1	049-00145

W-80-A35-3

196-40117 REV. 1/91

REQUEST FOR QUOTATION

RETURN TO THIS ADDRESS

RETURN 1 PRICED COPIES

RETURN 0 UNPRICED COPIES

Philadelphia Electric Company
2301 MARKET STREET
P.O. BOX 8699
PHILADELPHIA, PA 19101

DATE: 06/25/91

B5856

INQUIRY NUMBER: LS643396

RETURN YOUR QUOTE BY: 07/09/91

TO:
Coltec Industries
Fairbanks Morse Engine Div.
701 Lawton Avenue
Beloit WI 53511

FEDERAL TAX I.D. NUMBER

IF FEDERAL TAX I.D. NUMBER IS NOT SHOWN OR IS INCORRECT, PLEASE ENTER CORRECT NUMBER.

FOR DELIVERY TO:
Limerick Gen Stat STR 349
Evergreen & Sanatoga Road
LS643396
Limerick Twp. PA 19468

REPLY TO BUYER:
P. A. Lavelle
215-841-6507

ENTER BUYER'S NAME ON ENVELOPE

PAYMENT TERMS	F.O.B.	WANTED AT DESTINATION	DELIVERY PROMISED BY VENDOR	VIA (BEST WAY BASED ON WANTED DATE)
	ONLY F.O.B. DESTINATION PRICES WILL BE ACCEPTED	7/19/91		

PROPOSER NOTE — SHADED AREAS SHOULD BE COMPLETED BY YOU

LINE NO.	QUANTITY	UNIT	UNIT DESCRIPTION	CODE NUMBER	UNIT PRICE	EXTENDED LINE PRICE
1	2	P	Piece	114-44946		

DESCRIPTION

COVER, QUINCY COMPRESSOR 6942 KEY 31, VALVE LOW PRESSURE, INTAKE OR DISCHARGE, FOR QUINCY COMPRESSOR DIVISION, MODEL D-390-21 AIR COMPRESSOR, DWG #DM3901491, 11908370, S/N 104232-L, DIESEL GENERATOR, LIM 1&2, EQ #K513

LINE NO.	QUANTITY	UNIT	UNIT DESCRIPTION	CODE NUMBER
2	30	P	Piece	114-44962

DESCRIPTION

DISC, QUINCY COMPRESSOR 2087 KEY 13, VALVE, INTAKE OR DISCHARGE, FOR MODEL D-390-21 AIR COMPRESSOR, DWG #DM3901491, 11908370, S/N 104232-L, BPONO M-71, LIM 1&2, EQUIPNO K513

RECEIVED
JUL 1 1991
PARTS SERVICE MARKETING

Completed 7-2-91

NOTE: SEE REVERSE SIDE FOR IMPORTANT TAX INFORMATION.

IF YOU ARE UNABLE TO QUOTE, PLEASE RETURN THIS FORM AND INDICATE "NO BID".

TOTAL PRICE OF BID

APPROXIMATE SHIPPING WEIGHT

YOU ARE INVITED TO QUOTE PROMPTLY NET PRICES ON THE MATERIAL, LABOR OR SERVICE SPECIFIED ABOVE OR IN ACCORDANCE WITH SPECIFICATIONS AND/OR DRAWINGS ENCLOSED, SUBJECT TO THE GENERAL TERMS AND CONDITIONS ATTACHED HERETO. **FORMAL OBJECTION IS HEREBY MADE TO ANY TERMS OR CONDITIONS WHICH ARE DIFFERENT THAN OR IN ADDITION TO THESE GENERAL TERMS AND CONDITIONS.**

Terms And Conditions - Commodities 4/87

THIS IS NOT A PURCHASE ORDER

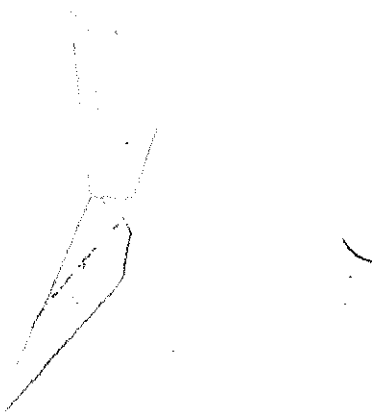
PROPOSAL SUBMITTED BY: _____ DATE: _____
SIGNATURE

NAME: _____ TITLE: _____
PRINT OR TYPE

PHONE NUMBER: ( ) _____

We reserve the right to accept or reject all or part of the above.

RETURN THIS COPY TO BUYER NAMED AT TOP OF THIS FORM



Coltec Industries

Fairbanks Morse
Engine Division

MEMO

TE: 2/27/92

TO: Frank Hand LOCATION:

FROM: Doug Brown LOCATION:

SUBJECT: P/N Change 124666-006

Please change P/N 124666-006 to 124666-004 per attached letter.

124666

Coltec Industries

Quincy
Compressor Division
3501 Wismann Lane
P.O. Box C2
Quincy, Illinois 62305-3116
217 / 222-7700

February 21, 1992

Coltec Ind
Power Systems Div
701 Lawton Ave
Beloit, Wi 53511

Attn: Dave Brown

Per our phone conversation on 2-21-92 regarding pressure switches, Quincy part number 124666-006 is no longer available. Our vendor can no longer supply this switch. Quincy now uses part number 124666-004 in place of part number 124666-006.

The Differences are as follows:

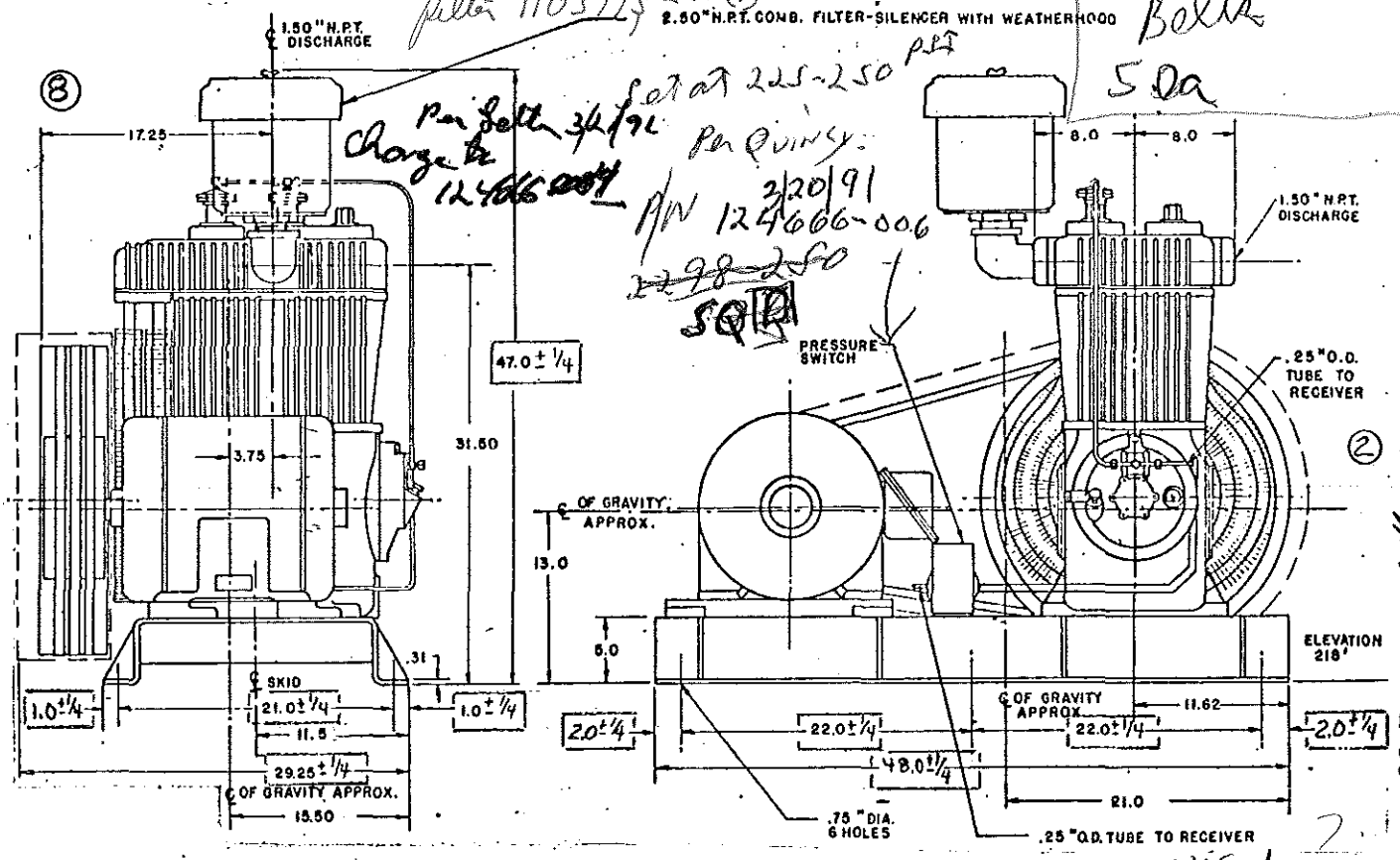
	124666-004	124666-006
RANGE CUT IN PRESSURE	Min 13 Max 425	Min 10 Max 265
ADJUSTABLE DIFFERENTIAL	Min 16 Max 90	Min 15 Max 25

If you have any questions, please call. Thank you.

Trenton Black
Trenton Black
Internal Sales Coordinator
Coltec Industries
Quincy Compressor Division

Element 110377E 200

110258 B105



DIM'S. WITHIN BOXES (▭) ARE FOR QA "AT SITE" INSP. PURPOSES.

LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX 239585
FAIRBANKS MORSE ORDER NO. 11-700000
S/N 104232-L

VENDOR: QUINCY COMPRESSOR

VENDOR DWG. NO.: DM3901491 ①

TITLE: COMPRESSOR, AIR

APPROVED Rev. 5	APPROVED Rev. 4	APPROVED Rev. 3
SEP 8 1977	AUG 5 1977	APR 22 1977
QUALITY CONTROL	QUALITY CONTROL	QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
8	11348	3-21-79	⑧ SIDE VIEW ADDED ⑦ ±1/4 TOLERANCES ADDED	LJD
7	11052	2-5-79	CHANGE SCFM FROM 46 AND HP FROM 15	J.H. RN
6	11014	8-7-78	ADD REV. STATE TO SUBTIER SPECS ⑥	NLS MSH
5	10163	9/27/77	⑤ Para 2.5 was Class B. ④ Para 1.1.2 was type 4	B.
4	10420	8/15/77	③ PARA. 1.1.7 (SH. 2) ADD 4" x 4" x 1/2"	SJV ITC
	10420	8/15/77	② ADDED PICTURE ① ADDED VENDOR DWG. NO.	SJV ITC
3	10300	4/28/77	Consolidate Spec Into One Dwg. - Retyped.	WHW

Colt Industries — Fairbanks Morse Engine Division			
REL. NO. PC1574	11/30 76	ASSY. OR LO.	
DR. BY J. Dorn	10/26/76	SCALE	
CHK'D. BY J. Whalen	11/4/76	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. H. D. Eglin	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11 908 370	SHEET 1 of 7	

11 908 370

ORIGINAL

STARTING AIR COMPRESSOR FOR STANDBY DIESEL/GENERATOR SET LIMERICK GENERATING STATION, UNITS 1 & 2, COLT FAIRBANKS MORSE ENGINE DIVISION SALES.ORDER 700000.

1 908 370

1. TECHNICAL SPECIFICATIONS

1.1 BASE MOUNTED, TWO STAGE, MOTOR DRIVEN QUINCY D-390 COMPRESSOR COMPLETE WITH THE FOLLOWING:

1.1.1 COMPRESSOR, ELECTRIC MOTOR AND V-BELT DRIVE ALL MOUNTED ON A STRUCTURAL STEEL BASE

④ 1.1.2 MANUAL AND AUTOMATIC START-STOP PRESSURE SWITCH, NEMA 13, CONTROLS - START AT 225 PSI, STOP AT 250 PSI.

1.1.3 AIR INLET FILTER - PROVIDED WITH PROTECTION HOOD TO PERMIT OPERATION WHEN SUBJECTED TO A FIRE SPRINKLER SYSTEM WITH A SPRAY ANGLE NOT EXCEEDING 15° FROM THE VERTICAL.

1.1.4 BELT GUARD

1.1.5 UNLOADING VALVE FOR LOADLESS STARTING

1.1.6 OIL PRESSURE GAUGE

1.1.7 THE COMPRESSOR BASE SHALL HAVE A GROUNDING PAD CONSISTING OF A PIECE OF NON-CORRODING METAL APPROXIMATELY ③ 2" BY 8" BY 1/2" THICK WELDED TO THE BASE. THE PAD SHALL BE DRILLED AND TAPPED FOR AND FURNISHED WITH A BURNDY TYPE NA, CATALOG NO. NA28-2N CLAMP TERMINAL.

1.1.8 NAMEPLATE - COMPRESSOR UNIT SHALL BE PROVIDED WITH A METAL NAMEPLATE FASTENED WITH METAL SCREWS. THE NAMEPLATE SHALL CONTAIN AS A MINIMUM THE FOLLOWING: MANUFACTURER'S NAME, SERIAL NUMBER, SIZE, TYPE, MODEL, AND RATING.

1.2 RATING -50.4 SCFM AT 250 PSIG.

2. MOTOR SPECIFICATION

2.1 MOTOR MANUFACTURER SHALL BE WESTINGHOUSE

2.2 ELECTRICAL RATING - 460 VOLTS, 3 PHASE, 60 Hz.

2.3 ENCLOSURE - NEMA DRIP-PROOF

2.4 TYPE - NEMA DESIGN "B"

⑤ 2.5 INSULATION - CLASS B

COLT FM MAR 1 1979 QA APP Rev. 5 Rev. 4

COLT FM JUL 31 1978 QA APP Rev. 6 Rev. 5

COLT FM JAN 25 1979 QA APP Rev. 7 Rev. 6

APPROVED Rev. 4 AUG 5 1977 QUALITY CONTROL

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Rev. 8 Rev. 7 Rev. 6 Rev. 5 Rev. 4 Rev. 3

2.6 AMBIENT TEMP. - 40°C.

2.7 SERVICE FACTOR - 1.15

2.8 THE FOLLOWING DATA IS TO BE FURNISHED ON A MOTOR CERTIFIED DATA DRAWING.

(1) HORSEPOWER
(2) SERVICE FACTOR
(3) VOLTAGE
(4) PHASE
(5) FREQUENCY-HERTZ
(6) SYNCHRONOUS SPEED - RPM
(7) FULL LOAD SPEED - RPM
(8) NEMA DESIGN LETTER
(9) INSULATION CLASS
(10) TEMP. RISE - °C. (BY RESIS.)
(11) FULL LOAD CURRENT
(12) LOCKED ROTOR CURRENT
(13) LOCKED ROTOR TORQUE - % F.L.
(14) BREAKDOWN TORQUE - % F.L.
(15) EFFICIENCY: 100% LOAD
75% LOAD
50% LOAD
(16) POWER FACTOR: 100% LOAD
75% LOAD
50% LOAD
(17) ENCLOSURE
(18) MOUNTING
(19) ROTATION, VIEWED FROM END OPPOSITE COUPLING
(20) BEARING TYPE
(21) FRAME NO.
(22) MANUFACTURER
(23) SERIAL NO.
(24) WEIGHT
(25) SPECIAL MODIFICATION
(26) SERVICE

3. TECHNICAL DATA

THE FOLLOWING DATA SHALL BE COMPLETED BY THE MANUFACTURER.

DELIVERY: SPECIFIED (SCFM) - 50.4

DISCHARGE PRESSURE (PSIG) - 250

ALTITUDE ABOVE SEA LEVEL (FEET) - 217

AMBIENT TEMPERATURE (DESIGN) °F. - 65 TO 104

RATED HORSEPOWER AT DRIVER SHAFT -

APPROVED Rev. 5 SEP 8 1977 QUALITY CONTROL

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APPROVED Rev. 3 APR 22 1977 QUALITY CONTROL

908 370

MAX. ALLOWABLE DISCHARGE PRESSURE -

AIR TEMP. LEAVING COMPRESSOR -

VERTICAL OR HORIZONTAL -

NO. OF STAGES -

NO. OF CYLINDERS: 1st STAGE/2nd STAGE -

BORE AND STROKE OF CYL: 1st STAGE/2nd STAGE -

PISTON DISPLACEMENT: 1st STAGE/2nd STAGE -

VOLUMETRIC EFF.: 1st STAGE/2nd STAGE -

SPEED: CRANKSHAFT (RPM)/PISTON (FT/MIN) -

LUBRICATION: CYLINDER/CRANKCASE -

MATERIAL: CYLINDER/CYLINDER LINER -
PISTON/PISTON RINGS -

STUFFING BOX PACKING: CYLINDER/CRANKCASE -

LENGTH DISTANCE PIECE (IF ANY) -

CONNECTIONS: SIZE INLET/DISCHARGE -
RATING INLET/DISCHARGE -
FACING INLET/DISCHARGE -

INTAKE FILTER-SILENCER: MFR/TYPE -
SIZE/MODEL NO. -

DRIVER: TYPE/RATED HORSEPOWER - MOTOR/ 20 HP
DRAWING REFERENCE -
DIRECT CONNECTED/V-BELT DRIVE -

SHEAVE PITCH DIAMETER: DRIVER/COMPRESSOR

BELTS: NO. MAKE AND TYPE/SERVICE FACTOR -

FLYWHEEL DIAMETER (IF ANY) -

TOTAL WR^2 IN COMPRESSOR -

TYPE OF CONTROL/CONTROL ELECT. POWER -

PRESS. COMPR.: LOADED OR STARTS/UNLOADED OR STOPS -

TYPE STARTING UNLOADERS -

COLT Rev 7 QA APP JAN 25 1979

COLT Rev 6 QA APP FM JUL 31 1978

COLT Rev 8 QA APP MAR 1 1979

Rev. 8 Rev. 7 Rev. 6 Rev. 5 Rev. 4 Rev. 3

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COMPRESSOR MANUFACTURER -
SIZE & TYPE -
WEIGHT: COMPRESSOR ONLY/HEAVIEST PIECE -

4. SPARE PARTS

THE MANUFACTURER SHALL FURNISH A LIST OF SPARE PARTS RECOMMENDED FOR ONE YEAR'S OPERATION. ONE YEAR'S OPERATION SHOULD BE BASED ON THIRTY COMPRESSOR STARTS AND FOR EACH START THE COMPRESSOR OPERATING AT RATED LOAD FOR 45 MINUTES. THE LIST SHALL BE COMPLETE WITH UNIT PRICES.

5. SPECIAL TOOLS

THE COVERING PURCHASE ORDER FOR THIS SPECIFICATION WILL SPECIFY 16 COMPRESSORS. FOR THE 16 COMPRESSORS ONE SET OF SPECIAL TOOLS CONSISTING OF (a) SPECIAL DIAPHRAM REMOVAL TOOL PART NO. 4-0-12; (b) HOLD DOWN SCREW REMOVAL TOOL PART NO. 6664N AND (c) HEAD BOLT REMOVAL AND HOLD DOWN SCREW REMOVAL TOOL PART NO. 6665N SHALL BE FURNISHED.

THE TOOLS SHALL BE SHIPPED IN A SEPARATE CONTAINER.

6. PAINTING

6.1 ALL INTERNAL AND EXTERNAL SURFACES SHALL BE THOROUGHLY AND COMPLETELY CLEANED OF ALL MILL SCALE, CUTTINGS, OIL, WELDING SPATTER, AND OTHER FOREIGN MATTER PRIOR TO PAINTING AND SHIPMENT.

6.2 BEFORE PAINTING, THE SURFACE SHALL BE MADE FREE OF OIL AND FOREIGN MATTER BY CLEANING ACCORDING TO SSPC-1. THE SURFACE SHALL THEN BE FURTHER CLEANED TO A MINIMUM REQUIREMENT AS SET DOWN BY SSPC-3 (POWER TOOL CLEANING). GOOD PAINT PRACTICE AS STATED IN SSPC-PA-1 SHALL BE OBSERVED.

6.3 PRIMER - SURFACES SHALL RECEIVE ONE COAT OF A STANDARD SHOP PRIMER CONFORMING TO TT-P-86e (TYPE II.) THE DRY FILM THICKNESS SHALL BE AT LEAST 1.5 MILS, BUT NO MORE THAN 2.0 MILS.

6.4 FINISH - SURFACES SHALL BE GIVEN THE MANUFACTURER'S SHOP STANDARD FINISH USING ANSI-61 LIGHT GRAY COLOR. THE FINISH COAT, WHEN FULLY DRY, SHALL BE 3.0 MILS THICK. IT MAY BE APPLIED IN MULTIPLE COATS. THE TOTAL FILM THICKNESS, INCLUDING THE PRIMER, SHALL BE AT LEAST 4.5 MILS.

6.5 THE UNDERSIDE OF THE COMPRESSOR BASE SHALL BE PROTECTED WITH BITUMASTIC BLACK SOLUTION (RULE 66) AS MANUFACTURED BY KOPPER COMPANY, INC.

APPROVED Rev. 5 SEP 8 1977 QUALITY CONTROL
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6.6 MACHINED SURFACES SHALL BE PROTECTED WITH AT LEAST 4 MILS (.004 INCHES) DRY FILM THICKNESS OF MIL-C-16173, GRADE 1 (FOR LONG TERM STORAGE) OR GRADE 5 (IF PRESERVATIVE) MUST BE READILY REMOVABLE).

7. DRAWINGS

7.1 THE FOLLOWING SHALL APPEAR ON THE MANUFACTURER'S DRAWINGS.

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71 REV. 3
EMERGENCY DIESEL GENERATOR STARTING AIR COMPRESSORS
PURCAHSE ORDER NO. LX-239585
COLT/FMED ORDER NO. 11-700000

7.2 THE MANUFACTURER'S SETTING PLAN FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS, DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE AND ANCHOR BOLT LOADINGS.

7.3 ANCHOR BOLT LOADINGS - THE MANUFACTURER'S SETTING PLAN DRAWING OF THE COMPONENT SHALL INDICATE THE ANCHOR BOLT LOADINGS IN THE FORMAT OF A NOTE. "THE SEISMIC AND OPERATING ANCHOR BOLT LOADINGS, EACH BOLT AT THE _____ LOCATIONS, _____ LBS. TENSION AND _____ LBS. SHEAR." THE VALUES TO COMPLETE THIS NOTE WILL BE FURNISHED BY COLT/FMED UPON COMPLETION OF THE SEISMIC ANALYSIS.

8. SHIPMENT

PROTECTION FOR FINISHED SURFACES, ELECTRICAL EQUIPMENT AND OTHER PARTS REQUIRING SAME SHALL BE AS PER THE MANUFACTURER'S STANDARD PROCEDURES FOR OUTDOOR STORAGE PRIOR TO INSTALLATION. ALL EQUIPMENT REQUIRING LUBRICATION AND STORAGE MAINTENANCE SHALL BE PROPERLY IDENTIFIED, AND INSTRUCTIONS FOR SUCH MAINTENANCE SHALL ACCOMPANY THE EQUIPMENT.

9. SEISMIC ANALYSIS

9.1 COLT FMED WILL PERFORM A SEISMIC ANALYSIS ON THIS COMPONENT AND TO ACCOMPLISH THIS THE VENDOR IS TO FURNISH DATA AND DETAIL DRAWINGS SUFFICIENT FOR COLT FMED TO ACCOMPLISH. THIS DATA AND DETAIL DRAWINGS MUST INCLUDE DIMENSIONS, METAL THICKNESSES, CENTER OF GRAVITY LOCATIONS, WEIGHT (OPERATING INCLUDING FLUID CONTENTS), MATERIAL SPECIFICATIONS AND INTERNAL DETAILS.

9.2 THE MOUNTING OF THE COMPRESSOR AND MOTOR TO THE BASE, MOUNTING OF THE BASE TO FOUNDATION (FOUNDATION BY OTHERS) AND THE COMPONENT INTEGRITY MUST BE ADEQUATE AND DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY, BOTH

APPROVED Rev. 3 APR 22 1977 QUALITY CONTROL

APPROVED Rev. 4 AUG 5 1977 QUALITY CONTROL

APPROVED Rev. 5 SEP 8 1977 QUALITY CONTROL

PARALLED AND PERPENDICULAR TO THE COMPRESSOR CENTERLINE AND ALL THREE FORCES ACTING SIMULTANEOUSLY.

10. QUALITY ASSURANCE REQUIREMENTS

10.1 QA REQUIREMENTS PER COLT/FM DWG. 11 870 888. REV. 0 ©

10.2 MERCURY CONTAMINATION - MERCURY BEARING INSTRUMENTS AND/OR EQUIPMENT WHICH MIGHT CAUSE CONTAMINATION SHALL NOT BE USED IN THE MANUFACTURING, FABRICATION, ASSEMBLY AND TESTING OF THIS COMPONENT.

10.3 A COLT FAIRBANKS MORSE ENGINE DIVISION QUALITY ASSURANCE ENGINEER WILL INSPECT THE UNITS PRIOR TO SHIPMENT AND COMPLETE BECHTEL FORM 3295, STATEMENT OF CONFORMANCE.

908 370

COLT Rev 7 QA APP JAN 25 1979

COLT Rev 8 QA APP JUL 31 1979

COLT Rev 8 QA APP MAR 1 1978

Rev. 8 Rev. 7

Rev. 5 Rev. 4 Rev. 3

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APPROVED Rev. 3 APR 22 1977 QUALITY CONTROL

Colt Industries — Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 370	SHEET 7 OF 7

Colt Industries

Quincy Compressor Division
217 Maine Street
Quincy, Illinois 62301

A division of the Colt Industries Operating Corp

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QR-25 Series Instruction Manual

QUINCY Air Compressors are manufactured with the highest quality of material and workmanship therefore, a long and useful life can be expected of these fine pieces of machinery, if they are installed and operated in accordance with the instructions contained in this manual.

AUTHORIZED Quincy COMPRESSORS SERVICE

READ CAREFULLY

RETAIN FOR FUTURE REFERENCE

COMPRESSOR INSTALLATION

Location

Select a location for the air compressor that is as close as possible to the point where the compressed air is to be used. In selecting this location, it is of utmost importance that the compressor have an ample supply of cool, dry and well circulated air. The pulley side of the compressor should be placed toward the wall (see Figure 1.) for safety reasons, but in no case should the pulley be closer than twelve (12) inches from the wall to allow ample circulation of air from the fan type pulley to the cylinder, intercooler and aftercooler cooling surfaces.

The compressor pulley, drive belts and motor pulley must be enclosed with an Occupational Safety and Health Administration ("OSHA") design belt guard assembly.

The air receiver should be leveled by using shims where necessary. Extreme care should be exercised when lagging the receiver to the floor, to prevent distortion of the receiver feet. It is preferable to mount the receiver on vibration isolators that require no lagging to the floor.

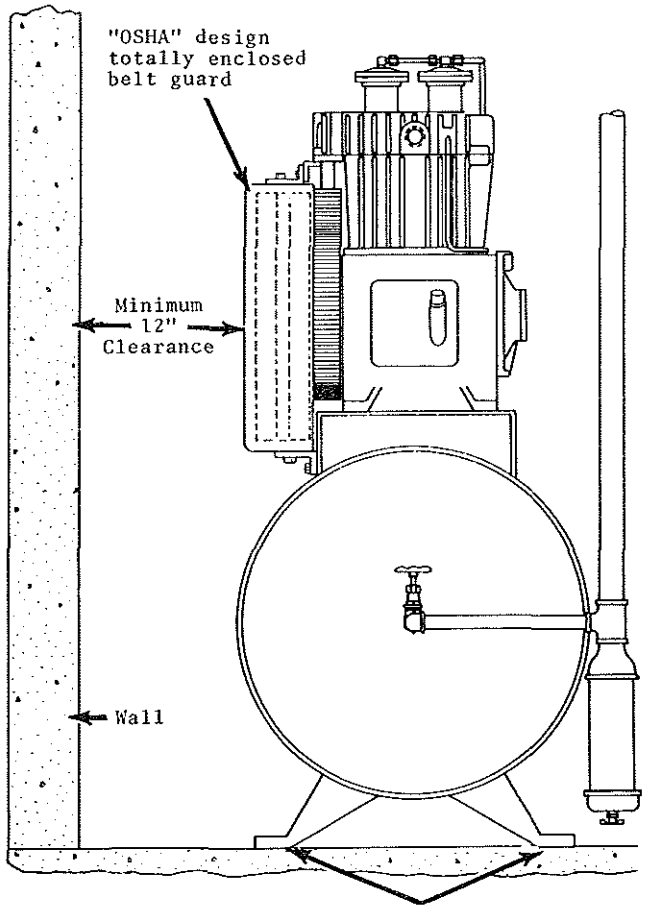


Figure 1.

Electrical

Have all electrical connections made by a competent electrician. It is imperative that the electric motor have the same characteristics as the electric line to which it is to be connected. Full voltage must be supplied to the motor as it is indicated on the motor nameplate.

Air Intake

A clean, cool and dry air supply is essential to the satisfactory operation of your QUINCY Air Compressor. The standard air filter that the compressor is equipped with when leaving the factory is of sufficient size and design to meet normal conditions, if properly serviced, in accordance with the maintenance section in this manual. If, however, the compressor is to be installed in a location where considerable dust, dirt and other contaminents are prevalent, it is strongly recommended that an oil bath filter be substituted for the standard filter. If long runs of intake pipe are necessary to supply the compressor with cool air, the intake should be increased by one pipe size for each eight feet of additional length beyond the intake port of the compressor head. If the intake is piped to the outside, a hood should be installed over the filter to prevent the entrance of rain and snow into the intake of the compressor head.

Discharge Piping

The compressed air distribution system should be constructed of sufficient pipe size that the pressure drop between the air receiver and the point of use will not exceed 10% of the initial receiver pressure. Fittings offering the least resistance to flow, such as long radius elbows, should be selected. Provision should be made not only for present requirements, but also for reasonable future growth.

All main line piping should be sloped away from the compressor at approximately 1/4" per foot, to a drop leg at the lowest part of the system (see Figure 2.). This makes it possible to drain the overnight accumulation of moisture from the lines and also prevents moisture from draining back into the compressor head. Outlets from the main line should be taken from the top of the main by using a tee and two elbows to get a necessary "U" shaped connection as illustrated in Figure 2.

CAUTION!! Do not place a shutoff valve in the discharge line between the compressor head and the air receiver without first installing a safety valve of proper size and design between the compressor head and the shutoff valve. This is a safety precaution to prevent disintegration of the compressor and its associated parts and injury to operating personnel, if the shutoff valve is accidentally closed while the compressor is running.

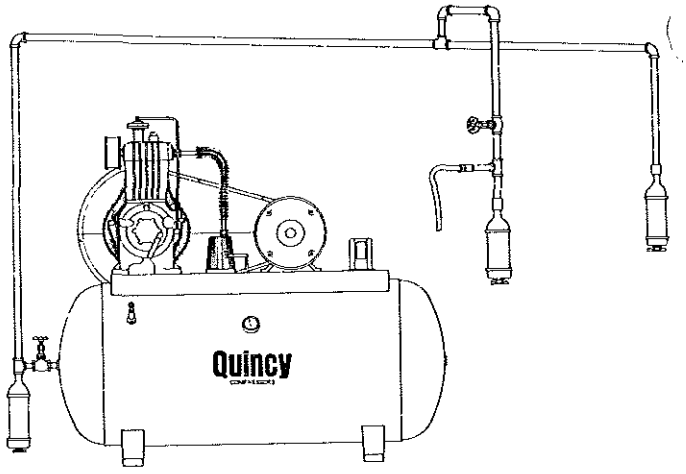


Figure 2.

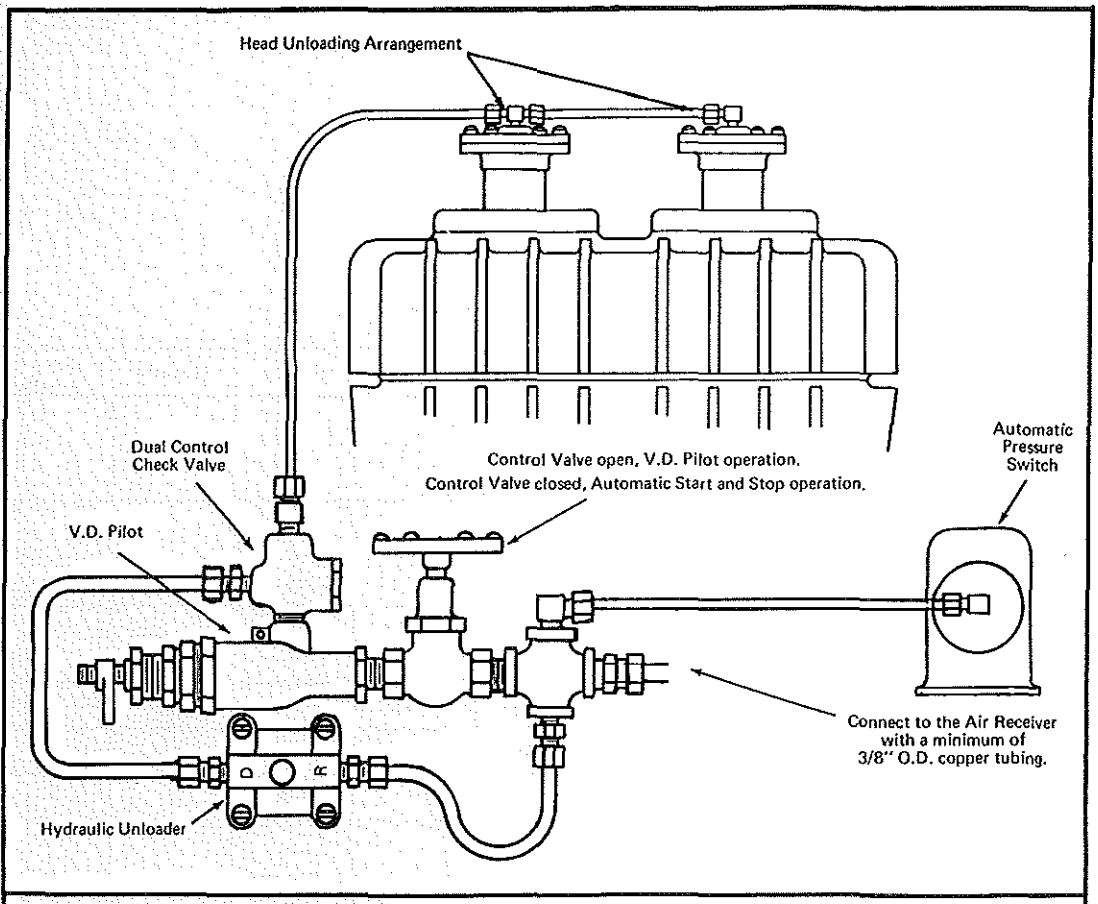
Water Piping

Throttle the inlet water on all watercooled compressors so that the discharge water temperature is maintained at 130°F. to 160°F.

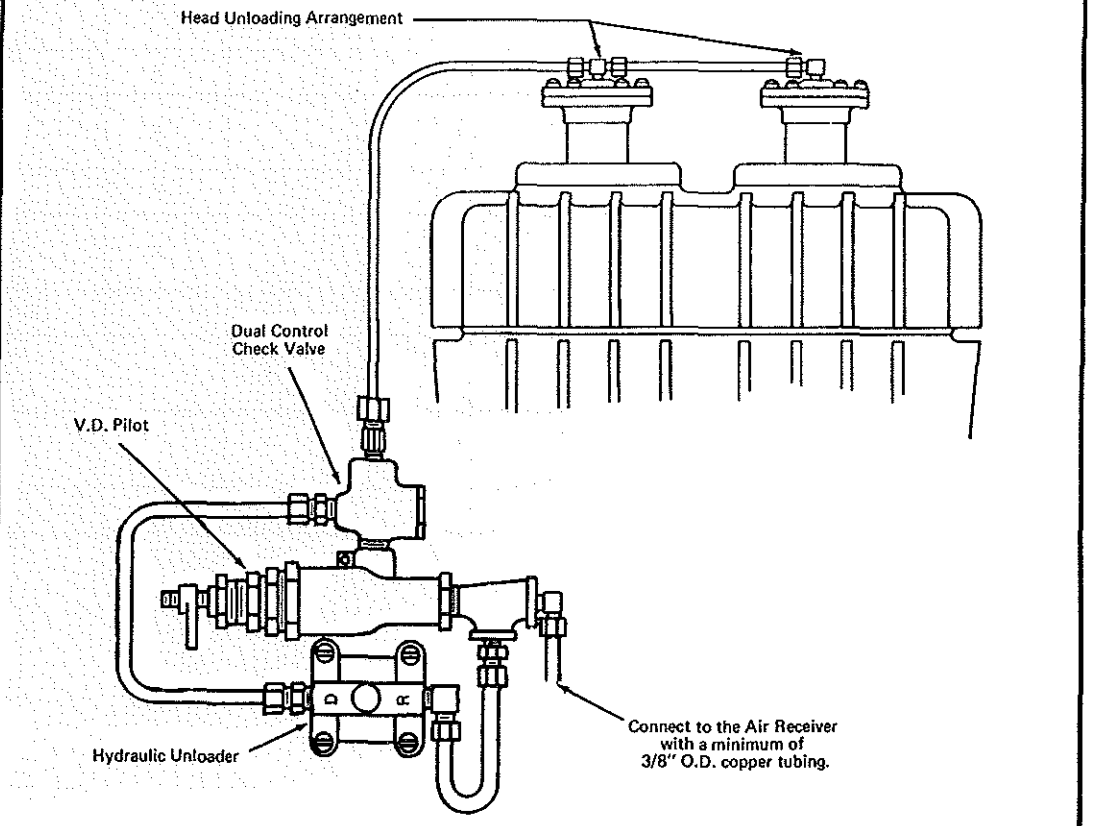
LUBRICATION

CAUTION!! The crankcase of this machine was drained before shipping. Fill the compressor crankcase with the recommended grade and viscosity of oil. Check the electric motor or engine manufacturer's recommendations and make certain that they are properly lubricated at all times.

Before starting this compressor, be sure to fill the crankcase to the full mark on the bayonet oil level gauge. Do not fill above the full mark on the bayonet oil level gauge. The oil level must be maintained be-



TUBING HOOKUP FOR DUAL CONTROL WITH SHUTOFF VALVE



TUBING HOOKUP FOR DUAL CONTROL WITHOUT SHUTOFF VALVE

MAINTENANCE CHART

Check	Daily	Weekly	Monthly	Semi-annually	Annually
1. Check oil pressure—maintain at approximately 15 lbs., except when pumping above 200 PSI air pressure, then maintain at a minimum of 25 PSI.	X				
2. Check oil level—maintain between high and low level marks on the bayonet oil level gauge. *CAUTION: Do Not Overfill!*	X				
3. Drain drop legs and traps in air distribution system.	X				
4. Give compressor overall visual check.	X				
5. Drain moisture accumulations from the air receiver.		X			
6. Check the air distribution system for air leaks.		X			
7. Clean the cooling surfaces of compressor intercooler and aftercooler.		X			
8. Operate Safety Valves.			X		
9. Replace or clean intake filter element. *(Check more often if extremely dirty conditions exist.)*			X		
10. Inspect oil for contamination and change if necessary.			X		
11. Check belts for correct tension.			X		
12. Check pulley clamp bolts and set screws for tightness.			X		
13. Inspect filter felts on the V.D. Pilot.			X		
14. Inspect filter felts on hydraulic unloader, 3-Way valve or V.D. Pilot whichever is applicable.			X		
15. Inspect valve assemblies.				X	
16. Inspect cushion chamber and discharge line for excessive carbon accumulations.					X
17. Inspect pressure switch diaphragm and contact points.					X
18. Inspect contact points in motor starter.					X
19. Lubricate electric motor or engine in accordance with manufacturer's recommendations.					X

tween the two marks on the gauge. Never allow it to fall below the lower mark.

The type of oil depends on operating conditions and ambient temperature at the point of installation. When compressors are operated for short periods only, and very intermittent service, regular non-detergent automotive oils are satisfactory. When compressors are operated fairly constantly, such as industrial applications, an oil listed on Form X-291 "RECOMMENDED LUBRICATION OILS FOR QUINCY QR-25 & QR-100 SERIES AIR COMPRESSORS" is recommended. For proper viscosity of oil refer to Figure 3. Figure 4., shows approximate crankcase oil capacities.

Ambient Temperature at point of installation.	SAE Viscosity or equilavent.
Below 0 Deg. F.	SAE 5W
0 Deg. F. to 32 Deg. F.	SAE 10W
32 Deg. F to 80 Deg. F.	SAE 20
Above 80 Deg. F.	SAE 30

Figure 3. Oil Viscosity

Compressor or Vacuum Pump Model Number	Approximate Capacity	
	Quarts	Pints
X-2, X-3	-	1/4
X-8	-	3/4
206, 207, 210, 211, 214, 215, 306	-	1-3/8
A-4, 106, 108, R-15, R-17	-	1-3/4
212, 216, 308, 310	-	3
230, 240, 325	2	-
244, 255, 340, 350, 370, W340, W350	6	-
390, W264, W280	7	1-1/4
4088, 4110, 4125	10	1
5080, 5105, 5120	10	1
W5080, W5105, W5120	10	1

Figure 4. Crankcase Oil Capacities

CHANGE OIL EVERY 500 HOURS OR EVERY 90 DAYS, WHICHEVER OCCURS FIRST.

If the oil becomes dirty or contaminated before 500 operating hours, or 90 days have elapsed, it should be changed. The crankcase should be thoroughly cleaned every time the oil is changed. It can be flushed by filling with SAE 5 motor oil, then turn the compressor on and allow it to run for five to ten minutes. Drain and fill with the appropriate viscosity of oil (see Figure 3).

Oil Pressure Adjustment

The oil pressure is regulated by a spring loaded ball mounted in the bearing carrier or in the crankcase on some models. Spring pressure is controlled by an adjusting screw. Turning the screw inward will increase the oil pressure, whereas turning the screw outward will decrease the oil pressure. Be sure to loosen the adjustment lock nut before making any adjustment, and turn the adjustment screw slowly until the oil gauge registers approximately 15 to 18 PSI. After adjustment has been made, tighten the adjustment screw lock nut. If the compressor is used for pumping 200 PSI or above, adjust the oil pressure to at least 25 PSI and consult the factory for further details.

Oil and moisture residue should be drained each week from the cushion chamber and air receiver. Excessive accumulations of oil residue in either cushion chamber or air receiver can be ignited by embers of carbon created by the heat of compression, causing an explosion with resulting damage to property and injury to personnel.

Minimum Speed

The lubrication systems of all models of QUINCY compressors are designed to operate at a minimum speed of 400 RPM. Consult the factory when deviation is necessary.

Types of Lubrication Systems

Model Number	Splash	Reversible Vane Type Oil Pump	Non-Reversible Vane Type Oil Pump*
X-2	Yes	–	–
X-3	Yes	–	–
X-8	Yes	–	–
A-4	Yes	–	–
R-15	Yes	–	–
R-17	Yes	–	–
106	Yes	–	–
108	Yes	–	–
206	–	–	Yes
207	Yes	–	–
210	–	–	Yes
211	Yes	–	–
212	–	Yes	–
214	–	–	Yes
215	Yes	–	–
216	–	Yes	–
230	–	Yes	–
240	–	Yes	–
244	–	Yes	–
255	–	Yes	–
W264	–	Yes	–
W280	–	Yes	–
4080	–	Yes	–
4110	–	Yes	–
4125	–	Yes	–
306	–	–	Yes
308	–	Yes	–
310	–	Yes	–
325	–	Yes	–
340	–	Yes	–
W340	–	Yes	–
350	–	Yes	–
W350	–	Yes	–
370	–	Yes	–
390	–	Yes	–
5080	–	Yes	–
5105	–	Yes	–
W5105	–	Yes	–
5120	–	Yes	–
W5120	–	Yes	–

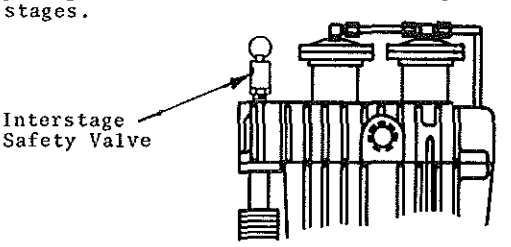
*The crankshaft on Non-Reversible Vane Type Oil Pumps must operate in a counter-clockwise rotation or serious damage will be done to the compressor through lack of lubrication.

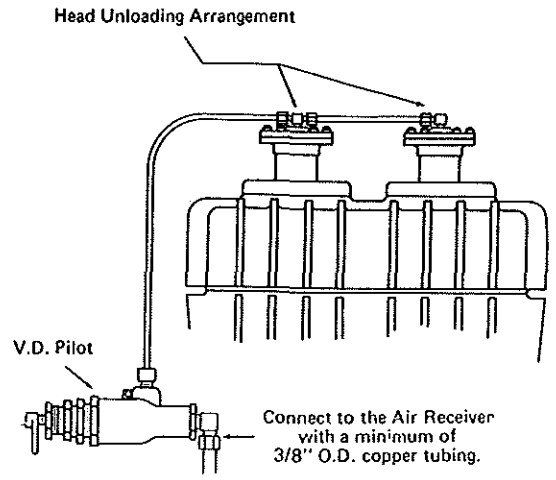
DANGER

AIR FROM THIS COMPRESSOR MUST NOT BE USED FOR FOOD PROCESSING OR BREATHING WITHOUT ADEQUATE FILTERING.

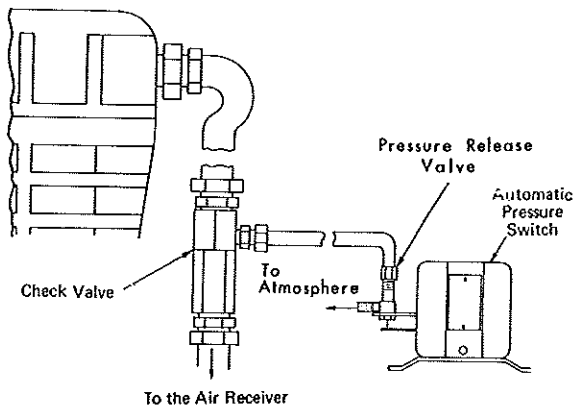
Interstage Safety Valve

The safety valve installed in the head of two-stage compressors is an interstage safety valve. It protects the compressor in case of an obstruction blocking the passages in the head between the high and low pressure stages.

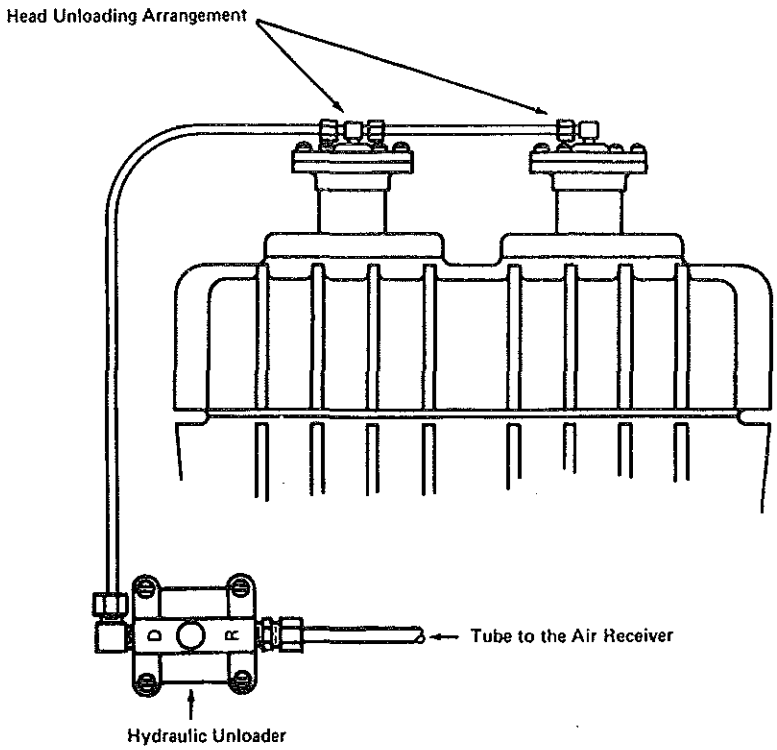




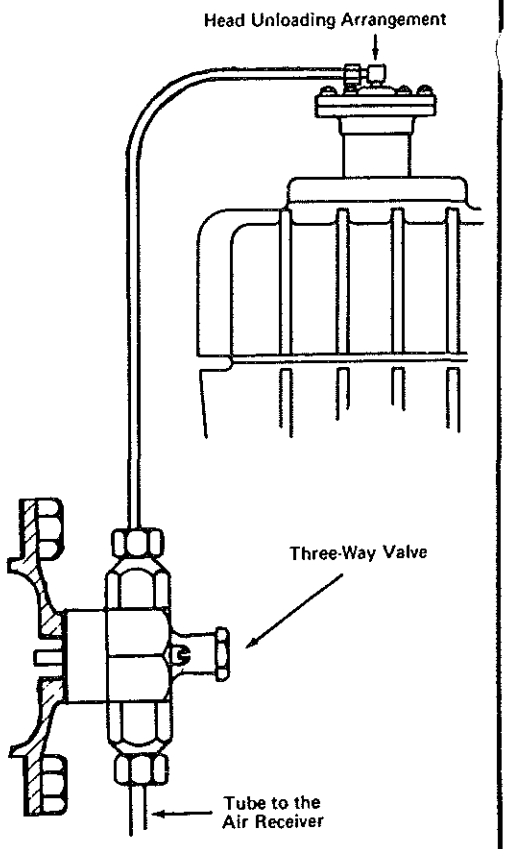
TUBING HOOKUP FOR V.D. PILOT



TUBING HOOKUP FOR COMPRESSORS USING DISCHARGE LINE CHECK VALVE AND PRESSURE SWITCH WITH 2-WAY RELEASE VALVE



TUBING HOOKUP FOR HYDRAULIC UNLOADER



TUBING HOOKUP FOR MECHANICALLY ACTUATED THREE-WAY VALVE AS USED ON THE MODEL 106 AND 108

TROUBLE CHECK CHART

Trouble	Probable Cause	Suggested Remedy
Low Discharge Pressure	1. Air Leaks	1. Listen for escaping air. Apply soap suds solution to all fittings and connections. Bubbles will appear at points of leakage. Tighten or replace leaking fittings or connections.
	2. Leaking Valves	2. Remove Valve Assemblies from the head, disassemble and inspect component parts for valve breakage, weak valve springs, scarred valve seats, etc. Replace inoperative parts and reassemble.
		CAUTION: *Be sure that old valve assembly gaskets are removed from the head valve pockets, and that they are replaced with new ones each time that the valve assemblies are removed from the head.*
	3. Restricted Air Intake	3. Clean the air filter in nonflammable solvent. Check for unnecessary elbows in the intake line and remove if they are materially restricting the flow of intake air to the compressor.
	4. Slipping Belts	4. Remove belts, mark a line at the present position of the motor feet with a scratch awl, pencil or chalk. Loosen motor clamping bolts and move the motor 1/16" to 1/4" in a direction away from the compressor, being sure that the motor shaft is perfectly parallel to the scribbled line. Tighten motor clamping bolts and reinstall belts. Proper tension of the belts should be gauged by flexing the belt with the hand a distance equal to the overall thickness of the belt.
	5. Unloading Mechanism not operating properly	5. Check the operation of the oil pump and pressure gauge by unscrewing the pressure gauge until oil seeps around the threads when the compressor is running. This indicates that oil pressure is reaching the system, and also indicates whether the pressure gauge is operating. If no oil appears at the threads of the oil gauge, this is an indication of possible oil pump failure. If oil appears at the threads of the gauge, and the oil pressure gauge indicates little or no pressure, suspect that the oil gauge may be faulty and replace. If, after determining that the oil pump and gauge are in good operating order, and the unloading mechanism of the compressor continues to be inoperative, remove the copper tube that leads from the hydraulic unloader to the unloading arrangement on the head. There should be no leakage of air at this point when the compressor is running. When the compressor is stopped, air should leak from the disconnected tube. This test tells us whether the hydraulic unloader is functioning properly. If, after testing the oil pump and the hydraulic unloader by the above methods, and the unloading mechanism continues to be inoperative, remove unloader arrangement and the valve assemblies from the head and inspect.
	6. Blown Gaskets	6. Replace any gaskets proven faulty on inspection.
	7. Low Compression	7. Low pressure can be due to worn rings and cylinder walls. Correction is made by replacing the rings or by reboring the cylinder to an oversize and installing new piston assemblies.
Knocking	1. Loose Motor or Compressor Pulley	1. Loose motor or compressor pulleys are a very common cause of compressors knocking. Tighten pulley clamp bolts and set screws.
	2. Lack of oil in crankcase	2. Check bayonet oil level gauge for proper oil level. If low, check for possible damage to bearings.
	3. Oil Pump not functioning	3. Check as in paragraph 5. above on *"UNLOADING MECHANISM NOT OPERATING PROPERLY".*
	4. Worn Connecting Rod Inserts	4. Remove Connecting Rod cap and inspect inserts. If worn or damaged, replace.
		CAUTION: *Before installing new Connecting Rod Inserts, check crankshaft oil channels for the possibility of being plugged with molten babbitt.*
	5. Worn Piston Pin Bushing	5. Remove rod and piston assemblies from the compressor and inspect for excessive wear. Replace excessively worn piston pin and/or bushing.
	6. Burned out Timken Bearing	6. Replace worn or burned out bearings and remedy cause of failure.
	7. Excessive Crankshaft End Play	7. Remove the cylinder and head assemblies from the running gear, and check crankshaft for end play. If end play can be felt, remove one thin bearing adjustment shim at a time, and recheck end play after each removal. The bearing, when properly adjusted, should have a very slight drag when turned over by hand. This adjustment should never be made while the rods are still connected to the crankshaft.
	8. Loose Valve Assemblies	8. Remove valve assembly and valve assembly gasket from the head. Replace valve assembly gasket with a new one and reinstall valve assembly after examining the valve pockets in the head and the valve assemblies for possible damage. Carefully tighten valve assembly holddown screws sufficiently to hold the valve solidly in place.

Trouble	Probable Cause	Suggested Remedy
Knocking (continued)	9. Loose Piston	9. Bore Cylinder to .010" or .020" oversize and install oversized pistons and rings.
	10. Piston hitting the head	10. Remove the compressor head and inspect for carbon deposits or other foreign material on top of the piston. Replace head with new head gasket and intercooler gaskets as the case may be.
Heating	1. Poor Ventilation	1. Relocate the compressor to an area where an ample supply of cool, clean, dry and well circulated air is available.
		CAUTION: *Avoid locations near boilers or other areas where there is a high ambient temperature.*
	2. Dirty cooling surfaces	2. Clean the cooling surfaces of the cylinder, intercooler and aftercooler.
	3. Incorrect pulley rotation	3. Check the arrow on the pulley for correct rotation. If incorrect, have a competent electrician check for the possibility of having the motor reversed.
Stall	1. Overloaded Motor	1. Have a competent electrician examine the motor and wiring, then proceed with his recommendations.
Excessive Belt Wear	1. Pulley out of alignment	1. Realign motor pulley with compressor pulley.
	2. Belt too loose or too tight	2. Adjust tension.
	3. Belt slipping	3. Adjust tension.
	4. Pulley wobble	4. Check for worn crankshaft, keyway or pulley bore, resulting from running the compressor or motor with loose pulleys. Check for bent pulleys or bent crankshaft.
Oil in the Discharge Air	1. Worn Piston Rings	1. Replace with new rings.
	2. Compressor air intake restricted	2. Clean filtering media in non-flammable solvent, and check for other restrictions in the intake system.
	3. Restricted breather valve	3. Clean and check breather valve for free operation.
	4. Excessive oil in compressor	4. Drain down to full mark on bayonet oil level gauge.
	5. Wrong oil viscosity	5. Check lubrication section of this manual for correct viscosity.
	6. Connecting Rod out of alignment	6. Have rod with piston attached checked and realigned. Most automotive engine rebuilding houses have equipment available to make this test.

Colt Industries

Quincy Compressor Division
217 Maine Street
Quincy, Illinois 62301

A division of the Colt Industries Operating Corp

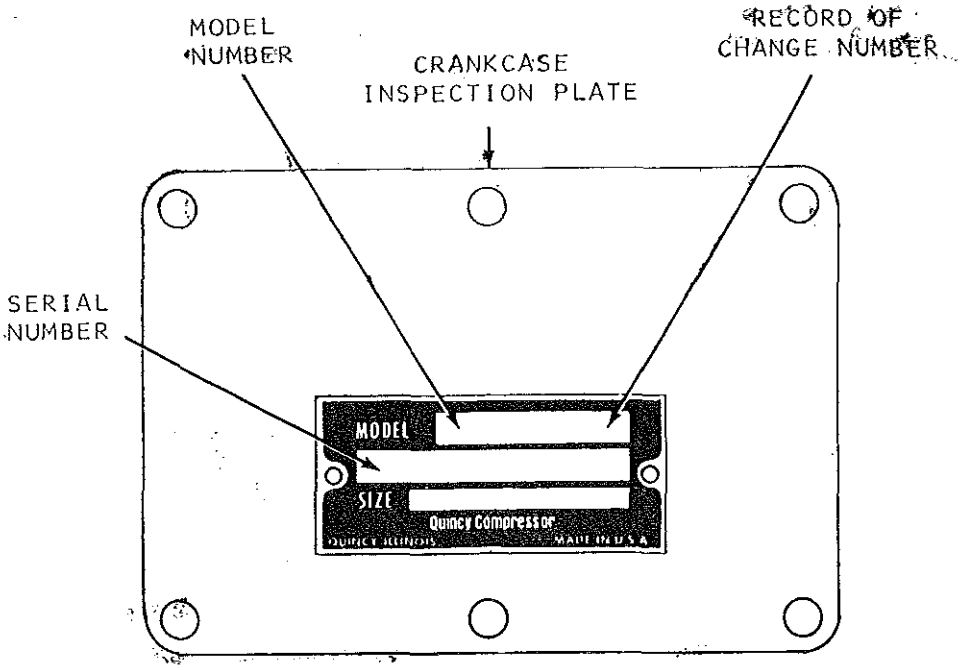
Form X-196
Revised 10-6-75

Printed in USA

PARTS LIST

THE MODEL NUMBER, RECORD OF CHANGE NUMBER AND SERIAL NUMBER, AS SHOWN ON THE SERIAL NAME PLATE OF THE COMPRESSOR, MUST BE GIVEN WHEN ORDERING REPAIR PARTS.

PARTS LIST
MODEL 390
AIR COMPRESSOR
RECORD OF
CHANGE 20 & 21
MINIMUM SPEED 400 RPM
MAXIMUM SPEED 900 RPM
for any deviation
from the above
consult the factory.



PROMPT SERVICE CAN BE RENDERED ON REPAIR PARTS ORDERS IF THE FOLLOWING IS ALSO GIVEN:

1. STATE THE EXACT PART NUMBER NEEDED. DO NOT ORDER BY INDEX NUMBERS, AS INDEX NUMBERS ARE REPEATED THROUGHOUT THIS MANUAL, AND IF USED FOR ORDERING REPAIR PARTS, WILL NECESSITATE TIME CONSUMING CORRESPONDENCE.
2. STATE EXACT QUANTITY NEEDED.
3. STATE PREFERRED TYPE OF TRANSPORTATION.

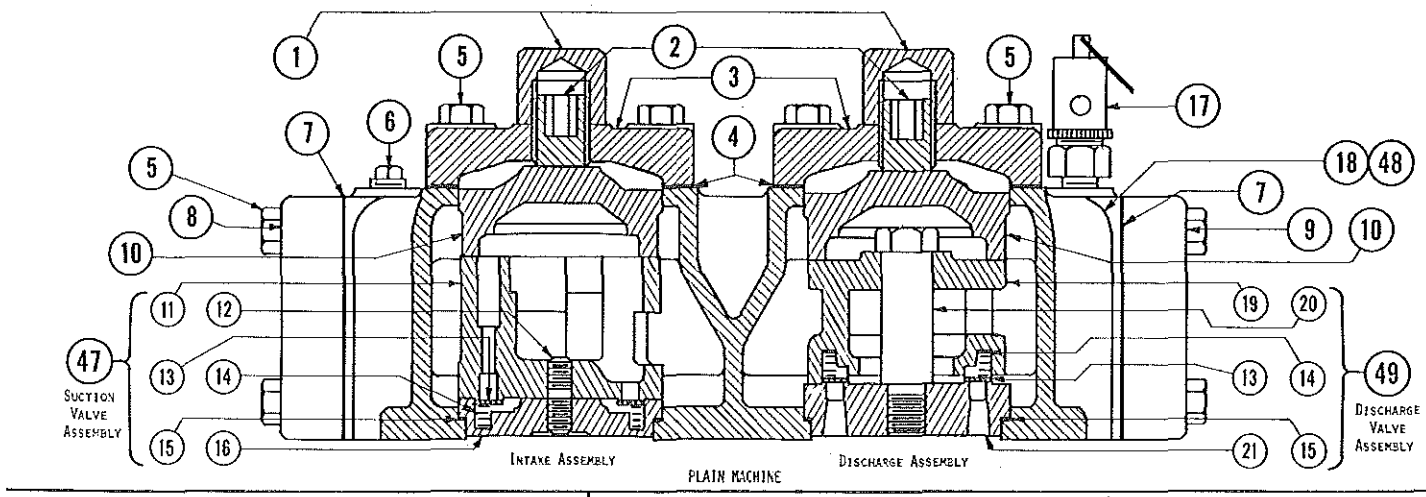
ALL REPAIR PARTS ORDERS WILL BE INVOICED F.O.B. QUINCY, ILLINOIS AT PRICES IN EFFECT AT TIME OF DELIVERY.

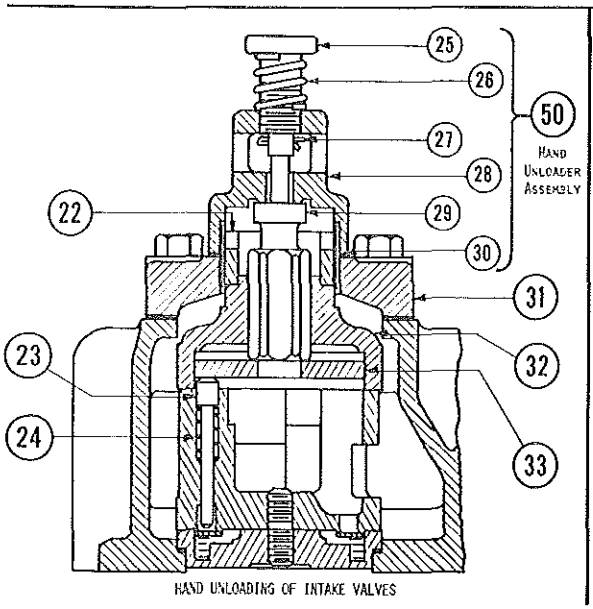
Colt Industries

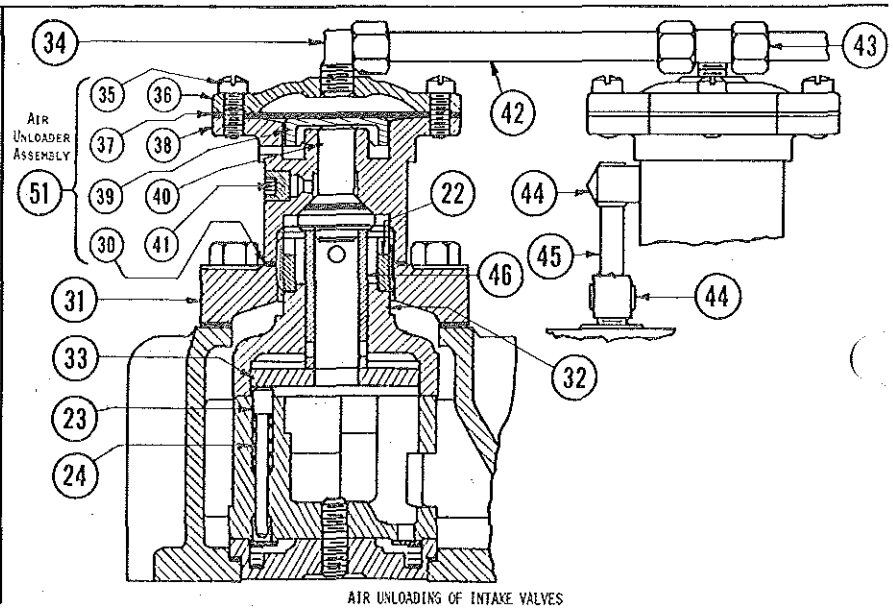
Quincy Compressor Division
217 Maine Street
Quincy, Illinois 62301

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HEAD GROUP





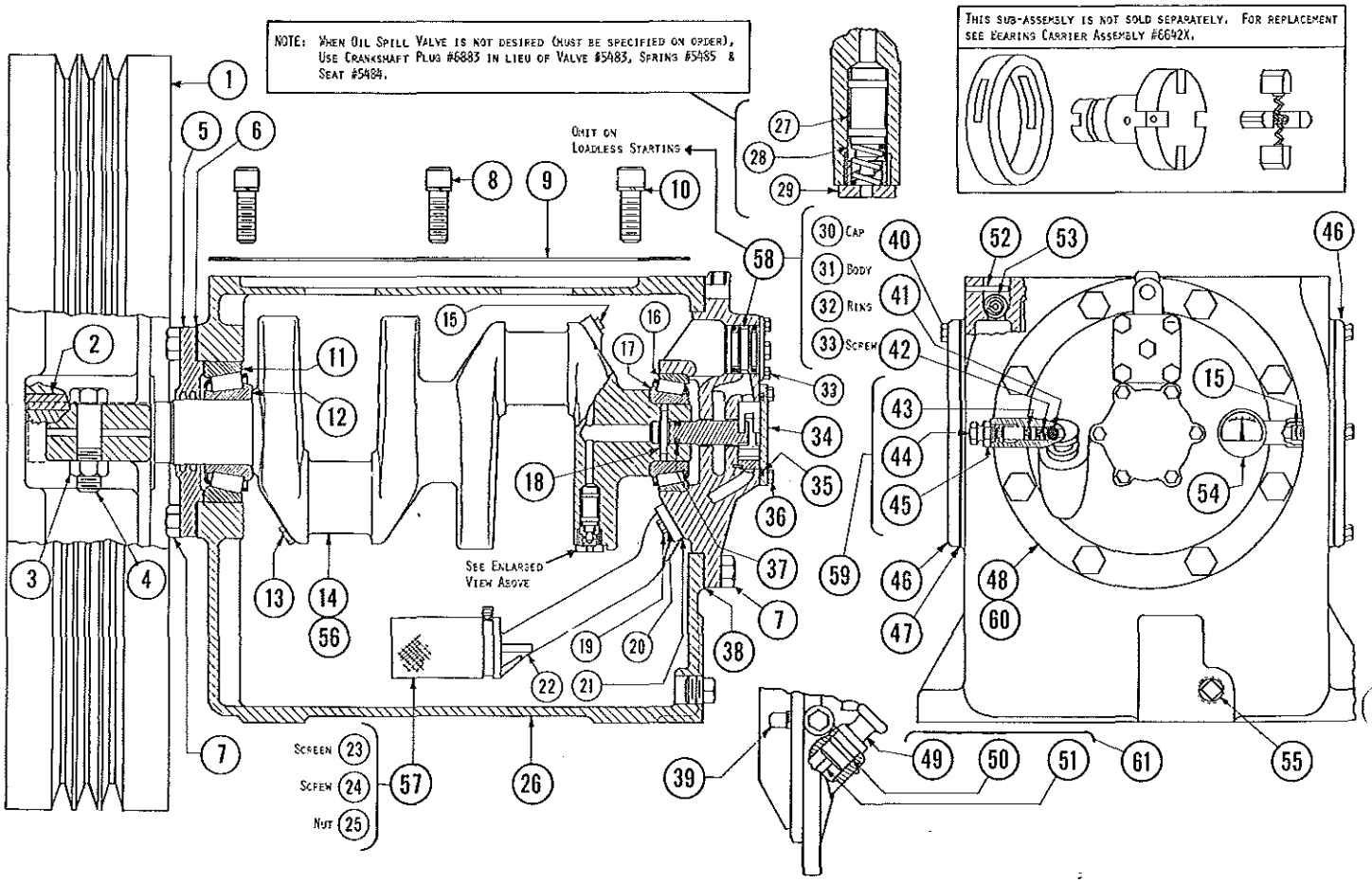


INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED FOR ONE MACHINE				
			PLAIN	LOADLESS	VD PILOT	DUAL CONTROL	HAND
1	2623	NUT - VALVE RETAINER SCREW LOCK	6	4	4	4	4
2	6953	SCREW - VALVE RETAINER	6	4	4	4	4
3	6941	PLATE - HIGH PRESSURE INTAKE OR DISCHARGE VALVE COVER	2	1	1	1	1
	6955	PLATE - LOW PRESSURE INTAKE OR DISCHARGE VALVE COVER	2	1	1	1	1
4	2347	GASKET - HIGH PRESSURE INTAKE OR DISCHARGE VALVE COVER PLATE	2	2	2	2	2
	2348	GASKET - LOW PRESSURE INTAKE OR DISCHARGE VALVE COVER PLATE	2	2	2	2	2
5	2763	SCREW - 1/2" NC X 1-3/4" HEX HEAD CAP	28	28	28	28	28
6	2057	PLUG - 1/2" NPT SQUARE HEAD PIPE	1	1	1	1	1
7	2346	GASKET - FLANGE NOTE: NOT INCLUDED IN COMPLETE HEAD ASSEMBLY	2	2	2	2	2
8	2350	FLANGE - 2-1/2" NPT INTAKE NOTE: NOT INCLUDED IN COMPLETE HEAD ASSEMBLY	1	1	1	1	1
9	2349	FLANGE - 1-1/2" NPT DISCHARGE NOTE: NOT INCLUDED IN COMPLETE HEAD ASSEMBLY	1	1	1	1	1
10	6952	SPACER - VALVE RETAINER	6	4	4	4	4
11	2002	SEAT - INTAKE VALVE	3	3	3	3	3
12	1429	STUD - INTAKE VALVE	3	3	3	3	3

HEAD GROUP - CONTINUED

INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED FOR ONE MACHINE				
			PLAIN	LOADLESS	VD PILOT	DUAL CONTROL	HAND
13	2087 ok	VALVE - INTAKE OR DISCHARGE	6	6	6	6	6
14	6909	SPRING - INTAKE OR DISCHARGE VALVE	6	6	6	6	6
15	1356	GASKET - INTAKE OR DISCHARGE VALVE	6	6	6	6	6
16	6949	BUMPER - INTAKE VALVE	3	3	3	3	3
17	3022-90	VALVE - 1/2" NPT SAFETY (SET 90 PSI)	1	1	1	1	1
18	2334	HEAD - BARE	1	1	1	1	1
19	6948	BUMPER - DISCHARGE VALVE	3	3	3	3	3
20	3297	STUD - DISCHARGE VALVE	3	3	3	3	3
21	1424A	SEAT - DISCHARGE VALVE	3	3	3	3	3
22	3008	SCREW - VALVE HOLDDOWN	-	2	2	2	2
23	1857	PIN - UNLOADER KICKOFF	-	6	6	6	6
24	6910	SPRING - UNLOADER KICKOFF PIN	-	6	6	6	6
25	2906	SCREW - HAND UNLOADER	-	-	-	-	2
26	1882	SPRING - HAND UNLOADER	-	-	-	-	2
27	2741	PIN - COTTER	-	-	-	-	2
28	1602	BODY - HAND UNLOADER	-	-	-	-	2
29	6954X	PLUNGER - HAND UNLOADER	-	-	-	-	2
30	1556	GASKET - VALVE COVER	-	2	2	2	2
31	6940	PLATE - HIGH PRESSURE INTAKE OR DISCHARGE VALVE COVER	-	1	1	1	1
	6942 ok	PLATE - LOW PRESSURE INTAKE OR DISCHARGE VALVE COVER	-	1	1	1	1
32	6951	SPACER - VALVE RETAINER	-	2	2	2	2
33	6938	PLATFORM - UNLOADER	-	2	2	2	2
34	1642	ELBOW - 1/8" NPT X 1/4" TUBE	-	1	1	1	-
35	7499	SCREW - 1/4" NC X 3/4" HEX HEAD SEMS	-	12	12	12	-
36	1818B	COVER - UNLOADER	-	2	2	2	-
37	1855	DIAPHRAGM - UNLOADER	-	2	2	2	-
38	7483	BODY - UNLOADER	-	2	2	2	-
39	5910	DISC - DIAPHRAGM	-	2	2	2	-
40	7532X	PISTON - UNLOADER	-	2	2	2	-
41	2755S	PLUG - 1/8" NPT PIPE	-	1	1	1	-
42	2586	TUBE - 1/4" X 10" COPPER	-	1	1	1	-
43	1665	TEE - 1/8" NPT X 1/4" TUBE X 1/4" TUBE	-	1	1	1	-
44	2709	ELBOW - 1/8" NPT X 5/16" TUBE	-	2	2	2	-
45	5322	TUBE - 5/16" X 17" COPPER	-	1	1	1	-
46	6950	PIN - UNLOADER	-	2	2	2	-
		ASSEMBLIES					
47	6949X	VALVE ASSEMBLY - INTAKE	3	1	1	1	1
	6949XU	VALVE ASSEMBLY - UNLOADER TYPE INTAKE	-	2	2	2	2
48	2334X16P	HEAD ASSEMBLY - PLAIN TYPE	1	-	-	-	-
	2334X16L	HEAD ASSEMBLY - LOADLESS, V.D. PILOT OR DUAL CONTROL TYPE	-	1	1	1	-
	2334X16H	HEAD ASSEMBLY - HAND UNLOADER TYPE	-	-	-	-	1
49	6948X	VALVE ASSEMBLY - DISCHARGE	3	3	3	3	3
50	1602X3	UNLOADER ASSEMBLY - HAND	-	-	-	-	2
51	7483X	UNLOADER ASSEMBLY - AIR	-	2	2	2	-

CRANKCASE & RUNNING GEAR GROUP



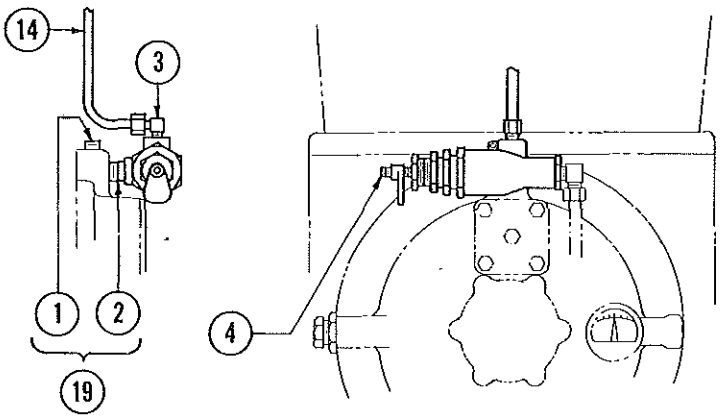
INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
1	8297	PULLEY - 23-1/2" O.D., 3 GROOVE, "B" SECTION, 2" BORE, COUNTERCLOCKWISE COMPRESSOR	1
	8306	PULLEY - 23-1/2" O.D., 3 GROOVE, "B" SECTION, 2" BORE, CLOCKWISE COMPRESSOR	*
2	2851	KEY - PULLEY	1
3	1883	NUT - 5/8" NF HEX	2
	3592	WASHER - 5/8" PLAIN	2
4	4260	BOLT - 5/8" NF X 3" HEX HEAD PULLEY HUB CLAMP	2
5	6643	PLATE - BEARING ADJUSTMENT	1
6	1498	SHIM - .005" THICK STEEL BEARING ADJUSTMENT	*
	1498A	SHIM - .007" THICK STEEL BEARING ADJUSTMENT	*
	1498B	SHIM - .020" THICK STEEL BEARING ADJUSTMENT	*
7	1707	SCREW - 1/2" NC X 1-1/4" HEX HEAD CAP	12
8	7694	SCREW - 5/8" NC X 1-1/2" "COUNTER-BOR" HEAD CAP	7
9	2344	GASKET - CYLINDER TO CRANKCASE	1
10	3457	WASHER - 5/8" LOCK	7
11	4357	CUP - PULLEY SIDE TIMKEN BEARING	1
12	6651	CONE - PULLEY SIDE TIMKEN BEARING	1
13	5486	PLUG - CRANKSHAFT ORIFICE	1
14	6947-2	CRANKSHAFT - BARE NOTE: NOT SOLD SEPARATELY, SEE CRANKSHAFT ASSEMBLIES #6947-2X AND #6947-2X1.	-
15	2755S	PLUG - 1/8" NPT SOCKET HEAD PIPE	2

CRANKCASE & RUNNING GEAR GROUP - CONTINUED

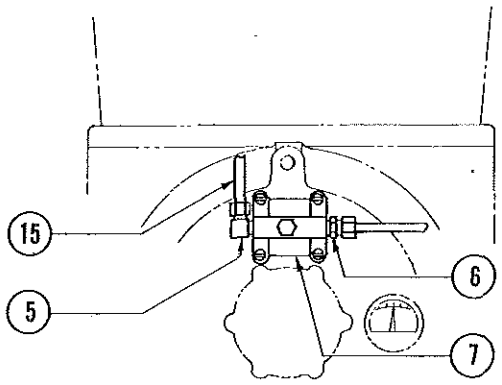
INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
16	3720	CUP - OIL PUMP SIDE BEARING CARRIER TIMKEN BEARING	1
17	3776	CONE - OIL PUMP SIDE BEARING CARRIER TIMKEN BEARING	1
18	6906	PIN - OIL PUMP ROTOR DRIVE	1
19	6907	SCREW - OIL INTAKE BRACKET MOUNTING	2
20	2830	WIRE - OIL INTAKE BRACKET MOUNTING SCREW LACING	1
21	6679	GASKET - OIL INTAKE MOUNTING BRACKET	1
22	8109	BRACKET - OIL INTAKE MOUNTING	1
23	5470	SCREEN - OIL INTAKE FILTER	1
24	1022	SCREW - #10-32 ROUND HEAD MACHINE	1
25	5496	NUT - #10-32 SQUARE	1
26	6946	CRANKCASE - BARE	1
27	5483	VALVE - SPILL	1
28	5485	SPRING - SPILL VALVE	1
29	5484	SEAT - SPILL VALVE	1
30	6289	CAP - HYDRAULIC UNLOADER OPENING CLOSURE ASSEMBLY	1
31	6327	BODY - HYDRAULIC UNLOADER OPENING CLOSURE ASSEMBLY	1
32	6286	"O" RING - HYDRAULIC UNLOADER OPENING CLOSURE ASSEMBLY	2
33	2138	SCREW - 1/4" NC X 1/2" HEX HEAD CAP	5
34	6269	COVER - OIL PUMP	1
35	6270	"O" RING - OIL PUMP COVER	1
36	3951	SCREW - 1/4" NC X 5/8" HEX HEAD CAP	6
37	2323	"O" RING - OIL PUMP ROTOR	1
38	5494	GASKET - BEARING CARRIER	1
39	7514	DEFLECTOR - OIL	1
40	2022	SCREW - 5/16" NC X 3/4" HEX HEAD CAP	12
41	1281	BALL - STEEL	1
42	1160	SPRING - OIL PRESSURE ADJUSTMENT SCREW	1
43	5491	"O" RING - OIL PRESSURE ADJUSTMENT SCREW	1
44	5489	SCREW - OIL PRESSURE ADJUSTMENT	1
45	5490	NUT - OIL PRESSURE ADJUSTMENT SCREW LOCK	1
46	1249	PLATE - INSPECTION	2
47	1315	GASKET - INSPECTION PLATE	2
48	6642	CARRIER - BEARING	
		NOTE: NOT SOLD SEPARATELY, SEE BEARING CARRIER ASSEMBLY #6642X.	-
49	6726	KNOB - BAYONET OIL LEVEL GAUGE	
		NOTE: NOT SOLD SEPARATELY, SEE BAYONET OIL LEVEL GAUGE ASSEMBLY #6727X.	-
50	6755	"O" RING - BAYONET OIL LEVEL GAUGE	1
51	6727	ROD - BAYONET OIL LEVEL GAUGE	
		NOTE: NOT SOLD SEPARATELY, SEE BAYONET OIL LEVEL GAUGE ASSEMBLY #6727X.	-
52	5932	BUMPER - BREATHER BALL	1
53	5783	BALL - BREATHER	1
54	1386	GAUGE - OIL PRESSURE	1
55	2057	PLUG - 1/2" NPT SQUARE HEAD OIL DRAIN	1
		ASSEMBLIES	
56	6947-2X	CRANKSHAFT ASSEMBLY	
		NOTE: INCLUDES: SPILL VALVE ASSEMBLY, ORIFICE, PLUG AND OIL PUMP ROTOR DRIVE PIN.	*
	6947-2X1	CRANKSHAFT ASSEMBLY	
		NOTE: INCLUDES: SPILL VALVE ASSEMBLY, ORIFICE, PLUG, OIL PUMP ROTOR DRIVE PIN AND TIMKEN BEARING CONES.	*
57	5470X	SCREEN ASSEMBLY - OIL INTAKE	1
58	6289X	CLOSURE ASSEMBLY - HYDRAULIC UNLOADER OPENING	*
59	5489X	SCREW ASSEMBLY - OIL PRESSURE ADJUSTMENT	1
60	6642X	CARRIER ASSEMBLY - BEARING	1
61	6727X	GAUGE ASSEMBLY - BAYONET OIL LEVEL	1
NOT SHOWN	7079	GASKET SET - COMPLETE COMPRESSOR OVERHAUL	1

*ASTERISK INDICATES THAT PARTS CAN BE USED IN THE CATEGORY INDICATED, BUT MUST BE ORDERED AS EACH INDIVIDUAL SITUATION REQUIRES.

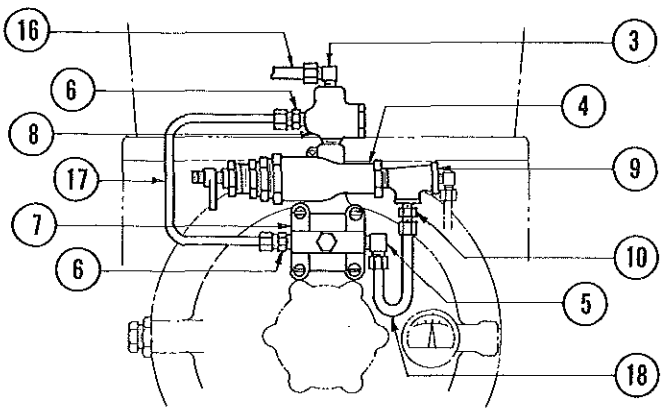
CONTROL GROUP



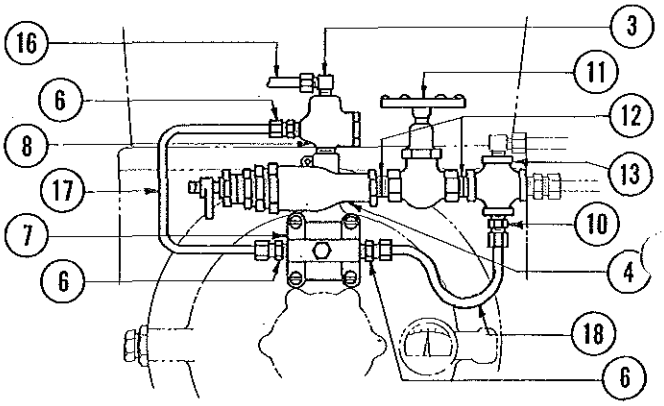
WITH V.D. PILOT ONLY
(FOR CONTINUOUS RUNNING)



WITH HYDRAULIC UNLOADER ONLY
(LOADLESS STARTING)



WITH DUAL CONTROLS



WITH DUAL CONTROLS
AND PILOT SHUTOFF VALVE

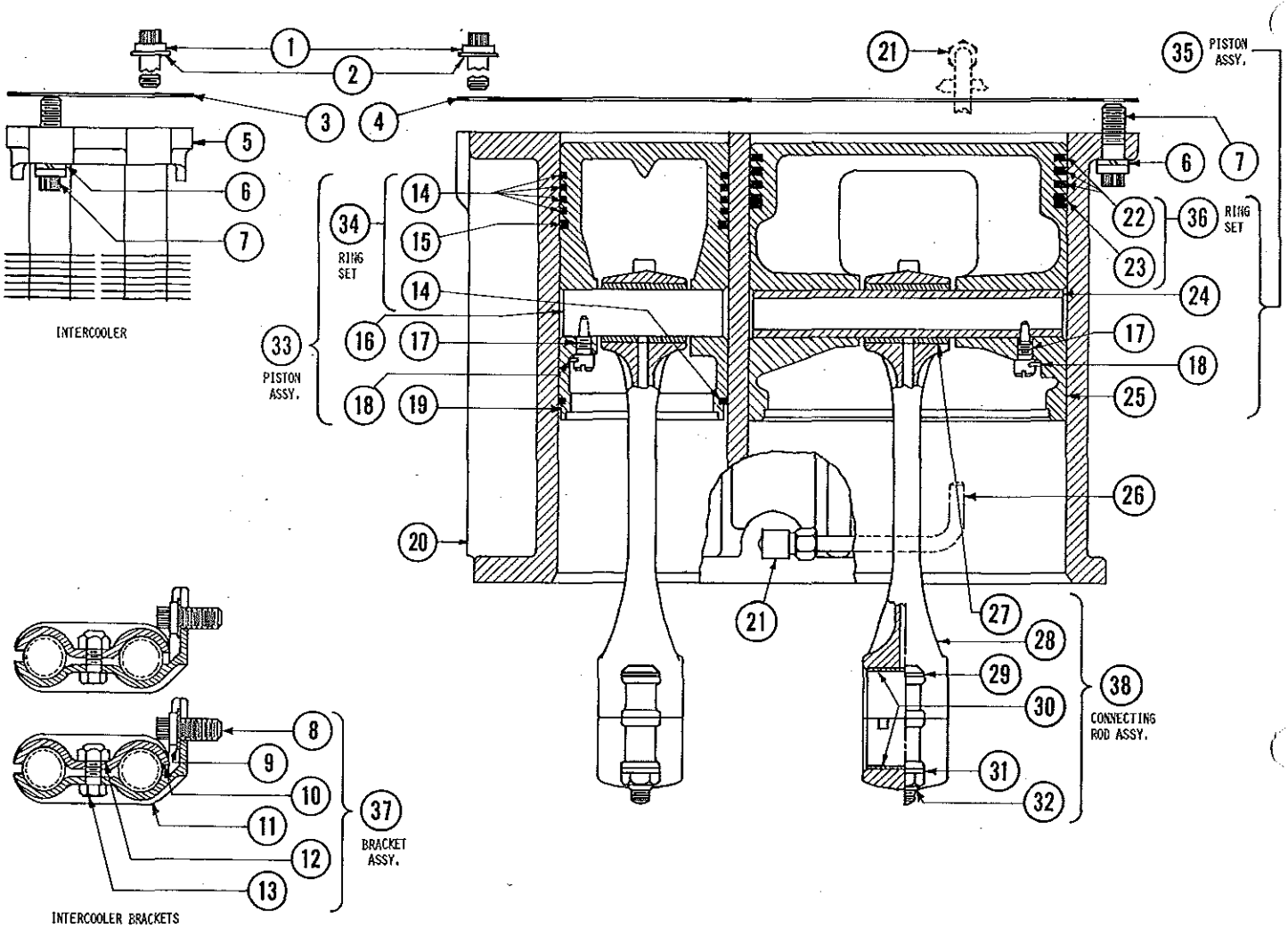
INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED FOR ONE MACHINE			
			LOADLESS	CONTINUOUS RUNNING	DUAL CONTROL LESS SHUTOFF VALVE	DUAL CONTROL WITH SHUTOFF VALVE
1	3080	SCREW - 3/8" NF X 1/2" SOCKET HEAD SET	-	1	1	1
2	6317	STUD - V.D. PILOT MOUNTING	-	1	1	1
3	2708	CONNECTOR - 1/4" NPT X 1/4" TUBE ELBOW	-	1	1	1
4	----	PILOT ASSEMBLY - V.D. NOTE: SEE V.D. PILOT BREAKDOWN IN THIS PARTS LIST.	-	1	1	1
5	1642	CONNECTOR - 1/8" NPT X 1/4" TUBE ELBOW	1	-	1	-
6	1643	CONNECTOR - 1/8" NPT X 1/4" TUBE STRAIGHT	1	-	2	3
7	----	UNLOADER ASSEMBLY - HYDRAULIC NOTE: SEE HYDRAULIC UNLOADER BREAKDOWN IN THIS PARTS LIST.	1	-	1	1
8	6194X	VALVE - DUAL CONTROL CHECK	-	-	1	1
9	3003	TEE - 1/4" NPT SERVICE	-	-	1	-
10	2704	CONNECTOR - 1/4" NPT X 1/4" TUBE STRAIGHT	-	-	1	1

CONTROL GROUP - CONTINUED

INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED FOR ONE MACHINE			
			LOADLESS	CONTINUOUS RUNNING	DUAL CONTROL LESS SHUTOFF VALVE	DUAL CONTROL WITH SHUTOFF VALVE
11	6200	VALVE - 1/4" NPT SHUTOFF	-	-	-	1
12	2177	NIPPLE - 1/4" NPT CLOSE	-	-	-	2
13	4805	CROSS - 1/4" NPT	-	-	-	1
14	1983	TUBE - 1/4" X 29" V.D. PILOT TO UNLOADERS	-	1	-	-
15	2971	TUBE - 1/4" X 31" HYDRAULIC UNLOADER TO UNLOADERS	1	-	-	-
16	2866	TUBE - 1/4" X 28" DUAL CONTROL CHECK VALVE TO UNLOADERS	-	-	1	1
17	1966	TUBE - 1/4" X 9" HYDRAULIC UNLOADER TO DUAL CONTROL CHECK VALVE	-	-	1	1
18	1870	TUBE - 1/4" X 7" HYDRAULIC UNLOADER TO SERVICE TEE OR CROSS	-	-	1	1
19	6317X	STUD ASSEMBLY - V.D. PILOT MOUNTING	-	1	1	1

DO NOT ORDER BY INDEX NUMBERS, INDEX NUMBERS ARE REPEATED THROUGHOUT THIS MANUAL, AND IF USED FOR ORDERING REPAIR PARTS, WILL NECESSITATE TIME CONSUMING CORRESPONDENCE.

CYLINDER, PISTON & ROD GROUP



INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
1	2357	SCREW - 1/2" NC X 5" "COUNTER-BOR" HEAD CAP	5
2	1478	WASHER - 1/2" COPPER	5
3	5694	GASKET - INTERCOOLER TO HEAD	1
4	5695	GASKET - CYLINDER TO HEAD	
		NOTE: FOR COMPLETE HEAD GASKETS, 1 EA. #5695 HEAD GASKET AND 1 EA. #5694 INTERCOOLER GASKET IS REQUIRED.	1
5	2343	INTERCOOLER - AIRCOOLED	1
6	3186	WASHER - 1/2" LOCK	15
7	2363	SCREW - 1/2" NC X 3/4" "COUNTER-BOR" HEAD CAP	13
8	6204	SCREW - 1/2" NC X 1" "COUNTER-BOR" HEAD CAP	2
9	2729	WASHER - 1/2" PLAIN	2
10	2359	CLAMP - INTERCOOLER	2
11	2358	BRACKET - INTERCOOLER	2
12	3199	NUT - 5/16" NF ELASTIC STOP	2
13	4927	SCREW - 5/16" NF X 1" HEX HEAD CAP	2
14	1464	RING - STANDARD HIGH PRESSURE COMPRESSION	5
	1464OV10	RING - .010" OVERSIZE HIGH PRESSURE COMPRESSION	*
	1464OV20	RING - .020" OVERSIZE HIGH PRESSURE COMPRESSION	*
15	1288	RING - STANDARD HIGH PRESSURE OIL CONTROL	1
	1288OV10	RING - .010" OVERSIZE HIGH PRESSURE OIL CONTROL	*
	1288OV20	RING - .020" OVERSIZE HIGH PRESSURE OIL CONTROL	*
16	2341	PIN - HIGH PRESSURE PISTON	1

CYLINDER PISTON & ROD GROUP - CONTINUED

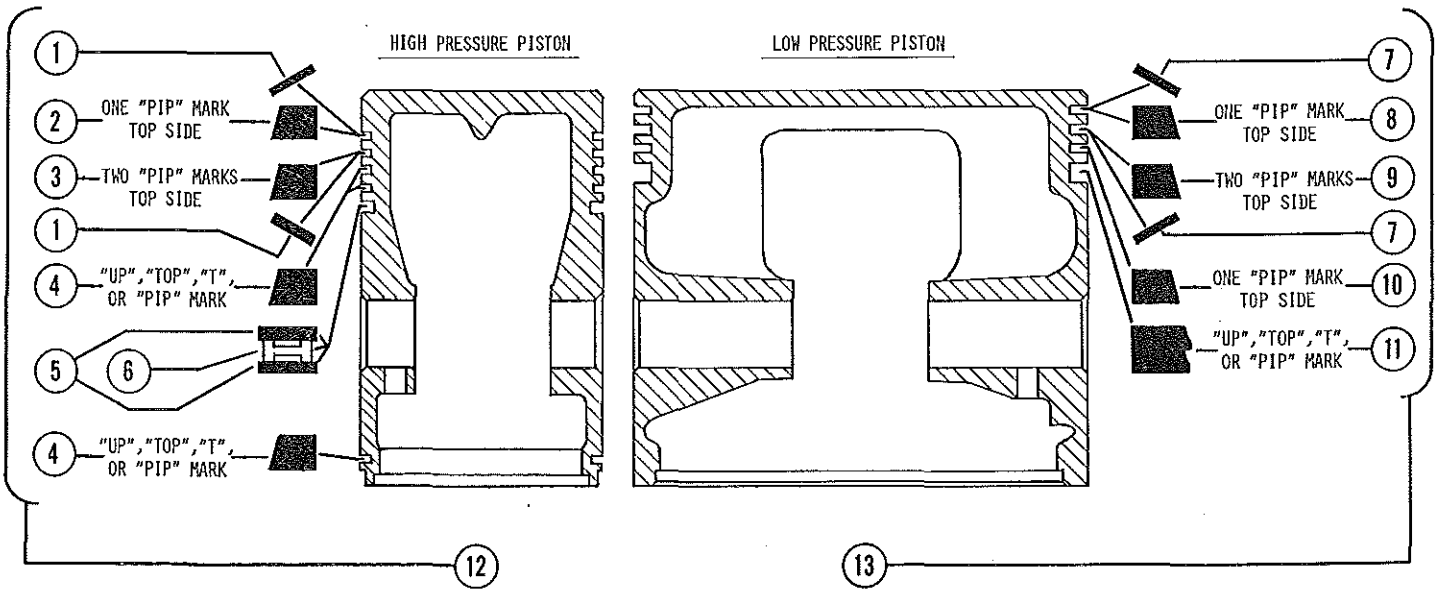
INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
17	1384	SCREW - PISTON PIN LOCK	2
18	1298	PIN - PISTON PIN LOCK SCREW COTTER	2
19	5645	PISTON - STANDARD HIGH PRESSURE	1
	5645OV10	PISTON - .010" OVERSIZE HIGH PRESSURE	*
	5645OV20	PISTON - .020" OVERSIZE HIGH PRESSURE	*
20	2333	CYLINDER - BARE	1
21	3145	CONNECTOR - 1/2" TUBE X 3/8" NPT ELBOW BREATHER TUBE	2
22	2337	RING - STANDARD LOW PRESSURE COMPRESSION	3
	2337OV10	RING - .010" OVERSIZE LOW PRESSURE COMPRESSION	*
	2337OV20	RING - .020" OVERSIZE LOW PRESSURE COMPRESSION	*
23	2338	RING - STANDARD LOW PRESSURE OIL CONTROL	1
	2338OV10	RING - .010" OVERSIZE LOW PRESSURE OIL CONTROL	*
	2338OV20	RING - .020" OVERSIZE LOW PRESSURE OIL CONTROL	*
24	2336	PIN - STANDARD LOW PRESSURE PISTON	1
25	2335	PISTON - STANDARD LOW PRESSURE	1
	2335OV10	PISTON - .010" OVERSIZE LOW PRESSURE	*
	2335OV20	PISTON - .020" OVERSIZE LOW PRESSURE	*
26	5693	TUBE - 1/2" BREATHER	1
27	1345	BUSHING - PISTON PIN	2
28	1331A	ROD - CONNECTING	
		NOTE: NOT SOLD SEPARATELY, SEE ASSEMBLY #1331AX.	-
29	1344	BOLT - CONNECTING ROD	4
30	2819PR	INSERTS - PAIR OF STANDARD	2
	2819PRUS	INSERTS - PAIR OF .010" UNDERSIZE	*
31	1319	WASHER - CONNECTING ROD BOLT	4
32	3201	NUT - 7/16" NF ELASTIC STOP	4
		ASSEMBLIES	
33	5645X	PISTON ASSEMBLY - STANDARD HIGH PRESSURE	1
	5645XOV10	PISTON ASSEMBLY - .010" OVERSIZE HIGH PRESSURE	*
	5645XOV20	PISTON ASSEMBLY - .020" OVERSIZE HIGH PRESSURE	*
34	5627	RING SET - STANDARD HIGH PRESSURE	1
	5627OV10	RING SET - .010" OVERSIZE HIGH PRESSURE	*
	5627OV20	RING SET - .020" OVERSIZE HIGH PRESSURE	*
35	2335X	PISTON ASSEMBLY - STANDARD LOW PRESSURE	1
	2335XOV10	PISTON ASSEMBLY - .010" OVERSIZE LOW PRESSURE	*
	2335XOV20	PISTON ASSEMBLY - .020" OVERSIZE LOW PRESSURE	*
36	2378	RING SET - STANDARD LOW PRESSURE	1
	2378OV10	RING SET - .010" OVERSIZE LOW PRESSURE	*
	2378OV20	RING SET - .020" OVERSIZE LOW PRESSURE	*
37	2358X	BRACKET ASSEMBLY - INTERCOOLER MOUNTING	2
38	1331AX	ROD ASSEMBLY - CONNECTING	2

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AUTHORIZED
Quincy
COMPRESSORS
SERVICE

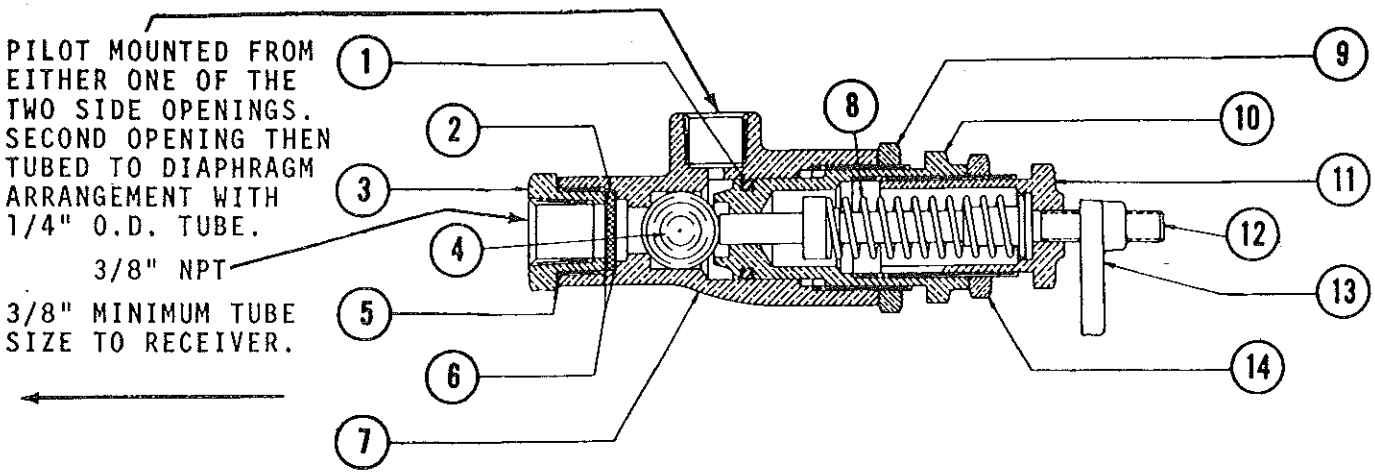
OPTIONAL SIDE SEALER RING ASSEMBLIES

APPLIES TO MODEL 390 HIGH & LOW PRESSURE PISTONS
RECORD OF CHANGE 21 ONLY



INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
1	6589	SPRING - HIGH PRESSURE PISTON SIDE SEALER RING	2
2	6587	RING - HIGH PRESSURE PISTON SIDE SEALER COMPRESSION	1
3	6588	RING - HIGH PRESSURE PISTON SIDE SEALER COMPRESSION	1
4	1464	RING - HIGH PRESSURE PISTON COMPRESSION	3
5	6591	RAIL - HIGH PRESSURE PISTON OIL CONTROL	2
6	6590	EXPANDER - HIGH PRESSURE PISTON OIL CONTROL RAIL	1
7	8059	SPRING - LOW PRESSURE PISTON SIDE SEALER RING	2
8	7969	RING - LOW PRESSURE PISTON SIDE SEALER COMPRESSION	1
9	8058	RING - LOW PRESSURE PISTON SIDE SEALER COMPRESSION	1
10	8057	RING - LOW PRESSURE PISTON COMPRESSION	1
11	2338	RING - LOW PRESSURE PISTON OIL CONTROL	1
		ASSEMBLIES	
12	8170	RING SET - HIGH PRESSURE PISTON SIDE SEALER NOTE: NOT AVAILABLE IN OVERSIZES.	1
NOT SHOWN	8905	PISTON ASSEMBLY - HIGH PRESSURE NOTE: INCLUDES: #5645 PISTON, #2341 PISTON PIN, #1384 LOCK SCREW, #1298 COTTER PIN AND #8170 SIDE SEALER RING SET. NOT AVAILABLE IN OVERSIZES.	1
13	8169	RING SET - LOW PRESSURE PISTON SIDE SEALER NOTE: NOT AVAILABLE IN OVERSIZES.	1
NOT SHOWN	8906	PISTON ASSEMBLY - LOW PRESSURE NOTE: INCLUDES: #2335 PISTON, #2336 PISTON PIN, #1384 LOCK SCREW, #1298 COTTER PIN AND #8169 SIDE SEALER RING SET. NOT AVAILABLE IN OVERSIZES.	1

V.D. PILOT ASSEMBLY



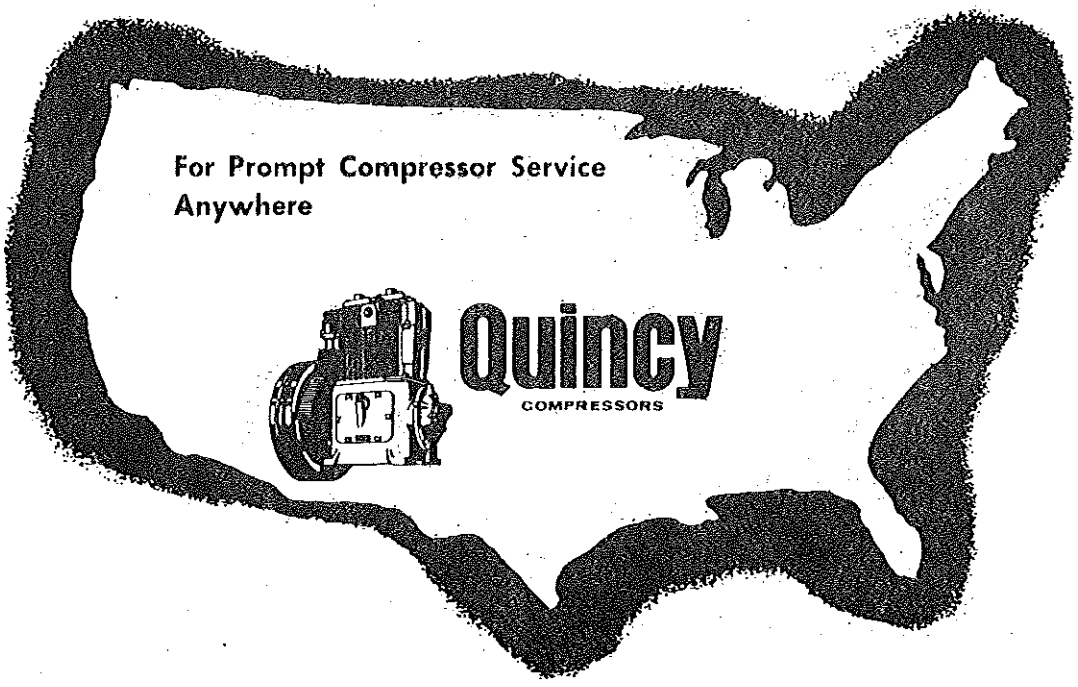
INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
1	2327	"O" RING - DIFFERENTIAL ADJUSTING SCREW	1
2	5883	FELT - FILTER	1
3	5917	CAP - AIR INLET	1
4	6175	BALL	1
5	6480	GASKET - AIR INLET CAP	1
6	5884	SCREEN - FILTER	2
7	6168	BODY - V.D. PILOT NOTE: NOT SOLD SEPARATELY.	-
8	3435	SPRING - ADJUSTMENT NOTE: COLORED RED.	*
	3078	SPRING - ADJUSTMENT NOTE: COLORED LIGHT YELLOW.	*
	3030	SPRING - ADJUSTMENT NOTE: COLORED LIGHT GREEN.	*
	5097	SPRING - ADJUSTMENT NOTE: NATURAL FINISH, NOT COLORED.	*
	6492	SPRING - ADJUSTMENT NOTE: COLORED LIGHT BLUE.	*
9	6170	NUT - DIFFERENTIAL SCREW LOCK	1
10	6169	SCREW - DIFFERENTIAL ADJUSTING NOTE: USED WITH 6168X3, 6168X4 & 6168X5 ASSEMBLIES.	*
	6169A	SCREW - DIFFERENTIAL ADJUSTING NOTE: USED WITH 6168X1 & 6168X2 ASSEMBLIES.	*
11	6171	SCREW - PRESSURE ADJUSTING	1
12	6173	ROD - TRIGGER	1
13	6174	NUT - TRIGGER ROD WING	1
14	6172	NUT - PRESSURE ADJUSTING SCREW LOCK	1
		ASSEMBLIES	
NOT SHOWN	6168X1	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 30-40 PSI)	*
NOT SHOWN	6168X1NS	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SETTING CAPABILITY: 22 PSI MINIMUM CUT-IN PRESSURE, 50 PSI MAXIMUM CUT-OUT PRESSURE.) SEE TABLE FOR V.D. PILOT PRESSURE RANGES.	*
NOT SHOWN	6168X2	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 70-80 PSI)	*
NOT SHOWN	6168X21	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 80-90 PSI)	*
NOT SHOWN	6168X22	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 90-100 PSI)	*
NOT SHOWN	6168X23	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 100-110 PSI)	*
NOT SHOWN	6168X2NS	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SETTING CAPABILITY: 40.5 PSI MINIMUM CUT-IN PRESSURE, 120 PSI MAXIMUM CUT-OUT PRESSURE.) SEE TABLE FOR V.D. PILOT PRESSURE RANGES.	*
NOT SHOWN	6168X3	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 130-140 PSI)	*
NOT SHOWN	6168X31	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 150-165 PSI)	*
NOT SHOWN	6168X32	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 165-175 PSI)	*
NOT SHOWN	6168X33	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 225-250 PSI)	*
NOT SHOWN	6168X3NS	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SETTING CAPABILITY: 87 PSI MINIMUM CUT-IN PRESSURE, 250 PSI MAXIMUM CUT-OUT PRESSURE.) SEE TABLE FOR V.D. PILOT PRESSURE RANGES.	*
NOT SHOWN	6168X4NS	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SETTING CAPABILITY: 163 PSI MINIMUM CUT-IN PRESSURE, 500 PSI MAXIMUM CUT-OUT PRESSURE.) SEE TABLE FOR V.D. PILOT PRESSURE RANGES.	*
NOT SHOWN	6168X5	PILOT ASSEMBLY - VARIABLE DIFFERENTIAL (SET 135-150 PSI)	*
NOT SHOWN	6243	KIT - V.D. PILOT REPAIR	*

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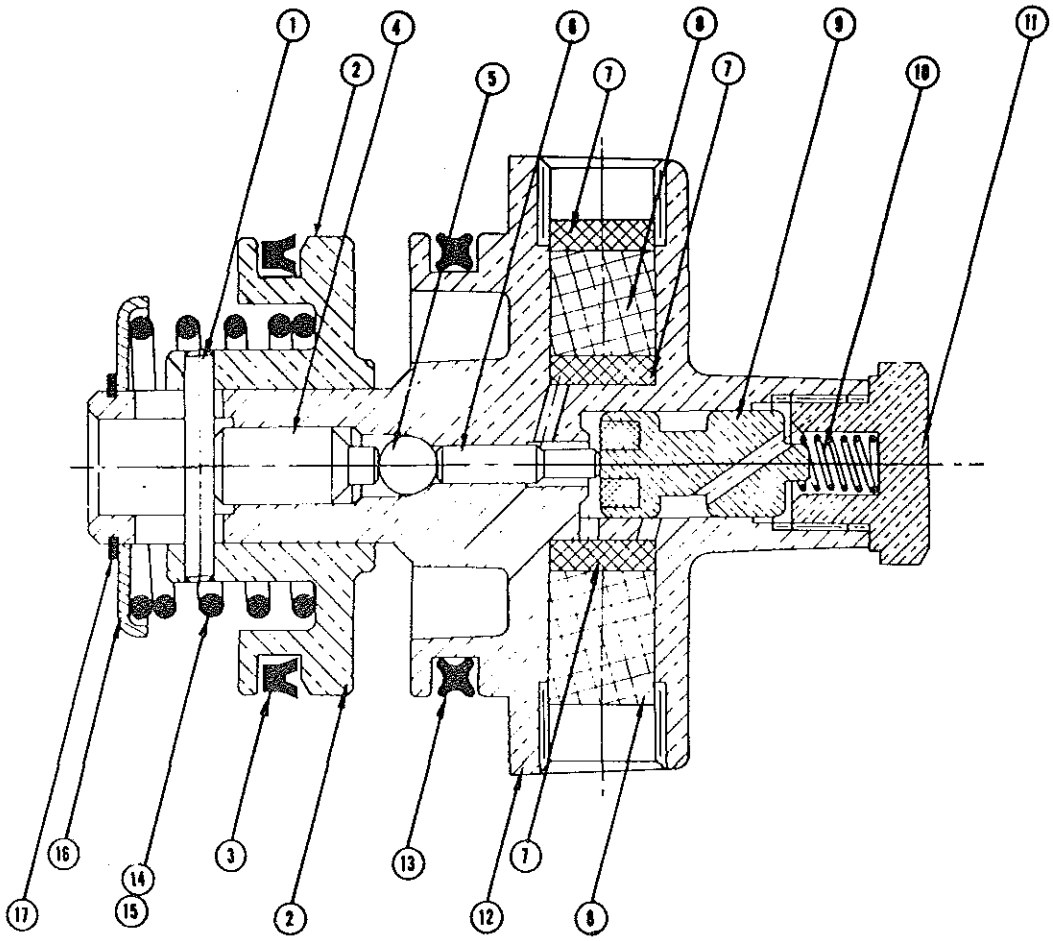
V.D. PILOT PRESSURE RANGES

PART NUMBER 6168X1			PART NUMBER 6168X2			PART NUMBER 6168X3			PART NUMBER 6168X4			PART NUMBER 6168X5		
SPRING #3435 (Color-Red)*			SPRING #3078 (Color-Light Yellow)*			SPRING #3030 (Color-Light Green)*			SPRING #5097 (Not Colored)			SPRING #6492 (Color-Light Blue)*		
Unload	Min. Lbs. Dif.	Max. Lbs. Dif.	Unload	Min. Lbs. Dif.	Max. Lbs. Dif.	Unload	Min. Lbs. Dif.	Max. Lbs. Dif.	Unload	Min. Lbs. Dif.	Max. Lbs. Dif.	Unload	Min. Lbs. Dif.	Max. Lbs. Dif.
25	2.5	3.0	50	4.0	9.5	100	6	13	200	15	37			
30	3.0	4.5	60	4.5	11.5	110	7	14	225	16	39			
35	3.5	6.0	70	5.5	13.5	120	7	16	250	17	42			
40	3.5	7.0	80	6.0	15.0	130	7	17	275	18	45			
45	4.0	8.5	90	7.0	17.0	140	8	18	300	20	50			
50	4.5	10.0	100	7.5	19.0	150	8	20	325	21	54	SET 135 PSI - 150 PSI ONLY		
			110	8.0	21.0	175	9	24	350	22	57			
			120	8.5	23.0	200	10	27	375	24	60			
						225	11	31	400	25	65			
						250	12	35	425	26	69			
									450	27	72			
									500	30	80			

*To avoid confusion, please note springs are colored to designate pressure range.



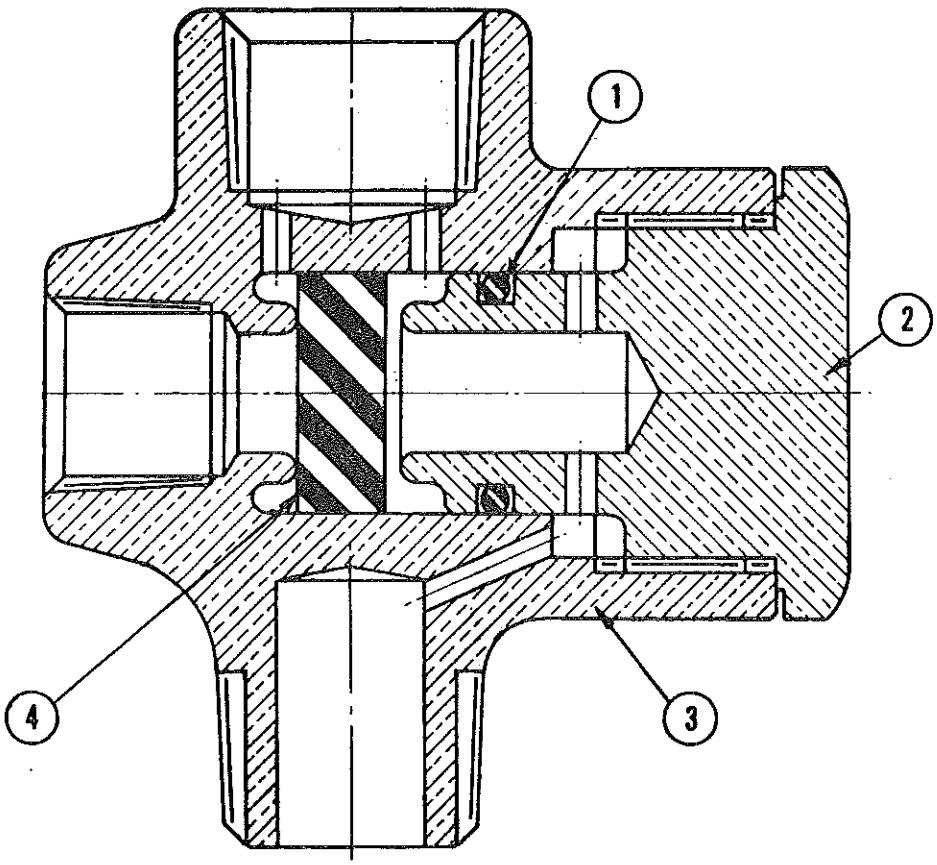
HYDRAULIC UNLOADER ASSEMBLY



INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
1	6284	PIN - ROLL	1
2	6279	PISTON	1
3	7958	"V" RING	1
4	7690	PISTON	1
5	5453	BALL	1
6	6281	ROD - PUSH	1
7	6097	SCREEN	3
8	6283	FELT	2
9	1985	VALVE - OUTER	1
10	1884	SPRING	1
11	3437	CAP	1
12	7460	BODY	
		NOTE: NOT SOLD SEPARATELY.	-
13	6286	QUAD RING	2
14	2326	SPRING	
		NOTE: USE ONLY FOR AIR PRESSURES UP TO AND INCLUDING 200 PSIG.	*
15	6598	SPRING	
		NOTE: USE ONLY FOR AIR PRESSURES ABOVE 200 PSIG.	*
16	6304	RETAINER - SPRING	1
17	6285	RING - RETAINING	1
		ASSEMBLIES	
NOT SHOWN	8063	KIT - HYDRAULIC UNLOADER REPAIR	*
NOT SHOWN	7970X	HYDRAULIC UNLOADER ASSEMBLY	
		NOTE: USE FOR AIR PRESSURES UP TO AND INCLUDING 200 PSIG.	*
NOT SHOWN	7970X1	HYDRAULIC UNLOADER ASSEMBLY	
		NOTE: USE FOR AIR PRESSURES IN EXCESS OF 200 PSIG. OIL PRESSURE MUST BE INCREASED TO 20 PSIG WHEN COMPRESSOR IS PUMPING IN EXCESS OF 200 PSIG AIR PRESSURE.	*

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DUAL CONTROL CHECK VALVE ASSEMBLY



INDEX NUMBER	PART NUMBER	DESCRIPTION	QUANTITY REQUIRED
1	6197	"O" RING - CAP	1
2	6195	SEAT - DUAL CONTROL CHECK VALVE	1
3	6194	BODY - DUAL CONTROL CHECK VALVE NOTE: NOT SOLD SEPARATELY.	-
4	6196	DISC - DUAL CONTROL CHECK VALVE	1
		ASSEMBLIES	
NOT SHOWN	6194X	VALVE ASSEMBLY - DUAL CONTROL CHECK	1

NUMERICAL PARTS INDEX

PART NUMBER	APPEARS ON		PART NUMBER	APPEARS ON		PART NUMBER	APPEARS ON		PART NUMBER	APPEARS ON	
	PAGE NO.	INDEX NO.		PAGE NO.	INDEX NO.		PAGE NO.	INDEX NO.		PAGE NO.	INDEX NO.
1022	5	24	2338	10	11	5486	4	13	6289X	5	58
1160	5	42		9	23	5489	5	44	6304	13	16
1249	5	46	2338OV10	9	23	5489X	5	59	6317	6	2
1281	5	41	2338OV20	9	23	5490	5	45	6317X	7	19
1288	8	15	2341	8	16	5491	5	43	6327	5	31
1288OV10	8	15	2343	8	5	5494	5	38	6480	11	5
1288OV20	8	15	2344	4	9	5496	5	25	6492	11	8
1298	9	18	2346	2	7	5627	9	34	6587	10	2
1315	5	47	2347	2	4	5627OV10	9	34	6588	10	3
1319	9	31	2348	2	4	5627OV20	9	34	6589	10	1
1331A	9	28	2349	2	9	5645	9	19	6590	10	6
1331AX	9	38	2350	2	8	5645OV10	9	19	6591	10	5
1344	9	29	2357	8	1	5645OV20	9	19	6598	13	15
1345	9	27	2358	8	11	5693	9	26	6642	5	48
1356	3	15	2358X	9	37	5694	8	3	6642X	5	60
1384	9	17	2359	8	10	5695	8	4	6643	4	5
1386	5	54	2363	8	7	5783	5	53	6651	4	12
1424A	3	21	2378	9	36	5883	11	2	6679	5	21
1429	2	12	2378OV10	9	36	5884	11	6	6726	5	49
1464	8	14	2378OV20	9	36	5910	3	39	6727	5	51
	10	14	2586	3	42	5917	11	3	6727X	5	61
1464OV10	8	14	2623	2	1	5932	5	52	6755	5	50
1464OV20	8	14	2704	6	10	6097	13	7	6906	5	18
1478	8	2	2708	6	3	6168	11	7	6907	5	19
1498	4	6	2709	3	44	6168X1	11	*	6909	3	14
1498A	4	6	2729	8	9	6168X1NS	11	*	6910	3	24
1498B	4	6	2741	3	27	6168X2	11	*	6938	3	33
1556	3	30	2755S	3	41	6168X21	11	*	6940	3	31
1602	3	28		4	15	6168X22	11	*	6941	2	3
1602X3	3	50	2763	2	5	6168X23	11	*	6942	3	31
1642	3	34	2819PR	9	30	6168X2NS	11	*	6946	5	26
	6	5	2819PRUS	9	30	6168X3	11	*	6947-2	4	14
1643	6	6	2830	5	20	6168X31	11	*	6947-2X	5	56
1665	3	43	2851	4	2	6168X32	11	*	6947-2X1	5	56
1707	4	7	2866	7	16	6168X33	11	*	6948	3	19
1818B	3	36	2906	3	25	6168X3NS	11	*	6948X	3	49
1855	3	37	2971	7	15	6168X4NS	11	*	6949	3	16
1857	3	23	3003	6	9	6168X5	11	*	6949X	3	47
1870	7	18	3008	3	22	6169	11	10	6949XU	3	47
1882	3	26	3022-90	3	17	6169A	11	10	6950	3	46
1883	4	3	3030	11	8	6170	11	9	6951	3	32
1884	13	10	3078	11	8	6171	11	11	6952	2	10
1966	7	17	3080	6	1	6172	11	14	6953	2	2
1983	7	14	3145	9	21	6173	11	12	6954X	3	29
1985	13	9	3186	8	6	6174	11	13	6955	2	3
2002	2	11	3199	8	12	6175	11	4	7079	5	*
2022	5	40	3201	9	32	6194	14	3	7460	13	12
2057	2	6	3297	3	20	6194X	6	8	7483	3	38
	5	55	3435	11	8		14	*	7483X	3	51
2087	3	13	3437	13	11	6195	14	2	7499	3	35
2138	5	33	3457	4	10	6196	14	4	7514	5	39
2177	7	12	3592	4	3	6197	14	1	7532X	3	40
2323	5	37	3720	5	16	6200	7	11	7690	13	4
2326	13	14	3776	5	17	6204	8	8	7694	4	8
2327	11	1	3951	5	36	6243	11	*	7958	13	3
2333	9	20	4260	4	4	6269	5	34	7969	10	8
2334	3	18	4357	4	11	6270	5	35	7970X	13	*
2334X16H	3	48	4927	8	13	6279	13	2	7970X1	13	*
2334X16L	3	48	4805	7	13	6281	13	6	8058	10	9
2334X16P	3	48	5097	11	8	6283	13	8	8059	10	7
2335	9	25	5322	3	45	6284	13	1	8063	13	*
2335OV10	9	25	5453	13	5	6285	13	17	8109	5	22
2335OV20	9	25	5470	5	23	6286	5	32	8169	10	13
2335X	9	35	5470X	5	57		13	13	8170	10	12
2335XOV10	9	35	5483	5	27	6289	5	30	8170	10	12
2335XOV20	9	35	5484	5	29				8297	4	1
2336	9	24	5485	5	28				8306	4	1
2337	9	22							8905	10	*
2337OV10	9	22							8906	10	*
2337OV20	9	22									

*Asterisk indicates that the part number is not illustrated on the page indicated.

NATIONWIDE SALES/SERVICE

Quincy service is always near. There are more than 135 Authorized Quincy Compressor Service Depots, located throughout the United States and Canada. They stock genuine Quincy replacement parts and accessories for a wide range of Quincy compressor models. Service specialists are factory trained and experienced in the compressor field. Quincy service will help keep you in business. Call for Authorized Quincy Compressor Service.



Colt Industries

Quincy Compressor Division
217 Maine Street
Quincy, Illinois 62301

A division of the Colt Industries Operating Corp

10-15-73 EDITION:
INCLUDES 7970X HYDRAULIC UNLOADER, 3 GROOVE COMPRESSOR PULLEYS, SIDE SEALER RINGS IN R.C. 21 AND NUMERICAL PARTS LIST.

PRINTED IN USA

11908370

Installation and Maintenance Instructions for your Westinghouse Medium Motor

I.L. 2930-11TD

RECEIVING

1. Check Nameplate Data.

2. Turn shaft by hand to check that it turns freely.

3. Request "Receiving and Storage Instructions" for long-term storage indoors or any storage outdoors.

4. Lifting eyebolts are designed for raising the motor alone and should be removed after installing motor.

Warning: The following safety precautions *must* be observed:

1. Electric rotating machinery and high voltage can cause serious or fatal injury if improperly installed, operated or maintained. Responsible personnel should be familiarized with NEMA MG2, safety standards for construction and guide for selection, installation and use of electric motors and generators, national electric code and *all local safety requirements.*

2. All power sources to the motor and to the accessory devices should be de-energized and disconnected and all rotating parts should be at standstill.

3. Lifting means, when supplied, are intended for lifting the motor *only.* When two lifting devices are supplied with the motor a dual chain must be used.

4. Suitable protection must be used when working near machinery with high noise levels.

5. Safeguard or protective devices must not be by-passed or rendered inoperative.

6. The frame of this machine must be grounded in accordance with the National Electrical Code and applicable local codes.

7. Avoid contact with start or run capacitors in single-phase motors until a safe discharge procedure has been followed.

8. A suitable enclosure should be provided to prevent access to the motor by other than authorized personnel. Extra caution should be observed around motors that are automatically controlled or have automatic re-setting relays as they may restart unexpectedly.

9. Enclose all belts to prevent injury from broken belts.

10. Shaft key must be fully captive before motor is started.

11. Provide proper safeguards for personnel against possible failure of motor-mounted brake, particularly on applications involving over-hauling loads.

LOCATION

1. Dripproof motors are intended for use where atmosphere is relatively clean, dry, and non-corrosive. Keep windings clean with a soft brush, cloth or suction.

2. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations. The drain plug in the end bracket must be removed periodically to drain accumulated condensation.

3. Explosionproof motors are built for use in hazardous locations as indicated by Underwriters' label on the motor.

Note: In all cases, no surrounding structure should obstruct normal flow of ventilating air through or over the motor.

INSTALLATION

Fasten securely to a flat base with maximum size bolts. All ball or roller bearing normal thrust motors may be mounted in any position. Do not drive sheaves, couplings, sprockets or pinions on motor shaft.

Direct Drive

Align shafts accurately. If reverse rotation is detrimental to the driven device check rotation BEFORE connecting the motor to the load. See "start up".

V-Belt Drive

1. Mount motor sheave close to bearing housing.

2. Allow sufficient clearance for rotor end play.

3. Sheave diameter should not be less than NEMA recommended value. See NEMA MG1-14.42.

4. Align sheaves carefully, tighten belts only enough to prevent slippage.

Flange Motor

Fits are accurately machined to mate with driven equipment. Mating surfaces must be free of dirt or burrs and solidly engaged. The assembly should turn freely without stressing shaft and bearings from misalignment and thrust.

ELECTRICAL CONNECTIONS

1. Connect motor per nameplate to correct power supply.

2. Install all wiring, fusing and grounding in accordance with National Electrical Code and local requirements.

3. Identify motor auxiliary devices such as space heaters or temperature sensors. Connect in proper circuits and insulate from motor power cables.

Wound Rotor Motors

a) Connect cables from secondary control to brushholder assembly. Bring cables through squeeze connector on front bracket, where provided.

b) Slip rings must be maintained smooth and true. Machine to restore proper surface for brushes.

c) Brushes must make good contact with slip rings along the whole face of brush. If needed, grind brushes in with fine sandpaper. Do not use lubricants. Service ports are provided for inspection of slip rings and brushes. Spring pressure is preset at about 1 lb. on 213-286T frames and 4 lbs. on 324-449T frames.

d) Must use same grade of brushes.

START UP

1. Disconnect load and start motor. Check direction of rotation. If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY. Interchange any two leads of a three phase motor. Reconnect a single phase motor per nameplate instructions. Fans on fan cooled motors that have directional rotation nameplates must be reversed on shaft if rotation is changed.

2. Connect load. The motor should start quickly and run smoothly. If not, shut power off at once. Recheck the assembly including all connections before restarting. For single phase motors, also examine capacitor wiring and mechanism for switching between starting and running.

3. If excessive vibration is noted, check for loose mounting bolts, too flexible motor support structure or transmitted vibration from adjacent machinery. Periodic vibration checks should be made; foundations often settle.

4. Operate under load for short period of time; check operating current against nameplate.

LUBRICATION: BALL OR ROLLER BEARINGS

Grease lubricated bearings as furnished are adequate for a long period of operation without relubrication. A good maintenance schedule for regreasing will vary widely depending on motor size, speed, duty and environment.

Frequency of Relubrication

The following table suggests relubrication intervals for motors on normal, steady running, light duty indoor loads in relatively clean atmosphere at 40°C (104°F) ambient temperature or less:

Type of Grease

Use Westinghouse 53701RY grease unless a special grease is specified on the nameplate. Some equivalent greases are:

Chevron SRI-2 – Standard Oil of California
Premium RB – Texaco Inc.
Unirex N2 – Exxon
Dolium R – Shell Oil Company
Rykon Premium – American Oil

Procedure for Relubrication

When regreasing, stop motor, remove outlet plug, and add amount of grease per reference table with hand lever gun only. Discontinue at once if grease appears at outlet plug, this may occur before specified amount is used, run for about ten minutes before replacing outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end; if the outlet plug is not accessible at surface of hood, it is the spring relief type and need not be removed when regreasing.

LUBRICATION: SLEEVE BEARINGS

Before starting the motor, fill both reservoirs through the filler plug with best quality, clean motor oil. The oil should have a viscosity of from 180 to 200 SSU (equivalent to SAE No. 10). During operation, no oil should be added until it drops below the full level. Do not flood the bearing. At about 2 year intervals, dismantle and thoroughly wash out the bearing housing, using hot kerosene oil.

Type of Enclosure	Insulation	Frame Size		
		143 to 215T	254 to 326T	364 to 449T
Open – DP	B	2 yrs.	18 mo.	1 yr.
Enclosed – FC Open – DP	B F	18 mo.	1 yr.	9 mo.
Enclosed – NV Enclosed – FC Open – DP Enclosed – Lint Free – FC	B F H B	1 yr.	9 mo.	6 mo.
Enclosed – NV Enclosed – FC Enclosed – Lint Free – FC	F H F	9 mo.	6 mo.	3 mo.

Note:
FOR MOTORS OVER 1800 RPM – Use 1/2 of tabled period.
FOR SEVERE DUTY – DUSTY LOCATIONS – Use 1/3 of tabled period.

Volume – Reference Table

Shaft Diameter (At Face of Bracket)	Amount of Grease to Add
3/4" to 1-1/4"	1/8 cu. in. or 0.1 oz.
1-1/4" to 1-7/8"	1/4 cu. in. or 0.2 oz.
1-7/8" to 2-3/8"	3/4 cu. in. or 0.6 oz.
2-3/8" to 3-3/8"	2 cu. in. or 1.6 oz.

Caution: Overgreasing is a major cause of bearing and motor failure. Make sure dirt and contaminants are not introduced when adding grease.

WARRANTY

Westinghouse warrants that the products sold by it will, upon shipment, be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during a period of one year after the date of installation or eighteen months from date of shipment, Westinghouse shall, upon prompt written notice from the purchaser, correct such non-conformity by repair or replacement, f.o.b. factory, of the defective part or parts. Correction in the manner provided above shall constitute a fulfillment of all liabilities of Westinghouse with respect to the quality of the products. The foregoing warranty is exclusive and in lieu of all other warranties of quality whether written, oral, or implied (including any warranty of merchantability or fitness for purpose).

The remedy(ies) provided above shall be purchaser's sole remedy(ies) for any failure of Westinghouse to comply with the warranty provisions, whether claims by the purchaser are based in contract or in tort (including negligence).

Westinghouse Electric Corporation
Medium Motor and Gearing Division, Buffalo, NY 14240

Printed in U.S.A.

(THIS SPACE RESERVED FOR VENDOR
DRAWING WHEN IT BECOMES AVAILABLE)

LIMERICK GENERATING STATION UNITS 1&2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO.11-700000

VENDOR:

VENDOR DWG. NO.:

TITLE: VALVE, PLUG 2"
ASME SECT. III, CL.-3.

APPROVED
Rev. 6
APR 25 1977
QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1673	4/29/77	ASSY. OR LO.
DR. BY J. Dorn	1/25/77	SCALE
CHK'D. BY J. Whitney	2/3/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD		

SHEET SIZE A | DWG. NO. 11 908 509 | SHEET 1 OF 3

ORIGINAL

2" HAND OPERATED PLUG VALVE IN AIR START SYSTEM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. ASME BOILER & PRESSURE VESSEL CODE SECTION III

   THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3 REQUIREMENTS. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FM ENGINE DIV. PURCHASE ORDER FOR THE COMPONENT.

2. GENERAL SPECIFICATIONS:

   2.1 FUNCTION - THE FUNCTION OF THE 2" PLUG VALVE IS TO PROVIDE ISOLATION OF THE AIR START TANKS IN THE EVENT THAT THE TANK MUST BE TAKEN OUT OF SERVICE FOR REPAIR.

   2.2 ENVIRONMENTAL CONDITIONS - VALVE WILL BE LOCATED INSIDE A BUILDING WITH MAXIMUM ROOM TEMPERATURE OF 115°F AND MINIMUM ROOM TEMPERATURE OF 65°F AND 50-100% RELATIVE HUMIDITY. THE VALVE WILL NOT BE SUBJECTED TO RADIATION.

   2.3 COMPONENT BOUNDARY DEFINITION - THE VALVE'S SOCKET WELD CONNECTIONS.

   2.4 MATERIAL - STAINLESS STEEL 316. IMPACT TESTING NOT REQUIRED.

   2.5 VALVE SHALL HAVE 2" SOCKET WELD CONNECTIONS.

   2.6 CONNECTIONS LOADS - THE VALVE VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

   2.7 SEISMIC LOADS - THE VALVE SHALL BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

   2.8

MAXIMUM OPERATING AIR PRESSURE:	275 PSI
MAXIMUM OPERATING AIR TEMPERATURE:	400°F
MINIMUM DESIGN PRESSURE:	300 PSI
MINIMUM DESIGN TEMPERATURE:	400°F
MINIMUM STANDARD PRESSURE CLASS:	ANSI 300 LB.

3. VALVE DRAWING - THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

4. QUALITY ASSURANCE REQUIREMENTS:

   4.1 QA REQUIREMENTS PER COLT/FM DWG. 11 908 456.

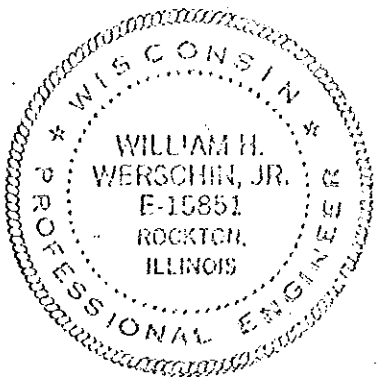
   4.2 THE VENDOR SHALL SUBMIT A COMPLETED BECHTEL STATEMENT OF CONFORMANCE FORM 3295, WITH EACH AND EVERY SHIPMENT.

APPROVED
Rev. 0
APR 25 1977
QUALITY CONTROL

ORIGINAL

5. CERTIFICATION:

THIS DESIGN SPECIFICATION IS HEREBY CERTIFIED TO BE CORRECT AND COMPLETE AND TO BE IN COMPLIANCE WITH THE REQUIREMENTS OF ASME SECTION III, CLASS 3, ARTICLES NA-3250 AND ND-3112.



William H. Werschin, Jr.

WILLIAM H. WERSCHIN, JR.

DATE: Apr. 25, 1977

REV.: 0

APPROVED
Rev. 0
APR 25 1977
QUALITY CONTROL

Colt Industries — Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 509	SHEET 3 OF 3

ORIGINAL

(THIS SPACE RESERVED FOR VENDOR
DRAWING WHEN IT BECOMES AVAILABLE)

LIMERICK GENERATING STATION UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR:

VENDOR DWG. NO.:

TITLE: VALVE, CHECK 1"
ASME SECT. III, CL. 3

APPROVED
Rev. 0
APR 25 1977
QUALITY CONTROL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV NO	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1679	4/29/77	ASSY. OR LO.
DR. BY J. Dorn	3/22/77	SCALE
CHK'D. BY J. Wrace	4/3/77	HEAT TR.

MAT'L

APPV. CAST. MAT'L.
MACH. ENGR.
WELD.

SHEET SIZE A | DWG NO. 11 908 510 | SHEET 1 OF 2

ORIGINAL

1" CHECK VALVE IN AIR START SYSTEM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. ASME BOILER & PRESSURE VESSEL CODE SECTION III

THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3 REQUIREMENTS. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/FM ENGINE DIV. PURCHASE ORDER FOR THE COMPONENT.

2. GENERAL SPECIFICATIONS

2.1 FUNCTION - THE FUNCTION OF THE 1" CHECK VALVE IS TO PREVENT THE LOSS OF STARTING AIR IN THE EVENT OF AN AIR LEAK OR RUPTURE OF THE AIR PIPING BETWEEN THE AIR COMPRESSOR AND THE CHECK VALVE.

2.2 ENVIRONMENTAL CONDITIONS - VALVE WILL BE LOCATED INSIDE A BUILDING WITH MAXIMUM ROOM TEMPERATURE OF 115°F AND MINIMUM ROOM TEMPERATURE OF 65°F AND 50 - 100% RELATIVE HUMIDITY. THE VALVE WILL NOT BE SUBJECTED TO RADIATION.

2.3 COMPONENT BOUNDARY DEFINITION - THE VALVES SOCKET WELD CONNECTIONS.

2.4 MATERIAL - STAINLESS STEEL 316. IMPACT TESTING NOT REQUIRED.

2.5 VALVE SHALL HAVE 1" SOCKET WELD CONNECTIONS.

2.6 CONNECTIONS LOADS - THE VALVE VENDOR SHALL FURNISH THE MAXIMUM ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAXIMUM ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

2.7 SEISMIC LOADS - THE VALVE SHALL BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMUTANEOUSLY.

2.8 MAXIMUM OPERATING AIR PRESSURE: 275 PSI.

MAXIMUM OPERATING AIR TEMPERATURE: 400°F.

MINIMUM DESIGN PRESSURE: 300 PSI.

MINIMUM DESIGN TEMPERATURE: 400°F.

MINIMUM STANDARD PRESSURE CLASS: ANSI 300 LB.

APPROVED
Rev. 0
APR 25 1977
QUALITY CONTROL

3. VALVE DRAWING - THE MANUFACTURER'S DRAWING FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

ORIGINAL

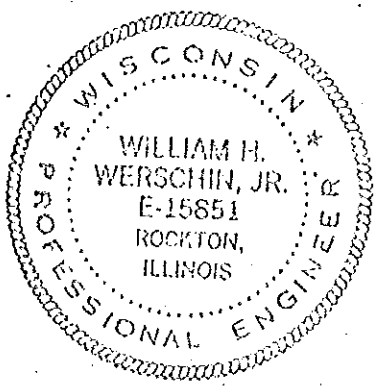
4. QUALITY ASSURANCE REQUIREMENTS

4.1 QA REQUIREMENTS PER COLT/FM DWG. 11 908456.

4.2 THE VENDOR SHALL SUBMIT A COMPLETED BECHTEL STATEMENT OF CONFORMANCE, FORM 3295, WITH EACH AND EVERY SHIPMENT.

5. CERTIFICATION

THIS DESIGN SPECIFICATION IS HEREBY CERTIFIED TO BE CORRECT AND COMPLETE AND TO BE IN COMPLIANCE WITH THE REQUIREMENTS OF ASME SECTION III, CLASS 3, ARTICLES NA-3250 AND ND-3112.



William H. Werschin, Jr.

DATE: Apr 25, 1977

REV.: 0

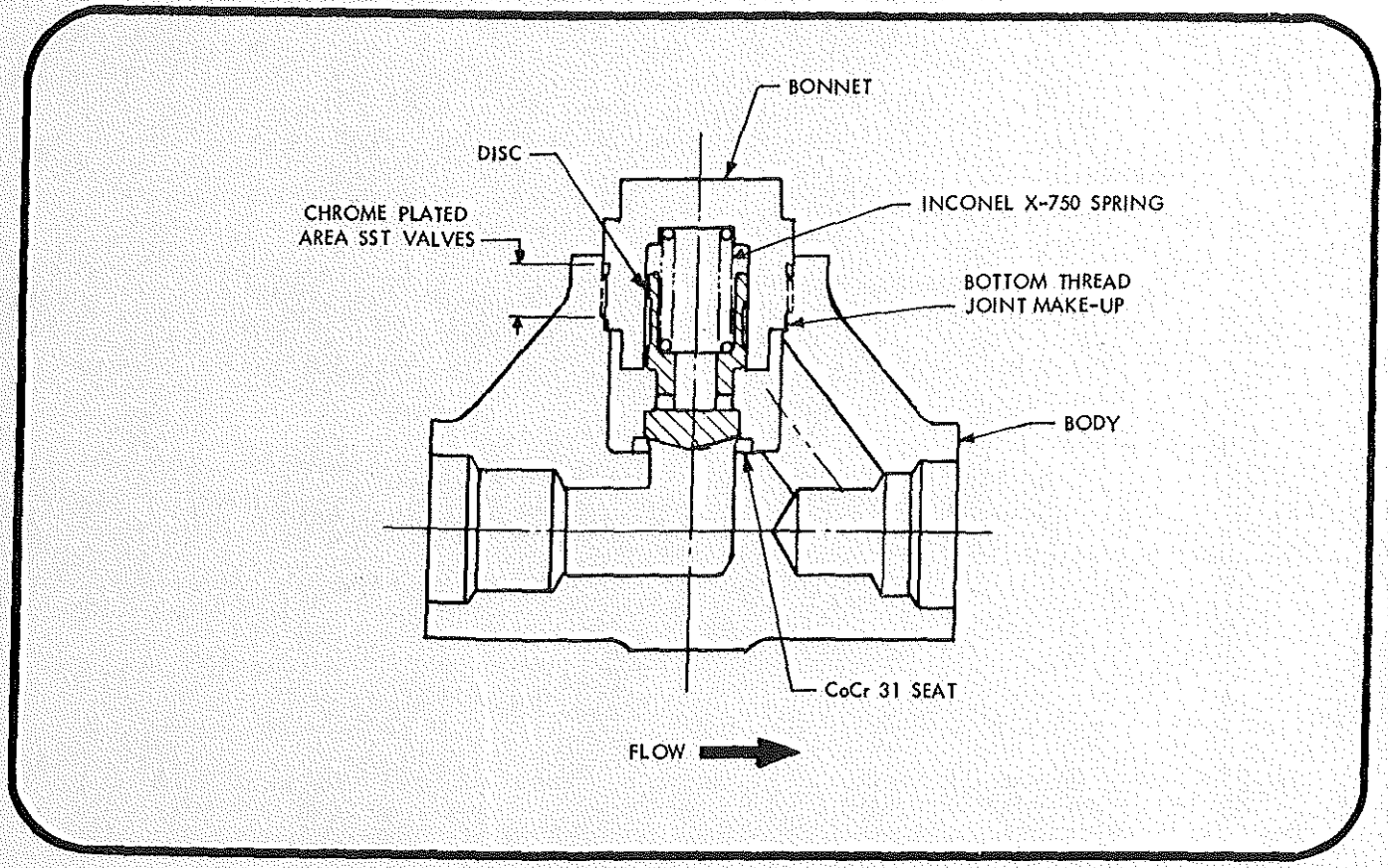
APPROVED
Rev. 0
APR 25 1977
QUALITY CONTROL

ORIGINAL

Sept. 1, 1977

OPERATING AND MAINTENANCE INSTRUCTIONS
AGCO GPC SERIES CHECK VALVES

11908510



The AGCO GPC Series Check Valves are designed for a variety of applications requiring automatic control of flow reversals.

Applications include high pressure, high temperature steam, condensate, water, air and gaseous systems. Both metal seated and elastomer seated valves are available. Elastomer seated valves are temperature limited by the elastomer.

DESIGN FEATURES

- Valve seats are cobalt-chromium alloy 31 inserts permanently welded to the valve body.
- Sealing and guiding surfaces on discs of metal seated valves are of cobalt-chromium alloy 6 for added wear resistance.
- Soft seated valves utilize a cobalt-chromium alloy 31 seat and hardened stainless steel (A564 GR 630 H1075/1100) discs.
- Screwed bonnets feature metal to metal below the thread make-up with an elastomer seal or seal weld.
- Bonnet threads on stainless steel valves are chromium alloy plated (above metal to metal make-up) to preclude galling.
- Available with ASME "N" Stamp Classes 1, 2, or 3 or to ANSI Standard B31.1

INSTALLATION

Piston check valves are normally installed in horizontal pipe runs with the bonnet near vertical. The piston check valves may be installed in vertical runs provided the normal system flow is upward through the valve.

The piston check valves are provided in standard materials as noted in Table 1. Suggested AWS-ASTM welding rods for each valve material is also tabulated. Since welding requirements are dependent upon various codes and specifications established by customers, contractors and/or government agencies, qualification to specific code requirements should be followed during valve installation. Use caution in welding valves having elastomer seals to avoid seal damage. Disassembly may be necessary.

TABLE 1

Suggested AWS/ASTM Welding Rods for the available body materials are:

BODY MATERIAL	WELDING ROD
Carbon Stl. A105	SFA 5.1 AWS E7018
Alloy Stl. A182-F22	SFA 5.5 AWS E9018-B3
Stn. Stl. A182-F316	SFA 5.4 AWS E309

ANDERSON, GREENWOOD & CO.
5425 S. RICE AVE. HOUSTON, TX 77081 P.O. BOX 1097 BELLAIRE, TX 77401
713/668-0631 • TWX: 910-881-2652 • TELEX: 0775219

OPERATION

The piston check valves are spring loaded closed and designed to open by system flow in the normal direction.

Flow reversal results in automatic closing of the valves. The spring assist feature precludes the possibility of slamming or water hammer in most systems. There is no provision for other than automatic operation.

VALVE MAINTENANCE

The piston check valves require no scheduled or preventative maintenance.

DISASSEMBLY

1. Insure that disassembly/maintenance/reassembly is performed in accordance with the applicable specification and codes. ("N" Stamped Valves Require Special Handling.)
2. Insure that both upstream and downstream pressures are relieved.
3. Secure the system against inadvertant pressurization.

ELASTOMER BONNET SEALED

1. Support body and unscrew bonnet being careful not to gall or damage threads. All threads are right hand.

NOTE: Spring forces are relieved before bonnet threads dis-engage.

2. Remove valve disc and spring.

SEAL WELDED BONNET

1. Remove seal weld by grinding or cutting.
2. Unthread bonnet-use caution to avoid galling or cross threading.
3. Remove valve disc and spring.

INSPECTION AND REPAIR

Visually inspect all valve components for evidence of wear, damage, or deterioration. *Elastomer components should always be replaced upon* disassembly.

Component parts should appear as follows:

The disc seating surfaces should be of smooth continuous surface finish free from gouges, wire drawing or other evidence of damage.

Examine valve seat for evidence of gouges, scratches or wire drawing. Resurface seat using the appropriate AGCO resurfacing tool. Recondition seats only when required. See specific instructions for resurfacing seat.

Examine the bonnet-body threads and joint make-up. Burrs, Scratches, gouges, and other detrimental defects must be repaired prior to reassembly. Remove and replace all elastomers.

SEAT RECONDITIONING

Specially designed AGCO tools are available for resurfacing of worn or damaged seats without removing valve bodies from the line. Select the proper tool set from Table II.

Handle tools with care to avoid edge chipping. Do not jam tool into seat. *Proceed with resurfacing as follows:*

1. Insert tool assembly engaging feed screw threads in body.
2. Rotate feed screw carefully until tool lightly contacts valve seat. Tighten and lock feed screw in position using lock nut provided.
3. Apply a uniform pressure against the valve seat and rotate the handwheel in a clock-wise direction. Rotate as smoothly as possible. Approximately 3 to 4 full revolutions are required.
4. Back feed screw out and remove tool assembly. Clean cutter of chips.
5. Examine valve seat. A bright continuous surface should be seen. Repeat steps (1) thru (4) if required.
6. Lapping may be required to obtain bubble tight shut-off.

RE-ASSEMBLY

1. Clean all components using clean acetone or approved equivalent.
2. *Lightly lubricate required elastomers and install on disc and/* or bonnet. Use Neolube or other approved lubricant.
3. Install valve disc and spring in valve body.
4. Uniformly lubricate bonnet threads using Neolube or other approved lubricant.
5. Assemble bonnet to body aligning disc and spring in bonnet cavity. Torque as specified.
6. Seal weld if required. Use appropriate code qualified weld procedure.
7. Test assembled valve as required by the appropriate specification or code.

TABLE II

AGCO TOOL SELECTION TABLE

Valve Size	Catalog Number	Seating	Seat Reconditioning Tool Number
½ - 1¼	GPCA	Metal Elastomer	1-1046
1½ - 2	GPCM	Metal Elastomer	1-1048
1½ - 4	GPCB	Metal Elastomer	1-1047

TABLE III

RECOMMENDED SPARE PARTS

PART DESCRIPTION	GPCA	GPCM	GPCB
Spring	03-6324-001	03-6381-001	04-3958-001
Elastomer-Disc	05-1058-031	05-1058-287	05-1058-123
Elastomer-Bonnet	05-1058-266	05-1058-085	05-1058-085

NOTE: Elastomers are 70 Durometer, Ethylene Proplyene Rubber.

ANDERSON, GREENWOOD & CO.
5425 S. RICE AVE. HOUSTON, TX 77081 P.O. BOX 1097 BELLAIRE, TX 77401
713/668-0631 • TWX: 910-881-2652 • TELEX: 0775219

(THIS SPACE RESERVED FOR VENDOR DRAWING WHEN IT BECOMES AVAILABLE)

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR:

VENDOR DWG. NO.

TITLE: VALVE, SAFETY, ½"
ASME SECTION VIII

APPROVED Rev. 0 MAR 10 1977 — SAFETY CONTROL
APPROVED Rev. 0 MAR 4 1977 — QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1728	3/11/77	ASSY OR LO.	
DR. BY J. Dorn	2/2/77	SCALE	
CHK'D. BY J. Whaley	2/2/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO 11 908 522		SHEET 1 OF 2

1/2" SAFETY VALVE IN THE AIR START SYSTEM FOR NUCLEAR STANDBY DIESEL/GEN SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL POWER CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REVISION 3, SPECIFICATION FOR DIESEL GENERATORS

1.1.1 PAGE 43, PARA. 6.3a - SHIPMENT

1.1.2 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE

1.2 QA REQUIREMENTS PER COLT/FM DWG. 11 908 456

1.3 ASME BOILER & PRESSURE VESSEL CODE SECTION VIII

2. TECHNICAL SPECIFICATION

2.1 1/2" SAFETY VALVE FOR 250 PSI AIR SERVICE AND AS FOLLOWS:

2.1.1 SET PRESSURE: 275 PSI

2.1.2 CAPACITY: 92 CFM AT 60°F MINIMUM

2.1.3 VALVE SHALL RESEAT AT NOT LESS THAN 260 PSI

2.1.4 MAXIMUM AIR TEMPERATURE: 400°F

2.1.5 CONNECTIONS: INLET - 1/2" NPT
OUTLET - 3/4" or 1" NPT

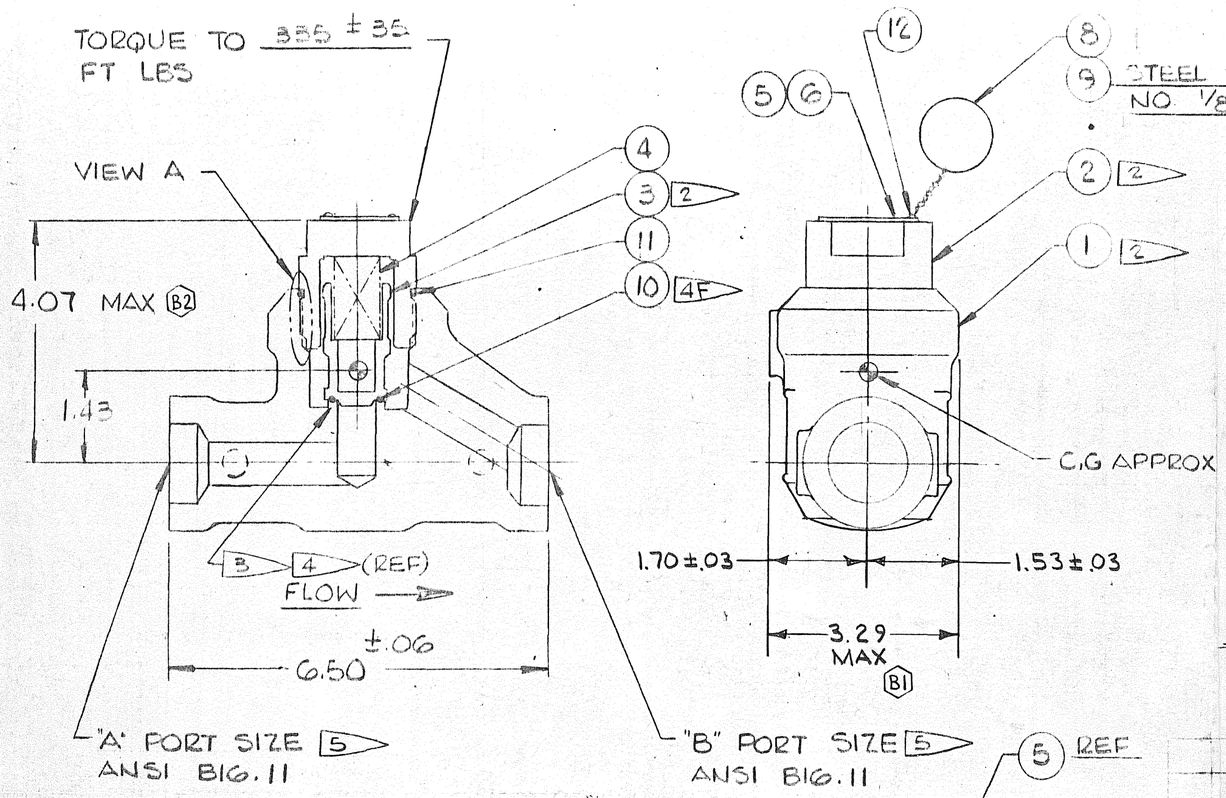
2.1.6 CONNECTION LOADS: THE VENDOR SHALL FURNISH THE MAX. ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAX. ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

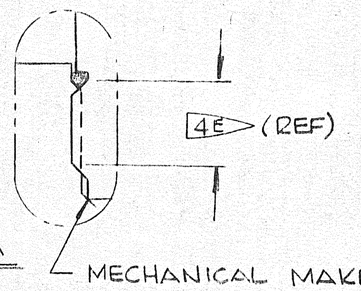
2.1.7 MATERIALS OF CONSTRUCTION - STAINLESS STEEL

2.1.8 THE VALVE MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.1.9 THE MANUFACTURER'S DWG. FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENTIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

APPROVED
Rev. 0
MAR 10 1977
QUALITY CONTROL





REVISIONS

SYM	DESCRIPTION	PART DISPOSITION	DATE	APVD
A	1-WAS 05-1058-031 2-WAS N03-6428-001	EFF. ALL PARTS	12-2-77	WDS DGraham DFrahm
B	1-WAS 3.14 MAX 2-WAS 4.06 MAX 3-NOTE 6 ADDED. 4 DELETED TOL. 5-CERTIFICATION ADDED	N/A	1-10-78	WDS DGraham DFrahm
C	ECR 5-196-05; ITEM 3 WAS N03-6428-501; 4, A. WAS N05-9000-200, DELETED F.			JA Cosby 2/18/85 JHK 7-18-85 T Hubbard 7-18-85 DM Nelson 7-18-85

NOTES:

1. DESIGN AND FABRICATION PER ASME CODE SECTION III, CLASS 3, 1974 ISSUE, W76 ADDENDA, AND NOTED CUSTOMER SPECIFICATIONS.

2. PRESSURE BOUNDARY COMPONENT.

3. VALVE SEAT IS CoCr 31 (AMS 5382 MOD) WELDED IN PLACE.

4. APPLICABLE FABRICATION PROCEDURES:
   - A. PT EXAMINE N05-9202-000
   - B. ATP PER N05-9005-022
   - C. CLEAN PER N05-9035-200
   - D. PACKAGE PER N05-9036-200
   - E. CHROME PLATE THREADS PER N05-9070-006 (Ref.)
   - ~~F. BOND O-RING TO DISC PER 02-0175-20~~

5. PROTECT PORT WITH POLYETHYLENE CAP OR PLUG.

(B3) 6. MAXIMUM ALLOWABLE CONNECTION LOADS:
   - A. AXIAL FORCE 260 LB.
   - B. SHEAR FORCE 130 LB.
   - C. BENDING MOMENT 700 IN.LB.
   - D. TORSIONAL MOMENT 700 IN.LB.

ANDERSON, GREENWOOD & CO.
PN NO3-6430-530
SN [ ] 197
720 PSI 100 °F
ANSI 300 O

(A1)

TABULATION	
PART NO	NO3-6430-530
CATALOG NO	GPCA03S-4S4S-3E
S.O. ITEM	1 THRU 8
NUCLEAR CL.	3
"A" PORT	1 NPS
"B" PORT	1 NPS
ANSI PR. CL.	300
SHELL TEST	1100
DISC TEST	720 PSIG
SEAT LEAK	NO BUBBLES
PRESS. RTG AT °F	400 PSIG AT 400°F
% WTR @ 60° F	10
WEIGHT LBS	12
VALVE TAG NO'S	11908510

DIMENSIONS SHOWN ARE CERTIFIED TO BE CORRECT FOR S.O. 94.0120.
W D Stringfellow PROJECT ENGINEER.

(B5)

REQD PER ASSY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	STOCK SIZE APPROX. NET	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION	HEAT TREAT	FINISH	UNIT WT.	ITEM NO.
AR	05-2081-002	WIRE TAB	.030 DIA	SST	18-8				12
1	05-1058-266	O-RING	ARP 568-132	EPR	70 DURO				11
1	05-1058-011	O-RING	ARP 568-019	EPR	80 DURO				10
1	05-0130-005	VALVE TAG		SST	18-8				9
AR	05-0010-002	LOCKWIRE	.030 DIA	SST	18-8				8
AR	05-1500-017	LUBRICANT		NEOLUBE	MIL-L-24131				7
2	05-1076-002	SCREW, DRIVE		SST	18-8				6
1	03-6165-006	NAMEPLATE		SST	18-8				5
1	03-6324-001	SPRING		INCONEL	AMS 5698				4
(A2) 1	N03-6428-520	DISC		SST	SA564 GR 630	H1100 H1075			3
		BONNET							2
		BONNET							2
1	N03-6323-002	BONNET		SST	SA479-316				2
		BODY							1
		BODY							1
1	N03-6270-009	BODY		SST	SA182-F316				1
		VALVE ASSY							
		VALVE ASSY							
✓	N03-6430-530	VALVE ASSY							

LIST OF MATERIAL OR PARTS LIST

NUCLEAR
Customer Approval

N03-6430-530 REV. C

(B4)

✓ ALL MACHINED SURFACES REF MIL-STD-10 UNLESS OTHERWISE SPECIFIED

DWN	JW	10/23/77
CHK	WDS	10-28-77
ENGR	WDStringfellow	10-28-77
PROD		
QA	DFrahm	11/2/77
ENGR	JSWebb	11/1/77

CUSTOMER COLT INDUSTRIES-FAIRBANKS MORSE
PROJECT
SPEC P.O. B464140-N
AGCO. S.O. 94.0120 ITEM 1 THRU 8

ANDERSON, GREENWOOD & CO.
HOUSTON, TEXAS

VALVE ASSY - PISTON CHECK VALVE GPCA SERIES

CODE IDENT. NO. 01343 | SIZE C | N03-6430-530

SCALE: 1/2 | NUCLEAR | SHEET 1 OF 1

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS FOR KUNKLE SAFETY AND RELIEF VALVES

The ASME Codes prohibit servicing of safety valves, except by the manufacturer or his trained and authorized service representative. However, proper installation, operation and maintenance procedures will prevent many problems and permit you to obtain good service from your Kunkle safety and relief valves.

INSTALLATION

1. Mount the valve in a vertical position so that discharge piping and Code required drains can be properly piped to prevent build-up of back pressure and accumulation of foreign material around the valve seat area.
2. Apply only a moderate amount of pipe compound to male threads only, leaving the first thread clean. Compound applied to female threads or used to excess can find its way into the valve, causing leakage.
3. Avoid over-tightening threaded connection valves as this can distort the seats. As the valve and the vessel are heated, the heat involved will grasp the valve more firmly.
4. When installing flange connected valves, use new gaskets and draw the mounting bolts down evenly.
5. Do not use the valve outlet or cap as a lever for installation. Use only flat jawed wrenches on the flats provided.
6. Arrange discharge piping (if used) so that it cannot bear on the valve when either hot or cold, by using a drip pan elbow or flexible connection between the valve and the escape pipe.

OPERATION

1. Avoid having the operating pressure too near the safety valve's set pressure. A minimum differential of 5# or 10% (whichever is greater) is recommended. An even greater differential is desirable and will assure better seat tightness and valve longevity.
2. Avoid excessive operation of the safety valve as even one opening can provide a means for leakage. Safety valves should be operated only often enough to assure that they are in good working order.
3. Pop test the valve by raising the operating pressure to the set pressure of the safety valve, allowing it to open and reseat as it would in normal service.
4. Do not hand operate the valve with less than 75% of the stamped set pressure exerted on the underside of the disc. When hand operating, be sure to hold the valve in an open position long enough to purge accumulated foreign material from the seat area and then allow the valve to snap shut.
5. Avoid wire, cable or chain pulls for attachment to levers that do not allow a vertical pull. The weight of these devices should not be directed to the safety valve.

MAINTENANCE

1. Develop a regular program of visual inspection, looking for clogged drains and discharge pipe, dirt build-up in and around the valve seat and broken or missing parts.
2. Test the safety valve every two to six months (depending on plant age and condition), preferably by raising the system pressure to the safety valve's set pressure or operating the hand lever (see point 4 under "Operations" above).
3. Do not paint, oil or otherwise cover any interior or working parts of any safety valve - safety valves do not require any lubrication or protective coating to work properly.

KUNKLE VALVE COMPANY, INC.
P. O. Box 1740
Fort Wayne, Indiana 46801

KUNKLE VALVE COMPANY, INC.

The paragraphs below are a condensed representation of the A.S.M.E. Code: Section I, Section VIII and Section IV; as it pertains to safety valves and safety relief valves. In most cases, the paragraphs are fore-shortened and paraphrased. Included are this manufacturer's own comments. The paragraph numbering system is from the Code and is for reference purpose only. All statements made herein are subject to verification.

SAFETY VALVE - An automatic pressure relieving device actuated by the static pressure upstream of the valve and characterized by full opening pop action. It is used for steam, air or vapor service.

RELIEF VALVE - An automatic pressure relieving device actuated by the static pressure upsteam of the valve which opens further with the increase in pressure over the opening pressure. It is used primarily for liquid service.

SAFETY-RELIEF VALVE - An automatic pressure relieving device suitable for use either as a safety valve or relief valve, depending on application.

ASME CODE SECTION I

-POWER BOILERS-

67.1 Each boiler shall have at least one safety valve and if it has more than 500 sq. ft. of water-heating surface or if an electric boiler has a power input more than 500KW, it shall have two or more safety valves.

67.2 The safety valve capacity for each boiler shall be such that the safety valve(s) will discharge all the steam that can be generated by the boiler without allowing the pressure to rise more than 6 percent above the highest pressure at which the valve is set and in no case to more than 6 percent above the maximum allowable working pressure.

To convert BTU's at the boiler nozzle to the steam relieving capacity, in pounds per hour, divide by 1000.

67.3 One or more safety valves on the boiler proper shall be set at or below the maximum allowable working pressure. If additional valves are used, the highest pressure setting shall not exceed the maximum allowable working pressure by more than 3 percent. The complete range of pressure settings of all the saturated steam safety valves on a boiler shall not exceed 10 percent of the highest pressure to which any valve is set. Pressure setting of safety relief valves on high-temperature water boilers may exceed this 10 percent range. Because safety relief valves in hot water service are more susceptible to damage and subsequent leakage, the valve setting for high-temperature boilers should be selected substantially higher than the desired operating pressure so as to minimize the times the safety relief valve must lift.

67.5 For high-temperature water boilers safety-relief valves shall be used. Such valves shall have a closed bonnet.

67.6 A safety valve over 3 inches in size, used for pressures greater than 15 PSI gauge, shall have a flanged inlet connection or a welded inlet connection.

71.1 When two or more safety valves are used on a boiler, they may be mounted either separately or as twin valves made by placing individual valves on Y-bases. The twin valves shall be of approximately equal capacity.

When not more than two valves of different sizes are mounted singly, the relieving capacity of the smaller valve shall be not less than 50 percent of that of the larger valves.

71.2 The safety valve(s) shall be connected to the boiler independent of any other connection and attached as close as possible to the boiler, without any unnecessary intervening pipe or fitting. Every safety valve shall be connected so as to stand in an upright position, with the spindle vertical.

71.3 The opening or connection between the boiler and the safety valve shall have at least the area of the valve inlet. No valve of any description shall be placed between the required safety valve(s) and the boiler, nor on the discharge pipe between the valve and the atmosphere. When a discharge pipe is used, the cross-sectional area shall be not less than the full area of the valve outlet or of the total of the areas of the valve outlets. It shall be as short and straight as possible and so arranged as to avoid undue stresses on the valve(s).

The installation of cast iron bodied safety relief valves for high-temperature water boilers is prohibited.

71.5 When a boiler is fitted with two or more safety valves on one connection, this connection to the boiler shall have a cross-sectional area not less than the combined areas of inlet connections of all the safety valves with which it connects.

72.1 After blowing down, all valves shall close at a pressure not lower than 96 percent of their pressure. The minimum blowdown in any case shall be 2 PSI. For valves set at 100, through and including 300 PSI, the blowdown shall not be less than 1 percent of the set pressure. Safety relief valves used on high-temperature water boilers may be set and adjusted to close after blowing down not more than 10 percent of the set pressure.

72.2 The popping point tolerance plus or minus shall not exceed the following: 2 PSI for pressures up to and including 70 PSI, 3 percent for pressure from 71 to 300 PSI, 10 PSI for pressures over 301 PSI to 1000 PSI and 1 percent for pressures over 1000 PSI.

72.3 The spring in a safety valve in service for pressures up to and including 250 PSI shall not be reset more than 10% above or below the marked set pressure. For higher pressure the spring shall not be reset more than 5 percent above or below the marked set pressure.

72.4 If the operating conditions of a valve are changed so as to require a new spring for a different pressure, the valve shall be adjusted by the manufacturer or his authorized representative who shall furnish and install a nameplate as required by the Code.

73.1.3 To insure the valve being free, each safety valve or safety relief valve shall have a substantial lifting device by which the valve disc may be positively lifted from its seat when the valve is subjected to pressure of at least 75 percent of the set pressure. The lifting device shall be such that it cannot lock or hold the valve disc in lifted position when the exterior lifting force is released. Discs of safety relief valves used on high-temperature water boilers shall not be lifted while the temperature of the water exceeds 200 F. If it is desired to lift the valve disc to assure that it is free, this shall be done when the valve is subjected to a pressure of at least 75 percent of the set pressure. For high-temperature water boilers, the valve(s) shall have a pressure tight packed lift lever.

73.1.5 A body drain below seat lever shall be provided in the valve and this drain shall not be plugged during or after field installation.

73.1.8 Means shall be provided in the design of all valves for sealing all external adjustments. Seals shall be installed by the manufacturer or assembler at the time of initial shipment and after field adjustment or repair of the valves by either the manufacturer, his authorized representative repairer or the user. Seals shall be installed in such a manner as to prevent changing the adjustment without breaking the seal and, in addition, shall serve as a means of identifying the manufacturer, assembler, repairer or user making the adjustment.

73.4.2 A tightness test shall be conducted at maximum expected operating pressure, but at a pressure not exceeding the reseating pressure of the valve. When testing, the valve exhibiting no visible signs of leakage shall be considered adequately tight.

ASME CODE SECTION VIII(DIVISION 1)

-PRESSURE VESSELS-

UG-125 (c) All pressure vessels shall be protected by pressure-relieving devices that will prevent the pressure from rising more than 10 percent above the maximum allowable working pressure.

UG-125 (g) Vessels that are to operate completely filled with liquid shall be equipped with liquid relief valves, unless otherwise protected against overpressure.

Ug-126 (c) The spring in a safety or relief valve in service for pressures up to and including 250 PSI shall not be reset for any pressure more than 10 percent above or below that for which the valve is marked. For higher pressures, the spring shall not be reset for any pressure more than 5 percent above or below that for which the safety or relief valve is marked.

UG-128 Any liquid relief valve used shall be at least ½ in. - iron pipe size.

UG-129 (b) Safety and relief valves certified for a steam discharge capacity under the provisions of Section I of the Code and bearing the official Code symbol may be used on pressure vessels, Section VIII and IV.

UG-134 (a) When a single safety or relief valve is provided, it shall be set to blow at a pressure not exceeding the maximum allowable working pressure of the vessel at the operating temperature. If the capacity is supplied on more than one safety or relief valve, only one valve need be set to open at a pressure not exceeding the maximum allowable working pressure of the vessel; the additional valves may be set to open at a higher pressure, but not to exceed 105 percent of the maximum allowable working pressure of the vessel.

(c) If the operating conditions of the valve are changed so as to require another spring rated for a different pressure, the relief setting shall be adjusted by the manufacturer or by an individual certified by the manufacturer of that safety valve. The valve shall be remarked by either of them in conformance with Code marking procedures or as set forth by the manufacturer.

(e) The set pressure tolerance, plus or minus, of safety or relief valves, shall not exceed 2 PSI for pressures up to and including 70 PSI; and 3 percent for pressures above 70 PSI.

UG-136 (3) Safety and relief valves for steam or air service shall be provided with a substantial lifting device so that the disc can be lifted from its seat when the pressure in the vessel is 75 percent of that at which the valve is set to blow.

Safety and relief valves for service other than steam and air need not be provided with a lifting device, although a lifting device is desireable if the vapors are such that their release will not create a nazard.

If the design of a safety or relief valve is such that liquid can collect on the discharge side of the disc, the valve shall be equipped with a drain at the lowest point where liquid can collect.

ASME CODE SECTION IV
-HEATING BOILERS-

HG-400.1 (a) Each steam boiler shall have one or more officially rated safety valve(s) of the spring pop type adjusted and sealed to discharge at a pressure not to exceed 15 PSI. Seals shall be attached in a manner to prevent the valve from being taken apart without breaking the seal. A body drain connection below seat level shall be provided by the manufacturer and this drain shall not be plugged during or after field installation.

(b) No safety valve for steam boiler shall be smaller than 1/2" nor larger than 4 1/2".

HG-400.2 (a) Each hot water heating boiler shall have at least one officially rated pressure relief valve. Safety relief valves officially rated as to capacity shall have pop action when tested by steam. When more than one safety relief valve is used on hot water heating the additional valve(s) shall be officially rated and may be set within a range not to exceed 6 PSI above the maximum allowable working pressure of the boiler up to and including 60 PSI and 5 percent for those exceeding 60 PSI.

HG-401 (g) There shall be a lifting lever and a mechanical connection between the lifting lever and the disc capable of lifting the disc from the seat a distance of at least 1/16 in. with no pressure on the boiler.

(k) The set pressure tolerances, plus or minus, of steam safety valves shall not exceed 2 PSI and for safety relief valves shall not exceed 3 PSI for pressures up to and including 60 PSIG and 5% for pressures above 60 PSIG.

HG-401.4 (e) Every valve shall be tested to demonstrate its popping point, blowdown, and tightness. A tightness test shall be conducted at a maximum expected operating pressure, but not at a pressure exceeding the reseating pressure of the valve. When testing on either water or steam, a valve exhibiting no visible signs of leakage shall be considered adequately tight.

HG-402.4 Safety valves for steam boilers shall be tested for capacity at 33 1/3 percent over the 15 PSI required set pressure. Capacity certification tests of safety-relief valves for hot water heating and hot water supply boilers shall be conducted at 110 percent of the pressure of which the valve is set to operate.

HG-406 Safety valves and safety relief valves requiring repairs shall be replaced with a new valve or repaired by the manufacturer.

73.1.5 A body drain below seat lever shall be provided in the valve and this drain shall not be plugged during or after field installation.

73.1.8 Means shall be provided in the design of all valves for sealing all external adjustments. Seals shall be installed by the manufacturer or assembler at the time of initial shipment and after field adjustment or repair of the valves by either the manufacturer, his authorized representative repairer or the user. Seals shall be installed in such a manner as to prevent changing the adjustment without breaking the seal and, in addition, shall serve as a means of identifying the manufacturer, assembler, repairer or user making the adjustment.

73.4.2 A tightness test shall be conducted at maximum expected operating pressure, but at a pressure not exceeding the reseating pressure of the valve. When testing, the valve exhibiting no visible signs of leakage shall be considered adequately tight.

ASME CODE SECTION VIII(DIVISION 1)

-PRESSURE VESSELS-

UG-125 (c) All pressure vessels shall be protected by pressure-relieving devices that will prevent the pressure from rising more than 10 percent above the maximum allowable working pressure.

UG-125 (g) Vessels that are to operate completely filled with liquid shall be equipped with liquid relief valves, unless otherwise protected against overpressure.

Ug-126 (c) The spring in a safety or relief valve in service for pressures up to and including 250 PSI shall not be reset for any pressure more than 10 percent above or below that for which the valve is marked. For higher pressures, the spring shall not be reset for any pressure more than 5 percent above or below that for which the safety or relief valve is marked.

UG-128 Any liquid relief valve used shall be at least ½ in. - iron pipe size.

UG-129 (b) Safety and relief valves certified for a steam discharge capacity under the provisions of Section I of the Code and bearing the official Code symbol may be used on pressure vessels, Section VIII and IV.

UG-134 (a) When a single safety or relief valve is provided, it shall be set to blow at a pressure not exceeding the maximum allowable working pressure of the vessel at the operating temperature. If the capacity is supplied on more than one safety or relief valve, only one valve need be set to open at a pressure not exceeding the maximum allowable working pressure of the vessel; the additional valves may be set to open at a higher pressure, but not to exceed 105 percent of the maximum allowable working pressure of the vessel.

(c) If the operating conditions of the valve are changed so as to require another spring rated for a different pressure, the relief setting shall be adjusted by the manufacturer or by an individual certified by the manufacturer of that safety valve. The valve shall be remarked by either of them in conformance with Code marking procedures or as set forth by the manufacturer.

(e) The set pressure tolerance, plus or minus, of safety or relief valves, shall not exceed 2 PSI for pressures up to and including 70 PSI; and 3 percent for pressures above 70 PSI.

UG-136 (3) Safety and relief valves for steam or air service shall be provided with a substantial lifting device so that the disc can be lifted from its seat when the pressure in the vessel is 75 percent of that at which the valve is set to blow.

Safety and relief valves for service other than steam and air need not be provided with a lifting device, although a lifting device is desireable if the vapors are such that their release will not create a nazard.

If the design of a safety or relief valve is such that liquid can collect on the discharge side of the disc, the valve shall be equipped with a drain at the lowest point where liquid can collect.

ASME CODE SECTION IV
-HEATING BOILERS-

HG-400.1 (a) Each steam boiler shall have one or more officially rated safety valve(s) of the spring pop type adjusted and sealed to discharge at a pressure not to exceed 15 PSI. Seals shall be attached in a manner to prevent the valve from being taken apart without breaking the seal. A body drain connection below seat level shall be provided by the manufacturer and this drain shall not be plugged during or after field installation.

(b) No safety valve for steam boiler shall be smaller than 1/2" nor larger than 4 1/2".

HG-400.2 (a) Each hot water heating boiler shall have at least one officially rated pressure relief valve. Safety relief valves officially rated as to capacity shall have pop action when tested by steam. When more than one safety relief valve is used on hot water heating the additional valve(s) shall be officially rated and may be set within a range not to exceed 6 PSI above the maximum allowable working pressure of the boiler up to and including 60 PSI and 5 percent for those exceeding 60 PSI.

HG-401 (g) There shall be a lifting lever and a mechanical connection between the lifting lever and the disc capable of lifting the disc from the seat a distance of at least 1/16 in. with no pressure on the boiler.

(k) The set pressure tolerances, plus or minus, of steam safety valves shall not exceed 2 PSI and for safety relief valves shall not exceed 3 PSI for pressures up to and including 60 PSIG and 5% for pressures above 60 PSIG.

HG-401.4 (e) Every valve shall be tested to demonstrate its popping point, blowdown, and tightness. A tightness test shall be conducted at a maximum expected operating pressure, but not at a pressure exceeding the reseating pressure of the valve. When testing on either water or steam, a valve exhibiting no visible signs of leakage shall be considered adequately tight.

HG-402.4 Safety valves for steam boilers shall be tested for capacity at 33 1/3 percent over the 15 PSI required set pressure. Capacity certification tests of safety-relief valves for hot water heating and hot water supply boilers shall be conducted at 110 percent of the pressure of which the valve is set to operate.

HG-406 Safety valves and safety relief valves requiring repairs shall be replaced with a new valve or repaired by the manufacturer.

BF 4422-D

ENGINEERING CHANGE REQUEST AND CHANGE ORDER

C.O. 16045

Colt Industries — Fairbanks Morse Engine Division

NUCLEAR

WW

PRODUCT D.P. NUC. SKID

ORDER AFFECTED 700000

CHARGE NO. NONE

☐ STANDARD

☒ MANDATORY

ENGR. SCHEDULE NO. 7978

GROUP REF. NO.

ITEM NO.	PART NAME	CHANGED FROM PART NO.	REV. NO.	B/M NO.	REV. NO.	CHANGED TO PART NO.	REV. NO.	B/M NO.	NO. REV.	SEE CODING BELOW CHANGE AFFECTS	REASON	DISP.	TYPE
A.	SAFETY VALVE 1/2" ASME	11908532	7	—		SAME	8	—		G	C	N	P

DESCRIPTION OF CHANGE A. REVISED SAFETY VALVE DWG. TO CHANGE VENDOR FIGURE NO. FROM 663-P TO 389P. ALSO CHANGE THE FOLLOWING DIMENSIONS FROM 7 5/8 TO 8 1/2 ± 1/4 AND 2 3/8 TO 2 7/16.

REASON: CUSTOMER REQUEST. KUNKLE PART NO. 663P. IS OBSOLETE

CHANGE AFFECTS
A — Field Repairs
B — Patterns or Temp
C — Foundry Equipment
D — Tools or Fixtures
E — Processing
F — Process Stock
G — Purchased Stock
H — Delivery
J — Sales Information
K — Cost
S — Spares

REASON FOR CHANGE
A — Engineering Request
B — Manufacturing Request
C — Vendor Request
D — Sales Request
E — Customer Request
F — Engrg. Error
G —

DISPOSITION
U — Use As Is
M — Modify
R — Return to Stk
S — Scrap
N — Not Affected
* — See Remarks

TYPE
P — Purch
W — Weldmt
C — Casting
M — Mach g
A — Ass'y.
D — Detail

REMARKS
DISP. NOT AFFECTED
SERVICE REQUEST

RECOMMENDED METHOD AND TIME OF EFFECTIVE CHANGE

☐ Advance Information Forwarded to: _____ On Date: _____

☐ Work Stopped — Resume Work per This Change Order

ACTUAL TIME OF ADOPTION

ITEM	SERIAL	DATE	ITEM	SERIAL	DATE

APPROVED / REJECTED AS APPLICABLE

ENGRG. 12-11-89	QA 12.11.89	MFGRG.
MRKTG.	PROC.	

EST. COST $ _____ AND/OR HRS. _____

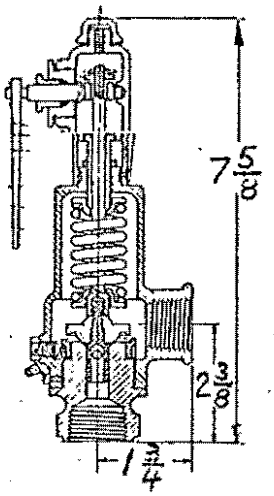
CHANGE SUGGESTED BY K. HESS

ISSUED DATE 12-13-89

C.O. NO. 16045

WRITTEN BY J. CHERRY

SH 1 OF 1



(4)

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC COMPANY
PURCHASE ORDER LX-239484
FAIRBANKS MORSE ORDER NO. 11-700000

VENDOR: KUNKLE VALVE CO. INC. (4)
8222 BLUFFTON ROAD
FORT WAYNE, IN 46809

VENDOR FIGURE: 663-P (4)

TITLE: VALVE, SAFETY, ½"
ASME SECTION VIII

APPROVED Rev.1 MAY 1 1977 — APPROVED Rev.0 MAR 10 1977 — APPROVED Rev.0 MAR 4 1977

QUALITY CONTROL — QUALITY CONTROL

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REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY
5	12965	6/16 82	(5) OMITTED PARA 2.1.3 RESEAT PRESS 240 PSI	H.R.S.
3	FS1148	3-5 [illegible]	(4) ADDED VENDOR PART NO & PICTURE	H.R.S.
2	11137	10-12 78	(3) DELETE REF TO REV. OF SPEC PG 42 & 43	JWW
1	11014	8-7-78	ADD REV. STATE TO SUBTIER SPECS (2)	WLS
	10776	4-21 78	(1) SHT 2 PARA 2.1.1 WAS "285 PSI"	GDJ
	10695	3-1-78	REVISED PARA. 1.2 RETYPED PAGE 283	JWW
	10311	5-6 77	PARA. 1.2 WAS 11 908 456.	WLS

(1) (F)

Colt Industries (7) Fairbanks Morse Engine Division

REL. NO. PC 1728	3/11 77	ASSY. OR LO.	
DR. BY J. Dorn	3/2 77	SCALE	
CHK'D. BY J. WHALEN	3/4 77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
MACH.		ENGR.	
WELD.			

SHEET SIZE A | DWG. NO. 11 908 532 | SHEET 1 of 3

COLT APR 11 1978 QA

Rev 3 eff

COLT APP FM JUL 31 1978 QA

Rev 2 eff

COLT APP FEB 15 1978 QA

225 806 A1

COLT Rev 6 eff QA

COLT Rev 5 eff QA

1/2" SAFETY VALVE IN THE AIR START SYSTEM FOR NUCLEAR STANDBY DIESEL/GEN. SET IN ACCORDANCE WITH BECHTEL SPECIFICATIONS FOR LIMERICK GENERATING STATION, UNITS 1 & 2.

1. SPECIFIC CUSTOMER SPECIFICATION REQUIREMENTS:

THE FOLLOWING REFERS TO SPECIFIC PORTIONS OF THE "BECHTEL POWER CORPORATION SPECIFICATION FOR THE LIMERICK GENERATING STATION, UNITS 1 & 2, PHILADELPHIA ELECTRIC COMPANY" THAT APPLY.

1.1 8031-M-71, REV. 3, SPECIFICATION FOR DIESEL GENERATORS.

1.1.1 PAGE 43, PARA. 6.3a - SHIPMENT.

1.1.2 PAGE 47, PARA. 8.2f - STATEMENT OF CONFORMANCE.

1.2 QA REQUIREMENTS PER COLT/FM DWG. 11 871 599, EXCEPT DELETE PARA. G AND ADD IN ITS PLACE "MATERIAL CERTIFICATION - MILL TEST REPORTS WHERE AVAILABLE. WHERE MILL TEST REPORTS ARE NOT AVAILABLE, MATERIAL CERTIFICATES OF CONFORMANCE IDENTIFYING THE MATERIALS USED WILL BE FURNISHED."

1.3 ASME BOILER & PRESSURE VESSEL CODE SECTION VIII.

2. TECHNICAL SPECIFICATION

2.1 1/2" SAFETY VALVE FOR 250 PSI AIR SERVICE AND AS FOLLOWS:

2.1.1 SET PRESSURE: 275 PSI.

2.1.2 CAPACITY: 92 CFM AT 60°F MINIMUM.

2.1.3 DELETED

2.1.4 MAXIMUM AIR TEMP.: 400°F.

2.1.5 CONNECTIONS: INLET - 1/2" NPT.
OUTLET - 3/4" OR 1" NPT.

2.1.6 CONNECTION LOADS: THE VENDOR SHALL FURNISH THE MAX. ALLOWABLE CONNECTION LOADS. DATA SHALL INCLUDE MAX. ALLOWABLE AXIAL FORCE, LATERAL FORCE, BENDING MOMENT AND TORSIONAL MOMENT.

2.1.7 MATERIALS OF CONSTRUCTION - STAINLESS STEEL.

2.1.8 THE VALVE MUST BE DESIGNED FOR SEISMIC FORCES OF 3.6G VERTICALLY AND 2.95G HORIZONTALLY. THE VERTICAL FORCE AND TWO HORIZONTAL FORCES, ONE PERPENDICULAR TO THE OTHER, ARE ACTING SIMULTANEOUSLY.

2.1.9 THE MANUFACTURER'S DWG. FOR THIS COMPONENT SHALL BE CERTIFIED FOR ALL DIMENSIONS AND DIMENSIONAL CLEARANCES REQUIRED FOR MAINTENANCE.

11 908 532

COLT Rev. 3 APPR QA
FM JUL 31 1978 APP

COLT Rev. 4 APPR QA
FM FEB 15 1978 APP

COLT Rev. 5 APPR QA
FM OCT 17 1978 APP

COLT Rev. 6 APPR QA
FM MAR 16 1982 APP

11 908 532

Colt Industries / Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 532 REV. 4	SHEET 3 OF 3

Rev. 3
APR 11 1979

REV. 5
REV. 6

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS FOR KUNKLE SAFETY AND RELIEF VALVES

The ASME Codes prohibit servicing of safety valves, except by the manufacturer or his trained and authorized service representative. However, proper installation, operation and maintenance procedures will prevent many problems and permit you to obtain good service from your Kunkle safety and relief valves.

INSTALLATION

1. Mount the valve in a vertical position so that discharge piping and Code required drains can be properly piped to prevent build-up of back pressure and accumulation of foreign material around the valve seat area.
2. Apply only a moderate amount of pipe compound to male threads only, leaving the first thread clean. Compound applied to female threads or used to excess can find its way into the valve, causing leakage.
3. Avoid over-tightening threaded connection valves as this can distort the seats. As the valve and the vessel are heated, the heat involved will grasp the valve more firmly.
4. When installing flange connected valves, use new gaskets and draw the mounting bolts down evenly.
5. Do not use the valve outlet or cap as a lever for installation. Use only flat jawed wrenches on the flats provided.
6. Arrange discharge piping (if used) so that it cannot bear on the valve when either hot or cold, by using a drip pan elbow or flexible connection between the valve and the escape pipe.

OPERATION

1. Avoid having the operating pressure too near the safety valve's set pressure. A minimum differential of 5# or 10% (whichever is greater) is recommended. An even greater differential is desirable and will assure better seat tightness and valve longevity.
2. Avoid excessive operation of the safety valve as even one opening can provide a means for leakage. Safety valves should be operated only often enough to assure that they are in good working order.
3. Pop test the valve by raising the operating pressure to the set pressure of the safety valve, allowing it to open and reseat as it would in normal service.
4. Do not hand operate the valve with less than 75% of the stamped set pressure exerted on the underside of the disc. When hand operating, be sure to hold the valve in an open position long enough to purge accumulated foreign material from the seat area and then allow the valve to snap shut.
5. Avoid wire, cable or chain pulls for attachment to levers that do not allow a vertical pull. The weight of these devices should not be directed to the safety valve.

MAINTENANCE

1. Develop a regular program of visual inspection, looking for clogged drains and discharge pipe, dirt build-up in and around the valve seat and broken or missing parts.
2. Test the safety valve every two to six months (depending on plant age and condition), preferably by raising the system pressure to the safety valve's set pressure or operating the hand lever (see point 4 under "Operations" above).
3. Do not paint, oil or otherwise cover any interior or working parts of any safety valve - safety valves do not require any lubrication or protective coating to work properly.

KUNKLE VALVE COMPANY, INC.
P. O. Box 1740
Fort Wayne, Indiana 46801

KUNKLE VALVE COMPANY, INC.

The paragraphs below are a condensed representation of the A.S.M.E. Code: Section I, Section VIII and Section IV; as it pertains to safety valves and safety relief valves. In most cases, the paragraphs are fore-shortened and paraphrased. Included are this manufacturer's own comments. The paragraph numbering system is from the Code and is for reference purpose only. All statements made herein are subject to verification.

SAFETY VALVE - An automatic pressure relieving device actuated by the static pressure upstream of the valve and characterized by full opening pop action. It is used for steam, air or vapor service.

RELIEF VALVE - An automatic pressure relieving device actuated by the static pressure upsteam of the valve which opens further with the increase in pressure over the opening pressure. It is used primarily for liquid service.

SAFETY-RELIEF VALVE - An automatic pressure relieving device suitable for use either as a safety valve or relief valve, depending on application.

ASME CODE SECTION I

-POWER BOILERS-

67.1 Each boiler shall have at least one safety valve and if it has more than 500 sq. ft. of water-heating surface or if an electric boiler has a power input more than 500KW, it shall have two or more safety valves.

67.2 The safety valve capacity for each boiler shall be such that the safety valve(s) will discharge all the steam that can be generated by the boiler without allowing the pressure to rise more than 6 percent above the highest pressure at which the valve is set and in no case to more than 6 percent above the maximum allowable working pressure.

To convert BTU's at the boiler nozzle to the steam relieving capacity, in pounds per hour, divide by 1000.

67.3 One or more safety valves on the boiler proper shall be set at or below the maximum allowable working pressure. If additional valves are used, the highest pressure setting shall not exceed the maximum allowable working pressure by more than 3 percent. The complete range of pressure settings of all the saturated steam safety valves on a boiler shall not exceed 10 percent of the highest pressure to which any valve is set. Pressure setting of safety relief valves on high-temperature water boilers may exceed this 10 percent range. Because safety relief valves in hot water service are more susceptible to damage and subsequent leakage, the valve setting for high-temperature boilers should be selected substantially higher than the desired operating pressure so as to minimize the times the safety relief valve must lift.

67.5 For high-temperature water boilers safety-relief valves shall be used. Such valves shall have a closed bonnet.

67.6 A safety valve over 3 inches in size, used for pressures greater than 15 PSI gauge, shall have a flanged inlet connection or a welded inlet connection.

71.1 When two or more safety valves are used on a boiler, they may be mounted either separately or as twin valves made by placing individual valves on Y-bases. The twin valves shall be of approximately equal capacity.

When not more than two valves of different sizes are mounted singly, the relieving capacity of the smaller valve shall be not less than 50 percent of that of the larger valves.

71.2 The safety valve(s) shall be connected to the boiler independent of any other connection and attached as close as possible to the boiler, without any unnecessary intervening pipe or fitting. Every safety valve shall be connected so as to stand in an upright position, with the spindle vertical.

71.3 The opening or connection between the boiler and the safety valve shall have at least the area of the valve inlet. No valve of any description shall be placed between the required safety valve(s) and the boiler, nor on the discharge pipe between the valve and the atmosphere. When a discharge pipe is used, the cross-sectional area shall be not less than the full area of the valve outlet or of the total of the areas of the valve outlets. It shall be as short and straight as possible and so arranged as to avoid undue stresses on the valve(s).

The installation of cast iron bodied safety relief valves for high-temperature water boilers is prohibited.

71.5 When a boiler is fitted with two or more safety valves on one connection, this connection to the boiler shall have a cross-sectional area not less than the combined areas of inlet connections of all the safety valves with which it connects.

72.1 After blowing down, all valves shall close at a pressure not lower than 96 percent of their pressure. The minimum blowdown in any case shall be 2 PSI. For valves set at 100, through and including 300 PSI, the blowdown shall not be less than 1 percent of the set pressure. Safety relief valves used on high-temperature water boilers may be set and adjusted to close after blowing down not more than 10 percent of the set pressure.

72.2 The popping point tolerance plus or minus shall not exceed the following: 2 PSI for pressures up to and including 70 PSI, 3 percent for pressure from 71 to 300 PSI, 10 PSI for pressures over 301 PSI to 1000 PSI and 1 percent for pressures over 1000 PSI.

72.3 The spring in a safety valve in service for pressures up to and including 250 PSI shall not be reset more than 10% above or below the marked set pressure. For higher pressure the spring shall not be reset more than 5 percent above or below the marked set pressure.

72.4 If the operating conditions of a valve are changed so as to require a new spring for a different pressure, the valve shall be adjusted by the manufacturer or his authorized representative who shall furnish and install a nameplate as required by the Code.

73.1.3 To insure the valve being free, each safety valve or safety relief valve shall have a substantial lifting device by which the valve disc may be positively lifted from its seat when the valve is subjected to pressure of at least 75 percent of the set pressure. The lifting device shall be such that it cannot lock or hold the valve disc in lifted position when the exterior lifting force is released. Discs of safety relief valves used on high-temperature water boilers shall not be lifted while the temperature of the water exceeds 200 F. If it is desired to lift the valve disc to assure that it is free, this shall be done when the valve is subjected to a pressure of at least 75 percent of the set pressure. For high-temperature water boilers, the valve(s) shall have a pressure tight packed lift lever.

73.1.5 A body drain below seat lever shall be provided in the valve and this drain shall not be plugged during or after field installation.

73.1.8 Means shall be provided in the design of all valves for sealing all external adjustments. Seals shall be installed by the manufacturer or assembler at the time of initial shipment and after field adjustment or repair of the valves by either the manufacturer, his authorized representative repairer or the user. Seals shall be installed in such a manner as to prevent changing the adjustment without breaking the seal and, in addition, shall serve as a means of identifying the manufacturer, assembler, repairer or user making the adjustment.

73.4.2 A tightness test shall be conducted at maximum expected operating pressure, but at a pressure not exceeding the reseating pressure of the valve. When testing, the valve exhibiting no visible signs of leakage shall be considered adequately tight.

ASME CODE SECTION VIII(DIVISION 1)

-PRESSURE VESSELS-

UG-125 (c) All pressure vessels shall be protected by pressure-relieving devices that will prevent the pressure from rising more than 10 percent above the maximum allowable working pressure.

UG-125 (g) Vessels that are to operate completely filled with liquid shall be equipped with liquid relief valves, unless otherwise protected against overpressure.

Ug-126 (c) The spring in a safety or relief valve in service for pressures up to and including 250 PSI shall not be reset for any pressure more than 10 percent above or below that for which the valve is marked. For higher pressures, the spring shall not be reset for any pressure more than 5 percent above or below that for which the safety or relief valve is marked.

UG-128 Any liquid relief valve used shall be at least ½ in. - iron pipe size.

UG-129 (b) Safety and relief valves certified for a steam discharge capacity under the provisions of Section I of the Code and bearing the official Code symbol may be used on pressure vessels, Section VIII and IV.

UG-134 (a) When a single safety or relief valve is provided, it shall be set to blow at a pressure not exceeding the maximum allowable working pressure of the vessel at the operating temperature. If the capacity is supplied on more than one safety or relief valve, only one valve need be set to open at a pressure not exceeding the maximum allowable working pressure of the vessel; the additional valves may be set to open at a higher pressure, but not to exceed 105 percent of the maximum allowable working pressure of the vessel.

(c) If the operating conditions of the valve are changed so as to require another spring rated for a different pressure, the relief setting shall be adjusted by the manufacturer or by an individual certified by the manufacturer of that safety valve. The valve shall be remarked by either of them in conformance with Code marking procedures or as set forth by the manufacturer.

(e) The set pressure tolerance, plus or minus, of safety or relief valves, shall not exceed 2 PSI for pressures up to and including 70 PSI; and 3 percent for pressures above 70 PSI.

UG-136 (3) Safety and relief valves for steam or air service shall be provided with a substantial lifting device so that the disc can be lifted from its seat when the pressure in the vessel is 75 percent of that at which the valve is set to blow.

Safety and relief valves for service other than steam and air need not be provided with a lifting device, although a lifting device is desireable if the vapors are such that their release will not create a nazard.

If the design of a safety or relief valve is such that liquid can collect on the discharge side of the disc, the valve shall be equipped with a drain at the lowest point where liquid can collect.

ASME CODE SECTION IV
-HEATING BOILERS-

HG-400.1 (a) Each steam boiler shall have one or more officially rated safety valve(s) of the spring pop type adjusted and sealed to discharge at a pressure not to exceed 15 PSI. Seals shall be attached in a manner to prevent the valve from being taken apart without breaking the seal. A body drain connection below seat level shall be provided by the manufacturer and this drain shall not be plugged during or after field installation.

(b) No safety valve for steam boiler shall be smaller than 1/2" nor larger than 4 1/2".

HG-400.2 (a) Each hot water heating boiler shall have at least one officially rated pressure relief valve. Safety relief valves officially rated as to capacity shall have pop action when tested by steam. When more than one safety relief valve is used on hot water heating the additional valve(s) shall be officially rated and may be set within a range not to exceed 6 PSI above the maximum allowable working pressure of the boiler up to and including 60 PSI and 5 percent for those exceeding 60 PSI.

HG-401 (g) There shall be a lifting lever and a mechanical connection between the lifting lever and the disc capable of lifting the disc from the seat a distance of at least 1/16 in. with no pressure on the boiler.

(k) The set pressure tolerances, plus or minus, of steam safety valves shall not exceed 2 PSI and for safety relief valves shall not exceed 3 PSI for pressures up to and including 60 PSIG and 5% for pressures above 60 PSIG.

HG-401.4 (e) Every valve shall be tested to demonstrate its popping point, blowdown, and tightness. A tightness test shall be conducted at a maximum expected operating pressure, but not at a pressure exceeding the reseating pressure of the valve. When testing on either water or steam, a valve exhibiting no visible signs of leakage shall be considered adequately tight.

HG-402.4 Safety valves for steam boilers shall be tested for capacity at 33 1/3 percent over the 15 PSI required set pressure. Capacity certification tests of safety-relief valves for hot water heating and hot water supply boilers shall be conducted at 110 percent of the pressure of which the valve is set to operate.

HG-406 Safety valves and safety relief valves requiring repairs shall be replaced with a new valve or repaired by the manufacturer.

1. THE FLEXIBLE HOSE ASSEMBLIES USED IN THIS DIESEL POWER GENERATING SET ARE FOR THE AIR START SYSTEM, THE LUBE OIL SYSTEM AND THE JACKET WATER SYSTEM.

2. THE FACTORY ASSEMBLED HOSE ASSEMBLIES SHALL CONSIST OF FC195 AQP (SAE 100 R2A) 2-WIRE BRAID HOSE, #4722 MALE PIPE FITTINGS, #4721 SAE 37° (J.I.C.) SWIVELS, AND #2022 INTERNAL PIPE/37° FLARE ADAPTERS IN SIZES AND LENGTHS SHOWN.

FH PART NO.	HOSE SIZE	HOSE LENGTH	MALE PIPE FITTING	SAE 37°FITTING
11908981	1-1/2"	24"	4722-24-24S	4721-24S
11908982	1-1/2	18	4722-24-24S	4721-24S
11908983	1	12	4722-16-16S	4721-16S
11908984	1/2	12	4722-8-8S	4721-8-8S

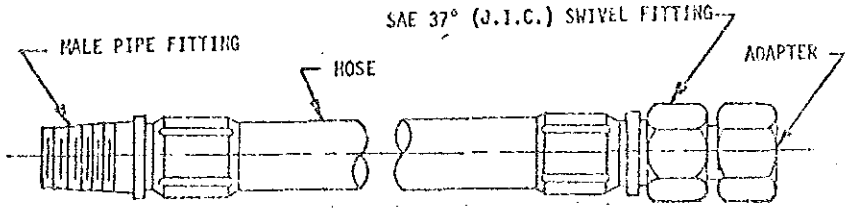
FH PART NO.	ADAPTER	HOSE ASSEMBLY FINISHED LENGTH
11908981	2022-24-24S	31.55
11908982	2022-24-24S	25.55
11908983	2022-16-16S	17.92
11908984	2022-8-8S	16.61

3. CADMIUM PLATED STEEL HOSE FITTINGS AND ADAPTERS.

4. HOSE ASSEMBLY MUST BE TESTED AT 200 PSI WITH WATER FOR (1) HOUR AND CERTIFIED BY VENDOR'S QUALITY CONTROL THAT THEY DO NOT LEAK. ANY LEAKING ASSY. WILL NOT BE REPAIRED OR REWORKED WITHOUT VENDOR'S QUALITY CONTROL APPROVAL. LEAKS IN THE HOSE PORTION WILL NOT BE REPAIRED OR REWORKED.

5. DRAWINGS: VENDOR TO FURNISH (2) REPRODUCIBLE DRAWINGS FOR APPROVAL. DRAWINGS TO INCLUDE THE FOLLOWING:

LIMERICK GENERATING STATION, UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.
PURCHASE ORDER NO. LX 239555
FAIRBANKS MORSE ORDER NO. 11-700000



VENDOR PART NO.:

VENDOR DWG. NO.:

VENDOR: AEROQUIP OR EQUIVALENT

11908985

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Colt Industries — Fairbanks Morse Engine Division

SO. NO. PC 1886 — 60077 — MDL. 6H-10

DR. BY J. ZOTH — 10-22-79

CHK'D. BY [illegible] — 11-13-79

MATL — COAT. — APPV. MACH. — WELD — APPV. ENGR.

SHEET 3 — DWG. NO. 11 053 005 — SIZE — REV. 1

TITLE: HOSE ASSY. NPT (M) x NPT (F)

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
FLAME CUTTING, SHEARING, NIBBLING, TOOL DESIGN ± .005
FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 PL .XXX ± .010 .XX ± .020 .X ± .030

REV NO	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D BY

11 909 497

DESCRIPTION: NORGREN AIR FILTER - REGULATOR WITH THE FOLLOWING FEATURES:

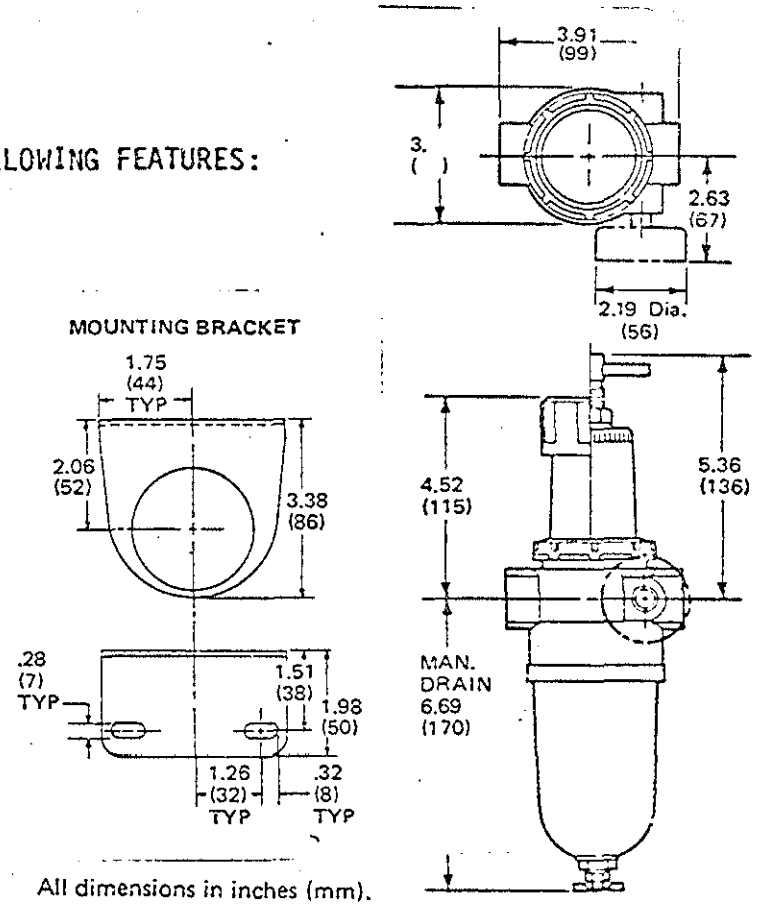
1. 1/4" NPT
2. 1-50 PSI REGULATED PRESSURE RANGE
3. WITH METAL FILTER BOWL
4. RELIEVING TYPE
5. MANUAL DRAIN
6. 5 MICRON FILTER ELEMENT
7. WITH MOUNTING KIT 5514-04

VENDOR's PC. NO. B12-225-MIE

VENDOR'S DWG. NO. SEE CATALOG

VENDOR: C. A. NORGEN CO.
REPR. C. A. THOMPSON CO.
7001 W. NORTH AVENUE
MILWAUKEE, WI 52313

NOTE: SUBSTITUTES NOT PERMITTED



All dimensions in inches (mm).

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: FILTER-REGULATOR (AIR) 1-50 PSI

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	10471	9/23/77	ASSY. OR LO.
DR. BY	L.M<M	9/12/77	SCALE —
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 909 497 | SHEET 1 OF 1

BF3009-2

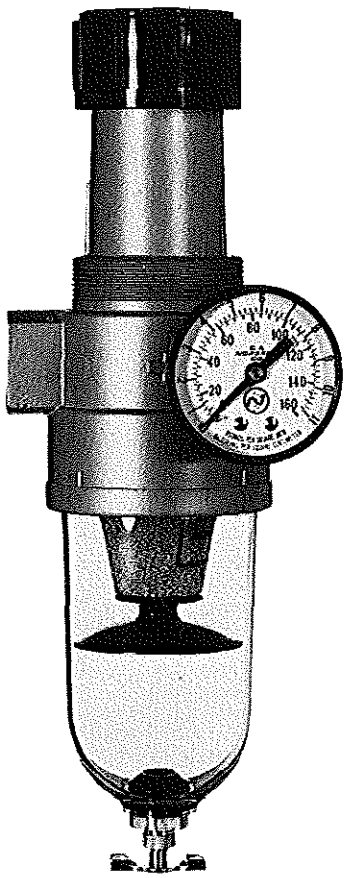
11909 497

C. L. THOMPSON CO.
PHONE 771-9020
7001 W. NORTH AVE.
Milwaukee, Wisconsin 53213

MILWAUKEE STOCK

50.5
NC-408
February, 1977
Supersedes May, 1976

TYPE B12 (KNOB ADJUSTMENT)
TYPE A12 (T-HANDLE ADJUSTMENT)



DESIGNER SERIES 1/2" BASIC FILTER/REGULATOR

FOR COMPRESSED AIR SYSTEMS

1/4", 3/8", 1/2", & 3/4" PIPE SIZES

AUTOMATIC OR MANUAL DRAIN

FEATURES

- Combines all features of separate filter and regulator in one.
- Removes liquid and solid contaminants to protect air tools and other equipment.
- B12 (standard) has nonrising adjusting knob with integral locking device which can be made tamper resistant with addition of optional seal wire. A12 has T-handle adjustment with locknut.
- Balanced valve design minimizes the effect of variations in primary pressure on secondary pressure.
- Excellent flow, regulation and response time.
- Relieving model permits secondary pressure reductions under dead-end conditions and also reduces excessive pressure build-up.
- Easily disassembled without removal from the air line when servicing is required.
- Attractive, lightweight, modern-design styling.

CAUTION

THIS FILTER/REGULATOR IS FOR COMPRESSED AIR SERVICE ONLY AND MUST NOT BE USED WHERE PRESSURE OR TEMPERATURE MAY EXCEED RATED OPERATING CONDITIONS. SEE SPECIFICATIONS.

THE POLYCARBONATE PLASTIC BOWL USED ON THIS DEVICE CAN BE DAMAGED AND POSSIBLY FAIL IF EXPOSED TO SUCH SUBSTANCES AS CERTAIN SOLVENTS, STRONG ALKALIES, COMPRESSOR OILS CONTAINING AROMATIC HYDROCARBONS, OR FIRE RETARDANT OILS. FUMES OF THESE SUBSTANCES IN CONTACT WITH THE POLYCARBONATE BOWL, EXTERNALLY OR INTERNALLY, CAN ALSO RESULT IN DAMAGE. CLEAN WITH WARM WATER.

SPECIFICATIONS

PORT THREADS: PTF (STD), ISO (OPT)
FILTER ELEMENTS (SINTERED BRONZE):
50-MICRON (STANDARD)
5- & 25-MICRON (OPTIONAL)
BOWL DRAINS:
MANUAL OR AUTOMATIC
MAXIMUM RATED OPERATING CONDITIONS:

POLYCARBONATE BOWL	METAL BOWL
150 psig (10.3 bar)	250 psig (17.2 bar)
125°F (52°C)	175°F (79°C)

REGULATOR:
RELIEVING (STD), NONRELIEVING (OPT)
GAUGE PORTS: TWO 1/4" PTF FULL FLOW (STD), ISO (OPT)
SECONDARY (REGULATED) PRESSURE RANGES*:
5 TO 125 psig (.3 TO 8.6 bar) (STANDARD)
5 TO 50 psig (.3 TO 3.5 bar) (OPTIONAL)
15 TO 250 psig (1.0 TO 17.2 bar) (OPTIONAL)

*Secondary pressure adjustment ranges are not minimum or maximum secondary pressure limits. Regulators can be adjusted to zero psig secondary pressure and, generally, to pressures in excess of those specified. The use of these regulators to control pressures outside of the specified ranges is not recommended.

APPLICATION

This space-saving Filter/Regulator is designed for general application in compressed air service where effective filtration and reliable, accurate pressure regulation with large flow capacity is required. Gauge ports are full flow and can be used as auxiliary outlet ports.

NORGREN
LITTLETON, COLORADO

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ORDER TABLE

Standard models normally available from distributor stock.

TRANSPARENT BOWL, 50-MIC. ELEMENT, KNOB ADJUSTMENT, RELIEVING TYPE, 5 TO 125 PSIG ADJUSTMENT RANGE & GAUGE STANDARD			
PIPE SIZE	DRAIN TYPE	W/BOWL GUARD	W/O BOWL GUARD
1/4"	Automatic Manual	B12-218-A3LA B12-218-M3LA	B12-221-A3LA B12-221-M3LA
3/8"	Automatic Manual	B12-318-A3LA B12-318-M3LA	B12-321-A3LA B12-321-M3LA
1/2"	Automatic Manual	B12-418-A3LA B12-418-M3LA	B12-421-A3LA B12-421-M3LA
3/4"	Automatic Manual	B12-618-A3LA B12-618-M3LA	B12-621-A3LA B12-621-M3LA

Use metal bowl in applications in which the filter/regulator might be exposed to substances which are incompatible with polycarbonate. See CAUTION note.

OPTIONS:

To order with bowl guard, without gauge, or with metal bowl, substitute the number group from the table below for the desired configuration in the 5th and 6th positions (B12-3__-A3LA) of the order number.

BOWL	RELIEF TYPE	5th & 6th POSITIONS	
		W/Gauge	W/O Gauge
Transparent w/Guard	Relieving	STD	17
Transparent w/o Guard	Relieving	STD	00
Metal	Relieving	25	24

For T-handle adjustment, substitute 'A12' for 'B12' in the order number.

For optional element rating, substitute the number for the desired rating in the 8th position (B12-421-A_LA):

5-Micron – "1"
25-Micron – "2"

For optional adjustment ranges, substitute the letter for the desired range in the 9th position (B12-618-A3_A):

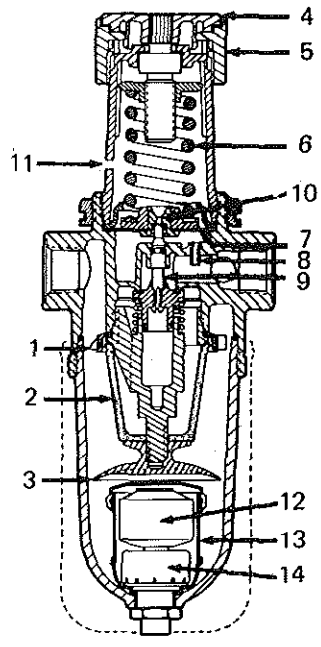
5 to 50 psig – "E"
15 to 250 psig – "S"

ACCESSORIES

Specify in addition to filter/regulator model number.

Bowl guard (Includes retaining spring) 5270-50
Wall mounting bracket (Includes mounting nut) 5514-04
Mounting nut 5226-89
Tamper resistant seal wire (Knob type adjustment) 2117-01
Gauges – Black metal case, plastic crystal, 1/4" PTF center-back connection, dual psi and bar scales –
0– 60 psi 18-013-208
0–160 psi 18-013-209
0–300 psi 18-013-210

OPERATION



Air entering the filter is guided into a swirling pattern by special design louvers (1). Airborne liquid and coarse particles are thrown against the bowl wall by centrifugal force and run down to the bottom of the bowl. Baffle (3) creates a 'quiet zone' at the bottom of the bowl and prevents air turbulence from re-entraining separated liquid into the outgoing air stream. Air leaving the bowl passes through filter element (2) where finer solid particles are removed and retained. Clean air flows from the filter element directly to regulator valve (9). Desired secondary pressure is adjusted by the nonrising adjusting knob (4) or T-handle.

The filter may have either a manual or automatic drain. The manual drain is a simple petcock at the bottom of the bowl. Manual drain models must be drained periodically. If liquid level in bowl is allowed to rise above the baffle, liquid will be carried downstream. The automatic drain (items 12, 13, 14) automatically dumps liquid as it collects. An accumulation of liquid in the bottom of the bowl causes float (12) to rise. This action admits bowl pressure into drain mechanism (14), opening a bleed valve and allowing the liquid to be expelled under pressure. Filter screen (13) protects the drain mechanism from large particles that will not pass through the drain. The automatic drain is normally open during shutdown periods so that any liquid in the bowl or which may later collect drains by gravity and does not overfill the bowl. At startup, the automatic drain will close when bowl pressure reaches approximately 5 psig. Minimum operating pressure is 10 psig.

The working parts of the regulator section are diaphragm (7), regulating spring (6), valve (9) and adjusting knob (4) or T-handle. The lower side of the diaphragm is referenced to the outlet (secondary) side of the regulator through aspirator tube (8).

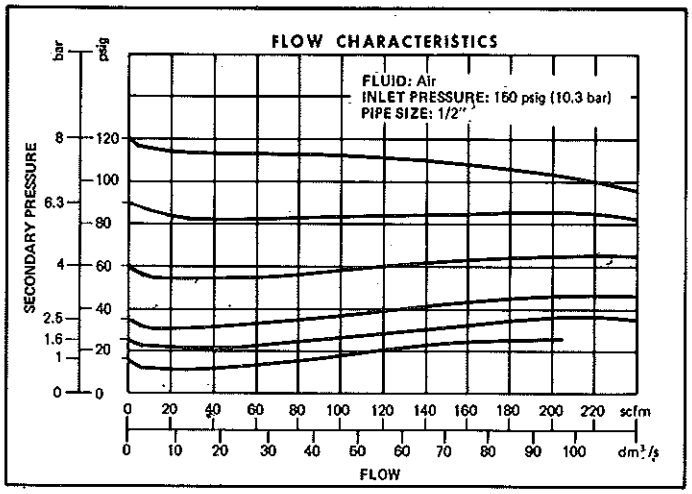
With the adjustment turned counterclockwise until no load is applied to the regulating spring, the valve is closed. When the adjustment is turned clockwise, a force is applied to the regulating spring which causes the diaphragm to move downward and open the valve. The increase in secondary (regulated) pressure, acting against the lower (pressure) side of the diaphragm, creates a force tending to move the diaphragm upward, compressing the regulating spring. This upward movement will continue until the force exerted by the pressure on the lower side of the diaphragm balances the spring force exerted on the upper side. If there is no downstream flow demand, this balance of forces will occur with the valve closed. If there is a flow demand, the balance of forces will occur with the valve open just the amount necessary to compensate for the demand, thus maintaining the desired pressure.

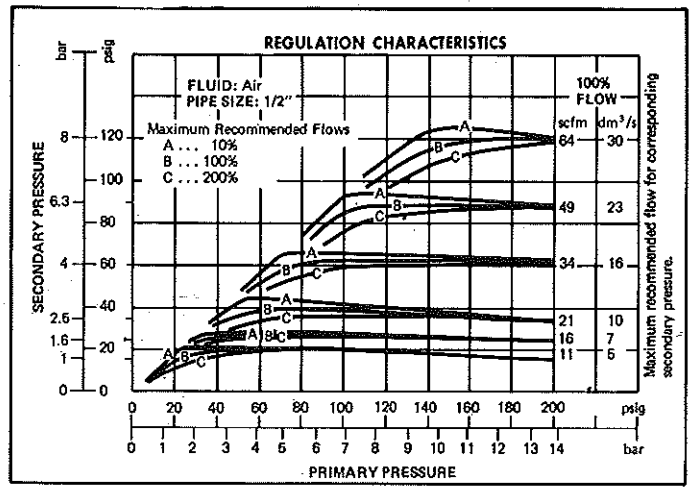
The regulator shown is a relieving type and should a secondary overpressure occur, the diaphragm will move further upward and open relief passage (10) in the diaphragm. This allows secondary air to escape into the regulator bonnet and thence to atmosphere through vent (11). As the overpressure condition is relieved, the diaphragm will move downward and close the relief passage. Nonrelieving models do not have a relief passage in the diaphragm but are otherwise identical to the relieving models. Since nonrelieving models will trap any overpressure on the downstream side, some other means of relieving overpressure must be provided.

Turn the adjustment (knob or T-handle) clockwise to increase secondary pressure, counterclockwise to lower the pressure. After the desired secondary pressure setting is made on B12 filter/regulators, push the outer ring (5) on the adjusting knob downward to lock the setting. To release, pull the ring upward. The setting can be made tamper resistant by installing a seal wire (see Accessories) in groove between lockring and top of knob.

With A12 filter/regulators, tighten locknut on T-handle to secure setting.

PERFORMANCE CHARACTERISTICS





REPAIR KITS

Non-relieving models	5550-05
Relieving models	5550-06

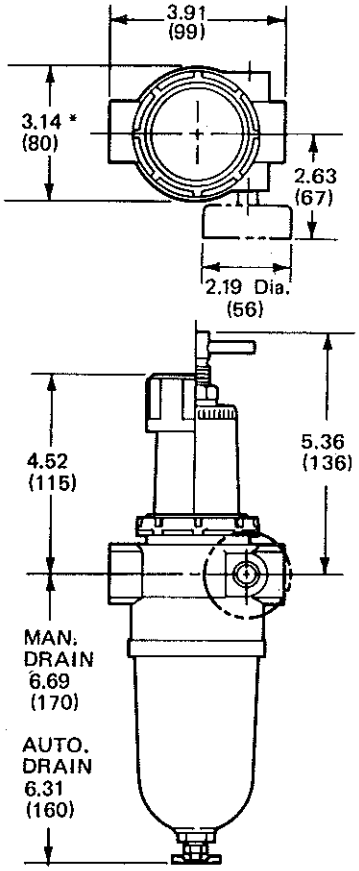
Kits contain all elastomers, diaphragm assembly, valve assembly and valve spring.

REPAIR PARTS

Regulating springs –	
5– 50 psig	5291-01
5–125 psig	5219-01
15–250 psig	5220-01
Diaphragm assemblies –	
Non-relieving	5228-57
Relieving	5228-56
Valve assembly (Includes seals)	5206-51
Filter element –	
5-Micron (Includes gasket)	2992-09
25-Micron	2992-03
50-Micron	2992-02
Bowl assembly –	
Transparent w/manual drain	5229-50
Metal w/manual drain	5403-51
Metal w/manual drain & sight glass	5403-64
Automatic drain assembly (Includes float)	3000-10
Automatic drain float	3003-52
Bowl guard retaining spring	5177-02

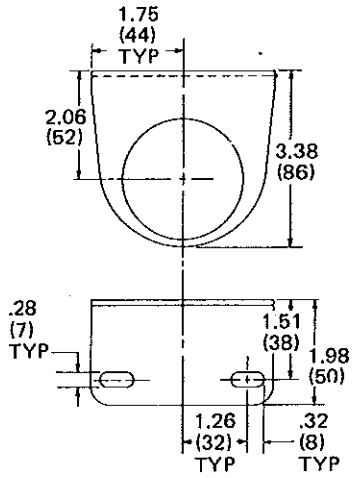
DIMENSIONS

All dimensions in inches (mm).



*Maximum OD w/bowl guard, 3.01 (76) w/o guard.

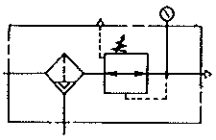
MOUNTING BRACKET



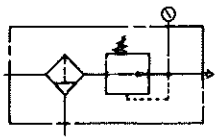
MATERIALS OF CONSTRUCTION

Body & Bonnet	Diecast Aluminum
Bowl	
Transparent	Polycarbonate
Metal	Diecast Aluminum
Valve Assembly	Brass & Acetal Resin
Element	Sintered Bronze
Elastomers	Neoprene & Buna-N

GRAPHIC SYMBOLS



Relieving model with automatic drain.



Non-relieving model with manual drain.

C. A. NORGREN CO.
LITTLETON, COLORADO 80120 / 303-794-2611

Printed in U.S.A.

11909437

INSTALLATION AND MAINTENANCE OF ARMSTRONG BALL FLOAT DRAINERS

INSTALLATION PROCEDURES

Pipe Fitting. Clean pipes carefully after cutting and threading before hooking up drainers. Before connecting drainers to system blow-down at full pressure to clear the pipes of dirt, pipe cuttings and other foreign objects.

Strainers are necessary if there is a chance that scale and sediment can be carried to the drainer.

Blow-Down Valve, as shown in Figs. 1 and 2 may also prove useful.

Shut-off Valves & Unions should be provided so the drainer can be examined and/or serviced without shutting down the unit drained by the drainer.

Operation. Maximum operating pressure is stamped on the drainer. Do not exceed this pressure.

1. Drainers must be located below the drain point.
2. Back Venting usually required.
   a. Pressure vessels should be vented back to any convenient point above the liquid level.
   b. Separators and drip points should be vented to the downstream side of the unit.
   c. On very light loads, 20 lbs., per hour or less, venting is not necessary; but use at least a ¾" connection between the vessel and the drainer.

Typical installations of Liquid Drainers are shown in Figs. 1 through 3.

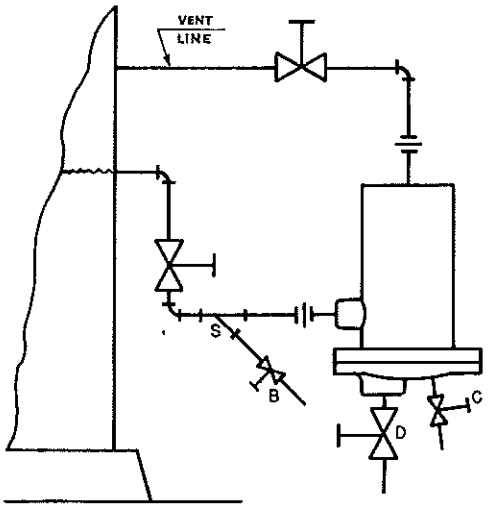


Fig. 1 — Installation of ball float drainer for medium or heavy loads. Strainer blow-down valve "B" and drainer blow-down valve "C" are optional. Discharge line valve "D" not required if drainer discharges water to ground.

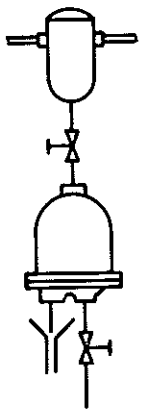


Fig. 2 — Installation of drainer when amount of liquid is small enough so liquid can flow to drainer countercurrent to gas displaced. *Note:* Drain line should be ¾" minimum and kept as short as possible. A gate valve must be used.

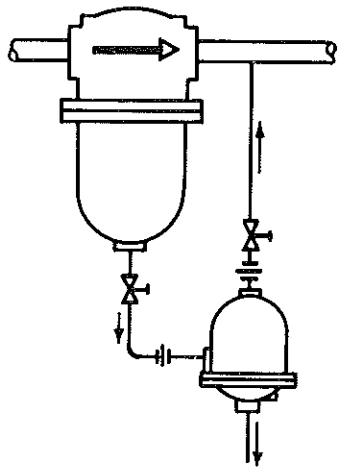


Fig. 3 — Installation of drainer for separator applications where back venting is necessary. Notice that the drainer is vented to the downstream side of the separator.

DRAINER TESTING AND TROUBLE SHOOTING

TESTING SCHEDULE:

A regular schedule should be set up for Drainer testing and preventative maintenance. Drainer size and operating pressure determine how frequently drainers should be checked. Drainers on normal industrial applications should be checked as follows:

High Pressure Drainers — 250 lbs. and up. Check anywhere from daily to weekly.

Medium Pressure Drainers — 60 to 250 lbs. Test weekly to monthly.

Low Pressure Drainers — 1 to 60 lbs. Test monthly to annually. Large 1¼" to 2" drainers on high capacity jobs can be tested more frequently to good advantage.

Drainers on gas and other critical applications should be checked at the same time valves and other line equipment are inspected. Your own experience will determine the required testing schedule.

TROUBLE SHOOTING:

A. Drainer Does Not Discharge.

1. Insufficient liquid coming to drainer to permit discharge. Continue operation.
2. Drainer filled with dirt or sludge. Remove drainer cap and mechanism, clean thoroughly. Install strainer on inlet side of drainer.
3. Differential pressure across drainer too high. Check inlet and outlet pressure. If the difference exceeds the maximum pressure stamped on the drainer, the drainer will remain closed. Reduce differential pressure if possible, or install properly sized valve and valve seat in drainer.
4. Worn valve seat. As the seat becomes worn, the seating area enlarges, lowering the drainer's maximum operating pressure. Replace with new valve and seat.
5. Inlet or outlet line valves closed. Open valves.
6. Strainer clogged. Clean strainer screen.
7. Float defective or collapsed. Replace float.

B. Drainer Discharges Continuously.

1. If drainer discharges full stream of liquid continuously and vessel fills full of liquid —
   a. Drainer too small for job. Replace with correct size.
   b. Abnormal amounts of liquid coming to drainers. Remedy cause or replace with drainer that has a larger capacity and will handle peak loads.

C. Drainer Blows Through

1. Dirt or scale on valve or seat. Remove cap, clean drainer, as well as valve and seat.
2. Worn valve, or seat that is wire-drawn. Remove cap, replacing valve and seat.

In the event of any unusual maintenance or operational difficulty, consult your Armstrong Representative, or the Armstrong Machine Works. Engineering Department.

ARMSTRONG MACHINE WORKS - - Three Rivers, Michigan

Form IB40

Printed in U.S.A.

11909437

Dimensions & Data cert.fied correct for:

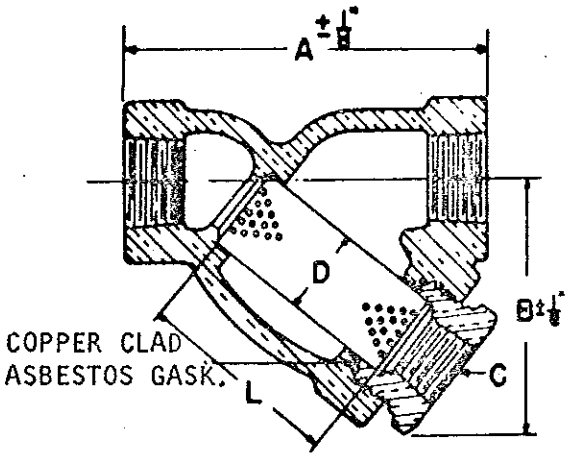
Customer _____ Order _____

Job _____

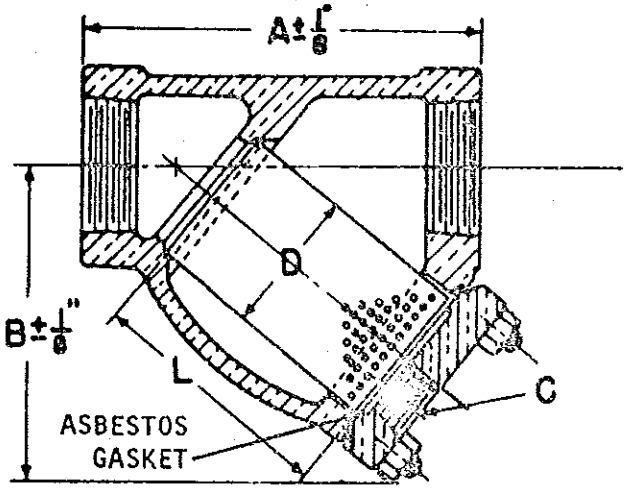
Job Requ rements:

ARMSTRONG MACHINE WORKS

By



1/2" - 2" size with screwed retainer



2-1/2" - 3" size with bolted retainer

Size	A	B	C	D	L	Wt. Lbs.
3/8"	3-1/2	2-5/8	3/8	13/16	2-1/16	1-1/2
1/2"	3-1/2	2-5/8	3/8	13/16	2-1/16	1-1/2
3/4"	4	3	1/2	31/32	2-3/8	2
1"	4-3/4	3-7/16	1/2	1-3/16	2-15/16	3-1/2
1-1/4"	5-1/4	3-7/8	1/2	1-1/2	3-3/8	5
1-1/2"	6	4-3/8	1/2	2	3-3/4	7-1/2
2"	7	5-1/16	1/2	2-3/8	4-5/8	12
2-1/2"	8-1/2	6-1/2	3/4	3-3/16	5-7/16	31-1/2
3"	10-1/2	8-1/8	1-1/4	4-3/16	6-5/8	54

MATERIALS:
Body: ASTM B-62 Cast Bronze
Retainer: 3/8" - 1" -- ASTM B-16
1-1/4, 2-1/2, 3" -- ASTM B-62
1-1/2, 2" -- ASTM B283-66A
Gasket: 3/8" - 2" -- Copper Clad Asbestos
2-1/2 - 3" -- Asbestos
Screen: Brass with 233 - .045" perf. per sq. in.
On 2-1/2" - 3"
Stud: ASTM A-193, Gr. B-7
Nut: ASTM A-194, Gr. 2-H

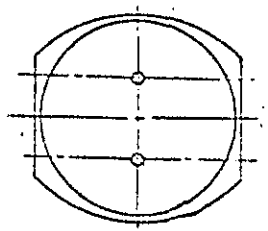
PRESSURE-TEMPERATURE RATING: (non-shock)
300 psi at 422°F
500 psi at 150°F

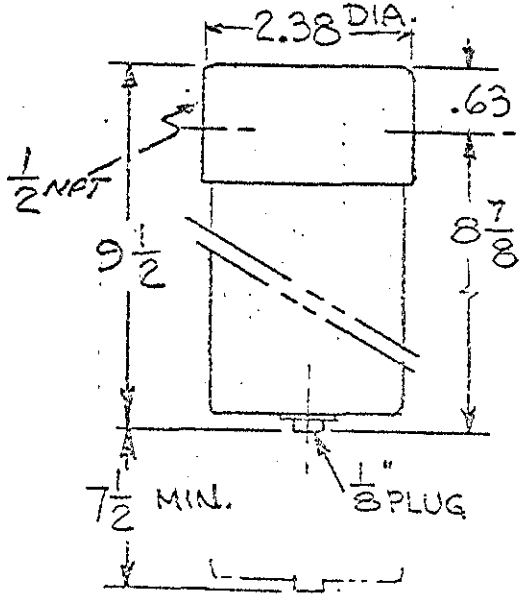
STRAINER CODE: F4SC

ARMSTRONG MACHINE WORKS	
3/8" - 3" Cast Bronze Str. Screwed Conn.	SM-630-A 9/9/75

11909674

DESCRIPTION: 1/2" NPT
BALSTON TYPE 36/25 FILTER WITH 100-25-DX
FILTER TUBE AND METAL BOWL (STAINLESS STEEL)
FOR 275 PSI AIR SERVICE





VENDOR: BALSTON, INC.
LEXINGTON, MA.

REPR. GUY SPEAKER CO.
MILWAUKEE, WI

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
FILTER, AIR START
CONTROL AIR
1/2 "

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

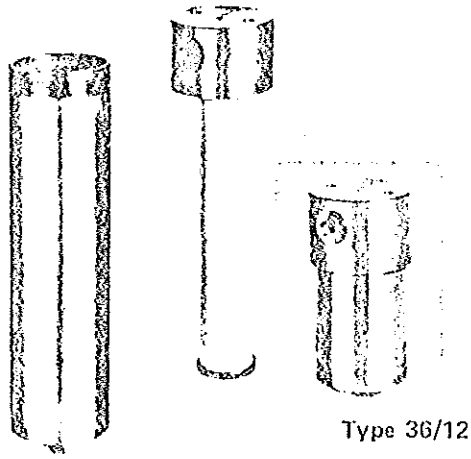
Colt Industries — Fairbanks Morse Engine Division

REL. NO. 106443	1/20/78	ASSY. OR LO.	
DR. BY L.McM	1/11/78	SCALE	—
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MATL.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11909674 | SHEET 1 OF 2

11909674

Type 36/12, 36/25



Type 36/12

Type 36/25

PRINCIPAL SPECIFICATIONS

Port Size: ½" NPT; Drain: ⅛" NPT

	Type 36/12	Type 36/25
Dimensions:		
Diameter	2⅜"	2⅜"
Height	5"	9½"
Filter Tube:		
Size	1" x 2½"	1" x 7"
Designation	100-12	100-25
Max. Flow Rates:		
Air at 100 psig, 2 psi drop, Grade D	85 SCFM	120 SCFM
Water at 5 psi drop, Grade D	150 gal. per hr.	300 gal. per hr.

Max. Pressure: 1000 psig

Max. Temperature: 400 F

Materials of Construction: Head and tie rod – 303 SS; Body – 321 SS; O-Ring – Viton A (Standard)

Optional Mounting Bracket: Order # 11038

Optional Automatic Drains: Refer to "Guide to Cleaning Compressed Air and Other Gases"

Optional Support Core: (Recommended for outside-in gas filtration and for liquid filtration)

Type 36/12 – SS-100-12; Type 36/25 – SS-100-25

DESIGN FEATURES

Rated for operating pressures to 1000 psig, the Type 36 filters are suitable for high pressure liquid and gas filtrations requiring stainless steel construction. The one-piece stainless steel bowl is secured to the head by hand tightening. Since the Microfibre Filter Tube is sealed in the housing without the use of gaskets, the only resilient seal in the system is a protected Viton O-ring in the head. The filter tube may be replaced without breaking the pipe connections.

APPLICATIONS

- Filtration of cylinder gas and other high pressure gases
- Sterilization of air and other gases
- High pressure liquid filtrations

Installation and Maintenance Instructions for Single Cartridge Compressed Air and Gas Filters

(Please refer to Bulletin A-1 for Guide to Air & Gas Filtration)

• Direction of Flow Through Filter Housing

In general, a compressed air or gas filter should be installed for inside-to-outside flow through the filter tube. Coalesced liquid will drip from the outside of the filter tube to the housing drain (see diagram). The exception to the general rule of inside-to-outside flow is the final filter following a desiccant dryer. In this case, since the gas is expected to be dry and there is a possibility of a significant quantity of solids carryover, flow should be outside-to-inside to take advantage of the larger solids holding volume outside the filter tubes. Internal support cores should be used when flow is outside-to-inside.

• Multiple Stage Filtration

When a filter as fine as Grade BX is required to obtain the desired air or gas cleanliness, a prefilter may be needed to ensure adequate life of the final filter. Grade DX should always be used for the prefilter. Flow direction through the prefilter should be inside-to-outside. Most of the liquid in the inlet gas will be removed by the prefilter, and adequate provisions should be made to drain it. If the gas is wet, a float drain is usually a good choice for the prefilter. Since the final filter will remove a smaller quantity of liquid, a constant-bleed or impulse drain should be satisfactory at that location (see diagram).

• Life of Filter Tubes

Since liquid drains continuously from a Microfibre Filter Tube, the life of a filter tube is dependent only upon the solids content in the gas. However, condensed water usually carries with it a considerable quantity of pipe scale and other dirt, so the life of a filter tube may be relatively short in a wet air or gas system. Expected life for a prefilter or an only filter is 1000 to 1500 hours. Life of a final filter protected by a Grade DX prefilter should be about 1500 hours.

There is no visual method for determining when a Microfibre Filter Tube should be changed. The only proper method is to observe the pressure drop across the tube. The tube should be changed when this pressure drop exceeds approximately three times the initial pressure drop. For example, if the initial pressure drop is 2 psi, the filter tube should be changed when the pressure drop exceeds 6 psi. In contrast to an adsorbent-type filter, a Microfibre Filter will continue to operate at its initial efficiency as long as it is in the line. Therefore, there is no danger in leaving a Microfibre Filter Tube in service with greater than the recommended pressure drop, so long as the burst strength of the tube is not exceeded. Since burst strength of any diameter Grade BX tube exceeds 100 psi, pressure gauges upstream and downstream of the filter will give adequate indication that a tube should be changed long before there is any danger of tube failure.

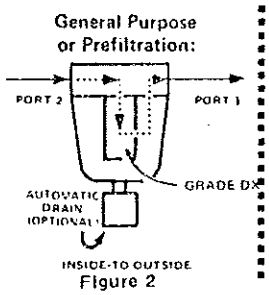


Figure 2

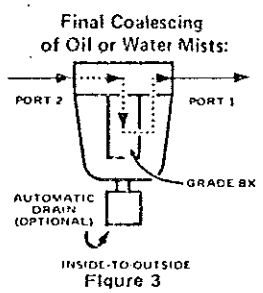


Figure 3

Recommended System for 99.95% Particle and Mist Removal from Compressed Air:

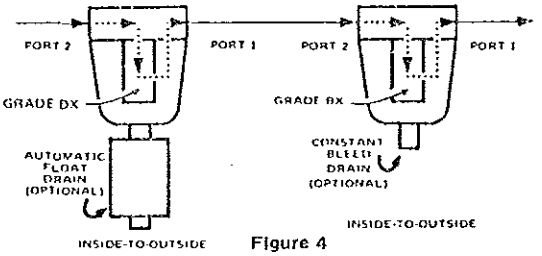


Figure 4

• Location of Filters in the System

A final filter protecting a sensitive end use point should be located as close to the end use point as possible, to minimize contamination by pickup of pipe scale or by further condensation downstream of the filter. However, a filter should always be located on the high pressure side of a pressure regulator, to protect the regulator and to ensure the greatest quantity of liquid removal. In a large air or gas distribution system, it is good practice to install one large filter with Grade DX filter tubes on the main supply line and smaller filters with Grade BX filter tubes on critical branch lines, such as instrument air lines and air lines to paint spray areas. The large central filter in a plant compressed air system should be installed downstream of the after cooler and receiver.

When water or other volatile condensed liquids are present, it is desirable to filter at least once at the highest pressure point in the system, because removal of the condensed liquid at this point will result in a lower dew point when the pressure is reduced and therefore minimize the possibility of further condensation even if the gas is subsequently cooled. Filtering at the highest pressure point is also desirable because a smaller filter housing is required for a given flow rate. As shown by the flow chart in Table IV*, the higher the line pressure, the higher the flow capacity of a given filter.

*See Specifications Sheet #1, Bulletin A-1

TABLE II-A4
Specifications of Balston Liquid Filters
Listed in order of increasing capacity

FILTER TYPE	PORT SIZE	FLOW WITH 0" FILTER TUBE, 5 PSI DROP, GAL PER HR.	DIMENSIONS (inches) Dia.	Ht.	FILTER TUBES No.	Dimen.	Desig.	MATERIALS OF CONSTRUCTION (see right for explanation of abbreviations) Head	Bowl	Internals	Seals	OPERATING CONDITIONS Max. Press. (psig)	Max. Temp. (°F)	SUPPORT CORE, REQUIRED (1)	MAX. PRESSURE DIFFERENTIAL ACROSS FILTER ELEMENT (PSI) Outside-in flow, with support core	Outside-in flow, without support core	Inside-out flow	DRAIN OR VENT	FILTER TYPE
95A	1/8" NPT	84	1¾	3½	1	½ x 2¼	050-11	A. Alum.	A. Alum.	304SS	Viton	3000	400	Incl.	70	(3)	60	1/8" NPT	95A
95P	¼" TUBE	22	1⅝	3½	1	½ x 2¼	050-11	Polypro.	Polypro.	None	Viton	100	220	(2)	(2)	20	60	1/4" TUBE	95P
95S	1/8" NPT	84	1¾	3½	1	½ x 2¼	050-11	303SS	304SS	304SS	Viton	5000	400	Incl.	70	(3)	60	1/8" NPT	95S
95T	1/8" NPT	84	1¾	3½	1	½ x 2¼	050-11	Teflon	Teflon	Teflon	Viton	100	300	Incl.	70	(3)	60	1/8" NPT	95T
90	¼" TUBE	46	1⅜	3¾	1	1 x 2½	100-12	Polypro.	Polypro.	None	None	Amb.	230	SS-100-12	70	10	25	None	90
92	1/2" NPT	150	2⅝	4½	1	1 x 2½	100-12	A. Alum.	Polycarb.	C.P. Steel	Buna-N	150	220	SS-100-12	70	10	25	(4)	92
92A	1/2" NPT	150	2⅝	4½	1	1 x 2½	100-12	A. Alum.	A. Alum.	C.P. Steel	Buna-N	250	400(5)	SS-100-12	70	10	25	(4)	92A
92AG	1/2" NPT	150	2⅝	4½	1	1 x 2½	100-12	A. Alum.	Pyrex	C.P. Steel	Buna-N	100	400(5)	SS-100-12	70	10	25	(4)	92AG
33	1/2" NPT	150	2⅝	4½	1	1 x 2½	100-12	304SS	304SS	304SS	Buna-N	150	400(5)	SS-100-12	70	10	25	1/8" NPT	33
33G	1/2" NPT	150	2⅝	4½	1	1 x 2½	100-12	304SS	Pyrex	304SS	Buna-N	100	400(5)	SS-100-12	70	10	25	1/8" NPT	33G
36/12	1/2" NPT	150	2⅞	5	1	1 x 2½	100-12	303SS	321SS	303SS	Viton	1000	400	SS-100-12	70	10	25	1/8" NPT	36/12
36/25	1/2" NPT	300	2⅞	9½	1	1 x 7	100-25	303SS	321SS	303SS	Viton	1000	400	SS-100-25	70	10	25	1/8" NPT	36/25
45	1/2" NPT	300	2⅞	9	1	1 x 7	100-25	304SS	304SS	304SS	Buna-N	150	400(5)	SS-100-25	70	10	25	1/8" NPT	45
45G	1/2" NPT	300	2⅞	9	1	1 x 7	100-25	304SS	Pyrex	304SS	Buna-N	100	400(5)	SS-100-25	70	10	25	1/8" NPT	45G
92/25A	1/2" NPT	300	2⅝	9	1	1 x 7	100-25	A. Alum.	A. Alum.	C.P. Steel	Buna-N	250	400(5)	SS-100-25	70	10	25	1/8" NPT	92/25A
92/25AG	1/2" NPT	300	2⅝	9	1	1 x 7	100-25	A. Alum.	Pyrex	C.P. Steel	Buna-N	100	400(5)	SS-100-25	70	10	25	1/8" NPT	92/25AG
70/35A	1" NPT	900	4	15	1	2 x 9	200-35	303SS	304SS	304SS	Buna-N	300	400(5)	SS-200-35	70	5	15	1/8" NPT	20/35A
25/35C	1" NPT	900	6⅞	15⅜	1	2 x 9	200-35	D. Iron	C	Brass	Buna-N	2000	275	10Z33	70	(3)	15	1/4" NPT	25/35C
26/35C-1000	1" NPT	900	5½	15 9/16	1	2 x 9	200-35	C	C	Brass	Buna-N	1000(6)	275	10Z33	70	(3)	15	1/4" NPT	26/35C-1000
26/35C-3000	1" NPT	900	7	16	1	2 x 9	200-35	C	C	Brass	Buna-N	3000(6)	275	10Z33	70	(3)	15	1/4" NPT	26/35C-3000
26/35C-5000	1" NPT	900	8½	16¼	1	2 x 9	200-35	C	C	Brass	Buna-N	5000(6)	275	10Z33	70	(3)	15	1/4" NPT	26/35C-5000
50	3/4" NPT	875	4⅞	12½	1	2 x 9	200-35	Acetal	Polycarb.	Polypro.(7)	Buna-N	150(7)	230	10Z33	70	(3)	15	None	50
20/80A	1" NPT	1020	4	25	1	2 x 18¾	200-80	303SS	304SS	304SS	Buna-N	300	400(6)	SS-200-80	70	5	15	1/8" NPT	20/80A
25/80C	1" NPT	1020	6⅞	26 7/16	1	2 x 18¾	200-80	D. Iron	C	Brass	Buna-N	2000	275	20Z33	70	(3)	15	1/4" NPT	25/80C

EXPLANATION OF ABBREVIATIONS:

A. Alum. – Anodized Aluminum
C – Carbon Steel
C.P. Steel – Cadmium Plated Steel
Polycarb. – Polycarbonate
303SS – 303 Stainless Steel
304SS – 304 Stainless Steel
321SS – 321 Stainless Steel
Polypro. – Polypropylene
Incl. – Included
D. Iron – Ductile Iron
Amb. – Ambient pressure

NOTES:

(1) Support core must be ordered separately unless otherwise noted
(2) Support core not available
(3) Housing cannot be used without support core
(4) Manual drain, can be replaced with 1/8" NPT plug or fitting
(5) With optional seals, maximum temperature with Buna N 250F
(6) These pressure ratings are ASME Code Stamped
(7) Liquid filtration pressure; maximum pressure for gas filtration 60 psig

11909674

EASYLINK 2940570A001 18MAY88 10:51/10:58 EST
FROM: 62428890
AUTOMATIC SWITCH CO
TO: 6083640382

ASCO - MILWAUKEE
PO BOX 17559
MILWAUKEE WI 53217
414-962-2294, 963-0808
EZLINK 62428890
FACSIMILE (414)963-0891

>>>>>>>>>> F A C S I M I L E M E S S A G E <<<<<<<<<<

PLEASE DELIVER THE FOLLOWING MESSAGE CONSISTING OF

1 PAGE (S) INCLUDING THIS PAGE

FROM: ALLEN BALES

11909677 Limerick
11909676 "
11909675 "

TO: COLT INDUSTRIES

ATTENTION: KAY MULLEN

REFERENCE YOUR REQUESTS DATED 5-4-88 AND 5-11-88 FOR VENDOR LISTING OF REPAIR PARTS FOR PART NO. 11909677 11909676 AND 11909675.

THE FACTORY HAS ADVISED DUE TO THE OLD DESIGN, PARTS ARE NO LONGER AVAILABLE.

REGARDS,

ALLEN BALES

MMMM

RECEIVED
TECHNICAL SERVICES
JUN 21 1988

Copy TO: Dan Royce & Tech Manual
FOLLOW UP None
FILE: 6-21-88

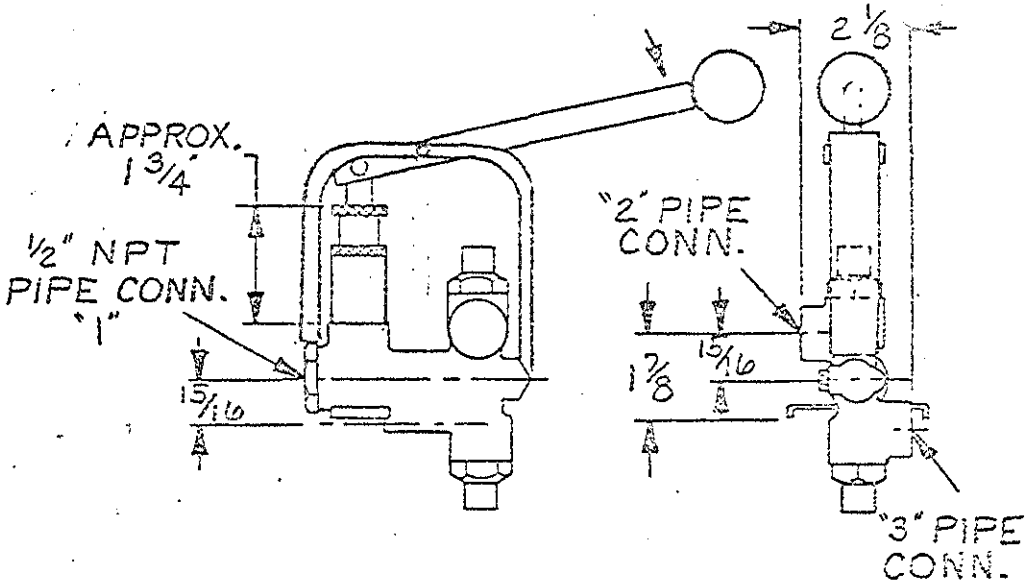
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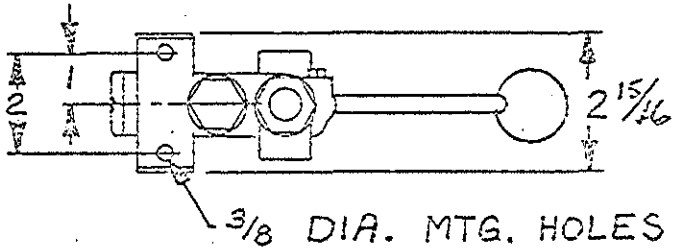
ASCO LEVER OPERATED 3-WAY AIR CONTROL VALVE WITH THE FOLLOWING FEATURES:

1. 1/2" PORTS
2. 3-WAY NORMALLY OPEN W/OPEN END EXHAUST.
3. WITH SPRING RETURNS VALVE TO POSITION. WHERE TAPPED PORTS ARE CONNECTED).
4. FOR 275 PSI AIR SERVICE, BUBBLE TIGHT SHUTOFF.
5. WITH MOUNTING FOOT.
6. TO BE STAINLESS STEEL THROUGHOUT EXCEPT HANDLE.
7. WITH RESILIENT SEAT.
8. PRESSURE AT "2" EXHAUST AT "3" CYL. AT "1".
9. 5/16 ORIFICE ① ②

VENDOR'S PART NO.: ASCO CAT. X8300A403RG

VENDOR: ASCO





See letter from Vendor

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
4	11188C	11-21 78	③ PRESS WAS "1" CYLINDER WAS "2"	J.H.
3	11135	11-3 78	① EXHAUST WAS "2" CYLINDER WAS "3"	J.H.
2	10723	3-28 78	ADDED VIEW. VENDOR PART NO., NOTES 8 & 9	NEW HRS.
1	10700	3-1 78	SEE SHEET 2	
1	"	"	NEW VENDOR REVISED & REDRAWN	

TITLE
VALVE - 3 WAY LEVER OPERATED

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN + .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- + .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY T. STEPANEK	3/15/78	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 909 675 | SHEET 1 of 2

81 3009 2

INSTALLATION AND MAINTENANCE INSTRUCTIONS

3-WAY DIRECT ACTING SOLENOID VALVES

BULLETINS
8300
8302
8315

DESCRIPTION

Bulletins 8300, 8302 and 8315, 3-way direct acting solenoid valves, have only four moving parts, a core, a lever and two poppet type valve discs. Bulletin 8315 valves are identical to Bulletin 8300 valves except for a high temperature coil and high temperature gaskets for use on steam service. Standard valves are supplied with stainless steel seats and discs. However, Bulletin Nos. 8300 and 8302 only can be supplied with resilient seats and stainless steel discs. Two types of bodies are supplied, a smaller version with 1/8", 1/4" and 3/8" N.P.T. connections (Type '37') and a larger version with 3/8" and 1/2" N.P.T. connections (Type '38') (refer to Figure No. 3). The standard valves have a General Purpose, NEMA Type 1 Solenoid Enclosure. Valves may also be equipped with an enclosure which is designed to meet NEMA Type 4 - Watertight, NEMA Type 7 (C or D) Hazardous Locations, Class I, Group C or D and NEMA Type 9 (E, F or G) Hazardous Locations, Class II, Group E, F or G.

OPERATION

Normally Closed (Suffix Letter 'F') (Refer to Figure 1)

Solenoid De-energized: Flow is from Cylinder Connection (1) to Exhaust Connection (3). Pressure Connection (2) is closed.

Solenoid Energized: Flow is from Pressure Connection (2) to Cylinder Connection (1). Exhaust Connection (3) is closed.

Normally Open (Suffix Letter 'G') (Refer to Figure 1)

Solenoid De-energized: Flow is from Pressure Connection (3) to Cylinder Connection (1). Exhaust Connection (2) is closed.

Solenoid Energized: Flow is from Cylinder Connection (1) to Exhaust Connection (2). Pressure Connection (3) is closed.

Universal (Suffix Letter 'U') (Refer to Figure 1)

Solenoid De-energized: Flow is from Connection (3) to Connection (1) or Connection (1) to Connection (3). Connection (2) is closed.

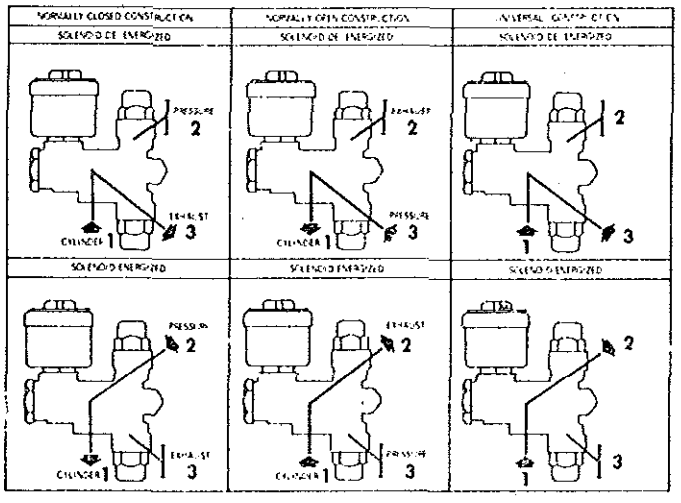
Solenoid Energized: Flow is from Connection (1) to Connection (2) or Connection (2) to Connection (1). Connection (3) is closed.

NOTE: Operation forms are identified by catalog suffix letters as follows:

Suffix Letter 'F' – Normally Closed Construction
Suffix Letter 'G' – Normally Open Construction
Suffix Letter 'U' – Universal Construction

Normally closed (F) and normally open (G) valves cannot be used for a different form unless internal parts are changed. Universal valves ('U') may be used for any form without internal changes.

IMPORTANT: No minimum operating pressure is required.



NOTE: PORT MARKINGS 1, 2, AND 3 CORRESPOND DIRECTLY TO A, B, AND C.

Figure 1.

MANUAL OPERATOR (Optional) (Refer to Figure 7)

DESCRIPTION

Valves with suffix 'MO' after catalog number are provided with a manual operator which allows operation when desired or during an interruption of electrical power.

OPERATION

To actuate valve manually, push knob upward and rotate one half (1/2) turn. Valve will now be in same position as when solenoid is energized. To disengage manual operator, rotate manual operator approximately one half (1/2) turn until guide pin in manual operator stem engages slots in stuffing box bonnet and drops down.

CAUTION: For valve to operate electrically manual operator stem must be fully retracted.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

POSITIONING

Valve must be mounted with the solenoid vertical and upright.

PIPING (Refer to Figure 1)

Connect piping to valve according to markings on the valve body and the form of flow indicated by the suffix letter ('F', 'G' or 'U') following the valve catalog number on the nameplate. Refer to flow diagram provided. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads it may enter valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening pipe, do not use valve as a lever.

IMPORTANT: For protection of the solenoid valve install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. For valves equipped with an explosion-proof, watertight enclosure (NEMA 4, 7 and 9) the electrical fittings must be approved for use in the approved hazardous locations. Housings for all solenoids are made with connections for 1/2 inch conduit. The general purpose enclosure (NEMA 1) may be rotated to facilitate wiring by removing the retaining cap. After rotating to the desired position, be certain to replace cap before operating.

NOTE: Alternating Current (A-C) and Direct Current (D-C) Solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid and not just the coil.

SOLENOID TEMPERATURE

Standard valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched by hand for only an instant. This is a safe operating temperature. Any excessive heat will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power and line pressure to valve before making repairs. It is not necessary to remove valve from pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on the media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation or excessive leakage will indicate that cleaning is required.

ASCO Valves

1971 Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. Operate the valve periodically to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

IMPROPER OPERATION

1. Faulty Control Circuit: Check the electrical system by energizing the solenoid. A metallic click signifies solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open-circuited or grounded coil, broken lead wires or splice connections.
2. Burned-Out Coil: Check for open-circuited coil. Replace coil if necessary.
3. Low Voltage: Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. Incorrect Pressure: Check pressure at the solenoid valve. Pressure to the valve must not exceed that stamped on nameplate.
5. *Incorrect Pressure Connection:* Refer to valve catalog suffix letter on nameplate and flow diagram (Figure 1).
6. Excessive Leakage: Disassemble valve and clean all parts and passageways. Leakage between the seats and discs is usually caused by lodgement of foreign material on the valve seating surfaces. The foreign material, though not present upon examination, may have damaged the seating surfaces enough to cause leakage.
   A. *Leakage thru the stainless steel (metal to metal) seats* can usually be corrected by regrinding and lapping (see section on grinding and lapping). If leakage should still exist, the seating surfaces may be worn more than grinding and/or lapping can correct. In that case, replace both seats and discs. NOTE: New seats and discs must be checked and adjusted for proper stroke where necessary. See section on seat and disc installation.
   B. *Leakage thru resilient seats can only be corrected by installing* new seat assemblies. When new seats are installed, the strokes must be rechecked and adjusted where necessary. See section on seat and disc installation.

COIL REPLACEMENT (Refer to Figure 4)

Turn off electrical power. *Disconnect coil lead wires.*

1. Remove retaining cap, retaining clip, nameplate and solenoid cover.
2. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. NOTE: Insulating washers are omitted when molded coil is used. In some D-C Constructions, a single flux plate over the coil replaces yoke, sleeves and insulating washers.
3. Reassemble in reverse order of disassembly.

CAUTION: The solenoid must be fully reassembled as the housing is part of and completes the magnetic circuit. Be careful to place insulating washers at each end of the coil if required.

VALVE DISASSEMBLY (Refer to Figure 4)

Depressurize valve and turn off electrical power.

1. Solenoid may be removed intact by loosening and removing solenoid base sub-assembly.
2. Remove end cap and end cap gasket.
3. Slip core off end of valve lever and lift out thru solenoid base sub-assembly opening.
4. Remove bonnet gasket.
5. *Unscrew disc guide caps (both ends). Remove disc guide cap gaskets* (both ends), upper and lower springs and upper and lower discs. CAUTION: Tag springs and discs. They are not interchangeable and must be returned to original locations.
6. Remove upper and lower seats using a thin wall socket wrench. CAUTION: Tag seats as they are not interchangeable and must be returned to original locations.
7. *Remove pin bearing screw and bearing gasket.*
8. Slide valve lever out thru end cap opening of valve body.
9. All parts and passageways are now accessible for cleaning and/or replacement. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.

VALVE REASSEMBLY (Refer to Figure 4)

1. Clean all parts and passageways thoroughly.
2. Reassemble valve in reverse order of disassembly. Parts must be installed in the same cavity that they were removed from. NOTE: Refer to sections on "New Seat and Disc Installation", "Grinding/Lapping Seats and Discs" and "New Spring Installation" where applicable.
3. Lubricate all rubber parts (gaskets) with Dow Corning's Valve Seal or equivalent silicone grease.

GRINDING/LAPPING SEATS AND DISCS

(Stainless Steel Construction only)

Depressurize valve.

1. Unscrew disc guide caps (both ends). Remove disc guide cap gaskets (both ends), upper and lower springs and upper and lower discs. CAUTION: Tag springs and discs. They are not interchangeable and must be returned to original locations.
2. Apply a small amount of fine grinding compound to the beveled seating surface of the disc and insert the disc in the proper valve seat (do not remove valve seat from body) (a fine grade of grinding compound grit size 900 is recommended).
3. Use a screwdriver in the slot provided in the disc and grind by rotating the disc back and forth using light pressure. After an evenly lapped surface has been obtained, repeat the grinding operation on the other disc.
4. Wipe all parts clean of grinding compound.
5. Reassemble parts in reverse order of removal replacing discs and springs in original positions. Be sure the shorter disc and weaker spring are located at the bottom (Connection '3'). If discs or springs are incorrectly reassembled the valve will not function properly. To determine which spring is the weaker, consult paragraph on New Spring Installation.

NEW SPRING INSTALLATION (Refer to Figures 2 & 3)

When it is desired to change to a different form of flow or operating conditions, new upper and lower springs corresponding to the new requirements must be installed. Also, if the springs have relaxed from repeated flexing they should be replaced.

De-pressurize valve. Remove the two disc guide caps and old springs. Install new springs in their proper location as indicated on the factory labeled tags and replace disc guide caps. The smaller diameter end of the Type '38" springs faces the discs.

NOTE: The lower spring is always the weaker of the two and should always be located at the bottom (Connection '3'). If the springs are installed in the wrong position the valve will not function properly.

A method to determine which spring is the weaker is by placing the two springs on the shaft of a screwdriver or similar tool and compressing them. The spring which compresses to the 'L' dimension (Figure 2) first is the weaker of the two springs and should be placed on the bottom.

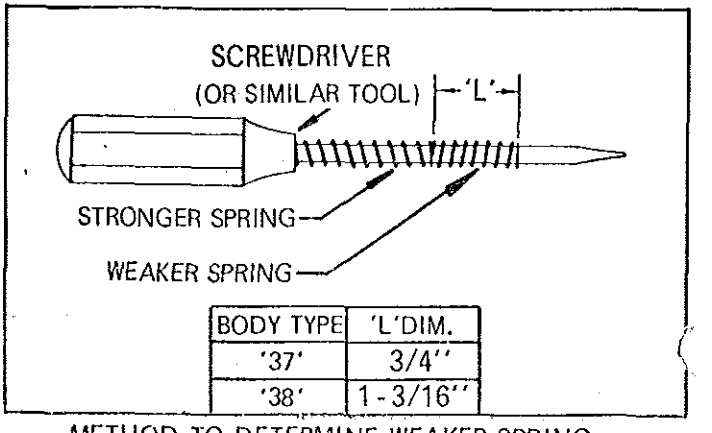
NEW SEAT AND DISC INSTALLATION

(Refer to Figures 3, 5 & 6)

Depressurize valve.

New seats and discs cannot be installed without making some minor adjustments. It is important that the stroke of the valve discs be set carefully in order to obtain proper orifice opening and reliable operation of the valve.

1. Remove the two disc guide caps, disc guide cap gaskets, upper and lower springs, upper and lower discs and upper and lower seats. Use a thin walled socket wrench to remove the seats.
2. Install new seats. A small amount of pipe compound should be used on the seat threads to avoid possible leakage.
3. With the valve in the de-energized position, install a new upper disc and using a depth gage measure the distance 'A' from the top of the valve body to the top of the upper disc as illustrated in Figure '5'.
4. Energize the solenoid or hold the valve in the energized position by lifting up the core. Do not disassemble the solenoid base sub-assembly from the valve body. Remove the end cap and lift the core thru end cap opening until it seats solidly in solenoid base sub-assembly. With the valve in the energized position measure the distance 'B' from the top of the valve body to the top of the upper disc as illustrated in Figure '5'.



BODY TYPE	'L' DIM.
'37'	3/4"
'38'	1-3/16"

METHOD TO DETERMINE WEAKER SPRING

Figure 2.

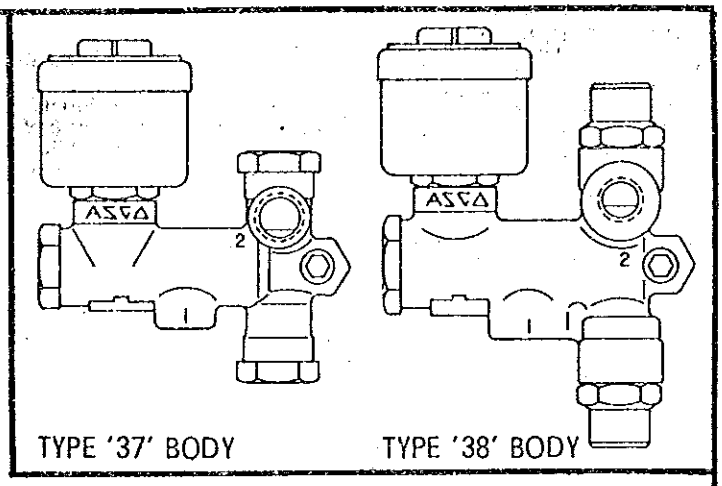


Figure 3.

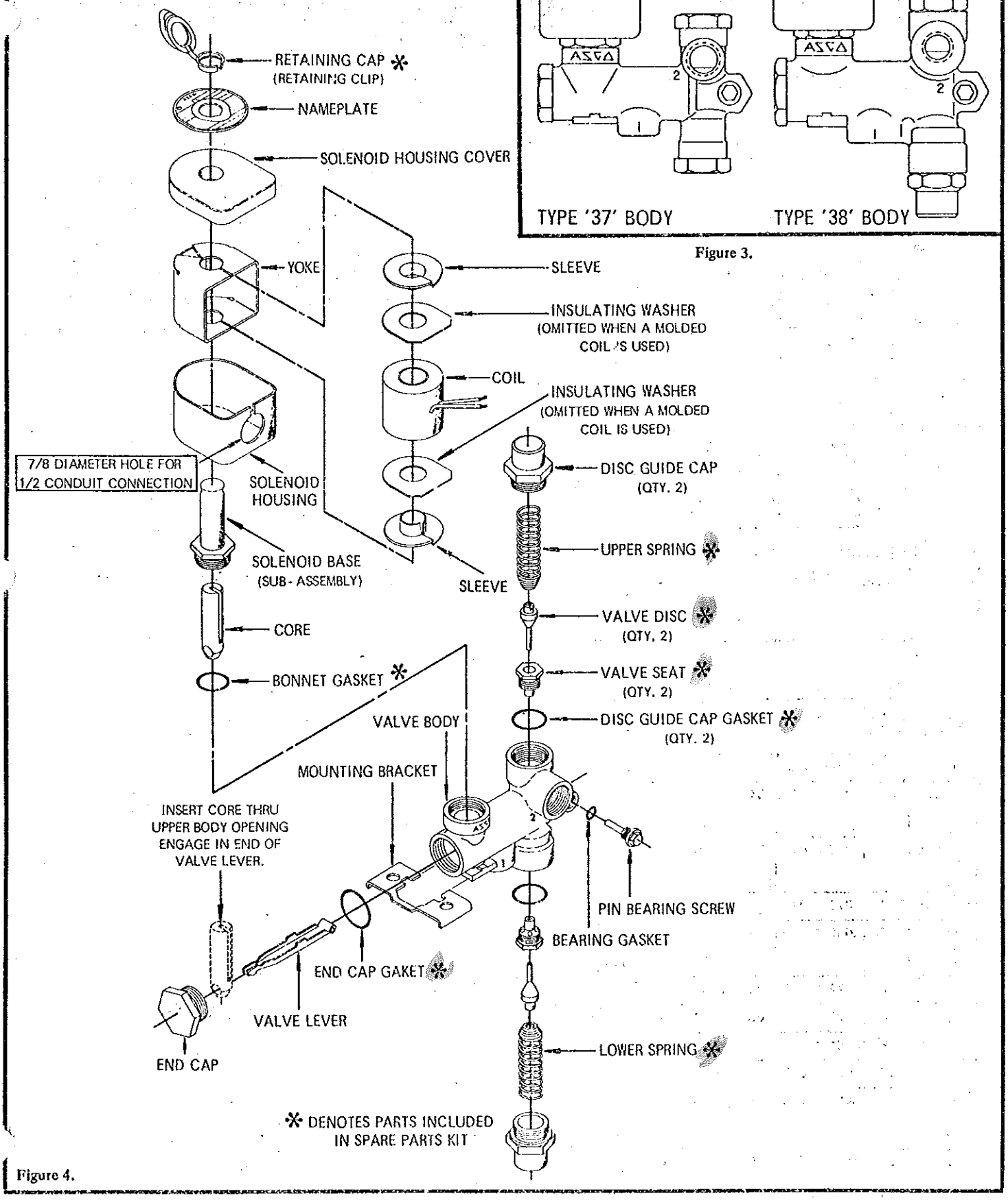


Figure 4.

5. The difference between the two distances measured 'A'–'B' is the stroke. If the stroke is more than that shown in Figure 6 (table) for the orifice size and body type, the small diameter end of the upper disc must be ground off until the proper stroke is obtained. After grinding, the end of the disc stem must be crowned slightly and polished smooth.
6. Follow the same procedure used in setting the upper disc stroke to set the lower disc stroke 'C'–'D'. Refer to Figure 5 and Figure 6 (table).
7. After setting both upper and lower strokes check for clearance between the upper disc and valve lever when the solenoid is de-energized. Also check for clearance between the lower disc and valve lever when the solenoid is energized. This clearance should be approximately 1/64 (.016) inch.
8. The discs must be ground/lapped to the seats to obtain tight seating on the stainless steel construction. (Do not grind/lap seat on resilient construction.) See section on grinding/lapping of seats and discs.
9. Reassemble parts in reverse order of disassembly. Refer to section on valve reassembly.

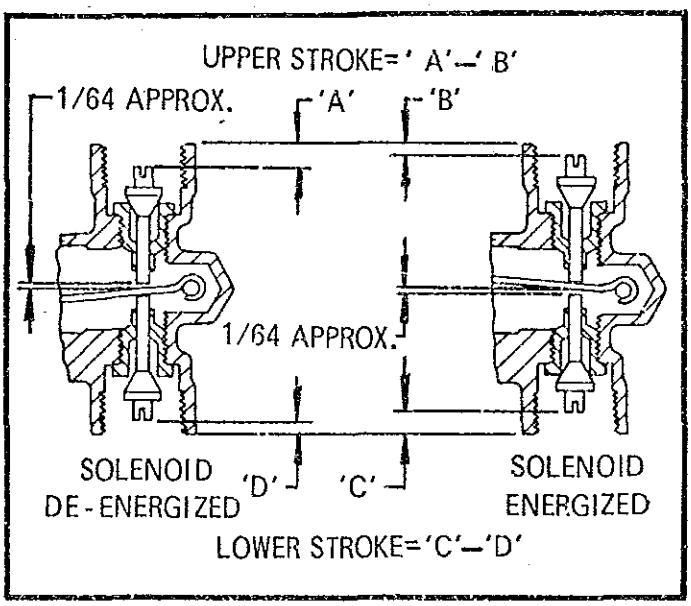


Figure 5.

Constr.	ORIFICE	TYPE BODY (Ref to Fig. 5)	A - C STROKES		D - C STROKES	
			Upper Disc	Lower Disc	Upper Disc	Lower Disc
Stainless Steel Seats	1/8	37	.062 ± .010	.047 ± .010 –.005	.047 +.010 –.005	.031 +.010 –.005
	3/16	37	.062 ± .010	.047 +.010 –.005	.047 +.010 –.005	.031 +.010 –.005
	3/16	38	.072 ± .010	.058 ± .010	.072 ± .010	.058 ± .010
	1/4	37	.062 ± .010	.047 +.010 –.005	.047 +.010 –.005	.031 +.010 –.005
	1/4	38	.072 ± .010	.058 ± .010	.072 ± .010	.058 ± .010
	5/16	38	.072 ± .010	.058 ± .010	.072 ± .010	.058 ± .010
	3/8	38	.101 ± .010	.078 ± .010	.072 ± .010	.058 ± .010
Resilient Seats	3/16	37	.062 ± .010	.047 ± .010	.047 ± .010	.031 ± .010
	1/4	37	.052 ± .010	.040 ± .005	.060 +.005 –.010	.045 +.005 –.010
	5/16	38	.072 ± .010	.058 ± .010	.072 ± .010	.058 ± .010

Figure 6.

MANUAL OPERATOR (Optional) (Refer to Figure 7)

OPERATION

To actuate valve manually, push knob upward and rotate one half (1/2) turn. Valve will now be in same position as when solenoid is energized. To disengage manual operator, rotate manual operator approximately one half (1/2) turn until guide pin in manual operator stem engages slots in stuffing box bonnet and drops down.

CAUTION: For valve to operate electrically manual operator stem must be fully retracted.

MANUAL OPERATOR DISASSEMBLY AND REASSEMBLY

(Refer to Figure 7)

1. Unscrew stuffing box bonnet from valve body. (Be certain manual operator stem is fully retracted.) Remove the manual operator intact.
2. Remove gasket from stuffing box bonnet.
3. Press or drive out knob/stem pin from operating knob and stem. CAUTION: When removing (knob/stem) pin from knob/stem sub-assembly do not let parts fly apart.
4. Remove spring and slide stem out of stuffing box bonnet. CAUTION: Before sliding stem thru stuffing box bonnet be certain there are no burrs on stem from removing knob/stem pin. Do not damage captive gasket seal ('O' ring) in stuffing box sub-assembly.
5. All parts are now accessible for cleaning and/or replacement. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.
6. Reassemble in reverse order of disassembly paying careful attention to exploded view provided.

SPARE PARTS KITS

Spare parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (*) are included in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

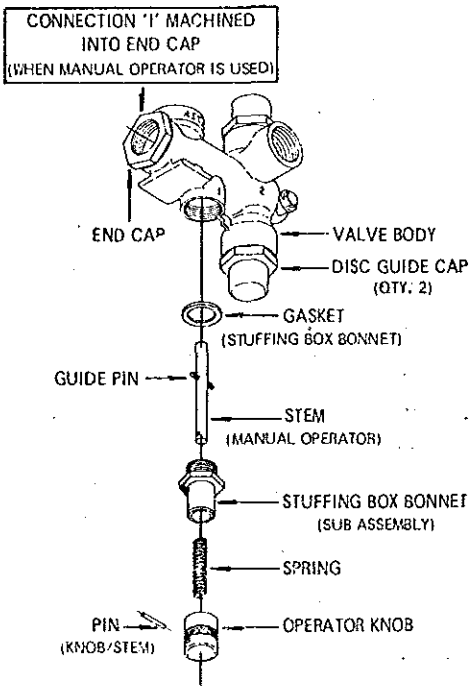


Figure 7. MANUAL OPERATOR

EASYLINK 2940570A001 18MAY88 10:51/10:58 EST
FROM: 62428890
AUTOMATIC SWITCH CO
TO: 6083640382

ASCO - MILWAUKEE
PO BOX 17559
MILWAUKEE WI 53217
414-962-2294, 963-0808
EZLINK 62428890
FACSIMILE (414)963-0891

>>>>>>>>>> F A C S I M I L E M E S S A G E <<<<<<<<<<

PLEASE DELIVER THE FOLLOWING MESSAGE CONSISTING OF

1 PAGE (S) INCLUDING THIS PAGE

FROM: ALLEN BALES

11909677 Limrick
11909676 "
11909675 "

TO: COLT INDUSTRIES

ATTENTION: KAY MULLEN

REFERENCE YOUR REQUESTS DATED 5-4-88 AND 5-11-88 FOR VENDOR LISTING OF REPAIR PARTS FOR PART NO. 11909677 11909676 AND 11909675.

THE FACTORY HAS ADVISED DUE TO THE OLD DESIGN PARTS ARE NO LONGER AVAILABLE.

REGARDS,

ALLEN BALES

MMMM

RECEIVED
TECHNICAL SERVICES
JUN 21 1988

Copy TO: Dan Royce & Tech Manual
FOLLOW UP None
FILE 6-21-88

11 909 676

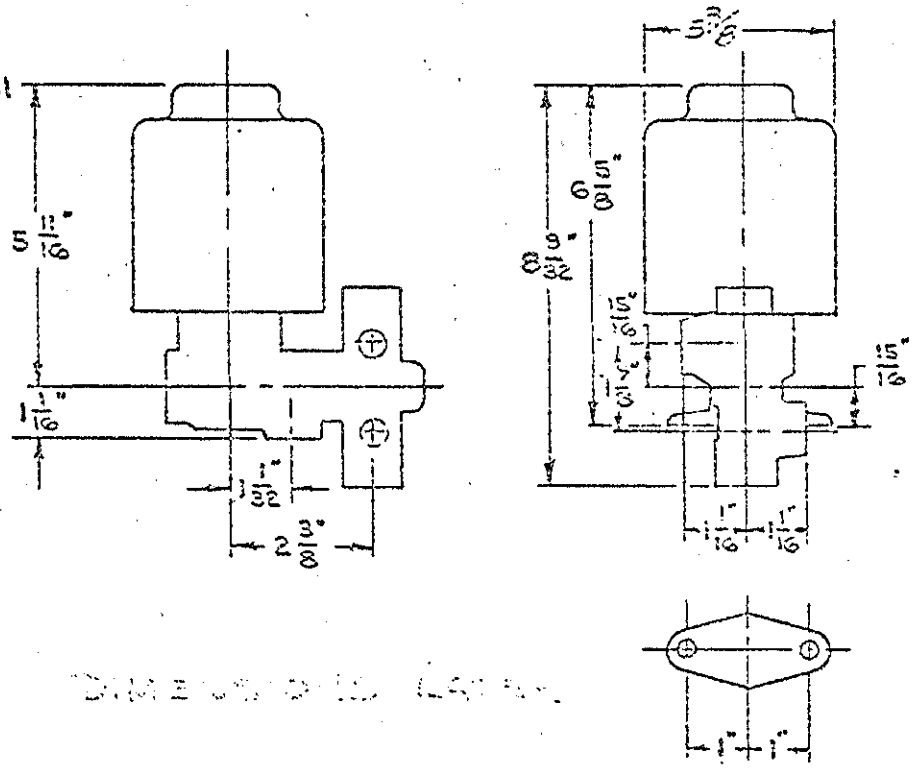
DESCRIPTION: ASCO 1/2" PIPE SIZE THREE-WAY SOLENOID VALVE WITH THE FOLLOWING FEATURES:

1. 1/2" PIPE SIZE, 3/16" ORIFICE
2. WITH CLASS "H" COIL FOR 120 VOLT DC., TPL8031
3. WITH RESILIENT SEAT (FOR TIGHT SHUT-OFF)
4. FOR 275 PSIG AIR SERVICE
5. WITH 1/2" THREADED CONDUIT CONNECTION
6. FORM G (NORMALLY OPEN)
7. ENCLOSURE, NEMA TYPE 4D
8. STAINLESS STEEL BODY

(1)

VENDOR'S PART NO: WPHTX8300A403RG

VENDOR: AUTOMATIC SWITCH COMPANY
5556 N. PORT WASHINGTON ROAD
SUITE 220
MILWAUKEE, WIS 53217



DIMENSIONAL DATA

See letter from vendor

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
A	11106	9-19-78	(1) WPHTX8300A403RG WAS WPX8300A403RG	JDS
1	10668	3-1-78	ADDED ALL DIM.S PER MAC. TYPE A	JDS

TITLE: VALVE, SOLENOID 3-WAY, 1/2"

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

SEL. NO.	10644B	1/20/78	ISSY. OR LO.
DR. BY	L. McM	1/11/78	SCALE FL
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV. CAST.			MAT'L
APPV. MACH.			FIN.
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11909676 | SHEET 1 OF 2

11909676
11909677

INSTALLATION AND MAINTENANCE INSTRUCTIONS

3-WAY PISTON OPERATED SOLENOID PILOT CONTROLLED VALVES NORMALLY CLOSED AND NORMALLY OPEN

BULLETIN 8331

ASCO

DESCRIPTION

Bulletin 8331 valves are packless, 3-way, piston operated, solenoid pilot controlled valves. Standard valves have a General Purpose, NEMA Type 1 Solenoid Enclosure. Valves may also be equipped with an enclosure which is designed to meet NEMA Type 4-Watertight, NEMA Type 7 (C or D) Hazardous Locations, Class I, Group C or D and NEMA Type 9 (E, F or G) Hazardous Locations, Class II, Group E, F or G.

OPERATION

NORMALLY CLOSED (Refer to Figure 1)

Solenoid De-energized: Flow is from Cylinder to Exhaust. Pressure connection is closed.
Solenoid Energized: Flow is from Pressure to Cylinder. Exhaust connection is closed.

NORMALLY OPEN (Refer to Figure 1)

Solenoid De-energized: Flow is from Pressure to Cylinder. Exhaust connection is closed.
Solenoid Energized: Flow is from Cylinder to Exhaust. Pressure connection is closed.

NOTE: To change from normally closed construction to normally open construction, the lower disc spring and the pilot body must be replaced. (consult factory)

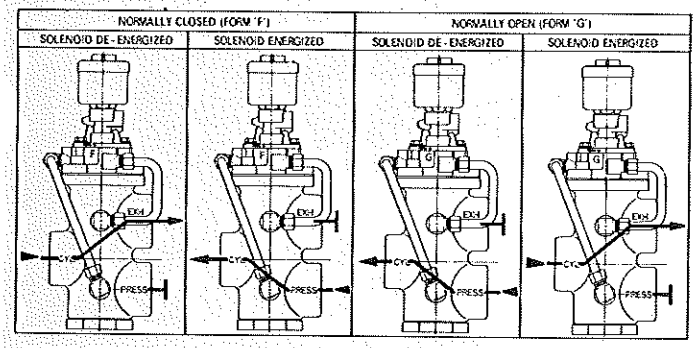


FIGURE 1

IMPORTANT: 10 to 20 P.S.I. minimum operating pressure differential is required. Check nameplate for minimum operating pressure differential on a particular valve.

MANUAL OPERATOR (OPTIONAL)

Refer to Figure 4)

DESCRIPTION

Valves with suffix "MO" after catalog number are provided with a manual operator which allows manual operation when desired or during an interruption of electrical power.

OPERATION

To actuate valve manually, turn manual operator clockwise to stop. Valve will be in same position as when solenoid is energized. For valve to operate electrically, manual operator must be turned counter-clockwise to stop.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

POSITIONING

Valve must be mounted vertical and upright with solenoid above main valve.

PIPING

Connect piping to valve according to markings on the valve body. Refer to flow diagram provided. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads it may enter valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. Pressure and exhaust lines must be full size and free from restrictions. When tightening the pipe do not use the valve as a lever.

IMPORTANT: For protection of the solenoid valve install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. For valves equipped with an explosion-proof, watertight enclosure (NEMA 4, 7 and 9), the electrical fittings must be approved for use in the approved hazardous locations. Housings for all solenoids are made with connections for 1/2 inch conduit. The general purpose enclosure (NEMA 1) may be rotated to facilitate wiring by removing the retaining cap. After rotating to desired position, be certain to replace cap before operating.

NOTE: Alternating Current (A-C) and Direct Current (D-C) Solenoids are built differently. To convert from one to the other it is necessary to change the complete solenoid, not just the coil.

SOLENOID TEMPERATURE

Standard valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched by hand for only an instant. This is a safe operating temperature. Any excessive heat will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power and line pressure to valve before making repairs. It is not necessary to remove the valve from pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on the media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation or excessive leakage will indicate that cleaning is required.

IMPROPER OPERATION

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure at the solenoid valve. Pressure to the valve must be within the range indicated on the nameplate. Flow must be adequate to maintain a minimum differential to allow valve to transfer. (See Pressure Limitation on nameplate)
5. **Excessive Leakage:** Disassemble valve and clean all parts and passageways. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.

COIL REPLACEMENT

Turn off electrical power, disconnect coil lead wires.

CAUTION: The solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Be careful to place insulating washers at each end of the coil if required.

COIL REPLACEMENT

(General Purpose - NEMA Type 1)
(Refer to Figure 3)

1. Remove retaining cap, nameplate and solenoid cover.
2. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. NOTE: Insulating washers are omitted when molded coil is used. In some D-C Constructions, a single flux plate over the coil replaces yoke, sleeves and insulating washers.
3. Reassemble in reverse order of disassembly.

COIL REPLACEMENT

(Watertight/Explosion-Proof — NEMA Type 4, 7 & 9)
(Refer to Figure 2)

1. Remove solenoid housing cover with retaining ring and nameplate attached.
2. Snap retainer from groove on core tube (solenoid base sub-assembly).
3. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly.
   NOTE: Insulating washers are omitted when a molded coil is used. The D-C Construction uses a yoke over the coil.
4. Reassemble in reverse order of disassembly.

NOTE: Installation and Maintenance of Explosion-Proof Equipment requires more than ordinary care to insure safe performance. All finished surfaces of the solenoid are constructed to provide a flame-proof seal. Be sure that surfaces are wiped clean before replacing. If Watertight, as well as Explosion-Proof is a requirement, grease the joints of the Explosion-Proof, Watertight Solenoid with Humble Oil's Nebula EP 2 grease or equivalent. A high grade silicone grease similar to Dow Corning's Valve Seal may also be used.

VALVE DISASSEMBLY (Refer to Figure 3)

Depressurize valve and turn off electrical power.

1. The solenoid may be removed intact by loosening and removing solenoid base sub-assembly. (General Purpose only)
   On Watertight and Explosion-Proof Construction, the solenoid must be disassembled (See Coil Replacement and Figure 2).
   NOTE: Use Special Wrench No. 102-649 to remove the solenoid base sub-assembly.
2. Remove core spring, core assembly and pilot body gasket respectively.
3. Remove two pilot body cap screws and lockwashers.
   IMPORTANT: Before separating pilot body from valve bonnet determine proper form, Delta Symbol 'V' will point to either 'F' (Normally Closed) or 'G' (Normally Open) on side of valve bonnet.
4. Lift off pilot body, invert and using a hooked tool (wire) inserted through center hole in bottom plug, pull bottom plug out of pilot body cavity.
5. Remove lower disc spring, lower disc assembly and bottom plug gasket.
6. Remove three gaskets between pilot body and main body.
7. Solenoid pilot is now completely disassembled and may be serviced.
8. Unscrew tubing hex nuts and remove all tubing.
9. Remove four socket head cap screws connecting valve bonnet to main valve body.
10. Remove valve bonnet and main body gasket.
11. Lift out piston and upper disc assembly.
12. Remove end cap and end cap gasket.
13. Remove lower main disc spring and lower disc holder assembly.
14. To disassemble lower disc holder assembly, unscrew disc nut and remove disc.
15. To disassemble upper disc holder assembly, remove roll pin and shaft guide. Unscrew disc nut and remove disc, snap ring, support ring and 'U' cup lip seal.
16. All parts and passageways are now accessible for cleaning and/or replacement. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.

VALVE REASSEMBLY (Refer to Figure 3)

1. Clean all parts and passageways thoroughly.
2. Reassemble parts in reverse order of disassembly. Parts should be installed in the same cavity that they were removed from. NOTE: Stake upper and lower disc nuts securely in place.
3. Delta Symbol 'V' on pilot body must point to same letter 'F' (Normally Closed) or 'G' (Normally Open) as when parts were disassembled.
4. Lubricate all rubber parts with Dow Corning's Valve Seal or equivalent silicone grease.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (*) are included in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS
When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

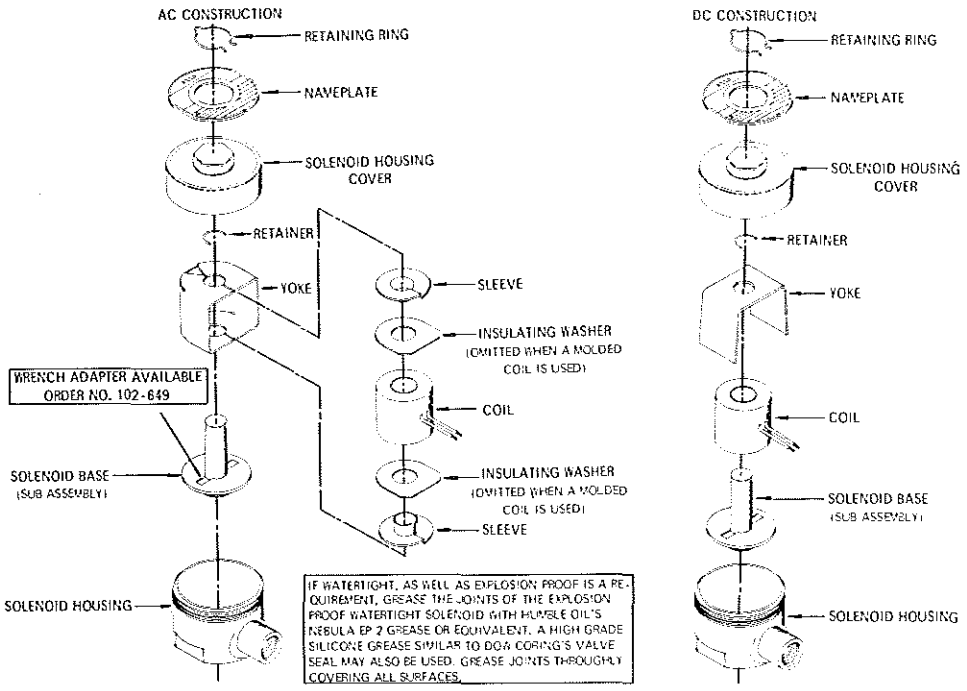


FIGURE 2

Watertight and Explosion-Proof Solenoid
NEMA Type 4, 7 & 9

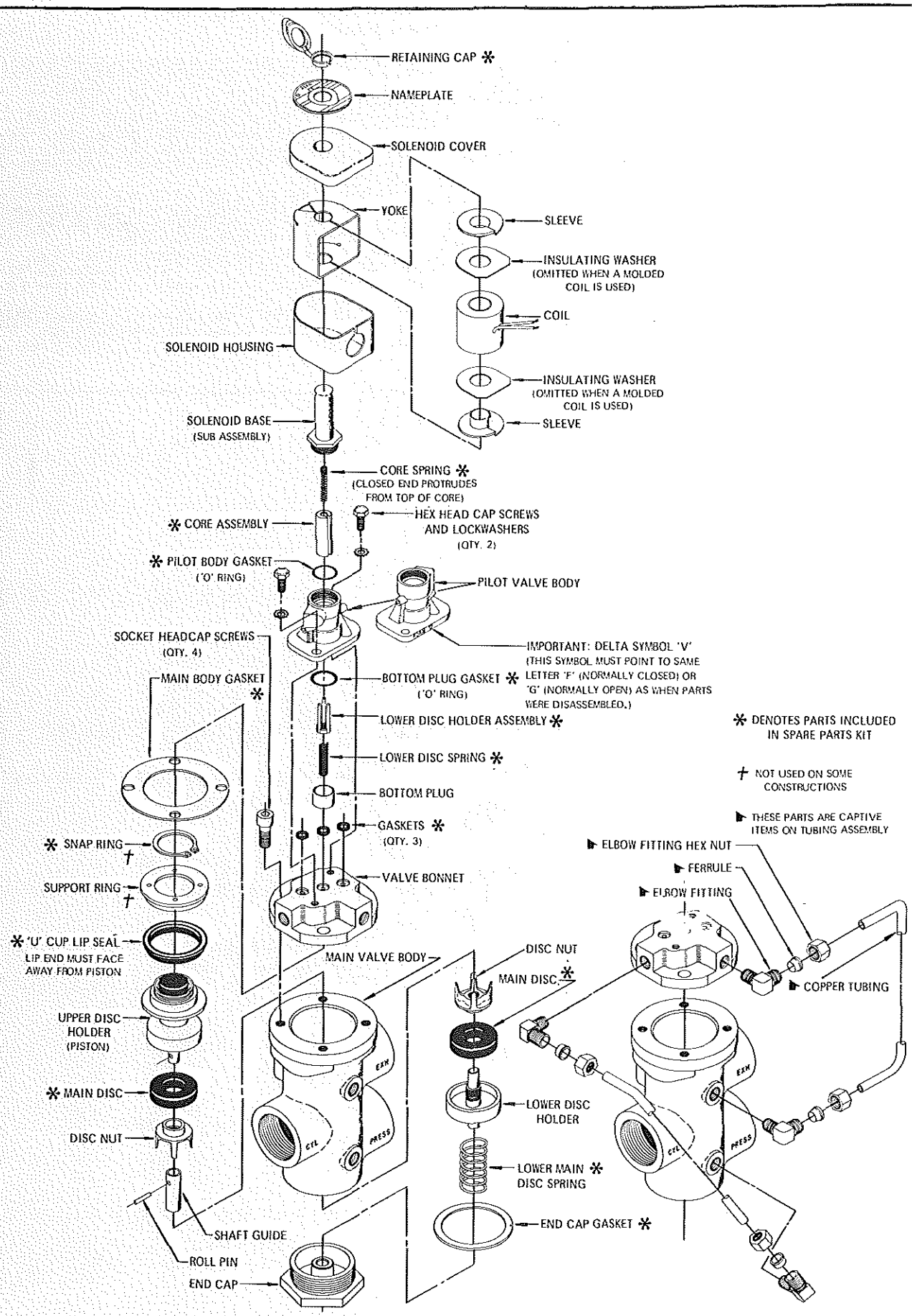


FIGURE 3

BULLETIN 8331

FORM NO. V-5094 R1 PRINTED IN U.S.A. 1971 Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932

MANUAL OPERATOR

To actuate valve manually, turn manual operator clockwise to stop. Valve will now be in same position as when solenoid is energized. For valve to operate electrically, manual operator must be turned counter-clockwise to stop.

MANUAL OPERATOR DISASSEMBLY
(Refer to Figure 4)

Depressurize valve and turn off electrical power.

1. Remove the solenoid intact by loosening and removing the solenoid base sub-assembly from the manual operator body.
2. Remove core spring, core and solenoid base to manual operator body gasket from manual operator body.
3. Unscrew manual operator body from main valve body.
4. Slip retainer from lower manual operator body threads, then slide manual operator stem/lever assembly from manual operator body.
5. Remove O-Ring from manual operator stem/lever sub-assembly.
6. All parts are now accessible for cleaning and/or replacement. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.

MANUAL OPERATOR REASSEMBLY
(Refer to Figure 4)

1. Reassemble manual operator in reverse order of disassembly. Note that the disc/disc holder sub-assembly and body gasket must be installed in the pilot body cavity before installing the manual operator body sub-assembly.
2. Pre-assemble the following manual operator body parts in th following order to make up the manual operator body sub-assembly There is a captive spacing washer on the manual operator stem/lever sub-assembly. Locate this stem/lever spacer on the outside of the retainer fork.
3. Having installed the stem gasket on the stem and correctly determined the proper location of the spacer, slip the stem assembly into the manual operator body and slide the retainer up over the lower threads engaging the stem/lever sub-assembly.
4. Screw manual operator body sub-assembly into main body.
5. Turn manual operator lever to the 9 o'clock position, i.e. this is the same position that the operator would be in if the valve was to be operated electrically.
6. Install the solenoid base to manual operator body gasket. Slide core onto the disc/disc holder sub-assembly. Install core spring.
7. Reinstall solenoid base sub-assembly complete with solenoid.

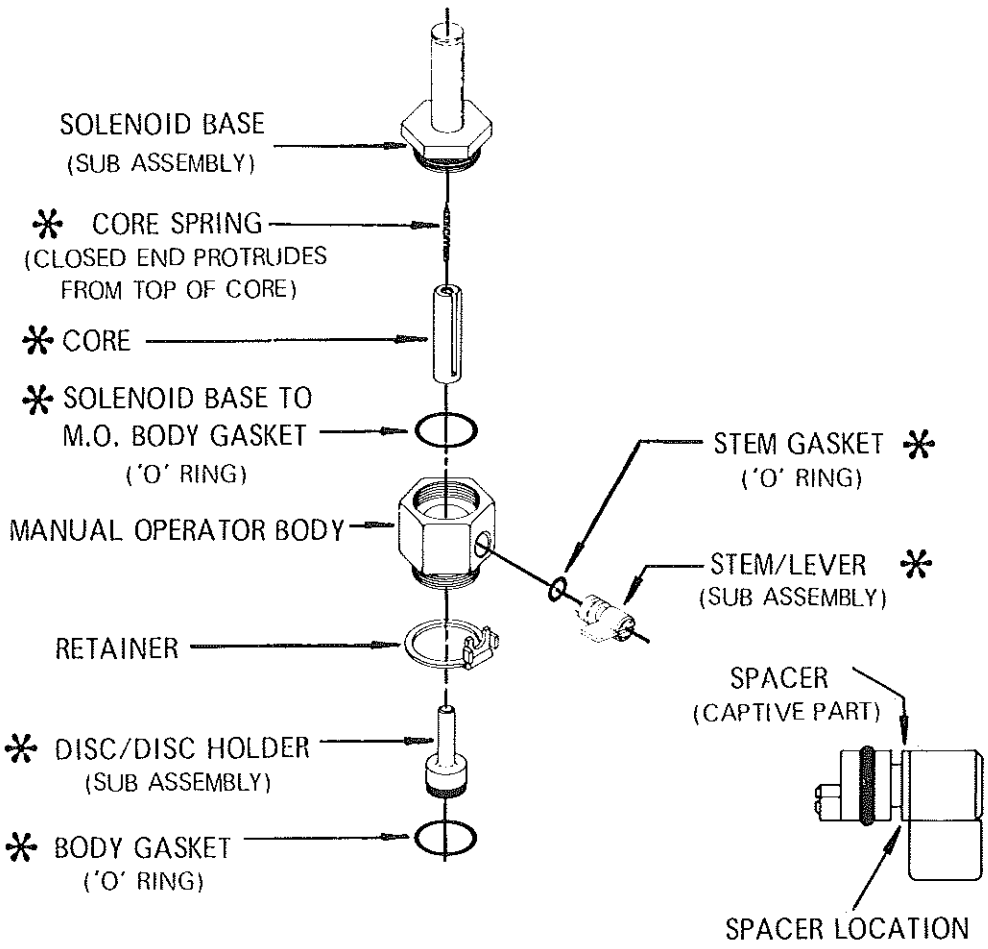


FIGURE 4 MANUAL OPERATOR

EASYLINK 2940570A001 18MAY88 10:51/10:58 EST
FROM: 62428890
AUTOMATIC SWITCH CO
TO: 6083640382

ASCO - MILWAUKEE
PO BOX 17559
MILWAUKEE WI 53217
414-962-2294, 963-0808
EZLINK 62428890
FACSIMILE (414)963-0891

>>>>>>>>>> F A C S I M I L E M E S S A G E <<<<<<<<<<

PLEASE DELIVER THE FOLLOWING MESSAGE CONSISTING OF

1 PAGE (S) INCLUDING THIS PAGE

FROM: ALLEN BALES

11909677 Simrick
11909676 "
11909675 "

TO: COLT INDUSTRIES

ATTENTION: KAY MULLEN

REFERENCE YOUR REQUESTS DATED 5-4-88 AND 5-11-88 FOR VENDOR LISTING OF REPAIR PARTS FOR PART NO. 11909677 11909676 AND 11909675.

THE FACTORY HAS ADVISED DUE TO THE OLD DESIGN PARTS ARE NO LONGER AVAILABLE.

REGARDS,

ALLEN BALES

MMMM

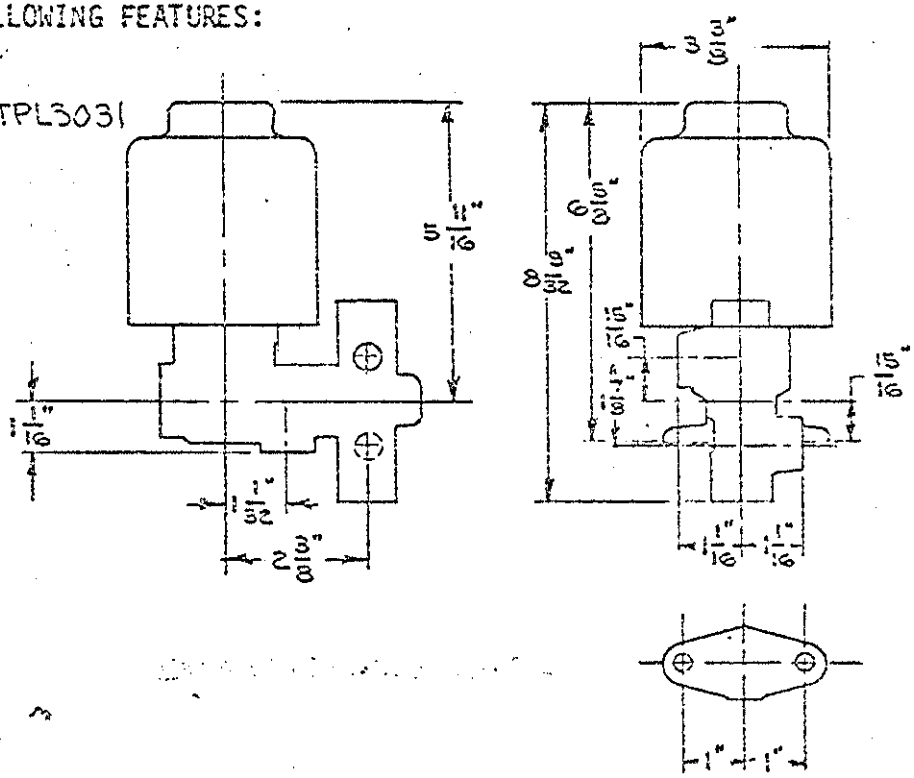
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TECHNICAL SERVICES
JUN 21 1988

Copy TO: Dawn Royce & Tech Manual
FOLLOW UP: None
FILE: 6-21-88

11909677

DESCRIPTION: ASCO 1/2" PIPE SIZE, THREE WAY VALVE TO BE USED AS TWO WAY VALVE BY BLOCKING "B" PORT. TO HAVE FOLLOWING FEATURES:

1. 1/2" PIPE SIZE, 3/16" ORIFICE.
2. WITH MOLDED CLASS "H" COIL FOR 125 VOLT D.C., TPL3031
3. S.S. SEAT.
4. FOR 250 PSIG AIR SERVICE.
5. WITH 1/2" THREADED CONDUIT CONNECTION.
6. FORM "G" (NORMALLY OPEN)
7. ENCLOSURE, NEMA TYPE 4.
8. STAINLESS STEEL BODY



VENDOR'S PART NO: WPX 8300A403G

VENDOR: AUTOMATIC SWITCH CO., INC
5856 N. PORT WASHINGTON ROAD
SUITE 220
MILWAUKEE, WISC 53217

see Vendor letter.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	10668	3-1-78	ADDED ALL DIM.S	

TITLE: VALVE, SOLENOID 2 WAY 1/2"

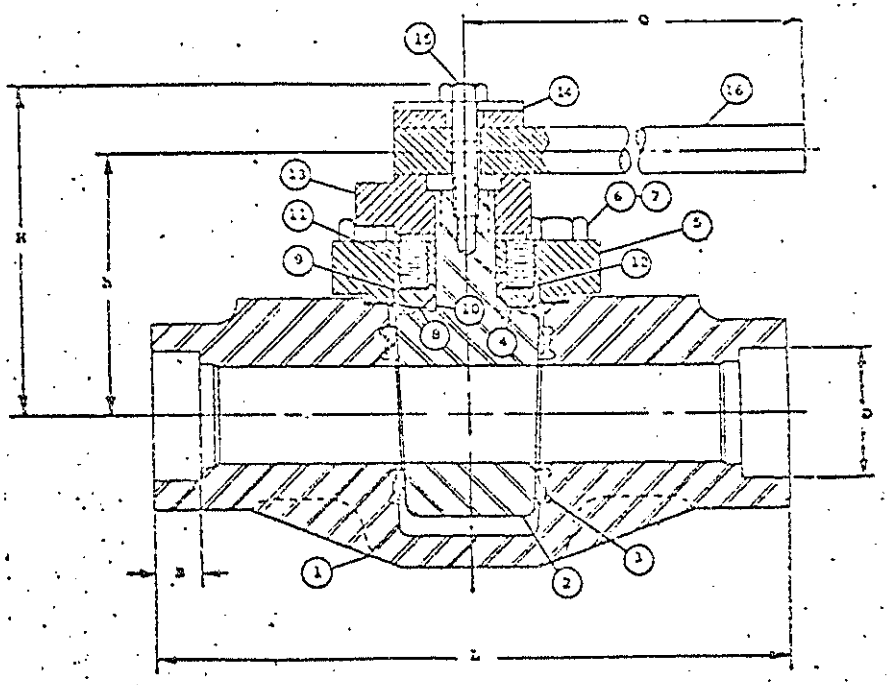
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10644 B	1/20/78	ASSY. OR LO.	
DR. BY L. McM	1/11/78	SCALE 3-2	
CHK'D.	"	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11909677 | SHEET 1 OF 2

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



Size	L	D	B	h	H	Q
1"	6.50	1.33	.50	3.81	2.48	7.38
1½"	7.50	1.92	.50	4.56	3.63	11.25
2"	8.50	2.41	.62	5.13	4.00	12.00

VENDOR NO: 1-1/2" FIG. 0366SW (ALL STAINLESS STEEL)

VENDOR: TUFLINE DIVISION OF
XOMOX CORP.
ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR.

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	11614	8-7-78	ADD REV. STATE TO SUB-TIER SPECS. ①	DLS MR

TITLE
VALVE, PLUG
S.S. 1-1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	10644E	1/26/78	ASSY. OR LO.
DR. BY	L.McM	1/16/78	SCALE
CHK'D.		/ /	HEAT TR.
MAT'L	PURCHASE		

APPV.	CASY.		MAG.
	MACH.		ENG.
	WELD.		

SHEET SIZE A | DWG. NO. 11 909 685 | SHEET 1 OF 4

11 908 185

QA JAN 31 1978 FMA JAN 1 1978 EM JAN 1 1978 QA

11909685

MR1-4

TUFLINE

Maintenance and Repair Instructions

For 1"-4" Plug Valves

Tufline valves are designed and built to give long, trouble-free service. Properly applied, adjusted and operated, they should require minimum attention. In most cases, a simple adjustment, as described below, is all that is necessary. In such cases, please first read these instructions carefully. If there are any questions, consult your Tufline valve representative.

Adjustments

Loss of Seal

All Tufline valves are factory adjusted for bubble-tight shutoff at 100 psi air pressure. Normally, no further adjustment is required. If seepage does occur at the plug shank or downstream, tighten the Allen-head screws uniformly ¼ turn at a time. Operate valve and check for leakage before tightening further.

Hard Turning

Torque adjustments should not be made before operating a valve for at least 12 hours under service conditions, since the initial breakaway torque normally reduces with usage and temperature. Otherwise, valve may become too loose. If still too tight, reduce torque by loosening Allen-head screws uniformly ¼ turn at a time. After operating valve, repeat as necessary, but no more than 2 or 3 times, or else leakage may occur. If valve is on cold service and after adjustment it is still too hard to turn, try heating valve with lamp or similar source of mild heat, being careful not to exceed temperature of 400°F.

Normal Running Torques

Size	TFE Ft.-lbs. at Stem	UHMWPE Ft.-lbs. at Stem
1"	15	22
1½"	20	30
2"	30	45
3"	50	75
4"	70	105

Valve Repairs

Field repair of 1"-4" sizes may be satisfactorily performed by carefully carrying out the following instructions, but again should be weighed against the advantage of returning valves to factory for repair where this is possible. Because of the specialized equipment available at the factory, such repairs can be performed in many instances more economically than in the field, even considering transportation charges back and forth. Also, factory repaired valves carry the standard new valve guarantee and, of course, are tested to the same specifications as new valves.

Parts Nomenclature and Identification

Since 1956 several model improvements have been introduced. For proper nomenclature and parts identification, check your latest Tufline catalog carefully before ordering replacements. Although parts are designed for maximum interchangeability between sizes, types and models of valves, in certain instances they are not interchangeable and must be specifically identified. If you have any questions, consult your local Tufline office.

Tools and Equipment for Field Repair

Special

Loading Ring	1"-4" Required
Sizing Plug	1"-4" Required
Plunger	1"-4" Optional*
Spreader	1"-4" Optional**

*Or a piece of round bar stock of the loading ring I.D.
**Or a piece of half round bar stock less than loading ring I.D.

Standard

Arbor Press (U-clamp or jack can be used on small valves)
Large Screw Driver
Sharp Knife
Crowbar
Allen & Standard Wrench Sets
Consult your regional office on availability of special tools.

Sleeve Replacement

Valve Removed from Service

IMPORTANT! If the valve has been used on a hazardous fluid, make certain that it has been thoroughly cleaned before disassembly. Loosen the cover bolts about 3 to 4 turns each, and then turn the plug to release any trapped pressure within the valve.

Removal of Sleeve – Lip Design Valve

(a) To remove the handle and hub, remove the Nyloc bolt.

(b) Remove the cover bolts and cover.

(c) Remove the plug and top seals by turning the plug with the hub-handle wrench.

(d) Slip the top seals – static eliminator, thrust collar, metal diaphragm, TFE delta ring and TFE diaphragms – from the plug. All that remains is the TFE sleeve in the valve body. (There may be a TFE thrust disc lying in the bottom of the valve. Remove. It need not be replaced.)

(e) To remove the sleeve, cut it with a sharp knife halfway between the ports. Care should be taken not to score the valve body.

(f) After the sleeve has been cut from top to bottom, insert a screwdriver behind the sleeve and curl the sleeve away from the body. Remove the sleeve.

(g) Clean the body and the plug. They should not be eroded and the plug's surface should be smooth. If the finish of the plug is questionable, replace.

Replacement of Sleeve

(a) Place the "loading ring" in the counterbore of the body.

(b) The sleeve has been sized and taped. (Do not remove tape until ready to use.) Remove the tape and insert the small end of the sleeve in the loading

ring so that it will enter the body inwardly offset ¼" from perfect alignment to clear the metal "lips" (protruding edge of the body that surrounds each port).

(c) Place the "plunger" on top of the sleeve and press the sleeve into the valve body with an arbor press. Reverse the plunger and use the small side of the plunger to press through the loading ring.

(d) When the sleeve is in the body, use a crowbar through the ports of the valve to turn the sleeve and to position the edges of the sleeve behind the "lips". The sleeve should now be in perfect alignment, and its edges at the ports should be against the valve body and locked behind the "lips".

(e) The bottom of the sleeve should rest on the lower ledge of the body, and the top of the sleeve should be tucked under the upper ledge of the body. (Make sure the sleeve is pressed tightly against the body.) To accomplish this, roll the valve handle or a bar in a stirring motion around the opening of the body.

(f) The sleeve must also be pressed to the valve body around the ports. A "spreading" tool is inserted into the sleeve and pressed to the bottom of the valve. This positions the sleeve so that it will not be torn when sizing with the sizing tool. A spreader is not required for out-of-the-line repairs, although it is helpful. A piece of half round bar stock with radius less than the I.D. of the loading ring can be used by pressing the sleeve against the body through the ports.

(g) Place the "sizing plug" in the sleeve and press the sizing plug to the bottom of the valve body. If you have a silicone lubricant, spray the sizing plug before inserting.

(h) Remove the sizing plug, with the jackscrew if necessary. Insert the standard plug with ports in open position. The top of the plug should drop within approximately ¼" of the counterbore for the top seal. If it does not, resize with the sizing plug.

(i) There may be a small excess of TFE around the ports or around the top and the bottom of the sleeve, which should be trimmed with a sharp knife.

(j) Reassembly: replace the standard plug and follow with the TFE diaphragm, the TFE delta ring, formed metal diaphragm, thrust collar and static eliminator. Note: Always use a *new* TFE diaphragm, delta ring and formed metal diaphragm.

(k) Back out the adjusting screws in the cover so that one thread is showing inside of the cover.

(l) Replace the cover and the cover bolts and tighten securely. The tightening of the cover can be done more easily if the valve is placed under an arbor press and the plug is pressed downward. Do not apply pressure on the cover. It will tend to cut the Teflon diaphragm. Press down only on the plug shank.

(m) Adjust the Allen-head adjusting screws ¼ turn at a time. Rotate the plug with the handle and the hub and continue to tighten as necessary until the normal running torque values, shown under the valve adjustment paragraph, are achieved.

(n) Replace the hub and bar wrench, nameplate and Nyloc bolt.

If satisfactory tightness is not obtained, please contact your Tufline representative.

Replacement of Sleeve (In Line)

Follow the standard instructions as outlined above, except use the following steps in lieu of those steps under "Replacement of Sleeve" above.

(c) A U-clamp or a jack would normally be used in place of an arbor press.

(d) When the sleeve is in the body, a "turning tool" is inserted in the sleeve and turned to position the edges of the sleeves behind the "lips" (protruding edge of the body that surrounds each port). Press down firmly on the "turning tool" and rotate until the sleeve has turned and the sleeve edges at the port have "popped" behind the lips. You should be able to feel this through the tool and should also hear the "pop". The sleeve should now be in perfect alignment, and the edges at the port should be against the body behind the "lips". (This "turning tool" is available from your regional office.)

Replacement of UHMWPE Sleeve

Follow the same general procedures as set forth in these instructions except as follows.

(a) Additional tooling will be required.

Sleeve Shrinking Die	1"-4" Required
Sleeve Shrinking Plunger	1"-4" Required
Sleeve Unloading Plunger	1"-4" Optional*

*Or a piece of round barstock.

(b) The UHMWPE sleeve is supplied untaped. Before the sleeve is put into the valve body, it is necessary to shrink the diameter.

(c) Place the sleeve in the sleeve shrinking die and press to the bottom using the sleeve shrinking plunger and an arbor press.

(d) Remove the sleeve from the shrinking die using the unloading plunger and immediately put sleeve into the valve body as described in section "Replacement of Sleeve".

XOMOX CORPORATION
4444 Cooper Road
Cincinnati, Ohio 45242

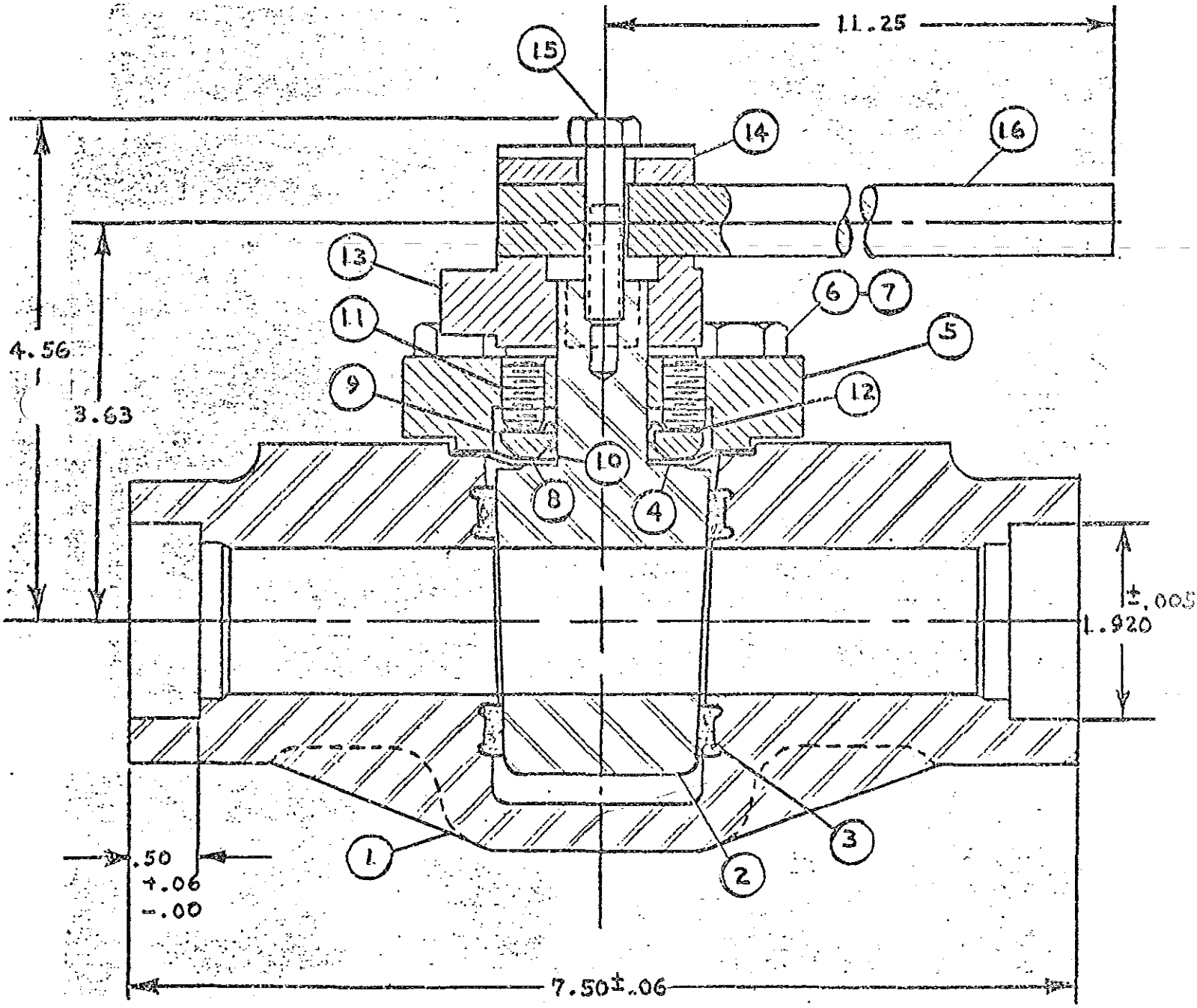
Bill of Material

No.	Qty.	Part Name	Material
1	1	Body	ASME SA216, Gr. WCB
2	1	Plug	ASME SA351, Gr. CF8M
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Cover	ASME SA216, Gr. WCB
6	4	Cover Studs	ASME SA193, B7
7	4	Cover Nuts	ASME SA194, 2H
8	1	Metal Diaphragm	ASTM A167, Type 302
9	1	Thrust Collar	ASTM A167, Type 304
10	1	Delta Ring	TFE
11	3	Adjustment Screws	AISI 303/Silver Plated
12	1	Static Eliminator	AISI 302
13	1	Wrench Hub	Malleable Iron/Painted
14	1	Name Plate	Stainless Steel
15	1	Hub Bolt	Steel/Zinc Plated
16	1	Wrench Handle	Steel/Painted

		DWN. KM	CHKD [illegible]	APP [illegible]	DATE 3/7/77
		NAME 1½" 0366SW			SPEC. No. NP1692-B
		TUFLINE DIVISION OF XOMOX CORPORATION 9994 COOPER ROAD · CINCINNATI, OHIO 45242			
DATE	REV.				

Style 0366SW Size 1½"
Socket Weld Ends,
Nuclear Class 3
P.O. #B-443532-N
N./11908183
Tufline Order #E-71728

Class 300 Plug Valve



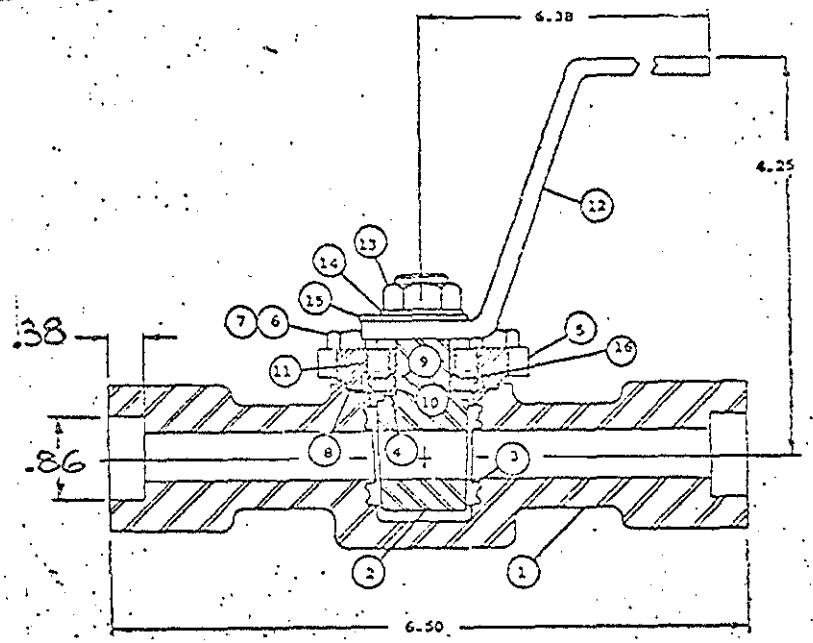
Recommended Spare Parts
Fig. 066 & 0366 Socket Weld
Size 1/2" - 2"
150# & 300#
Fig. 066 & 0366 Butt Weld
Size 3" - 4"
150# & 300#

Part Name	Valve Size					
	1/2&3/4	1	1-1/2	2	3	4
TFE Sleeve	283425	282281	282418	282287	285128	285129
TFE Diaphragm	013441	012279	012416	012284	012388	012300
Formed Metal Diaphragm	029373	029374	029375	029376	029377	029378
TFE Delta Ring	013443	013066	013067	013068	013068	013069
Static Eliminator*	026013	023596	023598	023599	023599	023600
Sizing Die	003937	002587	002588	002589	002590	002470
Loading Ring	Not Req	002574	002575	002473	002576	003128

*Static Elminator is not required with gear or actuator operated valves.

11 909 686

"THIS COMPONENT IS TO BE MADE IN ACCORDANCE WITH ASME SECTION III, CLASS 3. THE EFFECTIVE DATE OF THE CODE EDITION AND ADDENDA TO THE CODE IS THE DATE OF THE COLT/ FAIRBANKS MORSE ENGINE DIVISION PURCHASE ORDER FOR THE COMPONENT".



VENDOR NO: 1/2" FIG. 0366SW (ALL STAINLESS STEEL)

VENDOR: TUFLINE DIVISION OF
XOMOX CORP.
ELK GROVE, IL 60007

SEE 11 908 456 FOR COLT FMED Q.A. REQUIREMENTS ON VENDOR.

LIMERICK GENERATING STATION
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	11014	8-7 78	ADD REV. STATE TO SUB TIER SPECS ①	NLS

TITLE
VALVE, PLUG
S.S. 1/2"
ASME SECT. III, CL 3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	10644E	1/26/78	ASSY. OR LO.
DR. BY	L. McM	1/16/78	SCALE —
CHK'D. BY		/ /	HEAT TR.
MAT'L	PURCHASE		
APPV.	CAST.		MACH.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11 909 686 | SHEET 1 OF 4

BF3000.2

FM Rev. 0 JAN 1, 1978 API
FM Rev. 1 JUL 31 1978 API

11909686

Maintenance and Repair Instructions

For Tufline Valves ½" & ¾" Also 1" Ductile Iron Valves

Tufline valves are designed and built to give long, trouble-free service. Properly applied, adjusted and operated, they should require minimum attention. In most cases, a simple adjustment, as described below, is all that is necessary. In such cases, please first read these instructions carefully. If there are any questions, consult your Tufline valve representative.

Adjustments

Loss of Seal

All Tufline valves are factory adjusted for bubble-tight shutoff at 100 psi air pressure. Normally, no further adjustment is required. If seepage does occur at the plug shank or downstream, tighten the Allen-head screws uniformly ¼ turn at a time. Operate valve and check for leakage before tightening further.

Hard Turning

Torque adjustments should not be made before operating a valve for at least 12 hours under service conditions, since the initial breakaway torque normally reduces with usage and temperature. Otherwise, valve may become too loose. If still too tight, reduce torque by loosening Allen-head screws uniformly ¼ turn at a time. After operating valve, repeat as necessary, but no more than 2 or 3 times, or else leakage may occur. If valve is on cold service and after adjustment it is still too hard to turn, try heating valve with lamp or similar source of mild heat, being careful not to exceed temperature of 400°F.

Normal Running Torques

Size	Ft./lbs. at Stem
½"	10
¾"	15
1" DI Only	15

Valve Repairs

Field repair of valves may be satisfactorily performed by carefully carrying out the following instructions, but should be weighed against the advantage of returning valves to the factory for repair where possible. Because of the specialized equipment available at the factory, such repairs can be performed in many instances more economically than in the field, even considering transportation charges back and forth. Also, factory repaired valves carry the standard new valve guarantee and, of course, are tested to the same specifications as new valves.

Parts Nomenclature and Identification

Since 1956 several model improvements have been introduced. For proper nomenclature and parts identification, check your latest Tufline catalog carefully before ordering replacements. Although parts are designed for maximum interchangeability between sizes, types and models of valves, in certain instances they are not interchangeable and must be specifically identified. If you have any questions, consult your local Tufline office.

Tools and Equipment for Field Repair

Special

Sizing Plug	½"-¾" Required
Plunger	½"-¾" Optional*

*Or a piece of round bar stock of the sleeve OD.

Standard

Arbor Press (U-clamp or jack can also be used)
Sharp Knife
Drill
Allen & Standard Wrench Sets

Consult your regional office on availability of special tools.

Sleeve Replacement

Valve Removed from Service

IMPORTANT! If the valve has been used on a hazardous fluid, make certain it has been thoroughly cleaned before disassembly. Loosen the cover bolts about 3 to 4 turns each, and then turn the plug to release any trapped pressure within the valve.

Removal of Sleeve

(a) To remove the handle washer, handle and static eliminator (spring), remove the Allen-head bolt.

(b) Remove the cover bolts and cover.

(c) Remove the plug and top seals by turning the plug with the hub-handle wrench.

(d) Slip the top seals—thrust collar, formed metal diaphragm, TFE delta ring and TFE diaphragms—from the plug. All that remains is the TFE sleeve in the valve body. (There may be a TFE thrust disc lying in the bottom of the valve. Remove. It need not be replaced.)

(e) To remove the sleeve, cut it with a sharp knife half way between the ports. Care should be taken not to score the valve body.

(f) After the sleeve has been cut from top to bottom, insert a screwdriver behind the sleeve and curl the sleeve away from the body. Remove the sleeve.

(g) Clean the body and the plug. They should not be eroded, and the plug's surface should be smooth. If the finish of the plug is questionable, replace.

Replacement of Sleeve

(a) The sleeve has been sized and taped. (Do not remove tape until ready to use.) Remove the tape and insert the sleeve in the valve body.

(b) Place the "plunger" on top of the sleeve and press the sleeve into valve body. An arbor press is normally required. (For in-line replacement, a U-clamp or jack should be used.)

(c) Place the "sizing plug" in the sleeve and press the sizing plug to the bottom of the valve body. If you have a silicone lubricant, spray the sizing plug before inserting. Remove the sizing plug with the jackscrew, if necessary.

(d) When the sleeve is in the body, the upstream and downstream ports must be drilled out. Use a standard drill and drill out the ports in the sleeve to conform to the valve body by drilling through the ports. Then take a sharp knife and trim the burrs or excess Teflon around the port area.

(e) Insert the standard plug. The top of the plug should drop within approximately ¼" of the counterbore. If it does not, resize with the sizing plug.

(f) Reassembly: replace the standard plug and follow with the TFE diaphragm, TFE delta ring, formed metal diaphragm, and thrust collar. Note: Always use a *new TFE* diaphragm, delta ring and formed metal diaphragm.

(g) Back out the adjusting screws in the cover so that they are one thread within the inside of the cover.

(h) Replace the cover and cover bolts and tighten securely. The tightening of the cover can be done more easily if the valve is placed under an arbor press and the plug is pressed downward. (Do not pull the plug in with the cover. It will tend to cut the Teflon diaphragm.)

(i) Adjust the Allen-head adjusting screws ¼ turn at a time. Rotate the plug with the handle and hub, and continue to tighten as necessary until the normal running torques, shown under the valve adjustment paragraph, are achieved.

(j) Replace the static eliminator, handle, handle washer and Allen-head bolt.

Tufline, division of Xomox, 4444 Cooper Road, Cincinnati, Ohio 45242

6M-RA-6/74
MRI-74

XOMOX CORPORATION
4444 COOPER ROAD
CINCINNATI, OHIO 45242

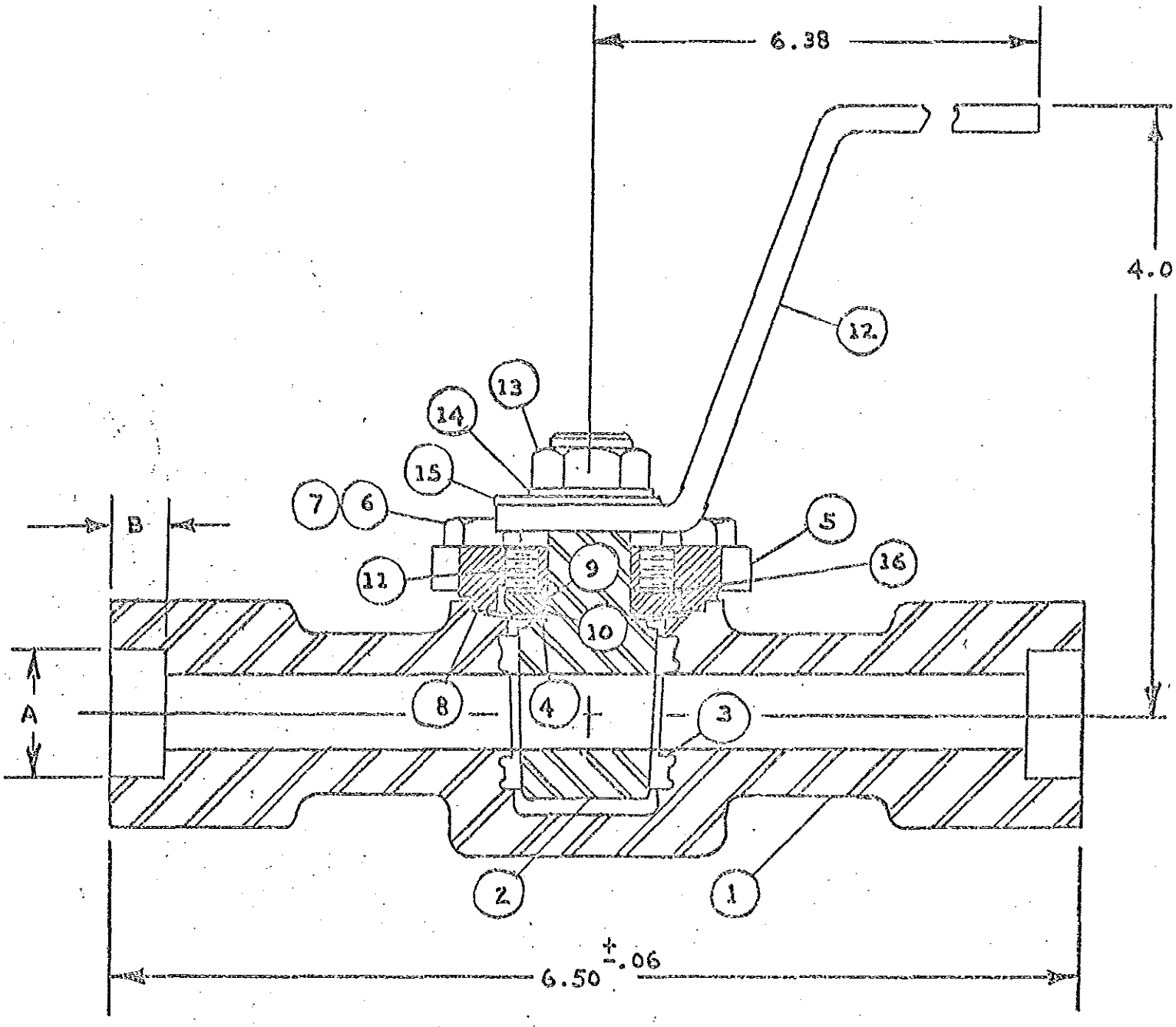
Bill of Material			
No.	Qty.	Part Name	Material
1	1	Body	ASME SA216, Gr. WCB
2	1	Plug	ASME SA479, Type 316
3	1	Sleeve	TFE
4	1	Diaphragm	TFE
5	1	Cover	ASME SA216, Gr. WCB
6	4	Cover Studs	ASME SA193, B7
7	4	Cover Nuts	ASME SA194, 2H
8	1	Metal Diaphragm	ASTM A167, Type 302
9	1	Thrust Collar	ASTM A167, Type 304
10	1	Delta Ring	TFE
11	3	Adjustment Screws	AISI 303/Silver Plated
12	1	Handle	Steel/Painted
13	1	Wrench Nut	AISI 304
14	1	Lock Washer	Steel/Zinc Plated
15	1	Name Plate	AISI 302
16	1	Static Eliminator	AISI 302

	A	B
1/2"	$.860^{+}_{-}.005$	$.375^{+.060}_{-.000}$
3/4"	$1.070^{+}_{-}.005$	$.500^{+.060}_{-.000}$

		DWN KW	CHKD JGS	APP. JLO	DATE 3/7/77
		NAME 1/2" & 3/4" 0366SW			SPEC. No NP1691-B
		TUFLINE DIVISION OF XOMOX CORPORATION 4444 COOPER ROAD - CINCINNATI, OHIO 45242			
DATE	REV				

Style 0366SW Size 1/2" & 3/4"
Socket Weld Ends,
Nuclear Class 3
P.O. #8-443532-N
1/2" – P.N./11908180
3/4" – P.N./11908181
Offline Order #E-71728

Class 300 Plug Valve



Recommended Spare Parts
Fig. 066 & 0366 Socket Weld
Size 1/2" - 2"
150# & 300#
Fig. 066 & 0366 Butt Weld
Size 3" - 4"
150# & 300#

TUTLINE

Part Name	Valve Size					
	1/2&3/4	1	1-1/2	2	3	4
TFE Sleeve	283425	282281	282418	282287	285128	285129
TFE Diaphragm	013441	012279	012416	012284	012388	012300
Formed Metal Diaphragm	029373	029374	029375	029376	029377	029378
TFE Delta Ring	013443	013066	013067	013068	013068	013069
Static Eliminator*	026013	023596	023598	023599	023599	023600
Sizing Die	003937	002587	002588	002589	002590	002470
Loading Ring	Not Req.	002574	002575	002473	002576	003128

*Static Elminator is not required with gear or actuator operated valves.

8. GAUGE BOARD

Part No.	Description
11 901 104	Gauge Mounting Ring
11 901 106	Gauge Snubber
11 902 078	Duplex Pressure Gauge
11 902 079	Duplex Pressure Gauge
11 903 798	Pyrometer
11 905 386	Duplex Pressure Gauge
11 905 641	Gauge Mounting Gasket
11 905 757	Pressure Gauge
11 906 213	Pressure Gauge
11 906 689	Tachometer Signal Generator
11 906 823	Tachometer Indicator
11 907 185	Pressure Gauge
11 907 532	Pressure Gauge
11 908 669	Vibration Mount
11 908 696	Differential Pressure Gauge
11 908 730	Gauge Panel Box
11 908 736	Differential Pressure Gauge
11 908 776	Temperature Gauge
11 908 777	Temperature Gauge
11 909 977	Null Meter

Description: Flush mounting ring for 4-1/2" Phenol "Turret Type" case.

Vendor: Manning, Maxwell & Moore, Inc.
Field Bldg.
135 South LaSalle Street
Chicago, Illinois

Piece/Part No.: 1278

Drg. No.: Cat. 300B, Page 12

Alternate Vendor: Hollecoid Gauge Division
American Chain & Cable Co.
Bridgeport, Connecticut

Piece/Part No.:

Drawing No.:

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified) ±1/64

LAYOUT OR ASSEMBLY NUMBER

REV. NO.	DATE	CHANGE ORDER NO.	NOTES
1	11-3-51	AQ195	Altered...

RELEASE NUMBERS ... DATE OF RELEASE ...

MANNING, MAXWELL & CO.
GENERAL DIVISION
ENGINEERING DEPARTMENT

DRAWN BY E. Beckhaus	DATE 7-27-51	SCALE
CHECKED BY K. C. Cooley	DATE 7-31-51	

NAME
RING, Cage Mounting

MATERIAL SPECIFICATION

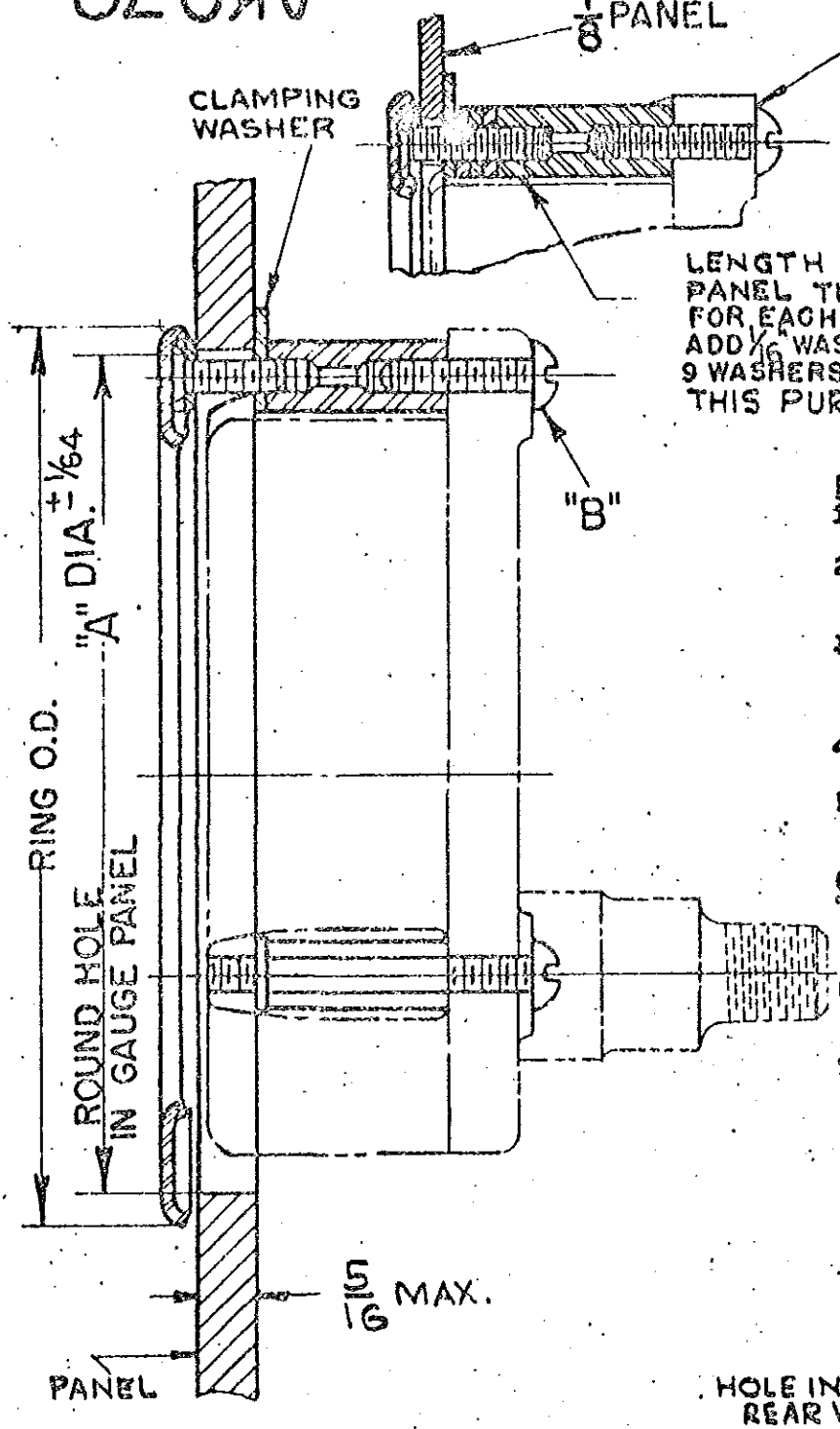
APPROVED

SHEET SIZE A

DWG. NO. 11 Cat 108

11901104

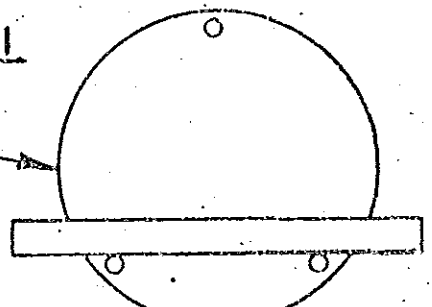
AKQ70



INSTRUCTIONS
FOR ASSEMBLING RING IN PANEL

1. APPLY RING FROM FRONT SIDE OF PANEL SO THAT, RING STUDS ENTER PANEL HOLE.
2. LOOSELY ASSEMBLE TOP SPACER POST, WORKING FROM FRONT OF PANEL, TO HOLD RING IN HOLE.
3. FROM REAR OF PANEL, APPLY THE TWO LOWER SPACER POSTS, JUST LOOSE ENOUGH TO STILL PERMIT ROTATION OF RING IN PANEL.
4. LAY A LEVEL OR STRAIGHT EDGE ACROSS THE TWO LOWER SPACER POSTS
5. ROTATE RING AS NECESSARY TO BRING POSTS IN A HORIZONTAL LINE. (SEE FIGURE 1).
6. TIGHTEN ALL SPACER POSTS.
7. WHEN NON MAGNETIC RING ASM. IS REQ'D. ISSUE SCREWS SMIR-144 & WASHERS SSSS-1051.
8. WHEN NON MAGNETIC RING ASM. IS REQ'D., ISSUE SCREWS SMIR-146 & WASHERS SSSS-1049.
9. WHEN NON MAGNETIC RING ASM. IS REQ'D., ISSUE SCREWS BK83 & WASHERS SSSS-1097

FIG. 1



SHOWING USE OF LEVEL TO LINE UP SPACER POSTS

MANNING, MAXWELL & MOORE
PART NOS. LISTED IN TABLE

CASE SIZE	RING O.D.	"A" DIA.	"B" THREE SCREWS SIZE	"B" THREE SCREWS PART NO	1/16" THICK WASHER PART NO
3 1/2	4.750	4 13/32	6-32 X 3/4	SMIR71 NOTE 7	AMP 9888
4 1/2	6.000	5 37/64	10-24 X 7/8	SMIR127 NOTE 8	SSSS-775
6	7.765	7 17/64	1/4-20 X 7/8	SMIR82 NOTE 9	SSSS-777
8 1/2	10.406	9 57/64	1/4-20 X 7/8	SMIR82 NOTE 9	SSSS-777

APPLICATION
TYPE 1278 RING FOR FLUSH MOUNTING PHENOL TURRET OR ALUMALIFE CASES (SLIP RING)

ASHCROFT GAUGE DIVISION
MANNING, MAXWELL & MOORE INC.
STRATFORD CONNECTICUT

DR. HK
CH. R.E.P.
APP. [illegible]
DATE 4-30-58

AKQ70

NO.	CHANGE	DATE
1	CHANGED SCREW NO. FROM SMIR 82 TO SMIR 127	4-30-58

FORM NO. 250-924 C

11201-101

Description: Ashcroft pulsation dampener 1/4 N.P.T.
Male and female.

Vendor: Manning, Maxwell & Moore, Inc.
Field Bldg.
135 South LaSalle Street
Chicago, Illinois

Piece/Part No.: 1/4-1106B

Drg. No.: Cat. 300B, Page 77

Alternate Vendor: Helicoid Gage Division
American Chain & Cable Co.
Bridgeport 2, Connecticut

Distributor: Ray Cordon, Inc.
3912 West Schlingler
Milwaukee, Wisconsin

Pc/Part No.: 138JB

APPROVED

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified) ±1/64

LAYOUT OR ASSEMBLY NUMBER

REV. NO.	DATE	CHANGE ORDER NO.	WAS
1	61	AC-501	Alt. Vendor Add

RELEASE NUMBER AA 277 | DATE OF RELEASE 7-

FAIRBANKS, MORSE & CO.
GENERAL EQUIPMENT
ENGINEERING DEPARTMENT

DRAWN BY F. Backhaus	DATE 7-17-59	SCALE
CHECKED BY M. G. Cooley	DATE 7-17-59	

NAME
SNUBBER, Gauge

MATERIAL SPECIFICATION

SHEET SIZE A | DWG. NO. 11201-101

11901106
11905386
11906213

ENGINEERING DATA

ASHCROFT® gauges

Maintenance and Repair

Form Number
250-1353-H

DRESSER INDUSTRIES

INDUSTRIAL VALVE & INSTRUMENT DIVISION
STRATFORD, CONNECTICUT 06497

SPECIAL ADDENDUM

FOR

MAINTENANCE AND REPAIR MANUAL

FORM No. 250-1353-F

(Please attach this to your Maintenance Manual)

Page 3 — We have extended our pocket test gauge product offering to include a 3½" size. Figure number 1081 has been assigned to this product.

Page 9 — Number six under both sections dealing with liquid filled gauges should state that gauges that are to be filled with "Fluorolube" can utilize either RTV 732 or 733 sealant. Standard O-rings are also usable with this fill.

Page 12 — In selecting suitable materials of construction where liquid filled gauges or gauge/diaphragm seal assemblies are required, an analysis must be made of the potential reaction of the process fluid with the liquid in the instrument in the event that a failure of the pressure boundary element occurs. "Fluorolube" liquid fill is available for applications where its stable characteristics will prevent a reaction.

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TEST EQUIPMENT FOR PRESSURE GAUGES

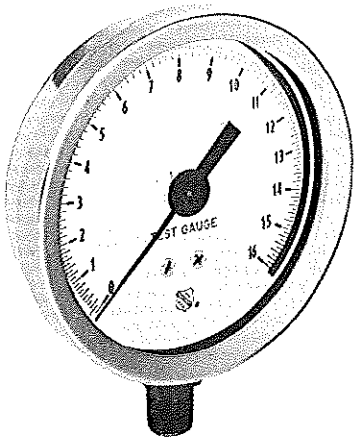
ASHCROFT® TEST GAUGES

Ashcroft test gauges are designed for highly precise reference work. To maintain their accuracy they should be used only as reference gauges. The very best accuracy and repeatability is obtained by lightly tapping the gauge before each pressure reading is observed. Test gauges are available in a number of design configurations. A detailed description of their features is included in the following sections.

Pressure test installations require proper arrangement and maintenance to assure that the pressure acting on the test gauge is the same as that acting on the gauge being tested. When liquid is used as a pressure transfer medium, variations of liquid head in the connecting piping will cause errors. When gas pressure is the pressure medium, oil residue and dirt trapped in the piping can limit the equalization of pressure thus causing errors. These errors will have the most effect when low pressure range gauges are tested.

Laboratory Test Gauge

The ASHCROFT Laboratory Test Gauge (Figure Number 1082) is a reference gauge used for checking and calibrating service gauges. This gauge is a highly precise and sensitive instrument, accurate to within ¼ of 1 percent of its range. It should always be handled with extreme care and kept where it is safe from possible damage.



ASHCROFT LABORATORY TEST GAUGE
Figure No. 1082

The dial includes a mirror surface under the pointer tip. By lining up the actual pointer with its mirrored reflection, parallax error is eliminated, and thus every reading is necessarily the same for every user.

Dials are linear. This provides the dual advantages of easier and faster recalibration. Hand marked dials, used by many manufacturers, are usually non-linear. Once calibration is disturbed on a hand-marked non-linear dial, it is practically impossible to restore the gauge to its original accuracy.

Even the best test gauges should be checked periodically, with an ASHCROFT dead weight tester or with an ASHCROFT Maxitest test Gauge.

When equipping an instrument shop, it is recommended that the ranges of shop test gauges be selected to match closely the ranges of the service gauges to be checked. Figure 1082 Series test gauges are available in 4½", 6", and 8½" sizes. The 8½" dial size is recommended for clearest readability.

Ashcroft Pocket Test Gauge

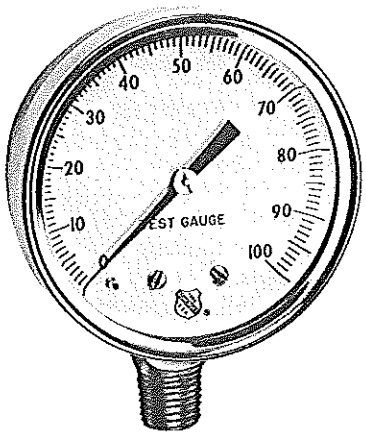


Figure No. 8452A

Occasionally a small size reference gauge is needed. The 2½" ASHCROFT 8452A Pocket Test Gauge has an accuracy of ½ of 1 percent of its range and is exceptionally readable for a smaller gauge. It is used primarily for field inspection work and available with protective covers.

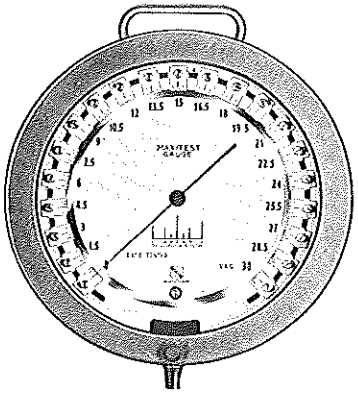
Ashcroft Maxitest Gauge

The Ashcroft test gauge is one of the finest Test Gauges available. Combining maximum accuracy with readability. As a master reference gauge, it is especially suited for calibrating and checking the accuracy of test gauges, receiver gauges, pressure transmitters, and other instruments.

Unique in every respect, the test gauge is designed for portability and easy reading under almost any conditions. The case is of durable, lightweight aluminum. The case and the anti-parallax dial are finished in contrasting colors scientifically developed to provide maximum readability and minimum eye strain.

Specially designed metal tabs are used instead of the usual printed dial graduations. These tabs are positioned near the outer circumference of the dial at the major graduation points. Each one can be individually and precisely set so that the pressure reading at each point is exact. This provides an accuracy,

at any dial tab reading, of not less than that of the calibration standard: 1/10th of 1 percent with the Dead Weight Gauge Tester. No intermediate dial graduations are provided.



ASHCROFT TEST GAUGE
Figure No. 1080

To further insure accuracy, each tab is marked to indicate any deviation from a standard reading.

Deviation is shown in terms equal to percent of total error, from ⅛ of 1 percent to 1 percent of total dial graduation. These extra marks are useful in checking another gauge to a specified accuracy. When used in this way, the gauge under test and the test gauge are connected to the same source of pressure and the pressure is adjusted so that the **gauge under test** indicates exactly at the center of a major graduation. The test gauge reading will then show the exact error of the gauge under test. This procedure eliminates the need to estimate and calculate errors on the gauge under test. The tolerance marks are correct when the test gauge is the same range as the gauge being tested. When they are of different ranges, the value of the tolerance lines will have to be estimated.

The dial and pointer are designed to eliminate parallax error.

A blank dial is available to permit setting of tabs according to the user's needs.

The test gauge is furnished in 8½" dial size.

CAUTION: DO NOT USE
TEST GAUGES AS SERVICE GAUGES

Ashcroft Dead Weight Gauge Tester Dual Range

CARE AND MAINTENANCE

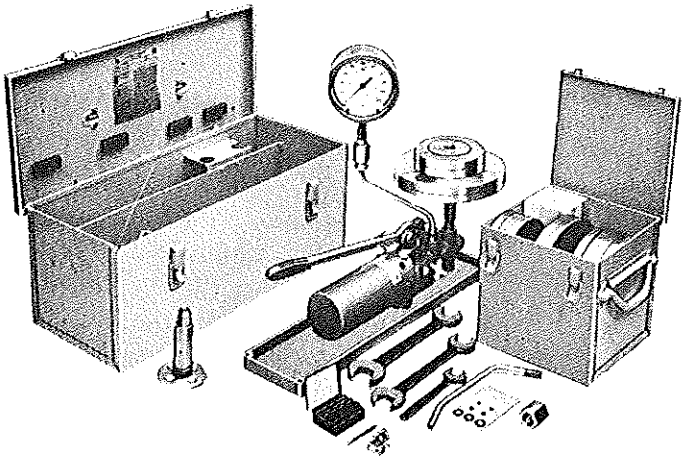
The Ashcroft Dead Weight Gauge Tester is a precision built hydraulic instrument which is a basic standard of pressure. It should receive the care and treatment that is accorded any other fine laboratory equipment.

The piston supporting the weight platform and the cylinder is manufactured to extremely close tolerances and to an area accuracy of 1/20 of 1 percent. The area of these parts is controlled by accurate measurement of the diameter by standards traceable to the National Bureau of Standards.

Dead Weights are carefully checked against weights certified by the National Bureau of Standards. (The accuracy of finished weights is better than 1/20 of 1 percent).

This Dual Range Tester is supplied with two interchangeable piston and cylinder assemblies.

One assembly is high pressure, with 1/80 square inch piston area. The other assembly is low pressure, with 1/16 square inch piston area. The area of the high and low pressure assemblies are in an exact ratio of 5:1. The same weights are used on both assemblies and are marked with the equivalent psi value for each area.



DEAD WEIGHT GAUGE TESTER
Figure No. 1305

As the range of the Dead Weight Tester increases, the area of the pistons supporting the weight platform decreases and the fit between the piston and cylinder becomes tighter. This closeness of fit prevents excess leakage of the hydraulic fluids past the piston. As the High Pressure Dead Weight Tester needs a closer fit, it is less sensitive when used on very low pressures. It is our recommendation, therefore, that when using the low pressure piston (1/16 square inch area) the lowest pressure that should be tested is 15 psi. When testing higher pressures with the high pressure piston (1/80 square inch area) the lowest pressure that should be tested is 75 psi. For testing under 15 psi we recommend that a mercury column manometer be used such as our Fig. 1370-36.

Periodically, the Dead Weight Tester should be flushed out with a solvent such as Naphtha and the hydraulic fluid should be kept very clean. Do not operate the pump while Naphtha is in the system. Lubricate all moving parts with recommended pump fluids before operating tester.

This care will assure the longest service life of the piston and cylinder assembly. It will also protect against possible sticking between piston and cylinder.

When a Dead Weight Tester is inactive for long periods, or when a piston and cylinder assembly is being replaced, the piston should always be removed from the cylinder and coated with oil. This will insure that it will never be operated in the dry state. When removing or replacing the piston always rotate it back and forth as it passes through the cylinder.

Although several fluids can be used in a Dead Weight Tester, a light grade (SAE 10 or 20) of machine or automotive oil is recommended. Less viscous oils cause increased leakage past the piston, with a resulting faster drop of the weights. Oils of higher viscosity, or fluids with lower lubricating properties, cause sticky piston action and make low pressure readings more difficult.

The exact accuracy of an Ashcroft Dead Weight Tester is the result of the original precision manufacture of piston, cylinder assembly and weights. This accuracy will last for an extended period unless the weights become damaged by mishandling; or unless the piston diameter wears. The only way that piston wear will occur is from improper or contaminated lubrication, excessive dirt, or after many years of normal continued use. A dead weight tester is self-checking for if the piston or cylinder does wear, the tester will leak oil past the piston at a very fast rate, prohibiting further operation. In this case, a new piston and cylinder assembly should be installed.

Sustained original accuracy is, then, automatic. No adjustments are needed to maintain it.

For detailed maintenance instructions see Maintenance Manual form No. 250-1526 furnished with each tester.

ASHCROFT PORTABLE TEST PUMP

Sometimes it is more convenient to make calibrations to a Test Gauge rather than to a Dead Weight Tester. Ashcroft Test Pump Series 1327 is specifically designed for this service. Instructions for the 1305 Dead Weight Tester apply to the Series 1327 Test Pump as the same parts are used, except that the Test Pump has a Test Gauge in place of the piston and cylinder assembly on the 1305 Tester.

It is furnished, conveniently boxed, with one or more Test Gauges.

Testing Oxygen Gauges

Fig. 1327BO Testers made for testing Oxygen Gauges use distilled or demineralized water.

Oil cannot be used because it is explosive with oxygen.

With water used as the testing fluid, a thin film coating of special non-hazardous lubricant is required on the pump piston. Frequent relubrication is required. The special coating is supplied, and can be reordered as Part S-417.

Ashcroft Portable Test Pump

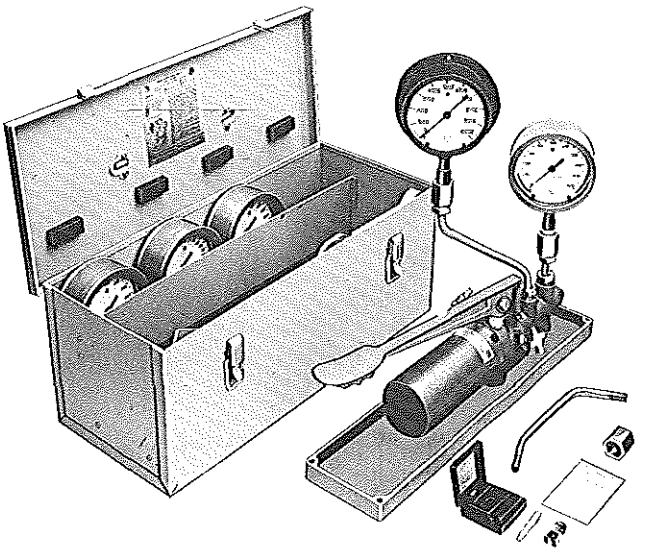


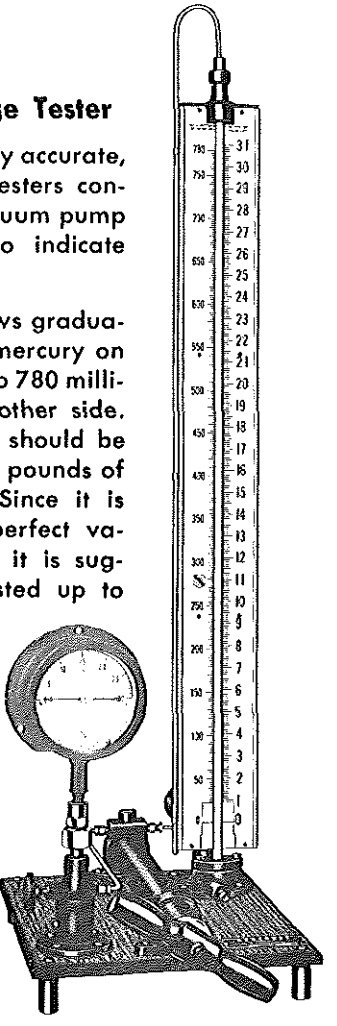
Figure No.

1327 Series

Ashcroft Vacuum Gauge Tester

Easy to operate and highly accurate, Ashcroft Vacuum Gauge Testers consist of a hand operated vacuum pump and a mercury column to indicate vacuum.

The mercury column shows graduations of 0 to 31 inches of mercury on one side of the scale and 0 to 780 millimeters of mercury on the other side. The reservoir of the Tester should be filled with approximately 3 pounds of double distilled mercury. Since it is impossible to produce a perfect vacuum with a hand pump, it is suggested that gauges be tested up to about 28 inches vacuum.



ASHCROFT VACUUM GAUGE TESTER
Figure No. 1332

These precision testers are furnished with a complete tool kit. The test gauge in the illustration is not supplied.

PRESSURE SUPPLY

A compressed air supply is a convenient source of pressure for checking and calibrating gauges. A small needle valve is required between the compressed air line and the gauges and another to vent the gauges. Operation of these valves will allow precise setting of the pressure to the reference gauge.

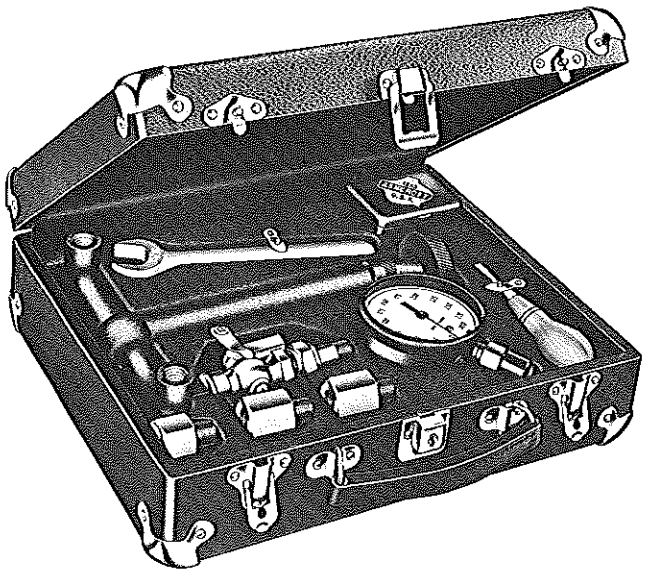
An efficient filtering system is recommended to remove oil from the air lines (even though this is not mandatory when checking conventional gauges only). Oil in air lines sometimes lodges in the gauge socket and causes low pressure gauges to indicate erratically. In addition, air breaking through a film of oil in the gauge socket causes the pointer to move in small jumps. This can make it appear as though the gauge movement teeth are defective. This condition is especially noticeable on pneumatic receiver gauges.

If no compressor is available, industrial air pressure tanks may be used as a pressure source. This air is usually quite clean and a filtering system is not necessary.

If a motor driven vacuum pump is available, it may be more convenient to use than the 1332 Vacuum Tester. A motor driven pump will create a more perfect vacuum. A vacuum mercury column or test gauge would be needed as a standard.

Inspectors Gauge Testing Set

The 1328 Ashcroft Gauge Testing Set is specially designed for inspectors and travelling engineers. It weighs about 12 pounds, is easily carried complete, and is used for testing pressure gauges up to 500 psi.



INSPECTORS' GAUGE TESTING SET
Figure No. 1328

INSPECTORS GAUGE TESTING SET
Consists of these units:

Black finished test pump with two connections.

Ashcroft Pocket Test Gauge, Catalog No. 1084P, graduated 0 to 300 psi, 3 inch dial size. Other pressures to order.

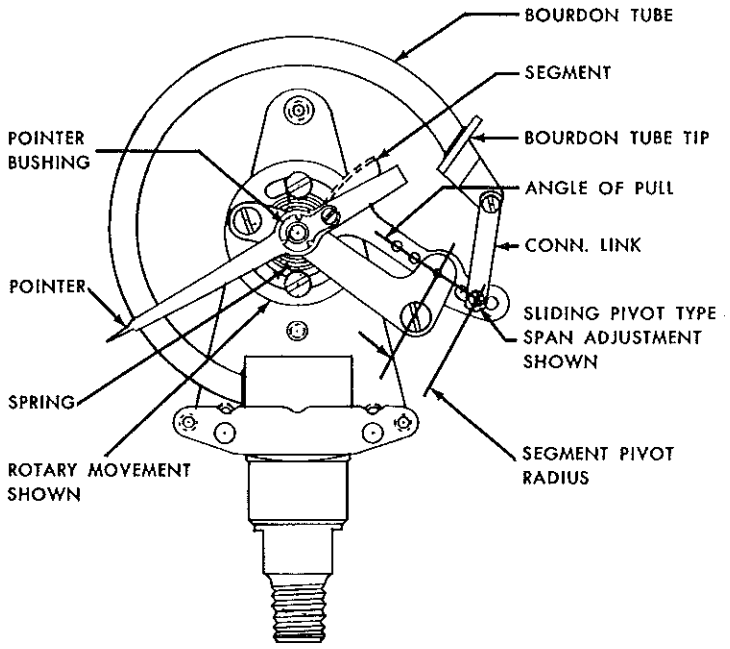
Tools and fittings.

Any light oil is recommended for use with the testing set.

CALIBRATION OF PRESSURE GAUGES

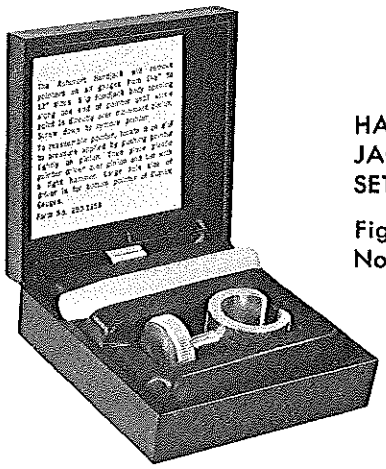
The movement and linkage may be worn if the gauge has been in service for some time, especially on an application which includes vibration and/or pressure pulsation. Under these conditions inspection of gauge operating conditions should be made. It may be found that complete replacement of the movement and linkage is needed, or the parts cleaned or that a calibration adjustment is all that's required. Most frequently, only a pointer adjustment is needed to regain gauge accuracy and is listed first. The additional adjustments are listed in a sequence that is recommended when more extensive adjustments are necessary including replacement of movement and linkage.

The following view identifies the gauge component parts and terminology used in calibrating pressure gauges.



(Continued on Page 8)

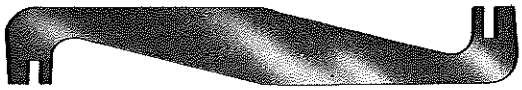
MISCELLANEOUS SMALL TOOLS FOR GAUGES



HAND
JACK
SET

Figure
No. A3220

Used to remove and drive pointers on pinion shafts. Consists of Gauge Pointer Remover.



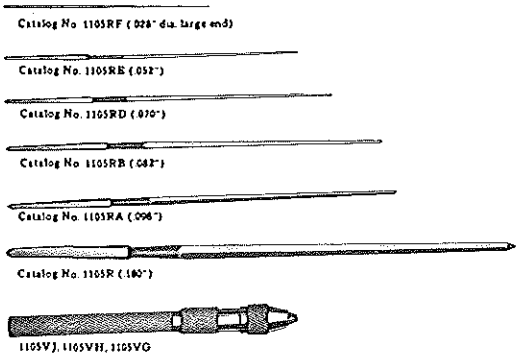
WIGGLER
Figure No. 1165W

For adjusting connection links to eliminate bind.

WRENCHES

A good selection of Wrenches should be available to ensure the proper connection of gauges. Gauges should be connected by applying force to the wrench flats on the socket. They should never be connected by applying force to the case.

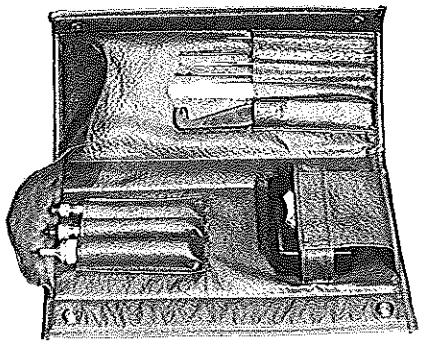
Note: Even though Gauges are heavier and more rugged than many other fine devices, they are still precision instruments and should be handled as such. Proper treatment of them results in long, accurate and economical service life.



REAMERS AND PIN VISE HOLDERS

For Reaming Pointer Bushings to
Fit on Movement Pinion Shaft

These Reamers are for use with Replacement Pointers. They are necessary because it is impractical to hold pinion shaft manufacturing tolerances close enough to permit interchangeable pre-reamed pointers. Replacement Pointers should be reamed to fit on the pinion shaft at a suitable height above the dial. Six reamer sizes are available to cover the entire range of pinion shaft sizes.



GAUGE TOOL KIT
Figure No. 1105T

For complete gauge maintenance. Kit includes Hand Jack Set, Rear Calibration Screw Driver, five Reamers, two Pin Vise Holders, Wiggler and Tweezer. All packed in a neat Carrying Case.

TWEEZERS
Figure No. T-1105TW
For Adjusting Hairsprings

Proper hairspring adjustment is essential to accurate gauge functioning. Hairsprings must be level and set so coils will not rub each other when they are wound.

Pointer Adjustment

Calibration that can be corrected by repositioning the pointer relative to the scale is called "rezeroing" the gauge. Some gauges are furnished with easily adjustable pointer reset devices that do not require removal of the pointer from the movement. Pointer reset devices are of the following types:

a) Adjustable pointers include the micrometer adjustable geared type and the friction type with a knurled bushing or with a screw driver slotted bushings.

b) Another method used to reset pointers is by rotating the movement. Here, a cam causes a slight rotation of the movement with a consequent shift in pointer position. This is not a complete recalibration as pointer resetting is only one part of calibration.

Where non-adjustable pointers are used, it is necessary to loosen the pointer with a pointer remover and retighten at the required position.

Adjustment for Sluggishness

Clean all bearings and gear teeth. Adjust the hairspring as recommended in the following steps, taking special care not to overtighten as too much tension causes friction and drag. Check link for binding and bend the link slightly with a "wiggler" if needed. Test for freeness of parts by deflecting the segment and letting it spring back. Free parts will vibrate and produce a characteristic sound. This test is run without a pointer.

Hairspring Adjustment

The function of the hairspring is to take up clearance in the movement and linkage. Its perfect adjustment is a vitally important step in calibration:

a) Hairsprings should be adjusted with a tweezer to set them perfectly level so that when wound up approximately 360° they will not distort.

b) Wind hairsprings tight enough to have torque throughout the whole range. Most Ashcroft gauges have the hairspring tightly wound at the zero pressure position. This is the safest position because should parts wear, due to unusual pulsation or vibration, the pointer will shift in a plus direction. Thus, more pressure will be indicated than that which actually exists in the pressure vessel.

Span Adjustment

A span adjustment is required when the pointer motion is uniform as uniform pressure changes are applied but the pointer goes excessively beyond or is short of the maximum scale value when the maximum range pressure is applied. To correct this condition the segment pivot radius requires adjustment. To reduce the pointer travel the pivot radius is increased. To increase the pointer travel the pivot radius is decreased.

The change in radius is accomplished in a number of ways depending on the movement design. Some designs utilize a separate piece that can be moved when the lock screws are loosened; others by a sliding pivot whose position can be locked in place.

In the low cost gauges the radius is adjusted by bending the metal crank.

Linearity Adjustment

This adjustment is required when the motion of the pointer either slows down or speeds up at the end of the range as the pressure is increased in uniform increments. The condition is readily corrected when the gauge includes a rotary movement. To speed up the motion of the pointer at the end of the range the movement is rotated in the downward direction which causes the angle between the connection link and the centerline of the segment to become larger. To slow the motion at the high end of the range the movement is rotated upward. Readjustment of the segment pivot radius is often required in conjunction with linearity adjustments.

Gauge designs that do not include a rotary design movement will require bending of the Bourdon tube tip or the substitution of a different length connection link to accomplish the needed change in angle of pull.

Calibration to "Better Than Normal" Accuracy

Changing hairspring tension slightly can result in "better than normal" accuracy, especially on low pressure gauges (such as receiver gauges). Try shifting the tension by an amount of one or two pinion teeth (plus or minus).

Shifting the dial slightly will also produce a certain degree of change.

Significant Calibration Features of the Ashcroft Duragauge Gauge

The Ashcroft Duragauge gauge provides the highest sustained accuracy and durability available in a production pressure gauge today. A recent added improvement is the utilization of a rotary movement that includes a thin coating of Teflon-S on the bearing surfaces to lower friction and provide a highly durable wear resistant surface. The movement design also incorporates a curved segment tail that greatly simplifies calibration for 4½" size gauges and lowers the calibration time of larger size gauge. The design eliminates the interaction between linearity and span adjustment on 4½" size gauge and reduces the interaction on larger size gauges.

The Duragauge gauge also includes a micrometer pointer to permit accurate re-zero adjustment.

CALIBRATION OPERATIONS

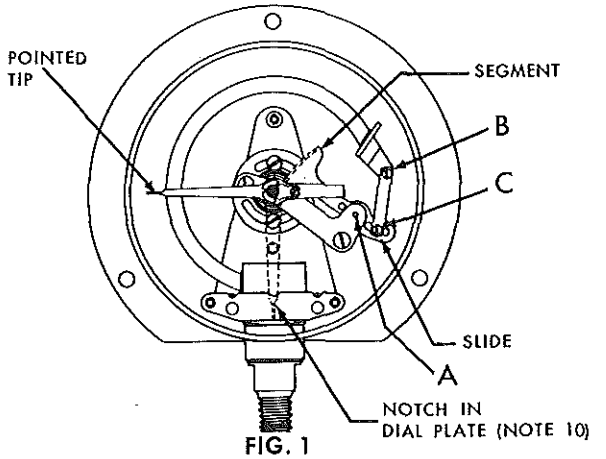


FIG. 1
POINTER AT 6 & 9 O'CLOCK POSITION

Straight Pressure Ranges:

1. Position movement bottom plate in system back plate locating hole and lightly secure movement with the two mounting screws.
2. With the gauge at a pressure corresponding to the lowest scale values, rotate movement until the distance between the segment shaft hole (A), and the

tube tip link hole (B) is the same as the distance between holes (B) and (C) in the link. Tighten the movement mounting screws.

3. With (B) disconnected, rotate the segment upward to disengage segment from pinion and wind hairspring until it just begins to distort; then re-engage segment and secure link to tip with link screw.
4. At zero pressure and with dial removed place pointer on the pinion shaft in the horizontal position with pointer tip at 9 O'clock. (See Fig. 1.)
5. Apply pressure equal to full range and adjust slide until pointer tip is centered in the notch on the dial mounting plate at 6 O'clock. (See Fig. 1.)
6. Reduce pressure to zero and adjust pointer if necessary to 9 O'clock position. If pointer adjustment was required repeat #5.
7. At zero pressure remove pointer and attach dial.
8. Apply pressure equal to mid scale figure interval and place pointer on pinion shaft at mid scale figure interval.
9. Apply pressure and check calibration at intermediate points.
10. Apply the same recalibration procedure for Maxisafe gauges that do not require dial removal. The 6 O'clock position is obtained by aligning the pointer with the Ashcroft Shield on the dial.

Vacuum and Compound Ranges:

The same procedure described for calibrating straight pressure ranges is to be used except the movement is to be positioned with full vacuum applied. Also, the correct pointer travel is to be gaged by utilizing the dial as a reference for all adjustments.

SPECIAL CALIBRATION PROCEDURE FOR LIQUID FILLED GAUGE

The Ashcroft liquid filled gauges are designed for service on applications where experience has shown that reduced performance of non-liquid filled gauges occurs. Such installations usually involve atmospheric corrosion or where excessive wear occurs the reduced performance is caused by instrument vibration and/or pressure pulsation. The tests of liquid filled gauges have demonstrated that they have marked improvement in long term performance on applications of this type, however, some change in accuracy is expected. The following are special instructions that are applicable where recalibration of these instruments are required.

Procedure for 45-1279 L Liquid Filled Duragauge Gauges

1. Hold the gauge in the horizontal position with the dial facing up and remove the ring, window and related parts by unscrewing the three ring assembly screws.
2. Hold the gauge over a large mouth container and drain the liquid by removing the plug and tilting the gauge.
3. Calibration correction requiring only a "Zero" adjustment may be made at this point without any further disassembly. A screwdriver is all that is needed to reposition the micrometer adjustable pointer.
4. When linearity adjustments are required, the pointer and dial must be removed. Remove the pointer with a pointer jack. To remove the dial use a razor to cut thru the sealant bead around the edge of the dial. Remove all dial mounting screws and lift dial.

   Note: Shave sealant from the edge of the dial and from the inside of the case.

5. Calibrate the gauge following the procedure included in section headed "Calibration of Pressure Gauges". **Important** — Care must be exerted to prevent foreign particles from entering the inside of the case. Gauges filled with glycerine may be washed with water; those filled with silicone may be washed with petroleum ether.
6. Apply a bead of RTV sealant around the upper 220° of the dial and under the top dial mounting screw. Use Dow Corning RTV 732 for glycerine filled gauges and allow 3 hours for curing. Use Dow Corning RTV 733 for silicone filled gauges. Allow 72 hours for curing. Assemble glass and ring by tightening screws uniformly to 25 In. Lbs.
7. With the gauge held in the vertical position fill the gauge slowly with a new liquid or with used liquid that has been filtered thru No. 90 filter paper.

   Note: Some of the blue coloring will be filtered out during the filtering process. The proper amount of filling will occur when the liquid has risen a little above the dial center and begins to overflow the fill hole. Approximately 12 ounces of liquid is required.

8. Insert the filler plug and tilt the gauge so that the air is transferred to the rear of the dial.

Procedures for 2½" and 3½" — 1009 L Liquid Filled Gauges

1. Loosen the ring using a strap wrench or equivalent.
2. Hold the gauge over a large mouth container and drain the liquid from the case.
3. Calibration correction requiring only a "zero" adjustment may be made at this point without any additional disassembly. A suitable screwdriver is all that is needed to reposition the pointer.
4. When linearity adjustments are required the system with dial attached must be removed from the case. Remove the system to case mounting screws, cut the sealant around the socket shank and force the system from the case. Trim away the sealant from the socket and case before reassembly.
5. Calibrate the gauge following the procedures included in section headed "Calibration of Pressure Gauges". **Important:** Care must be exerted to prevent foreign particles from entering the inside of the case. Gauges filled with glycerine may be washed with water; those filled with silicone may be washed with petroleum ether.
6. To reassemble the case apply a continuous bead of Dow Corning RTV 3145 sealant for glycerine filled gauges and RTV 733 sealant for silicone filled gauges, around the socket shank, also in and around the tapped mounting holes. Tighten the case mounting screws. Allow 12 hours for curing RTV 3145 and 72 hours for curing RTV 733.

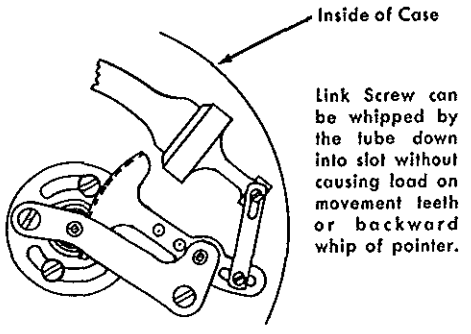
7. Tighten ring to case using a strap wrench. Hold the gauge in the vertical position and slowly fill the gauge with the filling fluid until the liquid rises to a level 3/8" below the top of the dial. Fill with new liquid or used liquid that has been filtered thru No. 90 filter paper. Replace the plug.

BENT POINTERS — CORRECTIVE MEASURES

BENT POINTERS are usually caused by a sudden increase or decrease of pressure. Gauges can be protected from this type of damage by the use of a link that is slotted at one end. When ordering new gauges for service that includes rapid pressure changes include the specification "gauge to be furnished with slotted link for sudden decrease pressure" or — for sudden "increase pressure".

BENT POINTERS may indicate the need for throttling devices. The Ashcroft Gauge Saver is recommended. An important advantage of this Saver is that it will not plug. When the Gauge Saver cannot be used (because of temperatures over 150°F. or because of service which will damage the Neoprene bulb) a Chemical Seal with dampening felts can be used. On clean liquids and on gases, other types of throttling devices can be used.

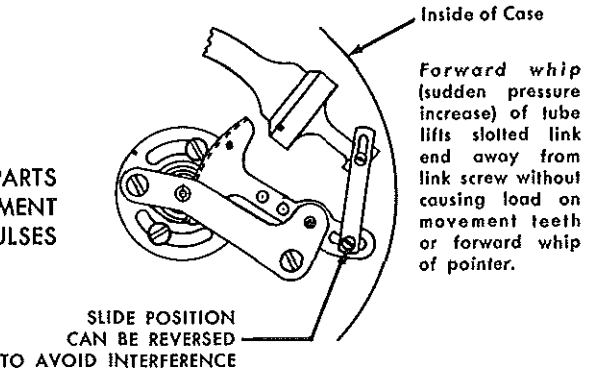
ARRANGED FOR SUDDEN DECREASE



SLOTTED LINK

HAIRSPRING KEEPS PARTS IN PROPER ENGAGEMENT UNDER NORMAL IMPULSES

ARRANGED FOR SUDDEN INCREASE



To convert gauge in the field, specify gauge size, direction of pressure surge and gauge range. Both movement and link change is required for sudden decrease service.

The figures show the gauge construction with slotted link. Note that the hairspring assembly is of vital importance. A slotted link should never be used if pulsating pressures are involved because the pointer may whip around and read considerably in error.

Pointers bent or indented by hitting the bottom edge of the stop pin are an indication that the gauge has been subjected to considerable over-pressure. For safety, the condition should be corrected or a higher range gauge should be used.

HOW TO MAKE ASHCROFT PRESSURE GAUGES LAST LONGER AND STAY ACCURATE WITH MINIMUM MAINTENANCE

Gauge Selection

Gauges are precision instruments. Handle them carefully.

Select a standard range gauge that is graduated to about double the average working pressure. This assures reserve strength to make the gauge last longer and the pointer will be easier to read at about top center of the dial.

Be sure to select gauges with the proper Bourdon tube metal and joint metal for the particular application.

Ashcroft Duragauge gauges and solid front gauges are noted for long life. It will be found that it is much more economical to use these gauges because of much longer, trouble-free service-life.

Gauge Installation

Always use a wrench on the square shank of the gauge socket to screw the gauge in place. Never apply force against the gauge case.

To screw a fitting to the gauge, hold a wrench on the socket flats. Do not twist against the gauge socket screws which hold the gauge mechanism in the case.

When installing a gauge on a wall or panel be certain that it is connected free from piping strains. Make sure the mounting surface is flat or insert washers under the flange of the gauge case to obtain three-point suspension. Preferably, the last length of piping leading up to the gauge should be flexible tubing. This insures that the gauge is free of piping strain.

Stem mounting eliminates problems of piping strain and is most economical.

Install gauges where they will not be affected by mechanical vibration, as this will wear out any gauge quickly. If possible, mount the gauge on a nearby wall and use flexible tubing to connect the gauge to a badly vibrating machine.

Protect gauges from frequent pressure pulsations by using throttle screws in the socket of the gauge, needle valves, pulsation dampeners, or Ashcroft gauge savers (See Pgs. 18, 19, 20, 21)

When mounting a gauge to indicate steam pressures, install a siphon filled with water between the gauge and the line. When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg to allow cleaning out of sediment. To compensate for the head effect of this piping leg, reset the pointer of the gauge.

Locate gauges where they will not be subject to high heat. In addition, high temperatures make gauges inaccurate (See Chart Page 12). Low cost gauges with soft soldered joints must not be heated or the joint will lose strength.

Install the gauge where it will be safe from moisture and corrosive fumes, if at all possible. Should this condition be unavoidable, ask your Distributor or contact Dresser-Industrial Value & Instrument Division for special recommendations.

Proper Gauge Use

Apply pressure slowly by gradually opening the gauge cock or valve. Quick opening of a gauge cock or valve places a severe strain on the Bourdon tube which may affect accuracy.

When the service has sudden pressure applications, use a needle valve or the Ashcroft gauge saver to throttle the pressure change.

Sudden pressure release has the same bad effects as sudden pressure application. It can be compensated for in the same way (See paragraph above).

Avoid over-pressure. Be sure that the apparatus has a relief valve and that the range of the gauge is higher than the set pressure of the relief valve.

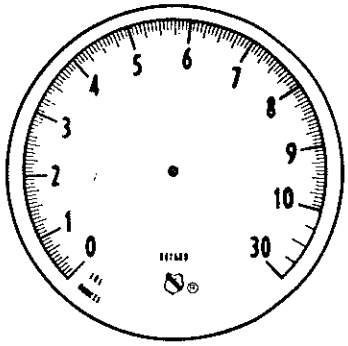
Replace broken dial covers immediately. This will help keep dirt out of movement bearings and gear teeth.

GAUGES WITH RETARD MOVEMENTS

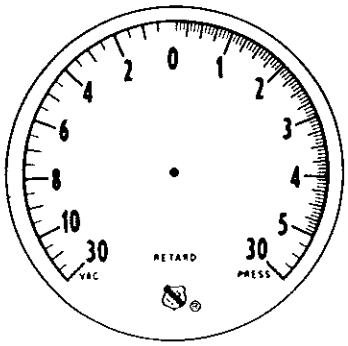
A retard gauge is one in which a portion of the total scale reading is spread out over approximately 90% of the dial. This is attained in the following manner:

A spring is attached to the gauge movement assembly so that, at the required point in the range of the gauge, the gauge movement arm comes in contact with the spring. This increases the proportionality of pressure to pointer rotation. The increased proportionality can be seen as a compressed portion of the dial scale

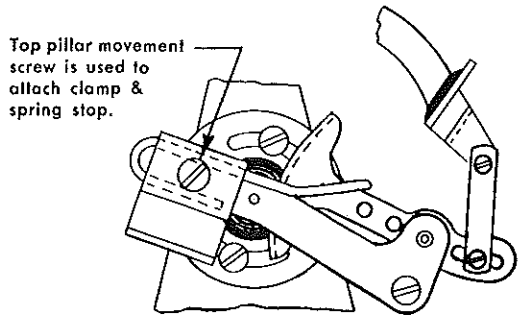
Retard movements are available for Ashcroft Duragauge and solid front gauges.



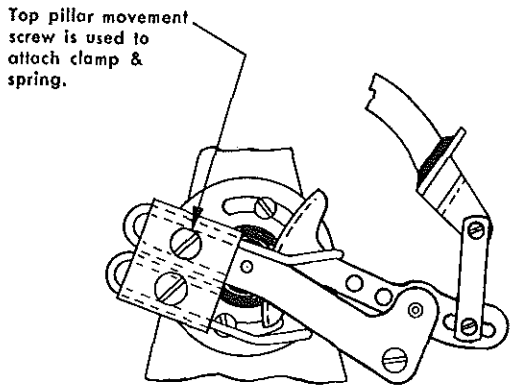
SINGLE RETARD
0 to 30 psi Dial



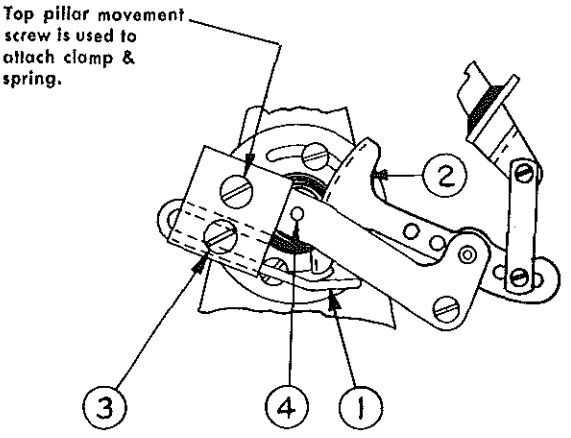
COMPOUND RETARD
30 psi and 30" Vac. Dial



ASHCROFT DURAGAUGE GAUGE SINGLE RETARD
(Vacuum)



ASHCROFT DURAGAUGE GAUGE
COMPOUND RETARD



ASHCROFT DURAGAUGE GAUGE SINGE RETARD
(Pressure)

The Retard Movement feature enables the gauge reader to see his normal range of pressures on an expanded scale and, it still provides the means to read pressures well outside the normal operating range.

TO CALIBRATE THE RETARD GAUGE

A. Calibrate the scale up to the retard portion in the usual manner. Make sure that the retard spring (1) does **not** contact the movement segment (2).

B. The retard portion of the scale is calibrated by adjusting the retard spring (1) to contact the movement segment at the exact start of the retard scale. The wire spring may be bent slightly to adjust the point of contact.

C. Increase the pressure to the top of the range. If the pointer runs over the pressure marked on the dial:
   1 Reduce the pressure.
   2. Loosen screw (3) that holds spring (1).
   3. Move spring (1) a small amount toward the pinion (4).

   (If the pointer runs below the top of the dial, pull out the spring).

D. Repeat steps B and C to obtain the contact of the spring at the start of the retard portion of the dial and to obtain the correct strength of the retard spring by adjustment of its length. Fine adjustment of the spring can be made with the wiggler tool (Catalog No. 1105W). Do not expect the retard portion of the scale to be as accurate as the unretarded range.

SAFETY RECOMMENDATIONS

Be sure the gauge has the proper range and construction for the service.

Follow installation instructions carefully.

If installation instructions cannot be followed, check gauges periodically for the effects of water, corrosion, vibration or other adverse conditions.

If special service is called for, ask your Distributor or Dresser-Industrial Valve & Instrument Division for the gauge that will fill the special requirements.
NOTE: A good gauge, properly selected and installed, should never fail by rupture of the Bourdon tube. However, on rare occasions, some failures do occur. These are generally caused by corrosion due to misapplication of material, high overpressure, shock pressure or large and frequent pressure pulsation.

Maximum Safety

The solid front gauge provides maximum safety with a solid wall between Bourdon tube and glass dial cover. This tough and protective wall is essentially gas tight and prevents the glass from being blown out of the case should the tube fail. The force of the break is thus expended toward the rear. A large blowout disc is provided in the back of the case to vent the pressure caused by a ruptured tube.

The Maxisafe Duragauge also features quick and easy access to operating parts — without removing the dial.

As an added safety feature a blowout disc is installed in conventional Ashcroft Gauges such as the Duragauge. A special synthetic rubber disc is used which is especially designed for Refinery gauge appli-

cations. This disc has greater corrosion resistance than metal blowouts, and makes a more practical dust and moisture-proof seal. It is applied in a 1" diameter hole drilled in the wall or back of the gauge case. This disc blows out at low pressure – well below the breaking pressure of even plain glass for gauge sizes up to 8½".

As a substitute for glass covers, plastic or shatterproof glass can be provided to attain the advantages afforded by these materials.

Temperature Affect

Rarely will full service line temperature be attained in the Bourdon tube itself. This is because the line to the gauge tube is a dead-end and cools. For that reason, when gauges are piped into high temperature service lines, it is recommended that the line leading to the gauge be as long as possible. A connecting line about 5 to 6 feet long will usually reduce the temperature of the gauge to approximately normal atmospheric temperature.

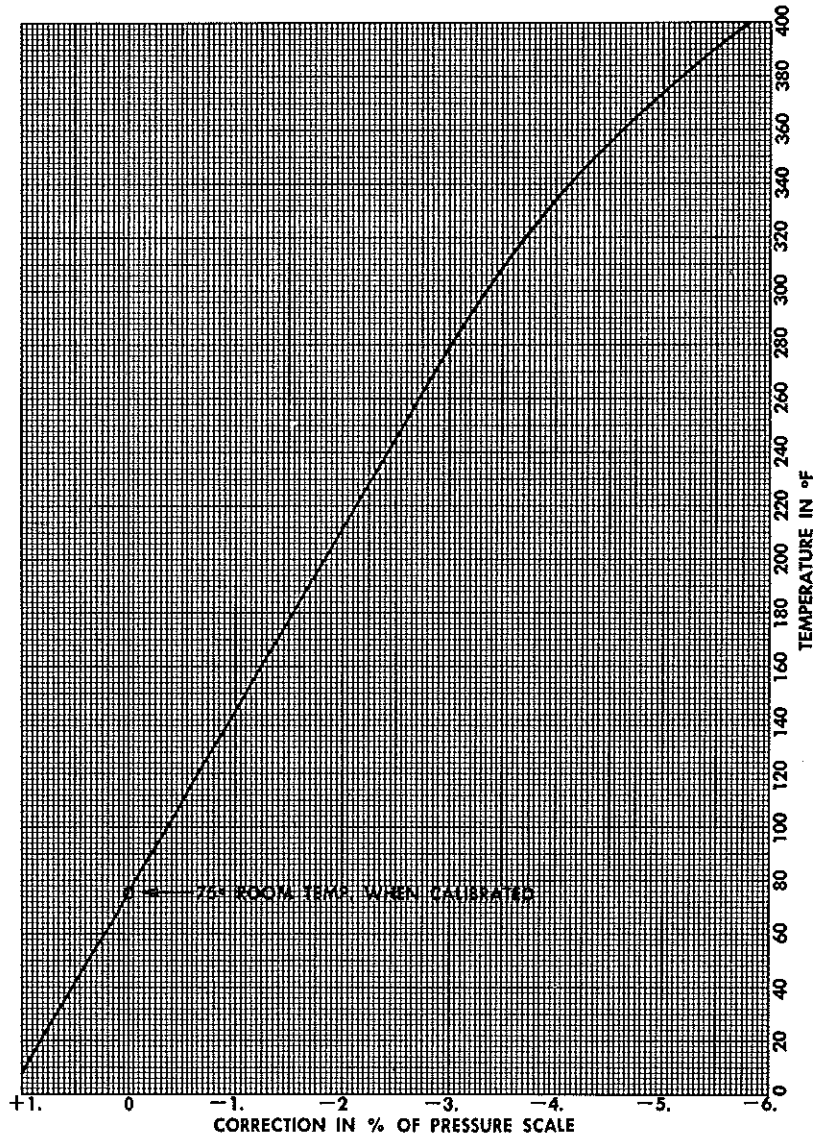
This generally keeps gauge temperature below 150°F even when the process line temperature may be quite high. When the fluid measured is steam, or another hot vapor, a siphon or other liquid-filled tube should be used between the line and the gauge. This should provide the needed drop in temperature.

The effect of temperature on gauge accuracy is shown by the following graph.

Other than discoloration of the dial and hardening of the gasketing that will occur as ambient temperatures exceed 150°F, metal and phenol case gauges, that are not liquid-filled, can withstand continuous ambient temperatures to 350°F.

HEAT AFFECTS GAUGE ACCURACY

Approximate error or change in calibration of a Bourdon tube type Pressure Gauge caused by changes in temperature.



EXAMPLE: Gauge working at 500 psi pressure and at 280° F. temperature would have a –3% correction and would read 3% or 15 psi fast .Temperatures over 150° F. are not recommended.

Adequate line length between the gauge and process fluids that are cold will also allow the gauge to operate at ambient temperatures. Where ambient temperature is low, gauge heaters are recommended to minimize the temperature changes affect on accuracy.

CALIBRATION CHANGES ON GAUGES

Drift

Presure elements of all Ashcroft Gauges are given a stress relieving heat treatment that prevents drift due to aging. Gauges that have been overpressured in service so that the Bourdon tube has set (a zero shift seen as a failure to return to zero) should be discarded because drift may be expected due to internal stresses.

Overpressure

When a gauge is overpressured to the extent of causing a pointer position shift of equal value all over the dial, the condition is known as "Set." If this occurs, the system should be discarded and replaced.

Bourdon Tube Corrosion

Corrosion of a Bourdon tube will result in a weakening of the tube, causing an error of indication that is greater at the high end of the scale than at the low end. For example, error on a 100 psi range may be +2 at 10 psi, +10 at 50 psi and +18 at 90 psi. Frequently corrosion proceeds so quickly that the tube will rupture before a change in indication is detected.

Bourdon tubes may fail from corrosion, overpressure fatigue from pulsation, hydrogen embrittlement or pressure shock. These conditions are often difficult to find, the first indication being rupture of the tube. Corrective and preventive measures for failures of these types include proper Bourdon tube material selection, adequate pressure ranges, overpressure stops and throttling devices. Shock pressure may also be caused by an operator who opens or closes valves too quickly.

After failure, a metallurgical examination of the tube should show whether trouble occurred because of corrosion or mechanical difficulties. If failure is due to corrosion, a more suitable tube material should be chosen or, in some cases, a diaphragm attachment should be used. Recommendations of this type can be made by Ashcroft when complete service details are supplied.

Gear Teeth and Bearing Wear

Gear teeth and bearing wear can cause calibration changes. This type of wear is usually the result of vibration, pulsation, or a combination of both. Evidence of teeth and bearing wear appears on the mechanism as a powder near the point of wear.

Vibration amplitude itself may be of such a small value that it cannot be seen with the eye. Yet, if the frequency is high (such as found in a turbine running at 3600 or 7200 RPM), it can be very damaging to a pressure gauge.

Gauges subjected to high frequency vibration should be isolated if at all possible. If the gauge cannot be isolated, dustproof gauges may be treated with a high quality instrument oil that will help lengthen their life. A more certain solution is to use the higher quality Ashcroft Duragauge in place of a lower quality gauge, especially the Ashcroft Liquid Filled Duragauge.

Mishandling

Dropping, or hitting a guage can cause calibration shift. Gauges are genuine precision instruments and must be treated accordingly. Proper care of the gauge will lengthen its service to you, help to retain its accuracy and to lower maintenance and replacement costs.

REPLACEMENT PARTS FOR GAUGES

Gauge System Assemblies

When replacing a gauge system be sure to use the same system material originally used in the gauge — unless service shows that another material should be chosen. Ashcroft Duragauge gauge dials identify the material of the system and sockets are stamped with catalog suffix letter code for material.

Bourdon tube joints are designed to meet specific service requirements. Ashcroft Duragauge gauges have welded joints with the exception of bronze and beryllium copper systems which are silver brazed. On welded systems weld material is the same as the base metal. On lower quality gauges soft solder may be used. Soft solder joint systems must not be used on high temperature application as joint strength is not adequate. Although gauges should be protected against temperatures exceeding 150° F., welded joints will stand 750° F., silver brazed joints 450° F., and soft soldered joints 250°F. for short times without rupture although other parts of the gauge will be destroyed and calibration will be lost.

When replacing a gauge system be sure to use the proper pressure rated system. This is identified on the system by the stamped range value.

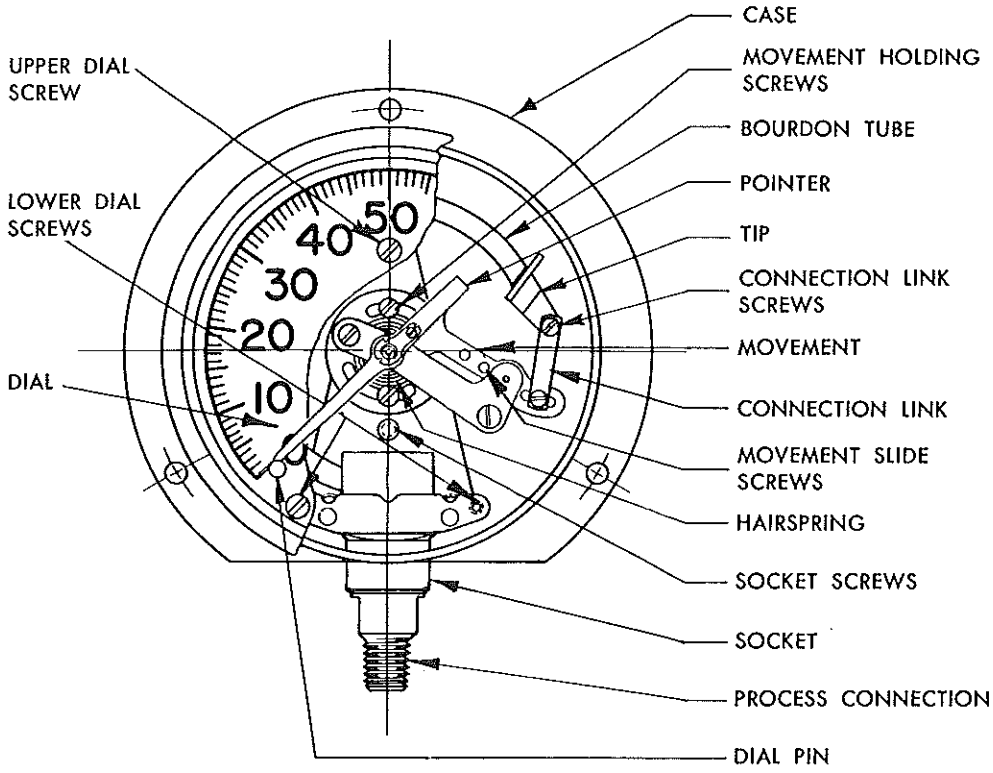
The Lower Connection Gauge Illustration (See Page 14) shows gauge parts and standard names. Use these names to facilitate the ordering of parts and to eliminate any misunderstanding in describing gauge construction.

Specify as much of this data as possible:

Size (Dial diameter)
Case material (Iron, Alumalife, Phenol)
Ring design (Slip, Threaded, Snap, Hinged)
Connection location (Lower, Back)
Connection size (¼", ½", etc.)
Bourdon Tube Material
Dial Range
Class of Gauge
Catalog Number if possible; otherwise mention whether parts are for Duragauge, Quality Gauge or Special Application Gauge.

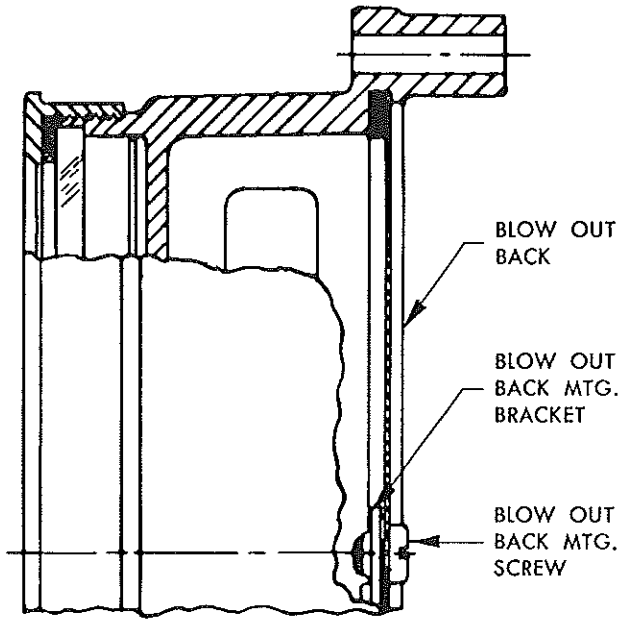
GAUGE PARTS

LOWER CONNECTION GAUGE SHOWN

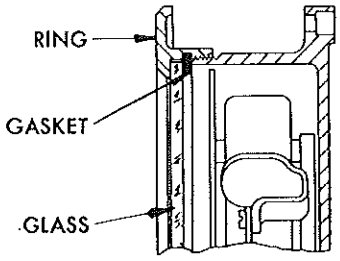


NOTE: The socket, tube and tip is furnished as one integral unit. The movement is supplied complete.

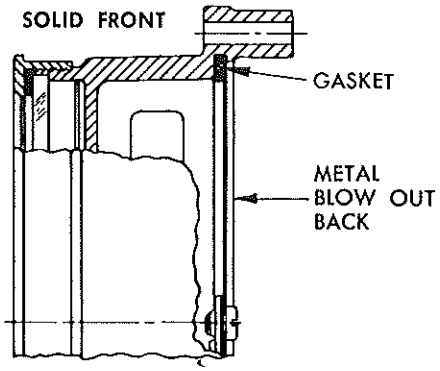
SPECIAL PARTS FOR SOLID FRONT DURAGAUGE



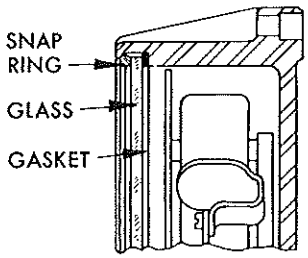
4½" & 6" GAUGE WITH THREADED METAL RING



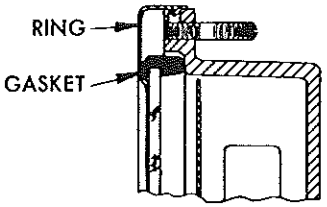
SOLID FRONT



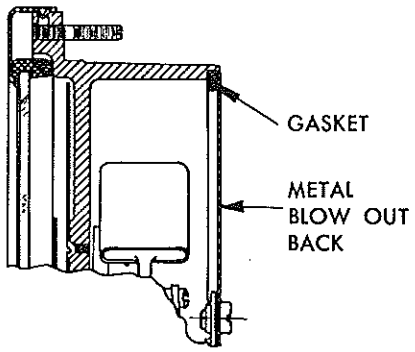
WITH SNAP RING



4½" & 6" GAUGE WITH HINGED RING

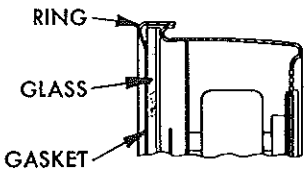


SOLID FRONT

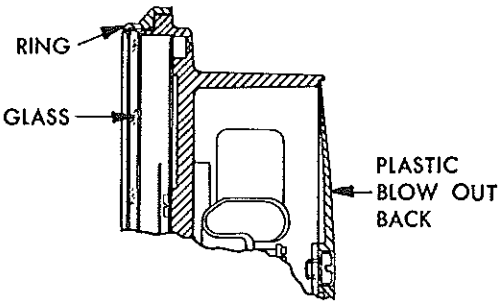


WITH BAYONET LOCK

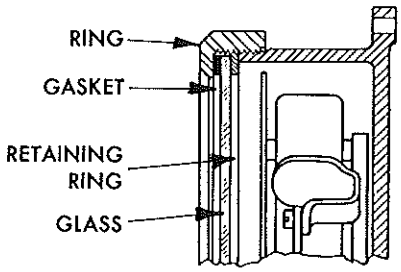
ST. ST.



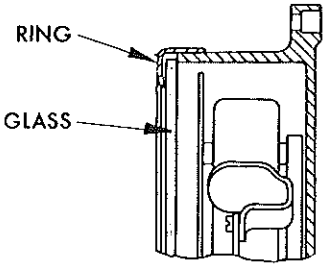
PLASTIC — SOLID FRONT



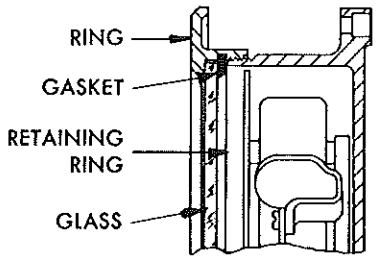
WITH THREADED PHENOL RING



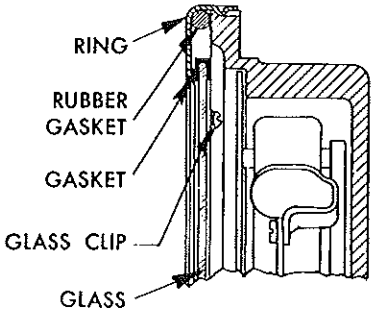
WITH SLIP RING



8½" GAUGE & OVER WITH THREADED METAL RING



8½" AND OVER WITH HINGED RING



MOVEMENT ASSEMBLIES FOR GAUGES

Ratio of Movement

When movements are replaced be sure that the proper ratio of movement is used. On Ashcroft Duragauges the ratio is stamped on the segment of the movement. With a little experience it is easy to recognize the ratio by the size of the pinion gear.

Material

The proper material is of prime importance in the selection of movement assemblies. Brass movements will not wear as well as Ashcroft Stainless Steel movements. Duragauge movements are stainless steel with Teflon "S" coated contact surfaces for greater wear resistance. The proper link and link screw must be used. A high quality movement will not stand up if a low quality link or link screw is used.

Replacement Pointers

Replacement pointers received from the manufacturer must be reamed so that when driven on a pinion they will be at the correct height (1/16" to 1/8") above the dial. A complete selection of reamers (6 sizes in Catalog No. 1105 Series) is shown on Page 7.

Gauge Movement Ratios

Gauge sizes to 3½" inclusive — 12:1 Ratio
"Quality" Gauges, All Sizes — 12:1 Ratio
"Duragauges" — As listed below in Table

Duragauge Type in Terms of Tube Material	Maximum Dial Graduation P.S.I.	Movement Ratio		
		12:1	16:1	25:1
All Materials (Drawn Tubes)	1000	x		
4½" Size — (Bored Tubes)	Over 1000 to 20,000 inclusive		x	
6" Size and Larger (Bored Tubes)	Over 1000 to 14,999 inclusive		x	
6" Size and Larger—Beryllium Copper Only	100 to 500 inclusive Over 500 to 20,000 inclusive	x	 x	
6" Size and Larger—All Materials Except Beryllium Copper	15,000 and 20,000 inclusive			x
6" Size 1382	30,000 to 100,000 inclusive		x	

ASHCROFT TYPE 1165 & 1166 ELECTRIC WARNING CONTACTS

Electrical Ratings

The Ashcroft Type 1165 and 1166 Electric contacts have been checked for continuity and are ready for operation. The contacts are rated at:

Volts	Amps.
120 AC	½ IND.
24 DC	½ RES.

Accuracy

Due to the slight drag of parts of the Electric Contacts, an additional ½ of 1% accuracy tolerance is added to the gauge for up to 20% rotation of a single contact except ranges 30 psi and under, which require up to 3% added tolerance. The accuracy is only slightly affected when the contacts are not rotated. The two contact arms can be set as close together or as far apart as wished. The make and break points are the same (within about ½ %) for either of the contacts.

Mounting

Wall mounting Duragauges or Maxisafe Duragauges equipped with Type 1165 Electric Contact is the same as mounting standard gauges. Each gauge contact ring assembly provides a ½" NPT female connection for attaching flexible electrical conduit.

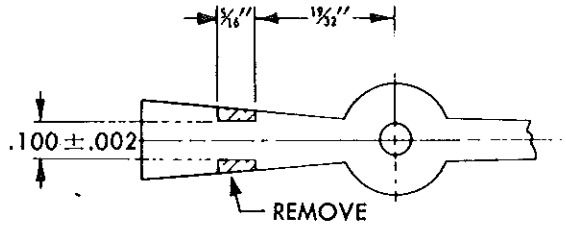
Flush mounting Ashcroft Duragauge or "solid front gauges," Series 1077, 1377, etc. equipped with Type 1166 Electric Contacts requires panel modifications in accordance with the Panel and Gauge Modification Table on Page 16.

Application of Type 1165 Electrical Contact to wall mounted Ashcroft Duragauge gauges, solid front and Quality gauges, and Series 1079, 1379, 1010, etc. in the field.

1. Accommodations for contact lead wires are provided in ring assembly.
2. On gauges with wide tail section that do not permit the yoke to fit freely modify the pointer as illustrated on page 16, or ream the furnished spare pointer to fit and substitute on gauge assembly.
3. Assemble contact ring assembly to the case by placing the yoke of the electric contacts over the tail end of the gauge pointer.
4. Mount ring assembly and tighten set screws.

Application of Type 1166 Electrical Contact to flush mounted Duragauges and Maxisafe Duragauges, Series 1077 and 1377 in the field.

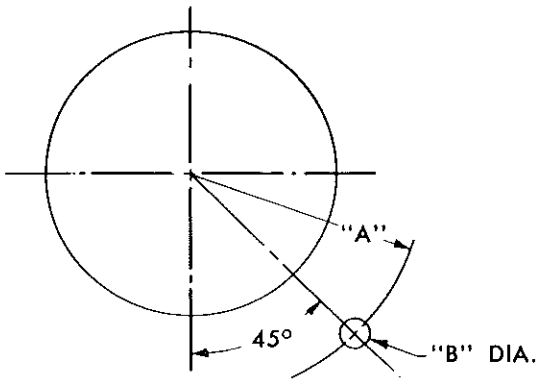
1. On gauges with wide tail section that do not permit the yoke to fit freely modify the pointer as shown in figure 27 drawing or ream the furnished spare pointer to fit and substitute on gauge assembly.



2. Make an additional hole through the gauge case and the mounting panel — of the size and location shown in Panel and Gauge Modification Table for the passage of the contact leads.
3. Pass the contact leads through the holes in the gauge case and panel.
4. Assemble the ring assembly to the gauge by placing the yoke of the electric contacts over the gauge pointer.
5. Mount ring assembly and tighten thumb screw.

PANEL AND GAUGE MODIFICATION TABLE

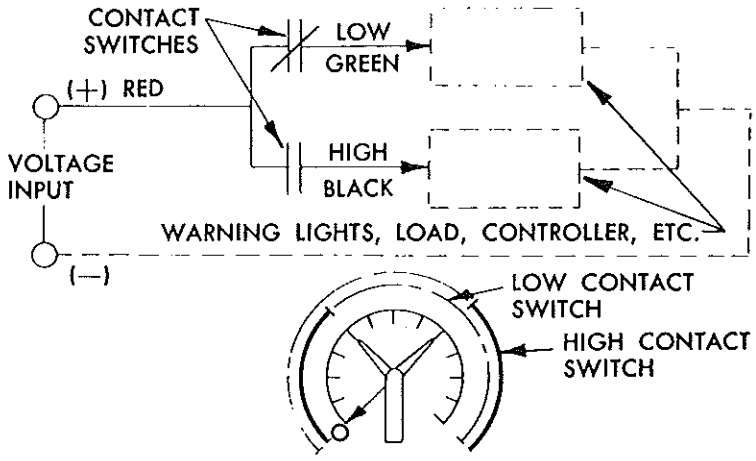
Gauge Size	A	B (Lead Hole)	
		Panel	Gauge
4½"	2 3/4"	¼"	¼"
6"	3 3/4"	¼"	¼"
8½"	4 3/4"	¼"	¼"



WIRING

These Schematic Wiring Diagrams illustrate contact arrangements for both the 1165 and 1166 Electrical Contacts. They indicate wire color code and the higher and lower contact settings.

DOTTED LINES INDICATE CUSTOMER WIRING

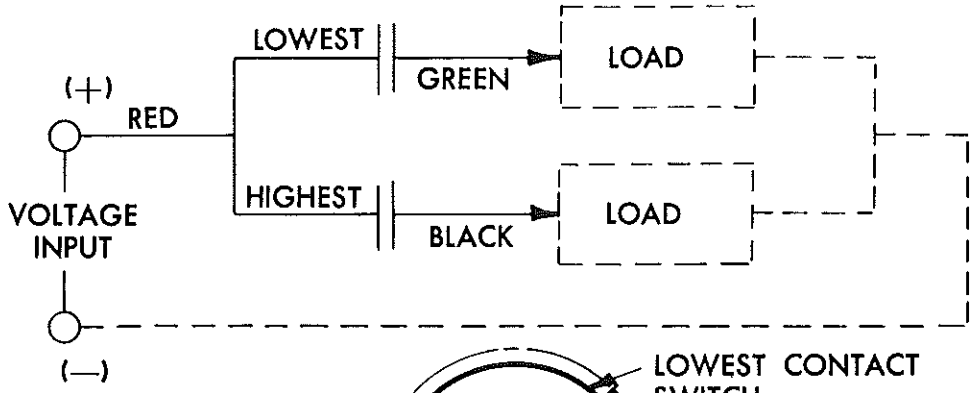


HIGH AND LOW

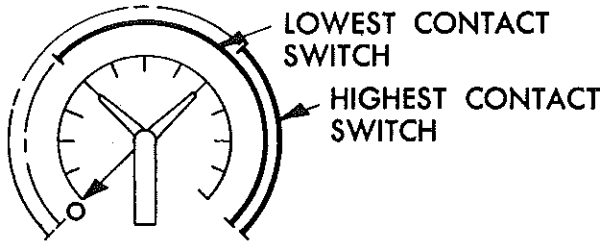
CONTACT CONDITIONS ARE SHOWN AT ZERO PRESSURE

DIAL SETTING

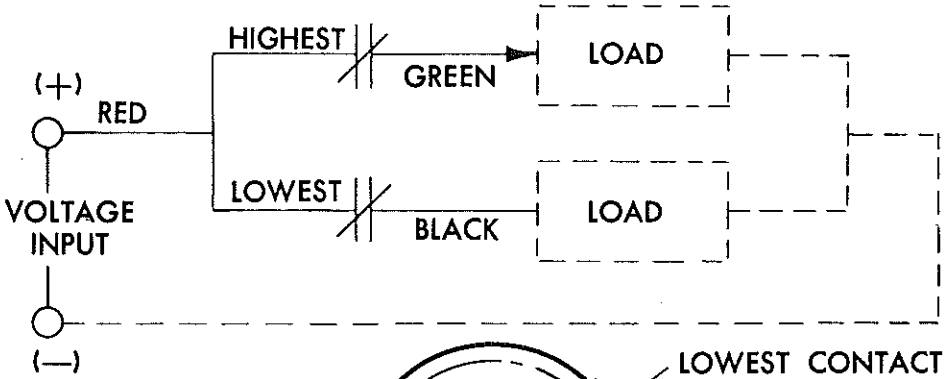
Broken lines indicate contact open.
Solid lines indicate contact closed.



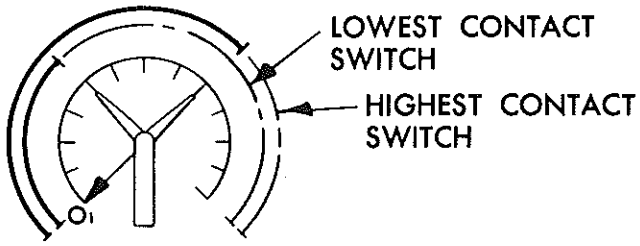
DOUBLE HIGH



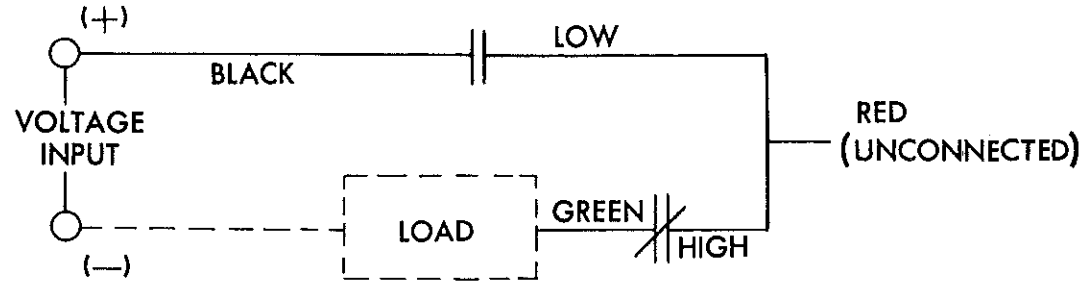
DIAL SETTING



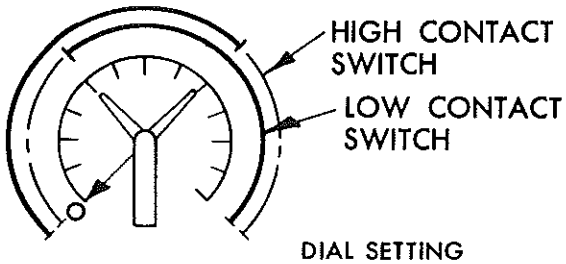
DOUBLE LOW



DIAL SETTING



OFF HIGH AND LOW



DIAL SETTING

THROTTLING DEVICES

Some type of Ashcroft Pressure Throttling Device should be used when the pressure gauge is subjected to constant and rapid pressure fluctuations. A throttling device radically reduces pressure impact, slows speed and range of pointer movement, helps prolong the life of the gauge and, in some types, acts as a safety device.

Several Ashcroft throttling devices will do this. They are all based fundamentally on providing a restricted orifice through which service pressure fluctuations must pass before they can reach the Bourdon tube of the gauge.

Ashcroft Gauge Saver

Under proper conditions, the Ashcroft Gauge Saver is the ideal pressure throttling (or dampening) device. It is unique in that a synthetic rubber bulb seals off the service pressure fluid from the gauge itself. No dirt can possibly get in, and, once the desired throttling rate is determined, it remains unchanged. The bulb also prevents any corrosive action from attacking the Bourdon tube.

The rubber bulb and the Bourdon tube of the gauge are completely filled with glycerin. This means they are absolutely free of air. Felt plugs, located between the bulb and the Bourdon tube, are compressed to restrict the flow of glycerin. This flow occurs when pressure acts on the outside of the bulb. The throttling effect is produced by the viscosity of the glycerin in conjunction with the restriction of flow through the felt plugs. The amount of felt compression governs the amount of throttling.

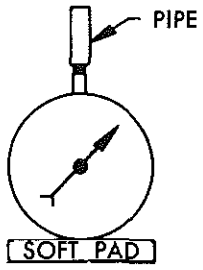
It should be understood that the gauge saver, like any throttling device, will so cut down rapid pressure fluctuations that the gauge will show an average or mean pressure.

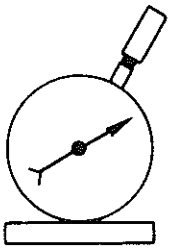
Filling the System

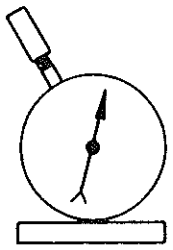
The entire system, from the tip of the gauge Bourdon tube to the bottom of the adapter bulb, must be completely filled with glycerin. If the Bourdon tube is not completely full, pressure on the bulb will collapse it.

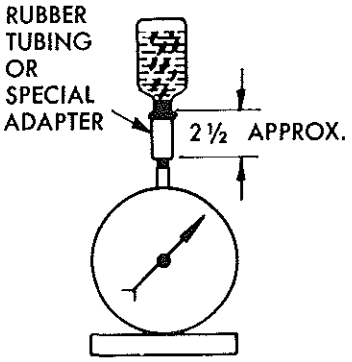
To fill the Bourdon tube completely, the air must first be removed by applying vacuum to the gauge connection. If a vacuum pump is not available to do this, the system can be filled as follows:

1. Attach a piece of pipe about 6" long to the gauge connection. Pipe must be in a vertical position. (See Figure 33).
2. Fill the pipe with glycerin, allowing it to run down into the gauge system.
3. While gauge system is filling, continually jar the gauge gently on a soft surface. This forces the glycerine to displace air in the spring. Rotate the gauge a few times to the right and left as the glycerin is going in (See Figures 34 and 35). You will see air bubbles coming up.









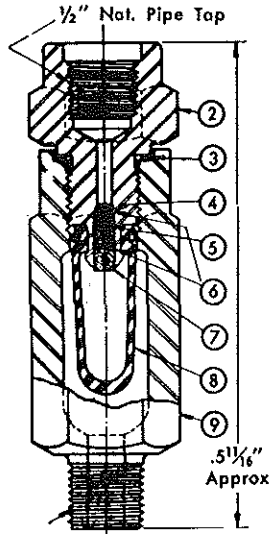
4. Continue jarring the gauge and fill until no more air bubbles come up through the glycerin, and until it is certain that the gauge system is filled.

NOTE: When the standard 2 oz. bottle of glycerin (Ashcroft Part No. AGA41) is used, it can be attached to the gauge connection by a short piece of rubber tubing. Tubing should be about ½" inside diameter for a ¼" gauge connection. With the bottle attached, gently jar the gauge on a soft surface. Air bubbles will rise in the bottle. Continue jarring until no more air bubbles rise.

5. When the gauge is filled, set it aside with connection up.

FILLING THE GAUGE SAVER

1. Unscrew the adapter (2) from the Gauge Saver cylinder.
2. Pull the bulb (8) from the adapter. If the bulb seems to stick, pry it off gently with a screwdriver.
3. Fill the adapter to the top of the threads with glycerin.
4. Screw it on the gauge. The excess glycerin will overflow and drip out through the felts (5B), thus properly saturating them.



ASHCROFT
GAUGE SAVER
Catalog No.
1073C, CT, and D Series

2. ADAPTER (Steel)
3. GASKET
4. WASHER
5. FELT PLUGS
6. STRAINERS
7. ADJUSTING SCREW
8. BULB
9. CYLINDER (Steel)

NOTE: Take every precaution to insure a perfectly tight joint at the gauge connection as glycerin leakage can collapse the bulb in service. A little nylon thread or Teflon pipe sealing tape wound around the male threads will help make a tight joint. Pipe compounds are not recommended as they might be forced into the felts 5 and clog them.

FILLING AND REPLACING THE BULB

1. Fill the bulb and push it back on the adapter. Be sure to push on the bulb flange only, so the glycerin will not squeeze out.

NOTE: Replacing the bulb will set up some pressure on the gauge. On low pressure gauges the pointer will move above zero. When this happens, pressure must be released. This is easily done by squeezing the bulb just enough to force out a few drops of glycerin until the gauge pointer returns to zero. While doing this keep the gauge upright. This insures that the weight of the glycerine and the internal parts will not exert a misleading effect on the pointer.

2. Screw the cylinder on the adapter.

The Gauge System and the Gauge Saver are now completely filled. Be sure all connections are tight. Any pressure on the bulb will now be transmitted to the gauge mechanism through the glycerin. If convenient, try out the throttling adjustment on a test pump (See Page 5) before final installation.

FELT PLUGS

The felt plugs are factory adjusted for average throttling conditions on medium pressure service. If more throttling is desired, screw in the adjusting screw (7). If less throttling is needed, loosen the adjusting screw. Usually from ¼ to ½ turn provides all the variation required.

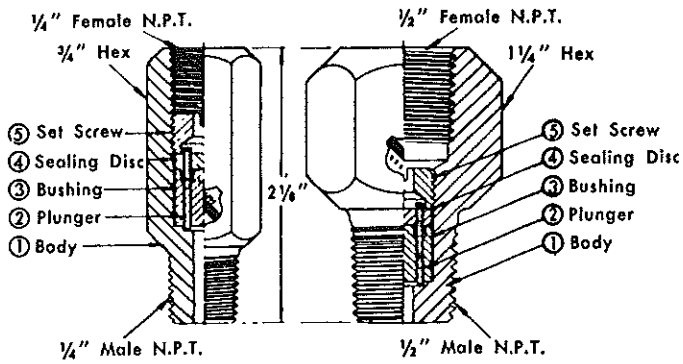
Felts should not be so loose that they are not under compression, nor so tight that they prevent the flow of glycerin through them. Looseness gives faulty readings, tightness gives no readings at all.

Throttling felts can be left out when the gauge saver is used as a safety device only, or when it is used to stop sticky fluids or harmful chemicals from entering the gauge tube.

If it is impractical to fill the gauge and gauge saver, order the Ashcroft Duragauge, complete with gauge saver, already filled at the factory.

Ashcroft Pulsation Dampener

The Ashcroft Pulsation Dampener is a moving pin type, which is a variation of the fixed orifice hole type known as a throttle screw. The difference is that the orifice is not a hole but is the clearance between a hole and a plunger. The plunger moves up and down in the hole under the influence of the pressure fluctuations. The up and down motion is self-cleaning and helps the device to remain free from plugging longer than any corresponding orifice area type in which the orifice boundaries do not move.



ASHCROFT PULSATION DAMPENER
(U.S. Patent 2,370,965)
Figure No. 1106 Series

The clearance between the plunger and the hole is just sufficient to provide the proper throttling action under certain conditions.

Since no throttling device is effective under all conditions (such as scope and rapidity of pressure fluctuations, and viscosity of pressure medium), five different size holes are provided. They are numbered 1 to 5 in the bushing (3). The plunger may be transferred easily from one hole to another, depending on how much dampening is required.

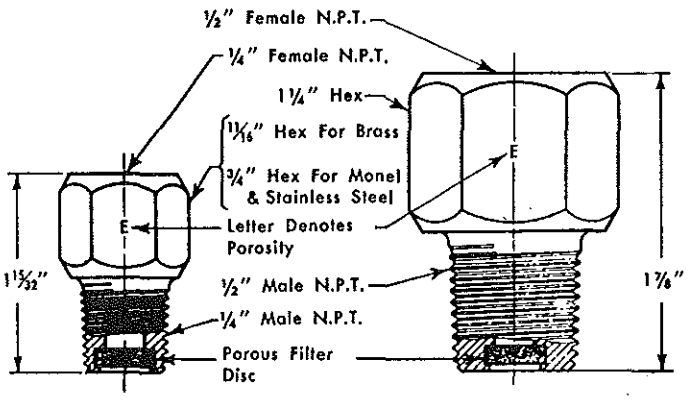
The sealing disc (4) seals off all holes except the one in use. Number 1 hole has the smallest diameter and provides the largest dampening effect because it has the least clearance between plunger and hole. All dampeners are shipped with the plunger in the No. 3 hole.

The ¼" size is only made in brass; and both ¼" and ½" sizes in free cutting 18% chrome, 8% nickel stainless steel. The dampener operates in any position.

Ashcroft Chemiquip Pressure Snubber

The heart of the Ashcroft Chemiquip Pressure Snubber is a ⅜" diameter by ⅛" thick porous metal filter disc. The disc is available in four standard grades of porosity which covers about 95% of service conditions.

Figure No. 1112 Series



PORE SIZE AND PERMEABILITY

For use with	Mean Pore Opening	Max. Pore Opening	Chemiquip Porosity Desig.
Oil (Heavy, over 50 SSU)	.0025"	.005"	D
Water and Light Oils (under 50 SSU)	.0013"	.0025"	E
Air, Steam & Gases	.0004"	.0009"	G
Mercury Manometer	.0002"	.0006"	HX
—	Approx.	Approx.	—

TO CLEAN SNUBBERS

All snubbers can be washed in solvents such as carbon tetrachloride, benzine, naphtha, etc. For chemical cleaning of various metals, these solutions are effective:

Brass: 1 part caustic soda to 6 parts water. Boil from 15 to 45 minutes.

Stainless Steel: 1 part caustic soda to 6 parts water or 1 part nitric acid to 6 parts water. Boil from 15 to 45 minutes. (Choose solution in which plugging material is most solucble)

Monel: 1 part caustic soda to 6 parts water or 1 part hydrochloric acid to 6 parts water. Boil from 15 to 45 minutes. (Choose solution in which plugging material is most soluble).

NOTE: After boiling, wash snubber in running tap water for about 45 minutes. Do not force tap water through the snubber as this will plug it.

Throttle Screws

The simplest way to produce a restricted orifice is with a throttle screw. Throttle screws are provided with Ashcroft Gauges, when specified. They have a small hole and are inserted into the gauge socket inlet. The size of the hole depends upon:

1. Viscosity of the pressure fluids
2. Rapidity of pressure fluctuations
3. Amount of throttling effect desired

CONSIDER THESE VARIABLES WHEN CHOOSING A THROTTLE SCREW:

A. The greater the viscosity of the pressure medium, the larger the orifice.

B. The greater the pulsation frequency, the smaller the orifice.

C. The greater the pressure, the smaller the orifice.

D. The amount of pointer travel desired.

E. The volume of the Bourdon tube.

Due to these variables, it is usually necessary to test several hole sizes to get the right one. A series of six hole sizes covers the average services encountered. Sizes are: .006", .0135", .020", .031", .040" and .070".

If proper hole size is unknown, contact your Distributor Dresser Industrial Valve & Instrument Division. Furnish kind of pressure fluid with viscosity data (if possible) and the frequency of pressure fluctuations per minute. This will aid greatly in selecting the most efficient throttle screw.

The major disadvantage of any throttle screw is the possibility of the hole plugging up, causing the gauge to stop functioning.

STANDARD MATERIAL IS BRASS
EXCEPT FOR AMMONIA SERVICE

Campbell Micro-Bean
Catalog. No. 1110 Series

The Micro-Bean is instantly adjustable to all conditions of flow, viscosity and surface tension. A very slight taper on the micro valve stem fits into a tapered hole in the body. The degree of dampening is easily adjusted by turning the micro valve. A filter is built into the Micro-Bean to keep dirt from plugging the dampening valve. The adjustment is not critical.*

Ashcroft Steel Needle Valve
Figure Nos. 7001, 7002, 7003 and 7004

- The Ashcroft Gauge Saver gives the best service of getting the exact orifice needed for any specific service. Even though this ideal orifice may be so restricted that it may eventually plug up, the needle valve can easily be opened to allow the pressure fluid to clear away the obstruction. It should be reset to the proper throttling position. Operators are cautioned about changing the valve setting.

HOW TO DECIDE WHICH TYPE
OF THROTTLING DEVICE TO USE

- The Ashcroft Gauge Saver gives the best service and should be used whenever possible.
- The Pulsation Dampener is the most universally suitable because it provides five possibilities of throttling effect and has a self-cleaning action.
- The Chemiquip Pressure Snubber may be used where systems have some solid inclusions.
- The Throttle Screw is the simplest way to get a restricted orifice but finding the correct hole size is somewhat complicated. There is the possibility, also, of hole plugging.
- The Campbell Micro-Bean allows quick adjustment of the degree of dampening.
- The Needle Valve has the widest range of general application where corrosive conditions do not prohibit its use.

THE GAUGE SIPHON

The use of a gauge siphon, sometimes known as a pigtail because of its shape, has long been standard practice on gauges installed on steam lines. The use of a siphon in these installations is to reduce the temperature of the pressure gauge below that of the steam being measured. If a siphon where not used, steam from the process would enter the socket and Bourdon tube of the pressure gauge, condense on the relatively cool metal and the condensate would then drain back into the process line allowing more steam to enter the Bourdon tube. Because of the very rapid heat transfer of condensing steam, and due to the continual circulation of steam into the gauge, the Bourdon tube would rapidly be heated to the temperature of saturated steam at the pressure being measured. These temperatures are higher than are desirable is a pressure gauge and can cause unsafe conditions when non-welded Bourdon tube joints are used because of the weakening of the joint by the excessive temperature.

When a siphon is installed, and the installation is operated properly, the gauge will be protected from excessive temperature. As the valve connecting the gauge to the line is opened slowly, steam will slowly enter the siphon and condense **in the siphon** to form water. Within a short time, this water will completely fill the Bourdon tube and most of the length of the siphon. This will completely block the entrance of steam to the pressure gauge. Steam will still enter the lower portion of the siphon and condense there, heating this portion to the temperature of the steam. The length of water filled siphon leading up to the pressure gauge is not heated directly by the process steam, but only by the conduction of heat along the siphon from the hot end up to the gauge. Tests and field practices have shown that the temperature very rapidly drops along a liquid filled siphon so that only six inches to one foot of liquid filled pipe will drop the temperature from several hundred degrees, which may be found at the process, to a temperature only slightly above the air temperature surrounding the pressure gauge. Thus, the pressure gauge is protected from excessive temperatures.

The use of a siphon will not always prevent overheating of the gauge when it is first connected to the process line. If a block valve from the process is opened rapidly, steam will immediately rush through the siphon and up into the Bourdon tube where it will condense, and there will be a period of perhaps one or two minutes when the Bourdon tube will be heated to the process temperature before the condensate from the steam will fill the Bourdon tube and the gauge end of the siphon. This condition can be dangerous and can cause harm to the pressure gauge. Opening the block valve slowly, while at the same time cooling the siphon by the application of water, or wet rags, will insure that the steam condenses in the siphon and not in the gauge until enough condensate has been formed to block the entry of steam to the gauge. Another recommended way of installing a siphon to prevent the initial surge of steam into the gauge is to fill the gauge system and the siphon with water at

installation and prior to opening the valve connecting it to the process. This is the most foolproof system and is recommended.

While the gauge siphon is used primarily for steam measurement, it should be used on measurement of all condensable, hot vapors. Various fluids other than water are used for heat transfer by boiling them and conducting the vapor to a radiator or kettle to be heated where they will condense and release the heat. Some of the more common fluids, other than water, which are used for this application are Dowtherm and Mercury. The reasons for using siphons on these condensable vapors are exactly the same as for using a siphon on steam.

The most common way to provide a liquid seal between the condensable vapor and the pressure gauge is a siphon, but other configurations of the connecting piping are acceptable and are occasionally more convenient. All that is required is that there be a low point in the tubing connecting the process to the pressure gauge where the condensate from the vapor can collect and form a liquid seal to prevent entry of the vapors into the pressure gauge. This low point should be a foot or more away from the gauge.

INSTALLATION OF GAUGES TO HOT LIQUID AND GAS LINES

There are frequent questions as to the proper method of connecting a pressure gauge to a hot process line carrying liquid or hot gas, but not a condensable vapor. There are several acceptable ways to make this connection so that the pressure gauge will not be overheated. Perhaps the most fool-proof installation is by the use of a chemical seal and capillary line between the process fluid and the pressure gauge. Even a relatively short capillary line of one foot will prevent the high temperature of the chemical seal from reaching the pressure gauge. There are times when a chemical seal and line are preferable to a siphon for use on steam. The most common example is where the water filled gauge might freeze.

A very common installation of a pressure gauge to a hot line is simply through a conventional length of connecting piping. As there is not the very high rate of heat transfer which occurs with the condensation of a vapor, there is only the very slow rate of heat transfer through the piping and liquid, just as there is in the liquid filled portion of a gauge siphon. Tests have shown that a water filled length of ½" connecting pipe only 1 foot long will reduce a process temperature of 200° F. down to approximately 120° F. at an atmospheric temperature of 80° F. Even with a process temperature as high as five or six hundred degrees F., 3 or 4 feet of ½" connecting pipe is normally sufficient to reduce the temperature at the pressure gauge to an acceptable value. The use of connecting tubing or piping smaller than ½" size will reduce the length required to get the necessary cooling.

LIQUID FILLING PROCEDURES FOR DIAPHRAGM SEALS AND ATTACHMENTS

Three rules are vital to the proper filling of Ashcroft Chemical Gauges and attachments. They are:

1. The fill fluid must completely fill the gauge and top part of the seal.
2. The fill fluid must be uncontaminated with other fluids which will boil or decompose to form gas at the operating temperature.
3. The seal diaphragm must be operating in its free position.

These rules are most important for low pressure ranges, especially vacuum ranges, and for seals that are to be operated at high temperatures. Failure to obtain good fill will result in temperature errors and loss of accuracy. It can also cause non-linearity of calibration.

The seal must not leak! Take special care to be absolutely certain of this. The small amount of liquid in the seal means that even the smallest leak will allow the fill to escape, making the seal in-operative.

Liquid Filling Procedures for Gauges With Diaphragm Seals.

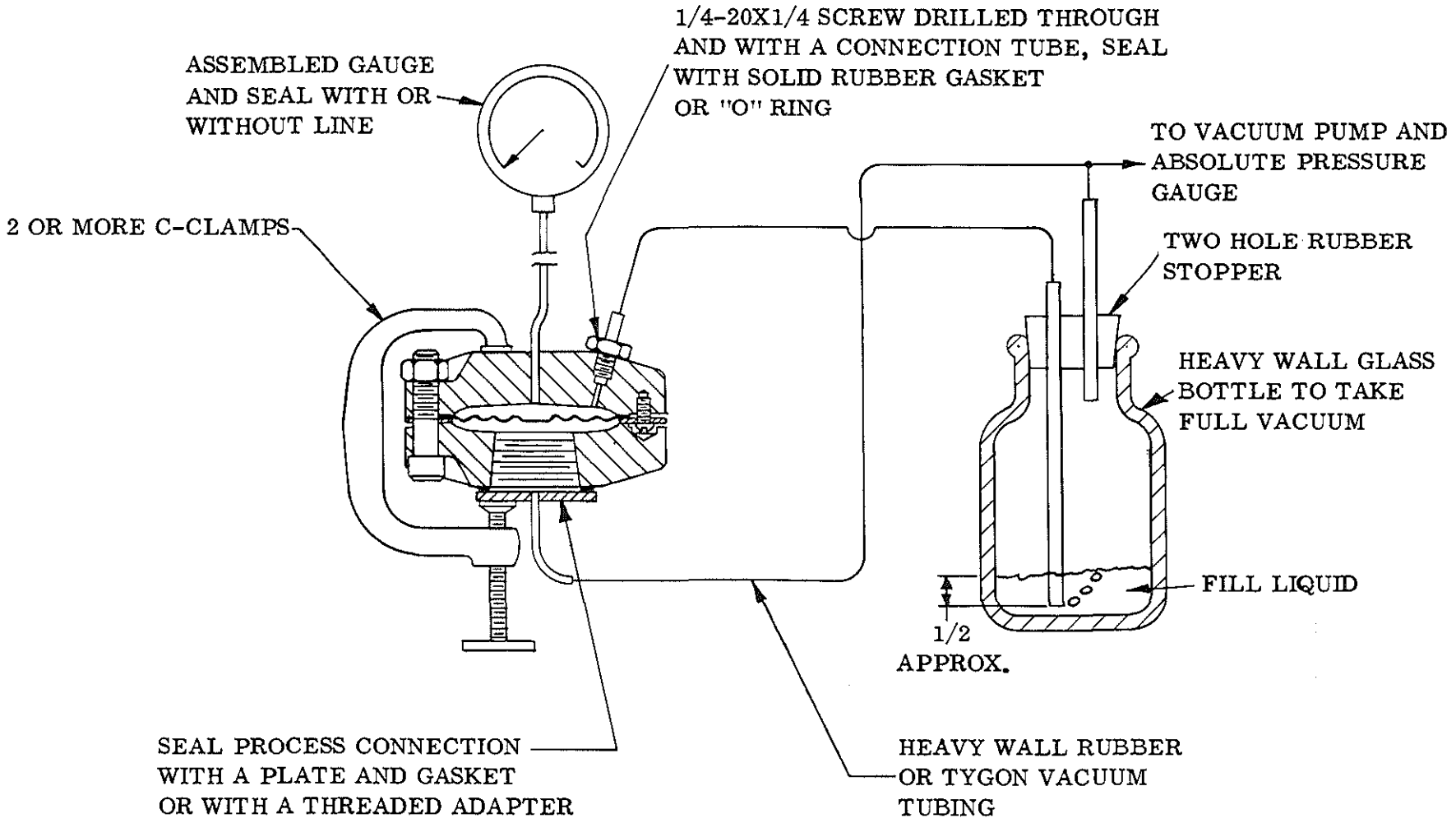
1. WITH EVACUATION

The best, and most universal, filling procedure is to evacuate the seal assembly and allow the fill to flow into the completed unit. Apply a few pounds pressure to drive the fill into the assembly.

On both evacuation and filling, it is important to equalize the pressure across the diaphragm. This prevents deforming of the diaphragm when the fill is let in.

EVACUATION METHOD

1. Operate vacuum pump until a good vacuum of 1 mm HG absolute pressure (or better) has been drawn and until the fill is degassed. (Figure 40)
2. Then shut off the vacuum pump.
3. Pinch shut the vacuum pump hose.



Simple Set up for Filling Diaphragm Seals
(Evacuation Method)
This set-up degasses the fill at the same time that the seal assembly is evacuated.

4. Disconnect the hose from the pump.

5. Open the hose slowly to draw the fill into the assembly. If the hose is opened too quickly the fill will "shoot" into the evacuated chamber. This could harm the seal diaphragm.

NOTE: A few pounds pressure can be applied to the evacuation line to speed the flow of fill into the gauge. When the fill stops flowing, take away the pressure and remove the filling fittings.

6. Install the vent plug in the top housing of the seal.

The fill liquid may be seen to boil during the evacuation procedure. This is caused by a contaminate (usually dissolved air and water) being released.

If it takes too long to purify the fill liquid by vacuum, heat it (before use) to about 300° F. This will also drive off contaminates. The fill must be cooled to room temperature prior to use and protected from air during cooling.

A fill should be selected which is compatible with the process fluid in the event of diaphragm rupture. For example, glycerin should not be used with fuming nitric acid, etc.

2. WITHOUT EVACUATION

The gauge and seal can be filled without evacuation if it is absolutely necessary. This can be done by following the method described in the "Filling the Gauge Saver" section on Page 20. Gauges supplied with a capillary bleeder can be filled by forcing the fill through the seal and out the bleeder hole.

Both these methods require considerable time and do not, usually, give best results.

CLEANLINESS OF GAUGE AND SEAL

To keep unwanted liquids from contaminating the fill, make sure that the gauge and seal assembly are absolutely clean. Even a small drop of water will form a large water vapor bubble in a unit used for vacuum measurements or which is operating at high temperatures. This will cause significant error.

Avoid contamination by oil because oil often contains water. Also, oil will break down at high temperatures to form an error-causing gas.

To Clean Gauge and Seal:

FOR WATER

Extra long evacuation will tend to remove water. Both gauge and seal should be pre-heated before evacuation.

FOR OIL

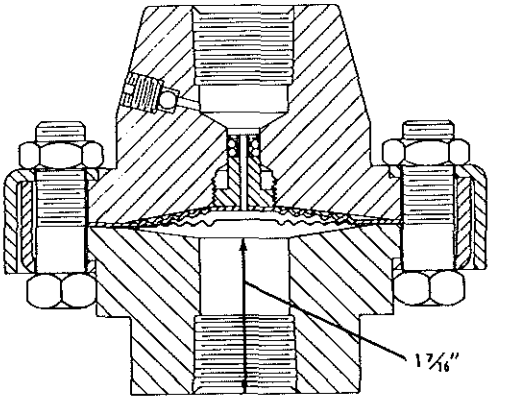
Wash the system with savasol or other solvent. Then bake the solvent out at 250° F. for one hour.

AFTER FILLING IS COMPLETED

After the filling operation (by any procedure) check to make sure that the fill liquid is not under pressure. If the vent screw is closed, open it to vent off any pressure. When doing this, remove the screw and *make certain that the seal ball is free.* This is necessary because sometimes the ball sticks on its seat. In this case the venting of internal pressure is not accomplished by merely loosening the screw, as the seal ball must be loosened for proper operation.

When certain that the fill liquid is not under pressure (and that the seal ball is free) close the vent screw.

With the fill pressure at zero, the diaphragm should be flat. This is checked by first measuring the distance of the diaphragm center from the bottom of the seal, before filling. After filling, this distance should be approximately the same (within 1/16"). For example, on the threaded seal, the distance from the diaphragm center to the bottom of the seal is 1 7/16". If the center is deformed due to overfilling, the temperature error will exceed the normal value.



ASHCROFT PLASTIC DIAPHRAGM

TO CHECK DIAPHRAGM FLATNESS

Perfect flatness is essential to metal diaphragms. Plastics diaphragms however, are not so dependent upon perfect flatness. They are much more flexible than metal diaphragms and give a much lower temperature error. For this reason the location of the center of the diaphragm is less critical.

Liquid Filling Procedure for Gauges Supplied with a Capillary Bleeder

Gauges with a capillary bleeder can be liquid filled when attached to a chemical seal. Air in the system can be removed by opening the bleeder (which vents the tip of the Bourdon tube) and then forcing the fill liquid in through a special fitting. The fitting is

attached to the vent hole in the top of the seal assembly.

Jar and rotate the gauge while it is being filled. This helps to get all air bubbles to the tip of the Bourdon tube where they will go out through the bleeder tube. When the fill has driven out all air, the filling fitting can be removed and the vent holes sealed.

Take care that the diaphragm is not deformed. Be sure that it is operating in its free position.

DIAPHRAGM SEALS—FAILURES AND CORRECTIVE STEPS (LIQUID FILLED TYPES)

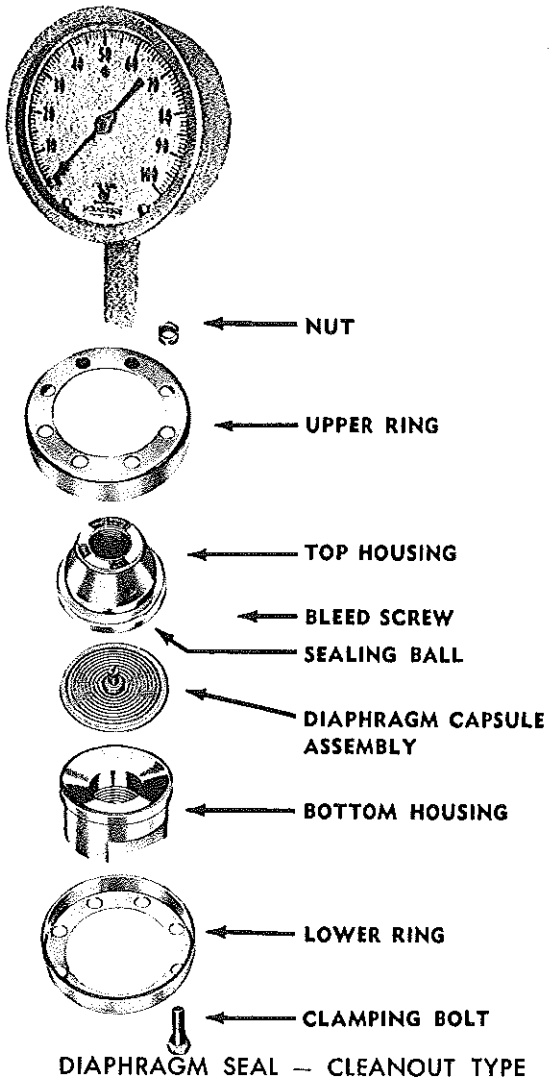
Three conditions account for the majority of diaphragm failures. They are:

1. Corrosion
2. High Temperatures
3. Filling leakage

Corrective measures to combat these causes include the following:

1. Corrosion

Diaphragm corrosion is generally due to choosing the incorrect material for a particular service. Modern chemistry is so complex that it is difficult to set up hard and fast rules regarding proper diaphragm materials. For example: A change in concentration or temperature of a chemical will cause corrosion which will not occur with the same chemical at a different concentration or temperature.



DIAPHRAGM SEAL — CLEANOUT TYPE

Diaphragm failures are seldom of a mechanical nature as diaphragm deflection (for the entire range of a Bourdon tube pressure gauge) is only a few thousandths of an inch. Never probe into the attachment with a sharp object such as a screw driver which can pierce the diaphragm.

If it is necessary to clean the attachment, use the removable type which permits the lower housing to be removed without disturbing the liquid seal.

Corrosion may also be due to the attachment being a different material from the piping. This can result in a galvanic cell effect that causes electrolytic corrosion.

Corrosion attacks on housings are seldom serious as housing thickness is many times greater than diaphragm thickness. Most metal diaphragms are only .004" & .005" thick for design reasons.

If a corrosion failure occurs consult your plant metallurgist or Dresser Industrial Value & Instument Division for a recommendation. When making such a request be sure to forward all possible service details. These should include: exact chemistry, concentration, temperature and pressure as well as additional pertinent data.

2. High Temperatures

High temperatures can cause the diaphragm to bulge. When such bulging occurs, the type of liquid fill should be examined. If the fill being used is unsuitable to the gauge operating temperature, a suitable fill should be used. When the attachment or gauge is to be refilled with another fill liquid it is most important to thoroughly clean out the old liquid. The "Liquid Filling Procedure for Chemical Gauges and Attachments" section explains the proper method of liquid filling.

3. Filling Leaking

Failure due to leakage of filling may be due to nicked gasketing surfaces at the "O" ring on the diaphragm capsule stud or the gauge connection into the attachment may not be tight. Therefore a new "O" ring or a new top housing (if the seal surface is nicked) or tightening is indicated.

CALIBRATION PROCEDURE — FIGURE 1188 BELLOWS GAUGE

CALIBRATION & TROUBLE CORRECTION DIAGRAM

POINTER JUMPING

STICKY PARTS
CLEAN ALL BEARINGS AND GEAR TEETH

LOOSE HAIRSPRING
REMOVE BACKLASH BY DISENGAGING PINION & ROTATE TO TIGHTEN

COUNTER BALANCE RUBBING
BEND IF NECESSARY TO CLEAR SOCKET IN TRAVEL

SLUGGISH MOVEMENT

TIGHT HAIRSPRING
LOOSEN BY DISENGAGING PINION & ROTATE

RANGE SPAN ADJUSTMENT

RANGE TOO SHORT
ADJ. SLIDE "S" INWARD

RANGE TOO LONG
ADJ. SLIDE "S" OUTWARD

NOTE: AFTER ADJUSTING RANGE SPAN, SET BOTH MOVEMENT STOPS. SET THE UNDERLOAD STOP SO THAT THE POINTER WILL STOP AT ZERO. SET THE OVERLOAD STOP SO THAT THE POINTER WILL PASS THE MAXIMUM RANGE APPROX. 5°.

AFTER ADJUSTING SPAN RE-ZERO POINTER BY REMOVING FROM PINION AND RE-ASSEMBLING AT THE PROPER DIAL MARK.

NON LINEAR

NON LINEAR FIRST 3RD.

ADJ. ANGLE OF PULL BY INCREASING ANGLE "A"

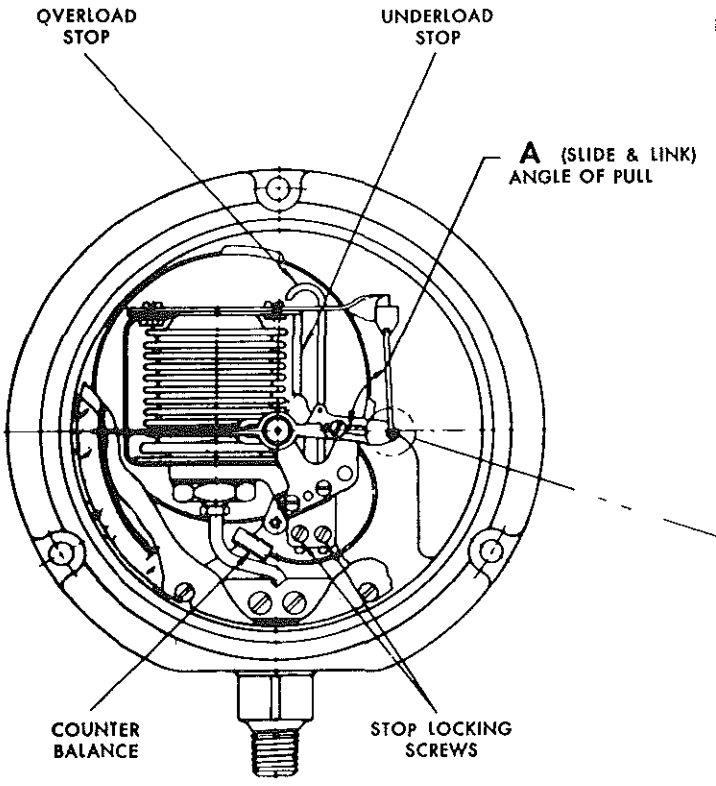
NON LINEAR LAST 3RD.

ADJ. ANGLE OF PULL BY DECREASING ANGLE "A"

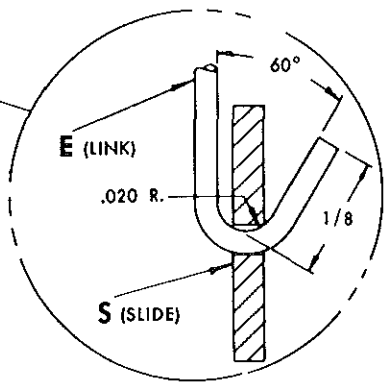
NOTE: TO INCREASE OR DECREASE ANGLE "A", BEND TIP INWARD OR OUTWARD AS REQUIRED. DOING THIS MAY RUN THE MOVEMENT SEGMENT OFF THE PINION. THIS CAN BE CORRECTED BY CUTTING OFF ONE END OF LINK "E" DECREASING ITS LENGTH, OR MAKING A NEW LENGTH FROM .032 DIA. PHOS. BRONZE WIRE.
CAUTION: WHEN REPRODUCING LINK END, FOLLOW FIGURE 44 VERY CLOSELY. THIS WILL PREVENT TOO MUCH PLAY, OR, BINDING IN OPERATION.

REF: REPLACING SYSTEM BELLOWS

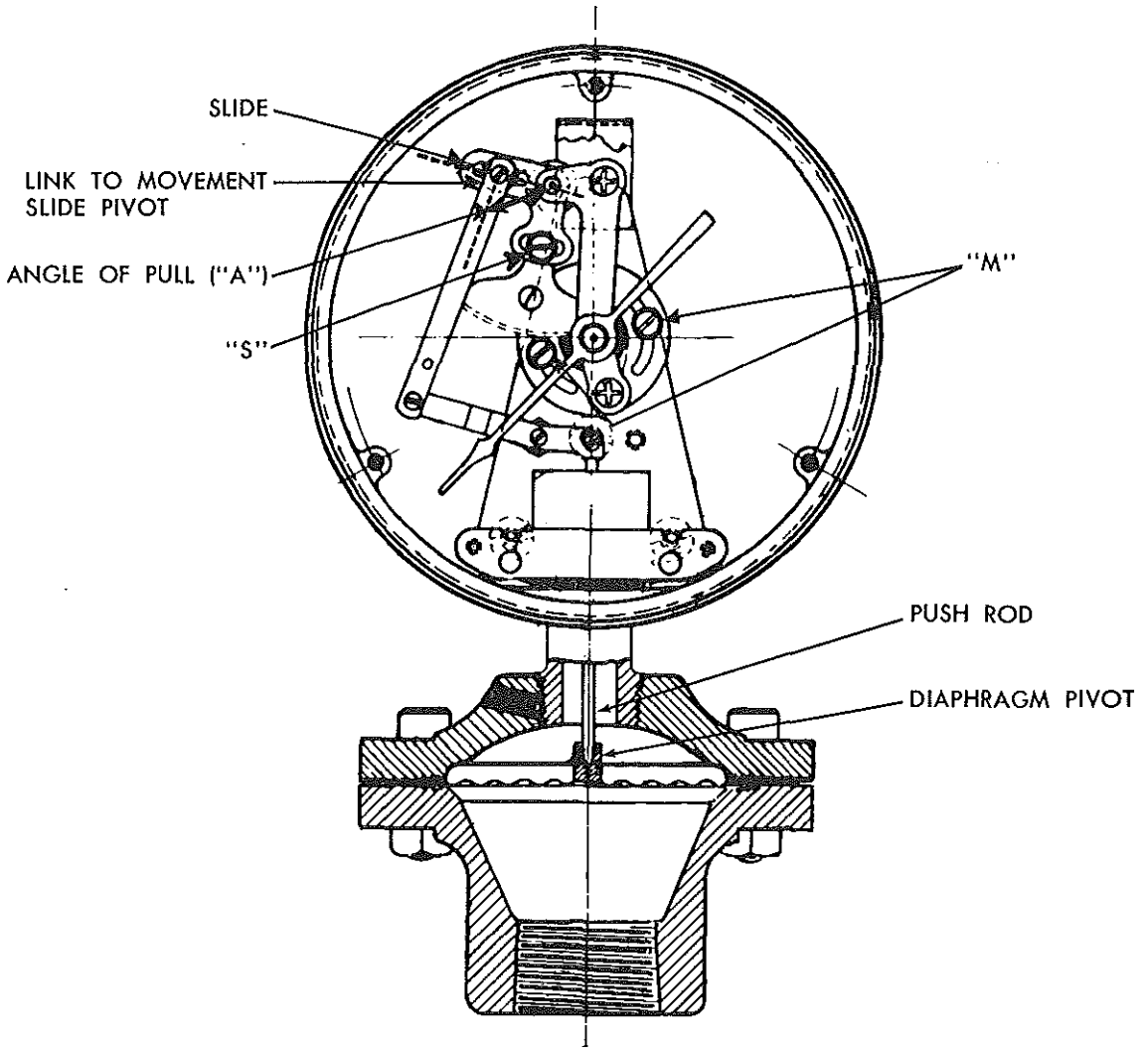
AFTER ASSEMBLING BELLOWS TO THE GAUGE SOCKET SECURELY, SUBJECT SYSTEM TO 30 P.S.I. FOR FIVE MINUTES, ALLOWING BELLOWS TO TRAVEL APPROX. 1/8 AGAINST THE OVERLOAD STOP. AFTER THIS, HEAT TREAT SYSTEM FOR 15 HOURS AT 250°F. THIS PROCEDURE IS NECESSARY TO PREVENT GAUGE DRIFT.



ENLARGED SIDE VIEW OF LINK AND SLIDE



CALIBRATION PROCEDURE — FIGURE 1072 & 1072A



Pointer Adjustment

It is necessary to first loosen the pointer from the pinion shaft with a pointer remover. Reposition to the correct location and retighten using a pointer set.

Adjustment for Sluggishness

Clean all bearings and gear teeth. Adjust the hairspring so that all backlash is eliminated (see page 6). Do not overtighten as too much hairspring tension causes friction and drag. Sufficient hairspring tension must be maintained to hold push rod in contact with diaphragm pivot. Check linkage for binding and bend link slightly with a "wiggler" if needed.

Too Fast or Too Slow Pointer

Recalibration may require that the pointer motion, under a given pressure, must be changed. Altering the radius length of the Link to the Movement Slide Pivot will accomplish this.

Loosen the screw at the pivot. When the pointer has moved to slow, decrease the radius. When the pointer has moved to fast, increase the radius. When properly set, tighten the Pivot Lock Screw. This is the adjustment of span. This adjustment, together with the resetting of the pointer (zero), is the most important.

Adjustment to Correct the Angle of Pull

"A" indicates the "angle of pull." "M" indicates the screws that hold the movement.

Even when the gauge Link to Movement Slide Pivot is set to the best location, the angle of pull "A" must be just right or the pointer will travel too fast at either the low or high end of the scale. By loosening screws "M", the movement can be rotated clockwise to speed up the pointer over the low end, or counterclockwise to speed up the pointer over the high end. Lock Screw "S" can be loosened and the slide rotated to reposition the segment to allow sufficient gear tooth engagement or to restore original hairspring tension.

Sales Offices

- ALEXANDRIA, LOUISIANA 71301
  P.O. Box 1430
  Tel: (318) 640-2250
- ATLANTA, GEORGIA
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  340 W. Ponce de Leon Ave.
  Tel: (404) 373-0102
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  Tel: (312) 625-5700
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  Tel: (203) 378-8281

International Operations

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  CH-8021 Zurich, Switzerland
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In Canada

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- **Field Advisory Service**

  Dresser Industrial Valve & Instrument Division sales engineers are readily available to assist in selecting the right types of ASHCROFT® Gauges and Instruments, CONSOLIDATED® and HANCOCK® Valves . . . for your specific installation requirements. This advisory service can be obtained promptly by contacting any of the sales offices listed above.

DRESSER INDUSTRIES

DRESSER

INDUSTRIAL VALVE & INSTRUMENT DIVISION
STRATFORD, CONNECTICUT 06497

Printed in U.S.A.

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified)	FINISH
LAYOUT OR ASSEMBLY NUMBER	

Description: ~~Ashcroft~~ 4-1/2" duplex pressure gauge, ~~phenolic~~ turret case, ~~phenolic~~ ring, 1/4" NPT

Phenol

Back connected, range 0-60 psi at 1 psi intervals and figures at 5 psi intervals.

White face and black markings.
Bronze bushed movement.

Vendor: ~~Marsh Instrument Co., Inc.~~ ~~Rich-Dale~~ ~~Duro Industrial Corp.~~ ~~Chicago, Illinois~~ Dresser Industries Industrial Valve and Instrument Division Stratford, Conn.

Piece/Part No.: ~~Superintendent~~ 1247E

Drawing No.:

Alternate Vendor: U. S. Gauge Co.
600 So. Michigan Avenue
Chicago 5, Illinois

Piece/Part No.: Fig. 539 with ~~phenolic~~ plastic turret case.

Alternate Vendor: The Ashton Valve Co.
Wrentham, Mass.

Piece/Part No.: Style AM-5"033 W/C Mounting Way

CODE IDENT NO. 02786

NO.	DATE	CHANGE ORDER NO.	REMARKS
4	3-26-72	8130	Per Mr. Wood 2-28-72; changed [illegible]
3	1-24-72	7734	Add [illegible]
2	1-25-61	12-978	Alt. Vend. [illegible] added
1	58	AE-6N	Drawn & Minor [illegible]
2	"	"	[illegible]
3	"	"	[illegible]

STORAGE NUMBER A-63-5[illegible] | LAST OF ITEMS 2-12-[illegible]

FAIRBANKS, MORSE & CO.
ENGINEERING DEPARTMENT

DRAWN BY L. Olson	DATE 2-5-62	SCALE
CHECKED BY L. Olson	DATE 2-8-62	

NAME
GAUGE, Pressure

MATERIAL SPECIFICATION

SHEET NO. A | DWG. NO. 11902078

ATTACHED

ASHCROFT® PRESSURE GAUGE
INSTALLATION AND OPERATING INSTRUCTION
PARTS LIST

GAUGES ARE INSTRUMENTS. HANDLE THEM AS CAREFULLY AS YOU WOULD A FINE WATCH

SELECTION

Gauges should be graduated to about double the average working pressure, selecting the nearest standard range. This will make the gauge last longer and pointer will be easier to read at about the top center of the dial.

Select gauges with the proper Bourdon tube material and joints for the service.

INSTALLATION

Always use a wrench on the flats of the gauge socket to screw the gauge in place. When a fitting is being screwed to the gauge, hold a wrench on the socket flats instead of twisting against the gauge socket screws which are intended to hold the gauge mechanism in the case.

When gauges are mounted on a wall or panel, make sure they are connected free from piping strains. Also see to it that the mounting surface is flat, or insert washers under the flange of the gauge case to obtain three-point suspension. Preferably, the last length of piping leading up to the gauge should be flexible tubing. This will insure that the gauge is free from strain.

Install gauges where they will be free from the effects of mechanical vibration as this will wear out any gauge quickly. Try to mount the gauge on a wall nearby and connect the gauge to the machine which vibrates badly by means of flexible line assembly.

Protect gauges from frequent pressure pulsations by using throttle screws in the socket of the gauge, needle valves, pulsation dampeners, or Ashcroft Gauge Savers.

When any gauge is used for steam pressures, a siphon filled with water must be installed between the gauge and the line. When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg to enable occasional cleaning out of the sediment. The head effect of this piping leg should be compensated for by resetting the pointer of the gauge.

Locate gauges where they will not be subject to high heat which will weaken soldered tube joints. Also, high temperatures make gauges inaccurate. See chart on this page. Install gauges where they will be free from moisture and corrosive fumes, if possible. If these conditions are unavoidable, ask for special recommendations and, in general, use phenol plastic cases which are resistant to most corrosive fumes and cannot rust.

PROPER USE

Apply pressure slowly. Do not open the gauge cock or valve too quickly — this imparts a severe strain on the Bourdon tube which may rupture it, or result in shortened life. When the service itself is subject to sudden pressure applications, use a needle valve, or the Ashcroft Gauge Saver.

Avoid over-pressure. See that the apparatus is provided with a relief valve and that the range of the gauge is higher than the set pressure of the relief valve.

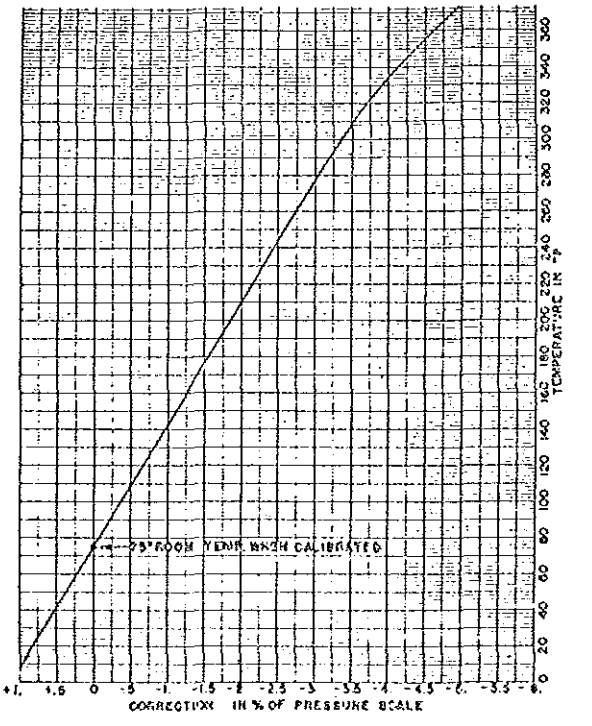
Sudden pressure release has the same detrimental effect and should be compensated for in the same manner as for pressure applications mentioned above. On hydraulic presses, Catalog Number 1056 Ashcroft Quality Gauge with slotted link should be specified. See Bulletin 302.

MAINTENANCE

Replace broken glasses and thus keep dirt out of the working bearings and teeth of the movement mechanism.

Never oil gauge movements or linkages except with high grade instrument oil. Regular oil attracts dirt and becomes gummy, thus causing the gauge to act sluggish and inaccurate.

Approximate Error or Change in Calibration of a Bourdon Tube Type Pressure Gauge Caused by Changes in Temperature



Example: Gauge working at 500 p.s.i. pressure and at 280° F. temperature would have a −3% correction and would read 3% or 15 p.s.i. fast.

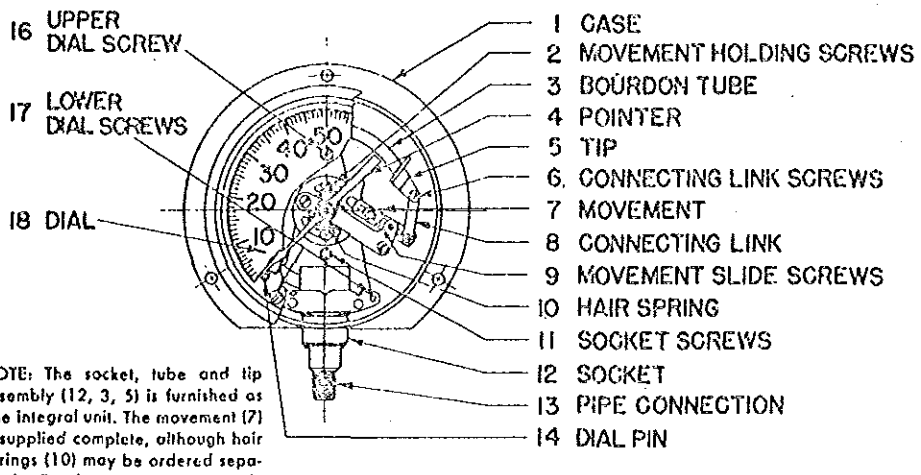
NAMES OF GAUGE PARTS AND DIAL DESIGNS

ENGINEERING DATA

The drawing below shows a typical lower connection gauge with all of the parts designated by their standard names. The use of these names will facilitate the ordering of parts and eliminate any misunderstanding in describing gauge construction.

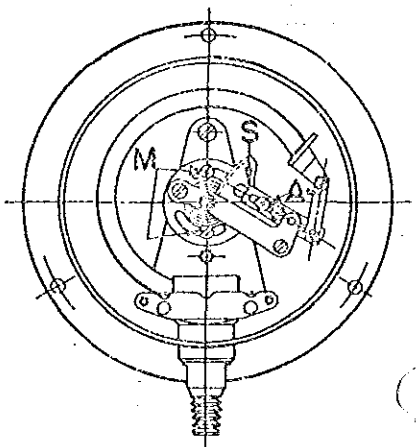
When ordering parts—specify as much of the following data as possible:

Size (dial diameter)—Case Material (Iron, Alumalife or Phenol)—Ring Design (Slip, Threaded, Snap or Hinged)—Connection Location (Lower or Back) — Connection Size (¼" or ½") — Bourdon Tube (Material)—Dial Range—Class of Gauge. Specify Catalog Number if possible; otherwise, mention whether parts are for Duragauge, Quality Gauge or Special Application Gauge.



NOTE: The socket, tube and tip assembly (12, 3, 5) is furnished as one integral unit. The movement (7) is supplied complete, although hair springs (10) may be ordered separately. Rarely will modern parts fit in old style gauges.

ADJUSTMENT OF ASHCROFT GAUGES HAVING ROTARY GEARED MOVEMENTS



Adjusting a gauge is a broad term and will be divided into specific operations.

1. Calibration correction by resetting the hand or by adjusting the micrometer pointer to agree with some desired standard. To do this, the ring with glass must be removed and the pointer or hand brought to the nearest agreement over the desired range.

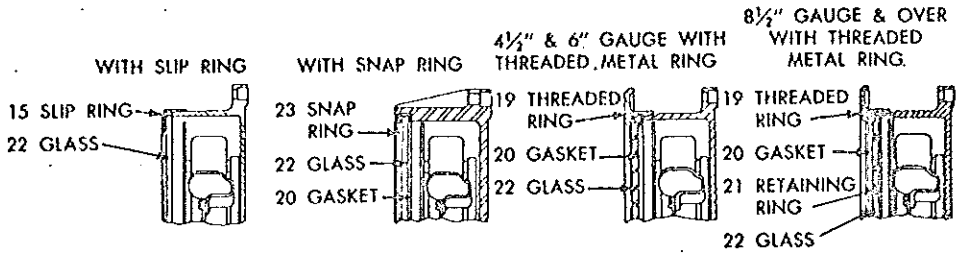
2. If this simple adjustment is not sufficient to give the desired accuracy, it is necessary to decide what is the cause; such as, sticky or sluggish action throughout the scale or at some points; or, the pointer travels too fast or too slow throughout the whole scale, or at either end of the scale.

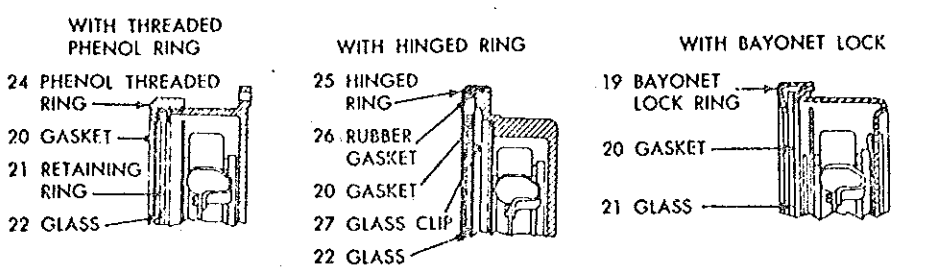
3. Correction for sluggishness is to clean all bearings and gear teeth. Hair spring to be adjusted so that all back lash is eliminated; too much tension will cause friction and drag.

4. The slide "S," moved in or out, changes the ratio of motion. A Bourdon tube may change slightly so that its motion under a given internal pressure is either more or less; therefore, the slide "S" is moved to compensate or agree with the Bourdon tube's motion. When the pointer moves too fast, the slide "S" should be pushed out; if the pointer moves too slow, the slide should be pushed in. When properly set, tighten slide screws.

5. Even with the slide set to the best location, it is necessary to have the angle of pull "A," just right or the pointer will travel too fast at either the low or high end of the scale. By loosening screws "M" the whole movement may be rotated to give the desired angle "A." If angle "A" is acute, the pointer will travel fast on the first part of the scale and slower on the last part.

For example, a gauge may read perfectly from zero to the top of the dial, or one half of the scale, and from there on go gradually slower. In this case, increase the angle "A" a little at a time until the hand begins to go faster for the last half of the scale. "A" = 76° approx. When a new movement is being adjusted to an old gauge, this rotary feature is extremely convenient.





DRESSER

INDUSTRIAL VALVE & INSTRUMENT DIVISION

STRATFORD, CONNECTICUT 06497

11902 079

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified)	±1/64
LAYOUT OR ASSEMBLY NUMBER	

Description: Ashcroft, 4-1/2" pressure gauge, phenol turret case, 1/4" NPT.

Back connected, range 0-400 psi at 5 psi intervals and figures at 50 psi intervals.

White face and black markings.

Vendor: Manning, Maxwell & Moore, Inc.
Field Bldg.
135 South LaSalle Street
Chicago, Illinois

Piece/Part No.: 1279A

Drawing No.:

REV. NO.	DATE	CHANGE ORDER NO.	WAS

RELEASE NUMBER AO-585 | DATE OF RELEASE 2-12-62

FAIRBANKS, MORSE & CO.
DIESEL
ENGINEERING DEPARTMENT

DRAWN BY R. Olson	DATE 2-8-62	SCALE
CHECKED BY R. Olson	DATE 2-8-62	

NAME

GAUGE, Pressure

MATERIAL SPECIFICATION

CODE IDENT NO. 82796

APPROVED

SHEET SIZE A | DWG. NO. 11902079

DESCRIPTION: Alnor FAX-16 pyrometer for flush mounting with selector switch for 16 point readings, range 0-1200°F.

VENDOR'S PC NO: FAX-16

VENDOR: Alnor Instrument Co.
Div. of Ill. Testing Lab.
420 North LeSalle St.
Chicago 10, Ill.

Note: Substitutes not Permitted.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: PYROMETER

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries — Fairbanks Morse Power Systems Division

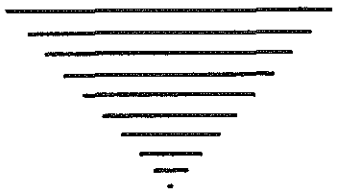
REL. NO.	[illegible]	4/19/65	ASS'Y. OR I.O.
DR. BY H. Dahlmann		4/7/65	SCALE
CHK'D. BY		4/7/65	APPV.
MAT'L			HEAT TR.

SHEET SIZE A | DWG. NO. 11 903 798 | SHEET 1

INSTRUCTIONS FOR INSTALLING AND OPERATING

Alnor®

THERMO-ELECTRIC PYROMETERS FOR DIESEL AND GAS ENGINE USE



ALNOR INSTRUMENT CO.

DIVISION OF

ILLINOIS TESTING LABORATORIES, INC.

420 NORTH LASALLE STREET CHICAGO, ILLINOIS 60610

INSTRUCTIONS FOR INSTALLING AND OPERATING "ALNOR" THERMO-ELECTRIC PYROMETERS FOR DIESEL AND GAS ENGINE USE

This pyrometer and selector switch have been designed and constructed expressly for measuring the exhaust temperatures of Diesel Oil Engines. The sturdy construction of this instrument will permit it to give long periods of trouble-free service if it is installed according to the following instructions.

INSTALLATION

(a) Mounting the Pyrometer

Securely mount the pyrometer where it is easy to read – either directly on the engine or at a distant location. Be sure to use very rigid supports so that the pyrometer panel does not vibrate against some other structure. When "shockproof" mountings are employed, be sure that the pyrometer does not experience excessive vibration at certain engine speeds. See drawing attached for mounting details.

(b) Mounting the Thermocouples

Be sure that the "L" Dimension is great enough to permit the thermocouple tip to reach the center of the exhaust pipe or chamber where the temperature is to be measured.

Mount one thermocouple in each pipe or chamber and try to have all of the thermocouple tips at about the same spacing from the exhaust ports.

CONNECTIONS

(a) General

The "Alnor" pyrometer, operating on the thermo-electric principle, consists of a rugged galvanometer which measures the voltage generated by the remotely connected thermocouple. Since this voltage is very small, use extreme care in making connections to be sure of putting together only clean, bright, dry wires and contacts. Notice the polarity markings on the terminals of both the Pyrometer and thermocouples. Connect the positive (+) terminal of #1 thermocouple to the positive terminal of the #1 pair on the pyrometer; etc. If you have to "ring out" the circuits to the thermocouples, be sure the pyrometer is disconnected. The relatively high current from the ringing out batteries will damage the pyrometer very seriously.

It is preferable to do the wiring in conduit because this gives a more reliable, long lasting job. Use either flexible or rigid metal conduit and try to avoid placing it in a path which will get excessively hot.

(b) Copper Connecting Wires

Since in most instances, the function of the pyrometer is to indicate uniformity of temperature or "cylinder balance", it is not necessary to have absolute temperature readings. In order to simplify the installation and to permit a saving in cost, it is common practice to use copper connecting wires. Such wire is usually available in a two-color code and it is recommended that a uniform color-code be adapted for the whole installation.

When copper connecting wires are used the cold-end temperature is that which prevails at the terminals of the thermocouple itself. In order to measure this temperature, place a small mercury-in-glass thermometer near these terminals when the engine has been running long enough to warm up.

(c) Alloy Connecting Wires

To obtain maximum accuracy in the pyrometer system, alloy connecting wires must be used between the thermocouples and the pyrometer. Alloy wires have polarity just as the thermocouple has. Attach the positive wire to the positive terminals of both thermocouple and pyrometer. Attach the negative wire to the negative terminals of both thermocouple and pyrometer. The cold end temperature is that which prevails at the pyrometer terminals. To measure this temperature, place a mercury-in-glass thermometer near the meter terminals for a few minutes, or until it reaches a steady temperature.

(d) Checking the Wiring

After completing the wiring as outlined above, note whether the indicator reads forward when the selector switch is positioned to heated thermocouples. If the reading is reversed, carefully check the connections at both ends to ascertain that the colors are matched. If alloy wires have been used a further check may be made by disconnecting the wires at the thermocouple terminals and twisting the alloy wires from the instrument together and applying heat. (The flame from a match is sufficient.) Under this condition the pyrometer should read forward. If it does not, then the alloy connecting wires must be reversed at the instrument's terminals. Carefully clean wires, removing any soot or dirt caused from the flame of match, and reconnect to the thermocouple terminals. If this

test has been carried out correctly the instrument will now read forward.

ADJUSTMENTS

(a) Manual Cold End Setting

When tests outlined above are completed, set the selector switch to the "OFF" position. Under this condition the indicator should read a temperature corresponding to the cold end temperature. If this reading is not correct adjust the "Cold End Adjuster" screw until the pointer reads the correct cold end temperature.

CAUTION: Never set the indicator pointer to the zero mark on the scale unless the cold end temperature actually is zero degrees.

(b) Automatic Cold End Compensation

If this mark @ is on the scale of the instrument, it means that the indicator is equipped with an internal automatic cold end compensator which will always regulate or adjust the indicator pointer to the proper cold end temperature. When subjected to severe vibration or to unusually hard treatment in transportation, this compensator occasionally gets out of synchronism with the ambient temperature. For this reason it is necessary, when starting a new installation or after a long period of operation to check the cold end setting and to make a manual adjustment in the manner outlined above by turning the "Cold End Adjuster" screw. The automatic cold end compensator is of value only when alloy connecting wires are used.

OPERATION

When the installation and adjustments have been completed, the pyrometer is ready to indicate the temperature of its thermocouples. Turn the selector switch so as to bring into the circuit whichever thermocouple is to be measured and then observe the pointer.

MAINTENANCE

An installation well made demands very little maintenance. Ordinary vibration does not affect the pyrometer. If severe vibration or concussion develop at the original location of the pyrometer, it should be mounted elsewhere.

When the pyrometer fails to respond to sudden changes in exhaust temperature remove the carbon which has accumulated on the thermocouple stem.

The thermocouple element is a pair of special alloy wires enclosed in a protecting tube mainly against mechanical damage. After long service, these wires or the protecting tube become defective and should be replaced with duplicates. (Give complete data when ordering replacements such as serial number of instrument, type of thermocouple, etc.)

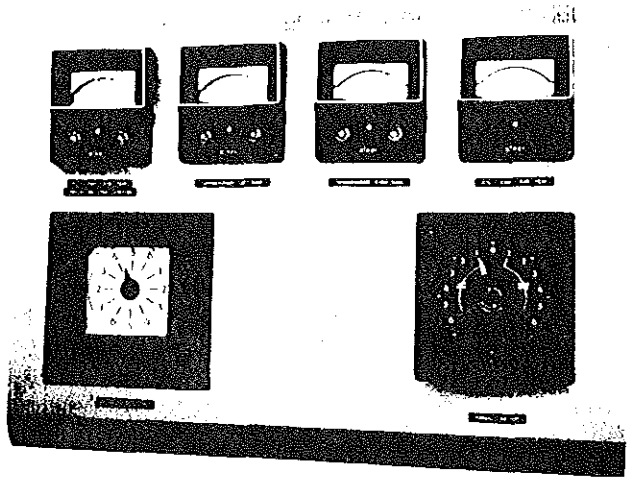
When writing for information regarding the performance of your pyrometer equipment, always describe your trouble in detail, giving also all the data marked on the pyrometer scale.

When ordering replacement parts always describe the part wanted, giving also the data marked on the pyrometer scale and especially the serial number if one is shown.

Please do not hesitate to ask for information, it will gladly be given as often as necessary to help you operate your pyrometer equipment most efficiently.

Why Pyrometers?

A review of the nature, care and use of this important engine instrument.



Portion of control panel showing continuous monitoring type pyrometer with automatic engine shut-down feature.

PYROMETERS have become so commonplace as a part of an engine's instrumentation that they are frequently taken for granted or not thoroughly understood. For this reason an occasional review of the pyrometer's design features, its functions and use, as well as its care, is helpful.

A pyrometer is a device by which heat energy is converted into electrical energy so as to simplify the instantaneous reading of temperatures on a sensitive meter. It is a convenient system that also permits remote indication.

The temperature sensing element is a thermocouple—generally iron and constantan for the temperature range of diesel exhaust gases—enclosed in a protection tube of a metal such as stainless steel. The electrical output is a function of the temperature at the junction of the metals and therefore can be calibrated to read as temperatures on the meter scale.

For diesel engines a thermocouple is generally installed in the exhaust elbow of each cylinder. A single meter is connected to any selected thermocouple by means of a multi-point switch. This is the most common arrangement, but modern trends toward more automatic operation and increased protective features have led to the development of more complex systems.

An example of this is the combination pyrometer and motor-driven switch units of the type installed in the Alcoa Point Comfort aluminum ore reduction plant. To facilitate rapid monitoring of exhaust temperatures, an electric motor drives the switch that serves to connect each cylinder thermocouple to the meter in turn.

Overlapping contacts prevent the needle from tending to drop to zero during the change from one cylinder to another. Thus, temperature readings on a well balanced engine should be substantially constant and a deviation from the norm is immediately noticeable. A synchronized pointer shows the offending cylinder. All indicators are so sized that they are visible from up to 20 feet away.

In addition to the increased facility in monitoring exhaust temperatures, this type of pyrometer permits the adaption of an additional safety device. It can be fitted with an excess temperature cutout. With this device, the maximum allowable exhaust gas temperature can be set on the meter and should the gas from any cylinder exceed this set limit, visual and audible alarms are instituted and, if desired, the engine can be shut down as well. Reset is manual.

No matter what system is used, the principle remains the same and the functions and correct use of pyrometers should be understood.

Function and Use

The primary function of the pyrometer is, of course, to measure temperatures and to see the tie-in, it must be made clear that engine exhaust temperatures have a direct relationship with events taking place within the cylinder.

In normally operating cylinders the exhaust temperatures vary with the load. Therefore, if temperatures are normal as specified for the engine it is a good indication that things are as they should be. Distribution of load among the cylinders can be checked by comparing the temperature readings of each cylinder. For maximum accuracy, an indicator should be used for balancing the cylinders and then the temperature readings noted. This will be discussed in greater detail later.

Now that the engine is known to be operating well, the pyrometer assumes the function of a maintenance tool. Periodic observation of cylinder exhaust temperatures will indicate the first sign of change. Remember that "change" is most significant. Any malfunctioning of the engine will be reflected in the exhaust temperatures.

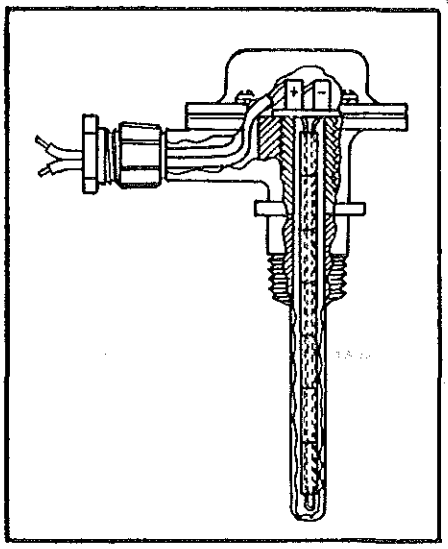
Nearly all troubles encountered in diesel operation are the result of maladjustment or wear. These will manifest themselves in a number of ways—improper injection, blow-by, stuck rings, other deposits, etc.—all of which are related to cylinder efficiency. Early trouble stages will reflect in a change (high or low) in cylinder exhaust gas temperatures.

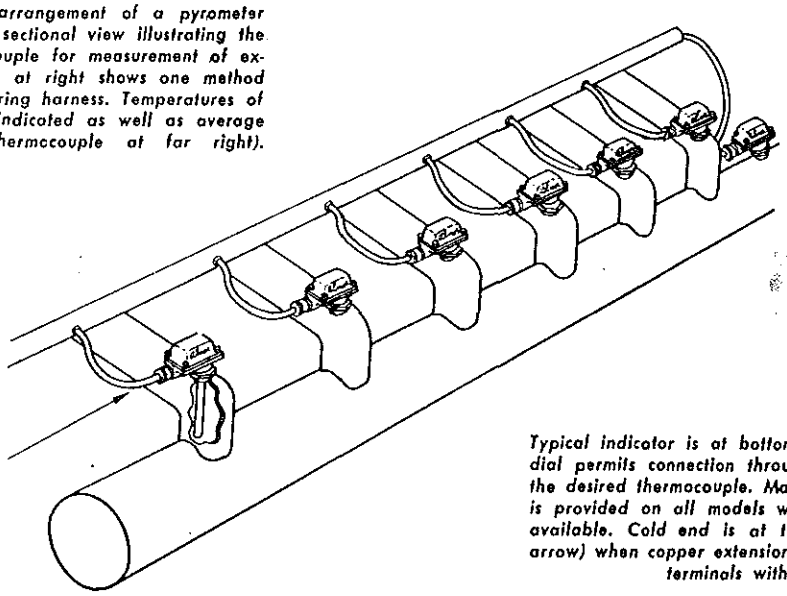
It is simple matter to tell by pyrometer reading whether the trouble is confined to a single cylinder or is

general throughout the engine. Then, combining this with other "tell-tales" it is possible to analyze the trouble and correct it in the early stages.

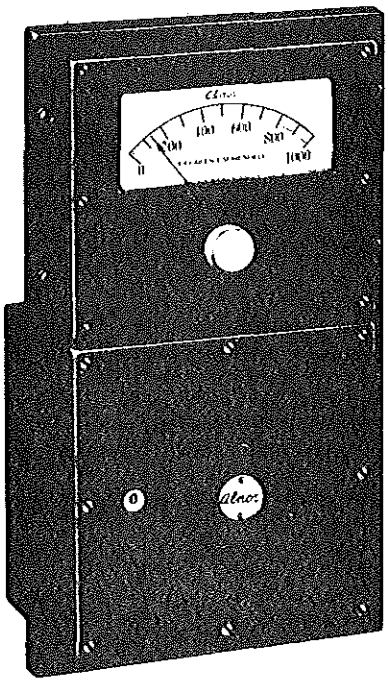
Combustion efficiency is reflected in three references that can be conveniently instrumented. In addition to the exhaust temperatures measured by pyrometers, these are the compression and firing pressures. Indicators of the maximum pressure and card drawing types will supply this additional data. Correlation of the three items of information will serve as a sound basis for diagnosis of troubles. Visual aids such as the exhaust color and noises should not be overlooked. These, along with the pyrometer, are the first detectors of brewing trouble. To indicate the method of analysis a few examples are given.

One of the most common causes of high exhaust temperatures is overloading. If the temperatures in all of the cylinders are consistantly high, the engine as a whole is overloaded; if only one cylinder is high, the trouble lies in the particular cylinder. A general overloading will be accompanied by high firing pressures and, depending on the degree of overload, may show exhaust smoke. In the case of a single cylinder, it is probably due to faulty injection equipment or maladjustment of the control linkage. High firing pressures will also be characteristic.





Components and typical arrangement of a pyrometer system. At top right is a sectional view illustrating the construction of a thermocouple for measurement of exhaust temperatures. Sketch at right shows one method of installation and the wiring harness. Temperatures of each exhaust elbow are indicated as well as average manifold temperature (thermocouple at far right).

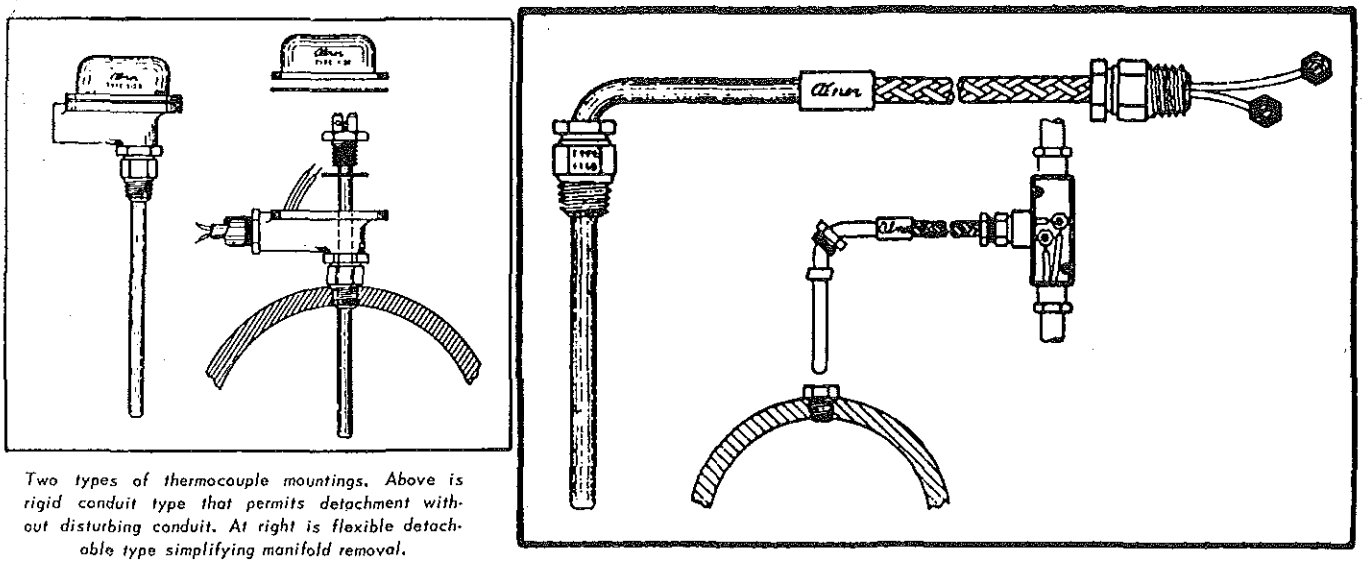


Typical indicator is at bottom left. Lower knob with its dial permits connection through a multi-point switch to the desired thermocouple. Manual cold-end compensation is provided on all models with automatic compensators available. Cold end is at thermocouple terminals (see arrow) when copper extension wire is used and at switch terminals with alloy wire.

Another reason for high exhaust temperatures is poor dissipation of cylinder heat to the water jackets. Scaling is a prime cause of this trouble because of its insulating qualities. Other contributory factors leading to high cylinder temperatures are: excessive friction created by faulty lubrication, partial piston seizures, excessive blow-by, etc.; and interference with the scavenging process such as by the carbonization of ports or intake passages. Shortage of air, whether it be the result of restriction of the scavenging air passages, faulty blower or air filter troubles, will cause high exhaust temperatures generally accompanied by a smokey exhaust.

The pyrometer will prove helpful in pinning down the particular trouble involved. For example, clogging of the scavenging air passages might occur in a single cylinder. The temperature reading for the particular cylinder would reflect this and the cause could be determined and corrected. On the other hand, a plugged air filter or leaking blower would affect the engine as a whole and reading on all cylinders would be high.

Low exhaust gas temperatures may be entirely normal since they will be reduced as load decreases. Most low exhaust gas temperatures brought about by other causes will be the result of insufficient fuel or poor ignition. These troubles will be accompanied by loss of power and ragged operation. Improper fuel, especially with regard to cetane rating, excessive-



Two types of thermocouple mountings. Above is rigid conduit type that permits detachment without disturbing conduit. At right is flexible detachable type simplifying manifold removal.

ly low engine temperatures, and water in the system are some possible causes of these conditions.

Fuels and the fuel system adjustment are frequent sources of faulty combustion. Improper fuel injection, *pre-ignition, delayed ignition, rapid* burning, sluggish burning and afterburning of the fuel will all affect exhaust temperatures. These all are functions of the fuel used and/or engine condition or adjustment. Injection timing, for example, is important. Early injection will result in low temperatures while late timing will have the opposite effect.

It is necessary that the interrelation of all the various factors be known if an intelligent trouble analysis is to be made. With this background, the pyrometer can be used to detect incipient troubles and then aid in locating them.

Care

Like all precision equipment, pyrometers require a certain amount of care. They also have limitations that should be understood if the user is not to be misled.

The primary unit of the pyrometer system is the thermocouple and as such it governs the accuracy of the system. They are rugged in construction, but should be protected from severe blows and other unusual treatment.

It should be understood that the pyrometers read average temperatures in the particular location where they are installed. The thermocouples are subjected to widely fluctuating temperatures during the cycle and, thus, must indicate an average. Being in the exhaust stream they are subject to the formation of carbon deposits that will alter their output characteristics. In addition, certain irregularities of a particular cylinder's component parts may lead to a stratification or deflection of the gases and alter the readings somewhat.

As has been pointed out, actual temperature readings are not so important as variations from the normal. However, if the readings are not reasonably accurate to begin with (compared with recommendations for the particular engine) there is no means of knowing whether the "normal" is actually too high or too low. It is possible to check the engine performance by means of an indicator.

Once the engine is shown to be operating normally, cylinders balanced, etc., the readings for each cylinder can be recorded as "normal" and variations from this will then reflect the beginning of troubles.

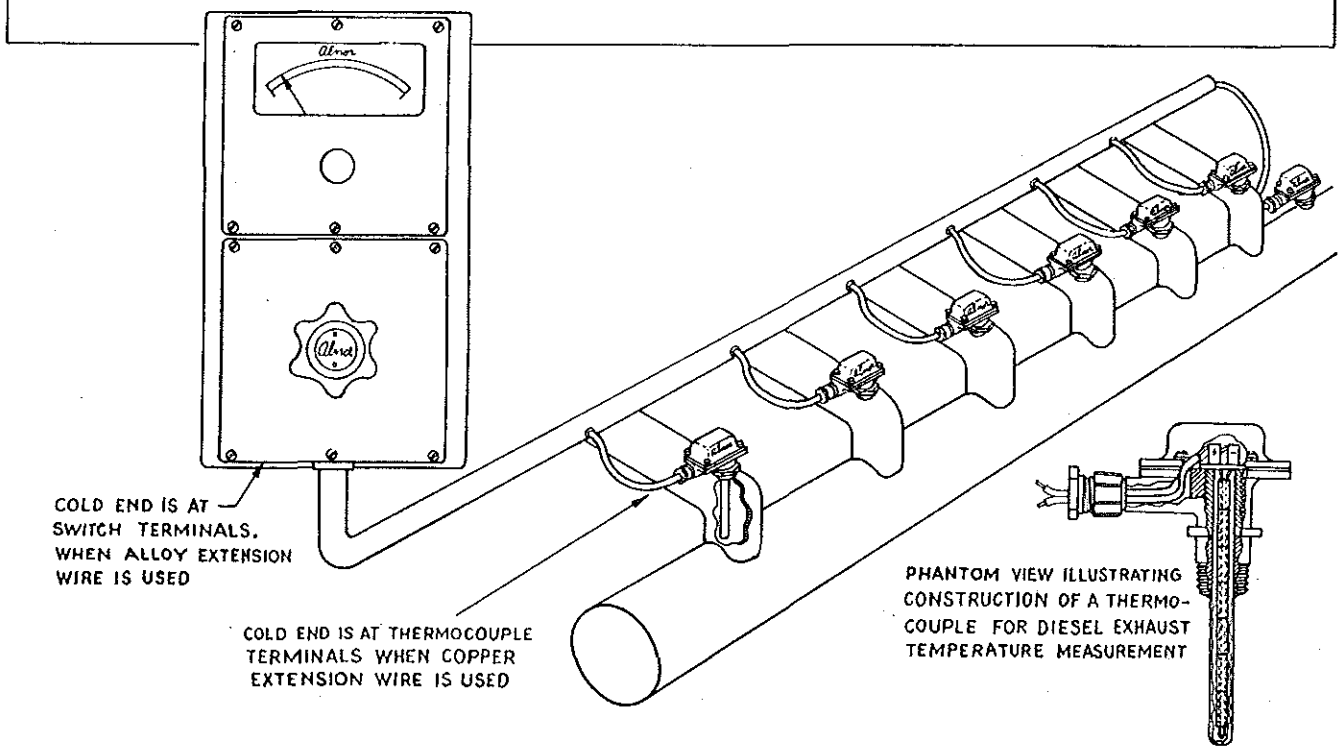
Carbon deposits on the protection tubes has been mentioned as an interference with normal heat transfer. These deposits should be removed carefully whenever the condition warrants and opportunity exists. For maximum uniformity of readings, cylinder to cylinder, all thermocouples should be cleaned at one time. Should a thermocouple require replacement, the type and characteristics of those in use should be duplicated.

The balance of the system is essentially an electrical circuit and as such is cared for in much the same way. Wires should be protected from injury to avoid shorts and grounds. Partially broken wires, loose or corroded terminals will all alter the resistance of the circuit and could lead to misinterpretation of inaccurate temperature readings. The meter should be accorded the care usually given to this type of equipment.

Conclusion

Properly and conscientiously used, the pyrometer will pay for itself over and over again as an important aid in securing maximum economy and minimum maintenance costs. It is the primary and most convenient means of checking on combustion efficiency.

Your Pyrometer - How It Works and How to Maintain It In First Class Condition



A PYROMETER system is easy to understand when each of its four basic components is considered separately. These components are the indicator, the switch, the extension wires, and the thermocouples. Meticulous attention to the following suggestions should materially increase the useful life of a pyrometer which is installed to measure exhaust gas temperatures in a Diesel or other internal-combustion engine.

CONSTRUCTION – OPERATION PRINCIPLES

A pyrometer indicator is an electrical instrument known as a milli-voltmeter.

A thermocouple is a unit containing two wires made of dissimilar metals which are welded together at one end. The other ends of these two wires are connected to the indicator or its selector switch by means of a pair of extension wires. In the case where several thermocouples are to be used with one indicator, a pair of extension wires is brought from each thermocouple to a selector switch, which in turn is connected to the indicator.

The welded end of the thermocouple is called the "hot" junction. The other end of the thermocouple, which connects to the indicator, is called the reference junction or "cold" end. When the hot junction of the thermocouple is heated so that its temperature rises above that of the reference junction, a small voltage is generated. This voltage is transmitted by the extension wires to the indicator, which measures its intensity.

The voltage generated by the thermocouple is proportional to the difference in temperature between the hot junction and the cold junction. This being true, it is possible to have the indicator scale marked in temperature degrees, instead of voltage, thus providing a direct indication of temperature without requiring constant reference to tables or charts.

REFERENCE JUNCTION OR COLD END

When a thermocouple is connected to the indicator by means of copper extension wires, the cold end or reference junction is located at the terminals of the thermocouple where the extension wires are attached.

In the case where a pair of alloy extension wires is used to extend the dissimilar metals of the thermocouple all the way to the indicator (or its selector switch), the reference junction or cold end is located where the extension wires are attached to the switch.

Alloy extension wires must *always* be used with those pyrometer indicators which contain automatic cold-end compensators.

POINTER SETTING

When a pyrometer indicator is *not* connected to *any* thermocouple, it should indicate the temperature at the cold end or reference junction. Use a thermometer to measure the cold-end temperature and see that the indicator pointer coincides with this temperature reading. (See previous paragraph entitled Reference Junction.)

When the cold end is located at the thermocouple terminals, temporarily fasten a thermometer with its bulb near these terminals and allow them to come to a stable temperature. Read the thermometer and adjust the indicator to correspond with this reading.

When the cold end is located at the switch or indicator terminals, place the thermometer bulb near these terminals and allow the whole unit to stablilize during a period of about an hour when the ambient temperature is stable and the instrument is shielded from drafts or direct radiation; this is especially important when the indicator contains a cold-end compensator.

After the temperature of the thermometer is steady take a reading and adjust the indicator.

Those indicators which contain automatic cold-end compensators will automatically move their pointers to follow the ambient temperature fluctuations if they have been properly and carefully adjusted.

Never set the indicator pointer on zero unless the temperature surrounding the cold end actually is 0 deg. F. or 0 deg. C. depending upon how the scale is printed.

If you are not sure whether copper or alloy extension wire is being used, disconnect both wires at one thermocouple and twist them together and apply some heat. If the pointer of the pyrometer moves up scale, then you can be sure that you have alloy extension wire because it is acting as a thermocouple under these conditions. If the pointer does not move, then of course you can assume that you have copper connecting wire. The pointer should never move down scale when the twisted wires are heated, because this indicates that the extension wires are reversed in polarity where they attach to the switch.

When the instrument is not in use, the switch should always be turned to the "Off" position. In this position, the pointer of the pyrometer is usually automatically locked; however, if not completely locked, it is at least damped to prevent excessive pointer swing.

SWITCH AND WIRE

Almost all pyrometer switches are equipped with clamp-type terminals to insure against loose connections, but periodic examination should be made of switches to be sure that there are no loose or corroded connections where the extension wire attaches to the terminals. It is very important that all extension wire be kept away from high heat zones as well as from cold zones. Be sure that the wires do not rest in any oil or water pools and also make sure that the insulation is not worn nor burned any place along its length. All connections which are subject to vibration should be kept tight and clean. This is especially true at the point where the extension wire attaches to the thermocouple. If the extension wire is the stranded type, inspect it at points of flexing and at terminals to be sure that no broken strands are in position to cause short circuits.

THERMOCOUPLES

To reduce the burning, contamination, and general deterioration of the thermocouple of a pyrometer system used for measuring the temperature of exhaust gases, the thermocouple is mounted in a protecting tube, which in turn is installed in the exhaust manifold. Quite frequently the surface of this tube becomes coated with carbon which interferes with the accuracy of the temperature indication. Besides interfering with the accuracy of the indication, the carbon deposit tends to make the pyrometer system slow in showing sudden changes in exhaust-gas temperature.

It is recommended that the assembly of protection tube and thermocouple be withdrawn from the exhaust manifold so that the carbon accumulation may be removed at regular intervals.

If it becomes necessary to disconnect the extension wires from the thermocouple terminals to extract the assembly, note carefully the polarity markings on the extension wires and the terminals so that the wires may be returned to their proper places. The manufacturer's instruction sheet should be consulted for aid in identifying the polarity of lead wires.

PIVOTS AND BEARINGS

After many years of service, or after abusive treatment, the pivots and jeweled bearings of the pyrometer indicator may require attention. Cleaning and polishing may be all that is required to restore the pivots and jeweled bearings to operation, although on occasion replacement is necessary. In either case the manufacturer recommends that the pyrometer indicator be returned to the factory or repair depot for this service. It is not feasible to attempt instrument repairs in the field where working quarters lack light, quiet, and cleanliness.

INDICATOR

A pyrometer system that is properly used will give long uninterrupted service and will show only those minor defects that develop with age. However, severe shock, extreme vibration, or other harsh treatment will definitely produce defects that will impair the accuracy of the pyrometer. Whenever a pyrometer has been subject to rough handling, it is wise to return it to the manufacturer or his repair depot for complete mechanical and electrical inspection.

CAUTION

Occasionally, someone not entirely familiar with pyrometers will want to check the operation of an indicator by using a battery of some sort in order to get a deflection of the instrument. This is perhaps the most serious abuse that can be given the pyrometer because the output voltage of a dry cell is over 30 times that required for full-scale deflection of the instrument. Applying a dry cell to the indicator terminals causes a bent pointer, burnt springs, and sometimes an open moving coil.

One Final Warning! Remember—Never Test A Pyrometer With A Battery.

ALNOR INSTRUMENT CO.

DIVISION OF

ILLINOIS TESTING LABORATORIES, INC.

420 NORTH LASALLE STREET CHICAGO, ILLINOIS 60610

11905386

DESCRIPTION: Ashcroft-4½ duplex pressure gauge with following features.

1. Phenol turret case.
2. ¼" MPT back connected.
3. Range 0-100 psi.
4. Whiteface black MARKINGS. (1)

VENDOR'S PART NO. 1038A With 1279A case

VENDOR: Manning, Maxwell & Moore Div.
Dresser Industries
Stratford, Conn.

Substitutes permitted without engr. approval provided phenol turret case is furnished.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	4665	3-21 69	ITEM 4 WAS "WHITEFACE BLACK HANDS" (1)	LWC

TITLE
GAUGE PRESS. DUPLEX 0-100psi

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 20561:2	2/12/69	ASSY. OR LO.
DR. BY L. W. Cooper	2/3/69	SCALE
CHK'D. BY FDC	2/3/69	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11905386 | SHEET 1 OF 1

EF3009-2

ASHCROFT® PRESSURE GAUGE
INSTALLATION AND OPERATING INSTRUCTION
PARTS LIST

GAUGES ARE INSTRUMENTS. HANDLE THEM AS CAREFULLY AS YOU WOULD A FINE WATCH

SELECTION

Gauges should be graduated to about double the average working pressure, selecting the nearest standard range. This will make the gauge last longer and pointer will be easier to read at about the top center of the dial.

Select gauges with the proper Bourdon tube material and joints for the service.

INSTALLATION

Always use a wrench on the flats of the gauge socket to screw the gauge in place. When a fitting is being screwed to the gauge, hold a wrench on the socket flats instead of twisting against the gauge socket screws which are intended to hold the gauge mechanism in the case.

When gauges are mounted on a wall or panel, make sure they are connected free from piping strains. Also see to it that the mounting surface is flat, or insert washers under the flange of the gauge case to obtain three-point suspension. Preferably, the last length of piping leading up to the gauge should be flexible tubing. This will insure that the gauge is free from strain.

Install gauges where they will be free from the effects of mechanical vibration as this will wear out any gauge quickly. Try to mount the gauge on a wall nearby and connect the gauge to the machine which vibrates badly by means of flexible line assembly.

Protect gauges from frequent pressure pulsations by using throttle screws in the socket of the gauge, needle valves, pulsation dampeners, or Ashcroft Gauge Savers.

When any gauge is used for steam pressures, a siphon filled with water must be installed between the gauge and the line. When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg to enable occasional cleaning out of the sediment. The head effect of this piping leg should be compensated for by resetting the pointer of the gauge.

Locate gauges where they will not be subject to high heat which will weaken soldered tube joints. Also, high temperatures make gauges inaccurate. See chart on this page. Install gauges where they will be free from moisture and corrosive fumes, if possible. If these conditions are unavoidable, ask for special recommendations and, in general, use phenol plastic cases which are resistant to most corrosive fumes and cannot rust.

PROPER USE

Apply pressure slowly. Do not open the gauge cock or valve too quickly — this imparts a severe strain on the Bourdon tube which may rupture it, or result in shortened life. When the service itself is subject to sudden pressure applications, use a needle valve, or the Ashcroft Gauge Saver.

Avoid over-pressure. See that the apparatus is provided with a relief valve and that the range of the gauge is higher than the set pressure of the relief valve.

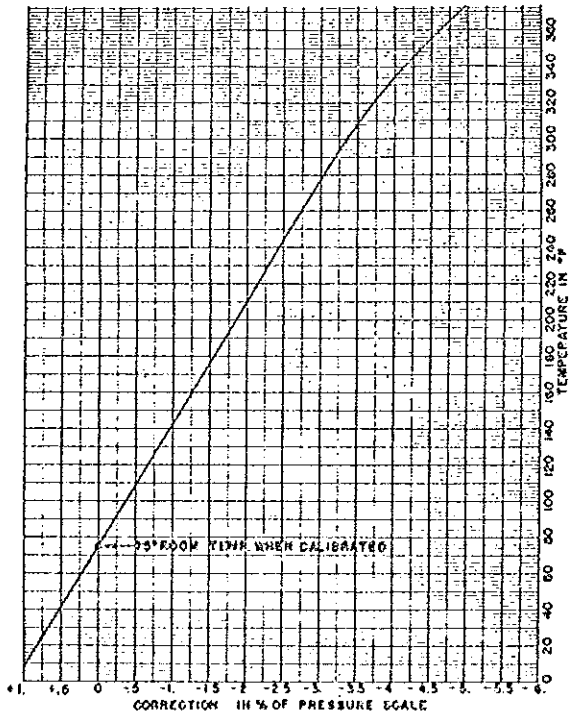
Sudden pressure release has the same detrimental effect and should be compensated for in the same manner as for pressure applications mentioned above. On hydraulic presses, Catalog Number 1056 Ashcroft Quality Gauge with slotted link should be specified. See Bulletin 302.

MAINTENANCE

Replace broken glasses and thus keep dirt out of the working bearings and teeth of the movement mechanism.

Never oil gauge movements or linkages except with high grade instrument oil. Regular oil attracts dirt and becomes gummy, thus causing the gauge to act sluggish and inaccurate.

Approximate Error or Change in Calibration of a Bourdon Tube Type Pressure Gauge Caused by Changes in Temperature



Example: Gauge working at 500 p.s.i. pressure and at 280° F. temperature would have a —3% correction and would read 3% or 15 p.s.i. fast.

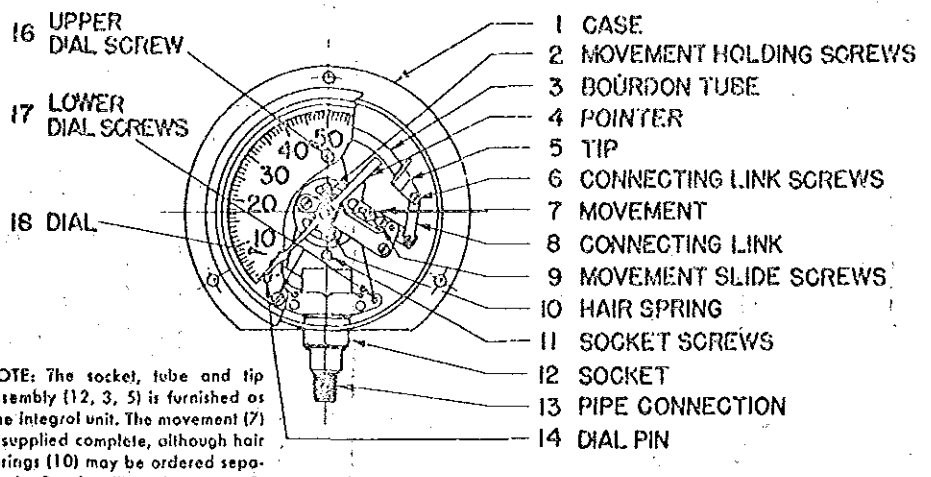
NAMES OF GAUGE PARTS AND RING DESIGNS

ENGINEERING DATA

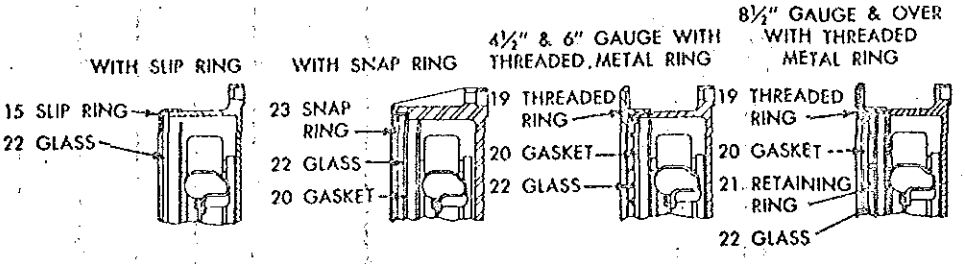
The drawing below shows a typical lower connection gauge with all of the parts designated by their standard names. The use of these names will facilitate the ordering of parts and eliminate any misunderstanding in describing gauge construction.

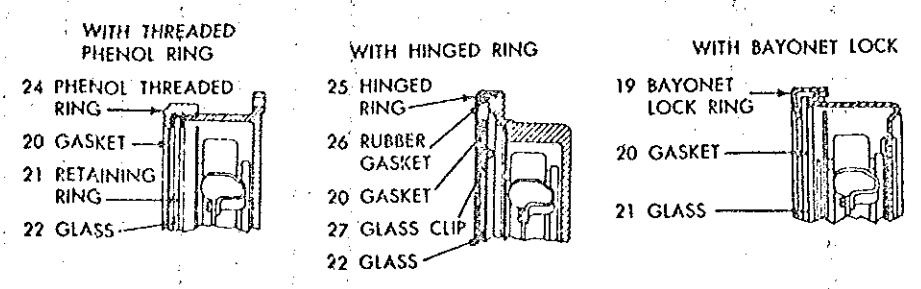
When ordering parts—specify as much of the following data as possible:

Size (dial diameter)—Case Material (Iron, Alumalife or Phenol)—Ring Design (Slip, Threaded, Snap or Hinged)—Connection Location (Lower or Back) — Connection Size (¼" or ½") — Bourdon Tube (Material)—Dial Range—Class of Gauge. Specify Catalog Number if possible; otherwise, mention whether parts are for Duragauge, Quality Gauge or Special Application Gauge.

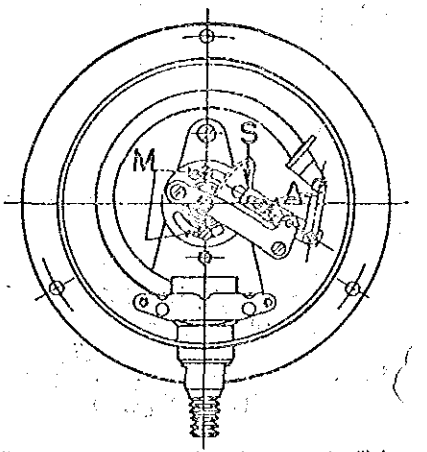


NOTE: The socket, tube and tip assembly (12, 3, 5) is furnished as one integral unit. The movement (7) is supplied complete, although hair springs (10) may be ordered separately. Rarely will modern parts fit in old style gauges.





ADJUSTMENT OF ASHCROFT GAUGES HAVING ROTARY GEARED MOVEMENTS



Adjusting a gauge is a broad term and will be divided into specific operations.

1. Calibration correction by resetting the hand or by adjusting the micrometer pointer to agree with some desired standard. To do this, the ring with glass must be removed and the pointer or hand brought to the nearest agreement over the desired range.

2. If this simple adjustment is not sufficient to give the desired accuracy, it is necessary to decide what is the cause; such as, sticky or sluggish action throughout the scale or at some points; or, the pointer travels too fast or too slow throughout the whole scale, or at either end of the scale.

3. Correction for sluggishness is to clean all bearings and gear teeth. Hair spring to be adjusted so that all back lash is eliminated; too much tension will cause friction and drag.

4. The slide "S," moved in or out, changes the ratio of motion. A Bourdon tube may change slightly so that its motion under a given internal pressure is either more or less; therefore, the slide "S" is moved to compensate or agree with the Bourdon tube's motion. When the pointer moves too fast, the slide "S" should be pushed out; if the pointer moves too slow, the slide should be pushed in. When properly set, tighten slide screws.

5. Even with the slide set to the best location, it is necessary to have the angle of pull "A," just right or the pointer will travel too fast at either the low or high end of the scale. By loosening screws "M" the whole movement may be rotated to give the desired angle "A." If angle "A" is acute, the pointer will travel fast on the first part of the scale and slower on the last part.

For example, a gauge may read perfectly from zero to the top of the dial, or one half of the scale, and from there on go gradually slower. In this case, increase the angle "A" a little at a time until the hand begins to go faster for the last half of the scale. "A" = 76° approx. When a new movement is being adjusted to an old gauge, this rotary feature is extremely convenient.

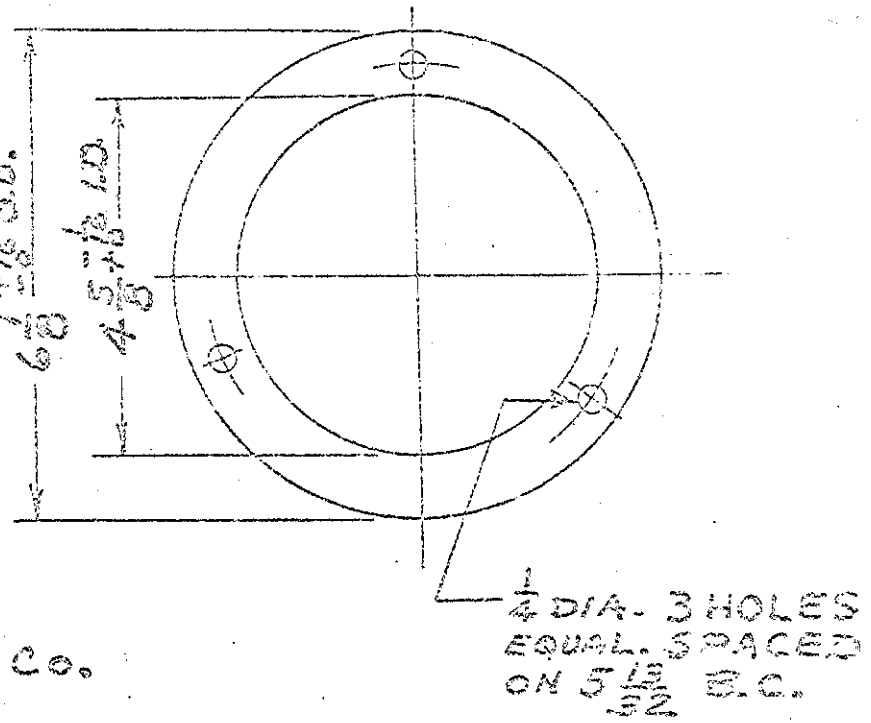
DRESSER

INDUSTRIAL VALVE & INSTRUMENT DIVISION

STRATFORD, CONNECTICUT 06497

1190564

DESCRIPTION: GASKET- RING
CLOSED CELL, NEOP. SPONGE RUBBER
WITHOUT ADHESIVE BACK
.0937 THICK



VENDOR'S PC NO.:

VENDOR'S DWG NO.:

VENDOR: WISCONSIN GASKET & MFG. Co.
11500 W. BROWN DEER RD.
MILWAUKEE, WISCONSIN 53224

REV NO	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D. BY

TITLE: GASKET

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

ACL. NO. 205700(B)	11 17/63	ASSY. OR LD.
DR. BY [illegible]	12 7 163	SCALE
CHK'D. BY [illegible]	1/17 63	HEAT TR.
MAT'L		

APPV. CAST. MAT'L
APPV. MACH. ENGR.
APPV. WELD.

SHEET SIZE A DWG. NO. 1190564 1

SHEET 1 OF 1

DESCRIPTION : Helicoid 4½" pressure gauge type 410 with the following features:

1. Range 0 - 30 PSI
2. Right hand movement
3. With Navy Phenol turret case
4. White dial with black figures
5. ¼" male back connected

VENDOR'S PC NO : Type 410 - 4½"

VENDOR'S DWG NO:

VENDOR : Helcoid Gage Division
American Chain & Cable Co.
Bridgeport, Connecticut

NOTE: SUBSTITUTES NOT PERMITTED.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE

GAUGE, PRESSURE
0 - 30 PSI

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± 1/16

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205706(B)	3/26/70	ASSY. OR LO.	
DR. BY W. Cooper	3/20/70	SCALE	
CHK'D. BY	/ /	APPV.	/ /
MAT'L		HEAT TR.	
SHEET SIZE A	DWG. NO. 11 905 757	SHEET 1 OF	

11905757

INSTRUCTIONS

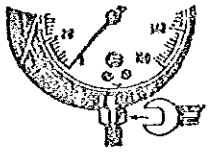
FOR INSTALLATION, USE, REPAIR AND RECALIBRATION OF

The Helicoid Gage

INSTALLATION

Helicoid Gages are designed for stem mounting with bottom connection, or surface mounting with bottom or back connection, or flush mounting on panel with back connection. The case is made with or without a flange for stem mounting, with a back flange for surface mounting and with a front flange for flush mounting. Standard connections are ¼" and ½" N.P.T.

The Bourdon tube is phosphor bronze, alloy steel, stainless steel (type 316) or K Monel. The right kind of tube should be selected for the service. A bronze tube should not be used at temperatures over 300F° or for working pressures over 600 p.s.i. A steel tube should be used for Ammonia. A K Monel tube should be used for sour oil or gas. For oxygen or hydrogen peroxide, the gage must be free from oil — otherwise an explosion may result. Hence, oxygen gages should be specified as such, and supplied with a Lucite lens and safety blow-out discs. These gages should be bronze, K Monel or Stainless Steel — never alloy steel. Use the right gage for the service.



USE WRENCH

A suitable pipe compound should be applied to the connection threads. The gage should then be turned into the fitting with a suitable wrench.

Never tighten gage connection by gage case.

When the piping to the gage vibrates excessively, the gage should be mounted on a rigid support and the connection made through a flexible metallic hose. This type of connection will provide longer, more useful life of gage.

Gages subject to violently pulsating pressures should be installed with a needle valve or a Helicoid Cartridge Snubber. The valve may be partly closed to provide pressure damping, whereas the snubber will automatically perform this service. A water-filled siphon must be installed below any gage for steam service.

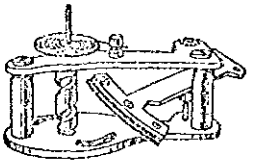
OPERATION

The normal operating range of pressure gages is the middle third of the scale. Although all Helicoid gages have been subjected to 50% over-pressure before calibration, for longest life they should not be operated

OPERATION (Con'd)

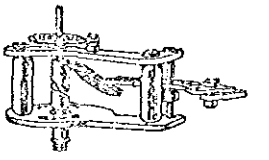
continually at more than two-thirds of the maximum dial graduation.

If a gage might be subjected to pressures beyond the maximum dial graduation, a Helicoid gage with a right-hand roller movement should be used because the cam releases from the roller at slightly beyond the maximum dial pressure. This is a feature exclusive with the Helicoid movement. Usually, such a gage can withstand about 50% over-pressure without damage to the Bourdon tube.



RIGHT HAND ROLLER

If a pressure gage is to be subjected to vacuum, or sudden reductions in pressure, as in hydraulic press service, a left-hand roller movement is used because the cam releases from the roller at slightly below zero. This prevents the gage pointer from slamming against the dial stop pin. The Helicoid vacuum gage is made so that the cam releases from the roller if the gage is subjected to pressure. It is the only vacuum gage thus protected. A compound gage should be used for indicating both pressure and vacuum.



LEFT HAND ROLLER

Any pressure gage is a fine instrument. It should be handled as you would a watch.

REPAIRS

To remove the pressure system from the case, pry the snap ring out of its groove by means of a knife or screw driver. The glass and gasket can then be lifted out. Removal of the three screws at back will allow the entire system, with dial and pointer attached, to be removed as a unit. A Helicoid Gage can then be calibrated without removing the pointer or dial.

If it is necessary to remove the dial for cleaning of parts, first lift off the pointer with a handijack and then remove the three dial screws.

The link is attached to the slotted extension of the cam by a shoulder nut, washer and screw. When reassembling, be sure that washer is placed between link and cam extension.

When a new movement is installed in a gage, be sure that the movement cam lines up in the same plane as the tip of the tube so the link does not bind. The link must have sufficient side play to prevent friction.

The disassembly and assembly of all other parts is obvious.

If movement has been disassembled, examine bearings for roughness and wipe clean if needed. Do not oil any moving parts. Oil attracts dust. If any moving parts appear worn or galled, replace complete movement.

(over)

THE HAIRSPRING

The function of the hairspring is to keep the roller groove surface in contact with the surface of the cam facing. The cam in the Helicoid movement can release from the roller and contact again without loss of calibration.

The hairspring is stainless steel. It will not corrode. It should not need replacing unless damaged. It is located at an accessible place above the top plate. It is secured to a hub that is pressed on the pointer shaft. The end is peened in a groove around a post. It is easily replaced by peening at a new location in the groove.

If the gage pointer jumps the stop pin on the dial due to shock, simply return it to the other side of the pin and the gage will be in correct calibration.

If the hairspring becomes unwound due to rough handling, it may be rewound by pressing on the end of the Bourdon tube sufficiently to release the cam from the roller, then turning the pointer one revolution before allowing the cam to contact the roller. The surface of the cam nearest the movement-mounting screws is the correct bearing edge. It is important that the hairspring be wound so that one end of the cam enters and leaves the roller without interference, yet develops *tension when the cam enters the roller.*

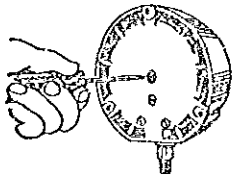
To adjust the tension in the hairspring, the hub on the pointer shaft may be rotated.

RECALIBRATION

To recalibrate, remove the complete system assembly from the case, with dial and pointer attached, and mount on a dead-weight tester or a test pump with an accurate test gage.

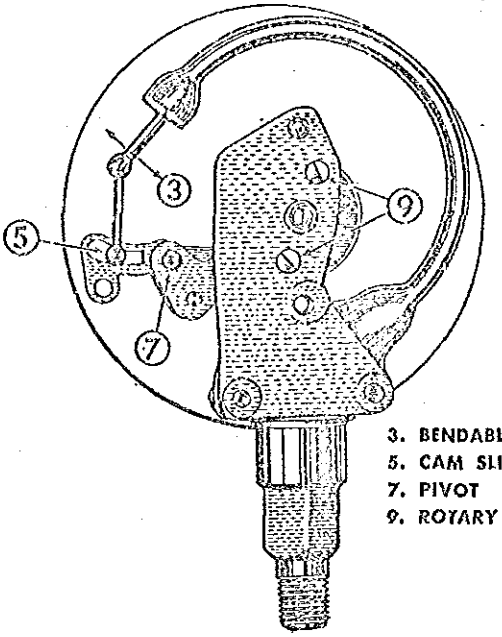
If intended for oxygen or hydrogen peroxide service the gage must be free of oil. Such gages should be tested with clean air or water.

It should be noted that the rear adjustment screw is for pointer setting; the cam slide adjustment (5) is to correct for variance of pointer travel; and adjustment of the rotary movement (9) is for positioning the cam in the roller.



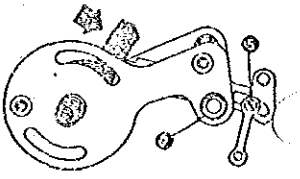
REAR ADJUSTMENT SCREW

1. Subject the gage to a pressure of 10% of total scale. Example: for a 100 lb. gage, run pressure up to 10 lbs. If the pointer does not indicate correctly, reset it by the rear adjustment screw. If pointer has been removed, press it on the staff to indicate at or near the 10% mark and reset exactly by rear adjustment screw.



3. BENDABLE TIP
5. CAM SLIDE ADJUSTMENT
7. PIVOT
9. ROTARY MOVEMENT

CONTACTING SURFACE ON THIS SIDE



2. Increase the pressure to full range. The pointer may indicate high or low, in which case lengthen or shorten distance of slide nut (5) from pivot (7). This is done by loosening the link screw (in slide nut 5) and sliding the link in or out. Retighten screw securely after this adjustment.

3. After this adjustment has been made, it may be necessary again to set the pointer at the 10% graduation by means of the rear adjustment screw. These adjustments must be continued until the pointer indicates correctly at the 10% graduation and at full scale.

4. With a pressure equivalent to half scale, note the pointer position. If pointer is high at half scale, bend the tip outward. If pointer is low at half scale, bend the tip inward. Caution: See that link does not bind at tip screw.

5. With pressure gradually increasing, note the position of the pointer at all major graduations. Should the pointer indicate correctly, recalibration has been completed; if not, continue as outlined under the preceding paragraphs.

ACCO

Helicoid Gage Division

AMERICAN CHAIN & CABLE COMPANY, INC.

BRIDGEPORT 2, CONNECTICUT

ACCO Helicoid Gage U.S.A.

SR-3884

Printed in U.S.A.

March 1955

11906213

DESCRIPTION: 4 1/2" duplex pressure gauge, phenol turret case with following features:

1. 1/4" Back conneted.
2. Range 0-600 p.s.i. figure intervals 50 p.s.i. int. graduations @ 5p.s.i. intervals.
3. White dial with black graduations & numerals.
4. 1% accuracy.

VENDOR'S PIECE NO.: 1245E

VENDOR: INDUSTRIAL VALVE & INSTRUMENT DIV.
DRESSER INDUSTRIES
STRATFORD,
CONNECTICUT

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: GAUGE, duplex 0-600 psi.

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205857	4/13/72	ASSY. OR LO.	
DR. BY	/ /	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11906213	SHEET 1 OF 1	

BF3009-2

11906213

ASHCROFT® PRESSURE GAUGE
INSTALLATION AND OPERATING INSTRUCTION
PARTS LIST

GAUGES ARE INSTRUMENTS. HANDLE THEM AS CAREFULLY AS YOU WOULD A FINE WATCH

SELECTION

Gauges should be graduated to about double the average working pressure, selecting the nearest standard range. This will make the gauge last longer and pointer will be easier to read at about the top center of the dial.

Select gauges with the proper Bourdon tube material and joints for the service.

INSTALLATION

Always use a wrench on the flats of the gauge socket to screw the gauge in place. When a fitting is being screwed to the gauge, hold a wrench on the socket flats instead of twisting against the gauge socket screws which are intended to hold the gauge mechanism in the case.

When gauges are mounted on a wall or panel, make sure they are connected free from piping strains. Also see to it that the mounting surface is flat, or insert washers under the flange of the gauge case to obtain three-point suspension. Preferably, the last length of piping leading up to the gauge should be flexible tubing. This will insure that the gauge is free from strain.

Install gauges where they will be free from the effects of mechanical vibration as this will wear out any gauge quickly. Try to mount the gauge on a wall nearby and connect the gauge to the machine which vibrates badly by means of flexible line assembly.

Protect gauges from frequent pressure pulsations by using throttle screws in the socket of the gauge, needle valves, pulsation dampeners, or Ashcroft Gauge Savers.

When any gauge is used for steam pressures, a siphon filled with water must be installed between the gauge and the line. When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg to enable occasional cleaning out of the sediment. The head effect of this piping leg should be compensated for by resetting the pointer of the gauge.

Locate gauges where they will not be subject to high heat which will weaken soldered tube joints. Also, high temperatures make gauges inaccurate. See chart on this page. Install gauges where they will be free from moisture and corrosive fumes, if possible. If these conditions are unavoidable, ask for special recommendations and, in general, use phenol plastic cases which are resistant to most corrosive fumes and cannot rust.

OPERATION

Apply pressure slowly. Do not open the gauge cock or valve too quickly — this imparts a severe strain on the Bourdon tube which may rupture it, or result in shortened life. When the service itself is subject to sudden pressure applications, use a needle valve, or the Ashcroft Gauge Saver.

Avoid over-pressure. See that the apparatus is provided with a relief valve and that the range of the gauge is higher than the set pressure of the relief valve.

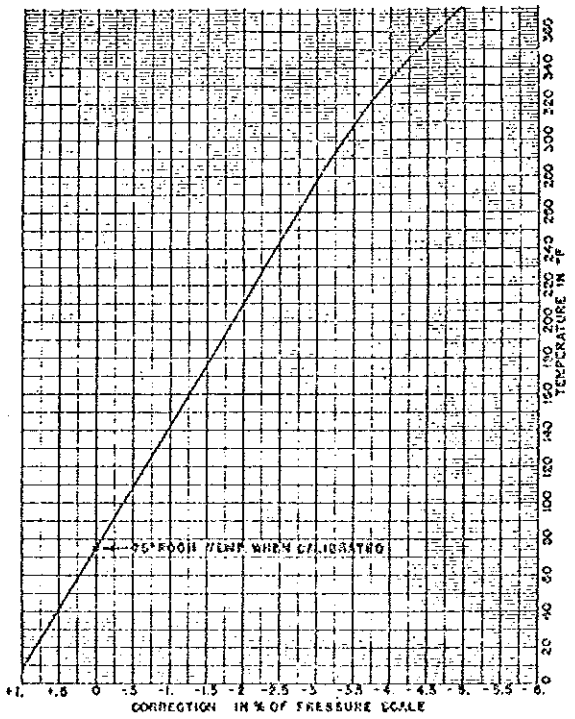
Sudden pressure release has the same detrimental effect and should be compensated for in the same manner as for pressure applications mentioned above. On hydraulic presses, Catalog Number 1056 Ashcroft Quality Gauge with slotted link should be specified. See Bulletin 302.

MAINTENANCE

Replace broken glasses and thus keep dirt out of the working bearings and teeth of the movement mechanism.

Never oil gauge movements or linkages except with high grade instrument oil. Regular oil attracts dirt and becomes gummy, thus causing the gauge to act sluggish and inaccurate.

Approximate Error or Change in Calibration of a Bourdon Tube Type Pressure Gauge Caused by Changes in Temperature



Example: Gauge working at 500 p.s.i. pressure and at 280° F. temperature would have a −3% correction and would read 3% or 15 p.s.i. fast.

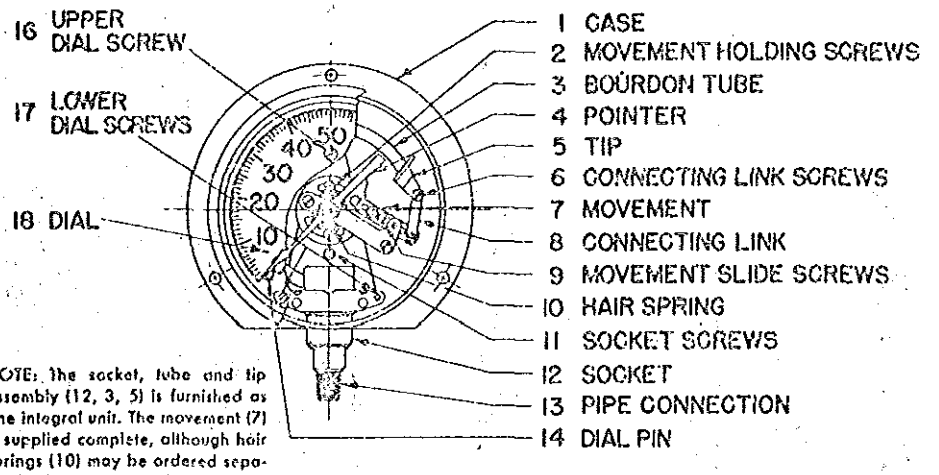
NAMES OF GAUGE PARTS AND RING DESIGNS

ENGINEERING DATA

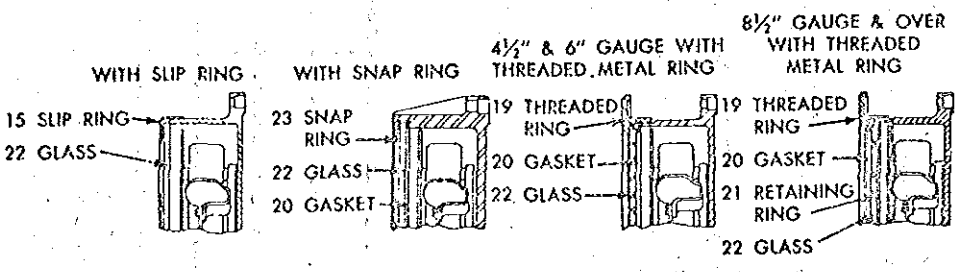
The drawing below shows a typical lower connection gauge with all of the parts designated by their standard names. The use of these names will facilitate the ordering of parts and eliminate any misunderstanding in describing gauge construction.

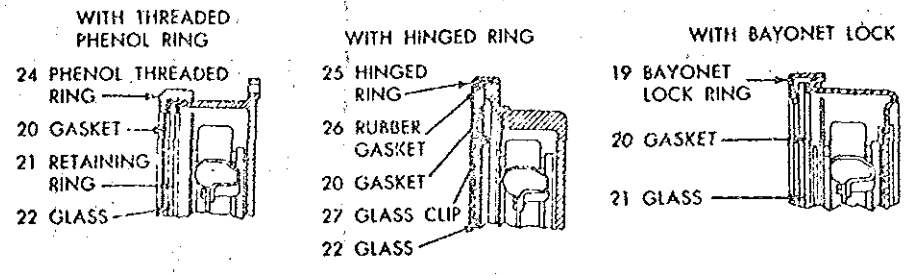
When ordering parts—specify as much of the following data as possible:

Size (dial diameter)—Case Material (Iron, Alumalife or Phenol)—Ring Design (Slip, Threaded, Snap or Hinged)—Connection Location (Lower or Back) — Connection Size (¼" or ½") — Bourdon Tube (Material)—Dial Range—Class of Gauge. Specify Catalog Number if possible; otherwise, mention whether parts are for Duragauge, Quality Gauge or Special Application Gauge.

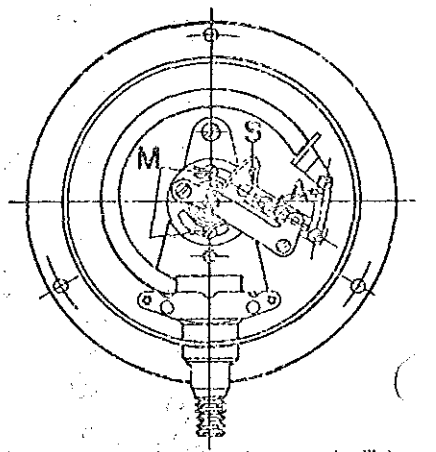


NOTE: The socket, tube and tip assembly (12, 3, 5) is furnished as one integral unit. The movement (7) is supplied complete, although hair springs (10) may be ordered separately. Rarely will modern parts fit in old style gauges.





ADJUSTMENT OF ASHCROFT GAUGES HAVING ROTARY GEARED MOVEMENTS



Adjusting a gauge is a broad term and will be divided into specific operations.

1. Calibration correction by resetting the hand or by adjusting the micrometer pointer to agree with some desired standard. To do this, the ring with glass must be removed and the pointer or hand brought to the nearest agreement over the desired range.

2. If this simple adjustment is not sufficient to give the desired accuracy, it is necessary to decide what is the cause; such as, sticky or sluggish action throughout the scale or at some points; or, the pointer travels too fast or too slow throughout the whole scale, or at either end of the scale.

3. Correction for sluggishness is to clean all bearings and gear teeth. Hair spring to be adjusted so that all back lash is eliminated; too much tension will cause friction and drag.

4. The slide "S," moved in or out, changes the ratio of motion. A Bourdon tube may change slightly so that its motion under a given internal pressure is either more or less; therefore, the slide "S" is moved to compensate or agree with the Bourdon tube's motion. When the pointer moves too fast, the slide "S" should be pushed out; if the pointer moves too slow, the slide should be pushed in. When properly set, tighten slide screws.

5. Even with the slide set to the best location, it is necessary to have the angle of pull "A," just right or the pointer will travel too fast at either the low or high end of the scale. By loosening screws "M" the whole movement may be rotated to give the desired angle "A." If angle "A" is acute, the pointer will travel fast on the first part of the scale and slower on the last part.

For example, a gauge may read perfectly from zero to the top of the dial, or one half of the scale, and from there on go gradually slower. In this case, increase the angle "A" a little at a time until the hand begins to go faster for the last half of the scale. "A" = 76° approx. When a new movement is being adjusted to an old gauge, this rotary feature is extremely convenient.

DRESSER

INDUSTRIAL VALVE & INSTRUMENT DIVISION

STRATFORD, CONNECTICUT 06497

1190689

Signal generator, direct 7/8"-18 female tachometer mounting. 0.19" dia. drive shaft with tang.

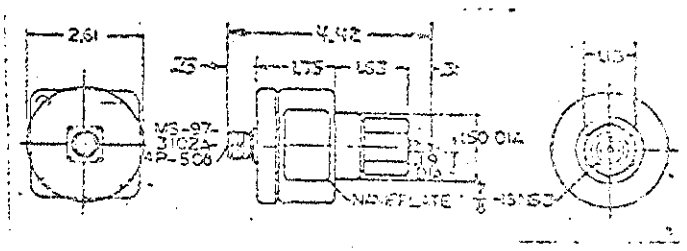
60 sinusoidal cycles per revolution. (Operation will be 0-2000 RPM)

1 volt peak output into 1K ohm load.

Temp. range −65°F. to +350°F.

With 2pin connector MS3102E-10SL-4P.

Vendor type - ES60



Vendor : Synchro-Start Products, Inc.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THIS COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THIS COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	9905	5-18-76	ADD PICTURE	SJV
1			Delete 7/8-32 terms.	RK

TITLE: GENERATOR, SIGNAL, TACHOMETER

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .010 0.0 - ± .005 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	8360	1/25/73	ASSY. OR LD.
DR. BY	R. KEYES	1/15/73	SCALE
CHK'D. BY	/ /		HEAT TR.
MAT'L			
APPV. CAST.			MAT'L
APPV. MACH.			ENGR.
APPV. WELD.			

SHEET SIZE A — DWG. NO. 1190689 — SHEET 1 OF 1

ELECTRONIC SIGNAL GENERATORS

GENERAL OPERATING INSTRUCTIONS

MOUNTING:

Model ESGO Signal Generator with drive tang should fit freely into the socket of the drive coupler. For Model ESGS units which are gear or belt driven, normal precautions should be taken to align the unit properly to the drive member.

OUTPUT CONNECTIONS:

The Signal Generators are available either with screw, MS, or Conduit Terminal connections. To minimize noise pickup, it is strongly recommended to use twisted pair signal leads. Ideally, it is desirable to use a shielded cable with the shield grounded only on the load end. If the load is a Synchro-Start electronic speed switch, the shield must be grounded to the negative supply terminal.

SIGNAL OUTPUT:

Output is sinusoidal, with 60 sinusoidal cycles per revolution. Minimum speed of operation is 150 RPM. Operating temperature range: -65° to 250° F. minimum. Output voltage level as follows: 3.00 volts peak to peak with 4.7K load between 200 RPM - 10,000 RPM.

Synchro-Start PRODUCTS, INC.
SUBSIDIARY OF KNOWLES ELECTRONICS, INC

SYNCHRO-START PRODUCTS, INC.
8109 N. Lawndale Ave., P.O. BOX 147, Skokie, Ill. 60076
Telephone: 312/673-7730
Telex: 724-424

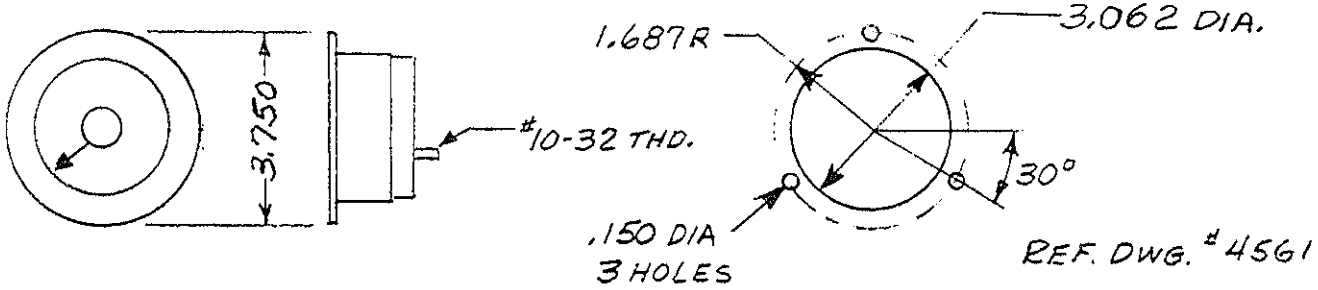
11906823

PROPRIETARY
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Colt Industries Fairbanks Morse Engine Division

① Synchro-Start Model 30 electronic
Tachometer indicator, scale 0-1500 RPM

1 M.A. DC meter, 250° movement, pivot & jewel.
Tracking accuracy ±2% (full scale).
Supplied with mounting hardware, terminal nuts & washers.

Note: Meter indicates output of ES generator
running at twice engine speed.



Vendor- SYNCHRO-START PRODUCTS, INC.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
M/F →	13902	4-17 84	ADDED MODEL NUMBER; RANGE WAS 0-1200 RPM	MSS RTC

TITLE
INDICATOR, TACHOMETER

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC463	11/20/73	ASSY. OR LO.	
DR. BY R. KEYES	11/13/73	SCALE	
CHK'D. BY R. K.	11/13/73	HEAT TR.	
MAT'L PURCHASE			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENG.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11906823 | SHEET 1 OF 1

F3009-2

O.P.



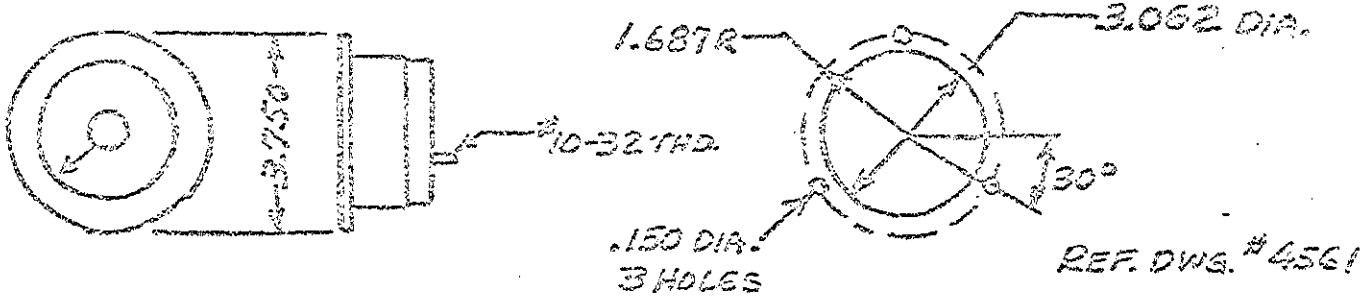
Tachometer indicator, scale 0-1200 RPM

1 M.A. DC meter, 250° movement, pivot & jewel.

Tracking accuracy ±2% (full scale).

Supplied with mounting hardware, terminal nuts & washers.

Note: Meter indicates output of ES generator running at twice engine speed.



Vendor: SYNCHRO-START PRODUCTS, INC.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
			Range 0-1500	
			Rev 13902	

TITLE: INDICATOR, TACHOMETER

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

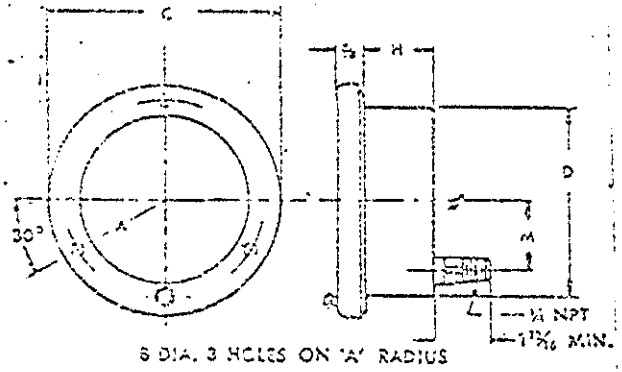
Colt Industries — Fairbanks Morse Power System Division

REL. NO. PC463	11/20/73	ASSY. OR LO.
DR. BY R. REYES	11/13/73	SCALE
CHK'D. BY R.K.	11/13/73	HEAT TR.
MAT'L PURCHASE		

APPV. CAST. MAT'L. MACH. ENGR. WELD.

SHEET SIZE A | DWG. NO. 11906823 | SHEET 1 OF 1

DESCRIPTION: GAUGE PRESSURE,
TYPE "BAI" REGAL GAUGE.
DIAL SIZE 4 1/2"
BOURDON TUBE, PHOSPHOR BRONZE.
DIAL WHITE LITHO BACKGROUND WITH
BLACK GRADUATIONS & NUMERALS.
PRESSURE RANGE DUAL SCALE 0-2 KG/CM^2 & 0-28 PSI,
FIGURE INTERVAL .2 KG & 5 PSI,
SMALLEST GRADUATION .02 KG & 1 PSI.
CASE TYPE "W" HINGED FRONT CASE,
ALUMINUM WITH BLACK TEXTURED ENAMEL
CONNECTION: 1/4 NPT MALE REAR LOCATION.



6 DIA. 3 HOLES ON 'A' RADIUS

DIAL SIZE	A	B	C	D	H	M	X
4½	2 11/16	3/32	6	4 13/16	1 31/32	1 5/8	4 15/16

X—Panel hole cut-out diameter

VENDOR PC NO: BA14W/0-2 KG/0-28 PSI/REAR CONN./WHITE

VENDOR: WEKSLER INSTRUMENT CORP.

DISTRIBUTOR: DURABLE CONTROLS
OCONOMOWOC, WI. 53066

SUBSTITUTES PERMITTED WITH ENGINEERING APPROVAL.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
P	10216	8/12/77	REV. & REDRAWN ADDED DUAL SCALE	RJC

TITLE
GAUGE, PRESS.
0-2 KG & 0-28 PSI
REAR CONN.

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .030
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY C Granzow	1/25/77	SCALE	
CHK'D. BY RJCALLAD	8/2/77	HEAT TR.	
MAT'L			
APPV.	CAST.	MAT'L.	
	MACH.	ENGR. RJC	
	WELD.		

SHEET SIZE A | DWG. NO. 11 907 185 | SHEET 1 OF 1

11 907185

WEKSLER INSTRUMENTS CORPORATION
80 Mill Road – Freeport, New York 11520

INSTRUCTIONS FOR INSTALLATION AND MAINTENANCE OF WEKSLER PRESSURE GAUGES

GENERAL

A pressure gauge must not be subjected to a pressure in excess of the dial range. If higher pressures are applied, permanent damage to the Bourdon tube may result. FOR BEST SERVICE the working pressure at which the gauge is to operate should be within the middle 1/3 of the scale range i.e. a gauge with range 0 to 200 psi should be used for working pressures between 60 and 140 psi.

INSTALLATION

Pressure gauges should be mounted in a vertical position and in a location free from excessive vibration. The gauge socket is provided with wrench flats which with a wrench of the correct size should be used exclusively when installing the gauge. *Under no circumstances should any force be applied to the gauge case directly.* Twisting of the case may disrupt the calibration of the gauge.

APPLICATION

When a gauge is to be used for steam pressures, a siphon filled with water is recommended between the line and gauge. This will prevent live steam from entering and damaging the Bourdon tube. Always install a shut-off cock between the siphon and the gauge.

If the gauge is installed on a liquid pressure line, arrange the piping so as to avoid vapor entrapment; otherwise readings may be inaccurate. If possible, provide for vents at high points in the line to bleed off the entrapped vapors.

On installations which are subject to severe pressure fluctuations, pulsations and/or line shock, the use of a snubber, gauge saver, or factory installed throttle screw is recommended. Where the pressure media will tend to corrode or clog the Bourdon tube a factory installed diaphragm attachment is recommended.

CALIBRATION CHECK

To check the calibration of a gauge it must be removed from the line or equipment and installed on a dead-weight tester, or test gauge manifold. Check calibration at 1/3, 1/2 and 2/3 of the dial range. If the readings are outside of the tolerance limits, the instrument requires recalibration. Remove the front ring, glass front (lens) and gasket. Then recalibrate, as follows:

RECALIBRATION

There are three specific adjustments. These are:

A. Zero Adjustment
B. Range Adjustment
C. Linearity Adjustment

(A) Zero Adjustment

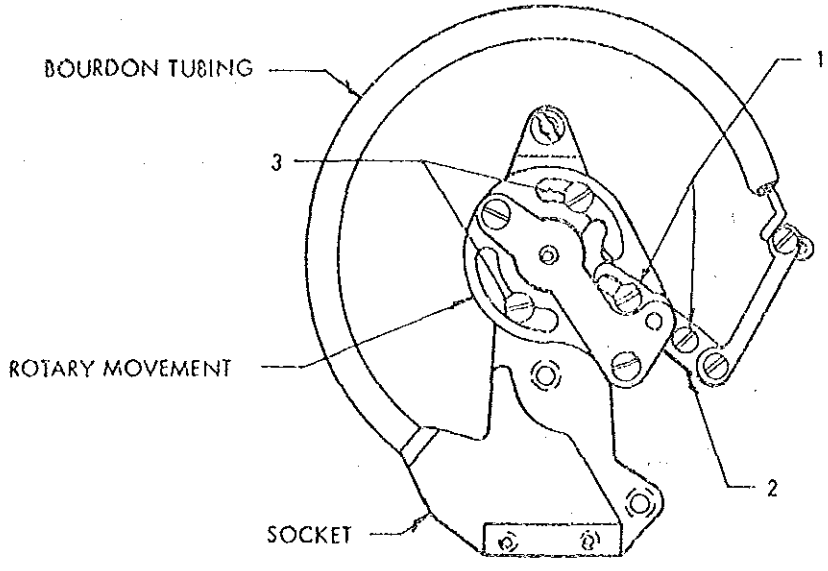
If the gauge shows an equal amount of incorrect reading, either too high or too low over the entire range, adjustment is made by resetting the indicating pointer. These are furnished in three types, i.e. micrometer, slotted and plain.

The micrometer type is adjusted by holding the pointer firmly with one hand and turning the micrometer screw with the other. Follow the same procedure for the slotted type, except rotate the slotted hub with a screwdriver. For gauges equipped with plain pointer make minor adjustments by rotating the slotted scale. Where this adjustment is not sufficient, remove the pointer (using a hand jack), and reset in desired position.

(B) Range Adjustment
If the gauge readings show a progressively increasing (plus or minus) error, from the lower to the upper end of the range, loosen the two slide screws (1) and proceed as follows: For plus error, the slide (2) must be moved outward; for minus error, the slide must be moved inward. After attaining proper adjustment, retighten the slide screws (1).

(C) Linearity Adjustment
Assuming the gauge reads accurately at high and low points (1/3 and 2/3 of gauge range) but inaccurate at the center of the scale, linearity adjustment is required.

A linearity adjustment, being the most difficult adjustment of the three due to the geometric function of all components, may in some instances be accomplished in the field by loosening the two movement mounting screws (3) and rotating the movement. Without a technical gauge background this would be a trial and error adjustment. After each adjustment (which should require no more than a few degrees), the gauge should be retested through the complete range, after setting pointer at approximately 5% of scale range. Make zero and/or range adjustments if required.



SPECIAL FEATURE ITEMS
(1) Maximum and/or Minimum Pointer(s): Furnished only as a special feature, a max-min pointer permits reading of the highest and/or lowest pressure attained during operation. To set the pointer(s), rotate the knob(s) in the center of the lens until the max-min pointer touches against the side of the gauge pointer.

As the gauge pointer moves, it will carry the frictionless max-min pointer with it, until the maximum (or minimum) pressure is attained. When the gauge pointer recedes, the max-min pointer will hold at the highest (or lowest) pressure point reached.

Gauges equipped with Max-Min Pointer should be installed only on vibration-free applications.

(2) Capillary Bleeder: Gauges equipped with this special feature have a cap screw fitting on the side of the instrument case.

To remove trapped air from the Bourdon tube, remove the bleeder cap screw and run the pressure fluid through the gauge until air bubbles no longer appear. In case of clogging follow the same procedure except continue bleeding until all foreign matter has been ejected and the flow (out of the bleeder) is continuous. Replace cap screw and tighten.

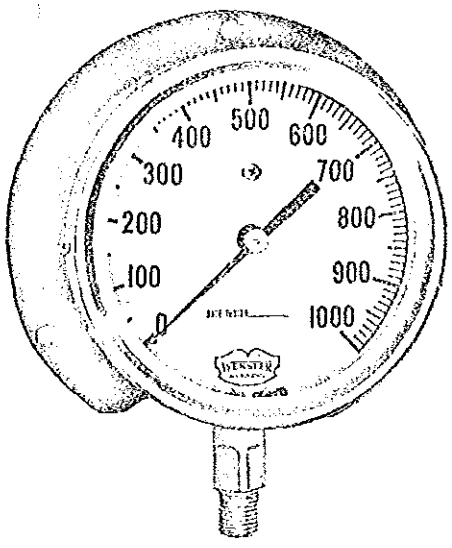
11907185

WEKSLER INSTRUMENTS

BRONZE TUBE
1,000# MAXIMUM
▲ 1% ACCURACY

TYPE BA1 Regal GAUGE

PRESSURE - VACUUM - COMPOUND



PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 15 lb.	1 lb.	¼ lb.
0— 30 lb.	5 lb.	½ lb.
0— 60 lb.	10 lb. †	1 lb.
0— 100 lb.	10 lb.	1 lb.
0— 160 lb.	20 lb.	2 lb.
0— 200 lb.	20 lb.	2 lb.
0— 250 lb.	25 lb.	5 lb.
0— 300 lb.	50 lb.	5 lb.
0— 400 lb.	50 lb.	5 lb.
0— 500 lb.	50 lb.	5 lb.
0— 600 lb.	100 lb. ††	10 lb. ††
0— 700 lb.	100 lb.	10 lb.
0— 800 lb.	100 lb.	10 lb.
0— 1,000 lb.	100 lb.	10 lb.

† Also available with figures at 5 lb. intervals.
†† Also available with 50 and 5 lb. markings.

VACUUM RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 30" Hg. Vac.	5 in.	½ in.

COMPOUND RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
30"—0— 15 lb.	5" & 3 lb.	1" & ¼ lb.
30"—0— 30 lb.	10" & 5 lb.	1" & 1 lb.
30"—0— 60 lb.	10" & 10 lb.	1" & 1 lb.
30"—0—100 lb.	15" & 10 lb.	2" & 1 lb.
30"—0—150 lb.	30" & 25 lb.	2" & 2 lb.
30"—0—200 lb.	30" & 20 lb.	5" & 5 lb.
30"—0—300 lb.	30" & 50 lb.	5" & 5 lb.
30"—0—400 lb.	30" & 50 lb.	5" & 5 lb.
30"—0—600 lb.	30" & 100 lb.	5" & 10 lb.

NOTE: On compound range gauges the zero graduation is not to be used as a calibration reference point.

Combination metric dials, in standard ranges up to 70 KG/CM² can be furnished at no additional charge.

SUITABLE FOR: Acetone, Air, Benzine, Benzol, Boric Acid, Brine, Butane, Butyl-Alcohol, Glycerine, Nitrogen, Steam (for pressures up to 400 psi), Tannic Acid, Water and other liquids or gases that will not corrode bronze. For steam service a siphon filled with water should be installed between line and gauge to prevent steam from entering the bourdon tube.

▲ *Also available in ½% accuracy, at additional cost.*

DIAL SIZES: ..... 3½", 4½", 6", 8½", 12".

BOURDON TUBE: ..... Seamless phosphor bronze, Grade A, over pressured and stress relieved.

SOCKET & TIP: ..... Forged brass.

JOINTS: ..... Silver brazed and stress relieved.

MOVEMENT: ..... Bronze bushed rotary with nickel silver pinion gear and shaft; phosphor bronze sector gear and hairspring; stainless steel link. Other parts are brass.

DIAL: ..... White litho background with black graduations and numerals. Black background with white markings available. 270° arc.

POINTER: ..... Slotted adjustable pointer.

CASE TYPES: ..... For Wall, Direct, Semi-Flush, or Flush mounting.

CASE MATERIALS: ..... Phenol, Aluminum, Brass, Iron, Steel.

CONNECTIONS: ..... ¼" male N. P. T. standard. ½" male N. P. T. can be furnished at additional charge.

Special connections on application.

CASE SELECTION: ..... See pages 2 and 3 for illustrated descriptions and identifying suffix letters.

DIMENSIONS: ..... See pages 29, 30 and 31.

WEIGHTS: ..... See back cover.

WHEN ORDERING: Specify (1) Gauge Type i.e. AA1, BA1, etc.; (2) Dial Size (by symbol) i.e. 3 = 3½", 4 = 4½", 6 = 6", 8 = 8½" and 9 = 12" dial size. (3) To the resultant 4-digit number, refer to page 4 or 5 and add appropriate "case type" symbol. Example: "Type AA14P" denotes 4½" dial size Royal Gauge in black phenol case.

In addition to Gauge Type Number . . . Specify Range; Connection (size and location); Dial (white, black or special).

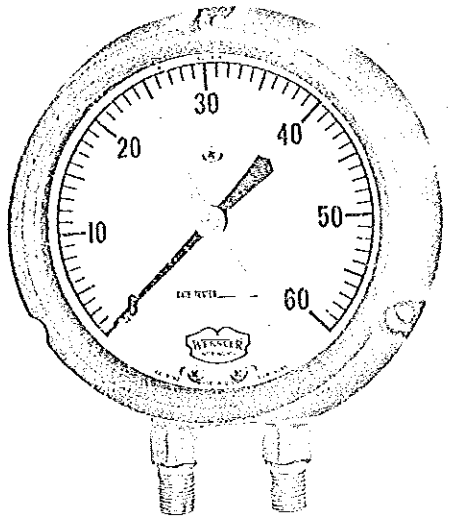
1190785

WEKSLER INSTRUMENTS

DUPLEX GAUGE
1% ACCURACY

TYPE BB1 Regal GAUGE

BRONZE TUBES STANDARD - OTHER MATERIALS AVAILABLE



DUPLEX GAUGE, TYPE BB1

SERVICE: To indicate two related pressures on the same dial. For use with air, water, steam, or any liquid or gas that will not corrode bronze.

DIAL SIZES: 4½", 6", 8½", 12"

BOURDON TUBES: Seamless phosphor bronze standard. (Can be supplied in alloy steel, beryllium copper, stainless steel, or Monel at extra charge, 4½" and 6" sizes only).

SOCKET & TIP: Forged brass.

JOINTS: Silver brazed and stress relieved.

MOVEMENT: Duplex type. Phosphor bronze sector gear, hairspring and link. Bronze bushed rotary; nickel silver pinion gear and shaft. All other parts are brass.

DIAL: White litho background with black graduations and numerals. Black background with white markings available.

POINTERS: Top pointer is orange; actuated from socket stamped RH (right hand).

Bottom pointer is black; actuated from socket stamped LH (left hand).

CASE TYPES: For Wall, Direct (stem), Semi-Flush, or Flush mounting.

CASE MATERIALS: Phenol, Aluminum, Brass or Iron.

CONNECTIONS: ¼" male N. P. T. only.

CASE SELECTION: See pages 4 and 5 for illustrated descriptions and identifying suffix letters.

DIMENSIONS: See pages 29, 30 and 31.

WEIGHTS: See page 2.

WHEN ORDERING: Specify (1) Gauge Type i.e. AA1, BA1, etc.; (2) Dial Size (by symbol) i.e. 3 = 3½", 4 = 4½", 6 = 6", 8 = 8½" and 9 = 12" dial size. (3) To the resultant 4-digit number, refer to page 4 or 5 and add appropriate "case type" symbol. Example: "Type AA14P" denotes 4½" dial size Royal Gauge in black phenol case.

In addition to Gauge Type Number . . . Specify Range; Connection (size and location); Dial (white, black or special).

PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 30 lb.	5 lb.	½ lb.
0— 60 lb.	10 lb.†	1 lb.
0— 100 lb.	10 lb.	1 lb.
0— 160 lb.	20 lb.	2 lb.
0— 200 lb.	20 lb.	2 lb.
0— 250 lb.	25 lb.	5 lb.
0— 300 lb.	25 lb.	5 lb.
0— 400 lb.	50 lb.	5 lb.
0— 500 lb.	50 lb.	5 lb.
0— 600 lb.	100 lb.††	10 lb.††
0— 700 lb.	100 lb.	10 lb.
0— 800 lb.	100 lb.	10 lb.
0— 1,000 lb.	100 lb.	10 lb.

†Also available with figures at 5 lb. intervals.
††Also available with 50 and 5 lb. markings.
NOTE: For higher ranges, price on application.

COMPOUND RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
30"—0— 15 lb.	5" & 3 lb.	1" & ½ lb.
30"—0— 30 lb.	10" & 5 lb.	1" & ½ lb.
30"—0— 60 lbs.	10" & 10 lb.	1" & 1 lb.
30"—0—100 lb.	15" & 10 lb.	5" & 1 lb.
30"—0—150 lb.	30" & 25 lb.	5" & 5 lb.
30"—0—200 lb.	30" & 20 lb.	5" & 5 lb.
30"—0—300 lb.	30" & 50 lb.	5" & 5 lb.

NOTE: On compound range gauges the zero graduation is not to be used as a calibration reference point.

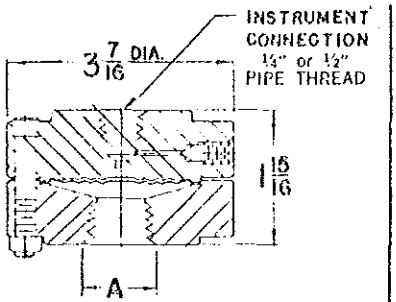
11907185

WELDED-DIAPHRAGM TYPE SEALS
FOR UNIVERSAL CONTINUOUS SERVICE

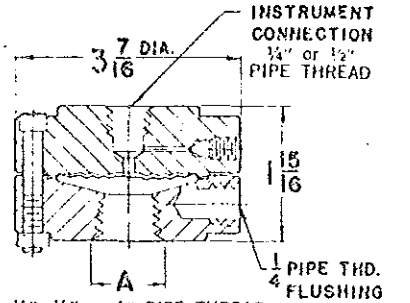
WEKSLER INSTRUMENTS

Universal use Welded-Diaphragm Type seals have all of the safety features offered by the Continuous Duty Type. In addition, in the construction of "welded in the top" diaphragm seals special equipment and procedures are used to weld an improved shape diaphragm in the top section. The possibility of leakage problems and the need for gasket clamping (middle) rings are completely eliminated.

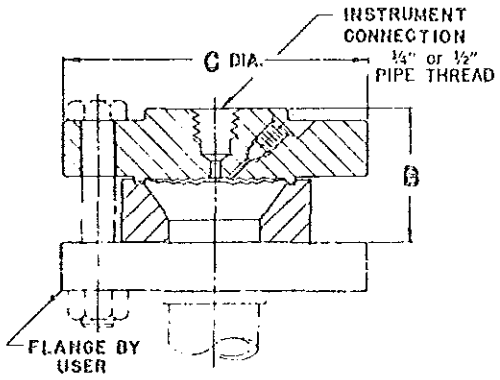
All seals listed on this page are Welded-Diaphragm Type and all are classed as Cleanout Type. They are designed for continuous service and can be used universally i.e. on either corrosive gas, corrosive liquids or clogging service. Inventory can be reduced accordingly.



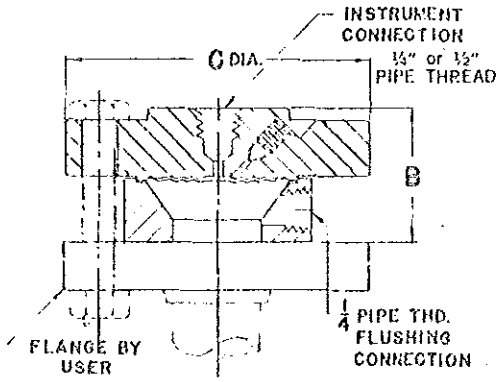
MODEL D19-2



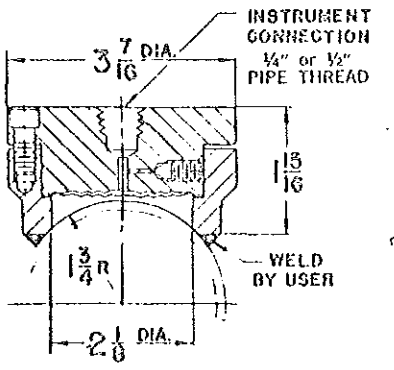
MODEL D19-7



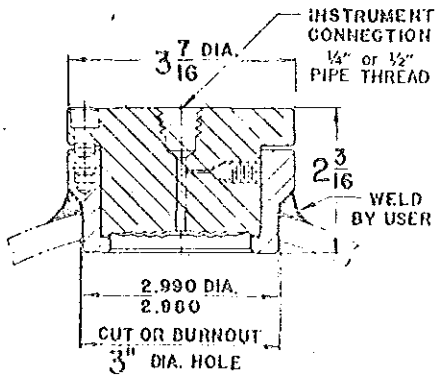
MODEL D19-3
1", 1½", 2" or 3" ASA RF SIZES
150#, 300#, 600# and 1500# RATINGS



MODEL D19-4
1", 1½", 2" or 3" ASA RF SIZES
150#, 300#, 600# and 1500# RATINGS

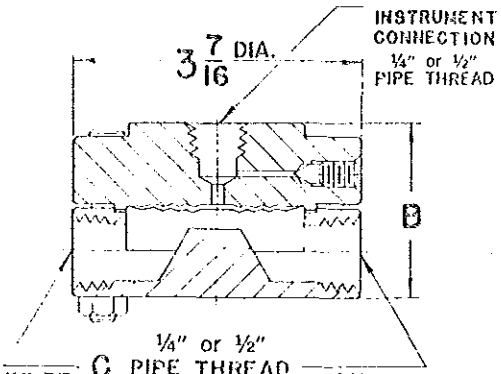


FOR 3" PIPE ONLY

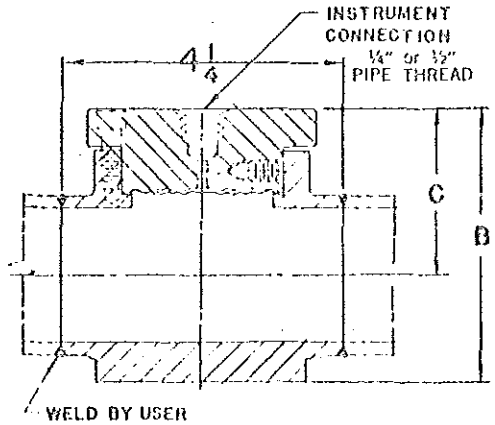


FOR 4" PIPE AND LARGER

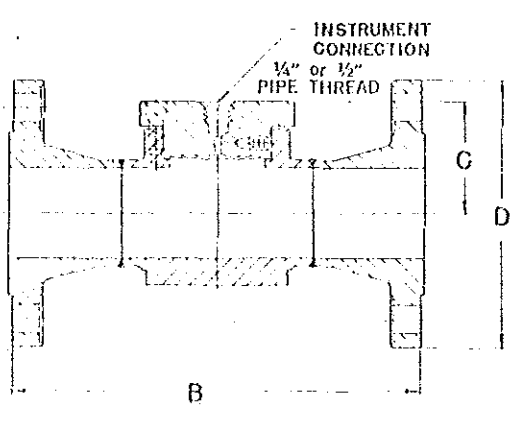
MODEL D19-10
SPECIFY PIPE SIZE



MODEL D19-11



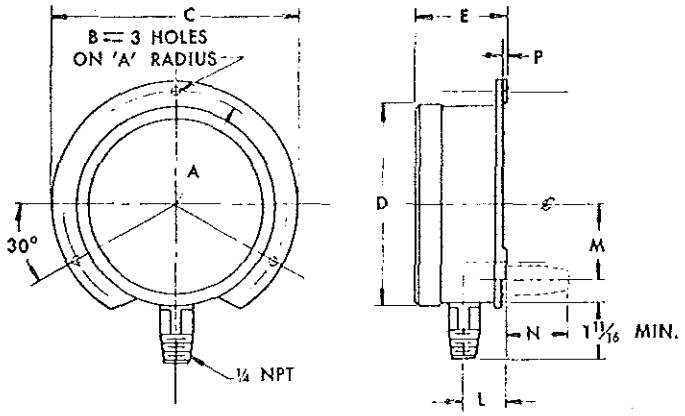
MODEL D19-13
FOR 1", 2" or 3" PIPE, SPECIFY



MODEL D19-14
1", 2" and 3" x 150# FLANGE SIZES, SPECIFY

Printed in U.S.A.

GENERAL DIMENSIONS

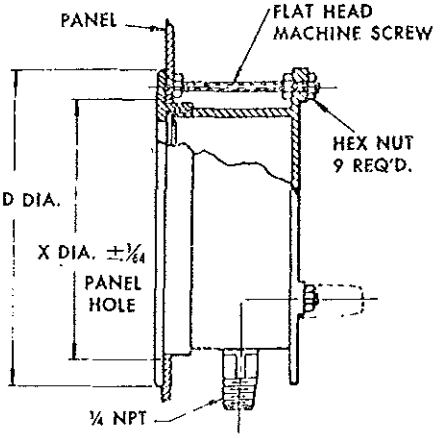


BACK FLANGED CASE

DIAL SIZE	A	B	C	D	E		L		M	N		P	
					Std.	Safety	Std.	Safety		Std.	Safety	Std.	Safety
3½	2⅛	7/32 x 3/8	5	4 3/16	2 1/16	1 31/32	13/16	13/16	1 5/32	1 11/16	1 1/16	⅛	3/16
4½	2 11/16	7/32 x 5/16	5⅞	5	2 9/16	2 5/8	1 1/32	1 1/32	1 19/32	1 21/32	15/16	5/32	5/16
6	3 ½	9/32 x 11/32	7 5/8	6½	2 17/32	2 7/16	1 1/32	1	1 9/16	1 13/16	1 1/16	1/16	3/16
8½	4 13/16	9/32	10 ¼	8 27/32	2 9/32	2 17/32	3/32	1	2⅛	1 3/16	1 1/16	1/16	3/16

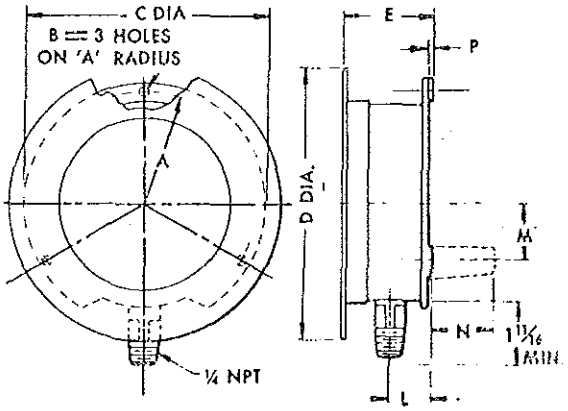
FLUSH MOUNTING RING ASSEMBLY

DIAL SIZE	X	D		SCREW SIZE	
		Std.	Safety	Std.	Safety
3½	4	4 29/32	4 15/16	10-32x1¾	10-32x2⅛
4½	5	5 31/32	5 31/32	10-32x2½	10-32x2¾
6	6 9/16	7 25/32	7 ¾	¼-20x2½	¼-20x2¾
8½	8 31/32	10 11/32	10 11/32	¼-20x2½	¼-20x2¾
12	12 19/32	14 ⅜	—	¼-20x3	—

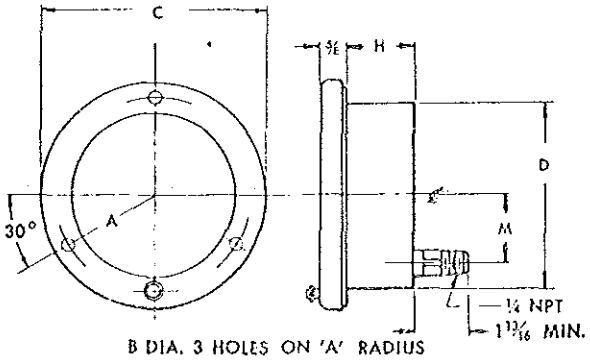


FLUSH MOUNTING CASE

DIAL SIZE	A	B	C	D	E		L		M	N		P	
					Std.	Safety	Std.	Safety		Std.	Safety	Std.	Safety
3½	2 7/32	7/32 x 3/8	5	4 29/32	1 7/16	2	13/16	25/32	1 5/32	1 11/16	1 1/16	⅛	3/16
4½	2 23/32	7/32 x 5/16	5 29/32	5 31/32	2 17/32	2 5/8	1 1/32	1 1/16	1 19/32	1 21/32	15/16	5/32	5/16
6	3 ½	9/32 x 11/32	7 5/8	7 25/32	2 9/16	2 7/16	1 3/32	1	1 9/16	1 13/16	1 1/16	1/16	3/16
8½	4 13/16	9/32	10 ¼	10 11/32	2 5/16	2 19/32	3/32	1	2⅛	1 3/16	1 1/16	1/16	3/16
12	6 ¾	9/32	14 ½	14 ⅜	2 25/32	—	1 ⅛	—	2⅛	1⅛	—	⅛	—



HINGED FRONT CASE

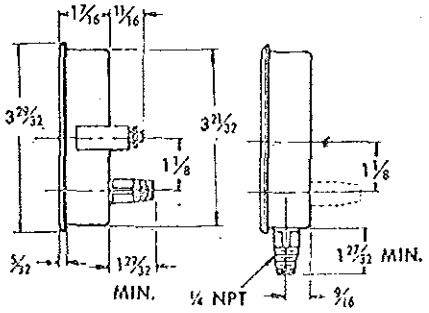


B DIA. 3 HOLES ON 'A' RADIUS

DIAL SIZE	A	B	C	D	H	M	X
4½	2 13/16	7/32	5	4 13/16	1 21/32	1 3/8	4 23/32
6	3½	7/32	7 5/8	6 11/32	1 11/16	2⅛	6 9/16

X—Panel hole cut-out diameter

3½" DRAWN STEEL CASE



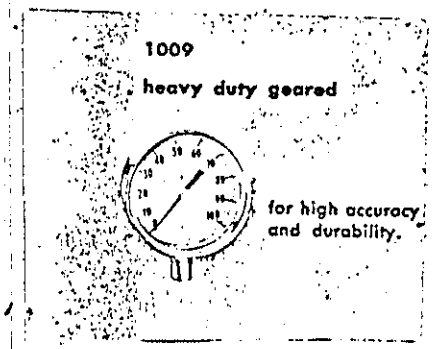
CAT. 525, p. 30

MS

11 907 532

DESCRIPTION: Ashcroft 4 1/2" dia. Model 1009A pressure gauge w/¼" NPT stem mounting, bronze bourdon tube and in accordance with the following:

(A) 0-600 PSI range
(B) 50 PSI figure intervals
(C) 5 PSI interval graduations



VENDOR'S PIECE NO. Gauge Fig. No. 1009A.

VENDOR: Ashcroft Pressure & Temperature Instruments
Dresser Industrial Valve & Instrument Division
Dresser Industries, Inc.
Stratford, Conn. 06497

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
3	PC1421	6/9/76	RELEASED	
2		4-14 76	Was No. 1020A.	JMW
1		12/12 75	REMOVED COCK & SNUBBER	JMW

TITLE
GAUGE,
PRESSURE 0-600 PSI

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

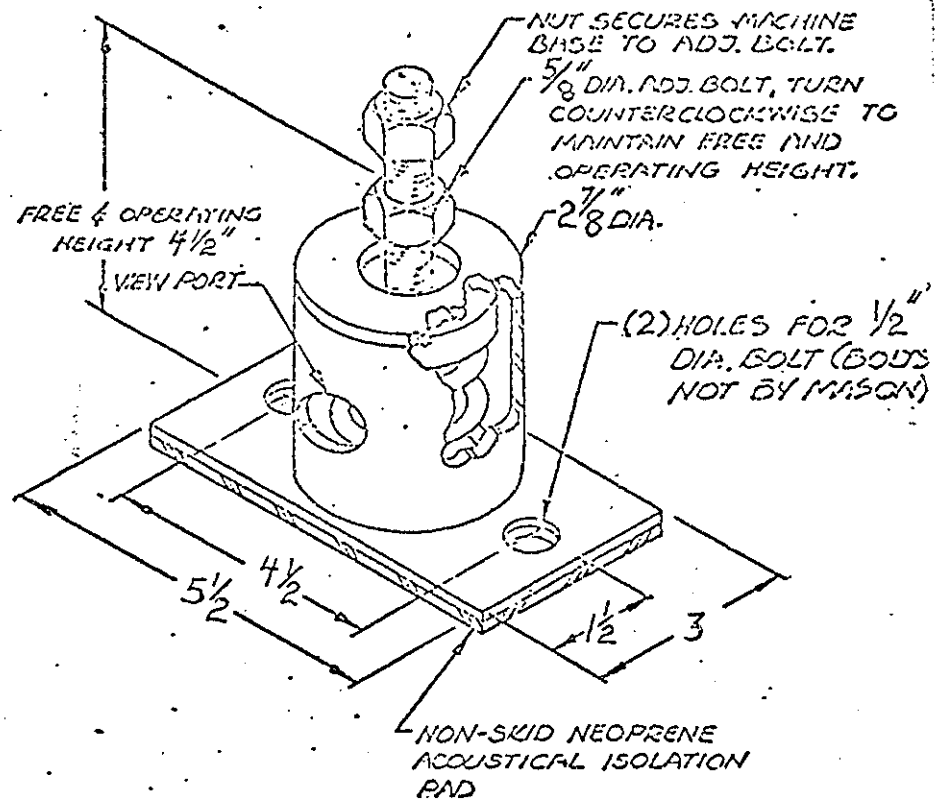
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	/ /	ASSY. OR LO.	
DR. BY J.Whalen	11/13/75	SCALE	
CHK'D. BY	6/3/76	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 907 532 | SHEET 1 OF 1

DESCRIPTION: MASON TYPE SSLFH SEISMIC SPRING ISOLATOR MOUNT.

1. SIZE -- 125
2. RATED CAPACITY -- 125 LB VERTICAL & HORIZONTAL
3. RATED DEFLECTION 1.33 IN. VERTICAL
4. SPRING GROUP A
5. SPRING CONSTANT 94#/IN
6. RATIO OF HORIZONTAL TO VERTICAL STIFFNESS K_x/K_y = .70 - .90



VENDOR'S PART NO: SSLFH-A-125

VENDOR: MASON INDUSTRIES, INC.
92-10 182ND PLACE
HOLLIS, N.Y. 11423
TELE: 212-523-3355

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: MOUNT VIBRATION, SEISMIC

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL NO. P16850	3/2/77	ASSY. OR LO.	
DR. BY K. HOWE	2/15/77	SCALE	
CHK'D. BY L. McM	2/21/77	HEAT TR.	
MAT'L PURCHASED			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 669 | SHEET 1 OF 1

BF3009-2

MASON INDUSTRIES, Inc.
Manufacturers of Vibration Control Products

92-10 182nd Place
Hollis, New York 11423
(Area Code 212) 523-3355

3335 East Pico Blvd.
Los Angeles, California 90023
(Area Code 213) 263-9557

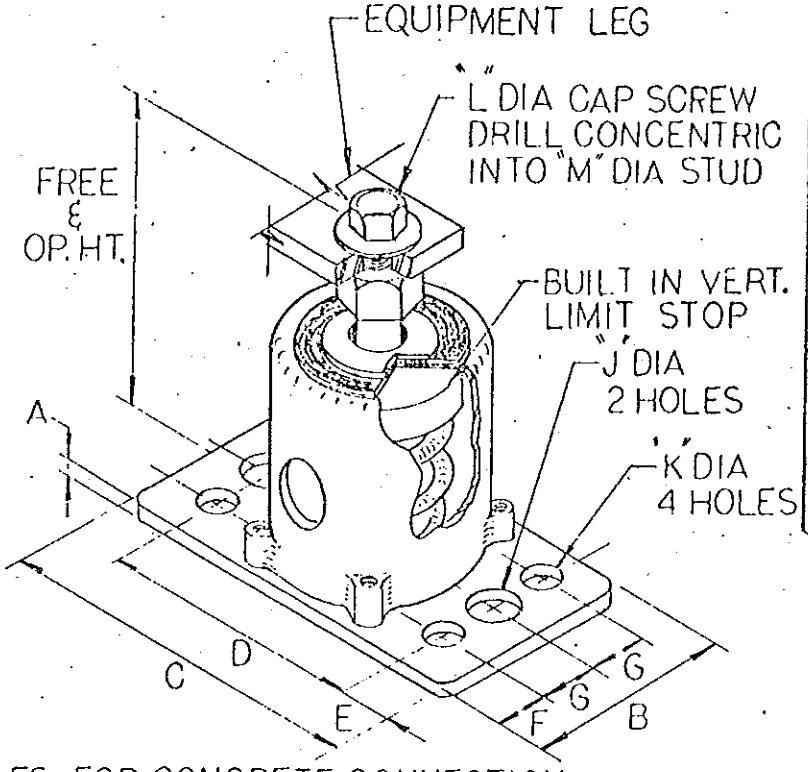
Job Name
Customer
Cust. PO
Mason SO

11908669

TYPE SSLFH SEISMIC MOUNT

Date

Dwg. No.



Type and Size	Rated Capacity (lbs)	Rated Defl. (in)	Mount Constant (lbs/in)	Color Code
SSLFH-A-45	45	1.60	28	Blue
SSLFH-A-75	75	1.50	50	Orange
SSLFH-A-125	125	1.33	94	Brown
SSLFH-A-200	200	1.15	174	Black
SSLFH-A-310	310	1.00	310	Yellow
SSLFH-B-60	60	2.14	28	Brown
SSLFH-B-140	140	1.97	71	Orange
SSLFH-B-280	280	1.60	174	Green
SSLFH-B-450	450	1.31	344	Red
SSLFH-B-750	750	1.12	670	White
SSLFH-B-1000	1000	1.00	1000	Blue
SSLFH-C-110	110	2.07	53	Purple
SSLFH-C-225	225	1.84	122	Blue
SSLFH-C-435	435	1.55	280	Gray
SSLFH-C-735	735	1.24	592	White
SSLFH-C-1000	1000	1.06	944	Black
SSLFH-C-1350	1350	1.00	1350	Yellow
SSLFH-C-1675	1675	1.00	1675	*Yellow
SSLFH-C-2100	2100	1.00	2100	**Yellow

NOTE 1. MOUNT CAN WITHSTAND 1.0 'G' ACCEL. IN ANY DIRECTION
2. MAX AIR GAP IN ALL THREE ORTHOGONAL MODES IS 1/4"

† "J" HOLES FOR CONCRETE CONNECTION
‡ "K" HOLES FOR STEEL CONNECTION

MOUNT SIZE	A	B	C	D	E	F	G	J†	K‡	L	M	FREE & OP. HT.
SSLFHA	1/4	3 1/2	6	4 3/4	5/8	5/8	1 1/8	5/8	1/2	3/8	3/4	5
SSLFHB	3/8	5	8 3/4	7	7/8	1	1 1/2	13/16	11/16	5/8	1 1/4	7 1/2
SSLFHC	3/8	5	8 3/4	7	7/8	1	1 1/2	13/16	11/16	5/8	1 1/4	7 1/2

*with GRAY spring inside
**with RED spring inside

CERTIFICATION DATA

TAG : _____

UNIT: _____

DWN:	CHK:	DATE:

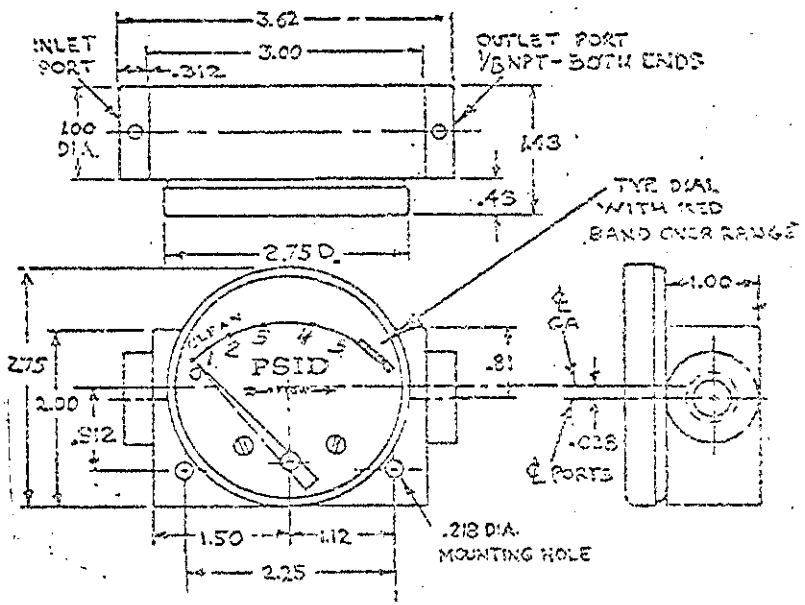
DESCRIPTION: ORANGE RESEARCH DIFFERENTIAL PRESSURE GAUGE FEATURES:

1. MAX. LINE PRESSURE 3000 PSI.
2. MIN. BURST PRESSURE 7500 PSI.
3. CONSTRUCTION ANOD. ALUM.
4. SEALS BUNA N.
5. DIAL 2-1/2".
6. SERVICE TEMP. 250°F.
7. RANGE 0-5 PSID.
8. PANEL OR LINE MTG.

VENDOR'S TYPE: 1201PG-1-2-1/2

VENDOR: ORANGE RESEARCH, INC.
404 BOSTON POST RD.
ORANGE, CONN. 06477

REPR: CYPRESS CONTROLS CO.
2535 HUEBNER RD.
OCONOMOWOC, WIS 53066



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
GAUGE, PRESSURE
DIFFERENTIAL
0-5 PSID

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

PEL. NO. 10282	4/21/77	ASSY. OR LO.	
DR. BY HERTENSTEIN	3/3/77	SCALE	4/1
CHK'D. BY H.R.S.	4/5/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 696 | SHEET - OF

1190869G

Orange Research, Inc.
404 Boston Post Road, Orange, CT 06477 203/795-6225

Differential pressure gauges, switches, indicating switches for filter-flow-liquid level

instructions SERIES 1201 & 1202 (PISTON TYPE)

INSTRUMENT IDENTIFICATION

GAUGES	SWITCHES	INDICATING SWITCHES
3000 psig . . . 1201PG-1-( )	1201PS-1-( )	1201PGS-1-( )-( )
5000 psig . . . 1202PG-1-( )	1202PS-1-( )	1202PGS-1-( )-( )
GAUGE SIZE	SWITCH SELECTION	GAUGE SIZE / SWITCH SELECTION

This Orange Research Differential Pressure Instrument is a rugged instrument featuring simplicity of design to provide long trouble-free service. Nevertheless, it should be installed properly and handled with care.

CAUTION: Do not exceed nameplate maximum operating pressure. Use only on fluids compatible with wetted parts.

HOW IT WORKS

These instruments work on the difference between two pressures (ΔP) acting on opposite sides of the pressure sensor (piston). Variations in pressure difference will cause the piston/magnet assembly to move in proportion to this change. On gauge models, a rotary pointer magnet, located in a separate cavity, follows the movement of the piston/magnet assembly and indicates the pressure loss or differential pressure on the gauge dial scale. On switch models, reed switches are located adjacent to the pressure chamber and are activated when the piston magnet field interacts at a preset point with the reed switch armature.

When used with a filter, the Filter Fink senses an increase in pressure drop across the filter media signifying filter condition as a function of dirt buildup. When used with an orifice plate, pitot tubes or venturi, the Flow Fink indicates the flow rate as a function of the pressure drop across the ΔP generator.

INSTALLATION

Check instrument parts for IN and OUT markings. IN identifies high pressure port; OUT the low pressure port. If instrument is installed backwards, it will neither operate nor be damaged. Reverse connections if installed backwards. Refer to drawings for connecting information.

PREVENTATIVE MAINTENANCE

It is suggested that the first preventative maintenance cleaning be done after one year of normal service. Successive cleaning cycles can be established after the findings of the first preventative cleaning cycle.

CLEANING

If switch or dial pointer action becomes sluggish or erratic, it might be an indication the piston has become dirty and movement is no longer smooth. This requires cleaning.

To clean, remove both end caps with a 1" spanner wrench and remove piston spring assembly. BE CAREFUL NOT TO LOSE SPRING SPACERS, IF ANY. Clean parts in a normal manner after removing "O"-ring seals from end caps since some solvents will attack the O-ring material. If lost or damaged, the end cap O-ring can be replaced using a size 018 ring (standard 3/4 ID x 7/8 OD).

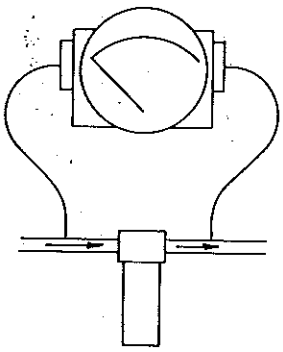
REASSEMBLY

When reinstalling the piston assembly, lubricate the bore lightly with vasoline, light oil, or silicone grease. Install the inlet end cap first and tighten with a 1" spanner wrench. Install piston/magnet assembly (magnet facing inlet end cap). Replace spacers in bottom of piston spring pocket and insert range spring. Reassemble outlet end cap being certain that spring is seated in end cap spring pocket. Tighten outlet end cap with the spanner wrench. The instrument is now ready for service. Recalibration is not required.

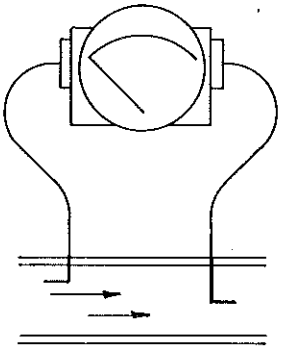
IMPORTANT: Magnet end of piston MUST be on inlet side of instrument, otherwise, the instrument will not operate.

SWITCH SETTINGS

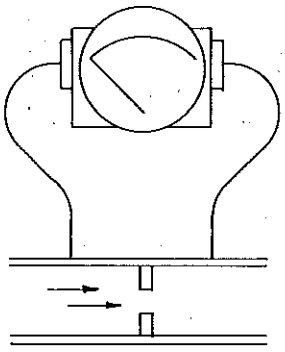
These instruments can be furnished with one or two switches and each switch can be field adjusted independently. To increase setting, move switch tube assembly towards OUT connection. To decrease setting, move switch tube assembly towards IN connection. Full range of adjustment covers approximately 1/2" of travel. To move switch(es), loosen one switch bracket screw. Move switch tube to approximate new position and retighten lock screw. Check for activation point. Repeat as required until desired setting has been reached.



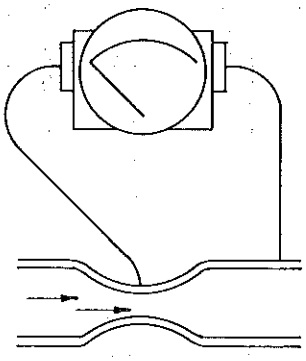
PRESSURE FILTER



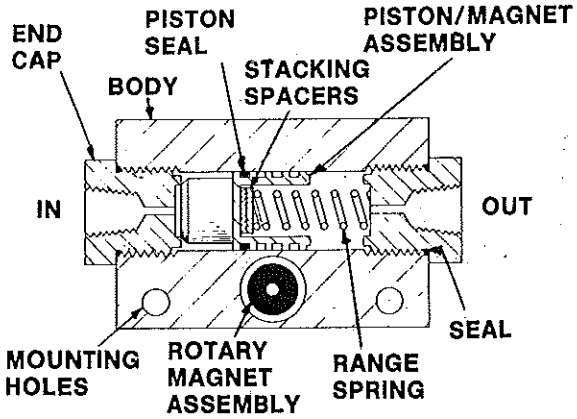
FLOW METER PITOT TUBES



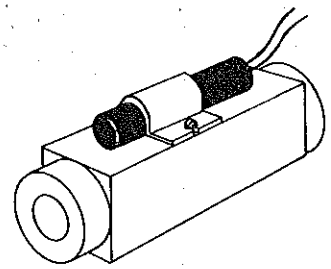
FLOW METER WITH ORIFICE

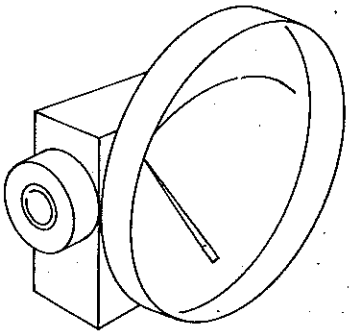


FLOW METER WITH VENTURI



MODEL 1201PS-1 SWITCH
Differential pressure switch provides remote warning signal and/or system control. One point or high/low limit control.





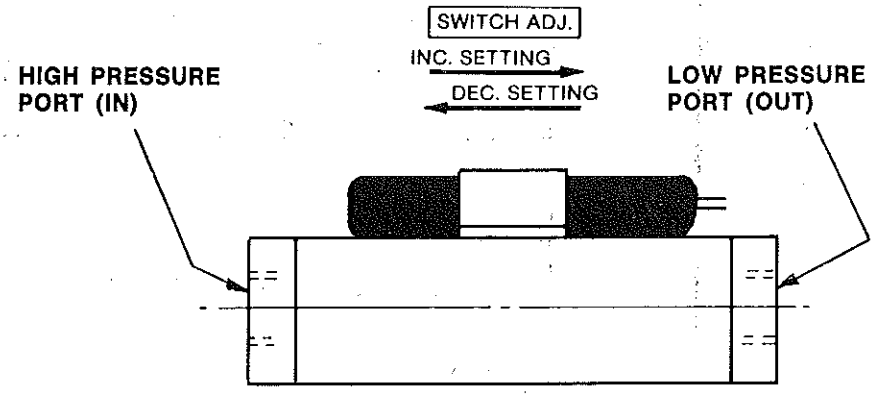
MODEL 1201PG-1 GAUGE
Differential pressure gauge provides direct reading in psid or flow. Scales graduated in English, Metric, English/Metric or special markings. Glass or plastic lens.

WHEN FURNISHED WITH REED SWITCHES— GAUGE BECOMES AN INDICATING SWITCH

REED SWITCH SELECTION

Dash number is used in the Model No. to identify the type of switch or switches to be supplied on the instrument. All switches rated for use up to 120 volt, 1 ph, 60 hz.

Dash No.	No. of Sw's	Switch Element
-1*	1	1 amp/15 watt - SPST
-2*	2	1 amp/15 watt - SPST
-3	1	0.5 amp/10 watt - SPDT
-4	2	0.5 amp/10 watt - SPDT
-5*	1	3 amp/100 watt - SPST
-6*	2	3 amp/100 watt - SPST



*Shipped N/O unless specified otherwise.

NOTES: All switches are field adjustable

a) Downstream adjustment increases set point.

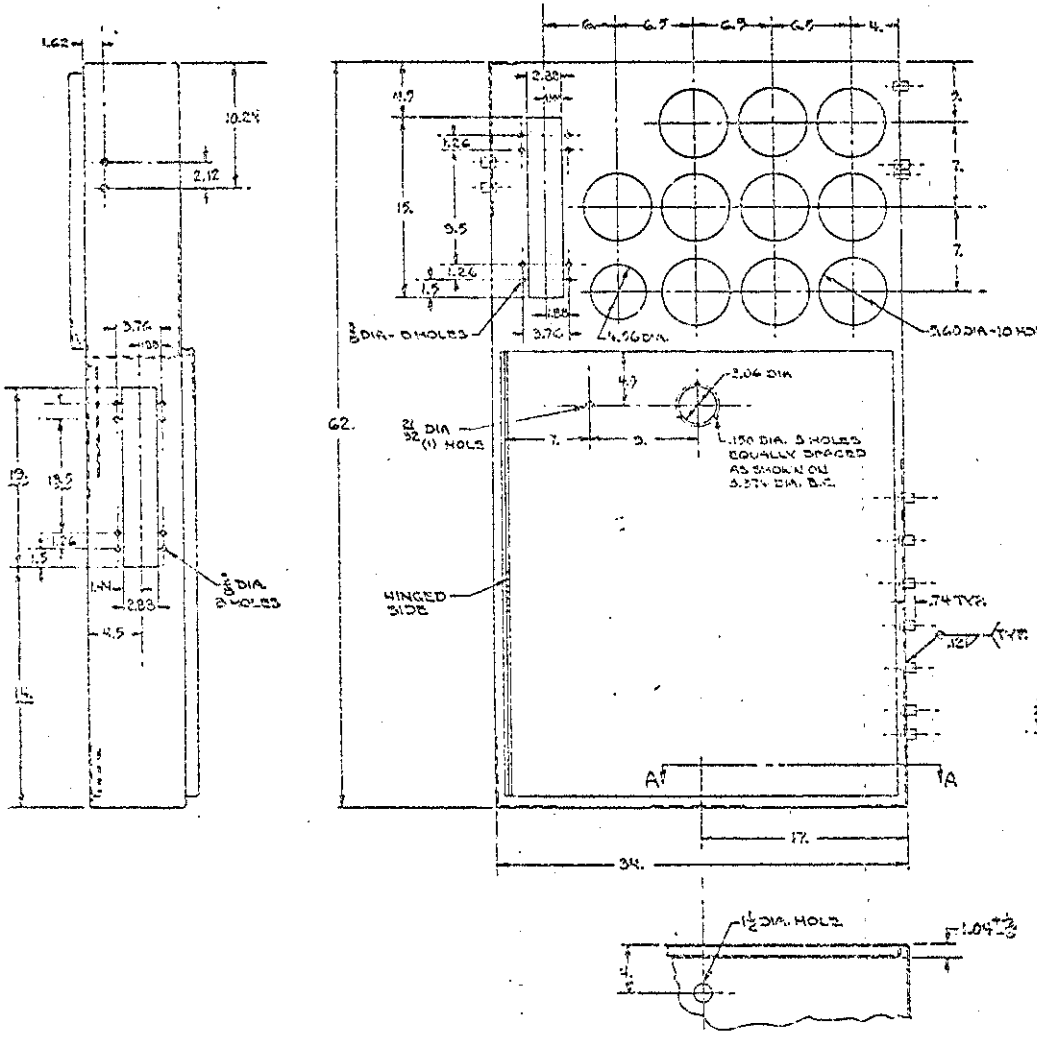
b) Upstream adjustment decreases set point.

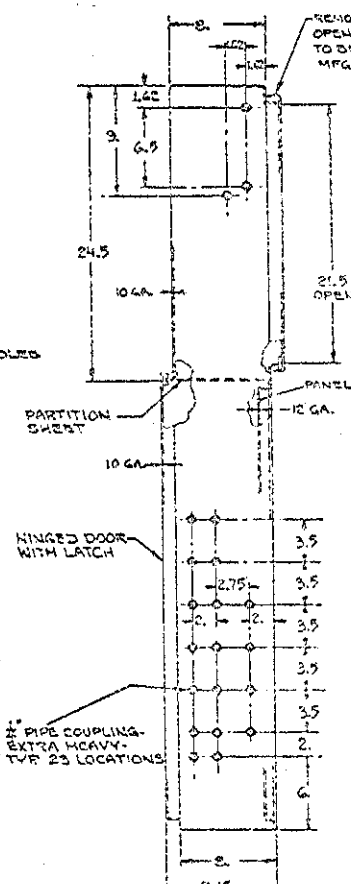
c) Units equipped with two switches - switches are independent of one another and can be positioned and adjusted independently.

d) Amp ratings given are resistive.

11908730 !

D.W. 11907694 & 11903440





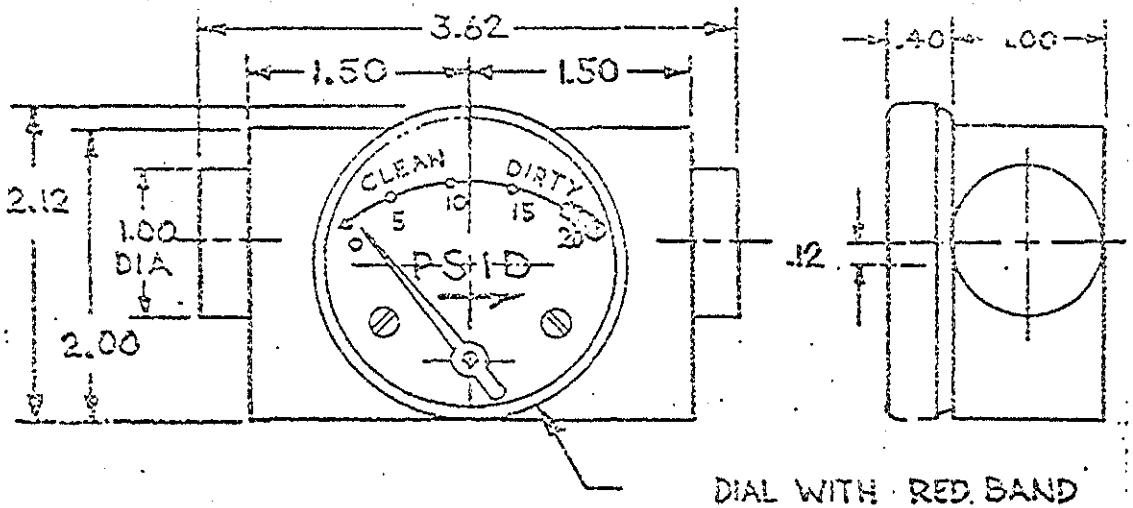
NOTES:

1. BOX TO BE CONSTRUCTED PER N.E.M.A. TYPE 12.
2. CAN BE A (2) SOX CONSTRUCTION IF DESIRED, WELDED TOGETHER.
3. BACK MUST HAVE REMOVABLE COVER OF RAIN TIGHT CONSTRUCTION.
4. PARTITION SHEET MUST BE LOCATED AT 24.5 AS SHOWN, OR CAN BE 300 TOM OF BOX IF (2) BOX CONSTRUCTION IS USED.
5. ALL CUT OUTS TO BE $\pm\frac{1}{32}$

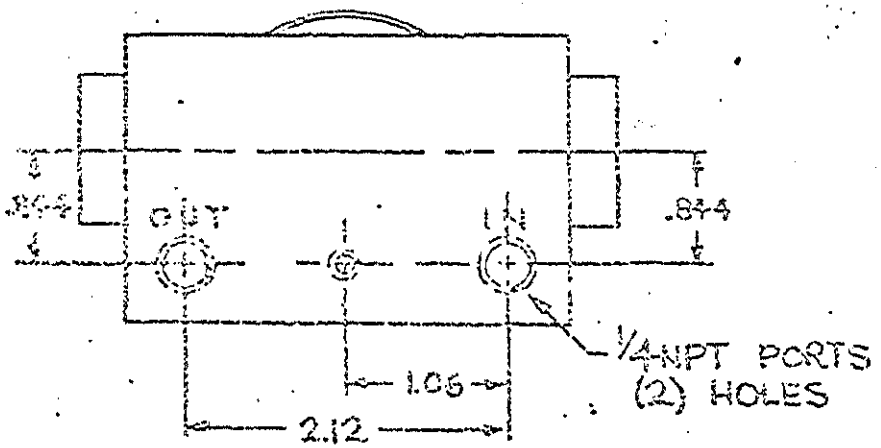
VENDOR:
ROHN ELECTRIC CORP.
OR ANY SUITABLE VENDOR

LIMERICK - 700030

			BOX - ENGINE GAUGE PANEL



BACKSIDE VIEW



DESCRIPTION: FILTER FINK DIFFERENTIAL PRESSURE INDICATOR WITH THE FOLLOWING FEATURES:

1. WITH 1/4" NPT SPECIAL BACK PORTING
2. BODY - NAVY BRONZE
3. FOR LINE PRESSURE TO 3000 PSI
4. SEALS: BUNA "N"
5. DIAL 2" - #4 (0-20 PSID WITH "CLEAN" - "DIRTY" MARKINGS, "DIRTY" ZONE TO BEGIN AT 18 PSID)

VENDOR'S PART NO: 1201 PG-1-2BP (BRONZE BODY)

VENDOR: ORANGE RESEARCH, INC.
ORANGE, CONN.

REPR: CYPRESS CONTROLS CO.
2536 HUEBNER RD.
OCONOMOWOC, WI 53066

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
DIFFERENTIAL PRESSURE INDICATOR

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1763	4/6/77	ASSY. OR LO.	
DR. BY L.W.COOPER	3/23/77	SCALE	
CHK'D. BY L.W.Coop	3/23/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. R.O.W.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11 908 736		SHEET 1 OF 1

11908.736

Orange Research, Inc.
404 Boston Post Road, Orange, CT 06477 203/795-6225

Differential pressure gauges, switches, indicating switches for filter-flow-liquid level

instructions
SERIES 1201 & 1202
(PISTON TYPE)

INSTRUMENT IDENTIFICATION

GAUGES	SWITCHES	INDICATING SWITCHES
3000 psig . . . 1201PG-1-( )	1201PS-1-( )	1201PGS-1-( )-( )
5000 psig . . . 1202PG-1-( )	1202PS-1-( )	1202PGS-1-( )-( )
GAUGE SIZE	SWITCH SELECTION	GAUGE SIZE / SWITCH SELECTION

This Orange Research Differential Pressure Instrument is a rugged instrument featuring simplicity of design to provide long trouble-free service. Nevertheless, it should be installed properly and handled with care.

CAUTION: Do not exceed nameplate maximum operating pressure. Use only on fluids compatible with wetted parts.

HOW IT WORKS

These instruments work on the difference between two pressures (ΔP) acting on opposite sides of the pressure sensor (piston). Variations in pressure difference will cause the piston/magnet assembly to move in proportion to this change. On gauge models, a rotary pointer magnet, located in a separate cavity, follows the movement of the piston/magnet assembly and indicates the pressure loss or differential pressure on the gauge dial scale. On switch models, reed switches are located adjacent to the pressure chamber and are activated when the piston magnet field interacts at a preset point with the reed switch armature.

When used with a filter, the Filter Fink senses an increase in pressure drop across the filter media signifying filter condition as a function of dirt buildup. When used with an orifice plate, pitot tubes or venturi, the Flow Fink indicates the flow rate as a function of the pressure drop across the ΔP generator.

INSTALLATION

Check instrument parts for IN and OUT markings. IN identifies high pressure port; OUT the low pressure port. If instrument is installed backwards, it will neither operate nor be damaged. Reverse connections if installed backwards. Refer to drawings for connecting information.

PREVENTATIVE MAINTENANCE

It is suggested that the first preventative maintenance cleaning be done after one year of normal service. Successive cleaning cycles can be established after the findings of the first preventative cleaning cycle.

CLEANING

If switch or dial pointer action becomes sluggish or erratic, it might be an indication the piston has become dirty and movement is no longer smooth. This requires cleaning.

To clean, remove both end caps with a 1" spanner wrench and remove piston spring assembly. BE CAREFUL NOT TO LOSE SPRING SPACERS, IF ANY. Clean parts in a normal manner after removing "O"-ring seals from end caps since some solvents will attack the O-ring material. If lost or damaged, the end cap O-ring can be replaced using a size 018 ring (standard 3/4 ID x 7/8 OD).

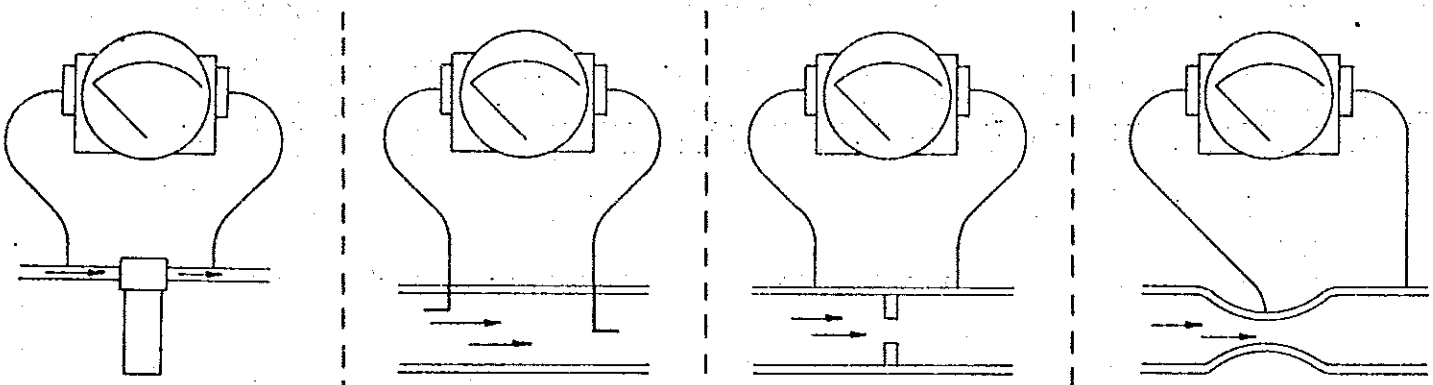
REASSEMBLY

When reinstalling the piston assembly, lubricate the bore lightly with vasoline, light oil, or silicone grease. Install the inlet end cap first and tighten with a 1" spanner wrench. Install piston/magnet assembly (magnet facing inlet end cap). Replace spacers in bottom of piston spring pocket and insert range spring. Reassemble outlet end cap being certain that spring is seated in end cap spring pocket. Tighten outlet end cap with the spanner wrench. The instrument is now ready for service. Recalibration is not required.

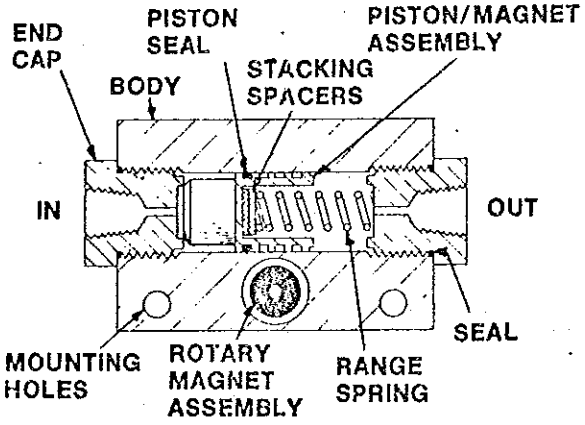
IMPORTANT: Magnet end of piston MUST be on inlet side of instrument, otherwise, the instrument will not operate.

SWITCH SETTINGS

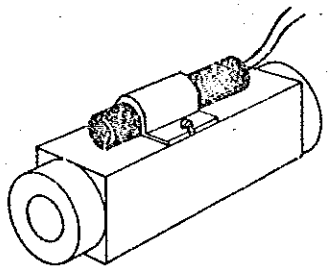
These instruments can be furnished with one or two switches and each switch can be field adjusted independently. To increase setting, move switch tube assembly towards OUT connection. To decrease setting, move switch tube assembly towards IN connection. Full range of adjustment covers approximately 1/2" of travel. To move switch(es), loosen one switch bracket screw. Move switch tube to approximate new position and retighten lock screw. Check for activation point. Repeat as required until desired setting has been reached.

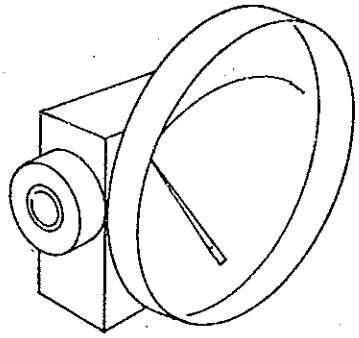


PRESSURE FILTER | FLOW METER PITOT TUBES | FLOW METER WITH ORIFICE | FLOW METER WITH VENTURI



MODEL 1201PS-1 SWITCH
Differential pressure switch provides remote warning signal and/or system control. One point or high/low limit control.





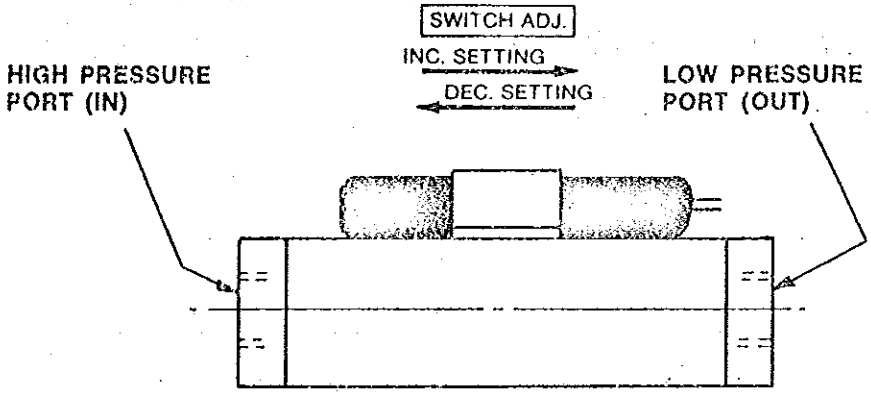
MODEL 1201PG-1 GAUGE
Differential pressure gauge provides direct reading in psid or flow. Scales graduated in English, Metric, English/Metric or special markings. Glass or plastic lens.

WHEN FURNISHED WITH REED SWITCHES—
GAUGE BECOMES AN INDICATING SWITCH

REED SWITCH SELECTION

Dash number is used in the Model No. to identify the type of switch or switches to be supplied on the instrument. All switches rated for use up to 120 volt, 1 ph, 60 hz.

Dash No.	No. of Sw's	Switch Element
-1*	1	1 amp/15 watt - SPST
-2*	2	1 amp/15 watt - SPST
-3	1	0.5 amp/10 watt - SPDT
-4	2	0.5 amp/10 watt - SPDT
-5*	1	3 amp/100 watt - SPST
-6*	2	3 amp/100 watt - SPST



*Shipped N/O unless specified otherwise.

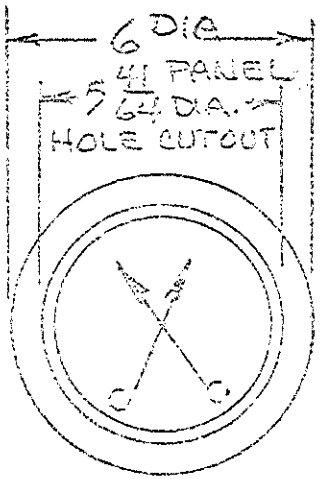
NOTES: All switches are field adjustable
a) Downstream adjustment increases set point.
b) Upstream adjustment decreases set point.
c) Units equipped with two switches - switches are independent of one another and can be positioned and adjusted independently.
d) Amp ratings given are resistive.

DESCRIPTION: WEKSLER 4-1/2" DUPLEX VAPOR ACTUATED REMOTE MOUNTING THERMOMETER WITH THE FOLLOWING FEATURES:

1. RANGE 40 TO 220°F.
2. 26 Ft. S TYPE CAPILLARY EACH BULB (COPPER CAPILLARY - BRONZE INTERLOCKED SPIRAL ARMOR).
3. WITH TURRET TYPE PHENOL CASE, TYPE "P".
4. WITH "J" TYPE BULB-1/2" x 3-1/2".
5. WITH BACK CONNECTIONS.
6. SYSTEM TYPE CLASS 2A.

VENDOR'S PART NO: 412A-JPR DUPLEX

VENDOR: DURABLE CONTROLS
P.O. BOX 696
OCONOMOWOC, WI 53066



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: GAUGE TEMPERATURE

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10282	4/21/77	ASSY. OR I.O.
DR. BY L. MCMASTER	4/1/77	SCALE NONE
CHK'D. BY H.P.S.	4/6/77	WEAT I.R.
MAT'L		

APPV. CAST. MAT'L. MACH. ENG. WELD.

SHEET SIZE A DWG. NO. 11 908 776 SHEET OF

11908776

WEKSLER INSTRUMENTS CORPORATION
80 Mill Road – Freeport, New York 11520

INSTRUCTIONS FOR INSTALLATION AND MAINTENANCE OF WEKSLER PRESSURE GAUGES

GENERAL

A pressure gauge must not be subjected to a pressure in excess of the dial range. If higher pressures are applied, permanent damage to the Bourdon tube may result. FOR BEST SERVICE the working pressure at which the gauge is to operate should be within the middle 1/3 of the scale range i.e. a gauge with range 0 to 200 psi should be used for working pressures between 60 and 140 psi.

INSTALLATION

Pressure gauges should be mounted in a vertical position and in a location free from excessive vibration. The gauge socket is provided with wrench flats which with a wrench of the correct size should be used exclusively when installing the gauge. *Under no circumstances should any force be applied to the gauge case directly.* Twisting of the case may disrupt the calibration of the gauge.

APPLICATION

When a gauge is to be used for steam pressures, a siphon filled with water is recommended between the line and gauge. This will prevent live steam from entering and damaging the Bourdon tube. Always install a shut-off cock between the siphon and the gauge.

If the gauge is installed on a liquid pressure line, arrange the piping so as to avoid vapor entrapment; otherwise readings may be inaccurate. If possible, provide for vents at high points in the line to bleed off the entrapped vapors.

On installations which are subject to severe pressure fluctuations, pulsations and/or line shock, the use of a snubber, gauge saver, or factory installed throttle screw is recommended. Where the pressure media will tend to corrode or clog the Bourdon tube a factory installed diaphragm attachment is recommended.

CALIBRATION CHECK

To check the calibration of a gauge it must be removed from the line or equipment and installed on a dead-weight tester, or test gauge manifold. Check calibration at 1/3, 1/2 and 2/3 of the dial range. If the readings are outside of the tolerance limits, the instrument requires recalibration. Remove the front ring, glass front (lens) and gasket. Then recalibrate, as follows:

RECALIBRATION

There are three specific adjustments. These are:

A. Zero Adjustment
B. Range Adjustment
C. Linearity Adjustment

(A) Zero Adjustment

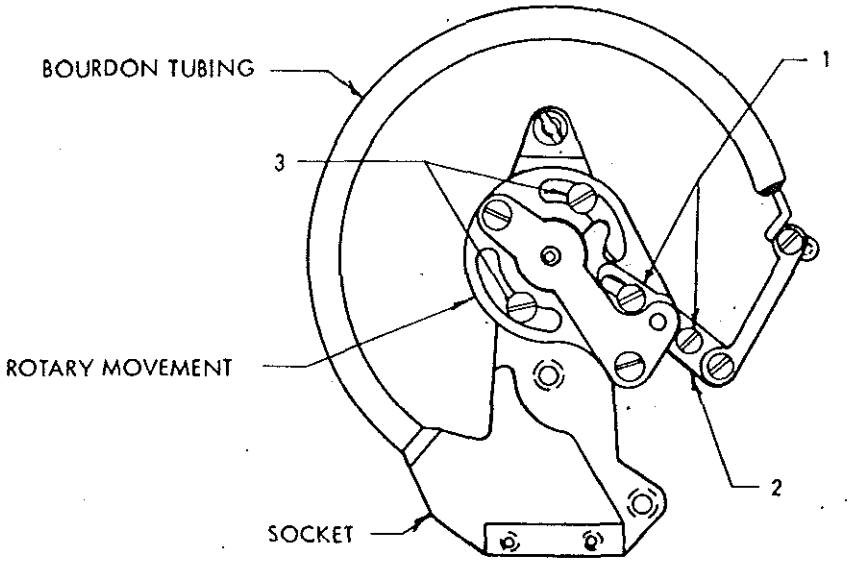
If the gauge shows an equal amount of incorrect reading, either too high or too low over the entire range, adjustment is made by resetting the indicating pointer. These are furnished in three types, i.e. micrometer, slotted and plain.

The micrometer type is adjusted by holding the pointer firmly with one hand and turning the micrometer screw with the other. Follow the same procedure for the slotted type, except rotate the slotted hub with a screwdriver. For gauges equipped with plain pointer make minor adjustments by rotating the slotted scale. Where this adjustment is not sufficient, remove the pointer (using a hand jack), and reset in desired position.

(B) Range Adjustment
If the gauge readings show a progressively increasing (plus or minus) error, from the lower to the upper end of the range, loosen the two slide screws (1) and proceed as follows: For plus error, the slide (2) must be moved outward; for minus error, the slide must be moved inward. After attaining proper adjustment, retighten the slide screws (1).

(C) Linearity Adjustment
Assuming the gauge reads accurately at high and low points (1/3 and 2/3 of gauge range) but inaccurate at the center of the scale, linearity adjustment is required.

A linearity adjustment, being the most difficult adjustment of the three due to the geometric function of all components, may in some instances be accomplished in the field by loosening the two movement mounting screws (3) and rotating the movement. Without a technical gauge background this would be a trial and error adjustment. After each adjustment (which should require no more than a few degrees), the gauge should be retested through the complete range, after setting pointer at approximately 5% of scale range. Make zero and/or range adjustments if required.



SPECIAL FEATURE ITEMS

(1) Maximum and/or Mininum Pointer(s): Furnished only as a special feature, a max-min pointer permits reading of the highest and/or lowest pressure attained during operation. To set the pointer(s), rotate the knob(s) in the center of the lens until the max-min pointer touches against the side of the gauge pointer.

As the gauge pointer moves, it will carry the frictionless max-min pointer with it, until the maximum (or minimum) pressure is attained. When the gauge pointer recedes, the max-min pointer will hold at the highest (or lowest) pressure point reached.

Gauges equipped with Max-Min Pointer should be installed only on vibration-free applications.

(2) Capillary Bleeder: Gauges equipped with this special feature have a cap screw fitting on the side of the instrument case.

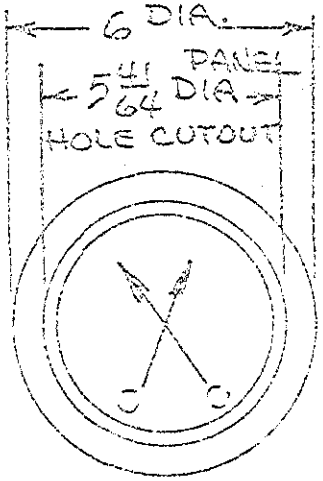
To remove trapped air from the Bourdon tube, remove the bleeder cap screw and run the pressure fluid through the gauge until air bubbles no longer appear. In case of clogging follow the same procedure except continue bleeding until all foreign matter has been ejected and the flow (out of the bleeder) is continuous. Replace cap screw and tighten.

DESCRIPTION: WEKSLER 4-1/2" DUPLEX VAPOR ACTUATED REMOTE MOUNTING THERMOMETER WITH THE FOLLOWING FEATURES:

1. RANGE 40 TO 220°F.
2. 8 TYPE CAPILLARY EACH BULB (COPPER CAPILLARY - BRONZE INTERLOCKED SPIRAL ARMOR)
   - RED HAND - 26 FT. LG.
   - BLACK HAND - 40 FT. LG.
3. WITH TURRET TUPE PHENOL CASE, TYPE "P";
4. WITH "J" TYPE BULB 1/2" x 3-1/2".
5. WITH BACK CONNECTIONS.
6. SYSTEM TYPE CLASS 2A.

VENDOR'S PART NO: 412A-JPR- DUPLEX

VENDOR: DURABLE CONTROLS
P.O. BOX 696
OCONOMOWOC, WI 53066



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: GAUGE TEMPERATURE

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .010
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .010 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 1028.2	4/21 77	ASSY. OR LO.	
DR. BY L. NOMASTER	4/1 77	SCALE	NONE
CHK'D. BY H.R.S.	4/6 77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

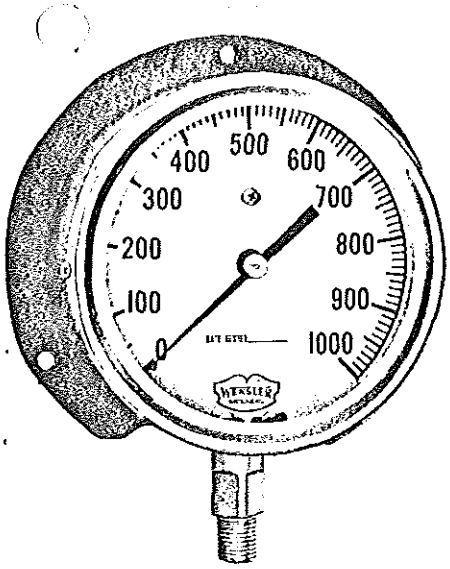
SHEET SIZE A | DWG. NO. 11 908 777 | SHEET OF

WEKSLER INSTRUMENTS

BRONZE TUBE
1,000# MAXIMUM
▲1% ACCURACY

TYPE [illegible] Regal GAUGE

PRESSURE - VACUUM - COMPOUND



PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 15 lb.	1 lb.	¼ lb.
0— 30 lb.	5 lb.	½ lb.
0— 60 lb.	10 lb.†	1 lb.
0— 100 lb.	10 lb.	1 lb.
0— 160 lb.	20 lb.	2 lb.
0— 200 lb.	20 lb.	2 lb.
0— 250 lb.	25 lb.	5 lb.
0— 300 lb.	50 lb.	5 lb.
0— 400 lb.	50 lb.	5 lb.
0— 500 lb.	50 lb.	5 lb.
0— 600 lb.	100 lb.††	10 lb.††
0— 700 lb.	100 lb.	10 lb.
0— 800 lb.	100 lb.	10 lb.
0— 1,000 lb.	100 lb.	10 lb.

† Also available with figures at 5 lb. intervals.
†† Also available with 50 and 5 lb. markings.

VACUUM RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 30" Hg. Vac.	5 in.	½ in.

COMPOUND RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
30"—0— 15 lb.	5" & 3 lb.	1" & ¼ lb.
30"—0— 30 lb.	10" & 5 lb.	1" & 1 lb.
30"—0— 60 lb.	10" & 10 lb.	1" & 1 lb.
30"—0—100 lb.	15" & 10 lb.	2" & 1 lb.
30"—0—150 lb.	30" & 25 lb.	2" & 2 lb.
30"—0—200 lb.	30" & 20 lb.	5" & 5 lb.
30"—0—300 lb.	30" & 50 lb.	5" & 5 lb.
30"—0—400 lb.	30" & 50 lb.	5" & 5 lb.
30"—0—600 lb.	30" & 100 lb.	5" & 10 lb.

NOTE: On compound range gauges the zero graduation is *not to be used as a calibration reference point.*

Combination metric dials, in standard ranges up to 70 KG/CM² can be furnished at no additional charge.

SUITABLE FOR: Acetone, Air, Benzine, Benzol, Boric Acid, Brine, Butane, Butyl-Alcohol, Glycerine, Nitrogen, Steam (for pressures up to 400 psi), Tannic Acid, Water and other liquids or gases that will not corrode bronze. For steam service a siphon filled with water should be installed between line and gauge to prevent steam from entering the bourdon tube.

▲ *Also available in ½% accuracy, at additional cost.*

DIAL SIZES: ..... 3½", 4½", 6", 8½", 12".

BOURDON TUBE: ..... Seamless phosphor bronze, Grade A, over-pressured and stress relieved.

SOCKET & TIP: ..... Forged brass.

JOINTS: ..... Silver brazed and stress relieved.

MOVEMENT: ..... Bronze bushed rotary with nickel silver pinion gear and shaft; phosphor bronze sector gear and hairspring; stainless steel link. Other parts are brass.

DIAL: ..... White lithio background with black graduations and numerals. Black background with white markings available 270° arc.

POINTER: ..... Slotted adjustable pointer.

CASE TYPES: ..... For Wall, Direct, Semi-Flush, or Flush mounting.

CASE MATERIALS: ..... Phenol, Aluminum, Brass, Iron, Steel.

CONNECTIONS: ..... ¼" male N. P. T. standard. ½" male N. P. T. can be furnished at additional charge.

Special connections on application.

CASE SELECTION: ..... See pages 2 and 3 for illustrated descriptions and identifying suffix letters.

DIMENSIONS: ..... See pages 29, 30 and 31.

WEIGHTS: ..... See back cover.

WHEN ORDERING: Specify (1) Gauge Type i.e. AA1, BA1, etc.; (2) Dial Size (by symbol) i.e. 3 = 3½", 4 = 4½", 6 = 6", 8 = 8½" and 9 = 12" dial size. (3) To the resultant 4-digit number, refer to page 4 or 5 and add appropriate "case type" symbol. Example: "Type AA14P" denotes 4½" dial size Royal Gauge in black phenol case.

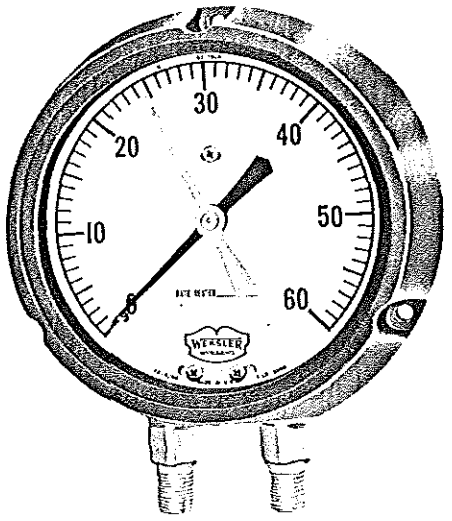
In addition to Gauge Type Number . . . Specify Range; Connection (size and location); Dial (white, black or special).

WEKSLER INSTRUMENTS

DUPLEX GAUGE
1% ACCURACY

TYPE BB1 Regal GAUGE

BRONZE TUBES STANDARD - OTHER MATERIALS AVAILABLE



DUPLEX GAUGE, TYPE BB1

SERVICE: To indicate two related pressures on the same dial. For use with air, water, steam, or any liquid or gas that will not corrode bronze.

DIAL SIZES: 4½", 6", 8½", 12"

BOURDON TUBES: Seamless phosphor bronze standard. (Can be supplied in alloy steel, beryllium copper, stainless steel, or Monel at extra charge, 4½" and 6" sizes only).

SOCKET & TIP: Forged brass.

JOINTS: Silver brazed and stress relieved.

MOVEMENT: Duplex type. Phosphor bronze sector gear, hairspring and link. Bronze bushed rotary; nickel silver pinion gear and shaft. All other parts are brass.

DIAL: White litho background with black graduations and numerals. Black background with white markings available.

POINTERS: Top pointer is orange; actuated from socket stamped RH (right hand).

Bottom pointer is black; actuated from socket stamped LH (left hand).

CASE TYPES: For Wall, Direct (stem), Semi-Flush, or Flush mounting.

CASE MATERIALS: Phenol, Aluminum, Brass or Iron.

CONNECTIONS: ¼" male N. P. T. only.

CASE SELECTION: See pages 4 and 5 for illustrated descriptions and identifying suffix letters.

DIMENSIONS: See pages 29, 30 and 31.

WEIGHTS: See page 2.

WHEN ORDERING: Specify (1) Gauge Type i.e. AA1, BA1, etc.; (2) Dial Size (by symbol) i.e. 3 = 3½", 4 = 4½", 6 = 6", 8 = 8½" and 9 = 12" dial size. (3) To the resultant 4-digit number, refer to page 4 or 5 and add appropriate "case type" symbol. Example: "Type AA14P" denotes 4½" dial size Royal Gauge in black phenol case.

In addition to Gauge Type Number . . . Specify Range; Connection (size and location); Dial (white, black or special).

PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 30 lb.	5 lb.	½ lb.
0— 60 lb.	10 lb.††	1 lb.
0— 100 lb.	10 lb.	1 lb.
0— 160 lb.	20 lb.	2 lb.
0— 200 lb.	20 lb.	2 lb.
0— 250 lb.	25 lb.	5 lb.
0— 300 lb.	25 lb.	5 lb.
0— 400 lb.	50 lb.	5 lb.
0— 500 lb.	50 lb.	5 lb.
0— 600 lb.	100 lb.††	10 lb.††
0— 700 lb.	100 lb.	10 lb.
0— 800 lb.	100 lb.	10 lb.
0— 1,000 lb.	100 lb.	10 lb.

† Also available with figures at 5 lb. intervals.
†† Also available with 50 and 5 lb. markings.
NOTE: For higher ranges, price on application.

COMPOUND RANGES

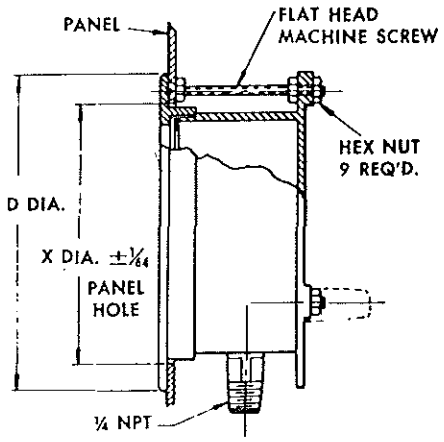
DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
30"—0— 15 lb.	5" & 3 lb.	1" & ½ lb.
30"—0— 30 lb.	10" & 5 lb.	1" & ½ lb.
30"—0— 60 lbs.	10" & 10 lb.	1" & 1 lb.
30"—0—100 lb.	15" & 10 lb.	5" & 1 lb.
30"—0—150 lb.	30" & 25 lb.	5" & 5 lb.
30"—0—200 lb.	30" & 20 lb.	5" & 5 lb.
30"—0—300 lb.	30" & 50 lb.	5" & 5 lb.

NOTE: On compound range gauges the zero graduation is not to be used as a calibration reference point.

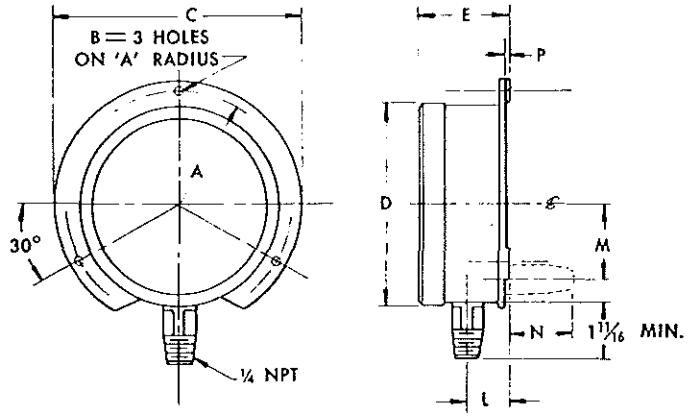
GENERAL DIMENSIONS

FLUSH MOUNTING RING ASSEMBLY

DIAL SIZE	X	D		SCREW SIZE	
		Std.	Safety	Std.	Safety
3½	4	4 29/32	4 15/16	10-32x1¾	10-32x2⅛
4½	5	5 31/32	5 31/32	10-32x2½	10-32x2¾
6	6 9/16	7 25/32	7 ¾	¼-20x2½	¼-20x2¾
8½	8 31/32	10 11/32	10 11/32	¼-20x2½	¼-20x2¾
12	12 19/32	14 ⅜	—	¼-20x3	—



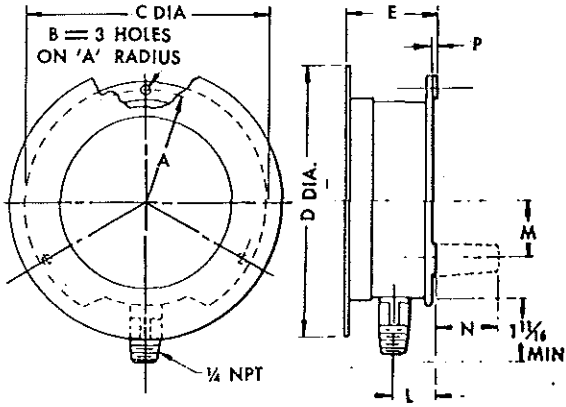
BACK FLANGED CASE



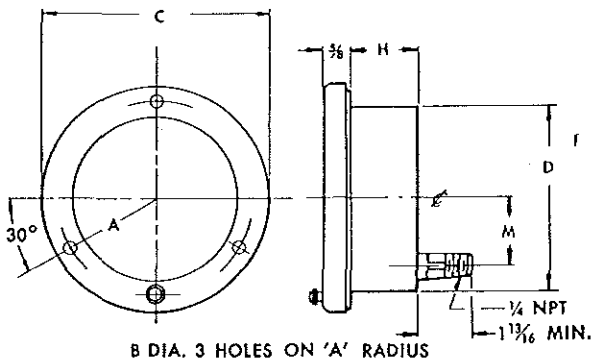
DIAL SIZE	A	B	C	D	E		L		M	N		P	
					Std.	Safety	Std.	Safety		Std.	Safety	Std.	Safety
3½	2⅛	7/32 x ⅜	5	4 3/16	2 1/16	1 31/32	13/16	13/16	1 5/32	1 11/16	1 1/16	⅛	3/16
4½	2 11/16	7/32 x 5/16	5 7/8	5	2 5/16	2 ⅝	1 1/32	1 1/32	1 19/32	1 21/32	15/16	5/32	5/16
6	3 ½	9/32 x 11/32	7 ⅝	6½	2 17/32	2 7/16	1 1/32	1	1 9/16	1 13/16	1 1/16	1/16	3/16
8½	4 13/16	9/32	10 ¼	8 27/32	2 9/32	2 17/32	31/32	1	2⅛	13/16	1 1/16	1/16	3/16

FLUSH MOUNTING CASE

DIAL SIZE	A	B	C	D	E		L		M	N		P	
					Std.	Safety	Std.	Safety		Std.	Safety	Std.	Safety
3½	2 7/32	7/32 x ⅜	5	4 29/32	1 7/16	2	13/16	25/32	1 5/32	1 11/16	1 1/16	⅛	3/16
4½	2 23/32	7/32 x 5/16	5 29/32	5 31/32	2 17/32	2 ⅝	1 1/32	1 1/16	1 19/32	1 21/32	15/16	5/32	5/16
6	3 ½	9/32 x 11/32	7 ⅝	7 25/32	2 9/16	2 7/16	1 3/32	1	1 9/16	1 13/16	1 1/16	1/16	3/16
8½	4 13/16	9/32	10 ¼	10 11/32	2 5/16	2 19/32	31/32	1	2⅛	13/16	1 1/16	1/16	3/16
12	6 ¾	9/32	14 ½	14 ⅜	2 25/32	—	1 ⅛	—	2⅛	1⅛	—	⅛	—



HINGED FRONT CASE

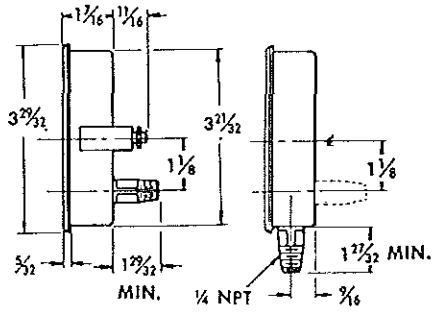


B DIA. 3 HOLES ON 'A' RADIUS

DIAL SIZE	A	B	C	D	H	M	X
4½	2 11/16	7/32	6	4 13/16	1 21/32	1 5/8	4 3/32
6	3½	7/32	7⅝	6 11/32	1 11/16	2⅛	6 7/16

X—Panel hole cut-out diameter

3½" DRAWN STEEL CASE



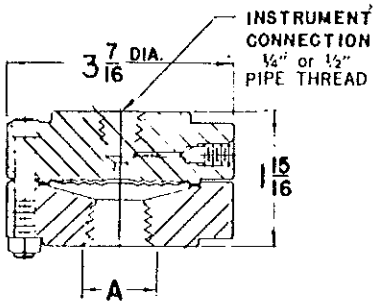
R++

WELDED-DIAPHRAGM TYPE SEALS
FOR UNIVERSAL CONTINUOUS SERVICE

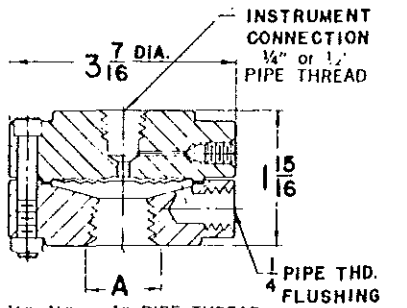
WEKSLER INSTRUMENTS

Universal use Welded-Diaphragm Type seals have all of the safety features offered by the Continuous Duty Type. In addition, in the construction of "welded in the top" diaphragm seals special equipment and procedures are used to weld an improved shape diaphragm in the top section. The possibility of leakage problems and the need for gasket clamping (middle) rings are completely eliminated.

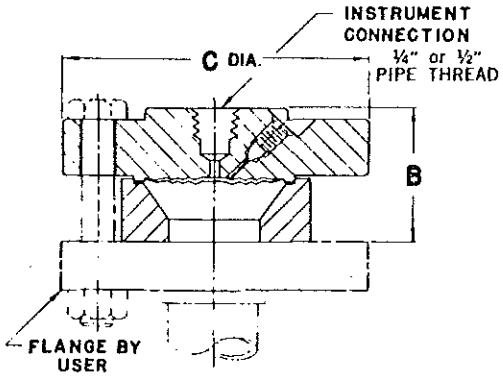
All seals listed on this page are Welded-Diaphragm Type and all are classed as Cleanout Type. They are designed for continuous service and can be used universally i.e. on either corrosive gas, corrosive liquids or clogging service. Inventory can be reduced accordingly.



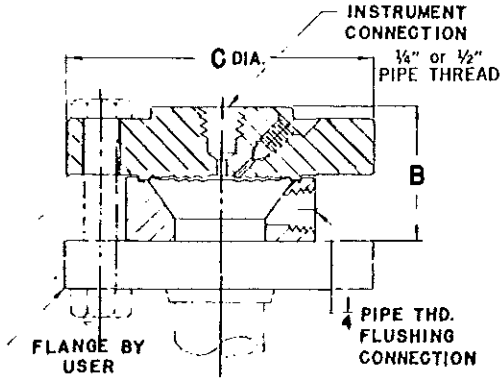
MODEL D19-2



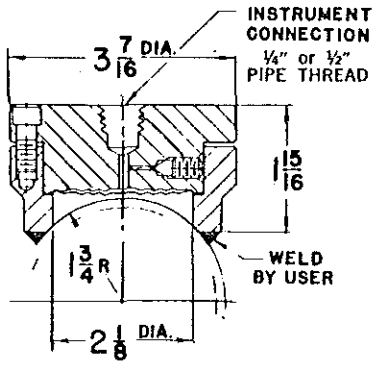
MODEL D19-7



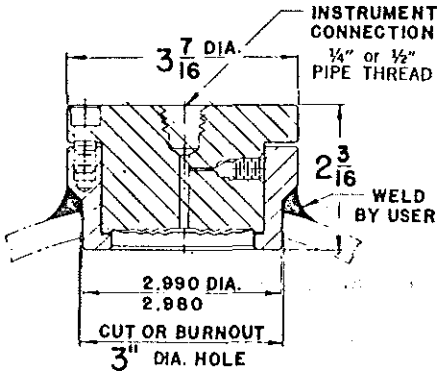
MODEL D19-3
1", 1½", 2" or 3" ASA RF SIZES
150#, 300#, 600# and 1500# RATINGS



MODEL D19-4
1", 1½", 2" or 3" ASA RF SIZES
150#, 300#, 600# and 1500# RATINGS

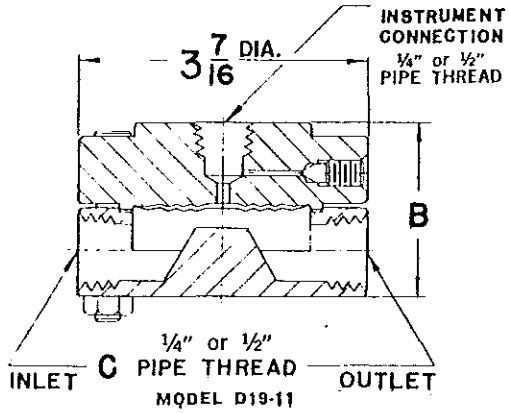


FOR 3" PIPE ONLY

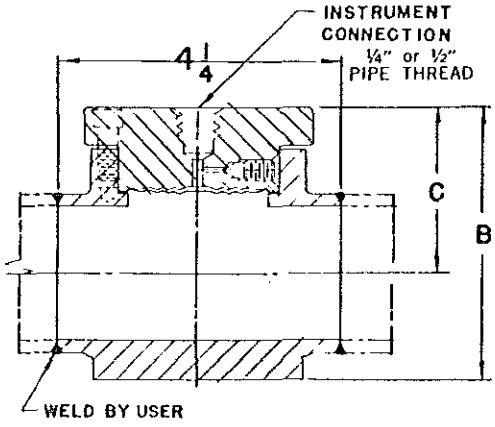


FOR 4" PIPE AND LARGER

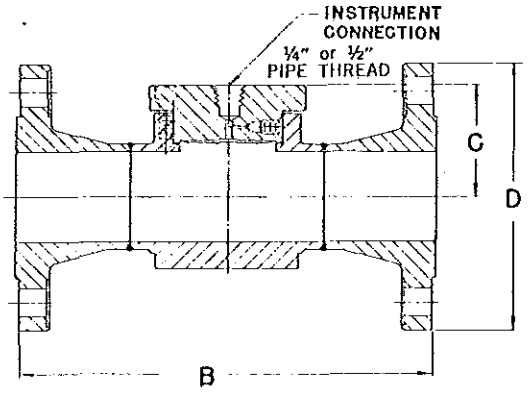
MODEL D19-10
SPECIFY PIPE SIZE



MODEL D19-11



MODEL D19-13
FOR 1", 2" or 3" PIPE, SPECIFY



MODEL D19-14
1", 2" and 3" x 150# FLANGE SIZES, SPECIFY

Printed in U.S.A.

11908777

WEKSLER INSTRUMENTS CORPORATION
80 Mill Road – Freeport, New York 11520

INSTRUCTIONS FOR INSTALLATION AND MAINTENANCE OF WEKSLER PRESSURE GAUGES

GENERAL

A pressure gauge must not be subjected to a pressure in excess of the dial range. If higher pressures are applied, permanent damage to the Bourdon tube may result. FOR BEST SERVICE the working pressure at which the gauge is to operate should be within the middle 1/3 of the scale range i.e. a gauge with range 0 to 200 psi should be used for working pressures between 60 and 140 psi.

INSTALLATION

Pressure gauges should be mounted in a vertical position and in a location free from excessive vibration. The gauge socket is provided with wrench flats which with a wrench of the correct size should be used exclusively when installing the gauge. *Under no circumstances should any force be applied to the gauge case directly.* Twisting of the case may disrupt the calibration of the gauge.

APPLICATION

When a gauge is to be used for steam pressures, a siphon filled with water is recommended between the line and gauge. This will prevent live steam from entering and damaging the Bourdon tube. Always install a shut-off cock between the siphon and the gauge.

If the gauge is installed on a liquid pressure line, arrange the piping so as to avoid vapor entrapment; otherwise readings may be inaccurate. If possible, provide for vents at high points in the line to bleed off the entrapped vapors.

On installations which are subject to severe pressure fluctuations, pulsations and/or line shock, the use of a snubber, gauge saver, or factory installed throttle screw is recommended. Where the pressure media will tend to corrode or clog the Bourdon tube a factory installed diaphragm attachment is recommended.

CALIBRATION CHECK

To check the calibration of a gauge it must be removed from the line or equipment and installed on a dead-weight tester, or test gauge manifold. Check calibration at 1/3, 1/2 and 2/3 of the dial range. If the readings are outside of the tolerance limits, the instrument requires recalibration. Remove the front ring, glass front (lens) and gasket. Then recalibrate, as follows:

RECALIBRATION

There are three specific adjustments. These are:

A. Zero Adjustment
B. Range Adjustment
C. Linearity Adjustment

(A) Zero Adjustment

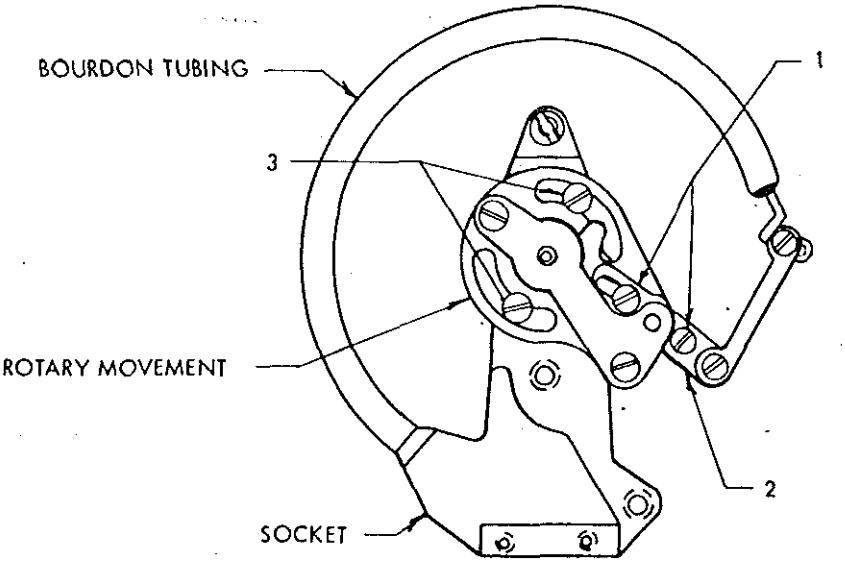
If the gauge shows an equal amount of incorrect reading, either too high or too low over the entire range, adjustment is made by resetting the indicating pointer. These are furnished in three types, i.e. micrometer, slotted and plain.

The micrometer type is adjusted by holding the pointer firmly with one hand and turning the micrometer screw with the other. Follow the same procedure for the slotted type, except rotate the slotted hub with a screwdriver. For gauges equipped with plain pointer make minor adjustments by rotating the slotted scale. Where this adjustment is not sufficient, remove the pointer (using a hand jack), and reset in desired position.

(B) Range Adjustment
If the gauge readings show a progressively increasing (plus or minus) error, from the lower to the upper end of the range, loosen the two slide screws (1) and proceed as follows: For plus error, the slide (2) must be moved outward; for minus error, the slide must be moved inward. After attaining proper adjustment, retighten the slide screws (1).

(C) Linearity Adjustment
Assuming the gauge reads accurately at high and low points (1/3 and 2/3 of gauge range) but inaccurate at the center of the scale, linearity adjustment is required.

A linearity adjustment, being the most difficult adjustment of the three due to the geometric function of all components, may in some instances be accomplished in the field by loosening the two movement mounting screws (3) and rotating the movement. Without a technical gauge background this would be a trial and error adjustment. After each adjustment (which should require no more than a few degrees), the gauge should be retested through the complete range, after setting pointer at approximately 5% of scale range. Make zero and/or range adjustments if required.



SPECIAL FEATURE ITEMS

(1) Maximum and/or Mininum Pointer(s): Furnished only as a special feature, a max-min pointer permits reading of the highest and/or lowest pressure attained during operation. To set the pointer(s), rotate the knob(s) in the center of the lens until the max-min pointer touches against the side of the gauge pointer.

As the gauge pointer moves, it will carry the frictionless max-min pointer with it, until the maximum (or minimum) pressure is attained. When the gauge pointer recedes, the max-min pointer will hold at the highest (or lowest) pressure point reached.

Gauges equipped with Max-Min Pointer should be installed only on vibration-free applications.

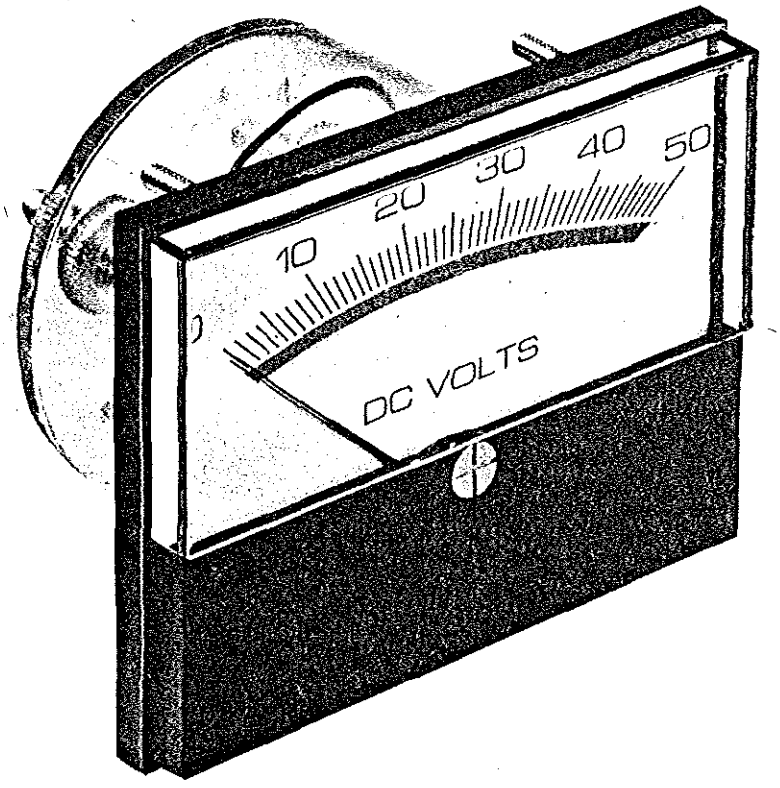
(2) Capillary Bleeder: Gauges equipped with this special feature have a cap screw fitting on the side of the instrument case.

To remove trapped air from the Bourdon tube, remove the bleeder cap screw and run the pressure fluid through the gauge until air bubbles no longer appear. In case of clogging follow the same procedure except continue bleeding until all foreign matter has been ejected and the flow (out of the bleeder) is continuous. Replace cap screw and tighten.

TAUT BAND

MODUTEC BLUE•DOT™ PANEL METERS

RUGGEDIZED (MIL SPEC)



K series

- **Sealed construction.**
- **Lexan* covers — highly resistant to impact, temperature, most chemicals.**
- **Resist flame — meet UL self-extinguishing *requirements.***
- **Shock and vibration resistant.**
- **High torque, shielded taut-band movements.**
- **Silicon semiconductors in AC meters.**
- **Cases and covers treated to eliminate the effects of static electricity.**
- **Temperature compensated.**
- **Meet MIL environmental specs.**

*Reg. T.M. for polycarbonate of G.E. Co.

SPECIFICATIONS

Environmental

General: Meet or exceed the environmental requirements of the following specifications:

MIL-T-945-A ("Test equipment for use with electronic equipment, general specifications for"):

UL BULLETIN 94, Class V-2 ("Test procedures, self extinguishing").

USA STND C-39.1 (ANSI C-39.1-1972) ("Requirements for electrical indicating instruments");

Temperature: Operating: −40°C to +71°C (2% accuracy derating); Storage: −62°C to +100°C (hot spot rating +100°C).

Altitude: To 10,000 feet.

Shock: *100g per lightweight machine of* MIL-STD-202C, method 202B.

Vibration: MIL-T-945-B, para. 4.4.5 (10-33 Hz, 0.06" max. double amplitude; 10-55 Hz, 0.03" max. double amplitude).

Humidity: MIL-STD-202-C, Method 103B, test condition B.

Sand, dust, salt spray: MIL-T-21200-H.

Flammability: Self-extinguishing Lexan covers meet requirements of UL Bulletin 94, Class V-2. UL rating +110°C.

Chemical resistance, covers: Resist water, *mineral and organic acids, aliphatic hydro*carbons, ether, and alcohols. Partially soluble in aromatic hydrocarbons such as acetone, MEK, trichlor, etc., and slowly decomposed by strong alkaline substances. Can be safely cleaned with detergents, alcohol, freon, kerosene (See General Electric *Lexan Bulletin CDC-392-A for complete* data).

Impact resistance, cases & covers: Have 10 times the impact resistance of customary transparent meter plastics, and 50 times that of window glass.

Modutec Blue-Dot Meters are available in three styles, five sizes, and most types. Their covers are Lexan, so that they easily withstand physical punishment that would break or damage ordinary meters. Their movements are specially shockproofed, sealed, and compensated. This means that now you can specify meters for tough situations — military, medical, industrial — without having to make concessions as to the style and size meter you prefer to use.

OPTIONS Many desirable options are readily available on Blue-Dot meters, at modest cost, to satisfy the particular needs of a specific application. These are described on pages 24-26. Note that suffix "H" option — high temperature case and cover, and suffix "S" option — sealed case, are already incorporated in Blue-Dot meters. They also have prefix "T" high torque ruggedized movements.

"J" DEAD SET POINTER

"J" Suffix additional charge $8.85 (8" meter $13.25)

In certain meter applications the addition of an externally adjustable (dead set) pointer provides added utility (setting minimum or maximum limits for current, voltage, temperature, etc.). Dead set pointers can be provided in 3½", 4½", 5½", and 8" meters in both the S Series surface mount (see note below) and Windo-Mount styles.

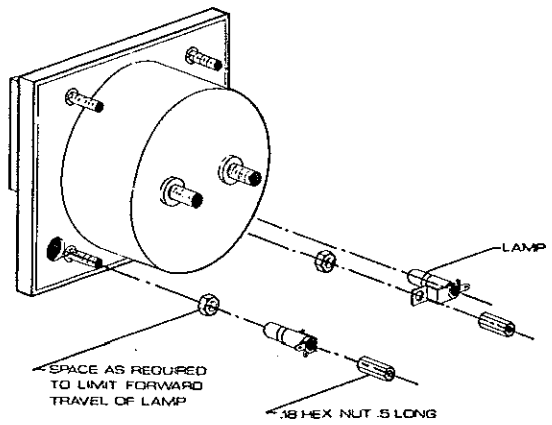
The standard dead set pointer is painted Day-Glo red (Suffix "J1") but a black pointer (Suffix "J2") may be specified at same additional charge. To order add the appropriate suffix code to the catalog number.

Note: Dead set pointers in surface mount meters require Windo-Mount type covers to provide necessary clearance between pointers. The covers are painted black unless specified otherwise.

"KW" ILLUMINATION

"KW" Suffix additional charge $6.60 per meter, without lamps; $8.45 per meter with 6, 12, or 28V lamps included.

Series S, BA, and W meters can be furnished with internal light wells, together with socket and bracket assemblies, hardware, and instructions, for attractive, glare-free illumination. (see drawing).



This suffix is applicable to sizes 2½" through 8", and mounting cutouts remain the same for the BA and W series. Series S meters require two additional clearance holes for the lamp sockets (ask for drawing AB-770).

Sockets accommodate midget grooved T-1¾ size lamps in all standard voltages — 6, 12, 28 volts, etc. Derating nominal voltages by 20% greatly extends lamp life with little loss in brightness. To order with lamps add voltage after suffix, e.g., 2S-AVU-000-AB-KW/28 (28v lamp on 2½" VU meter).

"L" HAND LETTERED CUSTOM DIALS

"L" Suffix additional charge $13.25 minimum (range $13.25-$26.50)

This option provides prompt service in hand-lettered custom dials. Unusual nomenclature and graphics can be accommodated. Customers find this a worth-while time and money saver in providing a practical answer to small quantity needs for prototypes, etc.

"M" MIRROR SCALE

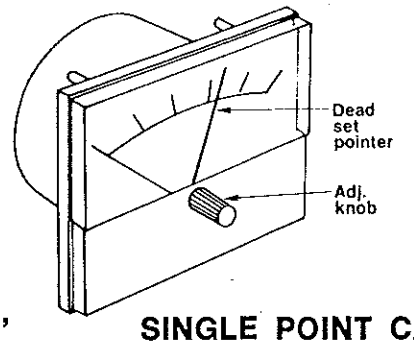
"M" Suffix additional charge $1.80 per unit.

"NL" HEAVY DAMPING

"NL" Suffix additional charge $1.80 per unit.

Heavy damping is often required to minimize pointer motion where meter is subjected to mechanical vibration. This option fills the need, with a corresponding degrading of response time.

Standard meters have a damping factor of 2.5 minimum, 5 typical, in accordance with USA STND C-39.1. This option provides considerably more damped performance, with damping factor ranging from 10 to infinity.



"P" SINGLE POINT CALIBRATION

"P" Suffix additional charge $4.00 (plus cost of custom scale, if required).

To order single point calibration at an accuracy of 1%, add the suffix "P" to the model number, and specify the calibration point; e.g., 2S-DVV-050-P36.

"Q" TINTED COVERS

Q-1 — Smoke grey
Q-2 — Amber
Q-3 — Blue

Additional charge $3.50 (8" meter $5.30)

Tinted covers offer an attractive alternate appearance to illuminated meters and tend to "black out" when lighting is turned off. The amber cover gives the illuminated dial a buff tone — traditional with VU meters. Other colors are available — consult factory.

"R" IMPROVED TERMINAL RESISTANCE TOLERANCE

"R" Suffix additional charge $1.80

The internal resistance of catalog meters, as given in the tabular listings, have tolerances of ±10%. This option provides for improving the internal resistance tolerance to ±5%.

"S" SEALED CASE

"S" Suffix additional charge $4.90

This feature, which provides for complete sealing of the case, is ideal for humid, corrosive, or dirt-laden environments, or where the possibility of splashing presents a problem.

"T" TEMPERATURE COMPENSATION

"T" Suffix additional charge $7.10

Normally the temperature influence is specified over a range of 25±10°C. This feature provides for extending the range to 25±30°C. The addition of this feature serves to increase the terminal resistance, as given in the tabular data, by 25%.

"U" UNIT METER PACKAGING

"U" Suffix additional charge $1.80 per meter

Normally meters are bulk packaged for shipment. This option provides for their being individually boxed and marked for identification as follows:

CAT. NO. _____
SIZE _____
RANGE _____
CUST. P/N _____

"V" HIGH RESISTANCE VOLTMETERS

"V" Suffix additional charge $5.30

Catalog voltmeters have a resistance of 1000 ohms/volt, which this feature increases to 10K ohms/volt.

"Z" REAR ZERO ADJUSTMENT

"Z" Suffix additional charge $4.00

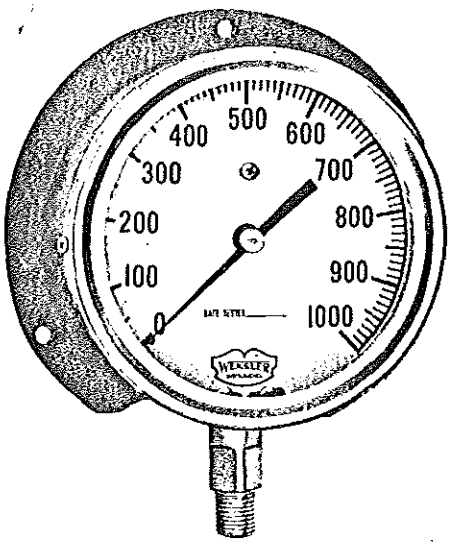
This option provides for a zero-adjuster on the rear of the barrel of the meter, and also disables the front-of-case zero adjuster normally used. It is most useful in the "W" series, where it eliminates the need for a zero-adjust clearance hole on the panel. It also prevents tampering.

WEKSLER INSTRUMENTS

BRONZE TUBE
1,000# MAXIMUM
▲1% ACCURACY

TYPE BA1 Regal GAUGE

PRESSURE - VACUUM - COMPOUND



SUITABLE FOR: Acetone, Air, Benzine, Benzol, Boric Acid, Brine, Butane, Butyl-Alcohol, Glycerine, Nitrogen, Steam (for pressures up to 400 psi), Tannic Acid, Water and other liquids or gases that will not corrode bronze. For steam service a siphon filled with water should be installed between line and gauge to prevent steam from entering the bourdon tube.

▲ *Also available in ½% accuracy, at additional cost.*

DIAL SIZES: ..... 3½", 4½", 6", 8½", 12".

BOURDON TUBE: ..... Seamless phosphor bronze, Grade A, over-pressured and stress relieved.

SOCKET & TIP: ..... Forged brass.

JOINTS: ..... Silver brazed and stress relieved.

MOVEMENT: ..... Bronze bushed rotary with nickel silver pinion gear and shaft; phosphor bronze sector gear and hairspring; stainless steel link. Other parts are brass.

DIAL: ..... White litho background with black graduations and numerals. Black background with white markings available. 270° arc.

POINTER: ..... Slotted adjustable pointer.

CASE TYPES: ..... For Wall, Direct, Semi-Flush, or Flush mounting.

CASE MATERIALS: ..... Phenol, Aluminum, Brass, Iron, Steel.

CONNECTIONS: ..... ¼" male N. P. T. standard. ½" male N. P. T. can be furnished at additional charge.

Special connections on application.

CASE SELECTION: ..... See pages 2 and 3 for illustrated descriptions and identifying suffix letters.

DIMENSIONS: ..... See pages 29, 30 and 31.

WEIGHTS: ..... See back cover.

WHEN ORDERING: Specify (1) Gauge Type i.e. AA1, BA1, etc.; (2) Dial Size (by symbol) i.e. 3 = 3½", 4 = 4½", 6 = 6", 8 = 8½" and 9 = 12" dial size. (3) To the resultant 4-digit number, refer to page 4 or 5 and add appropriate "case type" symbol. Example: "Type AA14P" denotes 4½" dial size Royal Gauge in black phenol case.

In addition to Gauge Type Number . . . Specify Range; Connection (size and location); Dial (white, black or special).

PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 15 lb.	1 lb.	¼ lb.
0— 30 lb.	5 lb.	½ lb.
0— 60 lb.	10 lb.†	1 lb.
0— 100 lb.	10 lb.	1 lb.
0— 160 lb.	20 lb.	2 lb.
0— 200 lb.	20 lb.	2 lb.
0— 250 lb.	25 lb.	5 lb.
0— 300 lb.	50 lb.	5 lb.
0— 400 lb.	50 lb.	5 lb.
0— 500 lb.	50 lb.	5 lb.
0— 600 lb.	100 lb.††	10 lb.††
0— 700 lb.	100 lb.	10 lb.
0— 800 lb.	100 lb.	10 lb.
0— 1,000 lb.	100 lb.	10 lb.

†Also available with figures at 5 lb. intervals.
††Also available with 50 and 5 lb. markings.

VACUUM RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 30" Hg. Vac.	5 in.	½ in.

COMPOUND RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
30"—0— 15 lb.	5" & 3 lb.	1" & ¼ lb.
30"—0— 30 lb.	10" & 5 lb.	1" & 1 lb.
30"—0— 60 lb.	10" & 10 lb.	1" & 1 lb.
30"—0—100 lb.	15" & 10 lb.	2" & 1 lb.
30"—0—150 lb.	30" & 25 lb.	2" & 2 lb.
30"—0—200 lb.	30" & 20 lb.	5" & 5 lb.
30"—0—300 lb.	30" & 50 lb.	5" & 5 lb.
30"—0—400 lb.	30" & 50 lb.	5" & 5 lb.
30"—0—600 lb.	30" & 100 lb.	5" & 10 lb.

NOTE: On compound range gauges the zero graduation is not to be used as a calibration reference point.

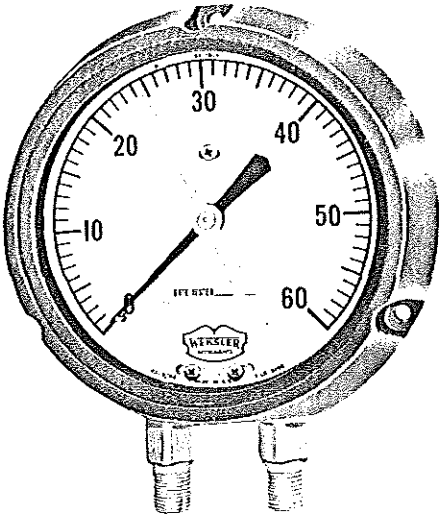
Combination metric dials, in standard ranges up to 70 KG/CM² can be furnished at no additional charge.

WEKSLER INSTRUMENTS

DUPLEX GAUGE
1% ACCURACY

TYPE BB1 Regal GAUGE

BRONZE TUBES STANDARD - OTHER MATERIALS AVAILABLE



DUPLEX GAUGE, TYPE BB1

SERVICE: To indicate two related pressures on the same dial. For use with air, water, steam, or any liquid or gas that will not corrode bronze.

DIAL SIZES: 4½", 6", 8½", 12"

BOURDON TUBES: Seamless phosphor bronze standard. (Can be supplied in alloy steel, beryllium copper, stainless steel, or Monel at extra charge, 4½" and 6" sizes only).

SOCKET & TIP: Forged brass.

JOINTS: Silver brazed and stress relieved.

MOVEMENT: Duplex type. Phosphor bronze sector gear, hairspring and link. Bronze bushed rotary; nickel silver pinion gear and shaft. All other parts are brass.

DIAL: White litho background with black graduations and numerals. Black background with white markings available.

POINTERS: Top pointer is orange; actuated from socket stamped RH (right hand).

Bottom pointer is black; actuated from socket stamped LH (left hand).

CASE TYPES: For Wall, Direct (stem), Semi-Flush, or Flush mounting.

CASE MATERIALS: Phenol, Aluminum, Brass or Iron.

CONNECTIONS: ¼" male N. P. T. only.

CASE SELECTION: See pages 4 and 5 for illustrated descriptions and identifying suffix letters.

DIMENSIONS: See pages 29, 30 and 31.

WEIGHTS: See page 2.

WHEN ORDERING: Specify (1) Gauge Type i.e. AA1, BA1, etc.; (2) Dial Size (by symbol) i.e. 3 = 3½", 4 = 4½", 6 = 6", 8 = 8½" and 9 = 12" dial size. (3) To the resultant 4-digit number, refer to page 4 or 5 and add appropriate "case type" symbol. Example: "Type AA14P" denotes 4½" dial size Royal Gauge in black phenol case.

In addition to Gauge Type Number . . . Specify Range; Connection (size and location); Dial (white, black or special).

PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
0— 30 lb.	5 lb.	½ lb.
0— 60 lb.	10 lb.†	1 lb.
0— 100 lb.	10 lb.	1 lb.
0— 160 lb.	20 lb.	2 lb.
0— 200 lb.	20 lb.	2 lb.
0— 250 lb.	25 lb.	5 lb.
0— 300 lb.	25 lb.	5 lb.
0— 400 lb.	50 lb.	5 lb.
0— 500 lb.	50 lb.	5 lb.
0— 600 lb.	100 lb.††	10 lb.††
0— 700 lb.	100 lb.	10 lb.
0— 800 lb.	100 lb.	10 lb.
0— 1,000 lb.	100 lb.	10 lb.

†Also available with figures at 5 lb. intervals.
††Also available with 50 and 5 lb. markings.
NOTE: For higher ranges, price on application.

COMPOUND RANGES

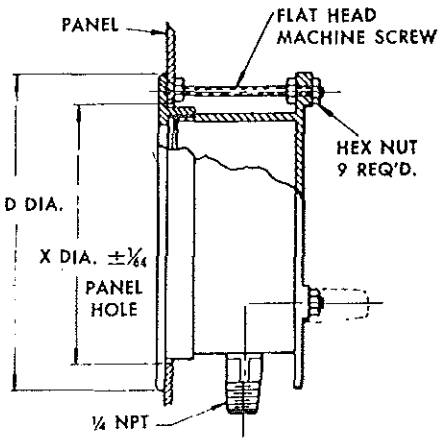
DIAL RANGES	FIGURE INTERVALS	INTERMEDIATE GRADUATIONS
30"—0— 15 lb.	5" & 3 lb.	1" & ½ lb.
30"—0— 30 lb.	10" & 5 lb.	1" & ½ lb.
30"—0— 60 lbs.	10" & 10 lb.	1" & 1 lb.
30"—0—100 lb.	15" & 10 lb.	5" & 1 lb.
30"—0—150 lb.	30" & 25 lb.	5" & 5 lb.
30"—0—200 lb.	30" & 20 lb.	5" & 5 lb.
30"—0—300 lb.	30" & 50 lb.	5" & 5 lb.

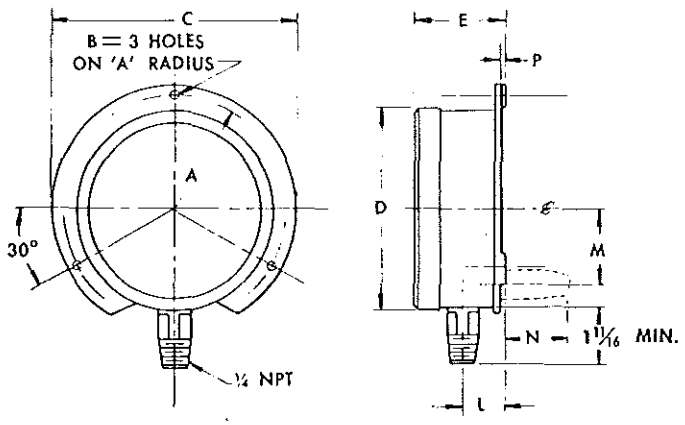
NOTE: On compound range gauges the zero graduation is not to be used as a calibration reference point.

GENERAL DIMENSIONS

FLUSH MOUNTING RING ASSEMBLY

DIAL SIZE	X	D		SCREW SIZE	
		Std.	Safety	Std.	Safety
3½	4	4 29/32	4 15/16	10-32x1¾	10-32x2⅛
4½	5	5 31/32	5 31/32	10-32x2½	10-32x2¾
6	6 9/16	7 25/32	7 ¾	¼-20x2½	¼-20x2¾
8½	8 31/32	10 11/32	10 11/32	¼-20x2½	¼-20x2¾
12	12 19/32	14 ⅜	—	¼-20x3	—



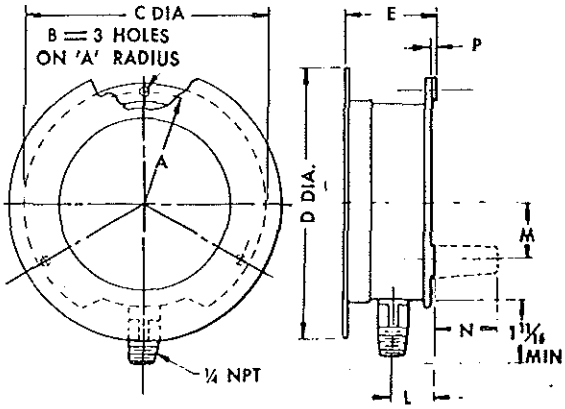


BACK FLANGED CASE

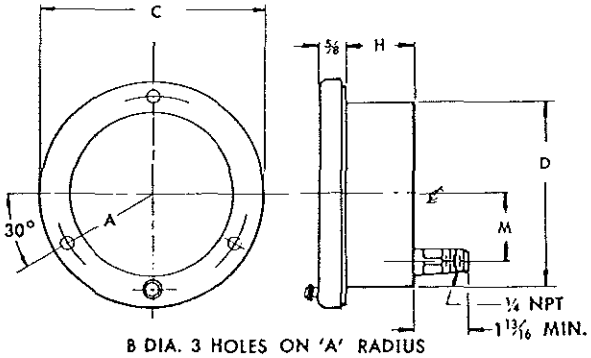
DIAL SIZE	A	B	C	D	E		L		M	N		P	
					Std.	Safety	Std.	Safety		Std.	Safety	Std.	Safety
3½	2⅛	7/32 x ⅜	5	4 3/16	2 1/16	1 31/32	13/16	13/16	1 5/32	1 11/16	1 1/16	⅛	3/16
4½	2 11/16	7/32 x 5/16	5⅞	5	2 5/16	2 ⅝	1 1/32	1 1/32	1 19/32	1 21/32	1 5/16	5/32	5/16
6	3 ½	9/32 x 11/32	7 5/8	6½	2 17/32	2 7/16	1 1/32	1	1 9/16	1 13/16	1 1/16	1/16	3/16
8½	4 13/16	9/32	10 ¼	8 27/32	2 9/32	2 17/32	31/32	1	2⅛	1 13/16	1 1/16	1/16	3/16

FLUSH MOUNTING CASE

DIAL SIZE	A	B	C	D	E		L		M	N		P	
					Std.	Safety	Std.	Safety		Std.	Safety	Std.	Safety
3½	2 7/32	7/32 x ⅜	5	4 29/32	1 7/16	2	13/16	25/32	1 5/32	1 11/16	1 1/16	⅛	3/16
4½	2 23/32	7/32 x 5/16	5 29/32	5 31/32	2 17/32	2 ⅝	1 1/32	1 1/16	1 19/32	1 21/32	15/16	5/32	5/16
6	3 ½	9/32 x 11/32	7 5/8	7 25/32	2 9/16	2 7/16	1 3/32	1	1 9/16	1 13/16	1 1/16	1/16	3/16
8½	4 13/16	9/32	10 ¼	10 11/32	2 5/16	2 19/32	31/32	1	2⅛	1 13/16	1 1/16	1/16	3/16
12	6 ¾	9/32	14 ½	14 ⅜	2 25/32	—	1 ⅛	—	2⅛	1⅛	—	⅛	—



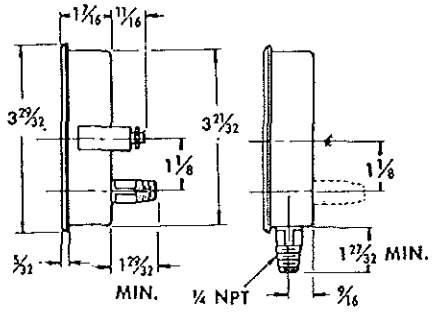
HINGED FRONT CASE



DIAL SIZE	A	B	C	D	H	M	X
4½	2 11/16	7/32	6	4 13/16	1 7/32	1 5/8	4 29/32
6	3½	7/32	7 5/8	6 11/32	1 11/16	2⅛	6 1/16

X—Panel hole cut-out diameter

3½" DRAWN STEEL CASE



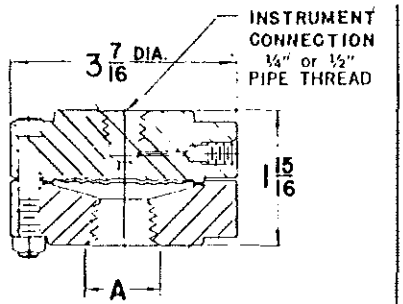
R++

WELDED-DIAPHRAGM TYPE SEALS
FOR UNIVERSAL CONTINUOUS SERVICE

WEKSLER INSTRUMENTS

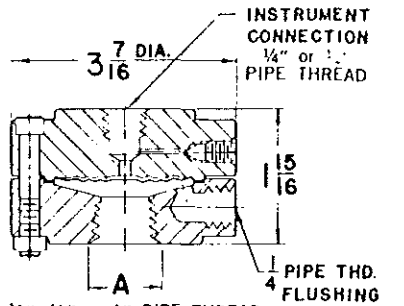
Universal use Welded-Diaphragm Type seals have all of the safety features offered by the Continuous Duty Type. In addition, in the construction of "welded in the top" diaphragm seals special equipment and procedures are used to weld an improved shape diaphragm in the top section. The possibility of leakage problems and the need for gasket clamping (middle) rings are completely eliminated.

All seals listed on this page are Welded-Diaphragm Type and all are classed as Cleanout Type. They are designed for continuous service and can be used universally i.e. on either corrosive gas, corrosive liquids or clogging service. Inventory can be reduced accordingly.



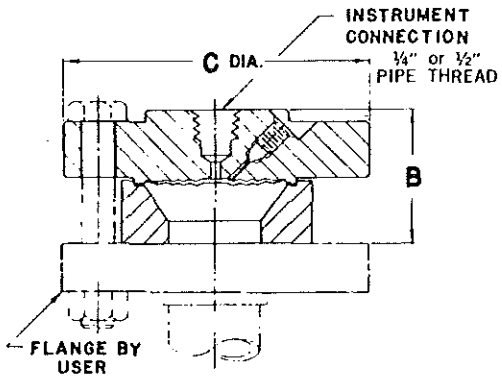
¼", ½" or 1" PIPE THREAD

MODEL D19-2

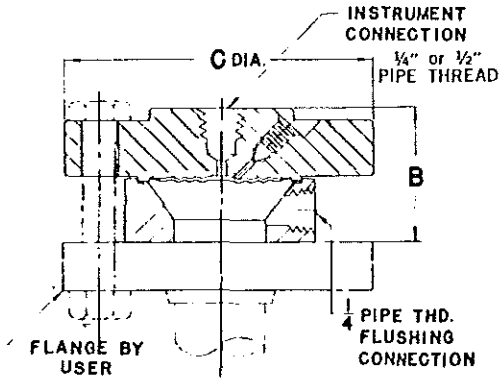


¼", ½" or 1" PIPE THREAD

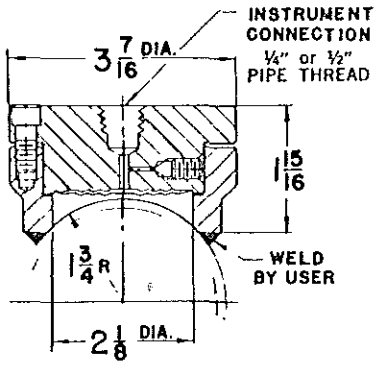
MODEL D19-7



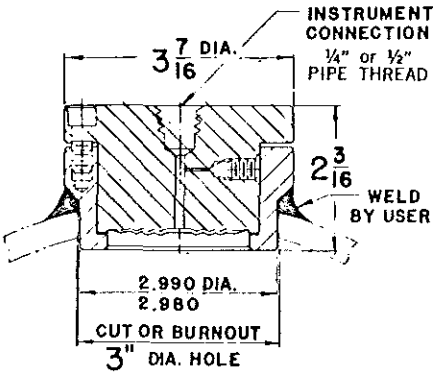
MODEL D19-3
1", 1½", 2" or 3" ASA RF SIZES
150#, 300#, 600# and 1500# RATINGS



MODEL D19-4
1", 1½", 2" or 3" ASA RF SIZES
150#, 300#, 600# and 1500# RATINGS

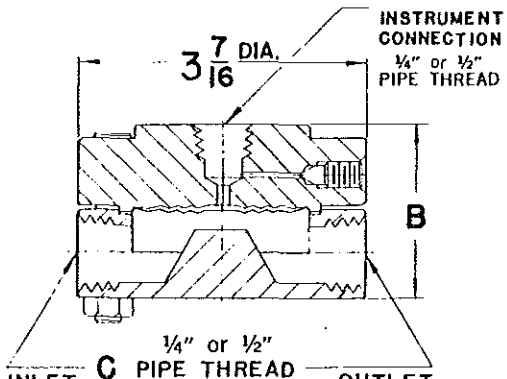


FOR 3" PIPE ONLY

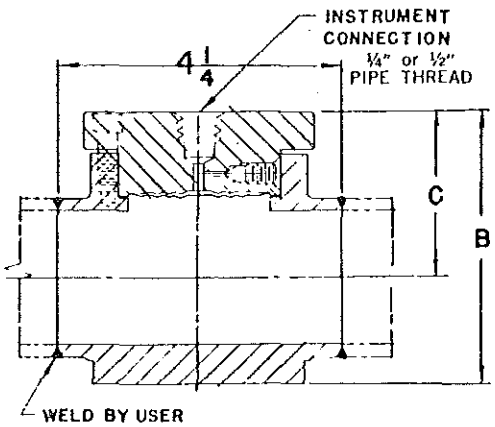


FOR 4" PIPE AND LARGER

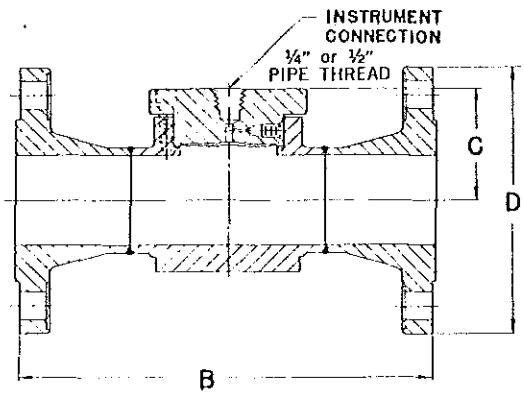
MODEL D19-10
SPECIFY PIPE SIZE



MODEL D19-11



MODEL D19-13
FOR 1", 2" or 3" PIPE, SPECIFY



MODEL D19-14
1", 2" and 3" x 150# FLANGE SIZES, SPECIFY

Printed in U.S.A.

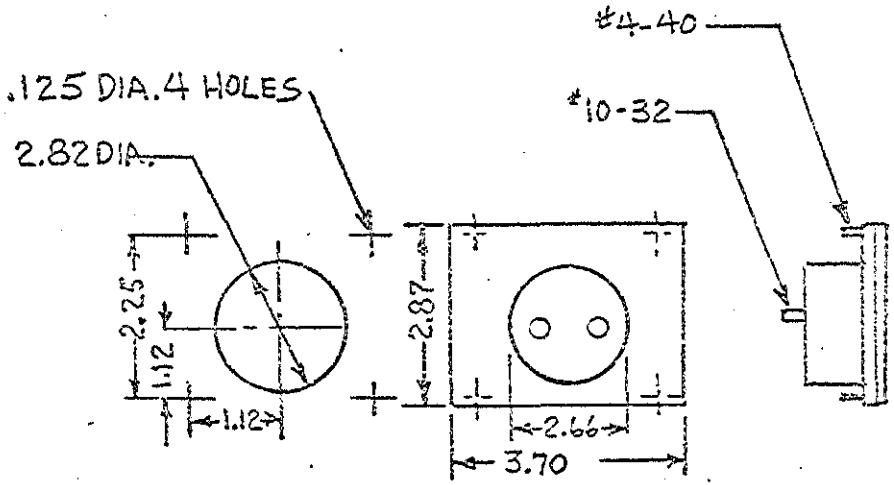
NULLMETER, 100-0-100 MICRO-AMPS.

3 1/2" METER

CAT. NO.: K3-S-NULL-100-M

VENDOR: MODUTEC, INC.
180 MARSHALL ST.
NORWALK, CT. 06854

203/853-3636



SUBSTITUTES PERMITTED WITH ENGINEERING APPROVAL.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
METER,
NULL
100-0-100 μA

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 2498	7/25/78	ASSY. OR LO.	
DR. BY R. Keyes	6/29/78	SCALE	
CHK'D. BY CG	6/30/78	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 909 977 | SHEET 1 OF 1

700000-16040-SHT. 1/4

BF 4422-D

ENGINEERING CHANGE REQUEST AND CHANGE ORDER

50

C.O. 16040

Colt Industries — Fairbanks Morse Engine Division

NUCLEAR

PRODUCT TD 8/8 QR NUC.

ORDER AFFECTED 700000 Limerick

CHARGE NO. NONE

☐ STANDARD

☒ MANDATORY

ENGR. SCHEDULE NO. 8203

GROUP REF. NO.

ITEM NO.	PART NAME	CHANGED FROM				CHANGED TO				SEE CODING BELOW			
		PART NO.	REV. NO.	B/M NO.	REV. NO.	PART NO.	REV. NO.	B/M NO.	NO. REV.	CHANGE AFFECTS	REASON	DISP.	TYPE
A.	ELECTRICAL PARTS REF. LIST	11876902	4	11876902	6	SAME	5	SAME	7	G	E	~~X~~	A
94	RELAY SOCKET	ADD (1)		5	5	11915300		5	5	5	5	5	P

DESCRIPTION OF CHANGE A. REVISED ELECTRICAL PARTS REF. LIST DWG. & B/M TO ADD LINE ITEM 94 11915300 RELAY SOCKET.

RELEASE NEW DWG. 11915300

REASON: CUSTOMER REQUEST. THE COMPANY THAT MADE THE PANELS FOR THIS CONTRACT IS NO LONGER IN BUSINESS - NEW REPLACEMENT PART REQUESTED.

CHANGE AFFECTS
A — Field Repairs
B — Patterns or Temp
C — Foundry Equipment
D — Tools or Fixtures
E — Processing
F — Process Stock
G — Purchased Stock
H — Delivery
J — Sales information
K — Cost
S — Spares

RTC

REASON FOR CHANGE
A — Engineering Request
B — Manufacturing Request
C — Vendor Request
D — Sales Request
E — Customer Request
F — Engrg. Error
G —

DISPOSITION
U — Use As Is
M — Modify
R — Return to Stk
S — Scrap
N — Not Affected
* — See Remarks

TYPE
P — Purch
W — Weldmt
C — Casting
M — Mach'g
A — Ass'y.
D — Detail

REMARKS: DISP. NEXT ORDERED

RECOMMENDED METHOD AND TIME OF EFFECTIVE CHANGE

☐ Advance Information Forwarded to: _____ On Date: _____

☐ Work Stopped — Resume Work per This Change Order

ACTUAL TIME OF ADOPTION					
ITEM	SERIAL	DATE	ITEM	SERIAL	DATE

APPROVED ~~REJECTED~~ AS APPLICABLE

ENGRG. 11-27-89	Q.C.	MFGRG.
MRKTG.	PROC.	

EST. COST $ _____ AND/OR HRS. _____

CHANGE SUGGESTED BY M. SIGNORA

ISSUED DATE 12-1-89

C.O. NO. 16040

WRITTEN BY J. CHERRY

SH 1 OF 1

9. ELECTRICAL COMPONENTS

Part No.	Description
11 900 052	Surge Capacitor
11 901 280	Junction Box Panel
11 905 666	Starter
11 905 699	Control Transformer
11 905 858	Enclosure
11 905 859	Enclosure Panel
11 905 869	Enclosure
11 905 870	Enclosure Panel
11 906 151	Current Transformer
11 906 159	Time Delay Relay
11 906 162	Enclosure
11 906 163	Enclosure Panel
11 906 274	Operator Selector Switch - 3 Position
11 906 279	D.C. Relay
11 906 280	D.C. Relay
11 906 281	Relay Contact Block Kit
11 906 282	Relay Contact Block Kit
11 906 284	Relay Mounting Strip
11 907 134	Control Transformer
11 907 510	Heating Contactor
11 907 513	Non-Reversing Starter
11 907 550	Relay
11 907 560	Time Delay Relay
11 907 561	Time Delay Relay
11 908 304	Time Delay Relay
11 908 396	Terminal Board
11 908 501	Current Transformer
11 908 506	Two Door Enclosure
11 908 508	Power Distribution Connector
11 908 537	Single Door Enclosure
11 908 538	Electronic Speed Switch
11 908 544	Circuit Breaker Panel Board
11 908 545	Terminal Board
11 908 548	Fuse Block
11 908 565	Non-Reversing Starter
11 908 566	Non-Reversing Starter
11 908 567	D. C. Full Voltage Starter
11 908 568	Time Delay Relay
11 908 569	Enclosure
11 908 570	Time Delay Relay
11 908 572	Time Delay Relay
11 908 577	Enclosure
11 908 578	Enclosure Panel

Contact Block

9. ELECTRICAL COMPONENTS (continued)

Part No.	Description
11 908 920	Generator Neutral Grounding Resistor
11 909 224	Fuse Block
11 909 260	Grounding Device
11 909 282	Enclosure
11 909 370	Relay
11 909 979	Junction Box
11 910 435	Overload Heater
11 910 436	Overload Heater
11 910 437	Overload Heater
11 910 928	Rectifier
11 911 141	Power Relay
11 911 187	Fuse - 1 amp
11 911 188	Fuse - 3 amp
11 911 189	Fuse - 10 amp
11 911 190	Fuse - 15 amp
11 911 857	Terminal Board
11 913 068	"SBM" Switch Ammeter Transfer
11 913 069	"SBM" Switch Voltmeter

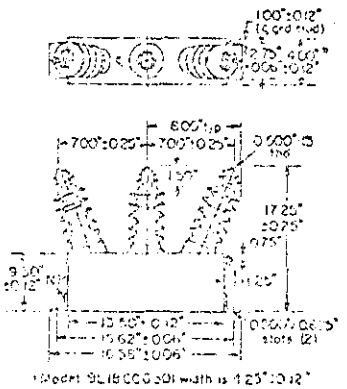
FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified)	±1/64
LAYOUT OR ASSEMBLY NUMBER	

Description: 4160 volt 3 pole, 3 phase. Line and ground terminals have solderless terminals for No. 2 max. stranded cable.
0.5 microfarads per pole.
65 lbs. net weight.

Vendor: General Electric Co.

Piece/Part No.: 9L18AAA301 (CCG)

Drg. No.: Bulletin 5910, Page 2 or Dwg. #18F586



Model 9L18CCG301 width is 1.25"±.12"

CODE IDENT NO. 82788

APPROVED

REV. NO.	DATE	CHANGE ORDER NO.	WAS
6	5/4/61	10301	WAS 9L18CCG301
5	3-3-61	9745	WAS 9L18ACG301
4	2-21-61	AC-449	Accpd Dwg. #18F586
3	5-1-61	AC-405	Replaces & Requisition
3	"	"	Fo. 10F58
3	"	"	Fo. 10F58 K05B8059

RELEASE NUMBER | DATE OF RELEASE

FAIRBANKS, MORSE & CO.
LOCOMOTIVE
ENGINEERING DEPARTMENT

DRAWN BY R.J. Keyes | DATE 4-5-16-61 | SCALE

CHECKED BY R.J. Keyes | DATE 4-16-61

NAME
CAPACITOR - Surge

MATERIAL SPECIFICATION

SHEET SIZE A | DWG. NO. 81 S00052

SUPERSEDES | SUPERSEDED BY

PROTECTIVE CAPACITORS FOR AC ROTATING MACHINES

MODEL 9L18

GENERAL SAFETY INSTRUCTIONS

The objective of these instructions is to help make capacitor users aware of application and handling practices which will aid them in the use of power capacitors. The guides cover good practices in receiving, handling, installation, fusing, field testing and disposal of power capacitor units. The guides do not address themselves to the requirements of national and/or local codes, nor to requirements of insurance underwriters, which may be applicable to any given capacitor application. Compliance with codes and insurance underwriters' requirements demand individual consideration on the part of capacitor users for each particular situation and should not be assumed to have been achieved simply by complying with the suggestions contained in these instructions.

PROTECTION AGAINST SHOCK

Power must be switched off before doing any work on capacitors or equipments. To be certain that the capacitors have been disconnected from the power source, it is necessary to make a visual check for an open-contact disconnect. After being disconnected, the capacitors or equipments should then be shorted and grounded as follows:

Capacitors for shunt or series application on power systems have internal discharge resistors (so indicated on the nameplate) which are designed to reduce the voltage, after the power is switched off, to 50 volts or less in ten minutes if an underground or submersible type, in five minutes for all others rated over 600 volts, and in one minute for all others rated 600 volts or less. After the indicated time, the capacitor or equipment should be shorted and grounded by utilizing an insulated grounding stick or equivalent and then the capacitor terminals should be connected together and to the case and grounded before handling.

Other types of capacitor units such as d-c energy storage, d-c filter and pulse forming applications, and certain types of induction heating capacitor units do not have internal resistors. With these types of units, the disconnecting, shorting and grounding procedures indicated above must be followed and should be accomplished by utilizing an external discharge resistor of at least the resistance in ohms equal to the maximum charge voltage that may have been on the capacitor. The shorting connection between terminals should be left on until the unit is reconnected in the circuit.

EXPLOSION HAZARD

The correct application of capacitor fuses will greatly minimize the possibility of case rupture; but since considerable stored energy may be available upon the occurrence of a fault inside a capacitor, it is possible to get explosive case rupture in any application, even with proper fusing. For three-phase capacitors fused only on two terminals, or single-phase two-bushing units fused on only one terminal, and applied on delta or ungrounded wye systems, an internal ground fault from the unfused phase to case might result in case rupture. These remote possibilities must be considered when locating the capacitors or equipments.

If capacitors or equipments are not supplied with fuses, follow the fusing guides recommended in NEMA Standard CP-1; ANSI Standard C-55.1; the General Electric Handbook Section 6212; or refer to the nearest General Electric Sales Office.

HANDLING OF FAILED CAPACITORS

Some failed capacitors may be found considerably bulged due to internal pressure from gassing prior to circuit clearing. Such units should be handled very carefully. A failed capacitor should be shorted with suitable insulated shorting sticks, to discharge any residual charge. It is further recommended that a bulged capacitor be permitted to cool before handling. This will lower the internal pressure, reducing the possibility of case rupture with leakage of gasses and liquid during subsequent handling.

In handling capacitors which have liquid leaking out, avoid contact with the skin, and prevent entry into sensitive areas such as the eyes. Close-fitting protective goggles should be worn when handling units which are leaking or might suddenly squirt impregnant while being handled. Contact with the

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

skin is taken care of by simply washing off thoroughly with soap and water as soon as possible. However, the eyes can be quite irritated by some impregnants, so they should be flushed with large amounts of water as soon as possible and then examined by a physician.

COMBUSTIBLE IMPREGNANT FIRE HAZARD

Units contain a Class IIIB combustible liquid which could possibly ignite if there is a case puncture or rupture in the presence of an electrical arc. Capacitors containing these materials should be suitably protected from mechanical damage and located where a possible fire could be contained and would result in minimum damage and hazard to the surrounding environment.

DISPOSAL OF CAPACITORS OR IMPREGNANT

The dielectric liquid has been formulated to be environmentally compatible. Good practice demands that the liquid be handled in a manner appropriate for the handling of hazardous chemical liquids, and that loss of the liquid into the environment should be avoided or minimized. The preferred method of liquid disposal is by incineration. If feasible, the solid portion of the capacitor, the roll pack, should also be incinerated and the capacitor case should be disposed of in a waste disposal site approved for hazardous industrial waste.

An alternate method of disposal to be considered is the incineration of the liquid and the disposal of the solid remainder, consisting of the roll pack and the capacitor case, in a waste disposal site approved for hazardous industrial waste.

Disposal of the whole capacitor, including the liquid in a site approved for hazardous industrial waste is a third method which may be considered for the disposal of the power capacitors.

APPLICATION

The General Electric protective capacitor is designed to operate in conjunction with lightning arresters to provide surge protection for a-c rotating machines. It does this by reducing the steepness of the wave front of the voltage surge, thereby reducing the stress on the turn and line-to-ground insulation. The unit consists of a *Dielektrol impregnated capacitor and associated discharge resistor, enclosed in a metal case suitable for indoor or outdoor service. The voltage, capacitance, number of poles, and frequency are shown on the nameplate.

Capacitors for application on circuits having maximum line-to-line voltage up 13800 volts may be either three-phase or single-phase units. Those for application on circuits having maximum line-to-line voltage greater than 13800 volts are single-phase units. The most common connections for these capacitors are shown in Figs. 1 and 2. For applications not shown, contact the nearest General Electric Sales Office.

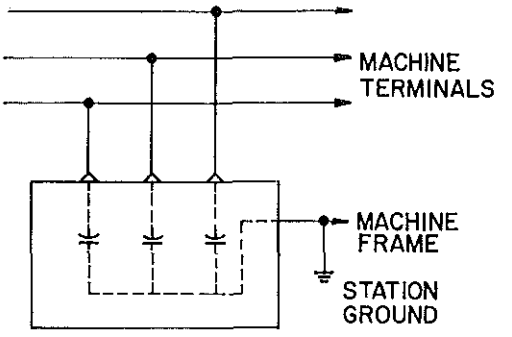


Fig. 1. Three-phase circuit, grounded or ungrounded neutral. Connect each capacitor line terminal separately to each line conductor. Capacitor ground terminal should be connected to station ground and machine frame.

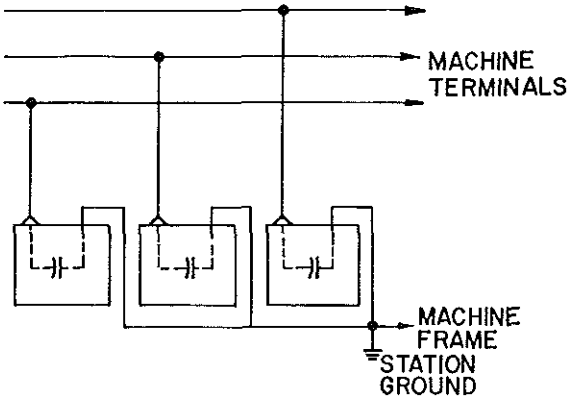


Fig. 2. Three-phase circuit, grounded or ungrounded neutral using single-phase units. Connect line terminal of capacitor to line conductor so that one capacitor is connected to each phase conductor. Each of the capacitor ground terminals should be connected to station ground and machine frame.

RECEIVING

Check the capacitor when received to make sure that no damage occurred during shipment. Minor damage such as small dents will not harm the unit's performance, but units with large dents, leaks, or broken bushings should not be installed. See the

section on "Maintenance" for the method of handling units with leaks. In case of major damage, file a claim against the carrier and also notify the nearest Sales Office of the General Electric Company for instructions regarding the disposition of the capacitor.

The nameplate should be checked to make certain that the rated circuit voltage and frequency on which the capacitor is to be applied do not exceed the capacitor rating. According to NEMA Standard CP-1 the recommended maximum continuous-working voltage to be applied to the capacitor shall be 110 percent of the nameplate rating. The peak continuous working voltage, including all harmonics, shall be 1.1 x $\sqrt{2}$ x the nameplate voltage rating. Any lower voltage is permissible.

INSTALLATION

Capacitors may be installed indoors or outdoors. The capacitor should be located as close as possible to the machine to be protected. Connections are to be made from line-to-ground (See Figs. 1 and 2) with the line connection being made on the load side of the breaker, so that in the event of a capacitor failure a bus short-circuit would not result. To obtain the maximum effectiveness from the capacitor in limiting impulse voltages, it is imperative that a low-resistance and low-inductance ground connection be made. The size of the conductor used to ground the capacitor should be at least equivalent to No. 6 AWG. The capacitor ground should be connected to the metal mounting racks or hold-down clamps, the frame of the machine to be protected, the common station ground, the lightning arrester ground, and to the overhead ground wire if used.

Fuses in series with protective capacitors are not recommended, but if such devices are preferred by the purchaser those of the non-inductive type having a resistance of not more than 0.1 ohm and ample short-circuit interrupting capacity should be used. The fuse should have a rating of not less than twenty amperes.

The connectors are plated to keep corrosion to a minimum. However, when aluminum conductors are used, especially in a salt or corrosive atmosphere, the slow galvanic action caused by the contact of different metals can be avoided if an oxidation preventative such as Penotrox A (Burndy Co.) or No-ox-id (Dearborn Chemical Co.) is used to coat the aluminum conductor at the point of connection.

*Registered Trademark of General Electric Co.

When tightening the terminal nut, it is necessary only to flatten the Belleville washers. This provides visual indication of sufficient tightening and results in follow-up pressure on the conductors of approximately 1000 pounds. Tightening to more than 25 foot-pounds is not required or recommended.

TEMPERATURE LIMITATIONS

These capacitors are designed to operate satisfactorily in an ambient temperature of 55 C (131 F) maximum under normal conditions of non-restricted ventilation, provided they are installed on solidly grounded neutral circuits or on non-grounded circuits which have positive provision for tripping on ground faults of one hour duration or less. The maximum allowable ambient temperature for installation on non-grounded circuits which may be subject to grounding of one line for periods in excess of one hour is 40 C (+104F). Capacitors should not be installed adjacent to any hot radiating surfaces or bodies, unless the ambient temperature is reduced.

Capacitors may operate continuously at any low temperature. However, if the internal temperature of an unenergized capacitor drops to less than -40°C (-40°F), the unit should not be energized. The unit then must be brought to at least -14°C (7°F) before it may be energized without possibility of damage. For this reason, if extremely low temperatures are anticipated, it is advisable to switch capacitors onto the line to keep their internal temperature above the critical point.

TESTING

Field tests may be made to evaluate the operating conditions of the capacitor. Such tests are warranted only if trouble is indicated or if the unit has been damaged. Evidence of open or internal short circuits as well as the approximate capacity of a protective capacitor may be determined by measuring the current taken when voltage is applied between each pole and ground terminal. The equipment required in making this test includes: (a) a source of rated voltage and frequency having good waveform and with sufficient current available for the capacitor being tested; (b) a suitable switching device, fuse or circuit breaker; and (c) an ammeter provided with short-circuiting switch. A short-circuited capacitor will be indicated by an immediate blowing of a fuse or operation of the protective device when the circuit is closed. An open-circuited capacitor will be indicated by a zero reading on the ammeter with its short-circuiting switch open. A normal current reading will indicate that the capacitor is in satisfactory condition. Allowances should be

made for capacitance tolerances of minus zero, plus twenty percent in calculating the normal current. The effect of the discharge resistors may be neglected.

Data on abnormally high or low currents and other irregularities, as determined by the above tests, should be referred to the nearest Sales Office of the General Electric Company for specific recommendations.

When insulation resistance tests are made on apparatus protected by capacitors, the capacitors should be disconnected from the circuit. This will assure that the resistance values being measured will not be influenced by the discharge resistors provided in the protective capacitors.

MAINTENANCE

Under normal service conditions, once a capacitor is installed no further maintenance is required during the life of the unit. Repainting of the units may be desired for appearance, and periodic cleaning of the bushings may be necessary in contaminated atmospheres to prevent arc-over.

Capacitors may be inspected periodically to see that they are operating. If indicating protective devices are not used, the capacitor can be checked most easily by de-energizing (reference Protection Against Shock) and immediately feeling the case side. An operating unit will be warm.

If a leak occurs in the capacitor, the hole should be sealed with solder, using alcohol-rosin flux. When this is impossible or if a bushing is broken, or if a large quantity of liquid impregnant is lost, cover the hole to prevent the entrance of dirt and further loss of liquid. The possibility of factory repair is dependent upon the extent of the damage; therefore, contact the nearest GE Sales Office for recommendations regarding disposition.

Units with large dents may be checked for operation as described under "Testing". If such testing is impossible or if results are unsatisfactory, contact the nearest GE Sales Office regarding the possibility of factory test and repair.

WARRANTY

The following basic information must be provided with respect to warranty claims:

Serial number, date in service, date failed, type of installation (i.e. pole type, stack rack), fixed or switched, conditions at the time of failure. Do not scrap an in-warranty capacitor unless authorized by manufacturer.

GENERAL ELECTRIC COMPANY
CAPACITOR PRODUCTS DEPARTMENT
HUDSON FALLS, NEW YORK 12839

GENERAL ELECTRIC

7-79 (2500)

11 901 280

Description: Panel for mounting in Hoffman 1008LP wiring box.

Vendor: Hoffman Engineering Corporation
Anoka, Minnesota

Piece/Part No.: 10P8

Drg. No.: Bulletin 117-457

FRACTIONAL MACHINING TOLERANCES (Unless Otherwise Specified) ±1/64

LAYOUT OR ASSEMBLY NUMBER

REV. NO.	DATE	CHANGE ORDER NO.	WAS

RELEASE NUMBER AQ-37 DATE OF RELEASE 3-31-60

FAIRBANKS, MORSE & CO.
LOCOMOTIVE
ENGINEERING DEPARTMENT

DRAWN BY R. J. Keyes DATE 3-30-60 SCALE

CHECKED BY R. J. Keyes DATE 3-30-60

NAME

PANEL (Box, Junction)

MATERIAL SPECIFICATION

APPROVED PZ

SHEET SIZE A DWG. NO. 11 901 280

SUPERSEDES

SUPERSEDED BY

11 905 666

DESCRIPTION: HEAVY-DUTY OILTIGHT DOUBLE CIRCUIT CONTACT BLOCK FOR PANEL MOUNTING 2 N.O. & 2 N.C. CONTACTS. ONE HOLE MOUNTING. USE WITH PUSH BUTTON OR SELECTOR-SWITCH OPERATOR.

VENDOR PART NO.: CR2940 U203

VENDOR DWG. NO.: BULLETIN NO. GEA-8112A, PAGE 24

VENDOR: GENERAL ELECTRIC.
GENERAL PURPOSE CONTROL DEPAPTMENT
BLOOMINGTON, ILLINOIS

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
CONTACT BLOCK

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 285700 (W)	1/ 7/70	ASSY. OR LO.	11865 831
DR. BY G.C.B.	11/18/69	SCALE	
CHK'D. BY J.T.C.	12/29/69	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE	DWG. NO.	SHEET OF
A	11 905 666	

11905699

DESCRIPTION: Control transformer, single phase, with fuseholder.

230/460 volts to 115 volts, 60 HZ.

100 volt-amperes.

VENDOR'S PC NO.: 1F0906 with S# 257A574G01 fuseholder.

VENDOR'S DWG NO.:

VENDOR: Westinghouse Electric Corp.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: TRANSFORMER CONTROL

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 295700(Q)	12/15/69	ASSY. OR LO.	
DR. BY R. REYES	12/10/69	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11905699 | SHEET 1 OF 1

11 905 699

Westinghouse Electric Corporation
Dry Type Distribution Transformer Division
Greenville, Pa. 16125

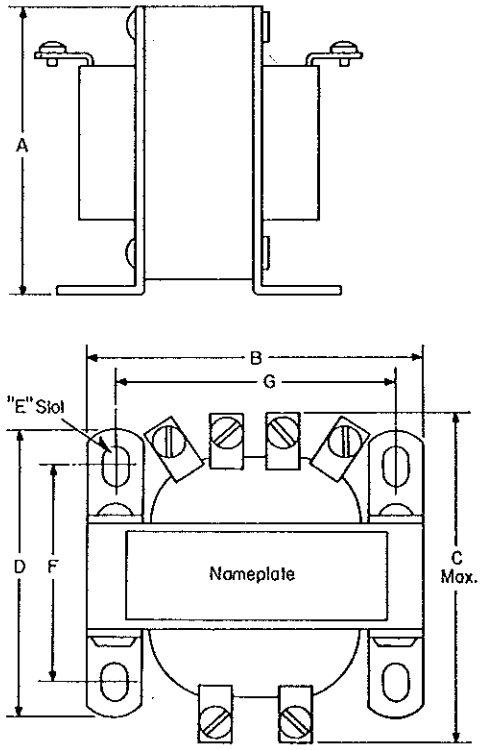
November, 1977
Supersedes 46-870 T WE A,
Page 1, Dated June, 1975

Mailed To: E, D/2071/2072/2079/DB, DS

Type MTA, MTC, Machine Tool

Control Transformers

Dimensions in Inches (Approximate)



Frame No.	Dimensions A	B	C Max.	D	E	F	G
1310	2 1/32	3	3 1/8	2 1/16	13/64 x 21/64	2	2 1/8
1312	2 1/32	3	3 1/8	2 13/16	13/64 x 21/64	2 1/4	2 1/8
1314	2 1/32	3	3 1/8	3 1/16	13/64 x 21/64	2 1/8	2 1/8
1412	2 1/8	3 3/8	4	2 1/8	13/64 x 21/64	2 1/16	2 13/16
1413	2 1/8	3 3/8	4	2 13/16	13/64 x 21/64	2 1/8	2 13/16
1510	3 1/16	3 1/8	3 1/8	2 1/16	13/64 x 21/64	2	3 1/8
1512	3 1/16	3 1/8	4	2 13/16	13/64 x 21/64	2 1/4	3 1/8
1513	3 1/16	3 1/8	4 1/8	3	13/64 x 21/64	2 1/16	3 1/8
1516	3 1/16	3 1/8	4 1/8	3 1/16	13/64 x 21/64	2 1/8	3 1/8
1517	3 1/16	3 1/8	4 1/8	3 1/16	13/64 x 21/64	2 1/8	3 1/8
1520	3 1/16	3 1/8	4 1/8	3 1/16	13/64 x 21/64	3	3 1/8
1714	3 13/16	4 1/2	4 1/2	3 1/16	13/64 x 21/64	2 1/2	3 1/8
1717	3 13/16	4 1/2	5	3 1/16	13/64 x 21/64	2 1/8	3 1/8
1721	3 13/16	4 1/2	5	3 1/8	13/64 x 21/64	3 1/16	3 1/8
1722	3 13/16	4 1/2	5 1/8	3 13/16	13/64 x 21/64	3 1/4	3 1/8
1723	3 13/16	4 1/2	5 1/2	3 15/16	13/64 x 21/64	3 1/8	3 1/8
1724	3 13/16	4 1/2	5 1/8	4 1/8	13/64 x 21/64	3 1/16	3 1/8
1726	3 13/16	4 1/2	6	4 1/16	13/64 x 21/64	3 1/8	3 1/8
1727	3 13/16	4 1/2	6	4 1/16	13/64 x 21/64	3 1/8	3 1/8
1730	3 13/16	4 1/2	6	4 1/8	13/64 x 21/64	4 1/16	3 1/8
1923	4 1/8	5 1/8	5 1/8	4 1/4	9/32 x 13/32	3 1/2	4 1/8
1930	4 1/8	5 1/4	6 1/4	5 1/4	5/16 x 11/16	4 1/4	4 1/8
1931	4 1/8	5 1/4	6 1/8	5 1/8	5/16 x 11/16	4 1/4	4 1/8
1932	4 1/8	5 1/4	6 1/4	5 1/2	5/16 x 11/16	4 3/8	4 1/8
1943	4 1/8	5 1/4	7 1/8	7	5/16 x 11/16	5 1/8	4 1/8
2236	5 1/16	6 1/8	7 1/2	6 1/16	5/16 x 11/16	5	5 1/16
C-613	5 1/4	6 1/8	6 3/4	5 3/4	5/16 x 5/16	4 3/4	5 1/4
C-614	6	6 1/8	7 1/2	6	5/16 x 5/16	5	6
C-822	6 1/8	6 1/8	8 3/8	7 1/2	7/16 x 3/8	6 1/8	5 1/4
C-823	6	6 1/8	8 1/2	8 1/8	7/16 x 3/8	7 1/4	5 1/4
C-824	7 1/8	8 7/16	8 3/4	7 1/2	7/16 x 3/8	6	7 1/8
C-825	7 1/8	8 11/16	11	9	7/16 x 3/8	7 1/2	7 1/2
C-827	5 1/8	6 1/8	8 1/2	7	7/16 x 3/8	6	6
C-828	6 1/2	8 3/16	8 3/4	7	7/16 x 3/8	6	7
C-829	7 1/8	8 11/16	10 1/4	8 1/2	7/16 x 3/8	7	8

Customer _____ Location _____ P.O. # _____

Distributor _____ Job _____ P.O. # _____

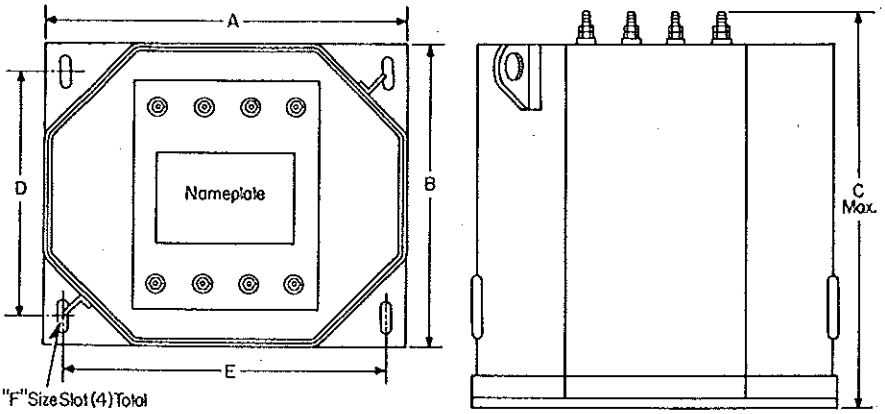
Apparatus Style _____ Diagram from TCS 46-871, Page _____ Diagram _____ Frame _____

Certified By _____ Date _____ Item # _____ Quantity _____ G.O. _____

Special Notes _____

Approval ☐
Reference ☐
Installation ☐

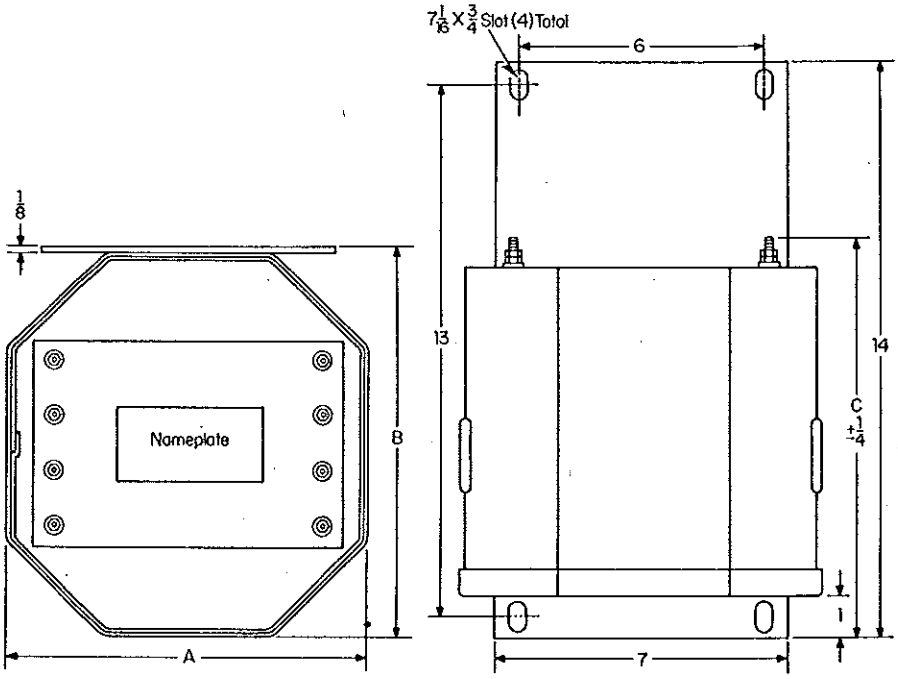
Dimensions in Inches



Bottom Mount (Figure No. 1)

Approx. Dimension (Figure No. 1)

Frame No.	KVA	A	B	C Max.	D	E	F
133	3	$7^{17}/_{32}$	$7^{17}/_{32}$	$8^{5}/_{16}$	6½	6½	$^{9}/_{32}$ x $^{17}/_{32}$
99	5	$9^{13}/_{32}$	$8^{25}/_{32}$	$9^{3}/_{16}$	7	8	$^{7}/_{16}$ x ¾
100	7½	$12^{1}/_{32}$	$10^{13}/_{32}$	9⅜	8½	10½	$^{7}/_{16}$ x ¾
101	10	$12^{1}/_{32}$	$10^{13}/_{32}$	11¼	8½	10½	$^{7}/_{16}$ x ¾
134	15	$11^{9}/_{32}$	$11^{9}/_{32}$	12½	9½	10	$^{7}/_{16}$ x ¾



Side/Wall Mount (Figure No. 2)

Approx. Dimension (Figure No. 2)

Frame No.	KVA	A	B	C
283	3	7½	7⅝	8⅞
256	5	8¾	$9^{9}/_{16}$	9¾
257	7½	8⅝	10¾	11⅝
258	10	10⅛	10¾	11⅝
259	15	$10^{7}/_{16}$	$12^{3}/_{16}$	12⅜

Customer _____ Location _____ P.O. # _____

Distributor _____ Job _____ P.O. # _____

Apparatus Style _____ Diagram from TCS 46-871, Page _____ Diagram _____ Frame _____

Certified By _____ Date _____ Item # _____ Quantity _____ G.O. _____

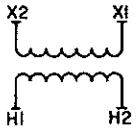
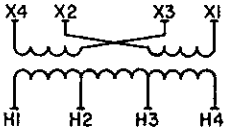
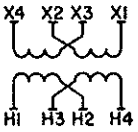
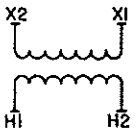
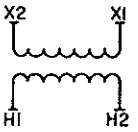
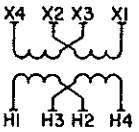
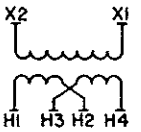
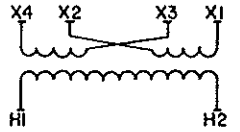
Special Notes _____

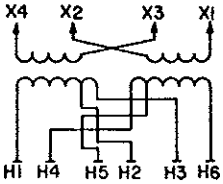
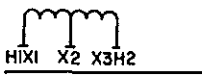
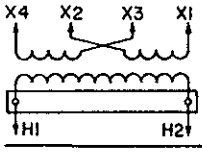
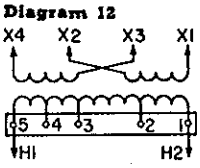
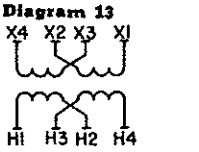
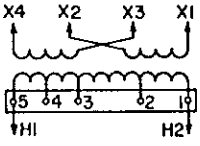
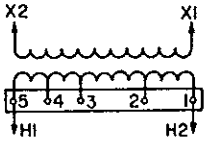
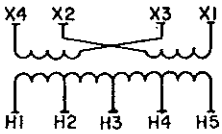
Approval ☐
Reference ☐
Installation ☐

Westinghouse Electric Corporation
Dry Type Distribution Transformer Division
Greenville, Pa. 16125

specialty transformers
dry type general purpose • 5000 volts and below

single phase: 050 kva through 25 kva
three phase: 3 kva through 30 kva

	volts	connections	line
Diagram 1 	600 120		H1-H2 X1-X2
Diagram 2 	600 570 540 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H4 H2-H4 H2-H3 X1-X4 X1-X3-X4 X1-X4
Diagram 3 	480 240 240 240/120① 120	H2 H3 H1 H3, H2 H4 X2 X3 X2 X3 X1 X3, X2 X4	H1-H4 H1-H4 X1-X4 X1-X3-X4 X1-X4
Diagram 4 	480 120		H1-H2 X1-X2
Diagram 5 	240 120		H1-H2 X1-X2
Diagram 6 	240 120 240 240/120① 120	H2 H3 H1 H3, H2 H4 X2 X3 X2 X3 X1 X3, X2 X4	H1-H4 H1-H4 X1-X4 X1-X3-X4 X1-X4
Diagram 7 	240 120 32	H2 H3 H1 H3, H2 H4	H1-H4 H1-H4 X1-X2
Diagram 8 	600 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H2 X1-X4 X1-X3-X4 X1-X4

	volts	connections	line
Diagram 9 	480 456 432 240 216 240 240/120① 120	H3 H4 H3 H5 H2 H5 H1 H4, H3 H6 H1 H5, H2 H6 X2 X3 X2 X3 X1 X3, X2 X4	H1-H6 H1-H6 H1-H6 H1-H6 H1-H6 X1-X4 X1-X3-X4 X1-X4
Diagram 10 	240 240/120①		H1-H2 X1-X2-X3
Diagram 11 	4160 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H2 X1-X4 X1-X3-X4 X1-X4
Diagram 12 	2400 2340 2280 2220 2160 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	1-5 1-4 2-5 2-4 2-3 X1-X4 X1-X3-X4 X1-X4
Diagram 13 	240 120 24 12	H2 H3 H1 H3, H2 H4 X2 X3 X1 X3, X2 X4	H1-H4 H1-H4 X1-X4 X1-X4
Diagram 14 	4365 4260 4160 4055 3950 480 480/240① 240	 X2 X3 X2 X3 X1 X3, X2 X4	1-5 1-4 2-5 2-4 2-3 X1-X4 X1-X3-X4 X1-X4
Diagram 15 	2520 2460 2400 2340 2280 600	 	1-5 1-4 2-5 2-4 2-3 X1-X2
Diagram 16 	504 492 480 468 456 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H5 H1-H4 H1-H3 H2-H4 H2-H3 X1-X4 X1-X3-X4 X1-X4

① three wire operation

customer..... address..... g. o.....

p. o. number..... item..... dimensions from 46-870 page..... frame.....

job..... diagram..... diagram no. [ ]

apparatus.....

approval ☐
reference ☐
construction or installation ☐
other ☐

.....certified..... date.....

October, 1964
new information
mailed to: E/1155, 1156/DB; D/825, 828/DB

Westinghouse Electric Corporation
Specialty Transformer Div. • Greenville plant • Greenville, Pa.
printed in U.S.A.

11905 858

DESCRIPTION: ENCLOSURE 16 HIGH, 20 WIDE & 6 DEEP — SINGLE DOOR WALL MOUNTED — NEMA 12.

VENDORS PC. NO. A-16 20 06 LP

VENDORS DWG. BULLETIN A-12 PAGE 3

VENDOR: HOFFMAN ENGINEERING CO.
ANOKA, MINN. 55303

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
ENCLOSURE
16H-20W-6D

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries
Fairbanks Morse Power Systems Division

REL. NO. 205637(N)	6/22/70	ASSY. OR LO.
DR. BY GRANZOW	6/11/70	SCALE
CHK'D. BY	/ /	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11905 858 | SHEET 1 OF 1

11905 859

DESCRIPTION: PANEL 13H x 17 W FOR SINGLE DOOR NEMA 12 ENCLOSURE 16H x 20 WIDE.

VENDORS PC. NO. A-20P16

VENDORS DWG. BULLETIN A-12 PAGE 3

VENDOR: HOFFMAN ENGINEERING CO.
ANOKO, MINN. 55303

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
PANEL
13H 17 W

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries
Fairbanks Morse
Power Systems Division

REL NO. 205637(N)	6/22/70	ASSY. OR LO.	
DR. BY GRANZOW	6/11/70	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 905 859 | SHEET 1 OF 1

11905 868

DESCRIPTION: ENCLOSURE NEMA TYPE 12 — REGULAR
SINGLE DOOR — 16H\12W\6D

VENDORS DWG. BULLA-12 PAGE 3

VENDORS PC. NO. A-161206LP

VENDOR: HOFFMAN ENG. CO.
ANOKA, MINN. 55303

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
ENCLOSURE
16H-12W-6D

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205637(Q)	6/26/70	ASSY. OR LO.	
DR. BY GRANZOW	6/24/70	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11905869 | SHEET 1 OF 1

SF3000-2

1190870

DESCRIPTION: PANEL 13 x 9 — FOR NEMA TYPE 12
ENCLOSURE 16 x 12

VENDORS DWG. BULL. A-12 PAGE 3

VENDORS PC. NO. A-16P12

VENDOR: HOFFMAN ENG. CO.
ANOKA, MINN. 55303

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: PANEL 13 x 9

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205637(Q) 6/26/12		ASSY. OR I.O.
DR. BY GKANE 6/26/12		SCALE
CHK'D. BY	/ /	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190870 | SHEET 1 OF 1

1190615

DESCRIPTION: TRANSFORMER, INDOOR CURRENT — TYPE JKM-3, 5000 VOLTS — WOUND TYPE — FULL WAVE IMPULSE LEVEL 60 KV. — RATIO 800 AMP. PRIMARY, 5 AMP. SECONDARY.

VENDORS DWG. CAT. SEC. 7980 PAGES 28, 185 & 187

VENDOR PC. NO. 497 X 35

VENDOR: GENERAL ELEC. CO.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: TRANSFORMER CURRENT

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002,
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .000 0.0 - ± .070 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205781(H)	4/15/71	ASSY. OR LO.	
DR. BY GRANROW	7/3/51	SCALE	
CHK'D. BY R.K	4/12/71	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A — DWG. NO. 1190615

GEH-230AE
Supersedes GEH-230AD

INSTRUCTIONS

INSTRUMENT TRANSFORMERS

BUTYL-MOLDED AND OTHER DRY TYPES

600-VOLT THROUGH 15-KV RATINGS

INTRODUCTION

These instructions apply to indoor and outdoor instrument transformers of butyl-molded and other dry-type constructions. For information on the installation and care of transformers with unusual ratings of frequency, voltage or current, or on installations where unusual conditions exist (refer to Requirements for Instrument Transformers, ANSI C57. 13-1968, Section 3), consult the nearest sales office of the General Electric Company. When special information is requested, give the complete nameplate data in order to identify the transformer.

BEFORE INSTALLATION

INSPECTION

Before installation, transformers should be inspected for physical damage that may have occurred during shipment or handling. During shipping, transformers usually are supported only by the base or mounting supports, except that certain butyl-molded types may be shipped from the factory supported by butyl surfaces. Transformers should be dry and the surface of the bushings should be clean. All butyl surfaces should be considered the same as the surface of a porcelain bushing in regard to cleanliness and dryness.

DRYING OUT

Transformers that have been submerged in water should be dried out before installation. Wet asphalt-impregnated or varnish-impregnated transformers may be dried by self-heating. To do this, allow the transformer to stand not less than twelve hours in a room of constant temperature. Measure and record the room temperature and resistance of the secondary winding. Short-circuit the primary winding and apply a controllable voltage to the secondary winding. Adjust the voltage so that sufficient current will flow in the winding to raise its temperature to approximately 80 C. The rate of temperature rise should not exceed 6 C per half hour. The winding temperature should be held at approximately 80 C until the transformer is dry. It will usually require 24 to 48 hours to dry a transformer.

The amount of current necessary to obtain a winding temperature of 80 C varies because of the differences in heat dissipation and current densities in the different types of transformers. It is advisable to start with a current not greater than two amperes in the secondary of a potential transformer, or not greater than five amperes in the secondary of a current transformer. Gradually increase this current until the proper heating is obtained. Increases of current should be made cautiously with frequent checking of the rise in temperature of the winding.

The temperature of the winding may be determined conveniently by the "resistance change" method. Since the resistance of a copper winding increases approximately 1 percent for each 2-1/2 C, the temperature rise may be calculated by measuring the "before" and "after" resistances and finding the percentage increase in resistance. For example, if the "after" resistance is 0.244 ohm and the resistance at the start (room) temperature is 0.200 ohm, the percentage increase is

$$\frac{0.244-0.200}{0.200} = 0.022 = 22\%$$

which corresponds to a temperature rise of 22 x 2-1/2 = 55 C (approximately). The approximate winding temperature at any time is the temperature rise at that time added to the ambient (room) temperature.

Butyl-molded Transformers

Butyl-molded transformers, particularly designs for outdoor use, are relatively impervious to moisture. If, due to unusual circumstances, insulation tests indicate the possibility of the entrance of moisture into a butyl-molded transformer, refer to the nearest General Electric Sales Office for detailed information on proper procedure.

TESTING

If it is desired to make insulation tests after the drying out period, or at any other time, these tests may be made in accordance with Requirements for Instrument Transformers, ANSI C57. 13-1968. (Note: Periodic field tests of insulation should not exceed 65 percent of the ANSI test voltage. Incoming tests of new equipment should not exceed 75 percent of the ANSI test voltage.)

Convenient methods for testing polarity are given in ANSI C57. 13, the Electrical Metermen's Handbook (published by Edison Electric Institute), and General Electric publication GET-97.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. The equipment covered by these operating instructions should be operated and serviced only by competent technicians familiar with good safety practices, and these instructions are written for such personnel and are not intended as a substitute for adequate training and experience in safe procedures for this type of equipment. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

For ratio and phase angle tests, refer to Electrical Metermen's Handbook and General Electric publications GET-97 and GET-1725.

Certificates

A certificate of test is supplied with many types of butyl-molded potential and current transformers. The certificate is in the form of a tag attached to each transformer. The tag shows the ANSI burden at which the transformer has been tested, and the actual test results of ratio correction factor and phase angle. The tag is perforated and can be detached as a 3- by 5-inch card for filing.

INSTALLATION

SAFETY PRECAUTIONS

Always consider an instrument transformer as a part of the circuit to which it is connected, and do not touch the leads and terminals or other parts of the transformer unless they are known to be adequately grounded.

The butyl surface of transformers should be considered the same as the surface of a porcelain bushing, since a voltage stress exists across the entire butyl surface from terminals to grounded metal parts.

Do not open the secondary circuit of a current transformer while the transformer is energized and do not energize while the secondary circuit is open. This precaution is advisable since current transformers may develop open-circuit secondary voltages which may be hazardous to personnel or injurious to the transformer or equipment connected in the secondary circuit.

Always ground the metallic cases and frames of instrument transformers. The secondaries should be grounded close to the transformers. However, when secondaries of transformers are interconnected, there should be only one grounded point in this circuit to prevent accidental paralleling with system grounding wires.

MOUNTING

Instrument transformers should be mounted so that connections can be made to the power or distribution lines in such a manner as to avoid placing appreciable strains upon the terminals of the transformers. For high-current transformer ratings, 2000 amperes and above, there may be some interference from the electric field of the return bus unless the bus centers are kept at a minimum distance of 15 inches apart; for ratings above 5000 amperes, this distance should be not less than 24 inches. If this type transformer is used with more than one primary turn, the loop should be at least 24 inches in diameter. Make sure that the secondary leads are twisted closely together and carried out without passing through the field of the primary conductors. It is not necessary that the bus exactly fill the window, but the bus or buses should be centralized. For ratings of 1000 amperes or less, these precautions are generally unnecessary.

CONNECTIONS

SECONDARY CONNECTIONS

The resistance of all primary and secondary connections should be kept as low as possible to prevent overheating at the contacts, and to prevent an increase in the secondary burden.

The resistance of the secondary leads should be included in calculating the secondary burden carried by current transformers. The total burden should be kept within limits suited to the transformers used. The voltage drop in the secondary leads of potential transformers will reduce the voltage at the measuring device. *

Short-circuiting Device

Many current transformers are provided with a device for short-circuiting the secondary terminals, and are normally shipped from the factory with this device in short-circuiting position. Check the position of the shorting device. The secondary terminals should be short-circuited by the shorting device, or equivalent, until a suitable burden (such as an ammeter, wattmeter, watthour meter, relay, etc.) has been connected to the secondary terminals.

Multi-ratio current transformers with tapped secondary windings are partially or completely inoperative when any portion of the secondary winding is short-circuited. Shorting devices should be connected across at least 50 percent of the secondary turns until a suitable burden has been connected to the secondary terminals. All short-circuiting devices must be in the open position for normal operation, so that no portion of the winding is short-circuited.

In contrast, on double-secondary or multiple-secondary current transformers, that is, transformers with two or more separate secondary windings, each having an independent core, the shorting device must be left closed on all unused secondary windings. (Unused secondary windings are those to which no suitable burden is attached.)

Before a burden is disconnected from a current transformer, the secondary terminals should be short-circuited.

PRIMARY BY-PASS PROTECTION

Thyrite® primary by-pass protectors are recommended for the proper protection of current transformers which are so located as to be exposed to the effect of surge currents. They are especially recommended for low primary-current ratings, as these ratings have a relatively high winding impedance.

Thyrite primary by-pass protectors consist of one or more Thyrite disks which are connected in parallel with the primary winding of the transformer. When high-frequency or steep-front voltage surges occur, the characteristic of the Thyrite is such that an appreciable part of the surge current

*Bars indicate changes included in this revision.

is by-passed through the protector. A high-surge voltage, which might result in failure within the primary winding, is thus prevented from building up across the winding.

POLARITY

In wiring instrument transformer circuits, it is necessary to maintain the correct polarity relation between the line and the devices connected to the secondaries. For this reason, the relative polarity of each winding of a transformer is indicated by a marker H_1 (or a white spot) on or near one primary terminal, and a marker X_1 (or a white spot) near one secondary terminal; and in some cases by white bushings. See Figure 1. Where taps are present, all terminals will be marked in order. The primary terminals will be H_1, H_2, H_3, etc.; the secondary terminals X_1, X_2, X_3, etc.; and Y_1, Y_2, Y_3, etc., if another secondary is present. The marker H_1 always indicates the same instantaneous polarity as X_1 and Y_1.

When connection is made to a secondary terminal having a polarity marking similar to a given primary terminal, the polarity will be the same as if the primary service conductor itself were detached from the transformer and connected directly to the secondary conductor. In other words, at the instant when the current is flowing toward the transformer in a primary lead of a certain polarity, current will tend to flow away from the transformer in the secondary lead of similar polarity.

When connecting instrument transformers with meters or instruments, refer to the Instructions furnished with the meters or instruments involved.

AMBIENT TEMPERATURE

All General Electric transformers are designed to operate at the ambient temperatures and ratings indicated by the Company, provided the altitude does not exceed 3300 feet. Refer to Requirements for Instrument Transformers, ANSI C57.13-1968, Section 3. Generally, the allowable ambient temperatures and ratings are marked on the transformer nameplate.

FUSES

Potential-transformer primary fuses are intended to protect the supply system rather than the transformer, although proper fuses will afford partial protection to the transformer in a large number of cases.

The fuses on butyl-type transformers, rated at 1.2-kv through 2.5-kv insulation class, are provided with molded fuse holders which are secured to the transformer by the spring action of the fuse clips. When replacing the fuse and holder, be sure that the plastic insulating piece, fastened under the transformer fuse clip, is inserted between the end of the fuse and the open end of the fuse enclosure; then, press the enclosure firmly onto the transformer to seat the fuse into both clips.

The fuses of some older dry-type transformers, 2400 volts and below, are supported by a hinged cover. If it is necessary to replace a fuse while the transformer is connected to an operating circuit, the cover should be opened by use of an insulating hook, which should be of sufficient length to prevent the operator from being burned in case a short circuit exists in the transformer.

In testing fuses for continuity of circuit, not more than 0.25 ampere should be used.

In replacing fuses, be certain that the voltage rating of the fuse is the one nearest above the line-to-line voltage of the circuit, regardless of the rated voltage of the transformer. Do not use fuses of higher voltage ratings, as undesirable overvoltages may result should the fuse blow. One permissible exception to this general rule is the use of Size A, Type EJ-1 fuse in the old Type JE-2 and present Type JVM-2 transformers. In this case the Size A fuse can be used on either 2400-volt, delta circuits or 2400/4160-volt, solidly grounded Y circuits.

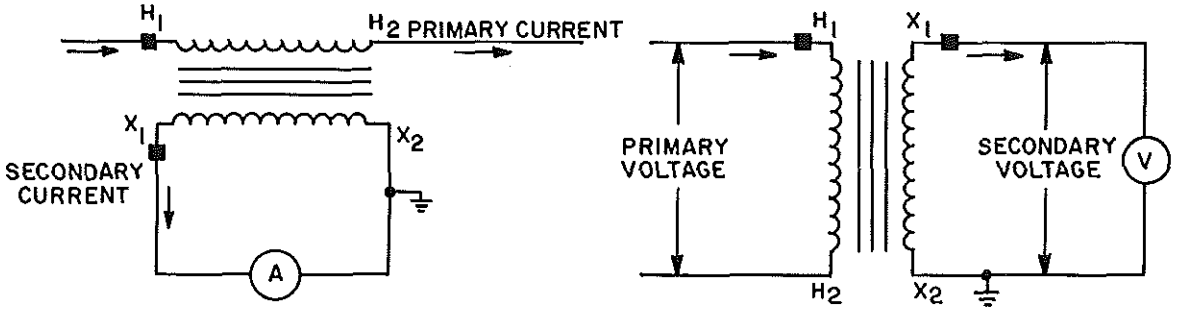


Fig. 1. Elementary connections of instrument transformers

MAINTENANCE

After instrument transformers for indoor use have been installed, they should need no care other than keeping them clean and dry. Transformers for outdoor installations should receive the same care in operation as power transformers of similar design and of similar voltage rating.

CLEANING BUSHINGS

Porcelain bushings may be cleaned by means of a wet cloth or by use of naphtha or "Stoddard" solvent, or ammonia. After cleaning a bushing, wash thoroughly with clean water to remove foreign material from the surface.

Butyl-molded transformers may be cleaned by scrubbing the butyl surface with detergent and a stiff brush to remove accumulated dirt or oil film. Remove the detergent by washing with clean water. Then, apply a light grade of silicone oil (GE Silicone Liquid, SF-96 or equal) to the butyl surface.

DEMAGNETIZING

If, by accident, a current transformer becomes magnetized, it should be demagnetized before being used for precision work. Connect the transformer in the test circuit as shown in Fig. 2. Pass rated current through the low-turn winding (usually H_1 - H_2). Increase the resistance (R) in the high-turn winding (usually X_1 - X_2) circuit until the transformer core is saturated; then, slowly reduce resistance to zero and disconnect the current source. Saturation of the core is indicated by a reduction of current in the high-turn winding circuit.

PRECAUTION: *A CONTINUOUSLY VARIABLE RESISTANCE MUST BE USED TO AVOID OPENING THE HIGH-TURN WINDING CIRCUIT WHEN RESISTANCE VALUES ARE CHANGED. AS THE RESISTANCE IS INCREASED, THE VOLTAGE ACROSS THE RESISTANCE WILL APPROACH OPEN-CIRCUIT VALUE.*

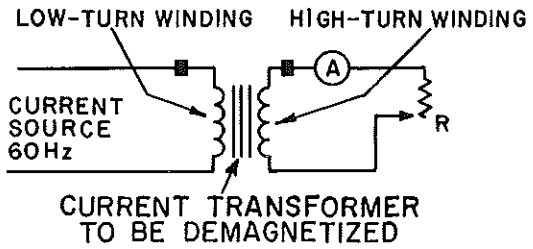


Fig. 2. Circuit for demagnetizing current transformers

Demagnetizing JAR-0 Auxiliary Transformers

Due to the wide range of current ratios available in the Type JAR-0 current transformer and the lack of standards for demagnetizing the odd ratios available, the following method is necessary to prevent voltages which are damaging to the transformer. See Fig. 3.

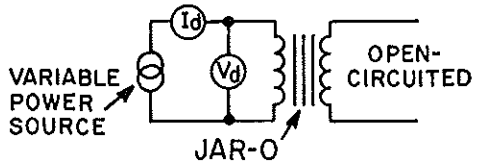


Fig. 3. Schematic diagram for demagnetizing JAR-0 transformers

Key to Fig. 3.

I_d = ammeter for reading demagnetizing current.

V_d = voltmeter for reading demagnetizing voltage.

The I_d reading shall not exceed:

$$\frac{\text{Rated current of the winding energized}}{50}$$

The V_d reading shall not exceed:

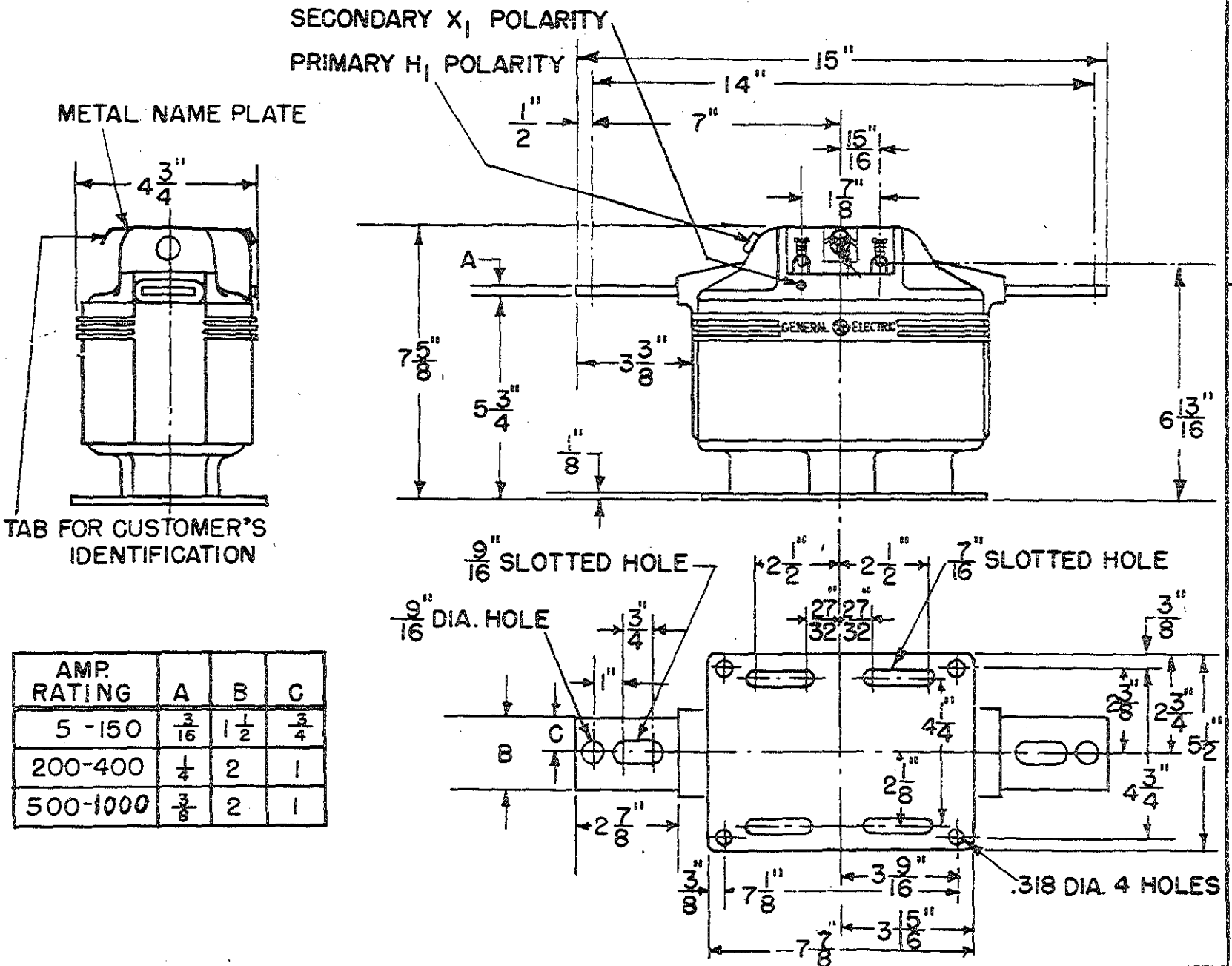
$$\frac{160}{\text{Rated current of the winding energized}}$$

For example, for demagnetizing any 5-ampere JAR-0 winding, do not exceed 32 volts and 0.1 ampere. The core will be adequately demagnetized when either the voltage or the current is increased to over 80 percent of the maximum value shown in the applicable formula (see above), and then gradually reduced to zero.

CAUTION: *ONE OR MORE WINDINGS ARE OPEN-CIRCUITED DURING THIS OPERATION. THESE WINDINGS MAY DEVELOP VOLTAGES WHICH ARE HAZARDOUS TO PERSONNEL. OBSERVE SAFETY PRECAUTIONS.*

DIFFERENTIAL PROTECTION

Standard General Electric current transformers may be used for differential protection through a considerable range of burden and overcurrent. The range is limited by the difference in burden, the maximum overcurrent, and the mechanical and thermal short-time rating. Information regarding these points may be obtained from the GE publication GET-97 or from the nearest sales office of the company.



AMP. RATING	A	B	C
5 -150	3/16	1 1/2	3/4
200-400	1/4	2	1
500-1000	3/8	2	1

REVISIONS			
C	Michelsen Apr. 15. 53	Retraced No change	
D	Saunders Sep. 10. 53	EL. 25-2381	
KM	RPELLEGRINI Sept. 19 1955	EL. 25-2872	1
6	BERGSTROM NEW DEV JKM-3 MAR 30 1976 REVISED		

MADE BY Chas. Holloway, Dec. 7, 1948
ISSUED BY E.O. Reynolds Oct. 15, 53

APPROVALS

METER & INSTRUMENT ..... DIV
SOMERSWORTH N. H.

K - 41 47858 CONT ON SHEET

PRINTS TO 8911T

K - 41 47858 SH NO.

GENERAL ELECTRIC

TITLE OUTLINE CURRENT TRANSFORMER TYPE JKM-3

FIRST MADE FOR

K - 41 47858 CONT ON SHEET

REV NO.

K - 41 47858 SH NO.

FF-803-W2-1C (REV.) 500 2-27-51 PRINTED IN U.S.A.

11906159

DESCRIPTION: RELAY TIMING,
AGASTAT 7000 SERIES.
OPERATION OFF-DELAY.
CONTACT ARRANGEMENT 4PDT.
COIL VOLTAGE 120 VDC
TIME RANGE 1 TO 10 MIN.

VENDOR PC. NO.: 7024 P F

VENDOR: AMERACE-ESNA
AGASTAT DIVISION
1027 NEWARK AVE.
ELIZABETH, NEW JERSEY 07208

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	8597	7-24-73	REDRAWN WAS 2422PF	

TITLE: RELAY 4PDT TDDO 1-10 MIN COIL 120VDC

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	——	/ - /	ASSY. OR LO.
DR. BY	GRANZOW	7/18/73	SCALE
CHK'D. BY		/ /	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11906159 | SHEET 1 OF 1

11906162

DESCRIPTION: ENCLOSURE NEMA TYPE 12 — SINGLE DOOR WALL MOUNTED — 24" HIGH, 20" WIDE, 8" DEEP.

VENDOR DWG. BULLETIN A-12 PAGES 1, 2 & 3

VENDORS PC. NO. A-24 20 08 LP

VENDOR: HOFFMAN ENGINEERING CO.

NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
ENCLOSURE
24H-20W-8D

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 20578101	4-15-71	ASSY. OR LO.	
DR. BY GRANZOW	7/4/11	SCALE	
CHK'D. BY P.K.	4/12/71	HEAT TR.	
MAT'L			
APPV.	CAST.	MAT'L.	
	MACH.	ENGR.	
	WELD.		

SHEET SIZE A | DWG. NO. 11906162 | SHEET 1 OF 1

BF3009-2

11906163

DESCRIPTION: PANEL 21 X 17 FOR NEMA 12 ENCLOSURE 24 X 20

VENDORS DWG: BULLETIN A-12 PAGES 1, 2 & 3

VENDORS PC. NO. A-24P20

VENDOR: HOFFMAN ENGINEERING CO.

REV NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY

TITLE
PANEL
21 X 17

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 ± .060 0.0 ± .030 0.00 ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO.	6/15/84	ASSY. OR LO.	
DR. BY	7/24/84	SCALE	
CHK'D. BY		HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11906163 | SHEET 1 OF 1

11906274

DESCRIPTION: HEAVY-DUTY OIL-TIGHT SELECTOR-SWITCH OPERATOR.— 3 POSITION MAINTAINED.— CAM NO. 6.— BLACK SELECTOR SWITCH RING.— LESS NAMEPLATE.

VENDORS DWG.: BULLETIN NO. GEA-8112A, PAGE 23.

VENDORS PC. NO.: CR2940 UB200F

VENDOR: GENERAL ELECTRIC

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: SWITCH ROTARY

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 7910	10/29/71	ASSY. OR LO.	
DR. BY GRANZOW	10/22/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11906274	SHEET 1 OF 1	

1190627?

DESCRIPTION: RELAY D.C. — CLASS J13 — 300 VOLT
CONVERTIBLE CONTACTS 2 N.O. —
COIL 125 VOLTS D.C.

VENDOR DWG.: ITE SPEEDFAX CAT. PAGE 105

VENDOR P.C. NO.: J13 P 20 12

VENDOR: ITE IMPERIAL CORP.

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REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
RELAY
2 NO
125 VDC

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

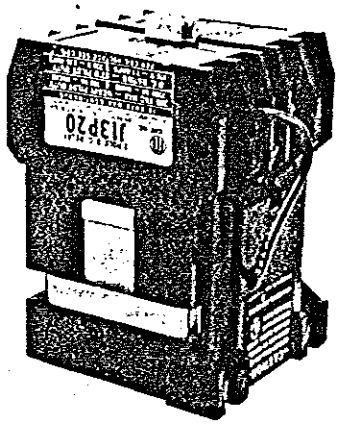
REL. NO. 205732 I	11/18/71	ASSY. OR LO. 11867 352	
DR. BY GRANDOW	10/27/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1190627S | SHEET 1 OF 1

INDUSTRIAL CONTROL
RELAYS

ELECTRICAL CONTACT RATINGS—DC STANDARD PILOT DUTY

Single Pole	1.1 amps—125 volts .55 amps—250 volts
Two Poles in Series	2.2 amps—125 volts 1.1 amps—250 volts



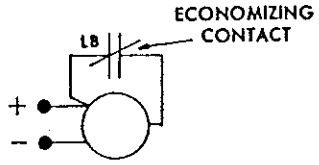
DC RELAYS CLASS J13

CONVERTIBLE CONTACTS

250 VDC MAX.

Total Poles⑥	Contacts① N.O.	N.C.	Cat. No.④⑤
2	2	0	J13P2012
	1	1	J13P1112
	0	2	J13P0212
3	3	0	J13P3012
	2	1	J13P2112
	1	2	J13P1212
	0	3	J13P0312
4	4	0	J13P4012
	3	1	J13P3112
	2	2	J13P2212
	1	3	J13P1312
	0	4	J13P0412
5	5	0	J13P5012
	4	1	J13P4112
	3	2	J13P3212
	2	3	J13P2312
	1	4	J13P1412
	0	5	J13P0512
6	6	0	J13P6012
	5	1	J13P5112
	4	2	J13P4212
	3	3	J13P3312
	1	5	J13P1512
	0	6	J13P0612
7	7	0	J13P7012
	6	1	J13P6112
	5	2	J13P5212
	4	3	J13P4312
	3	4	J13P3412
	2	5	J13P2512
	1	6	J13P1612
	0	7	J13P0712
8	8	0	J13P8012
	7	1	J13P7112
	6	2	J13P6212
	5	3	J13P5312
	4	4	J13P4412
	3	5	J13P3512
	2	6	J13P2612
	1	7	J13P1712
	0	8	J13P0812
9	9	0	J13P9012
	8	1	J13P8112
	7	2	J13P7212
	6	3	J13P6312
	5	4	J13P5412
	4	5	J13P4512
	3	6	J13P3612
	2	7	J13P2712
	1	8	J13P1812
	0	9	J13P0912
10	10	0	J13P10012
	9	1	J13P9112
	8	2	J13P8212
	7	3	J13P7312
	6	4	J13P6412
	5	5	J13P5512
	4	6	J13P4612
	3	7	J13P3712
	2	8	J13P2812
	1	9	J13P1912
	0	10	J13P01012
11	11	0	J13P11012
	10	1	J13P10112
	9	2	J13P9212
	8	3	J13P8312
	7	4	J13P7412
	6	5	J13P6512
	5	6	J13P5612
	4	7	J13P4712
	3	8	J13P3812
	2	9	J13P2912
	1	10	J13P11012
	0	11	J13P01112

WIRING DIAGRAM



The economizing contact is a late-break, normally closed contact which shunts some of the coil impedance initially to assist relay closure. Contact must remain wired in the circuit.

① Relays are normally stocked with all normally open contacts. Best delivery will be obtained by ordering normally open contacts and changing as desired in the field.

④ ¼" quick connect terminals available. Add $4.00 list per relay and specify on order.

⑤ Cat. No. shown is for 125 VDC coil. For different coil voltage use chart below and substitute suffix for last two digits, 12, in above Cat. Nos.

DC Coil Volt	6	12	24	32	48	64	250
Suffix	00	01	02	03	04	06	25

⑥ A special extra late break contact, factory installed in the first contact block, is used for a coil economizing circuit. The number listed under "Total Poles" indicates total usable poles and does not include the coil economizing contact.

For Dimensions and Weights—see page 227.
For Replacement Coils see page 109.

1190C280

DESCRIPTION: RELAY D.C. — CLASS J13 — 300 VOLT
CONVERTIBLE CONTACTS 3 N.O. —
COIL 125 VOLTS D.C.

VENDOR DWG.: ITE SPEEDFAX CAT. PAGE 105

VENDOR PC. NO.: J13 P 3012

VENDOR: ITE IMPERIAL CORP.

P 300
PAGE

Telemecanique

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY

TITLE: RELAY NO 125 VDC

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

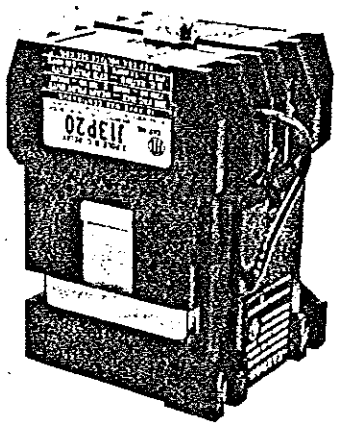
REL. NO. 205132 L	[illegible]	ASSY. OR LO. 1 367 352	
DR. BY GRANTZOU	12/28/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1190C280 | SHEET 1 OF 1

INDUSTRIAL CONTROL
RELAYS

ELECTRICAL CONTACT RATINGS—DC STANDARD PILOT DUTY

Single Pole	1.1 amps—125 volts .55 amps—250 volts
Two Poles in Series	2.2 amps—125 volts 1.1 amps—250 volts



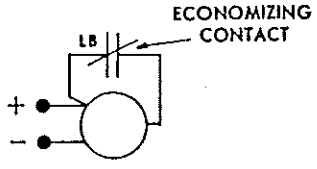
DC RELAYS CLASS J13

CONVERTIBLE CONTACTS

250 VDC MAX.

Total Poles⑥	Contacts① N.O.	Contacts① N.C.	Cat. No.④⑤
2	2	0	J13P2012
	1	1	J13P1112
	0	2	J13P0212
3	3	0	J13P3012
	2	1	J13P2112
	1	2	J13P1212
	0	3	J13P0312
4	4	0	J13P4012
	3	1	J13P3112
	2	2	J13P2212
	1	3	J13P1312
	0	4	J13P0412
5	5	0	J13P5012
	4	1	J13P4112
	3	2	J13P3212
	2	3	J13P2312
	1	4	J13P1412
	0	5	J13P0512
6	6	0	J13P6012
	5	1	J13P5112
	4	2	J13P4212
	3	3	J13P3312
	1	5	J13P1512
	0	6	J13P0612
7	7	0	J13P7012
	6	1	J13P6112
	5	2	J13P5212
	4	3	J13P4312
	3	4	J13P3412
	2	5	J13P2512
	1	6	J13P1612
	0	7	J13P0712
8	8	0	J13P8012
	7	1	J13P7112
	6	2	J13P6212
	5	3	J13P5312
	4	4	J13P4412
	3	5	J13P3512
	2	6	J13P2612
	1	7	J13P1712
	0	8	J13P0812
9	9	0	J13P9012
	8	1	J13P8112
	7	2	J13P7212
	6	3	J13P6312
	5	4	J13P5412
	4	5	J13P4512
	3	6	J13P3612
	2	7	J13P2712
	1	8	J13P1812
	0	9	J13P0912
10	10	0	J13P10012
	9	1	J13P9112
	8	2	J13P8212
	7	3	J13P7312
	6	4	J13P6412
	5	5	J13P5512
	4	6	J13P4612
	3	7	J13P3712
	2	8	J13P2812
	1	9	J13P1912
	0	10	J13P01012
11	11	0	J13P11012
	10	1	J13P10112
	9	2	J13P9212
	8	3	J13P8312
	7	4	J13P7412
	6	5	J13P6512
	5	6	J13P5612
	4	7	J13P4712
	3	8	J13P3812
	2	9	J13P2912
	1	10	J13P11012
	0	11	J13P01112

WIRING DIAGRAM



The economizing contact is a late-break, normally closed contact which shunts some of the coil impedance initially to assist relay closure. Contact must remain wired in the circuit.

① Relays are normally stocked with all normally open contacts. Best delivery will be obtained by ordering normally open contacts and changing as desired in the field.

④ ¼" quick connect terminals available. Add $4.00 list per relay and specify on order.

⑤ Cat. No. shown is for 125 VDC coil. For different coil voltage use chart below and substitute suffix for last two digits, 12, in above Cat. Nos.

DC Coil Volt	6	12	24	32	48	64	250
Suffix	00	01	02	03	04	06	25

⑥ A special extra late break contact, factory installed in the first contact block, is used for a coil economizing circuit. The number listed under "Total Poles" indicates total usable poles and does not include the coil economizing contact.

For Dimensions and Weights—see page 227.
For Replacement Coils see page 109.

11906281

DESCRIPTION: CONTACT BLOCK – CLASS J20 – CONVERTIBLE CONTACTS 2 N.O., 300 VOLT.

VENDOR PC. NO.: J20 B 20

VENDOR: ITE IMPERIAL CORP.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: CONTACT BLOCK 2 NO

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

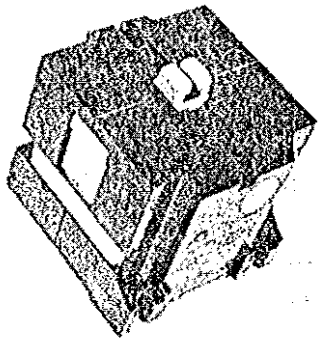
Colt Industries — Fairbanks Morse Power Systems Division

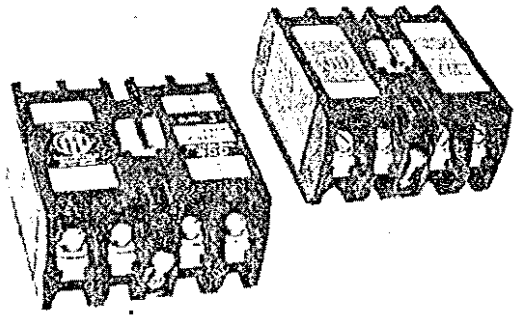
REL. NO. 205732 L	11/18/71	ASSY. OR NO. 11867352	
DR. BY GERANIOTIS	10/28/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

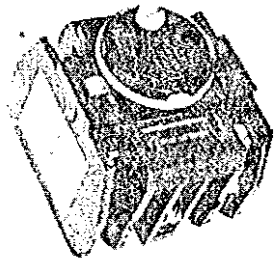
SHEET SIZE A | DWG. NO. 11906281 | SHEET 1 OF 1

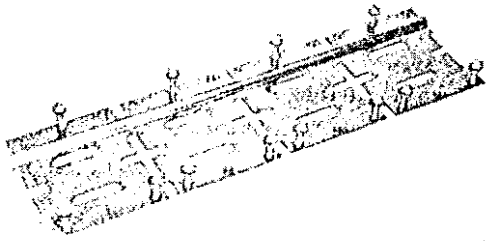
INDUSTRIAL CONTROL
RELAYS

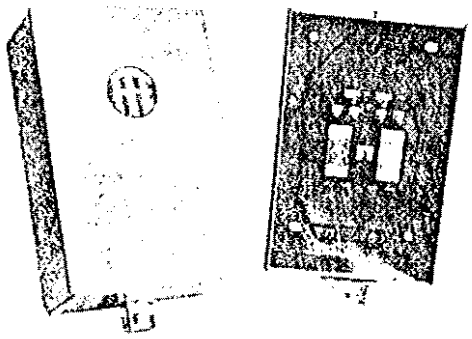
RELAY KITS FOR CLASS J RELAYS — CLASS J20











Description	Cat. No.
STANDARD MAGNET BLOCK WITH COIL③	
300V or 600V To 12 Circuits	J20M12①
CONTACT BLOCK—CONVERTIBLE POLES②④	
300V—2 N.O.	J20B20
300V—4 N.O.	J20B40
600V—2 N.O.	J20A20
600V—4 N.O.	J20A40
OVERLAPPING CONTACT KIT—CONVERTIBLE POLES	
300V—1 Set (1 N.O.—1 N.C. Pole)	J20BC
600V—1 Set (1 N.O.—1 N.C. Pole)	J20AC
PNEUMATIC TIMING UNIT	**600 VOLT**
Standard—One Universal Timed Contact	
.2 to 60 seconds range	J20T11
.2 to 180 seconds range	J20T31
Two Universal Timed Contacts	
.2 to 60 seconds range	J20T1
.2 to 180 seconds range	J20T3
MOUNTING STRIP	
For 4 Relays	J20S4
For 8 Relays	J20S8
For 12 Relays	J20S12
For 16 Relays	J20S16
NEMA 1 ENCLOSURE	
Class J10—4 Pole Relay	
Class J11—2 Pole Relay	J20E41
Class J13—3 Pole Relay	
Class J10—8 Pole and 12 Pole Relay	
Class J11—6 Pole Relay	
Class J12—Timed Contacts plus 4 Instantaneous Poles	J20E121
Class J13—7 Pole Relay	
Class J16—Timed Contacts plus 4 Instantaneous Poles	

① Cat. No. shown is for 120V coil. For different coil voltage use chart below and substitute suffix for last two digits, (12) in above Cat. Nos.

Coil Voltage	24	32	48	64	110	208/220	240	440	480	550	600
Suffix (60 Hertz)	02	03	04	06	11	22	24	44	48	55	60

② Class J20 relays are normally stocked with all N.O. instantaneous contacts. Best delivery will be obtained by ordering N.O. Contacts and changing as desired in the field.

③ When 25- or 50-Hertz coil are required, consult factory.

④ "Slip-on" connectors available on all Terminals—Add $4.00 list per relay—Specify on order.

11906282

DESCRIPTION: CONTACT BLOCK — CLASS J20 — CONVERTIBLE CONTACTS 4 N.O., 300 VOLT.

VENDOR PC. NO.: J20 B 40

VENDOR: ITE IMPERIAL CORP.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: CONTACT BLOCK 4 NO

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

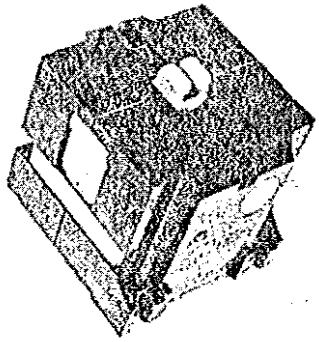
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205732 I	12/18/72	ASSY. OR DWG. NO. 11906282	
DR. BY GRIMM 2043	10/25/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11906282 | SHEET 1 OF 3

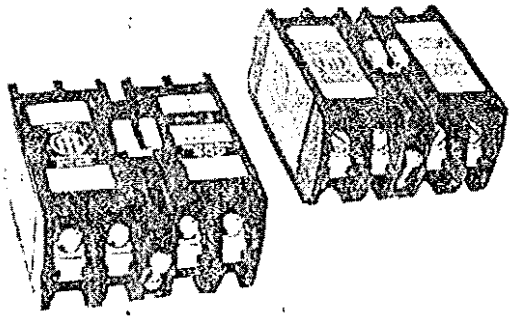
INDUSTRIAL CONTROL
RELAYS

RELAY KITS FOR CLASS J RELAYS — CLASS J20

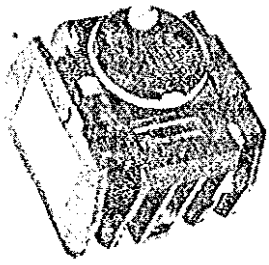


Description	Cat. No.
STANDARD MAGNET BLOCK WITH COIL③	
300V or 600V To 12 Circuits	J20M12①
CONTACT BLOCK—CONVERTIBLE POLES②④	
300V—2 N.O.	J20B20
300V—4 N.O.	J20B40
600V—2 N.O.	J20A20
600V—4 N.O.	J20A40

11.906.281
11.906.282
1190682

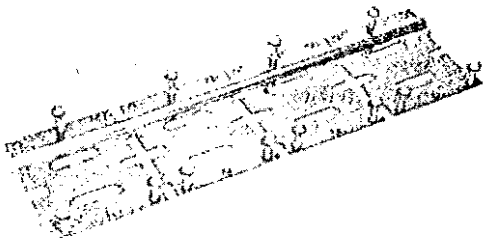


OVERLAPPING CONTACT KIT—CONVERTIBLE POLES	
300V—1 Set (1 N.O.—1 N.C. Pole)	J20BC
600V—1 Set (1 N.O.—1 N.C. Pole)	J20AC

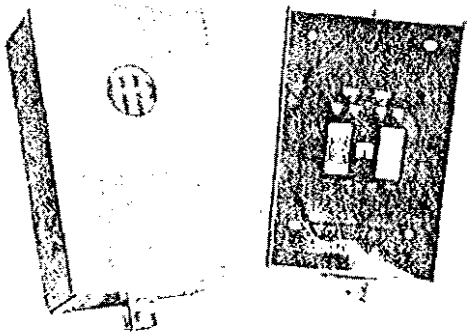


PNEUMATIC TIMING UNIT	**600 VOLT**
Standard—One Universal Timed Contact	
.2 to 60 seconds range	J20T11
.2 to 180 seconds range	J20T31
Two Universal Timed Contacts	
.2 to 60 seconds range	J20T1
.2 to 180 seconds range	J20T3

MOUNTING STRIP	
For 4 Relays	J20S4
For 8 Relays	J20S8
For 12 Relays	J20S12
For 16 Relays	J20S16



NEMA 1 ENCLOSURE	
Class J10—4 Pole Relay	
Class J11—2 Pole Relay	J20E41
Class J13—3 Pole Relay	
Class J10—8 Pole and 12 Pole Relay	
Class J11—6 Pole Relay	
Class J12—Timed Contacts plus 4 Instantaneous Poles	J20E121
Class J13—7 Pole Relay	
Class J16—Timed Contacts plus 4 Instantaneous Poles	



① Cat. No. shown is for 120V coil. For different coil voltage use chart below and substitute suffix for last two digits, (12) in above Cat. Nos.

Coil Voltage	24	32	48	64	110	208/220	240	440	480	550	600
Suffix (60 Hertz)	02	03	04	05	11	22	24	44	48	55	60

② Class J20 relays are normally stocked with all N.O. instantaneous contacts. Best delivery will be obtained by ordering N.O. Contacts and changing as desired in the field.

③ When 25- or 50-Hertz coil are required, consult factory.

④ "Slip-on" connectors available on all Terminals—Add $4.00 list per relay—Specify on order.

11906284

DESCRIPTION: RELAY MOUNTING STRIP — TO MOUNT 16 CLASS J10 OR J13 RELAYS —

VENDOR PC. NO.: J20 S 16

VENDOR: ITE IMPERIAL CORP.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
STRIP MOUNTING 16 RELAYS

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 205732 L	11/18/71	ASSY. OR LO. 11867352	
DR. BY CHANDLOW	11/2/71	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11906284 | SHEET 1 OF 1

11907134

Control transformer, type MTA, single phase

with fuseholder.

230/460V. pri., 115V. sec.

200 volt-amperes.

Cat. No. 1F0908 with 257A574G01 fuseholder.

Vendor: Westinghouse Electric Corp.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
TRANSFORMER CONTROL 200VA

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 8972	4/26/74	ASSY. OR LO.	
DR. BY R. KEYES	4/23/74	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENG.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11907134 | SHEET 1 OF 1

Westinghouse Electric Corporation
Dry Type Distribution Transformer Division
Greenville, Pa. 16125

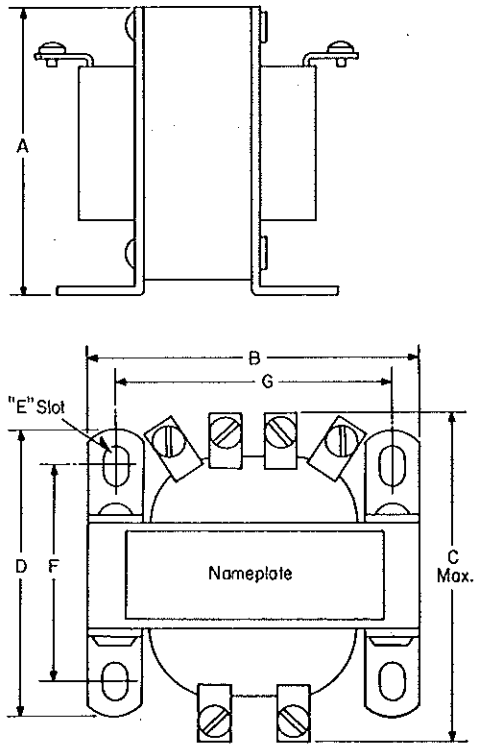
November, 1977
Supersedes 46-870 T WE A,
Page 1, Dated June, 1975

Mailed To: E, D/2071/2072/2079/DB, DS

Type MTA, MTC, Machine Tool

Control Transformers

Dimensions in Inches (Approximate)



Frame No.	Dimensions A	B	C Max.	D	E	F	G
1310	2 19/32	3	3¼	2 5/16	13/64 x 21/64	2	2½
1312	2 19/32	3	3¾	2 13/16	13/64 x 21/64	2¼	2½
1314	2 19/32	3	3¾	3 1/16	13/64 x 21/64	2½	2½
1412	2⅞	3⅜	4	2⅞	13/64 x 21/64	2 5/16	2 13/16
1413	2⅞	3⅜	4	2 15/16	13/64 x 21/64	2⅜	2 15/16
1510	3 1/16	3¾	3¾	2 5/16	13/64 x 21/64	2	3⅛
1512	3 1/16	3¾	4	2 13/16	13/64 x 21/64	2¼	3¼
1513	3 1/16	3¾	4⅛	3	13/64 x 21/64	2 7/16	3⅛
1516	3 1/16	3¾	4¾	3 1/16	13/64 x 21/64	2⅞	3⅛
1517	3 1/16	3¾	4¾	3 1/16	13/64 x 21/64	2⅞	3⅛
1520	3 1/16	3¾	4¾	3 1/16	13/64 x 21/64	3	3⅛
1714	3 13/16	4½	4½	3 1/16	13/64 x 21/64	2½	3¾
1717	3 13/16	4½	5	3 1/16	13/64 x 21/64	2⅞	3¾
1721	3 13/16	4½	5	3¾	13/64 x 21/64	3 1/16	3¾
1722	3 13/16	4½	5⅜	3 13/16	13/64 x 21/64	3¼	3¾
1723	3 13/16	4½	5½	3 15/16	13/64 x 21/64	3⅜	3¾
1724	3 13/16	4½	5⅜	4⅛	13/64 x 21/64	3 1/16	3¾
1726	3 13/16	4½	6	4 1/16	13/64 x 21/64	3¾	3¾
1727	3 13/16	4½	6	4 1/16	13/64 x 21/64	3⅜	3¾
1730	3 13/16	4½	6	4⅝	13/64 x 21/64	4 1/16	3¾
1923	4⅜	5¼	5⅝	4¼	9/32 x 13/32	3½	4⅜
1930	4⅜	5¼	6¼	5¼	5/16 x 11/16	4⅛	4⅜
1931	4⅜	5¼	6¼	5⅜	5/16 x 11/16	4¼	4⅜
1932	4⅜	5¼	6¼	5½	5/16 x 11/16	4⅜	4⅜
1943	4⅜	5¼	7⅜	7	5/16 x 11/16	5⅞	4⅜
2236	5 7/16	6⅜	7½	6 1/16	5/16 x 11/16	5	5 5/16
C-613	5¼	6⅛	6¾	5¾	5/16 x 5/16	4¾	5¼
C-614	6	6⅞	7½	6	5/16 x 5/16	5	6
C-822	6¼	6⅞	8⅜	7½	7/16 x ⅜	6⅜	6¾
C-823	6	6¾	8½	8⅜	7/16 x ⅜	7¾	5¾
C-824	7⅜	8 7/16	8¾	7½	7/16 x ⅜	6	7½
C-825	7⅞	8 11/16	11	9	7/16 x ⅜	7½	7½
C-827	5¾	6⅞	8½	7	7/16 x ⅜	6	6
C-828	6½	8 3/16	8¾	7	7/16 x ⅜	6	7
C-829	7⅜	8 11/16	10¼	8½	7/16 x ⅜	7	8

Customer _____ Location _____ P.O. # _____

Distributor _____ Job _____ P.O. # _____

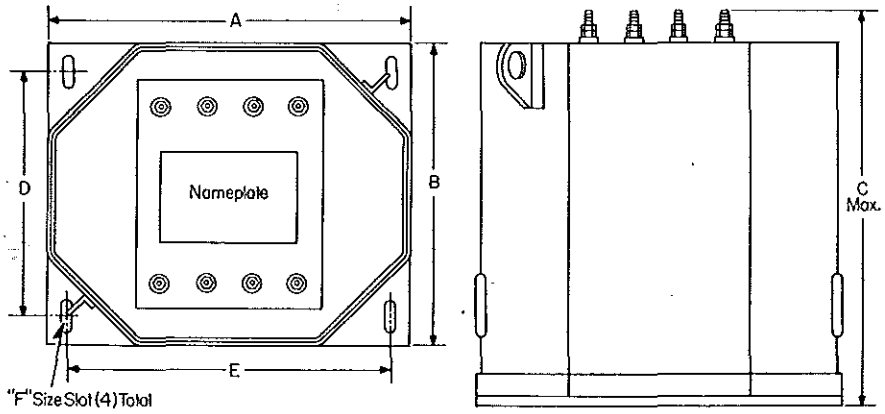
Apparatus Style _____ Diagram from TCS 46-871, Page _____ Diagram _____ Frame _____

Certified By _____ Date _____ Item # _____ Quantity _____ G.O. _____

Special Notes _____

Approval ☐
Reference ☐
Installation ☐

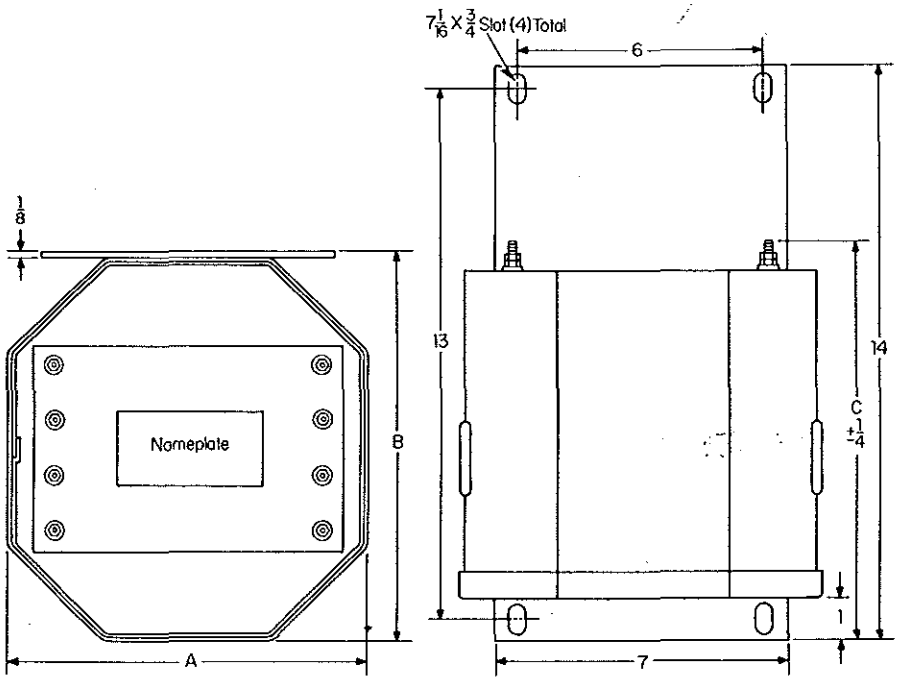
Dimensions in Inches



Bottom Mount (Figure No. 1)

Approx. Dimension (Figure No. 1)

Frame No.	KVA	A	B	C Max.	D	E	F
133	3	$7^{17}/_{32}$	$7^{17}/_{32}$	$8^{5}/_{16}$	6½	6½	$^{9}/_{32}$ x $^{17}/_{32}$
99	5	$9^{13}/_{32}$	$8^{25}/_{32}$	$9^{3}/_{16}$	7	8	$^{7}/_{16}$ x ¾
100	7½	$12^{1}/_{32}$	$10^{13}/_{32}$	9⅜	8½	10½	$^{7}/_{16}$ x ¾
101	10	$12^{1}/_{32}$	$10^{13}/_{32}$	11¼	8½	10½	$^{7}/_{16}$ x ¾
134	15	$11^{9}/_{32}$	$11^{9}/_{32}$	12½	9½	10	$^{7}/_{16}$ x ¾



Side/Wall Mount (Figure No. 2)

Approx. Dimension (Figure No. 2)

Frame No.	KVA	A	B	C
283	3	7½	7⅝	8⅞
256	5	8¾	$9^{9}/_{16}$	9¾
257	7½	8⅝	10¾	11⅝
258	10	10⅛	10¾	11⅝
259	15	$10^{7}/_{16}$	$12^{3}/_{16}$	12⅜

Customer _____ Location _____ P.O. # _____

Distributor _____ Job _____ P.O. # _____

Apparatus Style _____ Diagram from TCS 46-871, Page _____ Diagram _____ Frame _____

Certified By _____ Date _____ Item # _____ Quantity _____ G.O. _____

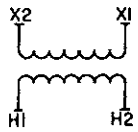
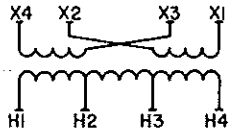
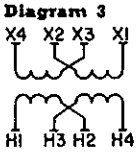
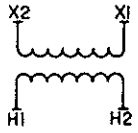
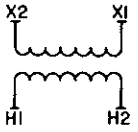
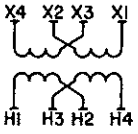
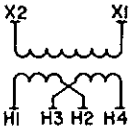
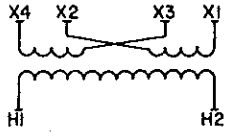
Special Notes _____

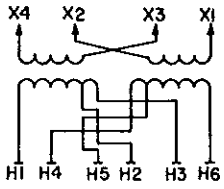
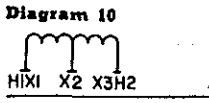
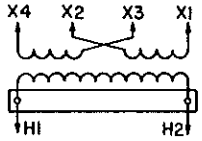
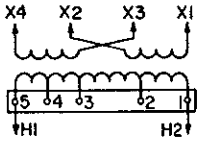
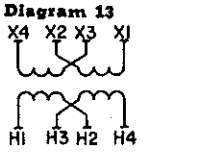
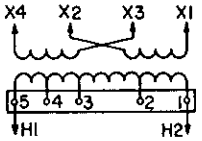
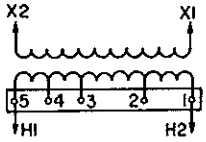
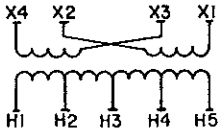
Approval ☐
Reference ☐
Installation ☐

Westinghouse Electric Corporation
Dry Type Distribution Transformer Division
Greenville, Pa. 16125

specialty transformers
dry type general purpose • 5000 volts and below

single phase: 050 kva through 25 kva
three phase: 3 kva through 30 kva

	volts	connections	line
Diagram 1 	600 120		H1-H2 X1-X2
Diagram 2 	600 570 540 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H4 H2-H4 H2-H3 X1-X4 X1-X3-X4 X1-X4
Diagram 3 	480 240 240 240/120① 120	H2 H3 H1 H3, H2 H4 X2 X3 X2 X3 X1 X3, X2 X4	H1-H4 H1-H4 X1-X4 X1-X3-X4 X1-X4
Diagram 4 	480 120		H1-H2 X1-X2
Diagram 5 	240 120		H1-H2 X1-X2
Diagram 6 	240 120 240 240/120① 120	H2 H3 H1 H3, H2 H4 X2 X3 X2 X3 X1 X3, X2 X4	H1-H4 H1-H4 X1-X4 X1-X3-X4 X1-X4
Diagram 7 	240 120 32	H2 H3 H1 H3, H2 H4	H1-H4 H1-H4 X1-X2
Diagram 8 	600 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H2 X1-X4 X1-X3-X4 X1-X4

	volts	connections	line
Diagram 9 	480 456 432 240 216 240 240/120① 120	H3 H4 H3 H5 H2 H5 H1 H4, H3 H6 H1 H5, H2 H6 X2 X3 X2 X3 X1 X3, X2 X4	H1-H6 H1-H6 H1-H6 H1-H6 H1-H6 X1-X4 X1-X3-X4 X1-X4
Diagram 10 	240 240/120①		H1-H2 X1-X2-X3
Diagram 11 	4160 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H2 X1-X4 X1-X3-X4 X1-X4
Diagram 12 	2400 2340 2280 2220 2160 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	1-5 1-4 2-5 2-4 2-3 X1-X4 X1-X3-X4 X1-X4
Diagram 13 	240 120 24 12	H2 H3 H1 H3, H2 H4 X2 X3 X1 X3, X2 X4	H1-H4 H1-H4 X1-X4 X1-X4
Diagram 14 	4365 4260 4160 4055 3950 480 480/240① 240	 X2 X3 X2 X3 X1 X3, X2 X4	1-5 1-4 2-5 2-4 2-3 X1-X4 X1-X3-X4 X1-X4
Diagram 15 	2520 2460 2400 2340 2280 600		1-5 1-4 2-5 2-4 2-3 X1-X2
Diagram 16 	504 492 480 468 456 240 240/120① 120	 X2 X3 X2 X3 X1 X3, X2 X4	H1-H5 H1-H4 H1-H3 H2-H4 H2-H3 X1-X4 X1-X3-X4 X1-X4

① three wire operation

customer..... address..... g. o.....

p. o. number..... item..... dimensions from 46-870 page..... frame.....

job..... diagram..... diagram no. .....

apparatus.....

approval ☐
reference ☐
construction or installation ☐
other ☐

.....certified..... date.....

October, 1964
new information
mailed to: E/1155, 1156/DB; D/825, 828/DB

Westinghouse Electric Corporation
Specialty Transformer Div. • Greenville plant • Greenville, Pa.
printed in U.S.A.

1190751O

3 POLE CONTACTOR FOR RESISTANCE HEATING CONTROL

30 AMP PER POLE, 110-120 V 60 HZ COIL, OPEN TYPE.

CAT. No.: 2200EB230AA

VENDOR: I-T-E IMPERIAL

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORD'R NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: CONTACTOR, HEATING 30 AMP.

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

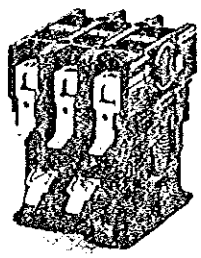
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. P01245	11/10/75	ASSY. OR SO	
DR. BY R. KEYES	10/29/75	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. R.D.K.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1190751O | SHEET 1 OF 1

CONTROL

CONTACTORS



25-40 AMPERE
HP and AMPERE RATED MOTOR CONTACTORS TYPE 2200EB

RESISTANCE HEATING—FLUORESCENT, INCANDESCENT LIGHTING, MERCURY VAPOR LAMP CONTACTORS

Resistance Lighting Ampere Rating①	Maximum Motor Ampere Rating: Full Load Amperes	Hermetic Compressor Lock Rotor Amperes 3 Phase 3 Pole Break— 1 Phase 2 Pole Break: 277V	480V	600V	Maximum Horsepower: Volts	Single Phase	3 Phase	No. of N/O Power Poles⑤	Coil② VAC	Open Type Cat. No.	General Purpose—NEMA Type 1 Cat. No.
								2	24	2200EB220EA	2200EB220EB
									110-120	2200EB220AA	2200EB220AB
									208-240	2200EB220BA	2200EB220BB
									440-480 (60 Hz)	2200EB220KA	2200EB220KB
								3	24	2200EB230EA	2200EB230EB
30	25	150	125	100	115	2	3		110-120	2200EB230AA	2200EB230AB
					230	3	5		208-240	2200EB230BA	2200EB230BB
					460-575	--	7½		440-480 (60 Hz.)	2200EB230KA	2200EB230KB
								4	24	2200EB240EA	2200EB240EB
									110-120	2200EB240AA	2200EB240AB
									208-240	2200EB240BA	2200EB240BB
									440-480 (60 Hz.)	2200EB240KA	2200EB240KB
								2	24	2200EB320EA	2200EB320EB
									110-120	2200EB320AA	2200EB320AB
									208-240	2200EB320BA	2200EB320BB
									440-480 (60 Hz.)	2200EB320KA	2200EB320KB
								3	24	2200EB330EA	2200EB330EB
40	30	180	150	120	115	2	5		110-120	2200EB330AA	2200EB330AB
					230	5	7½		208-240	2200EB330BA	2200EB330BB
					460-575	--	10		440-480 (60 Hz.)	2200EB330KA	2200EB330KB
								4	24	2200EB340EA	2200EB340EB
									110-120	2200EB340AA	2200EB340AB
									208-240	2200EB340BA	2200EB340BB
									440-480 (60 Hz.)	2200EB340KA	2200EB340KB
								2	24	2200EB420EA	2200EB420EB
									110-120	2200EB420AA	2200EB420AB
									208-240	2200EB420BA	2200EB420BB
									440-480 (60 Hz.)	2200EB420KA	2200EB420KB
								3	24	2200EB430EA	2200EB430EB
50	40	240	200	160	115	2	5		110-120	2200EB430AA	2200EB430AB
					230	5	10		208-240	2200EB430BA	2200EB430BB
					460-575	--	15		440-480 (60 Hz.)	2200EB430KA	2200EB430KB
								4	24	2200EB440EA	2200EB440EB
									110-120	2200EB440AA	2200EB440AB
									208-240	2200EB440BA	2200EB440BB
									440-480 (60 Hz.)	2200EB440KA	2200EB440KB

① Per Pole Rating:
Resistive—600V Max.
Lighting—Incandescent—250V Max.
Fluorescent and Mercury Vapor—277V max.—For use on 480V/277V system.

② Other standard coils available. Select voltage suffix code letter from coil chart and substitute for next to last letter in catalog number.

⑤ For normally closed power poles see page 27.

AC COILS

All AC Coils, Except Where Specifically Designated, Are 50/60 Hz

Volts	24	110-120	208-240	277	440-480 (60 Hz.) 380-460 (50 Hz.)	550-600	120/240③
Code Letter	E	A	B	G	K	D	AB

③ List price adder for dual voltage coils $6.00.

DC COILS④

12-14	24-28	40	60-70
H	J	L	T

④ List price adder for DC coils $35.00. Includes factory wired normally closed auxiliary.

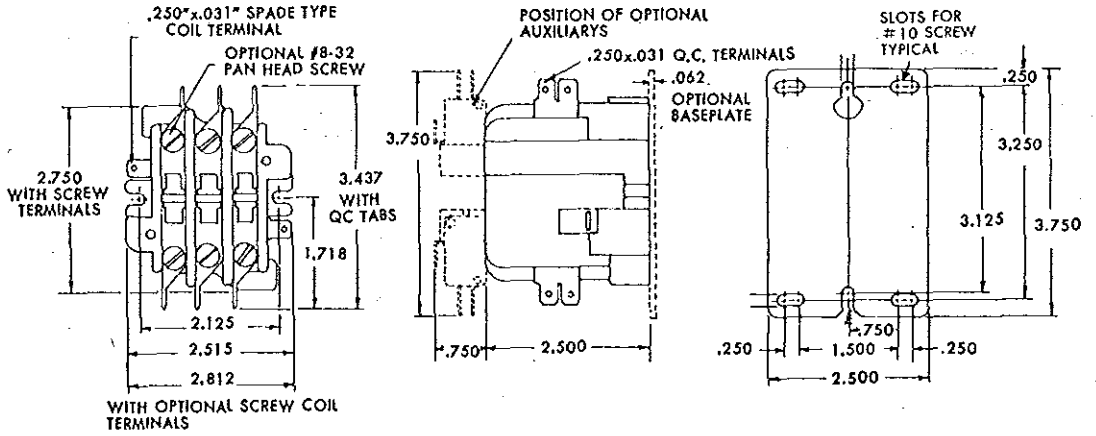
For Modifications, see page 27.
For Outline and Mounting Dimensions, see page 42.
For Coil Data, see page 30.
For Renewal Parts, see page 30.

11907510

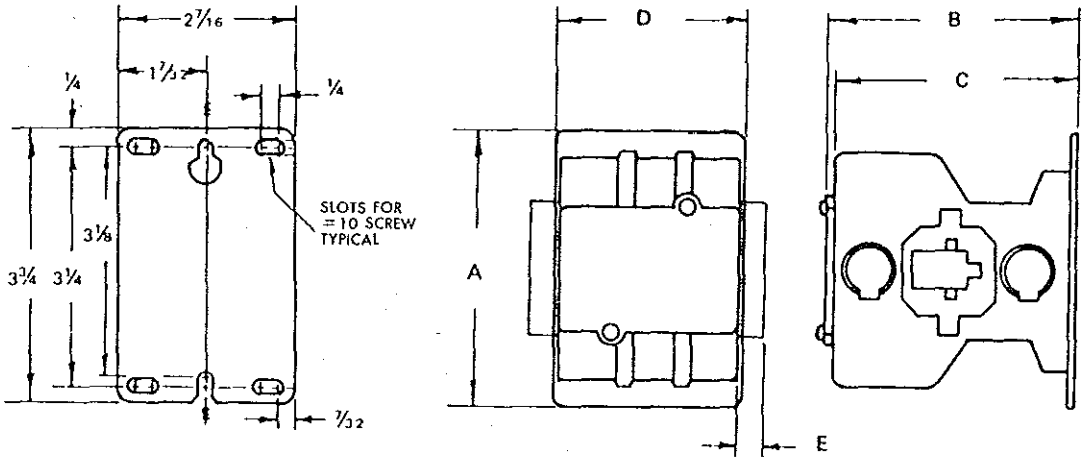
SPECIAL PURPOSE CONTACTORS

OUTLINE AND MOUNTING DIMENSIONS

TYPE DP SPECIAL PURPOSE CONTACTORS



TYPE EB, EBA, EBH SPECIAL PURPOSE CONTACTORS



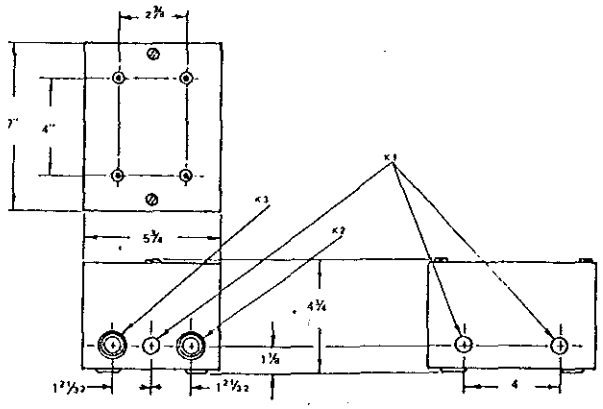
MOUNTING PLATE DIMENSIONS

Mounting plate interchangeable with: Arrow-Hart & Hegeman, Honeywell, General Electric, Cutler-Hammer, Clark, Furnas, Elmwood.

Unit	A	B	C	D	E①
2 & 3 pole EBC, EB, EBH	3¾	3 11/32	3 11/32	2 5/16	33/64
4 pole EBC, EB, EBH	3¾	3 17/32	3 11/32	3⅜	33/64
2 & 3 pole EBA	3¾	3 15/16	3 41/64	3⅜	33/64

① Additional width of unit for each auxiliary added.

TYPE DP, EB, EBA, EBH SPECIAL PURPOSE CONTACTORS (Enclosed)



NEMA 1—General Purpose Enclosure—Outline & Mounting Dimensions.

K1—Single knockout for standard ½" conduit is top, bottom, and sides.

K2—Triple knockout for standard ½" x ¾" x 1" conduit, 1 place in top and bottom.

K3—Triple knockout for standard ½" x ¾" x 1" conduit, 1 place in top and bottom.

1190 7513

TYPE EB DEFINITE PURPOSE NON-REVERSING STARTER,

OPEN TYPE. 7½ H.P. MAX. AT 460 V. 3 POLE.

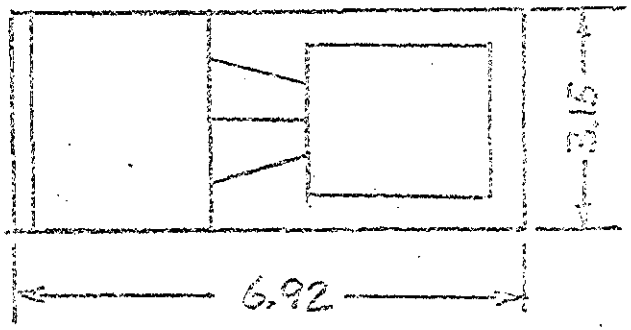
3 I-T-E OVERLOAD RELAYS.

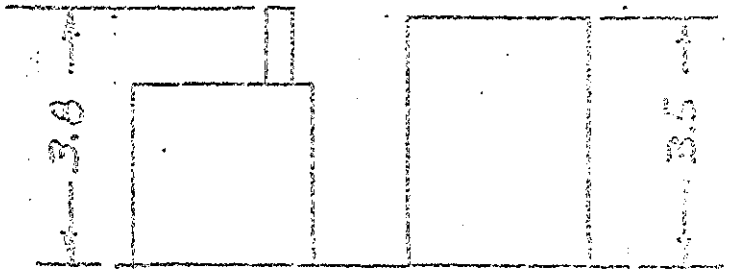
110-120 V. 60 HZ COIL.

WITH HOLDING CONTACT.

CAT. No.: 2201CEB331AA

VENDOR: I-T-E IMPERIAL





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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	P6893	3/25/77	WAS 2201CEB330AA	RK RTC

TITLE: STARTER 7½HP

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .062 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. P6 1245	11/10 75	ASSY. OR LO.	
DR. BY R. KEYES	10/27/75	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. R.C.W.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1190 7513 | SHEET 1 OF 1

DF1200-R

CONTROL

STARTERS

TYPE 2201I EB HP and AMPERE RATED MOTOR STARTERS

NON-REVERSING AC STARTERS WITH INDIRECTLY HEATED BI-METALLIC OVERLOAD RELAY

Volts	Max. H.P. Single Phase	Max. H.P. Three Phase	Full Load Amps	Locked Rotor Amps 277V	Locked Rotor Amps 480V	Locked Rotor Amps 600V	No. Overload Relays	Power Poles	Wired Hold In Contact	Open Type Cat. No.①②	General Purpose④ NEMA Type 1 Cat. No.①②
115 230 460–575	2 3 –	3 5 7½	25	150	125	100	1	2	–	2201IAEB220AA	2201IAEB220AB
							1	2	1	2201IAEB221AA	2201IAEB221AB
							2	3	–	2201IBEB230AA	2201IBEB230AB
							2	3	1	2201IBEB231AA	2201IBEB231AB
							3	3	–	2201ICEB230AA	2201ICEB230AB
							3	3	1	2201ICEB231AA	2201ICEB231AB
							2	4	–	2201IBEB240AA	2201IBEB240AB
							3	4	–	2201ICEB240AA	2201ICEB240AB
115 230 460–575	2 5 –	5 7½ 10	30	180	150	120	1	2	–	2201IAEB320AA	2201IAEB320AB
							1	2	1	2201IAEB321AA	2201IAEB321AB
							2	3	–	2201IBEB330AA	2201IBEB330AB
							2	3	1	2201IBEB331AA	2201IBEB331AB
							3	3	–	2201ICEB330AA	2201ICEB330AB
							3	3	1	2201ICEB331AA	2201ICEB331AB
							2	4	–	2201IBEB340AA	2201IBEB340AB
							3	4	–	2201ICEB340AA	2201ICEB340AB
115 230 460–575	2 5 –	5 10 15	40	240	200	160	1	2	–	2201IAEB420AA	2201IAEB420AB
							1	2	1	2201IAEB421AA	2201IAEB421AB
							2	3	–	2201IBEB430AA	2201IBEB430AB
							2	3	1	2201IBEB431AA	2201IBEB431AB
							3	3	–	2201ICEB430AA	2201ICEB430AB
							3	3	1	2201ICEB431AA	2201ICEB431AB
							2	4	–	2201IBEB440AA	2201IBEB440AB
							3	4	–	2201ICEB440AA	2201ICEB440AB
115 230 460–575	3 7½	7½ 15 25	50	300	250	200	1	2	–	2201IAEBA520AA	2201IAEBA520AB
							1	2	1	2201IAEBA521AA	2201IAEBA521AB
							2	3	–	2201IBEBA530AA	2201IBEBA530AB
							2	3	1	2201IBEBA531AA	2201IBEBA531AB
							3	3	–	2201ICEBA530AA	2201ICEBA530AB
							3	3	1	2201ICEBA531AA	2201ICEBA531AB
115 230 460–575	5 10	10 20 30	60	360	300	240	1	2	–	2201IAEBA620AA	2201IAEBA620AB
							1	2	1	2201IAEBA621AA	2201IAEBA621AB
							2	3	–	2201IBEBA630AA	2201IBEBA630AB
							2	3	1	2201IBEBA631AA	2201IBEBA631AB
							3	3	–	2201ICEBA630AA	2201ICEBA630AB
							3	3	1	2201ICEBA631AA	2201ICEBA631AB

① All starters listed with 120 VAC operating coil. For coil voltages other than 120 Volt, select voltage code letter from table and substitute for 12th character of catalog number.

AC COIL SELECTION

Volts	24	110–120	208–240⑤	277	440–460	480	550–600	120/240
Code Letter	E	A	B	G	K	C	D	AB③

② Price does not include thermal overload heater elements. Select heater elements from tables 1 or 5 on pages 141–147. Heater elements $6.00 list each. Discount Schedule T.

③ List price adder for dual voltage coils, (AB) $6.00.

④ For separate NEMA 1 enclosure use Cat. No. A1 at $8.00 list. Discount Schedule T.

For Coil Data, see page 56.
For Modifications see page 55.
For Dimensions see page 64.
For Renewal Parts see page 56.

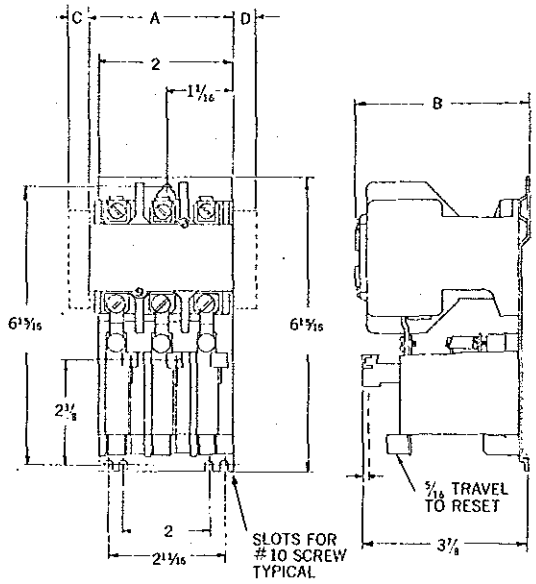
⑤ 220–240V for 50 & 60 amp devices.

11907513

SPECIAL PURPOSE STARTERS

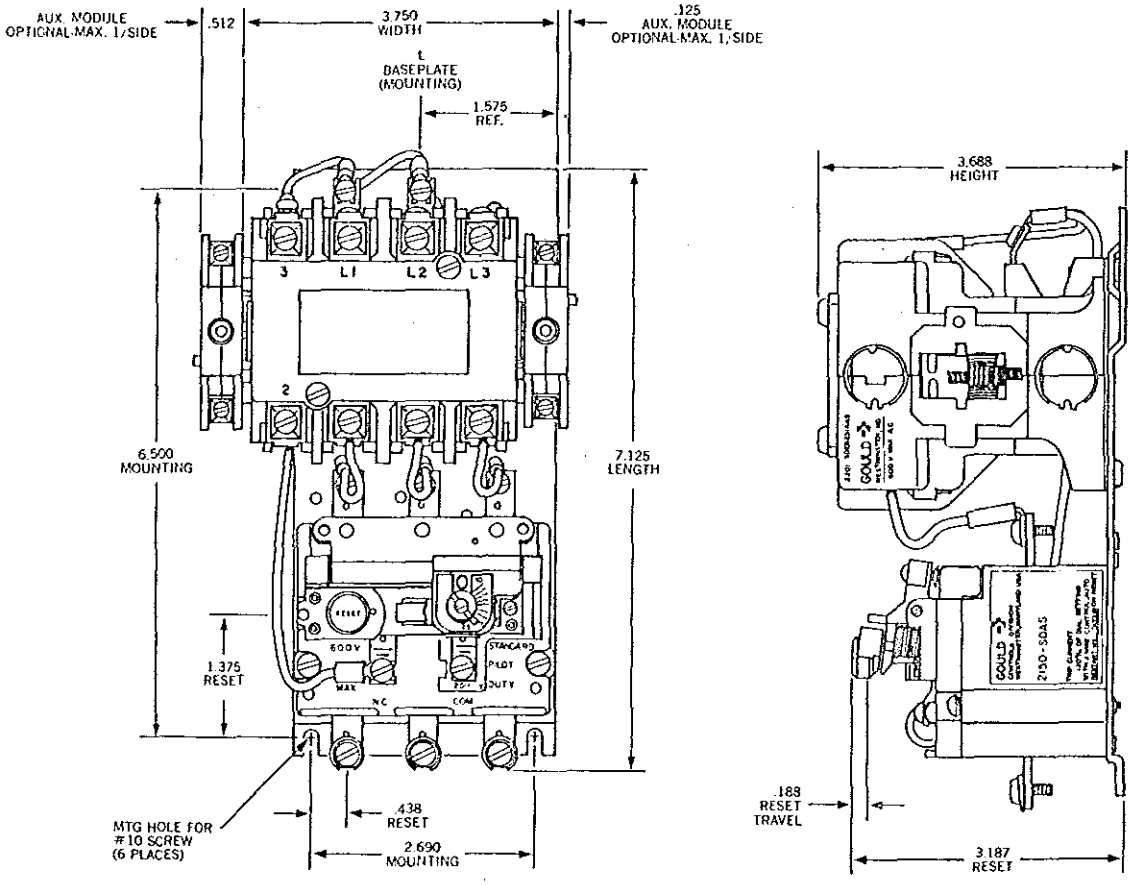
OUTLINE AND MOUNTING DIMENSIONS

TYPE EB SPECIAL PURPOSE AC NON-REVERSING STARTERS WITH 3 PHASE INDIRECTLY HEATED NON-COMPENSATED OR COMPENSATED OVERLOAD RELAYS



3 POLE UNIT WITH HOLD-IN CONTACT		
DIM	SIZE 00-2	SIZE 2½-2¾
A	3⅜	3¾
B	3 21/32	4
C	½	N/A
D	⅛	17/32

TYPE EB SPECIAL PURPOSE AC NON-REVERSING STARTERS WITH DIRECTLY HEATED BIMETAL OVERLOAD RELAYS



1190750

DESCRIPTION: RELAY A.C. — CLASS J10 — 600 VOLT — CONVERTIBLE CONTACTS 2 N.O. — COIL 480 VOLTS 60 HZ.

VENDOR DWG.: ITE SPEEDFAX CAT. MAR.75 PAGE 94.

VENDOR PC. NO.: J10 A 2048

VENDOR: ITE IMPERIAL CORP.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
RELAY
2 NO
480V. 60 HZ

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. P6190	2/23/76	ASSY. OR LO. 11870062	
DR. BY GRANZOW	2/15/76	SCALE	
CHK'D. BY R.K.	2/17/76	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11907550 | SHEET 1 OF 1

11907560

RELAY, 2PDT, TIME DELAY ON PICK-UP (ON DELAY)

COIL 120 VDC.

TIME RANGE 1.5-15 SEC.

AGASTAT 7000 SERIES

VENDOR CAT. NO. 7012 PC

VENDOR. AMERACE CORP.
CONTROL PRODUCTS DIV.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: RELAY 2PDT TDPU 1.5-15 SEC 120VDC

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .030 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. P618	2/20/76	ASSY. OR LO.	
DR. BY R. KEYES	2/10/76	SCALE	
CHK'D. BY C.K.	2/12/76	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			

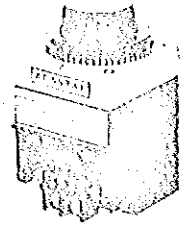
SHEET SIZE A | DWG. NO. 11907560 | SHEET 1 OF 1

DF-0003-2

AGASTAT®

7000 Series timing relay

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

Because of the skilled calibration and adjustment required on certain components prior to final assembly, we recommend that field servicing be limited to the replacement of the switch-block and coil assemblies, listed below. These have been designed to insure factory-built performance after field servicing without elaborate calibration. In cases where damage or abuse make it impossible to restore satisfactory performance by replacing these assemblies, the unit should be returned to the factory for repair or replacement.

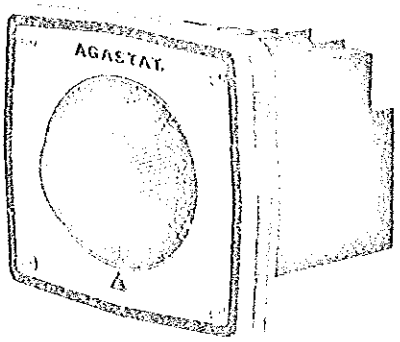
MOUNTING INSTRUCTIONS

A. VERTICAL

Normal mounting for the basic 7000 Series unit is in a vertical position, from the back of the panel. Four 8-32 tapped holes are provided in the back plate, making it interchangeable with earlier models. Mounting screws should not project more than 5/32" into the back of the unit, to prevent internal damage.

A bracket for mounting the unit from the front, and the screws required to attach it to the relay are also supplied with each unit. The bracket extends approximately 3/8" from each side of the unit.

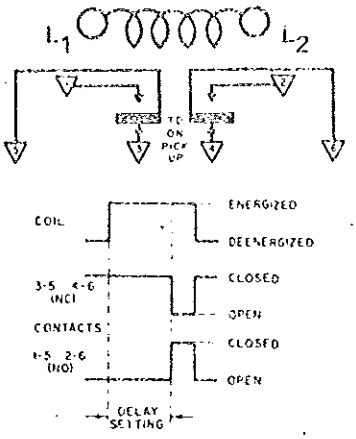
B. HORIZONTAL/PANELMOUNT



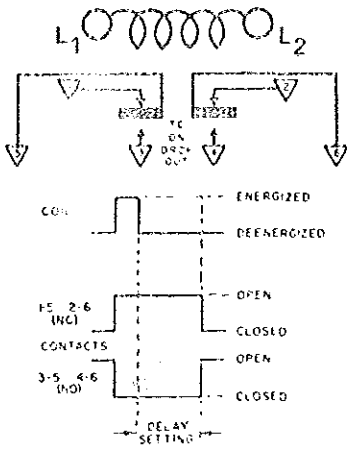
All basic 7000 Series units may be mounted horizontally. However, a dial calibration error (as much as 32% in some units) will result unless the timer is factory equipped with horizontal operation option X or Y1. A unit factory equipped with vertical-horizontal operation option Y2 will require the removal of the Position Compensation Spring in order to maintain accurate calibration. This spring may be removed after the removal of the plastic dust cover, which is fastened to the bottom of the timer with two screws. The dust cover must be replaced after removing the spring.

If the Panel Mounting Kit (option X) is added in the field to units not factory equipped with options Y1 or Y2, an error in dial calibration will result.

7012 SERIES



7022 SERIES



AUXILIARY SWITCH ADJUSTMENT

MODEL 7012

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downward stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization, and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.*

MODEL 7022

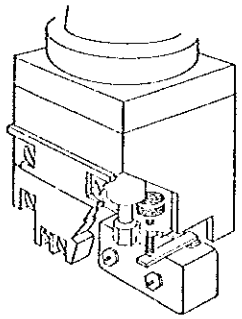
INSTANT TRANSFER AUX. SWITCH (CODE T)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before spindle returns to its normal position, following deenergization. To increase aux. switch delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.

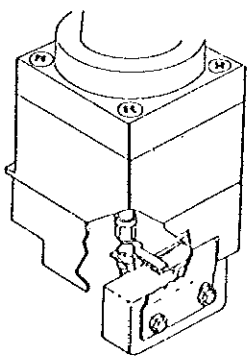
TWO STEP AUX. SWITCH (CODE T)

Check operation as for Instant Transfer, above. Increase first delay period by turning actuator screw clockwise until the desired delay before aux. switch transfer is reached.*

*First delay is independently adjustable, but must be no more than 30% of overall delay. (Recommended max. 100 sec.)



CODE L



CODE T

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102-132	110	93.5-121
	B	240	204-264	220	187-242
	C	480	408-528		
	D	550	468-605		
	E	24	20.5-26.5		
	F			127	108-139
	G			260	204-264
	H	12	10.2-13.2		
	I	6	5.1-6.6		
	J	208	178-229		
	K	DUAL VOLTAGE COIL (COMBINES A & E)			

AC SPECIALS L1, L2, etc.

A C Coils (Part No. = 2400 followed by dash and code letter above)

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range D C
2410—	M	28	22.5-33.5
	N	48	38.5-57.5
	O	24	19.2-28.8
	P	120	96-144
	Q	12	9.6-14.4
	R	60	48-74
	S	250	200-300
	T	550	440-660
	U	16	12.8-19.2
	V	32	25.6-38.4
	W	96	76.8-115
	Y	6	4.8-7.2
	Z	220	176-264

DC SPECIALS X1, X2, etc.

D C Coils (Part No. = 2410 followed by dash and code letter above)

All units draw approximately 8 watts power at rated voltage.

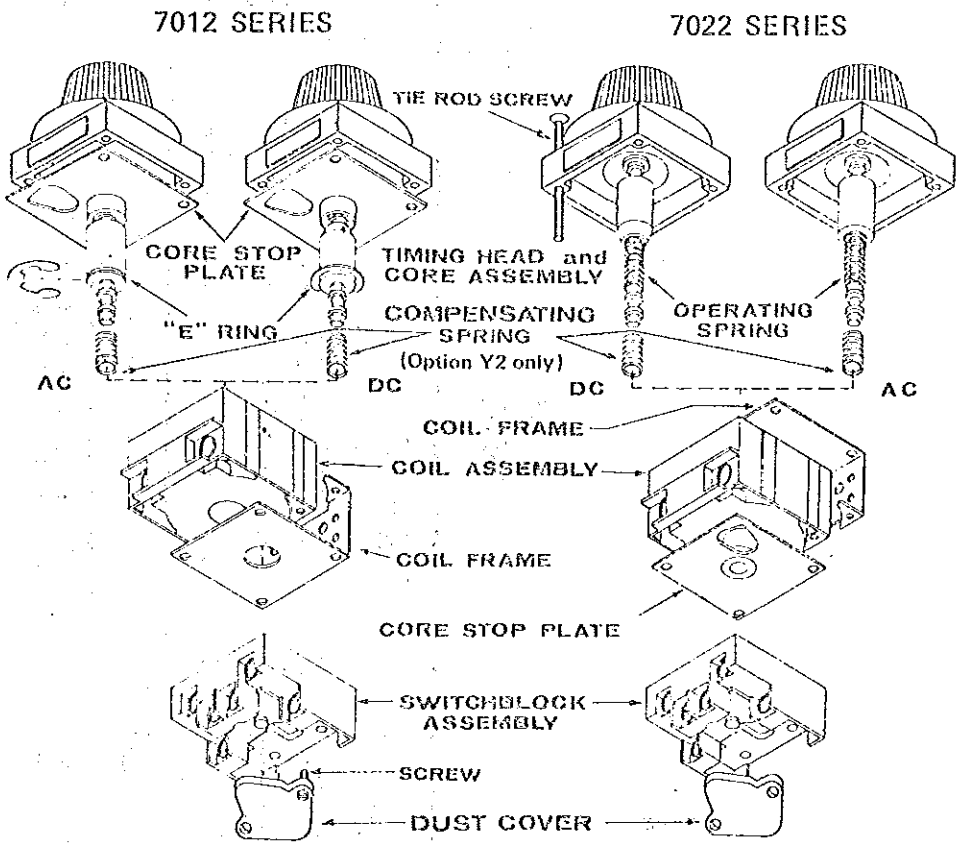
Minimum operating voltages are based on vertically mounted 7012 (on-delay) units. 7012 horizontally mounted or 7022 (off-delay) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

A C units drop out at approximately 50% of rated voltage. D C units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Intermittent duty = maximum 50% duty cycle and 30 minutes "on" time.)

REPLACING SWITCHBLOCK AND COIL ASSEMBLIES – MODEL 7012 AND 7022

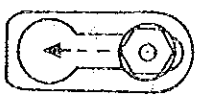
Switchblock assemblies are universally interchangeable between all standard 7000 Series units. The same assembly is used for A C and D C models for delay on pull-in or delay on dropout service. Neither timing head/core assembly nor coil assembly is interchangeable between A C and D C models.



REMOVING SWITCHBLOCK

1. Remove four tie rod screws.
2. Hold timing head and coil assembly in one hand, switchblock in the other.
3. Slide switchblock 1/2" forward of coil assembly to center spindle in large end of keyhole slot in switch blade. (See diagram A).
4. Slowly lift timing head and coil assembly off switchblock, being careful to keep spindle collar away from switchblade while withdrawing it.

REVERSE THIS PROCEDURE TO INSTALL NEW SWITCHBLOCK.



A

REMOVING COIL

Follow steps 1 to 4 above, then:

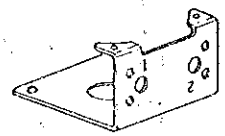
5. Remove timing head and core assembly. (On Model 7022 units the core stop plate and operating spring are loose pieces, located below the core rather than attached to the timing head and core assembly, as on the Model 7012 units. These two pieces should be removed before removing the coil frame, to prevent loss of the loose spring.)

7012 models require removal of "E" ring from core to permit removing core from coil.

6. Slide off coil frame.

When installing new coil, be sure to replace coil frame with proper side up. Number "1" on back of frame should be up on 7012 (Delay on Pull-in) Models, Number "2" should be up on 7022 (Delay on Drop-out) Models. See Diagram B.

On 7012 models, replace "E" ring in core slot after assembling coil frame to coil.



B

REPLACEMENT ASSEMBLIES

	Part No.
AC Coil Assembly	2400- *
DC Coil Assembly	2410- *
Switchblock Assembly	2412-30
Auxiliary Switch Kit (Code L)	7000-47
Auxiliary Switch Kit (Code T)	2412-121

* Specify voltage with code letter

LINEAR TIMING RANGE

Time Range Code	Models 7011, 7012, 7021, 7022, 7024	Models 7014, 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	1 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not avail.
J	3 to 120 Cyc.	Not avail.
K	1 to 300 Sec.	Not avail.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014, 7031 and 7032 are available with letter calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ¼ H.P., 10 A. Resistive; 600 V.A.C., 5A.G.P. 30 V.D.C., 15A.G.P.

WARRANTY

The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

FOR REPAIR SERVICE

Return defective units to:

CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 Hickory Street
Grafton, Wisconsin 53024

ATTENTION: Product Service Department

amerace CONTROL PRODUCTS DIVISION

Amerace Corporation
Control Products Div.
2350 Vauxhall Road
Union, New Jersey 07083

SR-30

January 1974 Printed in U.S.A.

1190756 1

RELAY, 2PDT, TIME DELAY ON DROP-OUT (OFF DELAY)

COIL 120V DC.

TIME RANGE: 20-200 SEC.

AGASTAT 7000 SERIES

VENDOR PART NO. 7022PE

VENDOR AMERACE CORP.
CONTROL PRODUCTS DIV.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: RELAY 2PDT TDDO 20-200 SEC. 120VDC

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

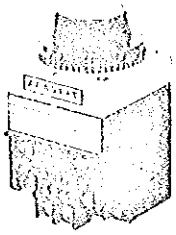
REL. NO. P6191	2/20/76	ASSY OR LO.
DR. BY R. KEYES	2/10/76	SCALE
CHK'D. BY CRS	2-12-76	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190756 | SHEET 1 OF 1

AGASTAT®

7000 Series timing relay

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

Because of the skilled calibration and adjustment required on certain components prior to final assembly, we recommend that field servicing be limited to the replacement of the switch-block and coil assemblies, listed below. These have been designed to insure factory-built performance after field servicing without elaborate calibration. In cases where damage or abuse make it impossible to restore satisfactory performance by replacing these assemblies, the unit should be returned to the factory for repair or replacement.

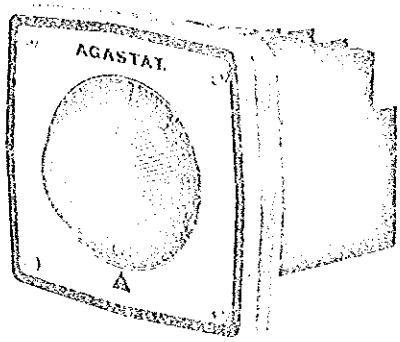
MOUNTING INSTRUCTIONS

A. VERTICAL

Normal mounting for the basic 7000 Series unit is in a vertical position, from the back of the panel. Four 8-32 tapped holes are provided in the back plate, making it interchangeable with earlier models. Mounting screws should not project more than 5/32" into the back of the unit, to prevent internal damage.

A bracket for mounting the unit from the front, and the screws required to attach it to the relay are also supplied with each unit. The bracket extends approximately 3/8" from each side of the unit.

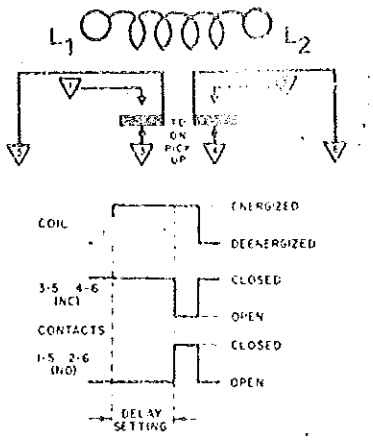
B. HORIZONTAL/PANEL MOUNT



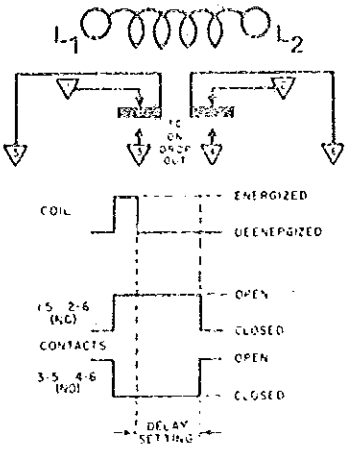
All basic 7000 Series units may be mounted horizontally. However, a dial calibration error (as much as 32% in some units) will result unless the timer is factory equipped with horizontal operation option X or Y1. A unit factory equipped with vertical-horizontal operation option Y2 will require the removal of the Position Compensation Spring in order to maintain accurate calibration. This spring may be removed after the removal of the plastic dust cover, which is fastened to the bottom of the timer with two screws. The dust cover must be replaced after removing the spring.

If the Panel Mounting Kit (option X) is added in the field to units not factory equipped with options Y1 or Y2, an error in dial calibration will result.

7012 SERIES



7022 SERIES



AUXILIARY SWITCH ADJUSTMENT

MODEL 7012

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downword stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization, and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.*

MODEL 7022

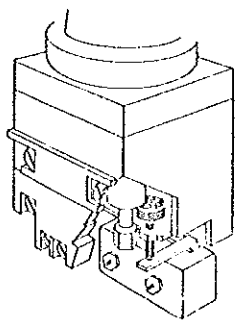
INSTANT TRANSFER AUX. SWITCH (CODE T)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before spindle returns to its normal position, following deenergization. To increase aux. switch delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.

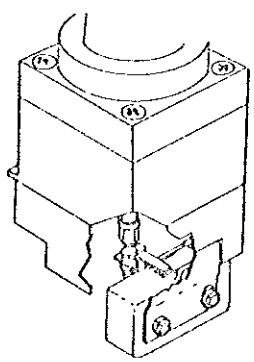
TWO STEP AUX. SWITCH (CODE T)

Check operation as for Instant Transfer, above. Increase first delay period by turning actuator screw clockwise until the desired delay before aux. switch transfer is reached.*

*First delay is independently adjustable, but must be no more than 30% of overall delay. (Recommended max. 100 sec.)



CODE L



CODE T

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102 - 132	110	93.5 - 121
	B	240	204 - 264	220	187 - 242
	C	480	408 - 528		
	D	550	468 - 605		
	E	24	20.5 - 26.5		
	F			127	108 - 140
	G			240	204 - 264
	H	12	10.2 - 13.2		
	I	6	5.1 - 6.6		
	J	208	178 - 229		
	K	DUAL VOLTAGE COIL (COMBINES A & E)			

AC

AC SPECIALS L1, L2, etc.

AC Coils (Part No. = 2400 followed by dash and code letter above

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range DC
2410—	M	28	22.5 - 33.5
	N	48	38.5 - 57.5
	O	24	19.2 - 28.8
	P	120	96 - 144
	Q	12	9.6 - 14.4
	R	60	48 - 72
	S	250	200 - 300
	T	550	440 - 660
	U	16	12.8 - 19.2
	V	32	25.6 - 38.4
	W	96	76.8 - 115
	Y	6	4.8 - 7.2
	Z	220	176 - 264

DC

DC SPECIALS X1, X2, etc.

DC Coils (Part No. = 2410 followed by dash and code letter above

All units draw approximately 8 watts power at rated voltage.

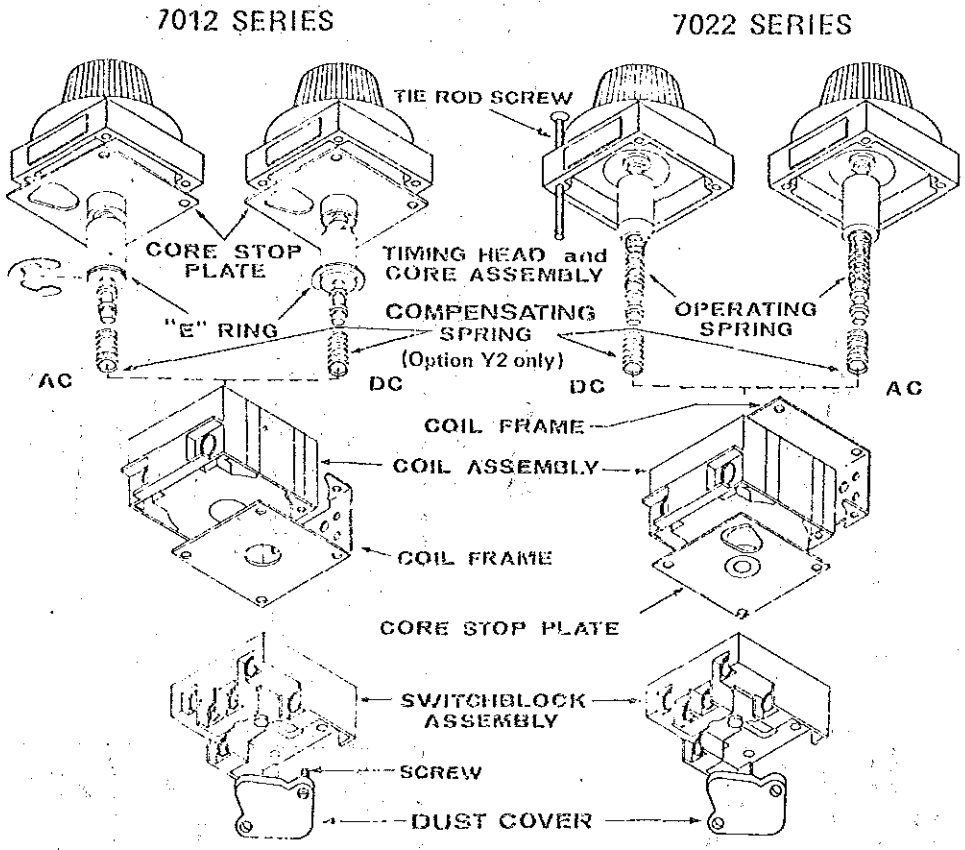
Minimum operating voltages are based on vertically mounted 7012 (on-delay) units. 7012 horizontally mounted or 7022 (off-delay) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

AC units drop out at approximately 50% of rated voltage. DC units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. Intermittent duty - maximum 50% duty cycle and 30 minutes "on" time.

REPLACING SWITCHBLOCK AND COIL ASSEMBLIES – MODEL 7012 AND 7022

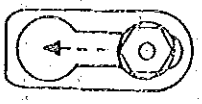
Switchblock assemblies are universally interchangeable between all standard 7000 Series units. The same assembly is used for A C and D C models for delay on pull-in or delay on dropout service. Neither timing head/core assembly nor coil assembly is interchangeable between A C and D C models.



REMOVING SWITCHBLOCK

1. Remove four tie rod screws.
2. Hold timing head and coil assembly in one hand, switchblock in the other.
3. Slide switchblock 1/2" forward of coil assembly to center spindle in large end of keyhole slot in switch blade. (See diagram A).
4. Slowly lift timing head and coil assembly off switchblock, being careful to keep spindle collar away from switchblade while withdrawing it.

REVERSE THIS PROCEDURE TO INSTALL NEW SWITCHBLOCK.



A

REMOVING COIL

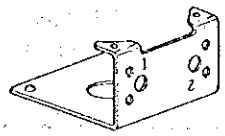
Follow steps 1 to 4 above, then:

5. Remove timing head and core assembly. (On Model 7022 units the core stop plate and operating spring are loose pieces, located below the core rather than attached to the timing head and core assembly, as on the Model 7012 units. These two pieces should be removed before removing the coil frame, to prevent loss of the loose spring.) 7012 models require removal of "E" ring from core to permit removing core from coil.

6. Slide off coil frame.

When installing new coil, be sure to replace coil frame with proper side up. Number "1" on back of frame should be up on 7012 (Delay on Pull-in) Models, Number "2" should be up on 7022 (Delay on Drop-out) Models. See Diagram B.

On 7012 models, replace "E" ring in core slot after assembling coil frame to coil.



B

REPLACEMENT ASSEMBLIES

	Part No.
AC Coil Assembly	2400- *
DC Coil Assembly	2410- *
Switchblock Assembly	2412-30
Auxiliary Switch Kit (Code L)	7000-47
Auxiliary Switch Kit (Code T)	2412-121

* Specify voltage with code letter

LINEAR TIMING RANGES

Time Range Code	Models 7011, 7012, 7021, 7022, 7024	Models 7014, 7031, 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	.7 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not avail.
J	3 to 120 Cyc.	Not avail.
K	1 to 300 Sec.	Not avail.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014, 7031 and 7032 are available with letter calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ¼ H.P., 10 A. Resistive; 600 V.A.C., 5A.G.P. 30 V.D.C., 15A.G.P.

WARRANTY

The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

FOR REPAIR SERVICE

Return defective units to:

CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 Hickory Street
Grafton, Wisconsin 53024

ATTENTION: Product Service Department

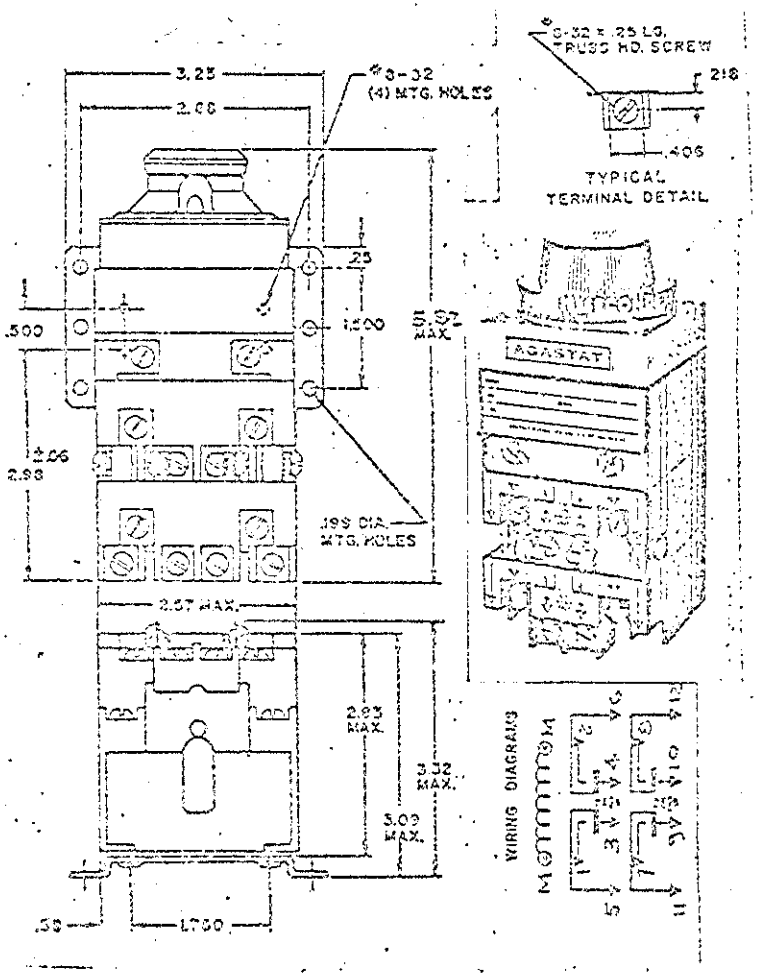
amerace CONTROL PRODUCTS DIVISION

Amerace Corporation
Control Products Div.
2330 Vauxhall Road
Union, New Jersey 07

SR-30

January 1974 Printed in U.S.A.

1190830



DESCRIPTION:
RELAY TIMING,
AGASTAT 7000 SERIES.
OPERATION ON-DELAY.
CONTACT ARRANGEMENT 4PDT.
COIL VOLTAGE 120VDC.
TIME RANGE 1.5 TO 15 SEC.

VENDOR PC. NO.:
7014 PC

VENDOR:
AMERACE CORP.
CONTROL PRODUCTS DIV.
2330 VAUXHALL ROAD
UNION, NJ. 07083

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
RELAY 4PDT TDPU
1.5-15 SEC. COIL
120 VDC.

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

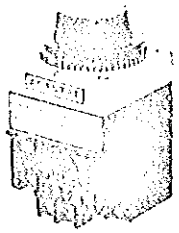
REL. NO. P6401	8130116	ASSY. OR LO.	
DR. BY GRANEOW	8 4 72	SCALE	
CHK'D. BY	/ /	HEAT TR.	
MAT'L			
APPV.	CAST.	MAT'L	
	MACH.	ENGR.	
	WELD.		

SHEET SIZE A | DWG. NO. 1190830-4 | SHEET 1 OF 1

AGASTAT®

7000 Series timing relay

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

Because of the skilled calibration and adjustment required on certain components prior to final assembly, we recommend that field servicing be limited to the replacement of the switch-block and coil assemblies, listed below. These have been designed to insure factory-built performance after field servicing without elaborate calibration. In cases where damage or abuse make it impossible to restore satisfactory performance by replacing these assemblies, the unit should be returned to the factory for repair or replacement.

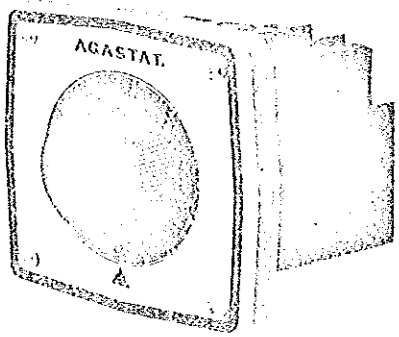
MOUNTING INSTRUCTIONS

A. VERTICAL

Normal mounting for the basic 7000 Series unit is in a vertical position, from the back of the panel. Four 8-32 tapped holes are provided in the back plate, making it interchangeable with earlier models. Mounting screws should not project more than 5/32" into the back of the unit, to prevent internal damage.

A bracket for mounting the unit from the front, and the screws required to attach it to the relay are also supplied with each unit. The bracket extends approximately 3/8" from each side of the unit.

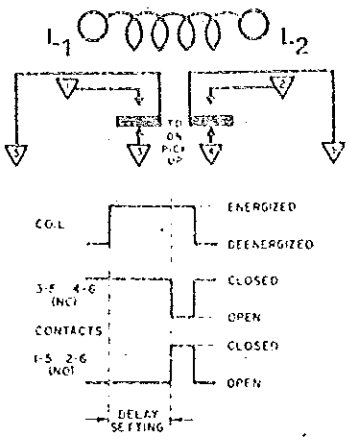
B. HORIZONTAL/PANELMOUNT



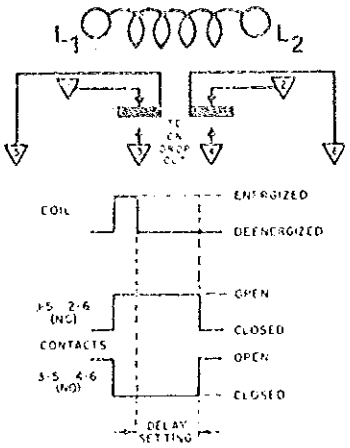
All basic 7000 Series units may be mounted horizontally. However, a dial calibration error (as much as 32% in some units) will result unless the timer is factory equipped with horizontal operation option X or Y1. A unit factory equipped with vertical-horizontal operation option Y2 will require the removal of the Position Compensation Spring in order to maintain accurate calibration. This spring may be removed after the removal of the plastic dust cover, which is fastened to the bottom of the timer with two screws. The dust cover must be replaced after removing the spring.

If the Panel Mounting Kit (option X) is added in the field to units not factory equipped with options Y1 or Y2, an error in dial calibration will result.

7012 SERIES



7022 SERIES



AUXILIARY SWITCH ADJUSTMENT

MODEL 7012

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downword stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization, and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.*

MODEL 7022

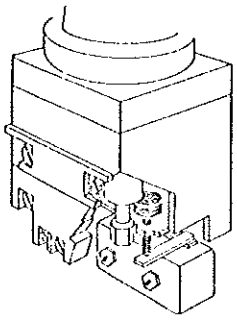
INSTANT TRANSFER AUX. SWITCH (CODE T)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before spindle returns to its normal position, following deenergization. To increase aux. switch delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.

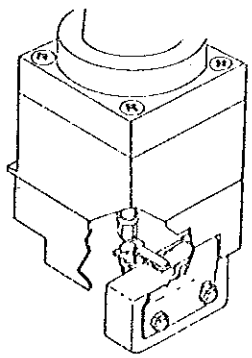
TWO STEP AUX. SWITCH (CODE T)

Check operation as for Instant Transfer, above. Increase first delay period by turning actuator screw clockwise until the desired delay before aux. switch transfer is reached.*

*First delay is independently adjustable, but must be no more than 30% of overall delay. (Recommended max. 100 sec.)



CODE L



CODE T

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	* Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102-132	110	93.5-121
	B	240	204-264	220	187-242
	C	480	408-528		
	D	550	468-605		
	E	24	20.5-26.5		
	F			127	108-140
	G			240	204-264
	H	12	10.2-13.2		
	I	6	5.1-6.6		
	J	208	178-229		
	K	DUAL VOLTAGE COIL (COMBINES A & B)			

AC

AC SPECIALS L1, L2, etc.

AC Coils (Part No. = 2400 followed by dash and code letter above)

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range D C
2410—	M	28	22.5-33.5
	N	48	38.5-57.5
	O	24	19.2-28.8
	P	120	96-144
	Q	12	9.6-14.4
	R	60	48-74
	S	250	200-300
	T	550	440-660
	U	16	12.8-19.2
	V	32	25.6-38.4
	W	96	76.8-115
	Y	6	4.8-7.2
	Z	220	176-264

DC

DC SPECIALS X1, X2, etc.

DC Coils (Part No. = 2410 followed by dash and code letter above)

All units draw approximately 8 watts power at rated voltage.

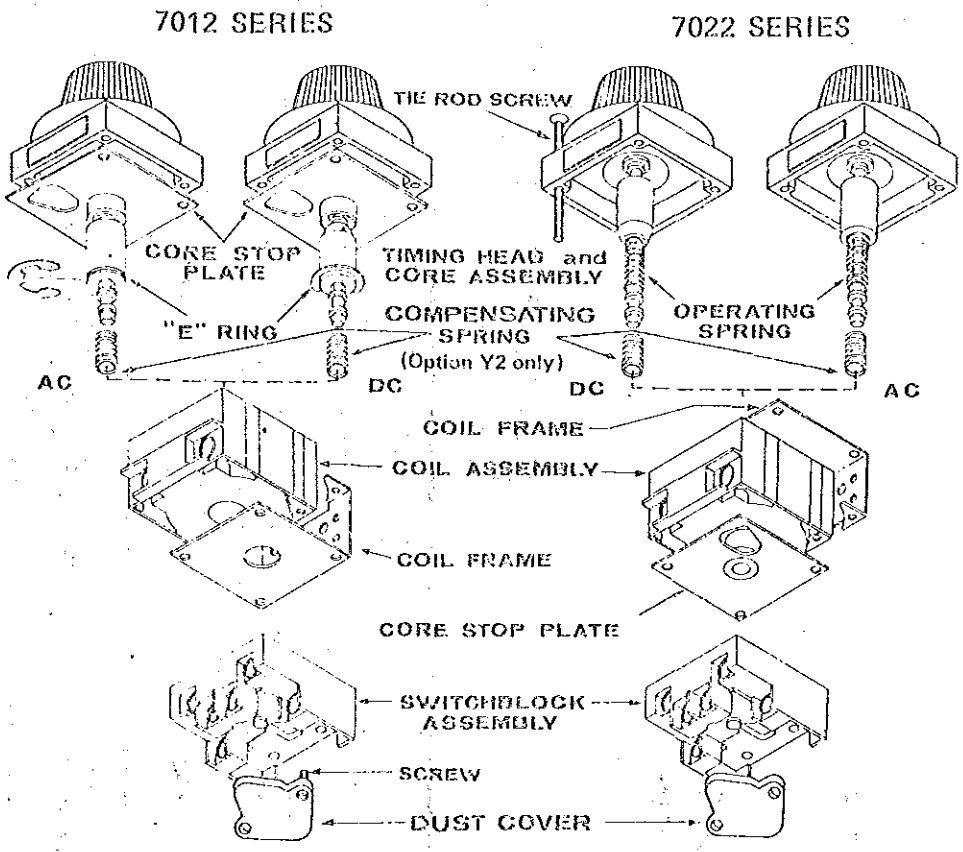
Minimum operating voltages are based on vertically mounted 7012 (on-delay) units. 7012 horizontally mounted or 7022 (off-delay) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

A C units drop out at approximately 60% of rated voltage. D C units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Intermittent duty—maximum 50% duty cycle and 30 minutes "on" time.)

REPLACING SWITCHBLOCK AND COIL ASSEMBLIES – MODEL 7012 AND 7022

Switchblock assemblies are universally interchangeable between all standard 7000 Series units. The same assembly is used for A C and D C models for delay on pull-in or delay on dropout service. Neither timing head/core assembly nor coil assembly is interchangeable between A C and D C models.



LINEAR TIMING RANGES

Time Range Code	Models 7011, 7012, 7021, 7022, 7028	Models 7014, 7031, 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	.7 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not avail.
J	3 to 120 Cycles	Not avail.
K	1 to 300 Sec.	Not avail.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014, 7031 and 7032 are available with letter calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

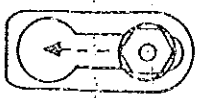
Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ½ H.P., 10 A. Resistive; 600 V.A.C., 5A.G.P. 30 V.D.C., 15A.G.P.

REMOVING SWITCHBLOCK

1. Remove four tie rod screws.
2. Hold timing head and coil assembly in one hand, switchblock in the other.
3. Slide switchblock 1/2" forward of coil assembly to center spindle in large end of keyhole slot in switch blade. (See diagram A).
4. Slowly lift timing head and coil assembly off switchblock, being careful to keep spindle collar away from switchblade while withdrawing it.

REVERSE THIS PROCEDURE TO INSTALL NEW SWITCHBLOCK.



A

REMOVING COIL

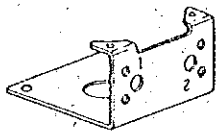
Follow steps 1 to 4 above, then:

5. Remove timing head and core assembly; (On Model 7022 units the core stop plate and operating spring are loose pieces, located below the core rather than attached to the timing head and core assembly, as on the Model 7012 units. These two pieces should be removed before removing the coil frame, to prevent loss of the loose spring.) 7012 models require removal of "E" ring from core to permit removing core from coil.

6. Slide off coil frame.

When installing new coil, be sure to replace coil frame with proper side up. Number "1" on back of frame should be up on 7012 (Delay on Pull-in) Models, Number "2" should be up on 7022 (Delay on Drop-out) Models. See Diagram B.

On 7012 models, replace "E" ring in core slot after assembling coil frame to coil.



B

REPLACEMENT ASSEMBLIES

	Part No.
AC Coil Assembly	2400- *
DC Coil Assembly	2410- *
Switchblock Assembly	2412-30
Auxiliary Switch Kit (Code L)	7000-47
Auxiliary Switch Kit (Code T)	2412-121

* Specify voltage with code letter

WARRANTY

The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

FOR REPAIR SERVICE

Return defective units to:

CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 Hickory Street
Grafton, Wisconsin 53024

ATTENTION: Product Service Department

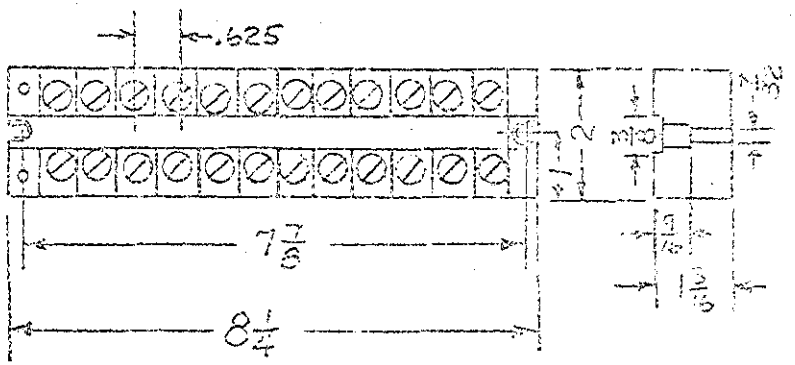
CONTROL PRODUCTS DIVISION

Amerace Corporation
Control Products Division
333 Vaughn Road
Union, New Jersey 07

SR-30

January 1974 Printed In U.S.A.

TERMINAL BLOCK, BARRIER TYPE, WITH MARKER STRIP DOWN CENTER. BRASS SCREWS, NICKEL PLATED, REMOVABLE LINE CONNECTOR. NO COVER. 12 LINES. 600V, 45 AMP. RATING



VENDOR PART NO.: 151213
VENDOR CAT. NO.: 1512 DJ

VENDOR: MARATHON SPECIAL PRODUCTS
BOWLING GREEN, OH. 43402

DISTR.: COMPLETE-READING ELEC. CO.
10448 N. PORT WASHINGTON RD.
MEQUON, WI. 53092
(414-241-3380)

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: TERMINAL BOARD 12 PT, 45A, 600V

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. P6799	2/15/7-	ASSY. OR LO.
DR. BY R. KEYES	1/31/7-	SCALE
CHK'D. BY CG	2/1/7-	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. RC
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190839G | SHEET 1 OF 1

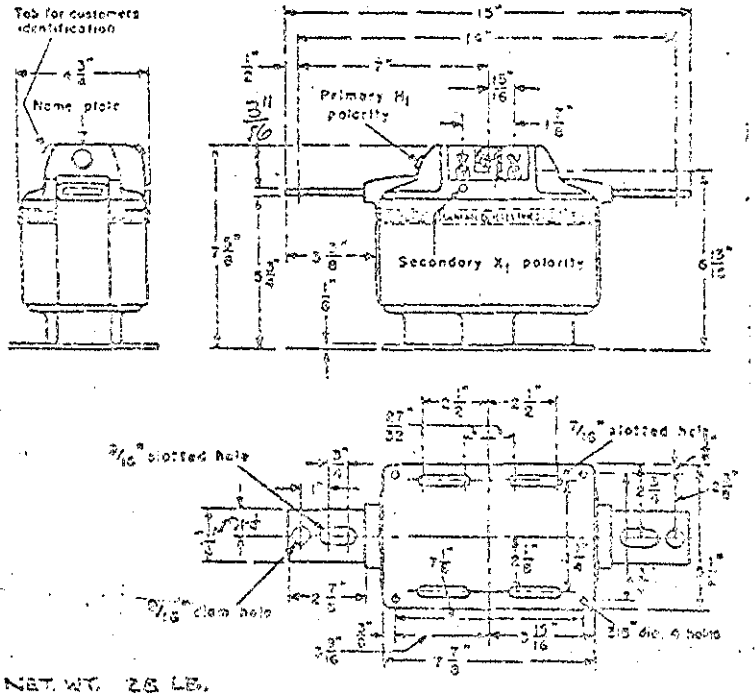
1190850

INDOOR CURRENT TRANSFORMER
TYPE JKM-3, 5000 VOLT

RATIO — 50/5 AMP.

CAT. NO. — 497X27

VENDOR: GENERAL ELECTRIC CO.



NET WT. 26 LB.

SUBSTITUTES PERMITTED WITH ENG'R'G APPROVAL.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
TRANSFORMER
CURRENT
50/5 JKM-3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .000 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1760	4 16 77	ASSY. OR LO.
DR. BY R. KEYES	3 10 77	SCALE
CHK'D. BY CG	3/10/77	HEAT TR.
MAT'L		

APPV.	CAST.	MAT'L
	MACH.	ENGR. RJC
	WELD.	

SHEET SIZE A | DWG. NO. 1190850 | SHEET 1 OF 1

GEH-230AE
Supersedes GEH-230AD

INSTRUCTIONS

INSTRUMENT TRANSFORMERS

BUTYL-MOLDED AND OTHER DRY TYPES

600-VOLT THROUGH 15-KV RATINGS

INTRODUCTION

These instructions apply to indoor and outdoor instrument transformers of butyl-molded and other dry-type constructions. For information on the installation and care of transformers with unusual ratings of frequency, voltage or current, or on installations where unusual conditions exist (refer to Requirements for Instrument Transformers, ANSI C57.13–1968, Section 3), consult the nearest sales office of the General Electric Company. When special information is requested, give the complete nameplate data in order to identify the transformer.

BEFORE INSTALLATION

INSPECTION

Before installation, transformers should be inspected for physical damage that may have occurred during shipment or handling. During shipping, transformers usually are supported only by the base or mounting supports, except that certain butyl-molded types may be shipped from the factory supported by butyl surfaces. Transformers should be dry and the surface of the bushings should be clean. All butyl surfaces should be considered the same as the surface of a porcelain bushing in regard to cleanliness and dryness.

DRYING OUT

Transformers that have been submerged in water should be dried out before installation. Wet asphalt-impregnated or varnish-impregnated transformers may be dried by self-heating. To do this, allow the transformer to stand not less than twelve hours in a room of constant temperature. Measure and record the room temperature and resistance of the secondary winding. *Short-circuit the primary winding* and apply a controllable voltage to the secondary winding. Adjust the voltage so that sufficient current will flow in the winding to raise its temperature to approximately 80 C. The rate of temperature rise should not exceed 6 C per half hour. The winding temperature should be held at approximately 80 C until the transformer is dry. *It will usually require* 24 to 48 hours to dry a transformer.

The amount of current necessary to obtain a winding temperature of 80 C varies because of the differences in heat dissipation and current densities in the different types of transformers. It is advisable to start with a current not greater than two amperes in the secondary of a potential transformer, or not greater than five amperes in the secondary of a current transformer. Gradually increase this current until the proper heating is obtained. Increases of current should be made cautiously with frequent checking of the rise in temperature of the winding.

The temperature of the winding may be determined conveniently by the "resistance change" method. Since the resistance of a copper winding increases approximately 1 percent for each 2-1/2 C, the temperature rise may be calculated by measuring the "before" and "after" resistances and finding the percentage increase in resistance. For example, if the "after" resistance is 0.244 ohm and the resistance at the start (room) temperature is 0.200 ohm, the percentage increase is

$$\frac{0.244-0.200}{0.200} = 0.022 = 22\%$$

which corresponds to a temperature rise of 22 x 2-1/2 = 55 C (approximately). The approximate *winding temperature at any time is the temperature* rise at that time added to the ambient (room) temperature.

Butyl-molded Transformers

Butyl-molded transformers, particularly designs for outdoor use, are relatively impervious to moisture. If, due to unusual circumstances, insulation tests indicate the possibility of the entrance of moisture into a butyl-molded transformer, refer to the nearest General Electric Sales Office for detailed information on proper procedure.

TESTING

If it is desired to make insulation tests after the drying out period, or at any other time, these tests may be made in accordance with Requirements for Instrument Transformers, ANSI C57.13–1968. (Note: Periodic field tests of insulation should not exceed 65 percent of the ANSI test voltage. Incoming tests of new equipment should not exceed 75 percent of the ANSI test voltage.)

Convenient methods for testing polarity are given in ANSI C57.13, the Electrical Metermen's Handbook (published by Edison Electric Institute), and General Electric publication GET-97.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. The equipment covered by these operating instructions should be operated and serviced only by competent technicians familiar with good safety practices, and these instructions are written for such personnel and are not intended as a substitute for adequate training and experience in safe procedures for this type of equipment. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

For ratio and phase angle tests, refer to Electrical Metermen's Handbook and General Electric publications GET-97 and GET-1725.

Certificates

A certificate of test is supplied with many types of butyl-molded potential and current transformers. The certificate is in the form of a tag attached to each transformer. The tag shows the ANSI burden at which the transformer has been tested, and the actual test results of ratio correction factor and phase angle. The tag is perforated and can be detached as a 3- by 5-inch card for filing.

INSTALLATION

SAFETY PRECAUTIONS

Always consider an instrument transformer as a part of the circuit to which it is connected, and do not touch the leads and terminals or other parts of the transformer unless they are known to be adequately grounded.

The butyl surface of transformers should be considered the same as the surface of a porcelain bushing, since a voltage stress exists across the entire butyl surface from terminals to grounded metal parts.

Do not open the secondary circuit of a current transformer while the transformer is energized and do not energize while the secondary circuit is open. This precaution is advisable since current transformers may develop open-circuit secondary voltages which may be hazardous to personnel or injurious to the transformer or equipment connected in the secondary circuit.

Always ground the metallic cases and frames of instrument transformers. The secondaries should be grounded close to the transformers. However, when secondaries of transformers are interconnected, there should be only one grounded point in this circuit to prevent accidental paralleling with system grounding wires.

MOUNTING

Instrument transformers should be mounted so that connections can be made to the power or distribution lines in such a manner as to avoid placing appreciable strains upon the terminals of the transformers. For high-current transformer ratings, 2000 amperes and above, there may be some interference from the electric field of the return bus unless the bus centers are kept at a minimum distance of 15 inches apart; for ratings above 5000 amperes, this distance should be not less than 24 inches. If this type transformer is used with more than one primary turn, the loop should be at least 24 inches in diameter. Make sure that the secondary leads are twisted closely together and carried out without passing through the field of the primary conductors. It is not necessary that the bus exactly fill the window, but the bus or buses should be centralized. For ratings of 1000 amperes or less, these precautions are generally unnecessary.

CONNECTIONS

SECONDARY CONNECTIONS

The resistance of all primary and secondary connections should be kept as low as possible to prevent overheating at the contacts, and to prevent an increase in the secondary burden.

The resistance of the secondary leads should be included in calculating the secondary burden carried by current transformers. The total burden should be kept within limits suited to the transformers used. The voltage drop in the secondary leads of potential transformers will reduce the voltage at the measuring device. *

Short-circuiting Device

Many current transformers are provided with a device for short-circuiting the secondary terminals, and are normally shipped from the factory with this device in short-circuiting position. Check the position of the shorting device. The secondary terminals should be short-circuited by the shorting device, or equivalent, until a suitable burden (such as an ammeter, wattmeter, watthour meter, relay, etc.) has been connected to the secondary terminals.

Multi-ratio current transformers with tapped secondary windings are partially or completely inoperative when any portion of the secondary winding is short-circuited. Shorting devices should be connected across at least 50 percent of the secondary turns until a suitable burden has been connected to the secondary terminals. All short-circuiting devices must be in the open position for normal operation, so that no portion of the winding is short-circuited.

In contrast, on double-secondary or multiple-secondary current transformers, that is, transformers with two or more separate secondary windings, each having an independent core, the shorting device must be left closed on all unused secondary windings. (Unused secondary windings are those to which no suitable burden is attached.)

Before a burden is disconnected from a current transformer, the secondary terminals should be short-circuited. *

PRIMARY BY-PASS PROTECTION

Thyrite® primary by-pass protectors are recommended for the proper protection of current transformers which are so located as to be exposed to the effect of surge currents. They are especially recommended for low primary-current ratings, as these ratings have a relatively high winding impedance.

Thyrite primary by-pass protectors consist of one or more Thyrite disks which are connected in parallel with the primary winding of the transformer. When high-frequency or steep-front voltage surges occur, the characteristic of the Thyrite is such that an appreciable part of the surge current

*Bars indicate changes included in this revision.

is by-passed through the protector. A high-surge voltage, which might result in failure within the primary winding, is thus prevented from building up across the winding.

POLARITY

In wiring instrument transformer circuits, it is necessary to maintain the correct polarity relation between the line and the devices connected to the secondaries. For this reason, the relative polarity of each winding of a transformer is indicated by a marker H_1 (or a white spot) on or near one primary terminal, and a marker X_1 (or a white spot) near one secondary terminal; and in some cases by white bushings. See Figure 1. Where taps are present, all terminals will be marked in order. The primary terminals will be H_1, H_2, H_3, etc.; the secondary terminals X_1, X_2, X_3, etc.; and Y_1, Y_2, Y_3, etc., if another secondary is present. The marker H_1 always indicates the same instantaneous polarity as X_1 and Y_1.

When connection is made to a secondary terminal having a polarity marking similar to a given primary terminal, the polarity will be the same as if the primary service conductor itself were detached from the transformer and connected directly to the secondary conductor. In other words, at the instant when the current is flowing toward the transformer in a primary lead of a certain polarity, current will tend to flow away from the transformer in the secondary lead of similar polarity.

When connecting instrument transformers with meters or instruments, refer to the Instructions furnished with the meters or instruments involved.

AMBIENT TEMPERATURE

All General Electric transformers are designed to operate at the ambient temperatures and ratings indicated by the Company, provided the altitude does not exceed 3300 feet. Refer to Requirements for Instrument Transformers, ANSI C57.13-1968, Section 3. Generally, the allowable ambient temperatures and ratings are marked on the transformer nameplate.

FUSES

Potential-transformer primary fuses are intended to protect the supply system rather than the transformer, although proper fuses will afford partial protection to the transformer in a large number of cases.

The fuses on butyl-type transformers, rated at 1.2-kv through 2.5-kv insulation class, are provided with molded fuse holders which are secured to the transformer by the spring action of the fuse clips. When replacing the fuse and holder, be sure that the plastic insulating piece, fastened under the transformer fuse clip, is inserted between the end of the fuse and the open end of the fuse enclosure; then, press the enclosure firmly onto the transformer to seat the fuse into both clips.

The fuses of some older dry-type transformers, 2400 volts and below, are supported by a hinged cover. If it is necessary to replace a fuse while the transformer is connected to an operating circuit, the cover should be opened by use of an insulating hook, which should be of sufficient length to prevent the operator from being burned in case a short circuit exists in the transformer.

In testing fuses for continuity of circuit, not more than 0.25 ampere should be used.

In replacing fuses, be certain that the voltage rating of the fuse is the one nearest above the line-to-line voltage of the circuit, regardless of the rated voltage of the transformer. Do not use fuses of higher voltage ratings, as undesirable overvoltages may result should the fuse blow. One permissible exception to this general rule is the use of Size A, Type EJ-1 fuse in the old Type JE-2 and present Type JVM-2 transformers. In this case the Size A fuse can be used on either 2400-volt, delta circuits or 2400/4160-volt, solidly grounded Y circuits.

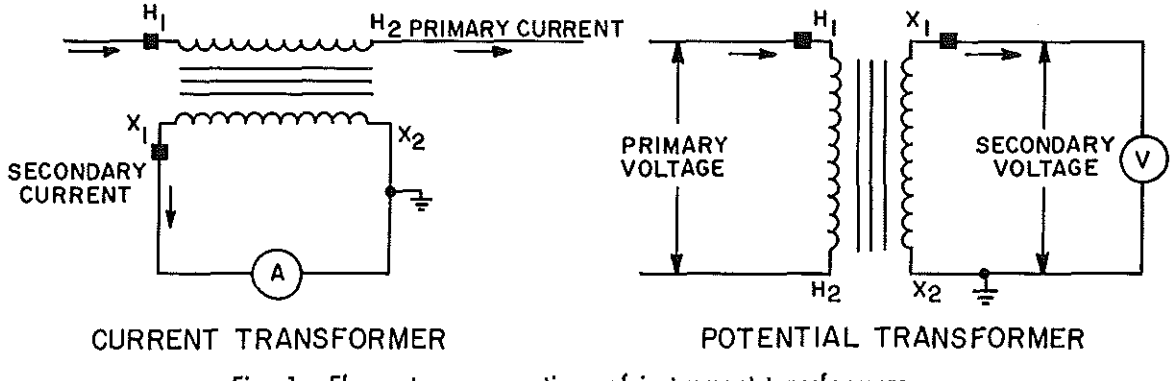


Fig. 1. Elementary connections of instrument transformers

MAINTENANCE

After instrument transformers for indoor use have been installed, they should need no care other than keeping them clean and dry. Transformers for outdoor installations should receive the same care in operation as power transformers of similar design and of similar voltage rating.

CLEANING BUSHINGS

Porcelain bushings may be cleaned by means of a wet cloth or by use of naphtha or "Stoddard" solvent, or ammonia. After cleaning a bushing, wash thoroughly with clean water to remove foreign material from the surface.

Butyl-molded transformers may be cleaned by scrubbing the butyl surface with detergent and a stiff brush to remove accumulated dirt or oil film. Remove the detergent by washing with clean water. Then, apply a light grade of silicone oil (GE Silicone Liquid, SF-96 or equal) to the butyl surface.

DEMAGNETIZING

If, by accident, a current transformer becomes magnetized, it should be demagnetized before being used for precision work. Connect the transformer in the test circuit as shown in Fig. 2. Pass rated current through the low-turn winding (usually H_1 - H_2). Increase the resistance (R) in the high-turn winding (usually X_1 - X_2) circuit until the transformer core is saturated; then, slowly reduce resistance to zero and disconnect the current source. Saturation of the core is indicated by a reduction of current in the high-turn winding circuit.

PRECAUTION: *A CONTINUOUSLY VARIABLE RESISTANCE MUST BE USED TO AVOID OPENING THE HIGH-TURN WINDING CIRCUIT WHEN RESISTANCE VALUES ARE CHANGED. AS THE RESISTANCE IS INCREASED, THE VOLTAGE ACROSS THE RESISTANCE WILL APPROACH OPEN-CIRCUIT VALUE.*

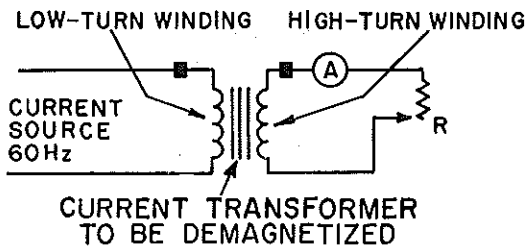


Fig. 2. Circuit for demagnetizing current transformers

Demagnetizing JAR-0 Auxiliary Transformers

Due to the wide range of current ratios available in the Type JAR-0 current transformer and the lack of standards for demagnetizing the odd ratios available, the following method is necessary to prevent voltages which are damaging to the transformer. See Fig. 3.

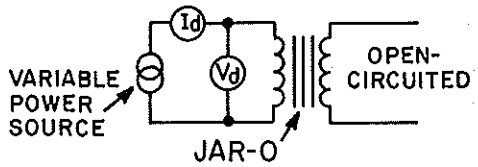


Fig. 3. Schematic diagram for demagnetizing JAR-0 transformers

Key to Fig. 3.

I_d = ammeter for reading demagnetizing current.

V_d = voltmeter for reading demagnetizing voltage.

The I_d reading shall not exceed:

$$\frac{\text{Rated current of the winding energized}}{50}$$

The V_d reading shall not exceed:

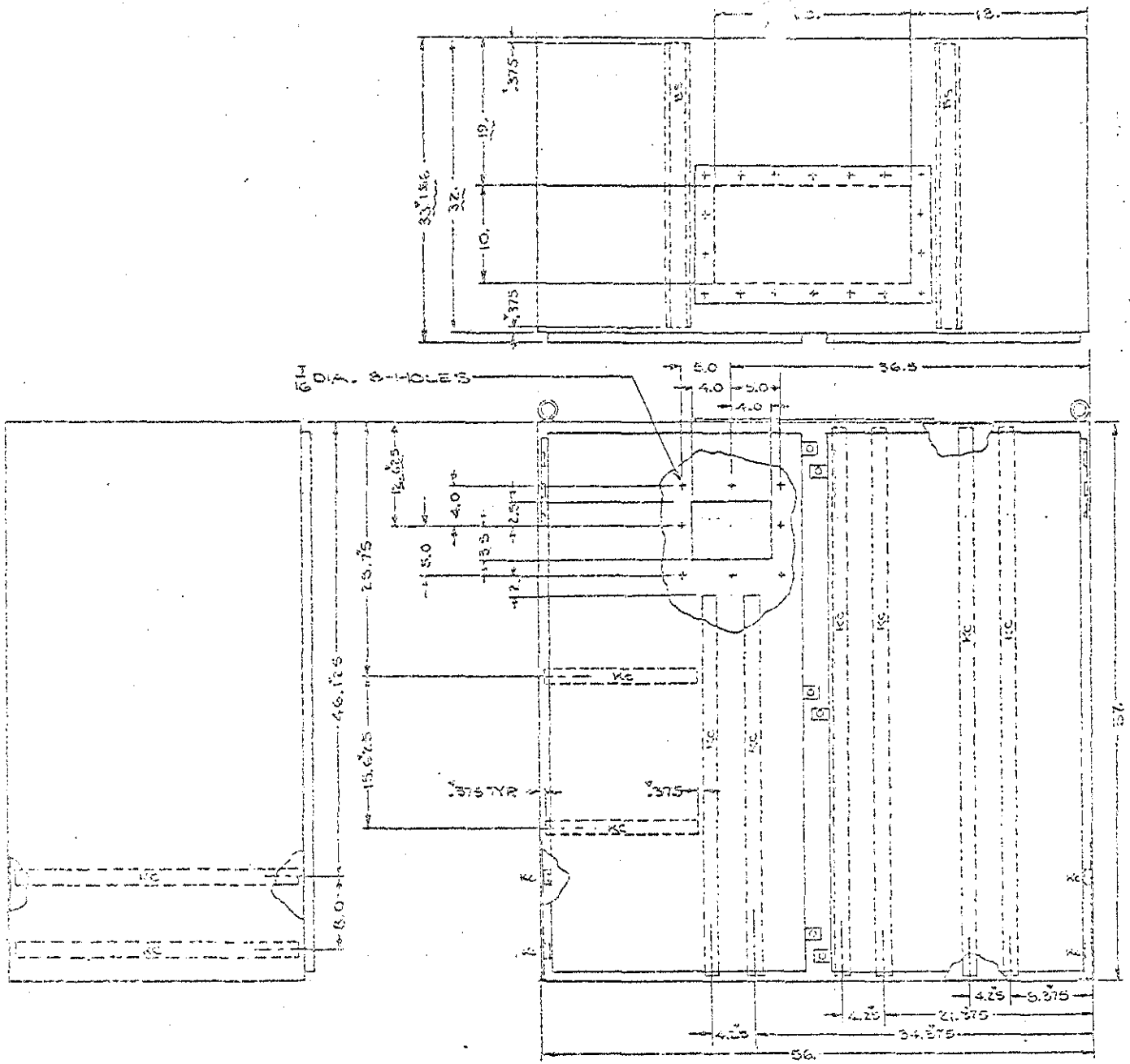
$$\frac{160}{\text{Rated current of the winding energized}}$$

For example, for demagnetizing any 5-ampere JAR-0 winding, do not exceed 32 volts and 0.1 ampere. The core will be adequately demagnetized when either the voltage or the current is increased to over 80 percent of the maximum value shown in the applicable formula (see above), and then gradually reduced to zero.

CAUTION: *ONE OR MORE WINDINGS ARE OPEN-CIRCUITED DURING THIS OPERATION. THESE WINDINGS MAY DEVELOP VOLTAGES WHICH ARE HAZARDOUS TO PERSONNEL. OBSERVE SAFETY PRECAUTIONS.*

DIFFERENTIAL PROTECTION

Standard General Electric current transformers may be used for differential protection through a considerable range of burden and overcurrent. The range is limited by the difference in burden, the maximum overcurrent, and the mechanical and thermal short-time rating. Information regarding these points may be obtained from the GE publication GET-97 or from the nearest sales office of the company.



DESCRIPTION: ENCLOSURE NEMA TYPE 12, TWO [illegible] NOMINAL SIZE 67 HIGH, 56 WIDE & 30 DEEP. CONSTRUCTION, MATERIAL & FINISH TO BE IN ACCORDANCE WITH HOFFMAN BULLETIN A-12 UNLESS SPECIFIED OTHERWISE ON THIS DRAWING. MATERIAL MIN. THICKNESS #10 GA. (.1345). HINGED DOORS OMIT HANDLE & 3 POINT LATCH. ADD REMOVABLE DOOR POST & APPROX. 3 CLAMPS PER DOOR SIMILAR TO HOFFMAN BULLETIN A-4. STAINLESS NOT REQUIRED. 10 X 20 HOLE IN TOP OF BOX WITH GASKETED COVER REMOVABLE FROM OUTSIDE OF ENCLOSURE. LIFTING EYES REQUIRED. TWO (2) BODY STIFFENERS MARKED "BS" ARE STANDARD HOFFMAN PART (SEE SECTION 2.2 BULLETIN A-12 PAGE 3) LOCATE AS CLOSE AS PRACTICAL TO HOLE IN TOP. TWELVE (12) CHANNELS MARKED "XC" ARE HINDORF S-906 1 1/2 X 3/4 OR EQUAL.

VENDOR: HOFFMAN ENGINEERING CO.
DIV. OF FEDERAL CARTRIDGE CORP.
ANOKA, MINNESOTA 55303

SUBSTITUTES PERMITTED WITHOUT ENGINEERING APPROVAL.

11908506

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL LOCUS ± .005
FLAME CUTTING, SHEARING, NIBBLING, PUNCHING AND WELDING ± .030
DIGITAL MACHINING TOLERANCES
C.I. ± .010 D.P. ± .020 .XXX ± .010

TITLE
ENCLOSURE
NEMA 12
STH-56W-32D

Colt Industries (FM)

REL. NO.	[illegible]	[illegible]
DR. BY	[illegible]	[illegible]
CHK'D. BY	[illegible]	[illegible]
DATE		

SCALE: DRWG. SIZE
APPROVALS
WELD

SIZE C DWG. NO. 11908506 SHEET 1 OF 1

NOT FOR USE

O.P.

11908508

POWER DISTRIBUTION CONNECTOR

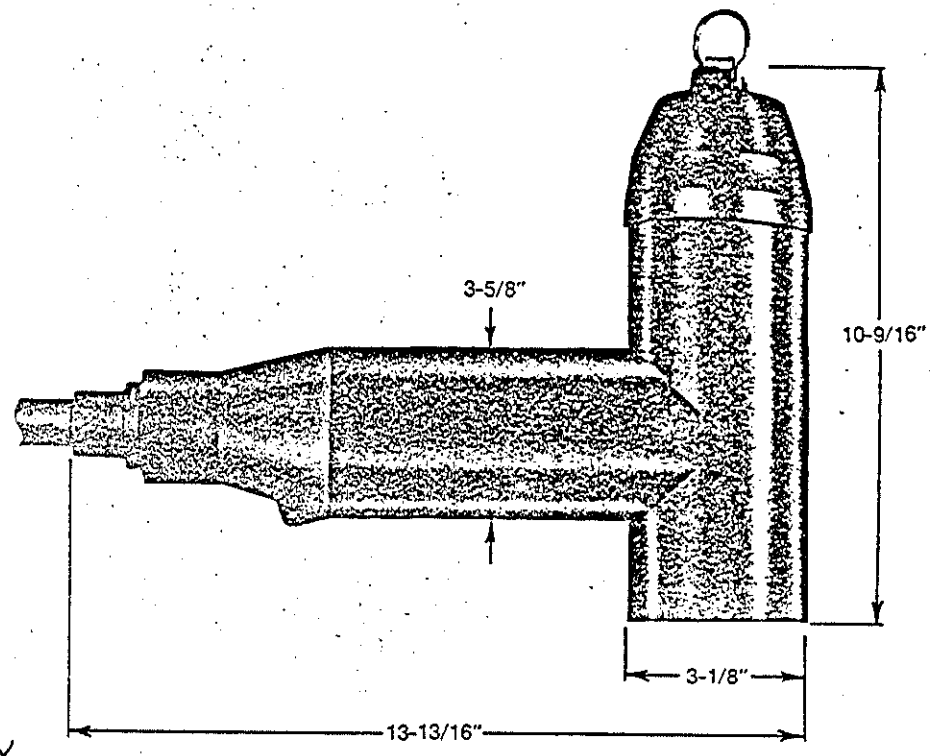
15-KV CLASS, 600 AMPS.

750MCM COMPACT CABLE
1.29 O.D. OVER INSULATION

VENDOR NO.: 650LR-JA650

VENDOR: ELASTIMOLD DIV.
AMERACE-ESNA CORP.
HACKETTSTOWN, N.J.

DISTR. WESTINGHOUSE ELEC. SUPPLY
ROCKFORD, IL.



SUBS. PERMITTED WITH ENG'R'G. APPROVAL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	FS1247	9-22-82	CABLE WAS 750 MCM STRANDED, 1.30	CAG RTC
2	"	"	O.D; VENDOR NO. WAS 650LR-JAB750.	
1	10664	2-6-78	WAS 1.6" O.D., AND 650LR-KAB750	RK RTC

TITLE
CONNECTOR, POWER DISTRIBUTION

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL NO.	10520	10/28/77	ASSY. OR LO.
DR. BY	R. REYES	3/11 77	SCALE
CHK'D. BY	CG	4/15 77	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L
	MACH.		ENGR. RTC
	WELD.		

SHEET SIZE A | DWG. NO. 11908508 | SHEET 1 OF 1

P

III 3009-2

DESCRIPTION:

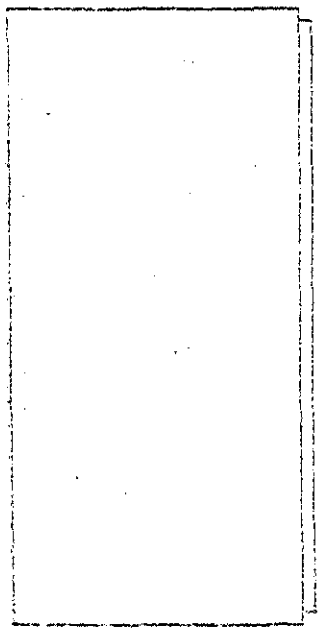
ENCLOSURE NEMA TYPE 12. SINGLE DOOR, NOMINAL SIZE 51 HIGH, 36 WIDE & 24 DEEP CONSTRUCTION, MATERIAL & FINISH TO BE IN ACCORDANCE WITH HOFFMAN BULLETIN A-12 UNLESS SPECIFIED OTHERWISE ON THIS DRAWING. MATERIAL MIN. THICKNESS #10 GA. (.1345). HINGED DOOR OMIT PADLOCK HASP & STAPLE. 10 X 12 HOLE IN TOP OF BOX WITH GASKETED COVER REMOVABLE FROM OUTSIDE OF ENCLOSURE. LIFTING EYES REQUIRED. CHANNEL MARKED "KC" ARE KINDORF E-906 1-1/2 x 3/4 OR EQUAL.

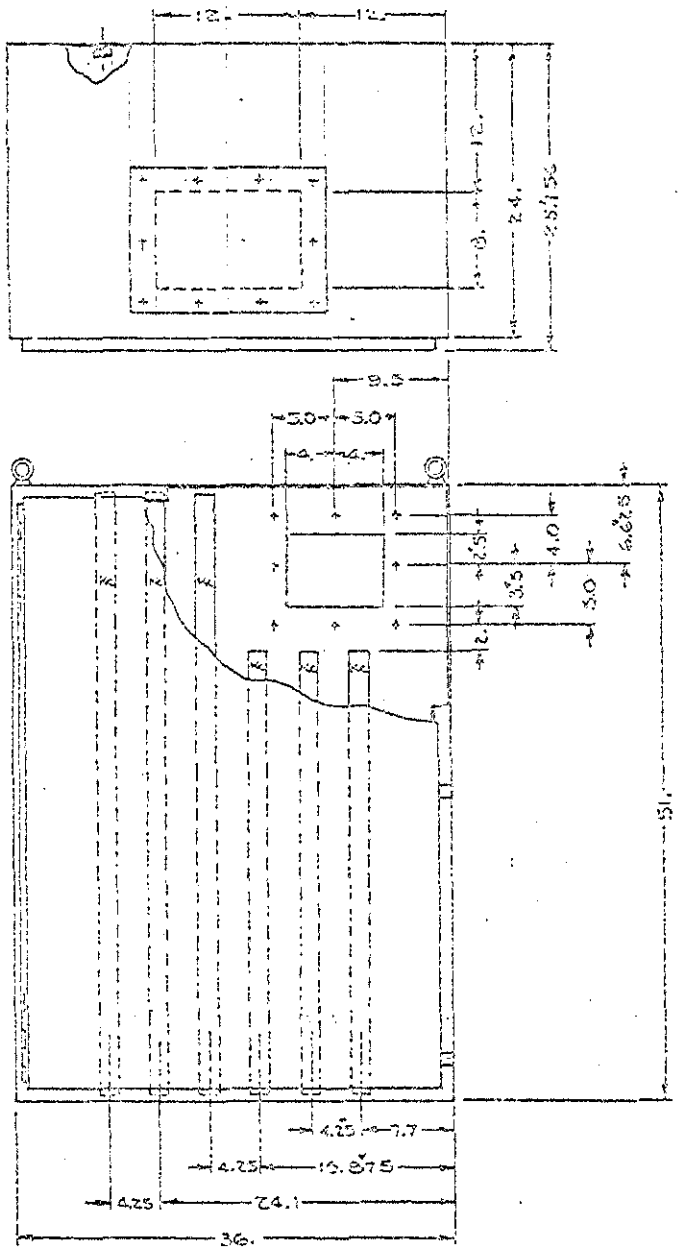
VENDOR:

HOFFMAN ENGINEERING Co.
DIV. OF FEDERAL CARTRIDGE CORP.
ANOKA, MN. 55303

SUBSTITUTES:

PERMITTED WITHOUT ENGINEERING APPROVAL.





11908537

				TITLE ENCLOSURE NEMA 12 - 51H-36W-24D	Cott Industries
				TOLERANCES Unless Otherwise Specified: FRACTIONAL MACHINED ± 1/64 TOOL DESIGN ± .005 SHEET CUTTING, STAMPING, MISSING FORMING AND WELDING ± .030 SPECIAL MATERIAL TOLERANCES	DRAWN APPD. MACH. MFG. DATE SCALE: WT. 3.7 LBS. SHEET 1 OF 1
REV. NO.	CHANGE NOTICE NO.	DATE	MADE / REVISED BY		

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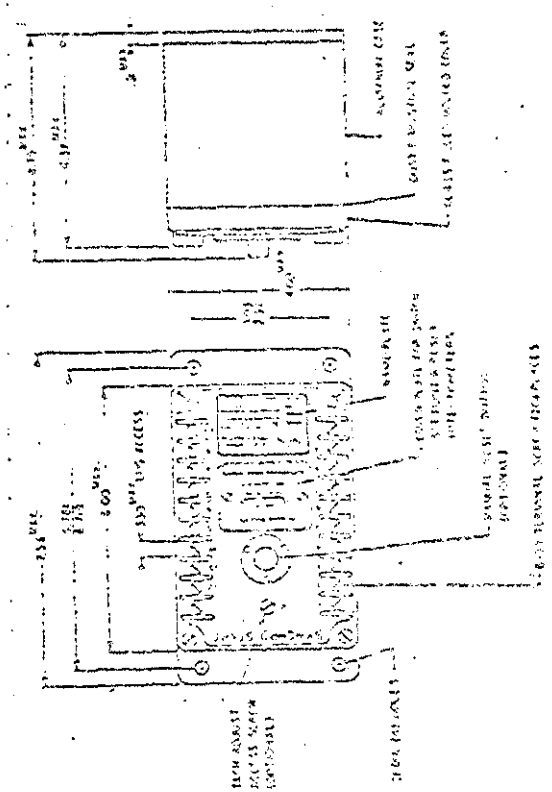
11908537

1190853B

TWO ELEMENT SPEED SWITCH TYPE ESSB
WITH FOLLOWING FEATURES:

1. SUPPLY VOLTAGE 95-144 VDC (125 VDC NOM.)
2. RELAYS TO ENERGIZE AND CLOSE CONTACTS AT AND ABOVE SET POINTS
   RELAY 1 - 400 SIGNAL GENERATOR RPM.
   " 2 - 1200 " " " "
   ADJUSTABLE 70% AND 130% OF SET POINT.
3. STANDARD AUTOMATIC RESET 15%
4. REVERSE POLARITY & TRANSIENT OVER-VOLTAGE (5000 V FOR 10 MILLISEC.) PROTECTION.
5. TACHOMETER OUTPUT FOR 3 MOD. 30 METERS.
6. INTERNAL TREATMENT FOR PROJECTED 40 YR. LIFE.

SWITCH WILL OPERATE FROM TYPE ES SIGNAL GENERATOR RUNNING TWICE ENGINE SPEED.



VENDOR : SYNCHRO-START PRODUCTS, INC.

SUBSTITUTES NOT PERMITTED

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
SWITCH, SPEED, ELECTRONIC

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC 1760	4/16/71	ASSY. OR LO.
DR. BY R. KEYES	3/22/71	SCALE
CHK'D. BY CG	3/23/71	HEAT TR.
MATL		
APPV. CAST.		MATL
APPV. MACH.		ENGR. PC
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190853B | SHEET 1 OF 1

INSTALLATION & ADJUSTMENT INSTRUCTIONS
MODEL ESSB ELECTRONIC SPEED SWITCH

1. MOUNTING INSTRUCTIONS:

Mounting dimensions are shown on drawing #4562. The unit may be mounted in either a horizontal or vertical position. Install 4 each 1/4" bolts in the .31" diameter mounting holes.

2. ELECTRICAL CONNECTIONS INSTRUCTIONS:

a. General: STUDY the terminal locations and terminal layout markings on the unit. #18AWG, or larger diameter, stranded copper wire must be used for ALL interconnecting wiring.

b. POWER INPUT terminals 19 and 20 are to be connected to the power supply. The required power supply voltage and polarity (if D. C.) is marked on the side of the unit. The power supply may be grounded if desired.

c. HZ SIGNAL INPUT terminals 11 and 12 are to be connected to the Hertz signal source. Ungrounded twisted pair cable is recommended. If it is impractical to route the interconnecting wiring away from high current sources and carriers, shielded twisted pair cable should be used. Connect the shield to terminal 14 only. Cable must have an insulating jacket over the shield to prevent grounding of the shield at any other point.

d. SWITCH OUTPUT terminals are to be connected to the electrical devices being controlled using wire sized to carry the required current. Switch output contacts are isolated and rated 10 amperes resistive load (approximately 5 amperes inductive) at either 115 V AC, or 28 V DC. Consult factory for contact ratings at other voltages.

e. REMOTE RESET (Manual) (Optional) terminals 17 and 18 are to be connected to the customer furnished momentary contact push button only when this option is supplied. The push button contacts must be normally closed or normally open as indicated by the markings on the side of the unit. These markings also indicate the applicable switch output number.

f. MANUAL RESET (Local) (Optional) push button is provided in the unit cover only when this option is supplied. The unit markings indicate the applicable switch output number. STD relay logic requires a jumper across terminals 17 and 18. REV relay logic does not require the jumper. If REMOTE RESET is desired in addition to cover mounted MANUAL RESET, wire as follows: Remove jumper from terminals 17 and 18 on STD logic units and wire to the remote normally closed momentary push button; on REV logic units wire terminals 17 and 18 to the remote normally open momentary push button. switch relay logic (STD or REV) is marked on side of unit.

g. TACH. OUTPUT (Optional) terminals are to be connected to an electronic tachometer only when this option is supplied. Nominal meter rating at full scale must be between 500 micro-amperes and 1 milliampere. For a meter having a nominal rating of 500 micro-amperes, the meter resistance must not exceed 750 ohms. For a meter having a nominal rating of 1 milliampere, the meter resistance must not exceed 400 ohms. Connect terminal 13 to the positive (+) meter terminal, and terminal 14 to the negative (-) meter terminal.

3. ADJUSTMENT INSTRUCTIONS:

a. General Adjustment Instructions: Field adjustments are not recommended unless ACCURATE Hertz measuring instrumentation is used. Should authorized adjustments be required, remove the metal plate by unscrewing the 2 #4-40 screws. Before attempting to make any adjustment, carefully study the potentiometer locations on the unit to locate the CORRECT potentiometer. Remove the #8-32 screw over the CORRECT potentiometer. Potentiometers are 20 turn rotation units with overtravel on either end. If a 'click' is heard and no adjustment affect is observed, rotate the potentiometer the opposite way. Potentiometer adjustments should be done VERY GRADUALLY.

After completion of adjustments replace seal screws and metal plate.

b. SET HZ Adjustment: The side of the unit is marked to indicate the applicable potentiometer identification letter and factory SET HZ for each switch number. Clockwise rotation of the potentiometer raises the set point Hertz: the reset point Hertz will also be raised.

c. RESET HZ Adjustment (Optional): If this option is supplied, the side of the unit is marked to indicate the applicable potentiometer identification letter and the factory RESET HZ for each switch number. Clockwise rotation of the potentiometer lowers the reset point Hertz; the set point Hertz will also be lowered to a small degree. Cycle through both the set point and reset point several times to verify that settings are correct.

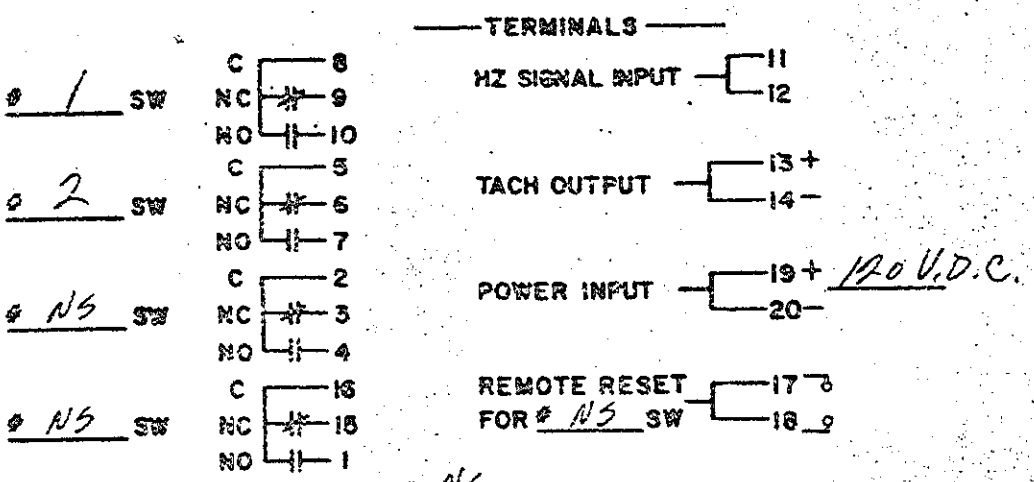
d. Electronic Tachometer Calibration (Optional): The TACH OUTPUT potentiometer is included when the TACH OUTPUT circuit is supplied. To obtain access to this potentiometer, remove the #8-32 seal screw over hole 'J'. The potentiometer should be adjusted so that tachometer indicates the correc speed when the proper Hertz signal is applied to terminals 11 and 12. Adjustment is usually made at the speed requiring the most accurate meter reading. Clockwise rotation of the potentiometer increases the speed indicated by the meter.

4. HERTZ SIGNAL SOURCE

The Hertz signal source must have a minimum output of 1.4 volts Peak-to-Peak for suitable operation above 100 Hertz. The signal must be a minimum of 3 volts Peak-to-Peak if either the set point or reset point is in the 60 to 100 Hertz range. The approximate input impedance is 4.5K ohms at 1KHZ and 3K ohms at 3KHZ. Suggested signal sources are: a) Synchro-Start Electronic Signal Generator or, b) Magnetic Pick-up of suitable output.

Synchro-Start PRODUCTS, INC.
SUBSIDIARY OF KNOWLES ELECTRONICS, INC.

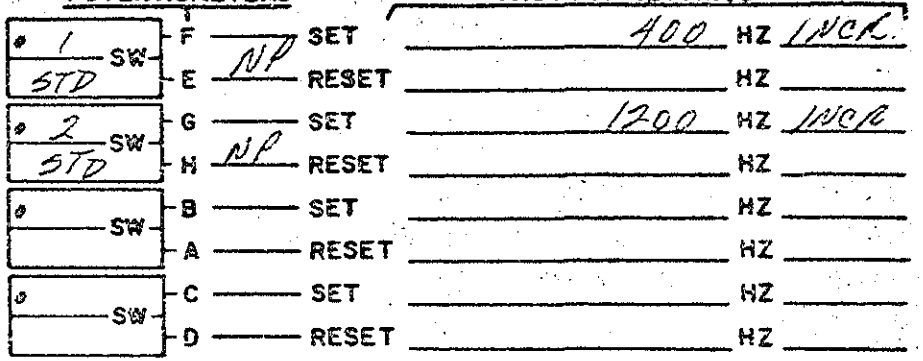
P. O. BOX 147
SKOKIE, ILLINOIS 60076
TELEPHONE: 312/267-1730



MANUAL RESET IN COVER FOR # NS SW

ALL CONTACTS SHOWN DE-ENERGIZED - NO POWER - NO SIGNAL

"NS" = NOT SUPPLIED



"STD" = SW RELAY ENERGIZES AT HZ INCR

"REV" = SW RELAY DE-ENERGIZES AT HZ INCR

NOTES:

1. THE ABOVE INFORMATION IS MARKED ON THE SIDE OF THE CAST ALUMINUM ENCLOSURE.

CUSTOMER: COLT INDUSTRIES
CUSTOMER ORDER NO.: B-458574-0
SYNCHRO-START ORDER NO.: 98556

TERMINAL LAYOUT
ELECTRONIC SPEED SWITCH
MODEL ESSB-2AT

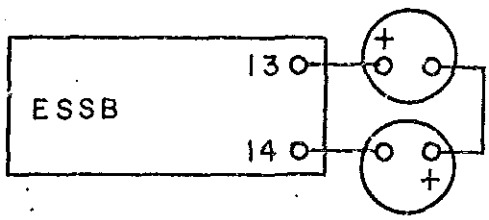
SYNCHRO-START PRODUCTS, INC
P.O.BOX 147 SKOKIE, ILLINOIS

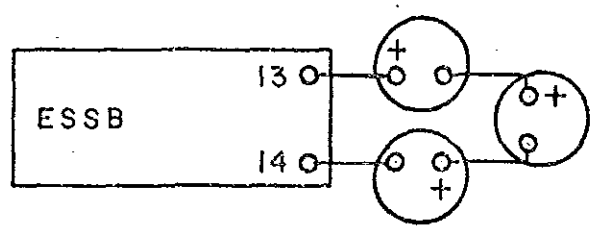
SCALE: NONE	DATE 5/13/77
DRAWN BY RAM	APP.BY

DRAWING NO. 4576

INSTALLATION & ADJUSTMENT INSTRUCTIONS FOR TWO OR THREE TACHOMETERS CONNECTED TO ONE MODEL ESSB ELECTRONIC SPEED SWITCH

1. Connect tachometers in series using #18 AWG or larger diameter stranded copper wire. Connect the positive (+) terminal of the first meter to the ESSB terminal No. 13. Connect the negative (-) terminal of the last meter to the ESSB terminal No. 14. The below diagrams depict the correct connections for two or three meters, as applicable.





CAUTION: Incorrect connection and/or polarity will cause improper operation and/or permanent damage to the meters and/or the ESSB.

2. Prior to operation of the equipment for the first time, individually adjust the ZERO ADJUST screw at the rear of each meter so it reads exactly zero.

3. Operate the equipment to be monitored at rated speed as determined by accurate test instrumentation. NOTE: The tachometers may be calibrated at any speed; however, rated speed is suggested since it will provide the highest degree of accuracy over the widest useful range.

4. Remove the #8-32 seal screw over hole "J" in the ESSB cover to obtain access to the TACH OUTPUT ADJUST potentiometer.

5. Insert a small screw driver in the access hole. NOTE: If the screw driver is too large for the access hole, it will also be too large for the potentiometer adjustment slot.

6. Adjust the potentiometer so the average reading of all the tachometers is equal to the speed indicated by the test instrumentation. Clockwise rotation of the potentiometer increases the speed indicated by all the meters.

7. Individually adjust the ZERO ADJUST SCREW at the rear of each meter so it reads exactly the same as the test instrumentation. NOTE: When the equipment is at zero speed, the tachometers may not read exactly zero.

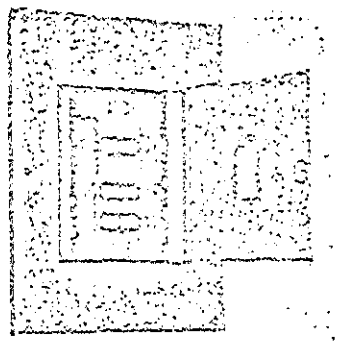
Synchro-Start PRODUCTS, INC.
SUBSIDIARY OF KNOWLES ELECTRONICS, INC.

Telephone: 312/673-7730
Telex: 724-424

SYNCHRO-START PRODUCTS, INC.
8109 N. Lawndale Ave., P.O. BOX 147, Skokie, Ill. 60076

CIRCUIT BREAKER PANELBOARD MEETING FED. SPEC. WP115A, TYPE 1, CLASS 1. FOR SURFACE MOUNTING. BOX SHALL BE FINISHED IN SAME MANNER AS THE FRONT. NEMA 1 ENCLOSURE WITH DRIP-SHIELDS OVER TOP AND OVER DOOR. DOOR TO HAVE LATCH & LOCK. 100 AMP. (MIN.) MAINS, 480 VOLTS LUGS AT BOTTOM.

CIRCUIT BREAKERS MEETING FED. SPEC. WC-375A CLASS 2F (22,000 A.I.C. ASYM. MIN.) ARRANGED AS SHOWN.



15A-3P	15A-3P
15A-3P	15A-3P
25A-3P	15A-3P

- LUGS -

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REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	10304	5-10-77	ADD 5TH 15A. CKT. BKR.	RK RJC

TITLE: PANELBOARD CIRCUIT BREAKER

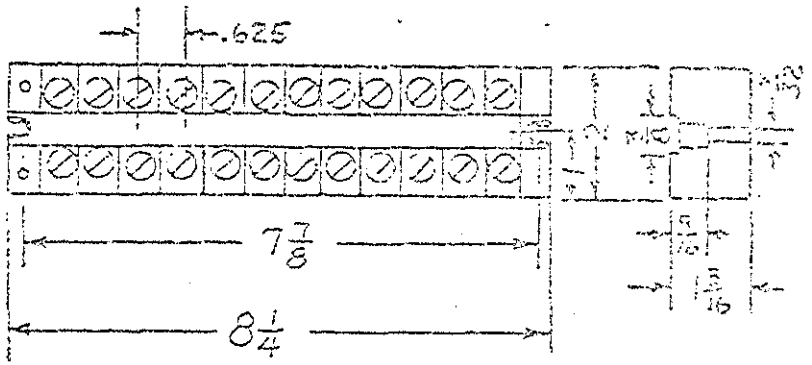
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. P-1770	4/6/77	ASSY. OR LO.
DR. BY R. KEYES	3/22/77	SCALE
CHK'D. BY CG	3/30/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. RJC
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190S544 | SHEET 1 OF 1

TERMINAL BLOCK, BARRIER TYPE, WITH MARKER STRIP, NICKEL PLATED BRASS TERMINAL SCREWS, SHORT CIRCUITING STRIP & PINS (2). NO COVER. 600 V, 45 AMP. RATING. MAX. WIRE SIZE #6. 12 LINES.



VENDOR PART NO.: 1512135
VENDOR CAT. NO.: 1512SG

VENDOR: MARATHON SPECIAL PRODUCTS
BOWLING GREEN, OH. 43402

DISTR.: COMPLETE-READING ELEC. CO.
10448 N. PORT WASHINGTON RD.
MEQUON, WI. 53092
(414-241-3320)

SUBS. PERMITTED WITH ENG'R'G. APPROVAL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
TERMINAL BOARD, 12PT. SC 45AMP 600V

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1760	4167	ASSY. OR LO.
DR. BY R. KEYES	3/23/77	SCALE
CHK'D. BY CG	3/24/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR. RTC
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190854 5 | SHEET 1 OF 1

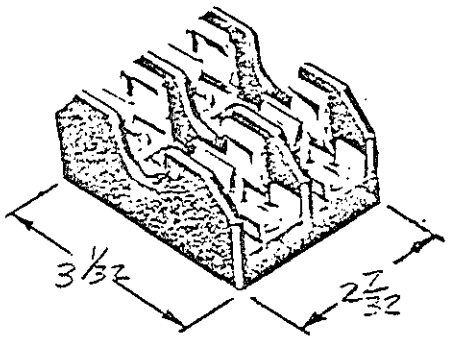
ORIGINAL

11908548

DESCRIPTION: FUSE BLOCK — 30A-250V — 2 POLE — SCREW CONNECTORS — REINFORCED RETAINING CLIPS. — TWO MTG. HOLES 7/32 DIA. W/3/8 C'BORE, ON 1-1/4 CENTERS. — FOR FUSES 2" OVERALL LGT. 1/2" DIA. OF TUBE & 9/16 DIA. OVER FERRULES.

VENDOR PC. NO. H25030-2SR

VENDOR: UNDERWRITERS SAFETY DEVICE CO.
7500 WEST WILSON AVE
CHICAGO, IL. 60656



NO SUBSTITUTES PERMITTED

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
2	P10302	7/22/80	① WAS 11530-2R REVISED & REDRAWN	RAB 7/24/80

TITLE
FUSE BLOCK
30A - 250V
2 POLE

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

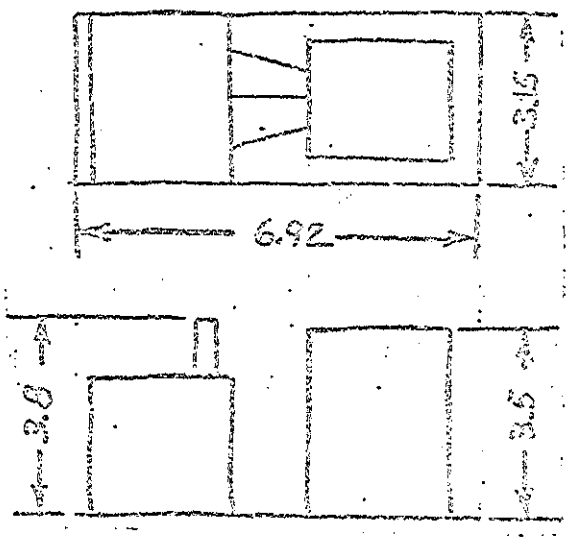
REL. NO.	—	/ /	ASSY. OR LO.
DR. BY	R. Blessin	6/27/80	SCALE 4
CHK'D. BY	D. MANN	6/27/80	HEAT TR.
MAT'L			
APPV.	CAST.		MAT'L.
	MACH.		ENGR.
	WELD.		

SHEET SIZE A | DWG. NO. 11908548 | SHEET 1 OF 1

TYPE EB DEFINITE PURPOSE NON-REVERSING
STARTER, OPEN TYPE, 3 POLE, WITH HOLDING CONTACT.
3 HP MAX. AT 460 V.
3 I-T-E OVERLOAD RELAYS WITH EXTRA
N.O. CONTACT. (YELLOW RESET BUTTON).
110-120 V. 60 HZ COIL.

CAT. NO.: 2201 ICEB 231AA WITH
L2 OVERLOAD RELAYS.

VENDOR: GOULD, INC (I-T-E)



SUBS. PERMITTED WITH ENG'R'G. APPROVAL.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
STARTER
3 HP

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

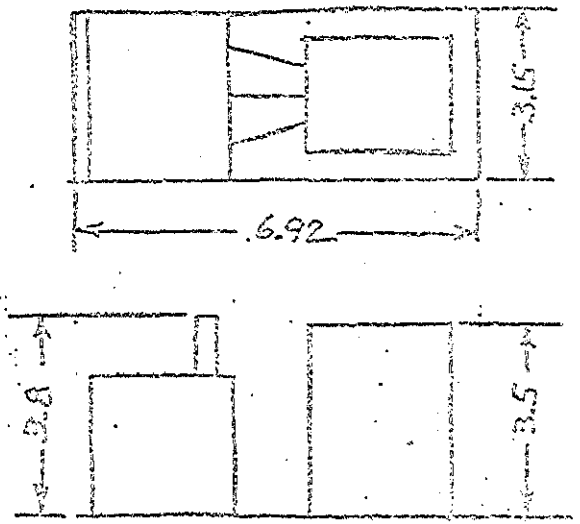
REL. No. 10287	4/22/77	ASSY. OR LO.
DR. BY R. REYES	4/13/77	SCALE
CHK'D. BY CG	4/13/77	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR. R.T.C
APPV. WELD.		
SHEET SIZE A	DWG. NO. 1908565	SHEET 1 OF 1

1190856 6

TYPE EB DEFINITE PURPOSE NON-REVERSING
STARTER, OPEN TYPE, 3 POLE WITH HOLDING CONTACT.
7½ H.P. MAX. AT 460 V.
3 I-T-E OVERLOAD RELAYS WITH EXTRA
N.O. CONTACT. (YELLOW RESET BUTTON).
110-120 V. 60 HZ COIL

CAT. NO.: 2201ICES331AA WITH L2
OVERLOAD RELAYS.

VENDOR: GOULD, INC. (FPE)



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SUBS. PERMITTED WITH ENG'R'G. APPROVAL.

REV. NO	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
STARTER
7½ H.P.

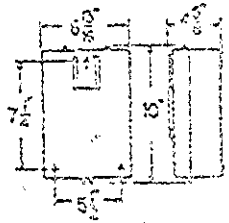
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 10287	4/22/87	ASSY. OR LO.
DR. BY R. KEYES	4/13/87	SCALE
CHK'D. BY C.G.	4/13/87	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. RTC
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1190856 6 | SHEET 1 OF 1

BULL. 209 D.C. FULL VOLTAGE STARTER FOR 1½ HP MAX. VOLTAGE WILL VARY BETWEEN 90 AND 140 VDC. NEMA 12 ENCLOSURE, NO RESET IN COVER.



HOLDING CONTACT AND ONE (1) N.O. AUX. CONTACT REQUIRED.

CAT. NO.: 209 BAG LESS EXTERNAL RESET & WITH 1 N.O. AUX. CONTACT.

VENDOR: ALLEN-BRADLEY CO.

SUBS. PERMITTED WITH ENG'R'G. APPROVAL

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	10324	5/27/71	ADD CAT. NO.	RK RTC
1	"	7/27/71	WAS NEMA 13, AND TERMS FOR RING TONGUE LUGS	RK RTC

TITLE
STARTER
-DC FULL VOLT.
1½ HP MAX.

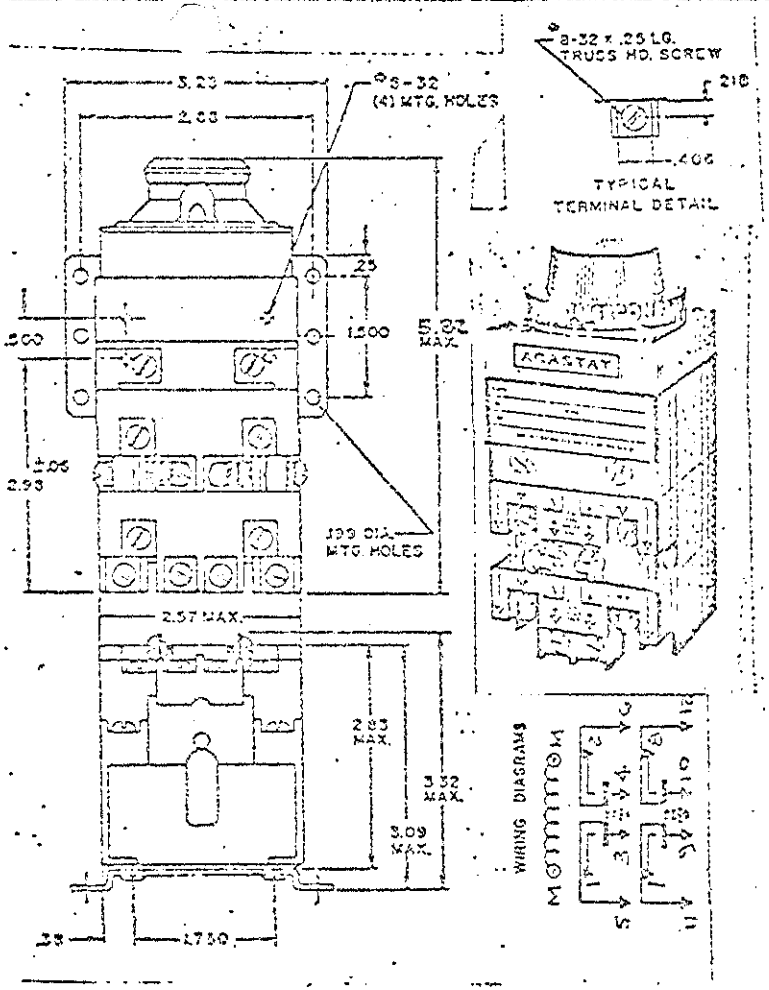
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .010 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 102287	4/22/71	ASSY. OR LO.
DR. BY R. REYES	4/13/71	SCALE
CHK'D. BY CG	4/14/71	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L
APPV. MACH.		ENGR. RTC
APPV. WELD.		

SHEET SIZE A | DWG. NO. 1908567 | SHEET

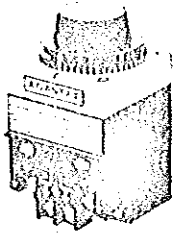
1190856B


8-32 x .25 LG. TRUSS HD. SCREW
.210
.406
TYPICAL TERMINAL DETAIL
5.23
2.63
8-32 (4) MTG. HOLES
.25
1.500
5.62 MAX.
.500
2.93
.406
.339 DIA. MTG. HOLES
2.57 MAX.
2.63 MAX.
3.32 MAX.
3.09 MAX.
.25
1.750
AGASTAT
WIRING DIAGRAMS
.312
.844
.437
.437
.437

AGASTAT®

7000 Series timing relay

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

Because of the skilled calibration and adjustment required on certain components prior to final assembly, we recommend that field servicing be limited to the replacement of the switch-block and coil assemblies, listed below. These have been designed to insure factory-built performance after field servicing without elaborate calibration. In cases where damage or abuse make it impossible to restore satisfactory performance by replacing these assemblies, the unit should be returned to the factory for repair or replacement.

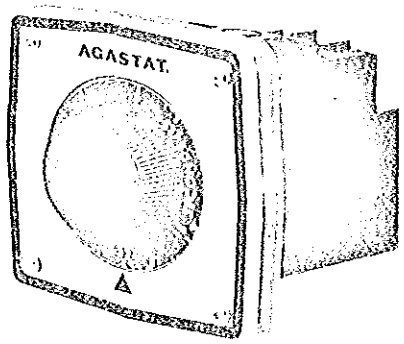
MOUNTING INSTRUCTIONS

A. VERTICAL

Normal mounting for the basic 7000 Series unit is in a vertical position, from the back of the panel. Four 8-32 tapped holes are provided in the back plate, making it interchangeable with earlier models. Mounting screws should not project more than 5/32" into the back of the unit, to prevent internal damage.

A bracket for mounting the unit from the front, and the screws required to attach it to the relay are also supplied with each unit. The bracket extends approximately 3/8" from each side of the unit.

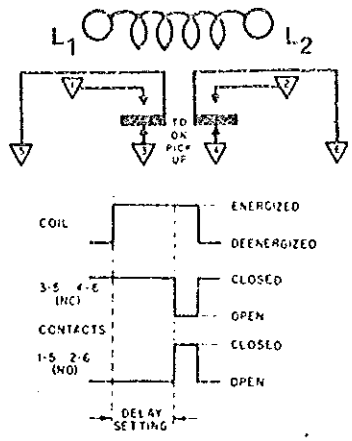
B. HORIZONTAL/PANELMOUNT



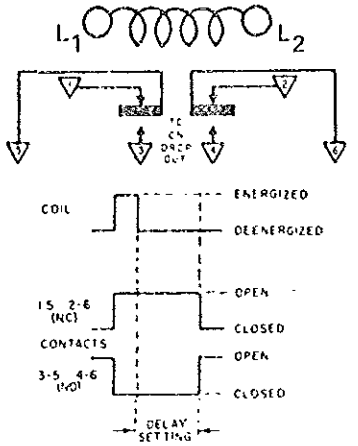
All basic 7000 Series units may be mounted horizontally. However, a dial calibration error (as much as 32% in some units) will result unless the timer is factory equipped with horizontal operation option X or Y1. A unit factory equipped with vertical-horizontal operation option Y2 will require the removal of the Position Compensation Spring in order to maintain accurate calibration. This spring may be removed after the removal of the plastic dust cover, which is fastened to the bottom of the timer with two screws. The dust cover must be replaced after removing the spring.

If the Panel Mounting Kit (option X) is added in the field to units not factory equipped with options Y1 or Y2, an error in dial calibration will result.

7012 SERIES



7022 SERIES



AUXILIARY SWITCH ADJUSTMENT

MODEL 7012

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downword stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization, and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.*

MODEL 7022

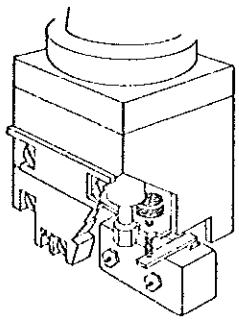
INSTANT TRANSFER AUX. SWITCH (CODE T)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before spindle returns to its normal position, following deenergization. To increase aux. switch delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.

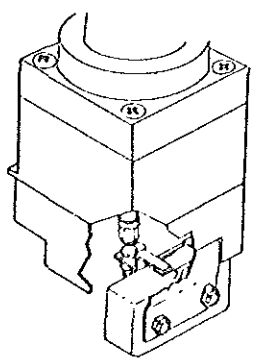
TWO STEP AUX. SWITCH (CODE T)

Check operation as for Instant Transfer, above. Increase first delay period by turning actuator screw clockwise until the desired delay before aux. switch transfer is reached.*

*First delay is independently adjustable, but must be no more than 30% of overall delay. (Recommended max. 100 sec.)



CODE L



CODE T

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102 - 132	110	93.5 - [illegible]
	B	240	204 - 264	220	187 - [illegible]
	C	480	408 - 528		
	D	550	468 - 605		
	E	24	20.5 - 26.5		
	F			127	108 - [illegible]
	G			240	204 - [illegible]
	H	12	10.2 - 13.2		
	I	6	5.1 - 6.6		
	J	208	178 - 229		
	K	DUAL VOLTAGE COIL (COMBINES A & E			

AC SPECIALS L1, L2, etc.

AC Coils (Part No. = 2400 followed by dash and code letter above

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range DC
2410—	M	28	22.5 - 33.5
	N	48	38.5 - 57.5
	O	24	19.2 - 28.8
	P	120	96 - 144
	Q	12	9.6 - 14.4
	R	60	48 - 74
	S	250	200 - 300
	T	550	440 - 660
	U	16	12.8 - 19.2
	V	32	25.6 - 38.4
	W	96	76.8 - 115
	Y	6	4.8 - 7.2
	Z	220	176 - 264

DC SPECIALS X1, X2, etc.

DC Coils (Part No. = 2410 followed by dash and code letter above

All units draw approximately 8 watts power at rated voltage.

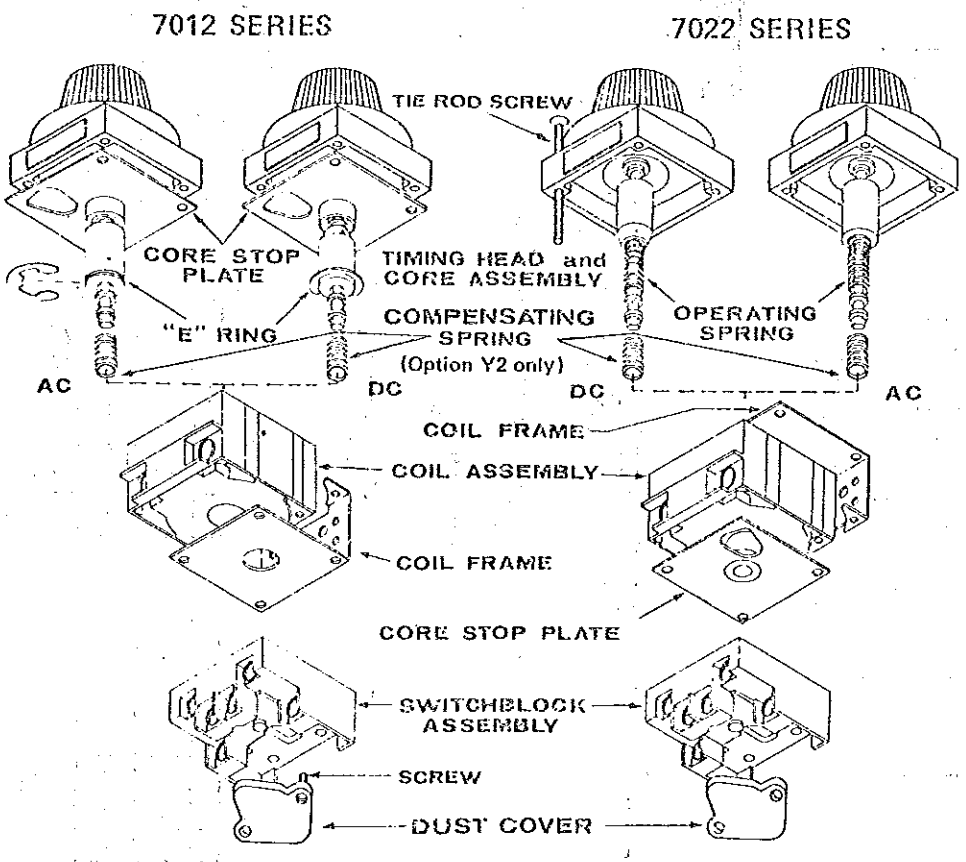
Minimum operating voltages are based on vertically mounted 7012 (on-delay) units. 7012 horizontally mounted or 7022 (off-delay) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

A C units drop out at approximately 60% of rated voltage. D C units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Intermittent duty—maximum 50% duty cycle and 30 minutes "on" time.)

REPLACING SWITCHBLOCK AND COIL ASSEMBLIES – MODEL 7012 AND 7022

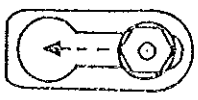
Switchblock assemblies are universally interchangeable between all standard 7000 Series units. The same assembly is used for A C and D C models for delay on pull-in or delay on dropout service. Neither timing head/core assembly nor coil assembly is interchangeable between A C and D C models.



REMOVING SWITCHBLOCK

1. Remove four tie rod screws.
2. Hold timing head and coil assembly in one hand, switchblock in the other.
3. Slide switchblock 1/2" forward of coil assembly to center spindle in large end of keyhole slot in switch blade. (See diagram A).
4. Slowly lift timing head and coil assembly off switchblock, being careful to keep spindle collar away from switchblade while withdrawing it.

REVERSE THIS PROCEDURE TO INSTALL NEW SWITCHBLOCK.



A

REMOVING COIL

Follow steps 1 to 4 above, then:

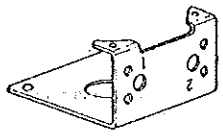
5. Remove timing head and core assembly. (On Model 7022 units the core stop plate and operating spring are loose pieces, located below the core rather than attached to the timing head and core assembly, as on the Model 7012 units. These two pieces should be removed before removing the coil frame, to prevent loss of the loose spring.)

7012 models require removal of "E" ring from core to permit removing core from coil.

6. Slide off coil frame.

When installing new coil, be sure to replace coil frame with proper side up. Number "1" on back of frame should be up on 7012 (Delay on Pull-in) Models, Number "2" should be up on 7022 (Delay on Drop-out) Models. See Diagram B.

On 7012 models, replace "E" ring in core slot after assembling coil frame to coil.



B

REPLACEMENT ASSEMBLIES

	Part No.
AC Coil Assembly	2400- *
DC Coil Assembly	2410- *
Switchblock Assembly	2412-30
Auxiliary Switch Kit (Code L)	7000-47
Auxiliary Switch Kit (Code T)	2412-121

* Specify voltage with code letter

LINEAR TIMING RANGES

Time Range Code	Models 7011, 7012, 7021, 7022, 7024	Models 7014, 7031, 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	.7 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not avail.
J	3 to 120 Cyc.	Not avail.
K	1 to 300 Sec.	Not avail.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014, 7031 and 7032 are available with letter calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ¼ H.P., 10 A. Resistive; 600 V.A.C., 5A.G.P. 30 V.D.C., 15A.G.P.

WARRANTY

The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

FOR REPAIR SERVICE

Return defective units to:

CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 Hickory Street
Grafton, Wisconsin 53024

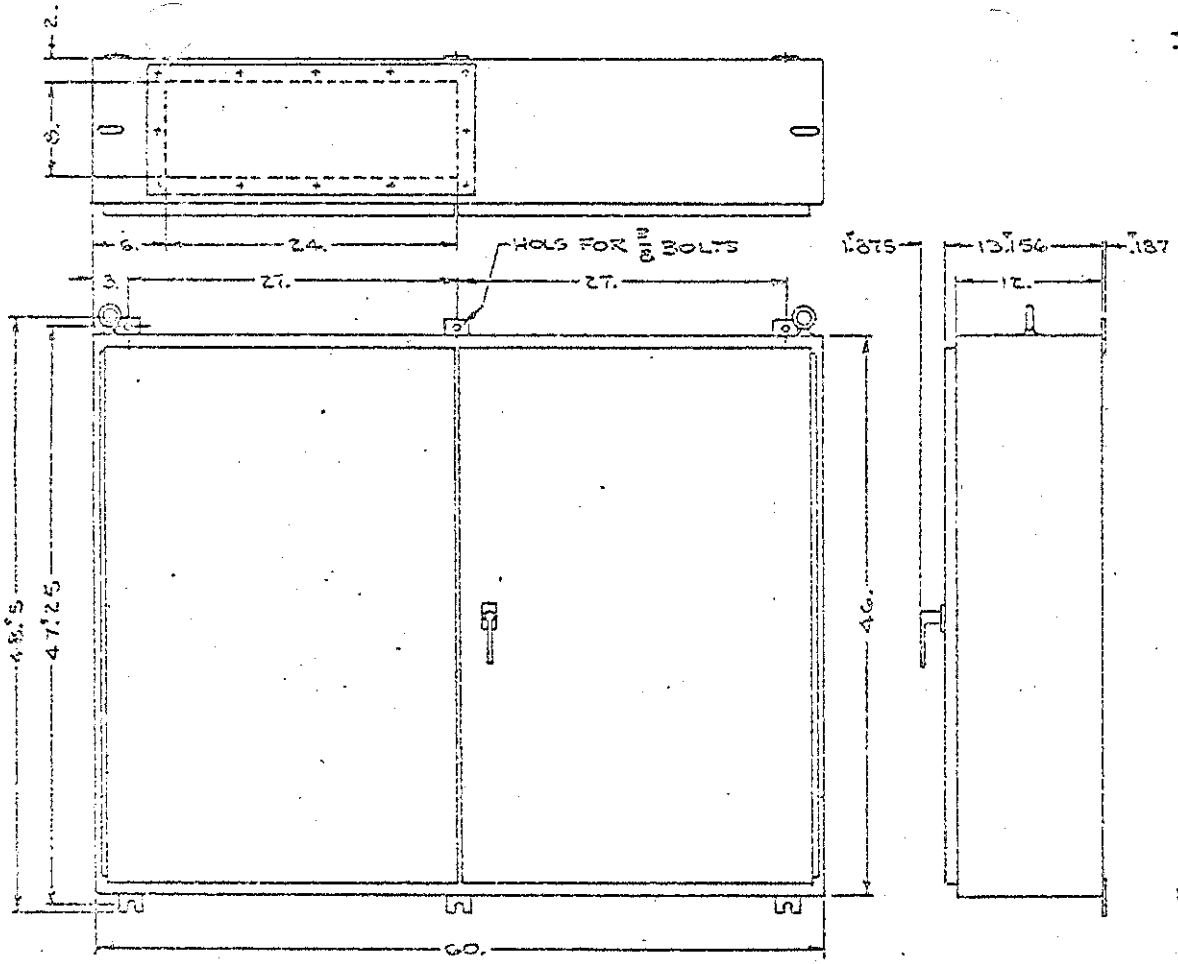
ATTENTION: Product Service Department

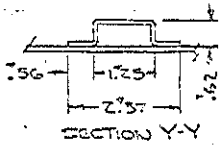
amerace CONTROL PRODUCTS DIVISION

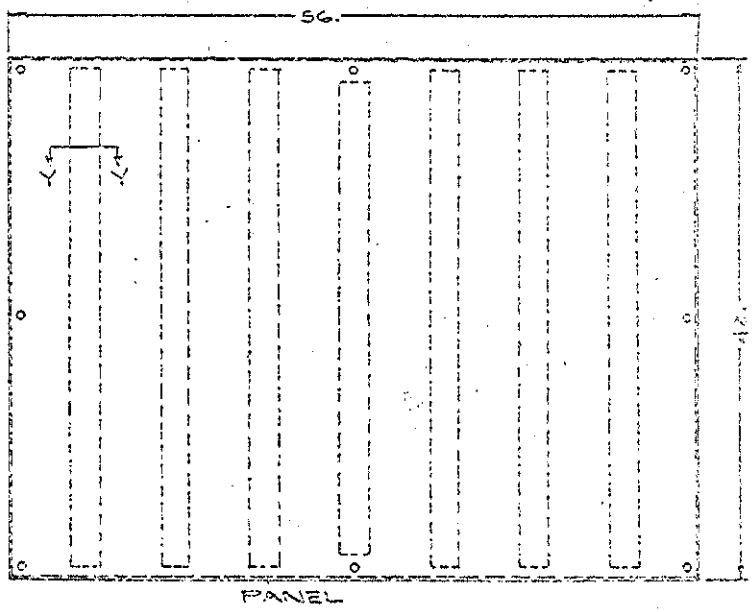
Amerace Corporation
Control Products Divis
2330 Vauxhall Road
Union New Jersey 0708

SR-30

January 1974 Printed In U.S.A.







11908569

DESCRIPTION: ENCLOSURE TWO DOOR WALL-MOUNTED NEMA TYPE 12. NOMINAL SIZE 46 HIGH, 60 WIDE & 12 DEEP. CONSTRUCTION, MATERIAL & FINISH TO BE IN ACCORDANCE WITH HOFFMAN BULLETIN A-12 UNLESS SPECIFIED OTHERWISE ON THIS DRAWING. ENCLOSURE MIN. THICKNESS #12 GA. (.1046). 9 X 24 HOLE IN TOP & BOTTOM WITH REMOVABLE GASKETED COVERS, TOP COVER REMOVABLE FROM OUTSIDE & BOTTOM COVER REMOVABLE FROM INSIDE ENCLOSURE. LIFTING EYES REQUIRED. SUB PANEL TO BE INCLUDED SIZE 42 X 56. MIN. THICKNESS #10 GA. (.1345). PANEL TO HAVE SEVEN (7) STIFFENERS EQUALLY SPACED.

VENDOR: HOFFMAN ENGINEERING CO.
DIV. OF FEDERAL CARTRIDGE CORP.
ANOKA, MN. 55303

SUBSTITUTES: PERMITTED WITHOUT ENGINEERING APPROVAL.

THE MATERIAL IS THE EXCLUSIVE PROPERTY OF EATON CORP. THE COMPANY AND SHALL NOT BE REPRODUCED, COPIED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY

REV. NO.	CHANGE ORDER NO	DATE	DESCRIPTION	CHKD. BY

TITLE: ENCLOSURE TWO DOOR NEMA 12 46H-60W-12D

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .005
FLAME CUTTING, SHEARING, PUNCHING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0 PL ± .060 0.0 PL ± .010 0.00 PL ± .005

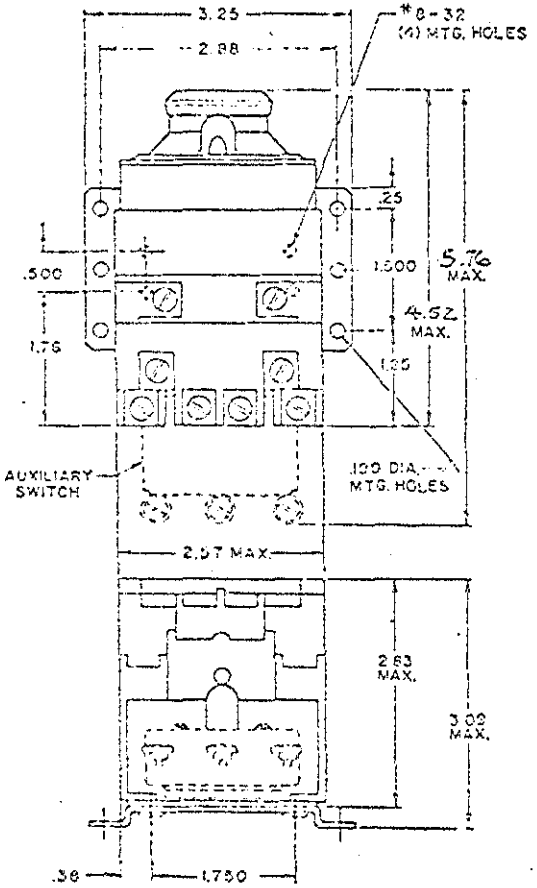
Cutler-Hammer Eaton Electrical Sector

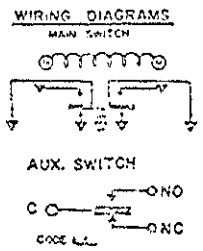
SOL NO. 10287	9/12/97	ASSY. OR I.D.	
DR. BY GRANZOW	9/12/97	SCALE	
CHKD. BY KCR	9/15/97	MFAT. #	
MATL			
APPV.	DATE	MATL	
	MACH	CHKD. KCR	
	WELD		

SHEET 1 OF 1 SIZE C DWG NO. 11908569 REV

11908569

1190857C





DESCRIPTION:

RELAY TIMING.
AGASTAT 7000 SERIES.
OPERATION ON-DELAY
CONTACT ARRANGEMENT 4PDT.
COIL VOLTAGE 120V.D.C.
TIME RANGE 20 TO 200 SEC.
AUX. SWITCH TWO INSTANTANEOUS
FORM C (SPDT) CONTACT.

VENDOR PC. NO.:
7014PELL

VENDOR:
AMERACE CORP.
CONTROL PRODUCTS DIV.
2330 VAUXHALL ROAD.
UNION, NJ. 07083.

SUBSTITUTES NOT PERMITTED.

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: RELAY 4PDT TDPU 20 TO 200 SEC. COIL 120VDC

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .040 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

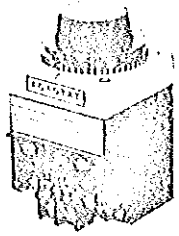
REL. NO. 10301	5/4/71	ASSY. OR LO.	
DR. BY GRADZOW	4/20/71	SCALE	
CHK'D. BY R.K.	4/21/71	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. PJC	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1190857O | SHEET 1 OF 2

AGASTAT®

7000 Series timing relay

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

Because of the skilled calibration and adjustment required on certain components prior to final assembly, we recommend that field servicing be limited to the replacement of the switch-block and coil assemblies, listed below. These have been designed to insure factory-built performance after field servicing without elaborate calibration. In cases where damage or abuse make it impossible to restore satisfactory performance by replacing these assemblies, the unit should be returned to the factory for repair or replacement.

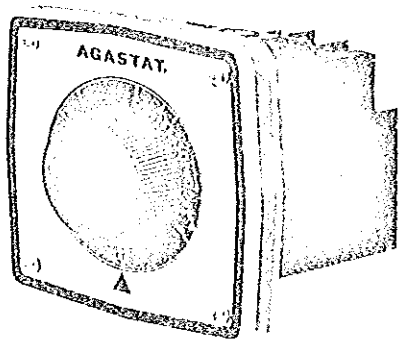
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Normal mounting for the basic 7000 Series unit is in a vertical position, from the back of the panel. Four 8-32 tapped holes are provided in the back plate, making it interchangeable with earlier models. Mounting screws should not project more than 5/32" into the back of the unit, to prevent internal damage.

A bracket for mounting the unit from the front, and the screws required to attach it to the relay are also supplied with each unit. The bracket extends approximately 3/8" from each side of the unit.

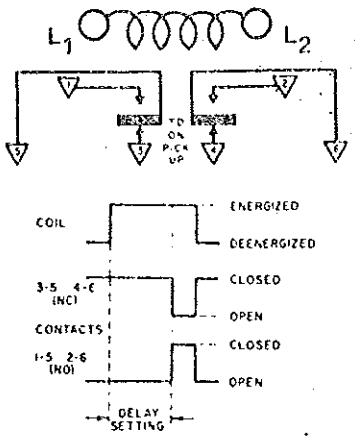
B. HORIZONTAL/PANELMOUNT



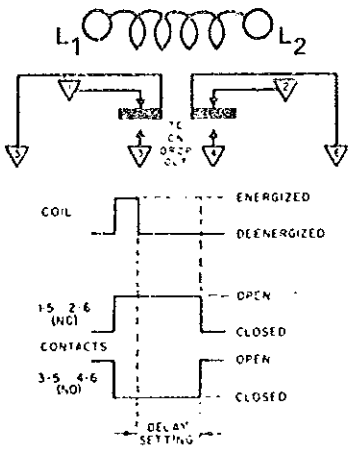
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If the Panel Mounting Kit (option X) is added in the field to units not factory equipped with options Y1 or Y2, an error in dial calibration will result.

7012 SERIES



7022 SERIES



AUXILIARY SWITCH ADJUSTMENT

MODEL 7012

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downword stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization, and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.*

MODEL 7022

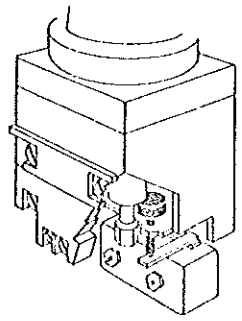
INSTANT TRANSFER AUX. SWITCH (CODE T)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before spindle returns to its normal position, following deenergization. To increase aux. switch delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.

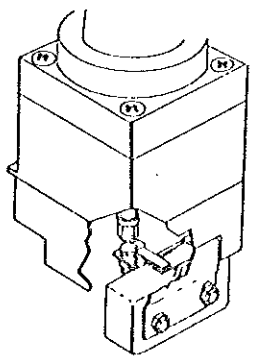
TWO STEP AUX. SWITCH (CODE T)

Check operation as for Instant Transfer, above. Increase first delay period by turning actuator screw clockwise until the desired delay before aux. switch transfer is reached.*

*First delay is independently adjustable, but must be no more than 30% of overall delay. (Recommended max. 100 sec.)



CODE L



CODE T

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102 - 132	110	93.5 - 121
	B	240	204 - 264	220	187 - 242
	C	480	408 - 528		
	D	550	468 - 605		
	E	24	20.5 - 26.5		
	F			127	108 - 140
	G			240	204 - 264
	H	12	10.2 - 13.2		
	I	6	5.1 - 6.6		
	J	208	178 - 229		
	K	DUAL VOLTAGE COIL (COMBINES A & B)			

AC

AC SPECIALS L1, L2, etc.

AC Coils (Part No. = 2400 followed by dash and code letter above)

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range DC
2410—	M	28	22.5 - 33.5
	N	48	38.5 - 57.5
	O	24	19.2 - 28.8
	P	120	96 - 144
	Q	12	9.6 - 14.4
	R	60	48 - 74
	S	250	200 - 300
	T	550	440 - 660
	U	16	12.8 - 19.2
	V	32	25.6 - 38.4
	W	96	76.8 - 115
	Y	6	4.8 - 7.2
	Z	220	176 - 264

DC

DC SPECIALS X1, X2, etc.

DC Coils (Part No. = 2410 followed by dash and code letter above)

All units draw approximately 8 watts power at rated voltage.

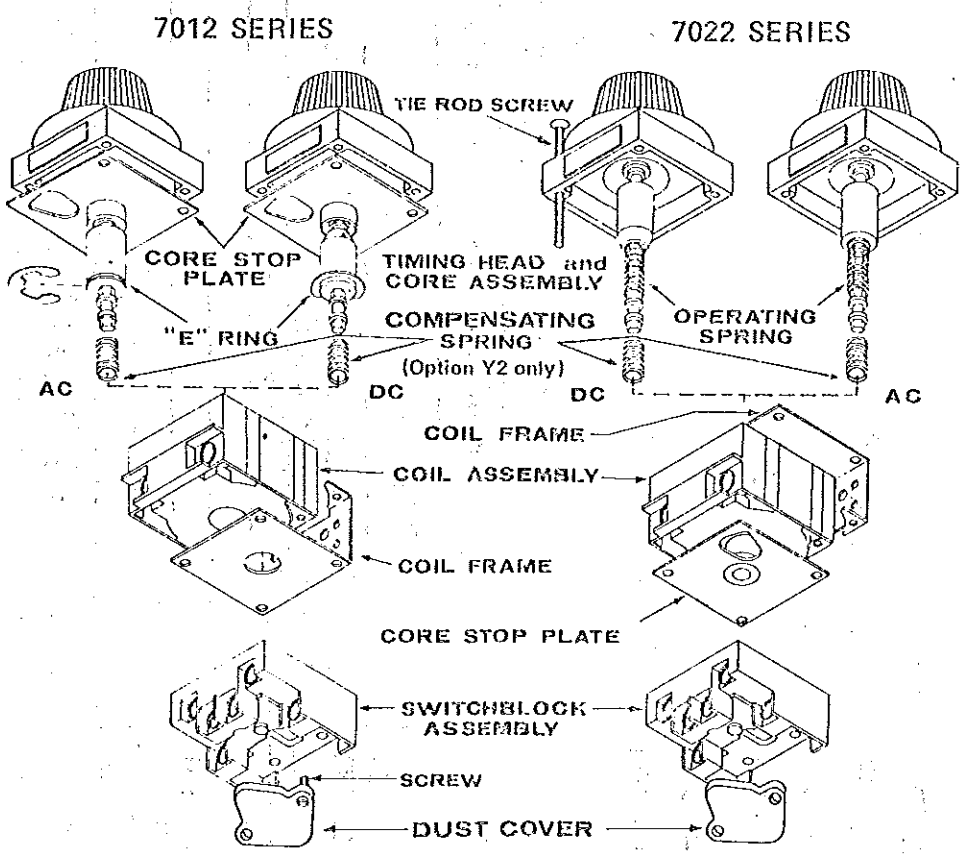
Minimum operating voltages are based on vertically mounted 7012 (on-delay) units. 7012 horizontally mounted or 7022 (off-delay) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

AC units drop out at approximately 50% of rated voltage. DC units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Intermittent duty—maximum 50% duty cycle and 30 minutes "on" time.)

REPLACING SWITCHBLOCK AND COIL ASSEMBLIES – MODEL 7012 AND 7022

Switchblock assemblies are universally interchangeable between all standard 7000 Series units. The same assembly is used for A C and D C models for delay on pull-in or delay on dropout service. Neither timing head/core assembly nor coil assembly is interchangeable between A C and D C models.



LINEAR TIMING RANGES

Time Range Code	Models 7011, 7012, 7021, 7022, 7024	Models 7014, 7031, 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	.7 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not available.
J	3 to 120 Cyc.	Not available.
K	1 to 300 Sec.	Not available.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014, 7031 and 7032 are available with letter calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

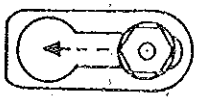
Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ¼ H.P., 10 A. Resistive; 600 V.A.C., 5A.G.P. 30 V.D.C., 15A.G.P.

REMOVING SWITCHBLOCK

1. Remove four tie rod screws.
2. Hold timing head and coil assembly in one hand, switchblock in the other.
3. Slide switchblock 1/2" forward of coil assembly to center spindle in large end of keyhole slot in switch blade. (See diagram A).
4. Slowly lift timing head and coil assembly off switchblock, being careful to keep spindle collar away from switchblade while withdrawing it.

REVERSE THIS PROCEDURE TO INSTALL NEW SWITCHBLOCK.



A

REMOVING COIL

Follow steps 1 to 4 above, then:

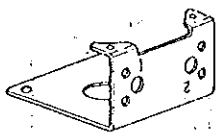
5. Remove timing head and core assembly. (On Model 7022 units the core stop plate and operating spring are loose pieces, located below the core rather than attached to the timing head and core assembly, as on the Model 7012 units. These two pieces should be removed before removing the coil frame, to prevent loss of the loose spring.)

7012 models require removal of "E" ring from core to permit removing core from coil.

6. Slide off coil frame.

When installing new coil, be sure to replace coil frame with proper side up. Number "1" on back of frame should be up on 7012 (Delay on Pull-in) Models, Number "2" should be up on 7022 (Delay on Drop-out) Models. See Diagram B.

On 7012 models, replace "E" ring in core slot after assembling coil frame to coil.



B

REPLACEMENT ASSEMBLIES

	Part No.
AC Coil Assembly	2400- *
DC Coil Assembly	2410- *
Switchblock Assembly	2412-30
Auxiliary Switch Kit (Code L)	7000-47
Auxiliary Switch Kit (Code T)	2412-121

* Specify voltage with code letter

WARRANTY

The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

FOR REPAIR SERVICE

Return defective units to:

CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 Hickory Street
Grafton, Wisconsin 53024

ATTENTION: Product Service Department

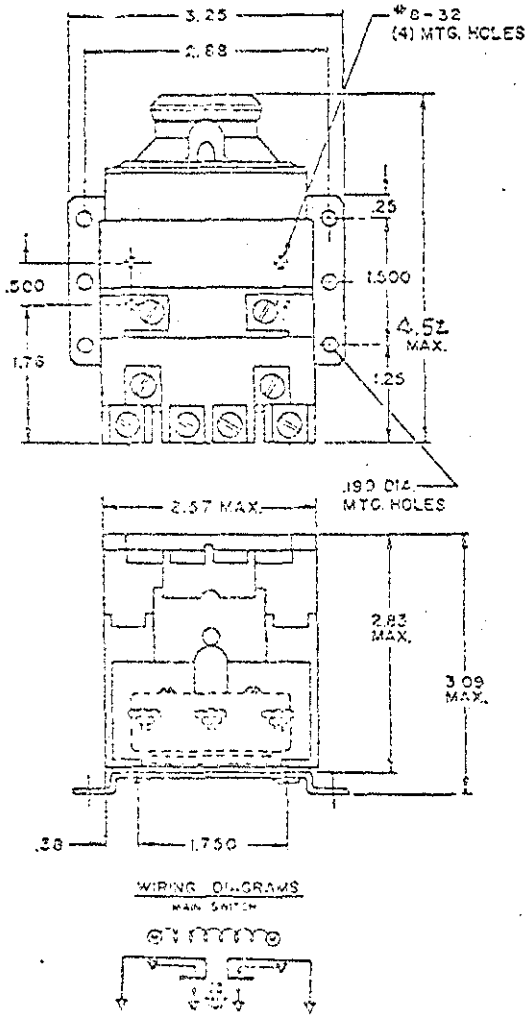
amerace CONTROL PRODUCTS DIVISION

Amerace Corporation
Control Products Division
2330 Vauxhall Road
Union, New Jersey 07083

SR-30

January 1974 Printed in U.S.A.

1190857?



DESCRIPTION:
RELAY TIMING,
AGASTAT 7000 SERIES.
OPERATION OFF-DELAY
CONTACT ARRANGEMENT DPDT
COIL VOLTAGE 120V. 60 HZ.
TIME RANGE 20 TO 200 SEC.

VENDOR PC. NO.:
7022AE

VENDOR:
AMERACE CORP.
CONTROL PRODUCTS DIV.
2330 VAUXHALL ROAD.
UNION, N.J. 07083

SUBSTITUTES:
NOT PERMITTED.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
RELAY 2PDT 7000
20 TO 200 SEC.
COIL 120V. 60 HZ

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .040 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. 10301	5/4/71	ASSY. OR LO.	
DR. BY GRANZOW	4/22/71	SCALE	
CHK'D. BY H.K.	4/22/71	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. RJC	
APPV. WELD.			

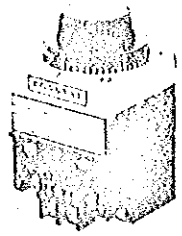
SHEET SIZE A | DWG. NO. 1190857? | SHEET 1 OF

DF3009-2

AGASTAT®

7000 Series timing relay

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

Because of the skilled calibration and adjustment required on certain components prior to final assembly, we recommend that field servicing be limited to the replacement of the switch-block and coil assemblies, listed below. These have been designed to insure factory-built performance after field servicing without elaborate calibration. In cases where damage or abuse make it impossible to restore satisfactory performance by replacing these assemblies, the unit should be returned to the factory for repair or replacement.

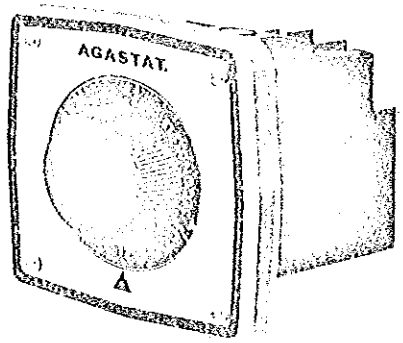
MOUNTING INSTRUCTIONS

A. VERTICAL

Normal mounting for the basic 7000 Series unit is in a vertical position, from the back of the panel. Four 8-32 tapped holes are provided in the back plate, making it interchangeable with earlier models. Mounting screws should not project more than 5/32" into the back of the unit, to prevent internal damage.

A bracket for mounting the unit from the front, and the screws required to attach it to the relay are also supplied with each unit. The bracket extends approximately 3/8" from each side of the unit.

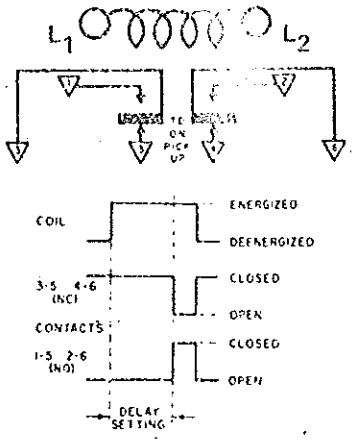
B. HORIZONTAL/PANELMOUNT



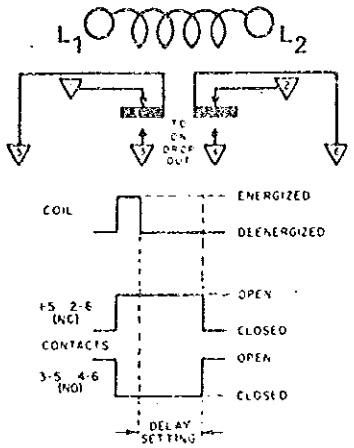
All basic 7000 Series units may be mounted horizontally. However, a dial calibration error (as much as 32% in some units) will result unless the timer is factory equipped with horizontal operation option X or Y1. A unit factory equipped with vertical-horizontal operation option Y2 will require the removal of the Position Compensation Spring in order to maintain accurate calibration. This spring may be removed after the removal of the plastic dust cover, which is fastened to the bottom of the timer with two screws. The dust cover must be replaced after removing the spring.

If the Panel Mounting Kit (option X) is added in the field to units not factory equipped with options Y1 or Y2, an error in dial calibration will result.

7012 SERIES



7022 SERIES



AUXILIARY SWITCH ADJUSTMENT

MODEL 7012

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downword stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization, and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.*

MODEL 7022

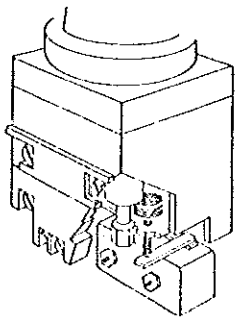
INSTANT TRANSFER AUX. SWITCH (CODE T)

Aux. switch should transfer immediately when relay coil is energized, and should reset shortly before spindle returns to its normal position, following deenergization. To increase aux. switch delay period, increase the distance between actuator screw head and arm by turning it clockwise, using 1/4" open end wrench.

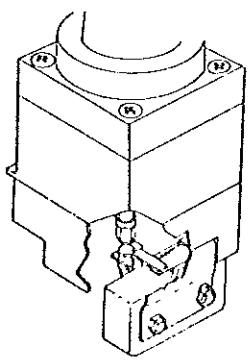
TWO STEP AUX. SWITCH (CODE T)

Check operation as for Instant Transfer, above. Increase first delay period by turning actuator screw clockwise until the desired delay before aux. switch transfer is reached.*

*First delay is independently adjustable, but must be no more than 30% of overall delay. (Recommended max. 100 sec.)



CODE L



CODE T

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102-132	110	93.5-121
	B	240	204-264	220	187-242
	C	480	408-528		
	D	550	468-605		
	E	24	20.5-26.5		
	F			127	108-140
	G			240	204-264
	H	12	10.2-13.2		
	I	6	5.1-6.6		
	J	208	178-229		
	K	DUAL VOLTAGE COIL (COMBINES A & B)			

AC

AC SPECIALS L1, L2, etc.

AC Coils (Part No. = 2400 followed by dash and code letter above)

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range DC
2410—	M	28	22.5-33.5
	N	48	38.5-57.5
	O	24	19.2-28.8
	P	120	96-144
	Q	12	9.6-14.4
	R	60	48-74
	S	250	200-300
	T	550	440-660
	U	16	12.8-19.2
	V	32	25.6-38.4
	W	96	76.8-115
	Y	6	4.8-7.2
	Z	220	176-264

DC

DC SPECIALS X1, X2, etc.

DC Coils (Part No. = 2410 followed by dash and code letter above)

All units draw approximately 8 watts power at rated voltage.

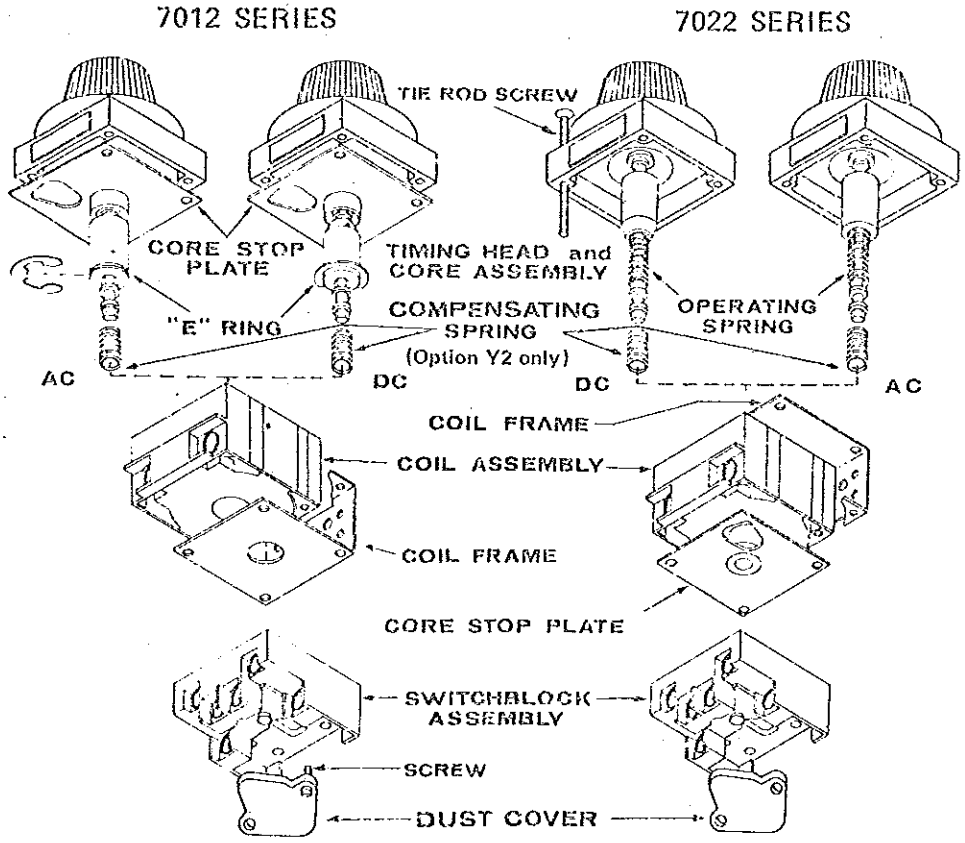
Minimum operating voltages are based on vertically mounted 7012 (on-delay) units. 7012 horizontally mounted or 7022 (off-delay) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

A C units drop out at approximately 50% of rated voltage. D C units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Recommended duty - maximum 50% duty cycle and 30 minutes "on" time.)

REPLACING SWITCHBLOCK AND COIL ASSEMBLIES – MODEL 7012 AND 7022

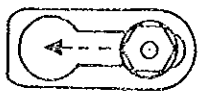
Switchblock assemblies are universally interchangeable between all standard 7000 Series units. The same assembly is used for A C and D C models for delay on pull-in or delay on dropout service. Neither timing head/core assembly nor coil assembly is interchangeable between A C and D C models.



REMOVING SWITCHBLOCK

1. Remove four tie rod screws.
2. Hold timing head and coil assembly in one hand, switchblock in the other.
3. Slide switchblock 1/2" forward of coil assembly to center spindle in large end of keyhole slot in switch blade. (See diagram A).
4. Slowly lift timing head and coil assembly off switchblock, being careful to keep spindle collar away from switchblade while withdrawing it.

REVERSE THIS PROCEDURE TO INSTALL NEW SWITCHBLOCK.



A

REMOVING COIL

Follow steps 1 to 4 above, then:

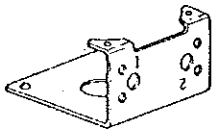
5. Remove timing head and core assembly. (On Model 7022 units the core stop plate and operating spring are loose pieces, located below the core rather than attached to the timing head and core assembly, as on the Model 7012 units. These two pieces should be removed before removing the coil frame, to prevent loss of the loose spring.)

7012 models require removal of "E" ring from core to permit removing core from coil.

6. Slide off coil frame.

When installing new coil, be sure to replace coil frame with proper side up. Number "1" on back of frame should be up on 7012 (Delay on Pull-in) Models, Number "2" should be up on 7022 (Delay on Drop-out) Models. See Diagram B.

On 7012 models, replace "E" ring in core slot after assembling coil frame to coil.



B

REPLACEMENT ASSEMBLIES

	Part No.
AC Coil Assembly	2400- *
DC Coil Assembly	2410- *
Switchblock Assembly	2412-30
Auxiliary Switch Kit (Code L)	7000-47
Auxiliary Switch Kit (Code T)	2412-121

* Specify voltage with code letter

LINEAR TIMING RANGES

Time Range Code	Models 7011, 7012, 7021, 7022, 7024	Models 7014, 7031, 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	.7 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not avail.
J	3 to 120 Cyc.	Not avail.
K	1 to 300 Sec.	Not.avail.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014, 7031 and 7032 are available with letter calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ¼ H.P., 10 A. Resistive; 600 V.A.C., 5A.G.P. 30 V.D.C., 15A.G.P.

WARRANTY

The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

FOR REPAIR SERVICE

Return defective units to:

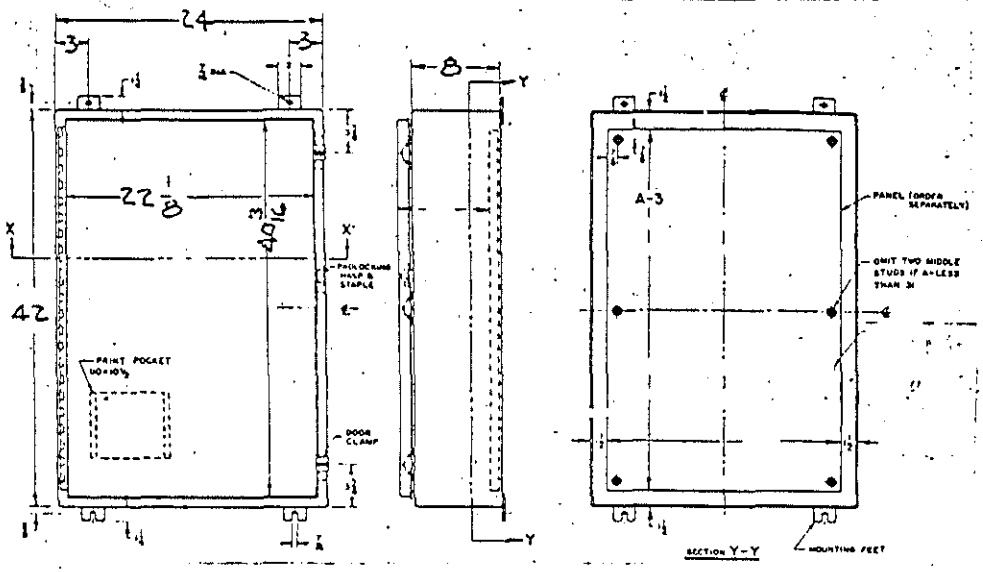
CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 Hickory Street
Grafton, Wisconsin 53024
ATTENTION: Product Service Department

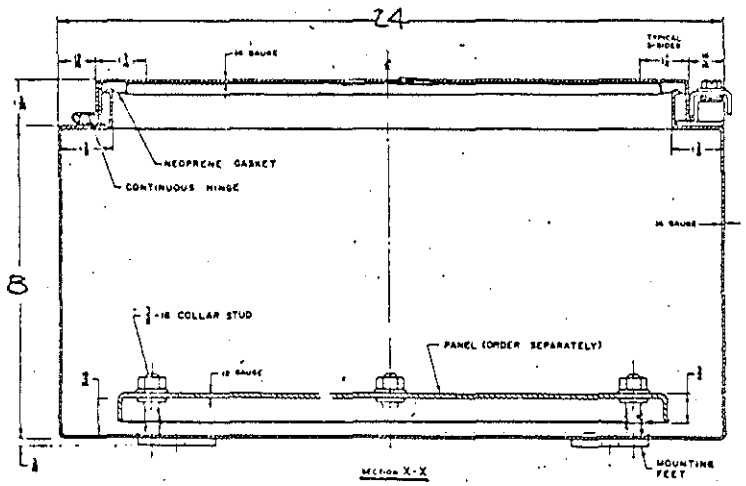
CONTROL PRODUCTS DIVISION
Amerace Corporation Control Products Div. 2330 Vauxhall Road Union New Jersey 07...

SR-30

January 1974 Printed in U.S.A.

11908577





DESCRIPTION: NEMA TYPE 12 ENCLOSURE, SINGLE DOOR WALL MOUNTED. 42" HIGH, 24" WIDE & 8" DEEP NOMINAL, 9-11/32" OVERALL DEPTH. CONSTRUCTION & FINISH PER HOFFMAN BULL. A-12, LESS PANEL.

VENDOR PC. NO. A-422408LP

VENDOR: HOFFMAN ENG. CO.
DIV. OF FEDERAL CARTRIDGE
ANOKA, MN. 55303

SUBSTITUTES: PERMITTED WITHOUT ENGINEERING APPROVAL.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
ENCLOSURE
NEMA 12
42H-24W-8D

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

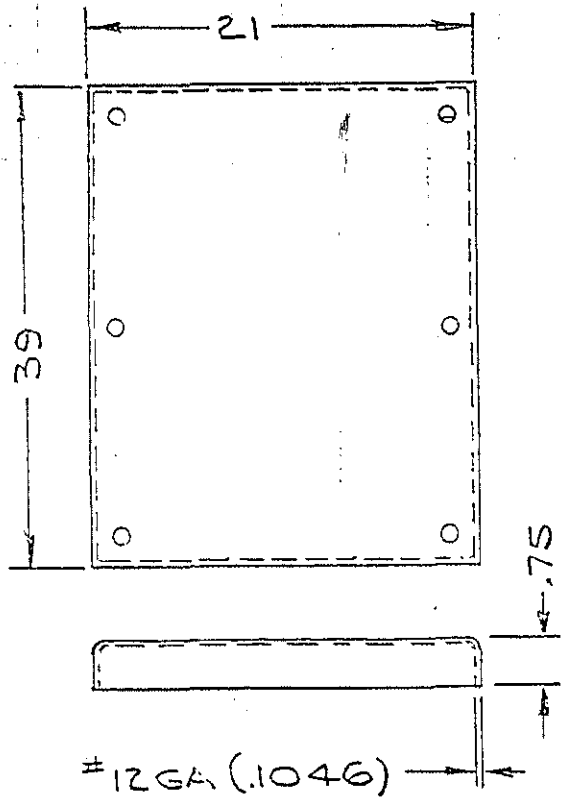
Colt Industries — Fairbanks Morse Power Systems Division

REL. NO. PC1790	5/10/77	ASSY. OR LO.	
DR. BY GRANROW	5/6/77	SCALE	
CHK'D. BY R.K.	5/6/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11908577 | SHEET 1 OF 1

RE3009-2

11908578



DESCRIPTION: PANEL 39"H X 21"W FOR NEMA 12 ENCLOSURE 42"H X 24"W. CONSTRUCTION, FINISH ETC PER HOFFMAN BULL. A-12.

VENDOR PC. NO: A-42P24

VENDOR: HOFFMAN ENG. CO. DIV. OF FEDERAL CARTRIDGE CO, ANOKA, MN. 55303.

SUBSTITUTES: PERMITTED WITHOUT ENGINEERING APPROVAL.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: PANEL 39"X21" NEMA 12 ENCLOSURE

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Power Systems Division

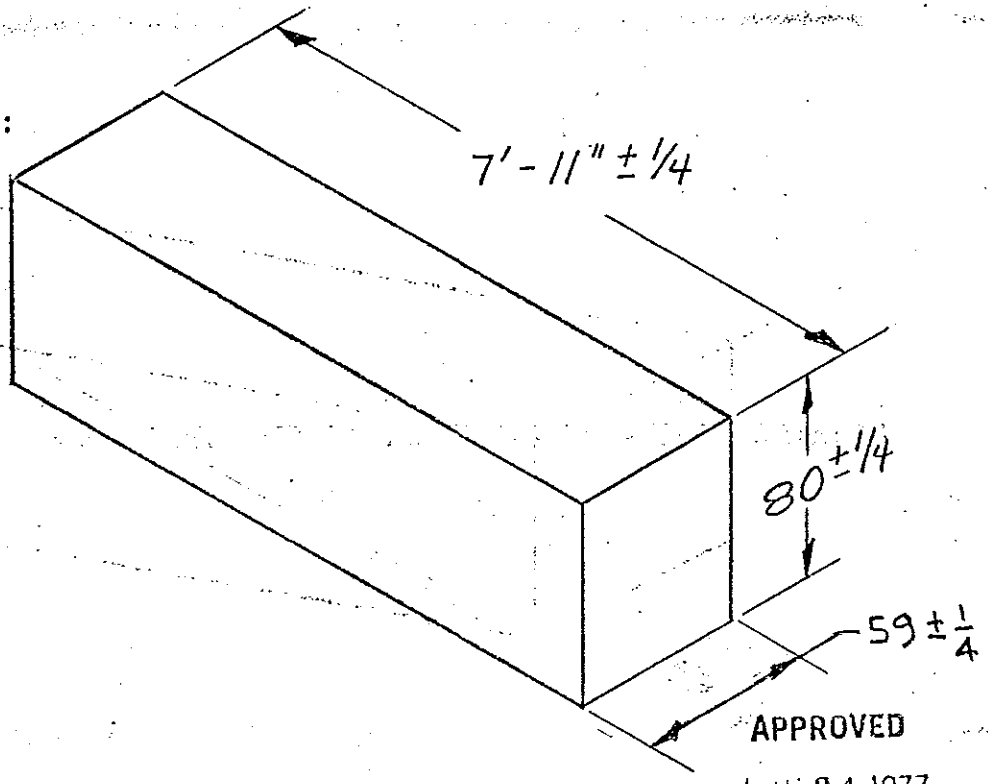
REL. NO. PC1790	5/10/77	ASSY. OR LO.	
DR. BY GRANZOW	5/6/77	SCALE	
CHK'D. BY R.K.	5/6/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11908578	SHEET 1 OF 1	

DESCRIPTION: GENERATOR NEUTRAL GROUNDING RESISTOR

VENDOR: GENERAL ELECTRIC CO.

TYPE:

② VENDOR DRAWINGS:
195B7798AN



APPROVED
AUG 24 1977
QUALITY CONTROL

LIMERICK GENERATING STATION UNITS 1 AND 2
PHILADELPHIA ELECTRIC COMPANY
SPEC. NO. 8031-M-71 REV 3 ①
EMERGENCY DIESEL GENERATORS
PURCHASE ORDER NO. LX 239585
COLT/FMED ORDER NO. 11-700000

THIS MATERIAL IS THE EXCLUSIVE PROPERTY OF FAIRBANKS MORSE INC. (THE COMPANY) AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS, EXCEPT AS AUTHORIZED BY CONTRACT WITH THE COMPANY, WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D BY
B	11348	3-21-79	② ADDED VENDOR'S P/N & PICTURE	LD
A	11014	8-7-78	ADD REV. STATE TO SUB TIER SPECS ①	DLS
18	10520	10-28-77	GENERAL REVISION.	RTC

Colt Industries — Fairbanks Morse Engine Division

REL. NO. PC1965	8/30/77	ASSY. OR LO.	
DR. BY R. J. Keyes	8/09/77	SCALE	
CHK'D. BY R.T. CALUD	8/23/77	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 11 908 920 | SHEET 1 OF 2

ORIGINAL

11 908 920

COLT Rev 2 APP QA JUL 31 1978 | FM COLT 12 3 QA FEB 26 1979 APP

NEUTRAL GROUNDING RESISTOR, INDOOR, 2400 VOLTS LINE TO NEUTRAL, 4160 SYSTEM, 60 OHMS, 40 AMPS, CONTINUOUS RATING.

FURNISH BURNDY TYPE YA CABLE LUGS, FOR 250 MCM CABLE FOR GENERATOR CONNECTION AND 750 MCM FOR THE GROUND CONNECTION.

FURNISH A RIGID, ALUMINUM, LOUVRED METAL ENCLOSURE.

RESISTOR SHALL BE DESIGNED, RATED, AND TESTED PER IEEE 32.

THE RESISTOR AND ENCLOSURE SHALL BE SEISMICALLY QUALIFIED BY TESTING PER BECHTEL CORP. SPECIFICATION 8031-G-14* WITH APPENDIX A FOR SEISMIC DESIGN AND ANALYSIS, FOR CLASS I SEISMIC. (RESPONSE CURVES LATER)

* BECHTEL SPEC. 8031-G-14 REV. 4

THE RESISTOR AND ENCLOSURE MANUFACTURERS OUTLINE AND MOUNTING PLANS SHALL INDICATE WEIGHT AND ANCHOR BOLT LOADINGS. ANCHOR BOLT LOADING SHALL BE IN THE FORM OF A NOTE.

"SEISMIC AND ANCHOR BOLT LOADINGS: EACH BOLT AT EACH OF _____ LOCATIONS, _____ LBS. TENSION AND _____ LBS. SHEAR."

APPROVED
AUG 24 1977
QUALITY CONTROL

Colt Industries — Fairbanks Morse Engine Division	SHEET SIZE A	DWG. NO. 11 908 920 REV. 3 REV. 2 REV. 1			SHEET 2 OF 2

11908920

NEUTRAL GROUNDING RESISTORS

APPLICATION

The main intent of a grounding resistor is to limit the maximum ground-fault current to a value which will provide protection to all associated equipment within a power system.

Neutral-grounding resistors are used for resistance grounding of industrial power systems and are connected between the ground and the neutral of wye-wound power transformers, grounding transformers or generators.

By installing grounding resistors in an industrial power system, sufficient fault current flows which allows operation of protective relays. The main benefit resulting from resistance grounding is the automatic isolation of the grounded circuit along with the limitation of the ground current to a value which will produce minimum damage to the system.

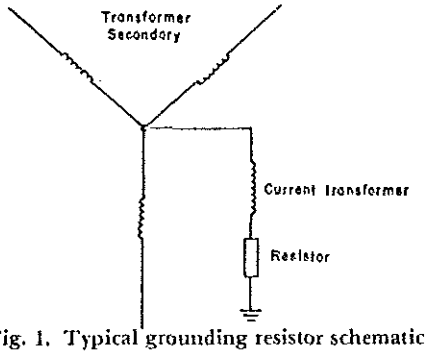


Fig. 1. Typical grounding resistor schematic

SPECIFICATIONS

General Electric neutral-grounding resistors are designed, manufactured and tested in strict accordance with IEEE standard No. 32-1972. These resistors are designed to suit individual needs with respect to ohmic values, current capacities, and times of operation.

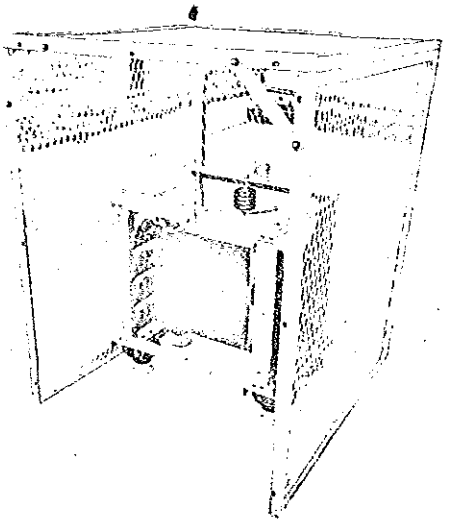
SERVICE REQUIREMENTS

The two classes of service requirements for neutral grounding resistors, as established by IEEE Standard 32-1972, are "steady state" and "rated time." The categories for "rated-time" resistors are: ten-second, one-minute and extended-time. The "steady-state" category refers to the rating when the resistor is to carry continuous current or to be on for a period beyond that permitted for the extended-time rating.

Rated Time

Ten-second Rating—This is the shortest time rating applied to neutral grounding devices which are used to reduce the ground current that may flow through a piece of equipment. The current permitted is usually considerably greater than the full-load current, so that dependence must be placed upon the relay operation to prevent damage not only to the neutral device but also to the main equipment.

One-minute Rating—A common use of neutral grounding devices has been to limit ground currents on outgoing feeders during faults to ground in order to reduce damage at the fault, limit overvoltages between sound phases and ground, and improve voltage regulation. The maximum ground current in such cases is often less than full-load current in the feeder. The use of a neutral grounding device with a ten-second rating is not satisfactory for limiting ground fault current on feeders because the device may be required to withstand several faults on different feeders in rapid succession. Thus these grounding devices should have a rated time of one minute at the rated current.



(Photo 1236898)

Fig. 2. IC300A resistor in grounded safety-screen enclosure.

Extended-time Rating—For all applications where a ground fault is permitted to persist for longer than ten minutes, the grounding device should have a rating based upon the temperature reaching a constant maximum value, but selected on the basis that such operation will be infrequent. The temperature rise permitted may be higher than the standard temperature rise for steady-state service, assuming that operation at maximum temperature rise will not be required for more than an average of 90 days per year with an average ambient not exceeding 30 C. For this application the extended-time rating is used.

Steady State

The IEEE standards have established for the continuous-current-rated neutral grounding resistors an allowable temperature rise of 385 C under steady-state conditions. For the extended-time rating, a temperature rise of 610 C is permitted for stainless-steel resistors. Thus, if the lower temperature rise is desired for stainless-steel-type resistors or if the resistor is to be on for an average above 90 days per year, a steady-state rating should be specified.

MINE SERVICE REQUIREMENTS

Where neutral-grounding resistors have been specified for mine service applications, an extended-time rating should be specified in accordance with IEEE 32-1972. General Electric's standard neutral-grounding

MINE SERVICE REQUIREMENTS (Cont'd)

resistor complies with all mining service requirements.

The use of a high value of resistance is recommended so that ground current is absorbed by the resistor. When a fault occurs, the voltage gradient to ground is low and mining personnel are not subjected to high-voltage hazards.

SEISMIC SHOCK REQUIREMENTS

Where the application requires the neutral grounding resistor be rated for seismic shock, specific requirements in terms of magnitude and frequency of the vibration should be obtained. Test reports certifying the resistor will meet a given shock requirement are optionally available. Refer to the Company for more details.

STAINLESS-STEEL EDGEWISE-WOUND TYPE

1. Resistor Units

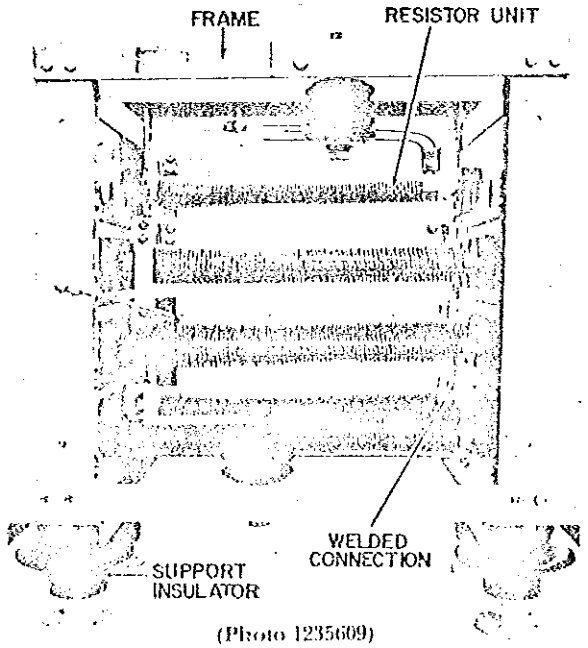
The resistor unit is comprised of an edgewise-wound helix strap consisting of AISI-430 or AISI-406 stainless-steel wound around a ceramic core on a stainless-steel tie rod. The resistor is suitable for indoor or outdoor service without any type of protection from normal atmospheric conditions.



(Photo 1236918)
Fig. 3. IC9033B wire-wound unit.

The resistor units are individually supported at each end by doughnut-shaped, glazed-ceramic insulators. This type of support allows proper thermal expansion of the resistor when it is subjected to high operating temperatures resulting from a ground fault.

2. Frame Assembly



(Photo 1235609)
Fig. 4. IC300A stainless-steel resistor in open frame with support insulators.

The resistor frame is constructed of corrosion-resistant zinc-chromate plated steel. Under normal atmospheric conditions the frame is impervious to corrosion and is able to withstand severe mechanical stress.

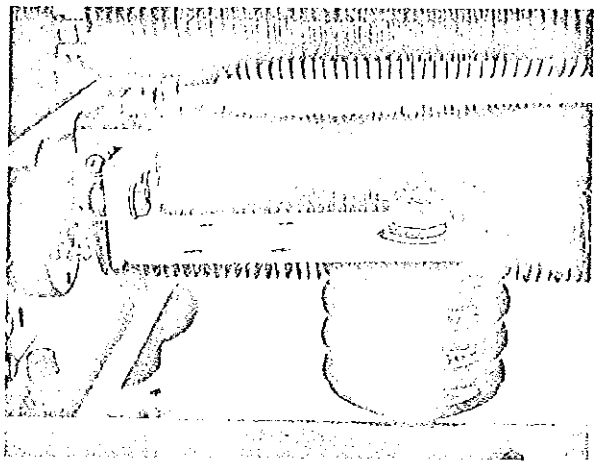
3. Welded Circuitry

Resistor elements within each tier are joined by stainless-steel connectors welded to the stainless-steel terminals. This provides a continuous positive electrical path within the resistor assembly regardless of atmospheric conditions. The resistor elements are connected in series or parallel which provides an ohmic value to comply with individual systems specifications.

4. Terminations

Stainless-steel resistors, Type IC-300A, are supplied with silver-plated copper termination pads with NEMA four-hole drilling. Universal clamp-type terminals, suitable for aluminum or copper cable sizes No. 2 to 600 MCM, are available for use with resistor termination pads.

Terminal assembly for entrance bushing and clamps for stand-off insulator and stand leg (ground clamp) are also available.



(Photo 1235699)
Fig. 5. IC300A resistor termination pad.

5. Cabling

Where the resistor rating requires two frames or more and the frames are stacked, the connection between frames is included. Where the rating requires two or more frames that are not stackable (such as extended time ratings), the connection between frames must be supplied by Purchaser. Cabling to and from entrance bushing and current transformer must also be supplied by Purchaser.

6. Dimensions

Refer to GEP-345A, pages 149 and 150.

7. Change in Resistance with Temperature (over the operating temperature range)

a. Ten-second or 60-second rating	90% increase max
b. Extended time rating	13% increase max
c. Continuous rating	40% increase max

CAST-GRID TYPE

1. Resistor Units

The IC9143 and IC9147 cast-grid neutral-grounding resistors are made up of cast-iron grids mounted in steel frames. The grids are of uniform cross section and are supported at the two end points. The individual elements are assembled on metal tie rods, insulated by mica tubes which provide increased electrical and thermal life.

2. Specifications

RESISTANCE MATERIAL

a. **Short-time ratings:**
Cast iron composed of approximately 93% iron, 4% carbon and the remainder of manganese, phosphor, sulphur and silicon.

b. **Extended-time ratings:**
Cast iron composed of approximately 93% iron, 4% carbon and the remainder of manganese, phosphor, sulphur and silicon.

TEMPERATURE RISE (in accordance with IEEE-32 Standards)

a. **Short-time ratings:**	500 C rise for one minute, 450 C rise for ten minutes
b. **Extended-time ratings:**	375 C
c. **Continuous ratings:**	375 C

CHANGE IN RESISTANCE WITH TEMPERATURE (over the Operating Temperature Range)

a. **Short-time ratings:**	35% increase
b. **Extended-time ratings:***	24% increase

CORROSION RESISTANCE
The cast grids for outdoor service are housed in aluminum enclosures to prevent direct contact with the weather.

RUGGEDNESS OF RESISTOR UNITS
Cast-iron grids are mounted in a rugged framework on insulated tie rods. Grids are securely clamped in place by nuts and heavy lock washers.

3. Frame Assembly

The individual cast-grid elements are mounted within a steel framework suitable for use indoors or outdoors. The enclosure for the cast-grid neutral-grounding resistor is fabricated from aluminum with suitable characteristics for use outdoors in most environmental conditions. When two or more frames of resistors are required, they may be stacked one on top of the other. The stacks are electrically insulated from each other by insulators rated 5.0 kV. The individual stack will then be insulated from ground by insulators 7.5 kV or higher, as dictated by the system line-to-neutral voltage. For outdoor locations, the IC9147 resistors are enclosed in a weatherproof aluminum enclosure with removable covers.

4. Terminals

Electrical connections for the cast-grid neutral-grounding resistor are brought out through the metal enclosure through a cable bushing. Each resistor unit enclosure contains a bushing for the incoming line and a bushing for the outgoing line. When two or more frames are required for a given application, the resistors are electrically connected together by cables which are supplied with a resistor. The end of each cable includes, where specified on the order, a clamp-type, butt connector for a minimum of No. 8 to a maximum of 1-4/0 cable. If terminals are not specified with the order, they will not be included. This connection must be made after the frames are stacked at the installation.

5. Base Insulators

Indoor and outdoor neutral-grounding resistors use cap-and-pin type porcelain-base indicators. The specific rating of the insulators is determined by the rating or the system voltage.

6. Dimensions

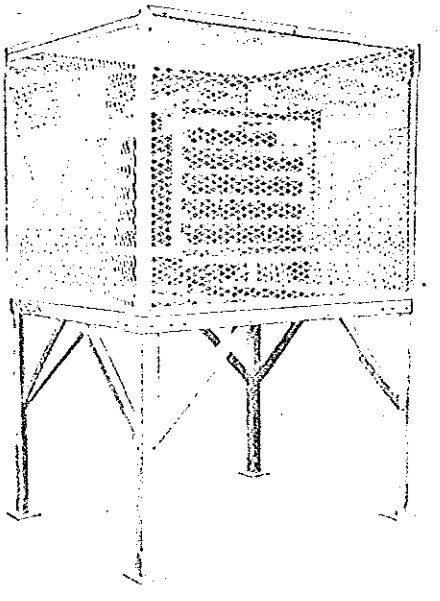
Refer to Company.

MOUNTING

1. Stands

Resistor mounting stands elevate the resistor frame four feet above ground level. The stand provides support for the resistor and is available with an optional safety-screen enclosure around all six sides of the resistor. All stands with the optional safety-screen enclosure have provisions for entrance bushing, stand-off insulator and current transformer.

The stand is fabricated with steel-angle legs and support members which are zinc-chromate plated to insure corrosion resistance for outdoor service.



(Photo 1235698)

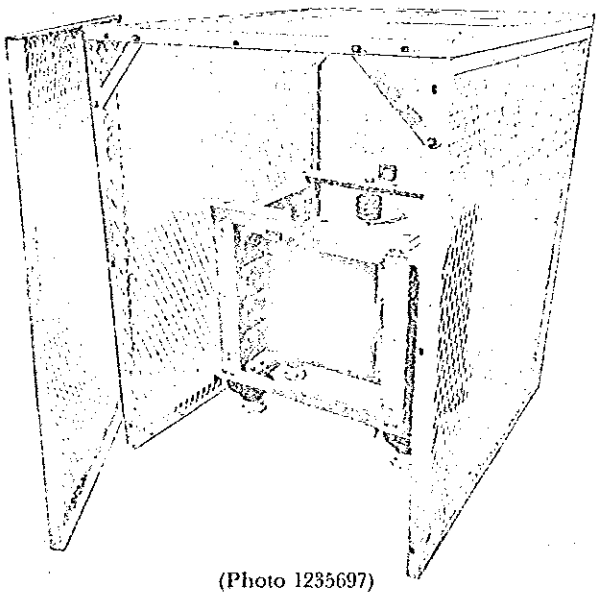
Fig. 6. Stand with optional grounded safety-screen enclosure.

MOUNTING (Cont'd)

2. Safety-screen Enclosure

For indoor locations personnel protection can be provided by specifying resistors complete with the grounded safety-screen enclosure. The resistor is surrounded at top and sides by a self-supporting enclosure that provides adequate electrical clearance from the frame. The enclosure is bolted to the floor, pad or stand (described on page 3) and the sides are removable for access. For outdoor applications these enclosures are designed for protecting the resistor from falling or flying objects and rodents.

The screens are hot-dipped galvanized expanded-metal with 1.2-inch by 2.6-inch openings.



(Photo 1235697)

Fig. 7. Resistor in grounded safety-screen enclosure.

3. Bolted Screened, Louvered or Ventilated Covers

For indoor or outdoor applications where the resistor is installed in an isolated protected area (such as the top of the transformer), the resistor can be supplied with the screened, louvered or ventilated metal cover attached to the resistor frame. These covers are designed for protecting the resistor from falling or flying objects and rodents.

OPTIONS

1. Current Transformers

JKW wound-type current transformers are available for applications up to 15-kV maximum with a maximum ratio of 800:5. These current transformers may be used indoors or outdoors without a weather protective enclosure.

2. Entrance Bushing

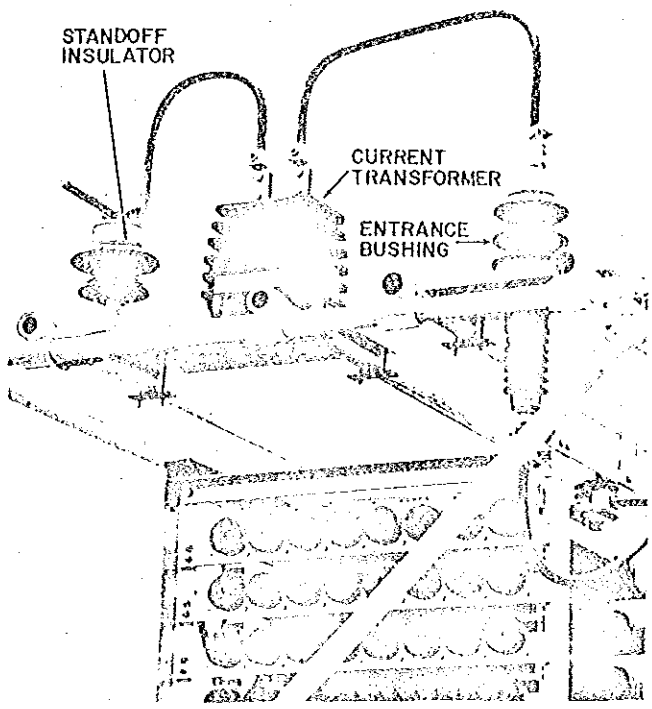
Entrance bushings are available for mounting on the top screen of a safety-screen enclosure or stand to allow for means of connecting customer incoming conductor to the resistor.

3. Stand-off Insulators

Stand-off insulators are available for supporting Customer incoming conductor to relieve stress at the incoming connection point. These insulators are light grey cap and pin construction. The support insulators for the resistor frame (commonly referred to as stand-off insulators) are supplied as part of the resistor frame assembly.

4. Resistor Stacking

Stainless-steel resistor frames may be stacked (2 frames high maximum) for 10-second or 60-second time rating to reduce the floor space used by the neutral-grounding resistor. The units are shipped separately and must be stacked and interconnected at installation by the Customer.



(Photo 1224748)

Fig. 8. Optional stand-off insulator, current transformer, and entrance bushing.

INSTRUCTIONS

IC9138-S1 & S2 NEUTRAL GROUNDING RESISTORS

Resistor

Upon receipt of equipment check material for breakage. Make certain there are no broken insulators or loose connections between units.

Set support insulators on foundation or floor and place resistor frame on the insulators. Resistors rated 600 volts, line-to-neutral, or less have no support insulators. Bolt resistor to the insulators and insulators to the foundation. Clearance on all sides of the resistor should be not less than the insulator height.

Connect line and ground terminals. Terminals on resistor are 1/4 x 3 inch (7.4 x 76 mm) flat bus with NEMA 4 hole drilling. If standard cable terminals are provided, they will accommodate AWG #2 to 600 MCM cable, copper or aluminum. The incoming and outgoing lines must not touch the frame and should be kept as far away from any part of the frame as is practical. Frames rated over 600 volts have a solid copper wire connected from the approximate mid-point of the resistor to the frame. This connection should not be removed as it serves to limit the voltage on the spool insulators.

All resistors over 4160 volts, line-to-neutral consist of two or more frames (4160 volts maximum per frame). The frame to frame connection should be made with cable using procedure above. If in doubt about size, 4/0 is normally the maximum size required.

Periodically, and after each ground fault, check the resistor for broken insulators, debris, and loose connections.

Screens

If screens are supplied, they are always shipped knocked down. The outline has instructions for assembly. The screen enclosure, if not supplied

Screens (Continued)

with an entrance bushing, should be cut to provide an opening for the incoming and/or outgoing lines if necessary.

Stands

If aluminum pipe stands are supplied, they are shipped assembled. The outline has instructions mounting of options which may be supplied. If an entrance bushing is not supplied, the top screen should be cut to provide an opening for the incoming and/or outgoing lines if necessary.

Renewal Parts

Because all resistor elements in each tier are welded, individual resistor elements cannot be supplied. If a resistor element does burn out, replacement will be on a whole tier basis only. Refer to the nearest G. E. Company office giving the complete catalog number and the number of the tier from the top or bottom that the element is in. For insulators, order by description also giving the complete catalog number of the resistor.

If any questions arise which are not covered by these instructions, contact the nearest General Electric Company office.

11908920

RENEWAL

parts

LIST OF CONTROL EQUIPMENT

FURNISHED ON

CUST: COLT INDUSTRIES

REQN: 393-42200

ITEM 1 8 - IC9138S1 Neutral Grd Resistor Asm 358X696C648	FOR PARTS DATA REFER TO PARTS LIST
ITEM 1Z 16 - cat. YA29 Terminals (Gen Side)	
ITEM 1Y 16 - cat. YA39 Terminals (Grd Side)	
ITEM 2 8 - cat. 202B3709G10 Alum Enclosures	NO PARTS RECOMMENDED

GENERAL ELECTRIC

INDUSTRIAL CONTROL DEPARTMENT

IC 323B (02-79)

11908920

renewal parts

PRINCIPAL RENEWAL PARTS LIST

FOR - Neutral Grounding Resistor IC ØØXXX 9138 S2

Cat. 358X696C648

76 -	IC9033 J7C16	Resistance Units (These units are welded together and individual replacement is not recommended)
4 -	Cat. 6009919P1	Large Porcelain Insulator 7.5KV
-	Cat. 6009920P1	Large Porcelain Insulator 15.KV
-	Cat. 218A8499G1	Large Porcelain Insulator 5KV
152 -	Cat. 138A1126P1	Round Spool Type Insulator for Ends of Resistance Units
2 -	Cat. 5747553P1	Insulator for bus bar

Other parts may be ordered by reference number and description, but not by catalog number, from GEF.

GENERAL ELECTRIC

INDUSTRIAL CONTROL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

273A3677
CONT ON SHEET FL SH NO. 1

REV NO. 273A3677
CONT ON SHEET FL SH NO. 1

TITLE OUTLINE
7.5 KV NEUTRAL GROUNDING RESISTOR

FIRST MADE FOR IC9138-S1 REQ. 393-42200

REVISIONS

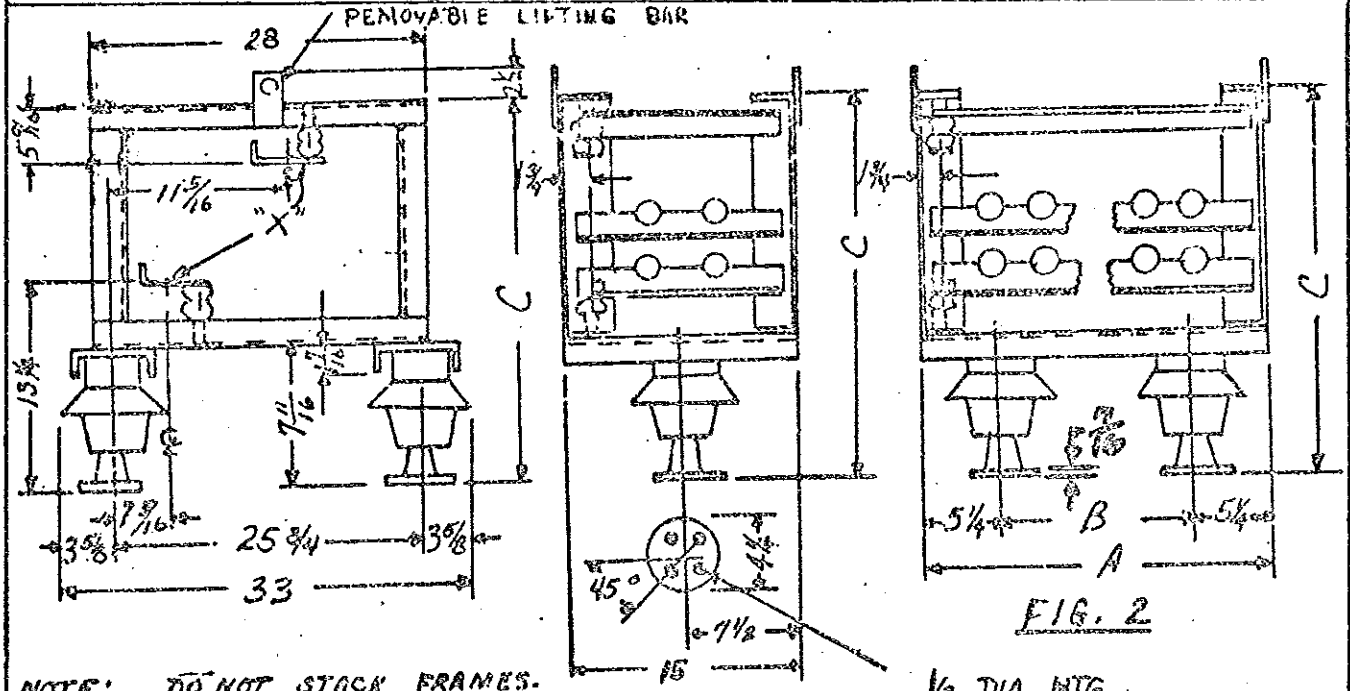


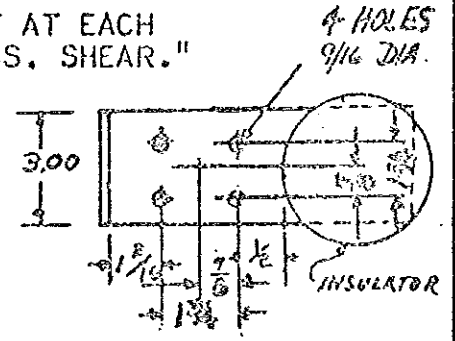
FIG. 1

FIG. 2

NOTE: DO NOT STACK FRAMES. FRAMES TO BE MOUNTED 10" APART.

½ DIA. MTG. BOLTS 3" B.C

NOTE:
"SEISMIC AND ANCHOR BOLT LOADINGS: EACH BOLT AT EACH OF 16 LOCATIONS, 332.5 LBS. TENSION AND 32.3 LBS. SHEAR."



CUSTOMER CONN "X"

PT	A	B	C	NO TIERS.	MAX UNITS	FIG NO.	MAX WT.
1	—	—	23 3/4	2	4	1	175
2	—	—	28 3/4	3	6	1	205
3	—	—	33 3/4	4	8	1	235
4	—	—	38 3/4	5	10	1	265
5	22 1/2	12	28 3/4	3	12	2	310
6	22 1/2	12	33 3/4	4	16	2	365
7	22 1/2	12	38 3/4	5	20	2	420
8	22 1/2	12	43 3/4	6	24	2	475
9	37 1/2	27	33 3/4	4	32	2	550
10	37 1/2	27	38 3/4	5	40	2	650
11	37 1/2	27	43 3/4	6	48	2	750
12	37 1/2	27	48 3/4	7	56	2	850
13	37 1/2	27	53 3/4	8	64	2	950
14	37 1/2	27	58 3/4	9	72	2	1050
15	37 1/2	27	63 3/4	10	80	2	1150

LIMERICK GENERATING STATIONS
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.
COLT PO3-471410-0
COLT DWG. NO. 11908920

TAG NO.
1 (2) AG 503
1 (2) BG 503
1 (2) CG 503
1 (2) DG 503

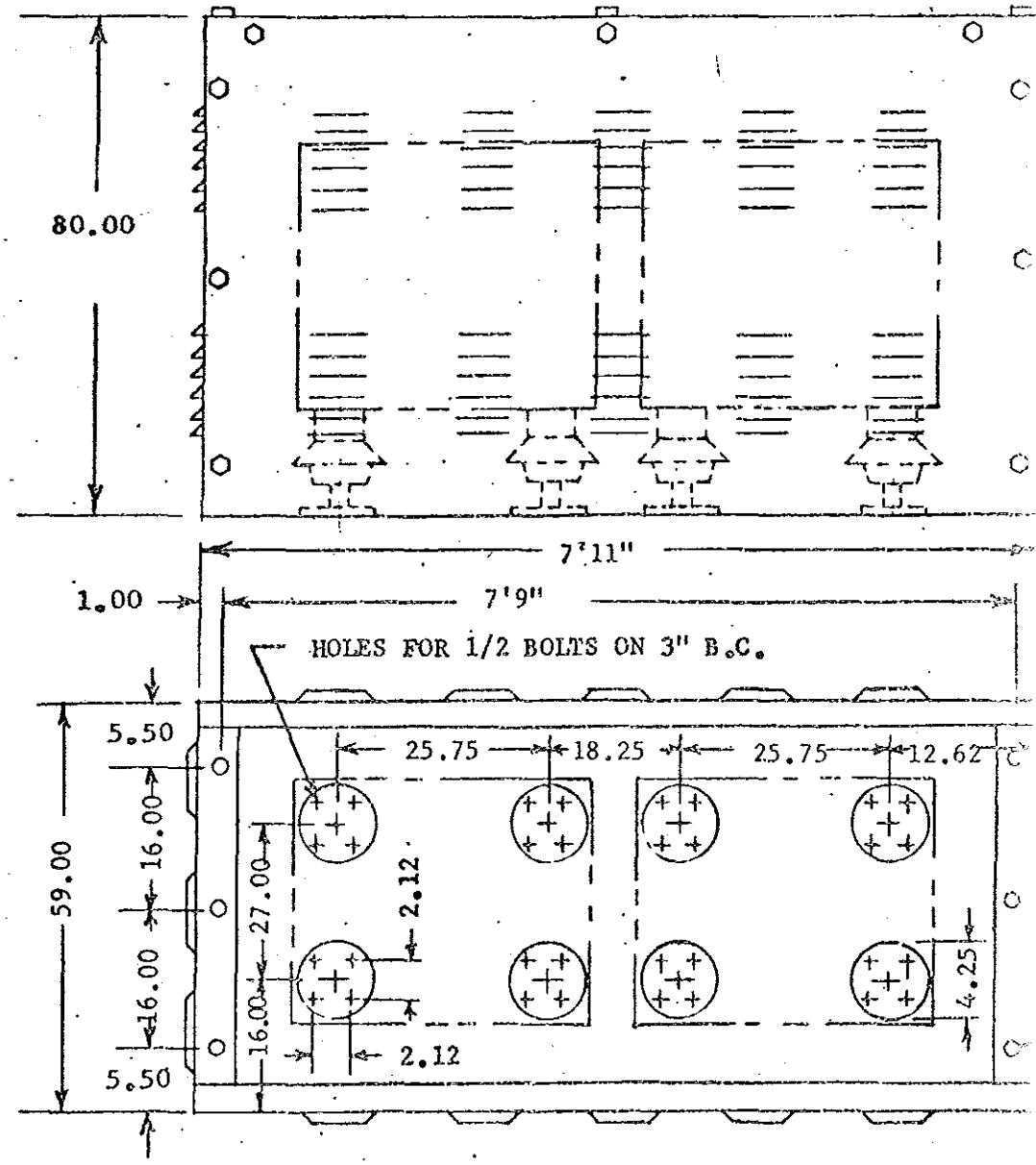
IMS3.4
IEB2
IEB1
PRINTS TO

MADE BY J. COPLAND
ISSUED 6/9/75
APPROVALS
INDUSTRY CONTROL DIV OR DEPT
SALEM, VA LOCATION
273A3677 FL SH NO.
C
CODE IDENT NO.

PF-603 WP (11-71)
PRINTED IN U.S.A.

1190820

DRAWING NO. 195B7798AN
CONT ON SHEET FL SH NO. 1



NOTE:
DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.

FF-808 WF (3-78)

11908920

GENERAL ELECTRIC

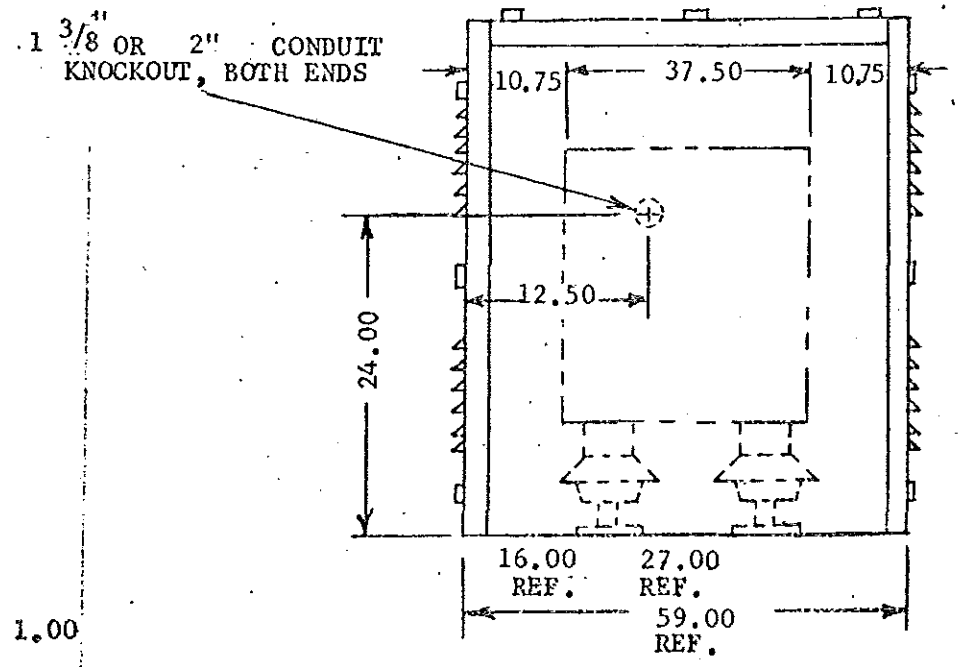
195B7798AN

CONT ON SHEET FL SH NO. 1

REV NO.	TITLE OUTLINE
195B7798AN	NEUTRAL GROUNDING RESISTOR ENCLOSURE (LOUVERED COVER)
CONT ON SHEET FL SH NO. 1	FIRST MADE FOR REQ. 393-42200 S.O. IC9138-S1

NOTE: "SEISMIC AND ANCHOR BOLT LOADINGS: EACH BOLT AT EACH 8 LOCATIONS, 47.1 LBS. TENSION AND 57.7 LBS. SHEAR."

LIMERICK GENERATING STATIONS
UNITS 1 & 2
PHILADELPHIA ELECTRIC CO.
COLT POB-471410-0
COLT DWG. NO. 11908920



TAG:

1 (2) AG503

1 (2) BG503

1 (2) CG503

1 (2) DG503

ALUMINUM ENCLOSURE
LBS. MAXIMUM FOR TOTAL WEIGHT
ADD THE WEIGHT OF THE RESISTOR FROM THE RESISTOR OUTLINE

LOUVERED COVER ASSEMBLY

1. EACH PART IS MARKED END, SIDE OR TOP ON SIDE OF FLANGE.
2. AFTER RESISTOR IS MOUNTED, ASSEMBLE ENDS AND TOP AS SHOWN.
3. PUNCH A HOLE IN THE CONDUIT KNOCKOUT FOR THE INCOMING LINE.
4. AFTER WIRING ASSEMBLE SIDES.

NOTES:

1. ALL CABLE OR BUS CONNECTIONS TO RESISTOR TO BE FURNISHED BY OTHERS.
2. CABLE TERMINALS TO BE FURNISHED BY G.E. BURNDY HYDENT, TYPE YA COMPRESSION CONNECTOR FOR ONE 15KV, 250 MCMIL COPPER CABLE ON THE LINE SIDE AND ONE 750 MCMIL COPPER CABLE ON THE GROUND END.
3. THE ENCLOSURE IS SHIPPED DISASSEMBLED.

1MJ3 2
1EA2
1
068
PRINTS TO

REVISIONS	MADE BY	APPROVALS		
	D. Lavick 5-18-79	JEP 7	IND. CONTROL	195B7798AN
	ISSUED May 18, 1979		DIV OR DEPT SALEM, VA. LOCATION	CONT ON SHEET FL SH NO. 1

11909 22

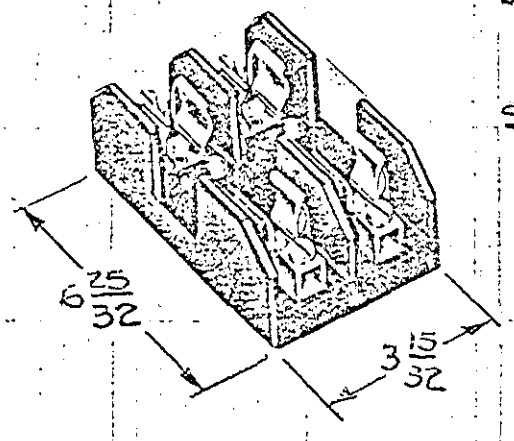
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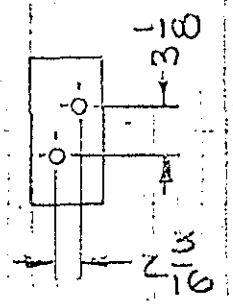
VENDOR PC. NO. 11630-2R W/SCREW CONN.

VENDOR: UNDERWRITERS SAFETY DEVICE CO. 7300 WEST WILSON AVE. CHICAGO, IL. 60656

DIST. MUNTZ ELEC. 1211 TWENTY-THIRD AVE. ROCKFORD, IL. 61105

SUBSTITUTES PERMITTED WITH ENG. APPROVAL





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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
FUSE BLOCK
30A-600V
2-POLE

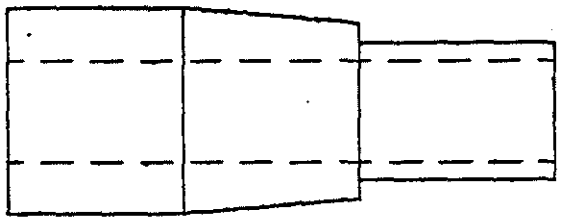
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Power Systems Division

REL NO. 10675	4/10/78	ASSY. OR LO.	
DR. BY GRANROW	10/13/77	SCALE	
CHK'D. BY R.K.	2/16/78	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. R.TC	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11909224	SHEET 1 OF 1	

O.P.

11909260



DESCRIPTION:
CABLE SHIELD ADAPTER

VENDOR PART NO.:
10TL-JA

VENDOR:
AMERACE-ESNA
ELASTIMOLD DIVISION
ESNA PARK
HACKETTSTOWN, N.J. 07840

PROPRIETARY-THIS MATERIAL IS CONFIDENTIAL AND CONTAINS PROPRIETARY INFORMATION AND OTHER RIGHTS WHICH ARE THE SOLE AND EXCLUSIVE PROPERTY OF FAIRBANKS MORSE ENGINE DIVISION. POSSESSION OF THIS MATERIAL DOES NOT CONVEY OR TRANSFER ANY RIGHTS THERETO AND ANY REPRODUCTION, USE, COPYING OR DISCLOSURE TO OTHERS IS FORBIDDEN WITHOUT THE PRIOR WRITTEN CONSENT OF AN OFFICER OF FAIRBANKS MORSE ENGINE DIVISION.

REV NO.	CHANGE ORDER	DATE	DESCRIPTION	CHK. BY
-1	FS-1247	09/22/82	REDRAWN WAS GNDING DEVICE VENDOR NO. WAS 31 MA-JAB	

TITLE
CABLE SHIELD ADAPTER

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .060 0.0 ± .030 0.00 ± .010

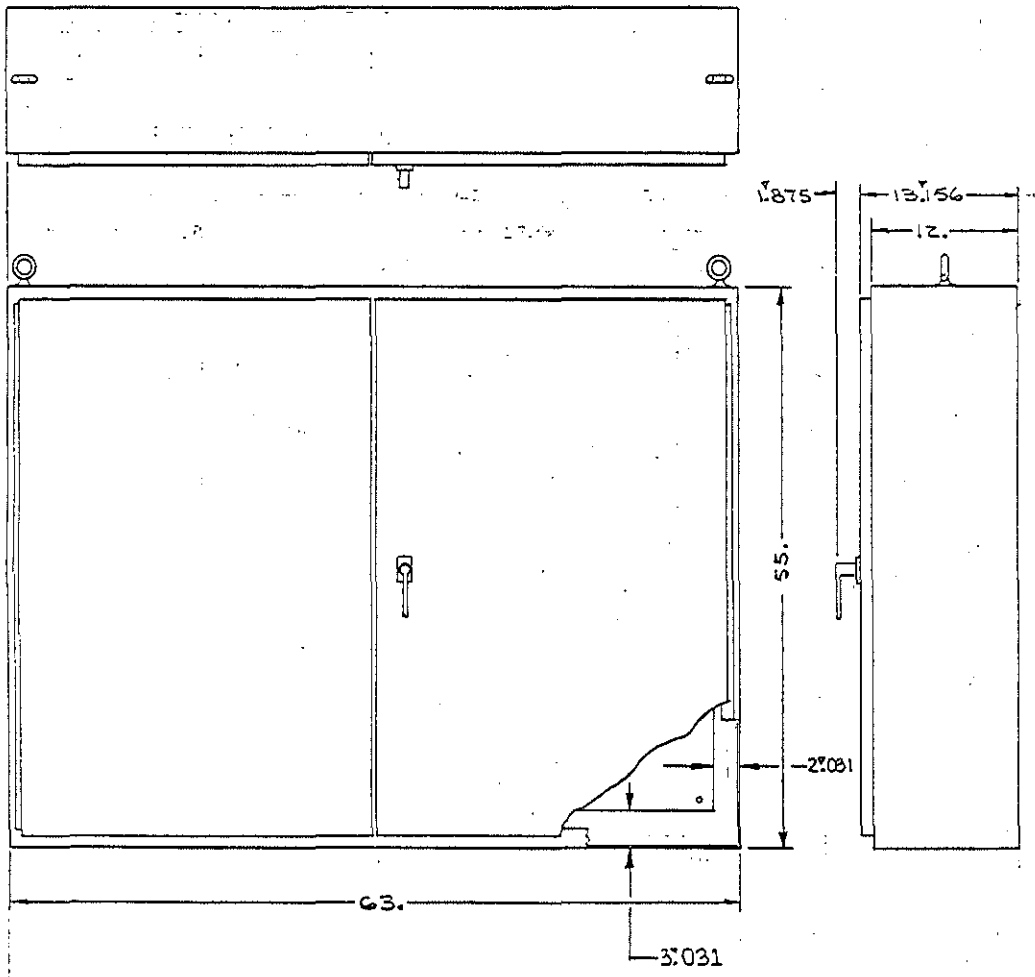
COLT INDUSTRIES
FAIRBANKS MORSE ENGINE DIVISION

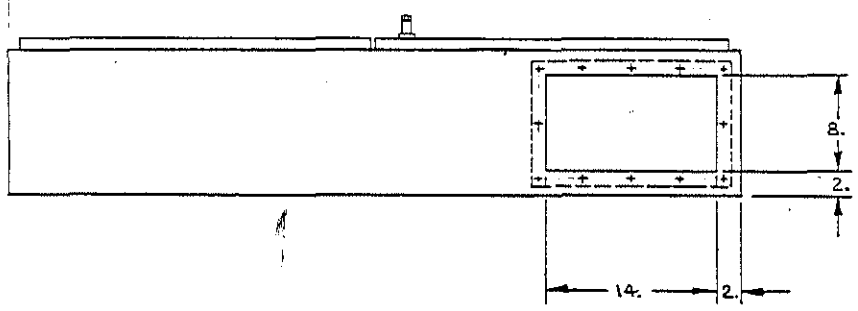
REL.NO..		ASSY.OR LO..
DR.BY GRANZOW	9/15/82	SCALE NONE
CHK'D.BY. RTC	9/16/82	HEAT TR.
MAT'L.		
APPV CAST.		MATL.
APPV MACH.		ENGR. RTC
APPV WELD.		

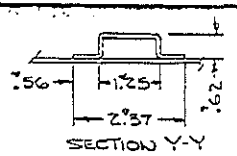
SHT. SIZE A | DWG. NO. 11909260 | SHEET 1 OF 1

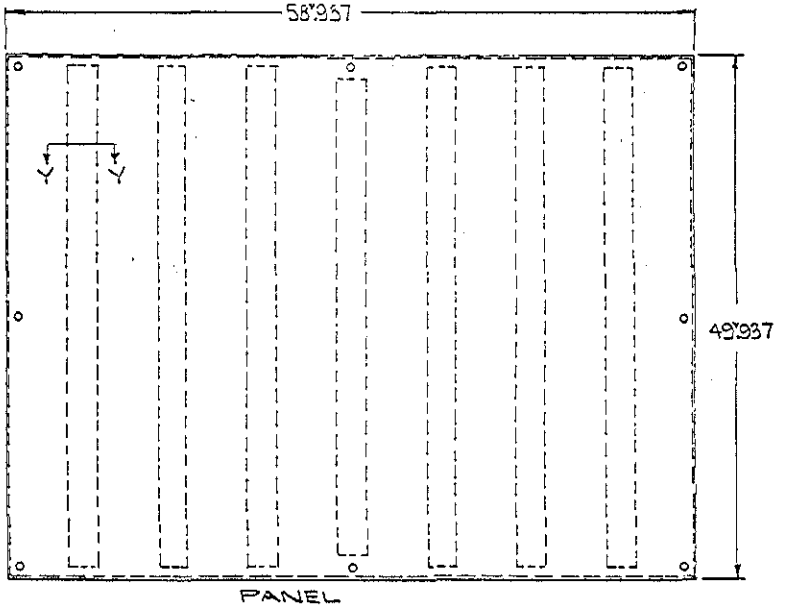
RF 3009-2

SUPERSEDES DWG. REL. ON 10664 (2-6-78)









11909282

DESCRIPTION: ENCLOSURE TWO DOOR WALL-MOUNTED NEMA TYPE 12. NOMINAL SIZE 55 HIGH, 63 WIDE & 12 DEEP. CONSTRUCTION, MATERIAL & FINISH TO BE IN ACCORDANCE WITH HOFFMAN BULLETIN A-12 UNLESS SPECIFIED OTHERWISE ON THIS DRAWING. ENCLOSURE MIN. THICKNESS #12 GA. (.1046). 8 X 14 HOLE IN . BOTTOM WITH REMOVABLE GASKETED COVER , COVER REMOVABLE FROM INSIDE ENCLOSURE. LIFTING EYES REQUIRED. SUB PANEL TO BE INCLUDED SIZE 49.937X58.937 MIN. THICKNESS #10 GA. (.1345). PANEL TO HAVE SEVEN (7) STIFFENERS EQUALLY SPACED.

VENDOR: HOFFMAN ENGINEERING CO.
DIV. OF FEDERAL CARTRIDGE CORP.
ANOKA, MN. 55303

SUBSTITUTES: PERMITTED WITHOUT ENGINEERING APPROVAL.

APPROX. WT. 450 LBS.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: ENCLOSURE TWO DOOR NEMA 12 55H-63W-12D

TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries

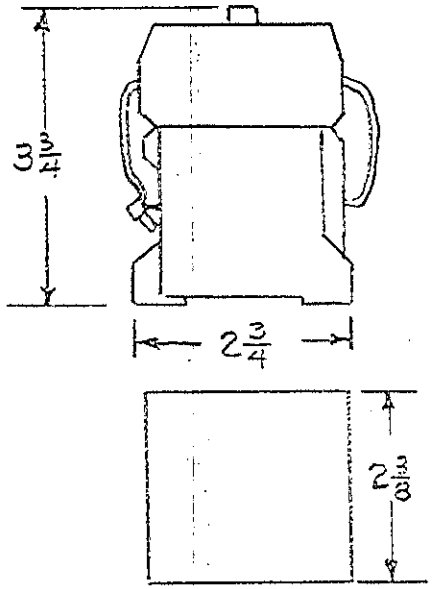
REL. NO. 10675	4/10/79	ASSY. OR LO.	
DR. BY GRANROW	1/25/79	SCALE	NOT TO SCALE
CHK'D. BY R.K.	1/26/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR. RTC	
APPV. WELD.			
SHEET SIZE C	DWG. NO. 11909282	SHEET 1 OF 1	

11909370

CLASS J10 AC CONTROL RELAY, 600 V.
CONVERTIBLE CONTACTS, 10 AMP. CONT.
2 N.O. POLES.
120 V. 60 HZ COIL.

CAT. NO.: J10A2012

VENDOR: GOULD INC.
CONTROL & SYSTEMS DIV.



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SUBS. NOT PERMITTED

REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
RELAY
2 N.O. 120V60HZ

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

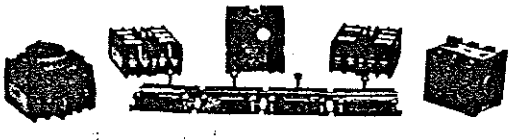
REL. NO. 10851	5/11 78	ASSY. OR LO.	
DR. BY R. KEYES	4/27 78	SCALE	
CHK'D. BY CG	4/27 78	HEAT TR.	
MAT'L			
APPV.	CAST.	MAT'L.	
	MACH.	ENGR. R/C	
	WELD.		
SHEET SIZE A	DWG. NO. 11909370	SHEET 1 OF 1	

P

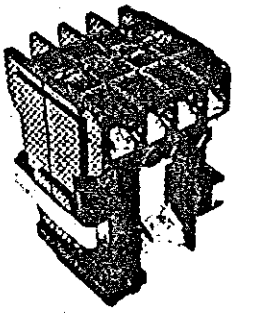
RELAYS—ITE AND ROWAN

Various types of control relays are available for the many applications where relays are required—pilot devices, designed to switch coil currents of starters and contactors, and machine tool applications. Relays for specific applications, such as interfacing with solid state systems and DC power supply switching, are also available.

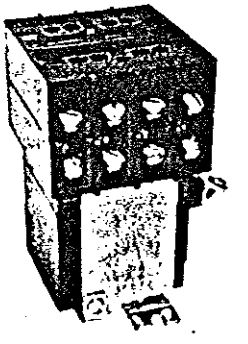
Class 'J'—Family of industrial control relays uses a unique concept of modular 'building block' construction to offer maximum flexibility from a minimum number of basic parts. From just seven modular 'building block' components over 500 variations of control relays can be factory or field assembled to meet all normal AC or DC requirements and, using pneumatic or solid state timing heads, makes it possible to assemble relays with timed and instantaneous contacts. Contacts are easily field convertible from normally open to normally closed and vice versa. Both the 300 volt and 600 volt contact blocks are interchangeable on the same operating coil magnet block, and allows for easy addition of contact blocks to existing relays. A complete line of pneumatic and solid state timing heads are available along with a line of solid state protective relays.



Type 2190 'E'—A compact relay available up to eight poles with a unique bifurcated spring steel movable contact for zero contact bounce. The compact size and zero bounce makes this relay ideal for applications such as solid state circuitry interface, and circuits where contact bounce could cause false triggering and damaging voltage/current spikes.



Type 2180 & 2180 D 'FE'—A 'power relay' rated 15 amperes @ 300 volts and 5 amperes @ 600 volts, that is available up to eight poles. The DC operating coil has a constant current (inrush and sealed current are identical) making this device ideal for applications where low voltage DC power supplies are used. The constant current coil allows the power supply size to be kept to a minimum. Relays are also horsepower rated and may be used for motor starting on inherently protected motors. Relays are available in mechanically interlocked varieties, suitable for reversing or two speed applications. Also available is the Type 2180 'FEB'—A 'power relay' rated 15 amperes @ 300 volts and 5 amperes @ 600 volts, available up to 20 poles for multiple circuit switching.



Not all components or equipment styles manufactured by Gould are shown in this section. For equipment class 2180FER, 2180FEB information consult your nearest Gould/ITE Control distributor or sales office.

INDUSTRIAL CONTROL
RELAYS

CLASS J10 AC CONTROL RELAY

CONVERTIBLE CONTACTS — 10 AMPERE, 25-60 HERTZ②

Total Poles	Contacts①④ N.O.	Contacts①④ N.C.	300-Volt Relay③④ Cat. No.⑤	600-Volt Relay③④ Cat. No.⑤
2	2	0	J10B2012	J10A2012
	1	1	J10B1112	J10A1112
	0	2	J10B0212	J10A0212
3	3	0	J10B3012	J10A3012
	2	1	J10B2112	J10A2112
	1	2	J10B1212	J10A1212
	0	3	J10B0312	J10A0312
4	4	0	J10B4012	J10A4012
	3	1	J10B3112	J10A3112
	2	2	J10B2212	J10A2212
	1	3	J10B1312	J10A1312
	0	4	J10B0412	J10A0412
6	6	0	J10B6012	J10A6012
	5	1	J10B5112	J10A5112
	4	2	J10B4212	J10A4212
	3	3	J10B3312	J10A3312
	2	4	J10B2412	J10A2412
	1	5	J10B1512	J10A1512
	0	6	J10B0612	J10A0612
8	8	0	J10B8012	J10A8012
	7	1	J10B7112	J10A7112
	6	2	J10B6212	J10A6212
	5	3	J10B5312	J10A5312
	4	4	J10B4412	J10A4412
	3	5	J10B3512	J10A3512
	2	6	J10B2612	J10A2612
	1	7	J10B1712	J10A1712
	0	8	J10B0812	J10A0812
10	10	0	J10B10012	J10A10012
	9	1	J10B9112	J10A9112
	8	2	J10B8212	J10A8212
	7	3	J10B7312	J10A7312
	6	4	J10B6412	J10A6412
	5	5	J10B5512	J10A5512
	4	6	J10B4612	J10A4612
	3	7	J10B3712	J10A3712
	2	8	J10B2812	J10A2812
	1	9	J10B1912	J10A1912
	0	10	J10B01012	J10A01012
12	12	0	J10B12012	J10A12012
	11	1	J10B11112	J10A11112
	10	2	J10B10212	J10A10212
	9	3	J10B9312	J10A9312
	8	4	J10B8412	J10A8412
	7	5	J10B7512	J10A7512
	6	6	J10B6612	J10A6612
	5	7	J10B5712	J10A5712
	4	8	J10B4812	J10A4812
	3	9	J10B3912	J10A3912
	2	10	J10B21012	J10A21012
	1	11	J10B11112	J10A11112
	0	12	J10B01212	J10A01212

① Relays are normally stocked with all normally open contacts. Best delivery will be obtained by ordering normally open contacts and changing as desired in the field.

② When 25 or 50 Hertz coil is required consult factory.

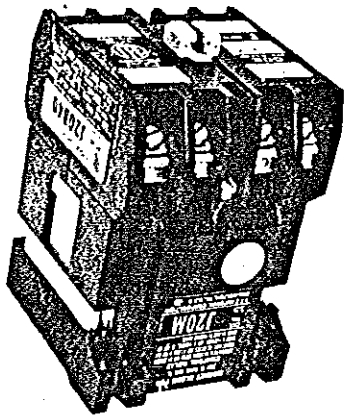
③ For factory installed overlapping contacts add $12.00 list for 300 volt relays or $18.00 list for 600 volt relays per 2 pole arrangement and specify on order.

④ ¼" quick connect terminals available. Add $4.00 list per relay and specify on order.

⑤ Cat. No. shown is for 120V coil. For different coil voltage use chart below and substitute suffix for last two digits, 12, in above Cat. Nos.

Coil Voltage	24	32	48	64	110	120	208/220	240	440	480	550	600
Suffix (60 Hertz)	02	03	04	06	11	12	22	24	44	48	55	60

For Dimensions & Weights—see page 227.
For Replacement Coils see page 109.



ELECTRICAL CONTACT RATINGS—AC

Relay Type	Volts	Pilot Duty⑥ Make	Pilot Duty⑥ Break	Ratings Continuous Amperes⑦
300V	0–120 120–277	60A 7200VA	6A 720VA	10
600V	0–120 120–600	60A 7200VA	6A 720VA	10

⑥ The AC Pilot Duty rating is based on 35% P.F.
⑦ The AC Continuous Ampere rating is based on 75% P.F.

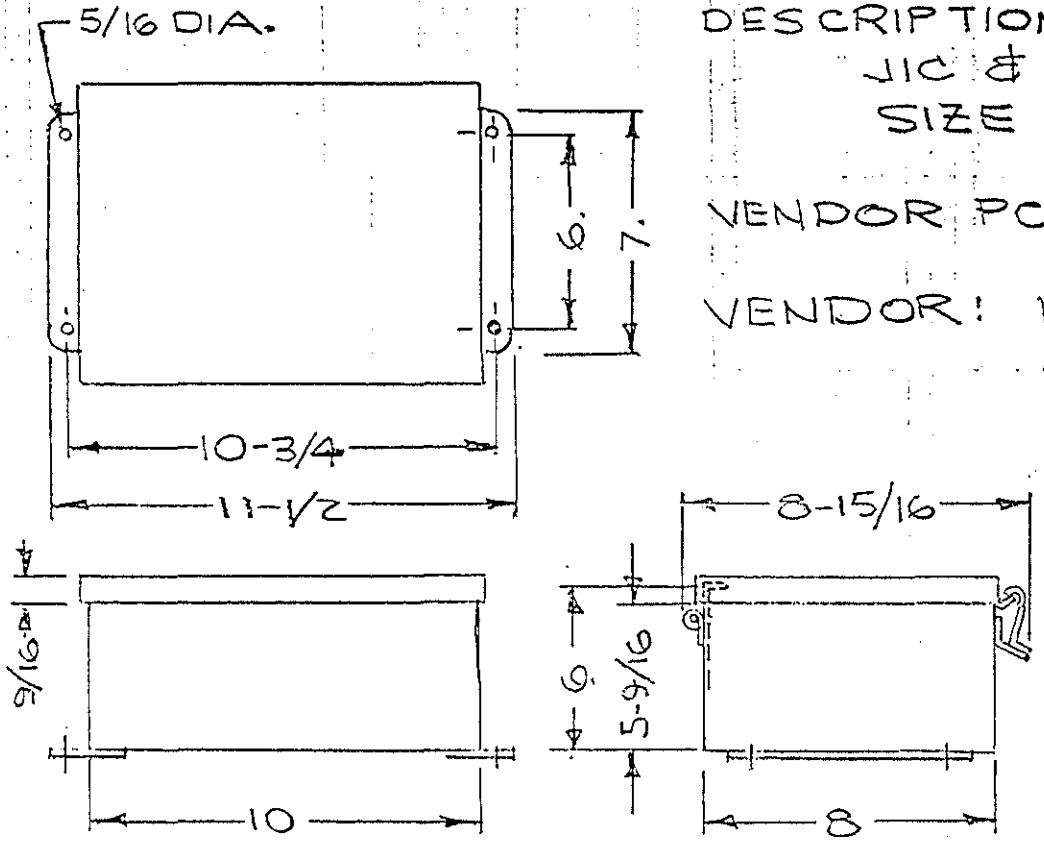
ELECTRICAL CONTACT RATINGS—DC

Relay Type	Volts	Standard Pilot Duty (Make & Break)	Ratings Continuous Amperes⑦
300V and 600V	125	1.1A	10
	250	0.55A	10

11 909 370

11909370

1190997



DESCRIPTION: "CH" CONTINUOUS HINGE
JIC & UL OIL TIGHT JUNCTION BOX
SIZE 10" X 8" X 6"

VENDOR PC. NO.: A-10086CH

VENDOR: HOFFMAN ENGINEERING CO.
ANOKA, MN. 55303

SUBSTITUTES PERMITTED.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
BOX JUNCTION
JIC 10-8-6

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries
Fairbanks Morse
Power Systems Division

REL. NO. 11035	8/8 76	ASSY. OR LO.
DR. BY GRANTOW	8/1 76	SCALE
CHK'D. BY RTCALLAND	8/1 76	HEAT TR.
MAT'L		

APPV.	CAST.	MAT'L.
	MACH.	ENGR. RTC
	WELD.	

SHEET SIZE A | DWG. NO. 11909979 | SHEET 1 OF 1

11910435

DESCRIPTION:
CLASS G30 OVERLOAD
HEATER UNIT.

VENDOR PC. NO.
G30T25

VENDOR:
GOULD INC.
(ITE-IMPERIAL)

SUBSTITUTES:
NOT PERMITTED.

NO
PICTURE
AVAILABLE

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
HEATER
OVERLOAD
G30T25

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries
Fairbanks Morse
Power Systems Division

REL. NO. 11132	10/6 78	ASSY. OR LO.	
DR. BY GRANZOW	10/5 78	SCALE	
CHK'D. BY R.T.CALLAND	10/5 78	HEAT TR.	
MAT'L			
APPV.	CAST.	MAT'L.	
	MACH.	ENGR. RTC	
	WELD.		

SHEET SIZE A | DWG. NO. 11910435 | SHEET 1 OF 1

P

1191043(

DESCRIPTION:
CLASS G30 OVERLOAD
HEATER UNIT.

VENDOR PC. NO.
G30T34

VENDOR:
GOULD INC.
(ITE-IMPERIAL)

NO
PICTURE
AVAILABLE

SUSTITUTES:
NOT PERMITTED.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
HEATER
OVERLOAD
G30T34

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries
Fairbanks Morse
Power Systems Division

REL. NO. 11132	10/6/78	ASSY. OR LO.	
DR. BY GRANZOW	10/5/78	SCALE	
CHK'D. BY RTCALUD	10/5/78	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. RTC	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1191043G | SHEET 1 OF 1

1191043?

DESCRIPTION:
CLASS G30 OVERLOAD
HEATER UNIT.

VENDOR PC. NO.
G30T38

VENDOR:
GOULD INC.
(ITE-IMPERIAL)

NO
PICTURE
AVAILABLE

SUSTITUTEE:
NOT PERMITTED

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
HEATER
OVERLOAD
G30T38

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

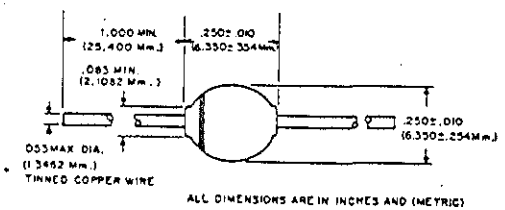
Colt Industries
Fairbanks Morse
Power Systems Division

REL. NO. 4132	10/6 [illegible]	ASSY. OR LO.	
DR. BY GRANZOW	10 5 1/2	SCALE	
CHK'D. BY RJCALLAND	10/5 1/2	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. RJC	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11910437	SHEET 1 OF 1	

P

11910 928

OUTLINE DRAWING



ALL DIMENSIONS ARE IN INCHES AND (METRIC)

DESCRIPTION: RECTIFIER 3 AMP Io — TYPE NO. 1N4724 800 VOLT RRM

VENDOR PC NO: 1N4724

VENDOR: MOTOROLA

REP. NEWARK ELECTRONICS OR EQUAL.

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE

RECTIFIER
1N4724

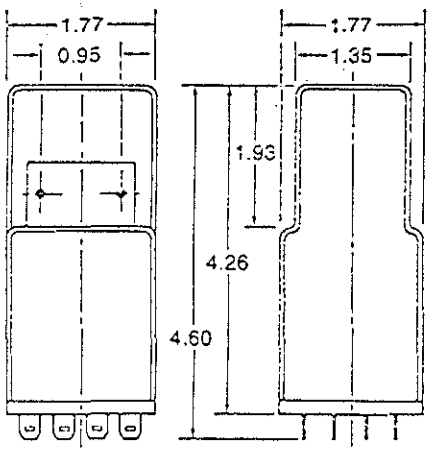
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

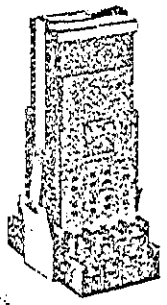
Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11405	4/10/79	ASSY. OR LO.	
DR. BY C A GRANZOW	4/10/79	SCALE	
CHK'D. BY RT CALLAD	4/10/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR:	
APPV. WELD.			

SHEET SIZE A — DWG. NO. 11910 928 — SHEET 1 OF 1

Dimensions

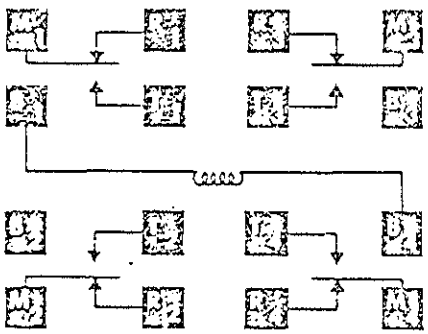


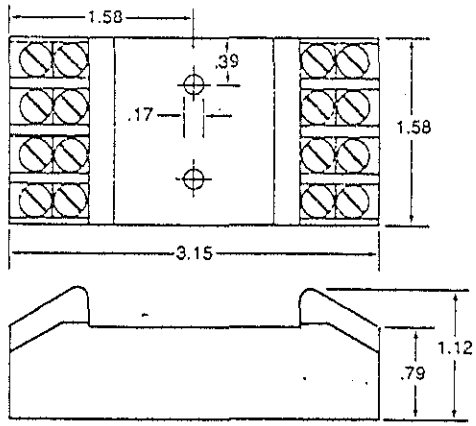


DESCRIPTION: POWER RELAY. "EGP" SERIES.

COIL VOLTAGE 125VDC.
CONTACTS 4PDT.
INTEGRAL MAGNETIC BLOW-OUT DEVICE.
TO INCLUDE CR0002 FRONT CONNECTED SOCKET, SCREW TERMINALS (TIERED). CR0133 HEAVY DUTY LOCKING STRAP (STRAP PLATE AND NECESSARY BRACKETS INCLUDED).
CR0188 PLUG-IN ORIENTING PINS (1 SET).
SEISMIC QUALIFICATION TEST RESULTS MUST BE PROVIDED TO COLT CONFORMING TO TEST PLAN AND TEST RESPONSE SPECTRA ATTACHED TO AMERACE 5/17/79 MEMO FROM E. J. LESZCZAK.

D-C





VENDOR PC NO.
EGPDN-001, CR0002, CR0133, CR0188

VENDOR:
CONTROL PRODUCTS DIV. AMERACE CORP.
2330 VAUXHALL RD.
UNION, N.J. 07083

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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY
1	11481	6-13-79	CHANGED FROM LOCKING SPRING TO HEAVY DUTY LOCKING STRAP	RJCS RTC

TITLE
POWER RELAY
"EGP" SERIES
COIL 125VDC

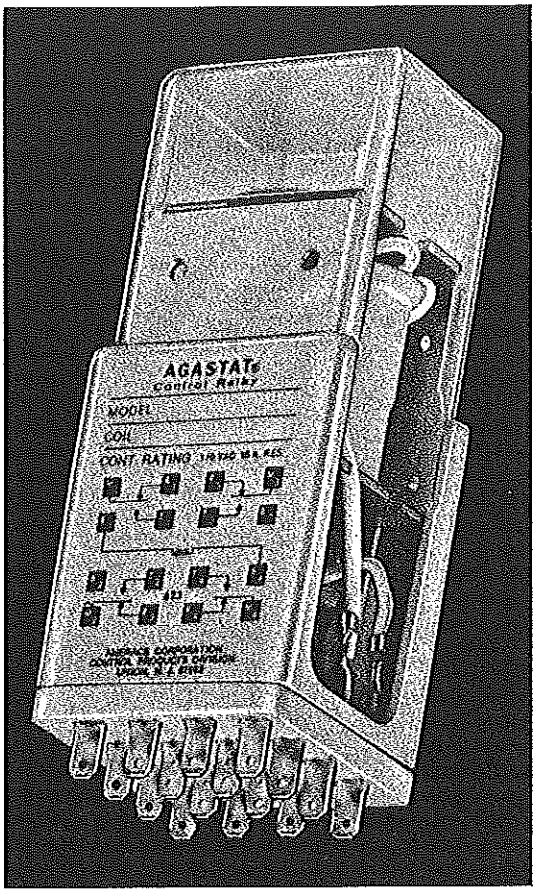
TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 1460	6/7/79	ASSY. OR LO.	
DR. BY CAG	5/21/79	SCALE	
CHK'D. BY RTCALUD	5/21/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR. RTC	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1191.141 | SHEET 1 OF 1

AGASTAT®



control relays

This line of AGASTAT Control Relays introduces a number of significant advances over existing control relay designs. It provides unusually high contact density without sacrificing current carrying capacity, and a unique contact operating mechanism offering life expectancies of 100 million mechanical operations.

The heart of this mechanism is an articulated moving arm assembly which amplifies the movement of the solenoid core. This permits the use of an efficient, short stroke coil to produce an extremely wide contact gap. At the same time, it eliminates the need for long flexible arms which support the movable contacts in conventional relays. The result is increased current switching capacity and high tolerance to shock and vibration.

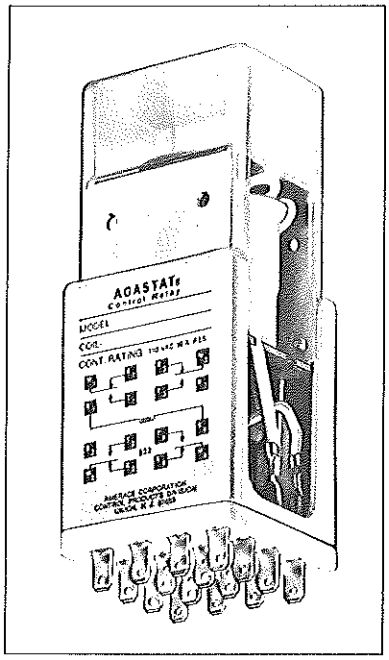
The movable contacts are connected to nylon links which provide low-friction transmission of movement from the magnet core without metal-to-metal contact. Together with a plastic core stop, this also eliminates heavy impacts at the end of the core stroke, adding to the extended life expectancy inherent in this design.

amerace

CONTROL PRODUCTS DIVISION

Agastat® control relays GP series power relay

features



AGASTAT Control Relays are suitable for: relay logic switching operations as well as for heavier duty applications where small contactors would normally be used. In industrial applications it can be used for the control of inductive loads of several kilowatts such as solenoid valves, small motors, etc. It lends itself to a variety of installation methods, due to the various options of electrical connections and mounting styles. It may be wired from the front or rear of a panel, and is available with a variety of sockets and mounting hardware. It occupies a very small area of panel space and may be mounted singly, in continuous rows, or in groups.

The relay is available with a screw-terminal or quick-connect molded socket.

Operating coils are available in a variety of D.C. or A.C. voltages. In the latter case a built-in rectification circuit insures efficient operation of the relay without noise or chatter. The unit is protected by a transparent plastic cover which keeps out dust and facilitates inspection of the relay's operation.

The nominal rating of the contacts is 10 amps on inductive A.C. circuits and 1 amp for resistive loads at 125 volts D.C. For overload performance in a resistive circuit each contact will break 40 amps at 240 volts A.C. or 48 volts D.C. The adjacent curve shows the number of operations versus current.

With the addition of an integral magnetic blow-out device (Option N) the D.C. current carrying capacity is increased approximately ten times for both NO and NC contacts. In both A.C. and D.C. operation, the addition of this device will normally double the contact life, due to reduced arcing.

AGASTAT Control Relays are operated by a moving core electro magnet whose main gap is at the center of the coil. A shoe is fitted to the core which overlaps the yoke and further increases the magnetic attraction.

The coil itself is in the form of an elongated cylinder, which provides a low mean turn length and also assists heat dissipation. Since the maximum travel of the electro magnet does not provide optimum contact movement, an ingenious amplifying device has been designed.

This consists of a W shaped mechanism, shown at the right. When the center of the W is moved vertically, the lower extremities move closer to each other as can be seen in the illustration. The center of the W mechanism is connected to the moving core of the electro magnet and the two lower points are connected to the moving contacts.

Two of these mechanisms are placed side by side to actuate the four contact sets of the relay. The outer arms of the W mechanisms are leaf springs, manufactured from a flat piece of non-ferrous metal. Each of these outer arms act as return springs for their corresponding contacts. This provides each contact with its own separate return spring, making the contacts independent.

The mechanical amplification of the motion of the electro magnet permits a greater distance between the contacts, while the high efficiency of the electro magnet provides a nominal contact force in excess of 100 grams on the normally open contacts.

All the contacts are positioned well away from the cover and are well ventilated and separated from each other by insulating walls.

The absence of metal to metal friction, the symmetrical design of the contact arrangement and the lack of heavy impacts provides a mechanical life of 100,000,000 operations.

For use on A.C. circuits the relay is supplied with a built-in rectification circuit, thus retaining the high D.C. efficiency of the electro magnet. The current peak on energizing is also eliminated and consequently the relay can operate with a resistance in series (e.g. for high voltages or for drop-out by shorting the coil). The use of the rectification circuit offers still other advantages. The same model can operate at frequencies ranging from 40 to 400 cycles. Operation of the relay is crisp; even with a low A.C. voltage, there is a complete absence of hum and vibration.

The plastic cover has two windows through which the iron yoke protrudes to facilitate cooling and also to allow direct mounting of the relay irrespective of the terminals.

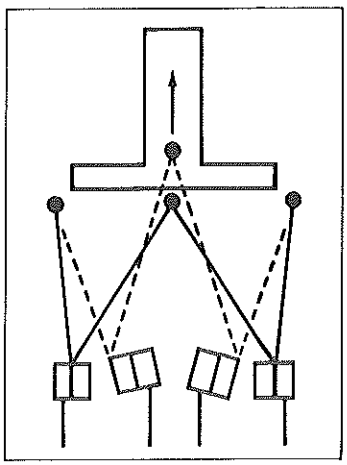


Diagram illustrating amplification obtained by articulated operating mechanism

specifications

Coil

Nominal Rating
12 to 250 volts D.C.
24 to 220 volts A.C.

See table for coil operating voltages

For 380 volts A.C.
Use 6800 ohms 4 watt resistor in series with 220 volts A.C. relay

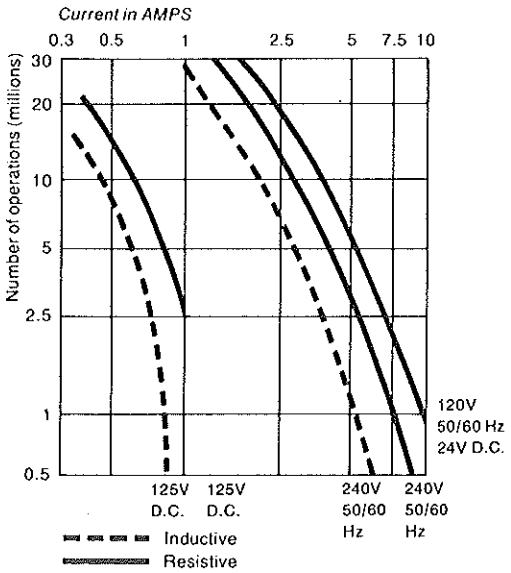
For 440 volts A.C.
Use 8200 ohms 6 watt resistor in series with 220 volts A.C. relay .

Coil drop-out voltages are between 10% and 40% of the rated operating voltages for both D.C. and A.C. (For example: in a 120V unit drop-out will occur between 12 and 48 volts.) D.C. relays will function with unfiltered D.C. from a full-wave bridge rectifier.

Coil Operating Voltages

	D.C.					50/60 Hz			
Nominal Coil Voltage	12	24	48	125	250	24	48	120	220
Minimum Pick-up voltage at 20°C	9	18	36	94	187	19	37	92	175
Minimum Pick-up voltage at 40°C	9·5	19	38	100	200	20	41	102	188
Maximum voltage for continuous use	13·5	27	53	143	275	27	53	137	245
Code Letter	A	B	C	D	F	G	H	I	J

Load life characteristics



Voltage	Current (Amps)	Power Factor or Time Constant	Number of Operations	Remarks
540V A.C.	3	cos φ = 0.5	15 000	2 contacts in series
380V A.C.	15	Resistive	10 000	2 contacts in parallel
380V A.C.	10	Resistive	200 000	
380V A.C.	3 × 3.3	cos φ = 0.8	200 000	3hp motor
220V A.C.	20	Resistive	20 000	2 contacts in parallel
220V A.C.	15	cos φ = 0.5	20 000	2 contacts in parallel
220V A.C.	10	Resistive	400 000	
220V A.C.	3 × 6	cos φ = 0.8	200 000	3hp motor
220V A.C.	5		1 500 000	Filament lamps
220V A.C.	5	Resistive	3 000 000	
220V A.C.	2.5	cos φ = 0.25	2 000 000	
220V A.C.	2	Resistive	15 000 000	
220V A.C.	1.25	Resistive	30 000 000	
120V D.C.	1.5	Resistive	20 000 000	with blow-out device
48V D.C.	10	Resistive	1 000 000	
48V D.C.	1.5	5 ms	18 000 000	

Agastat® control relays GP series power relay

specifications

Power consumption

Typical power consumption at rated voltage is 6VA for A.C. coils and 6 Watts for D.C. coils. There is no surge current during operation.

Contacts

Number of contacts
4 single pole double throw

Nominal rating
10A @ 120 Volts A.C.

Typical pressure between moving contact and
Normally closed contact:
30 grams
Normally open contact:
100 grams

Contact resistance measured at terminals
250 milliohms @ 125V D.C., 1 amp.

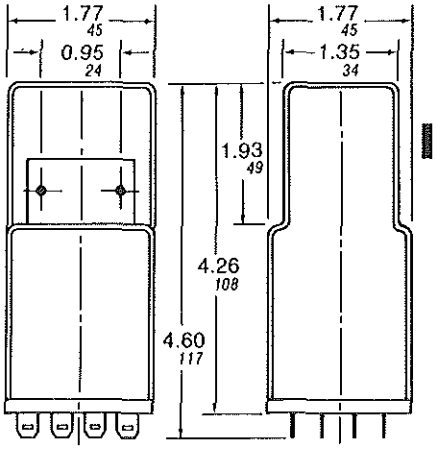
Insulation resistance

Between all non-connected terminals as well as between non-connected terminals and the relay yoke: 1000 megohms at 500 volts D.C.

Dielectric

2000 volts RMS 60 Hz between points specified above.

Dimensions



Operate time

Operate time at 20°C and rated voltage:

Between energizing and opening of normally closed contacts/less than 18 milliseconds on A.C. and less than 15 milliseconds on D.C.

Between energizing and closing of normally open contacts/less than 35 milliseconds on A.C. and less than 30 milliseconds on D.C.

Between de-energizing and opening of normally open contacts/less than 70 milliseconds on A.C. and less than 8 milliseconds on D.C.

Between de-energizing and closing of normally closed contacts/less than 85 milliseconds on A.C. and less than 25 milliseconds on D.C.

Operating temperature range

0°C to 60°C.

Shock

The relay, when kept energized by means of one of its own contact sets, will withstand 40g shock load when operating on D.C. and 150 g shock load on A.C.

Vibration

Single axis fragility curve data are available on request at frequencies from 5 Hz to 33 Hz.

Life

100,000,000 mechanical operations.

Weight

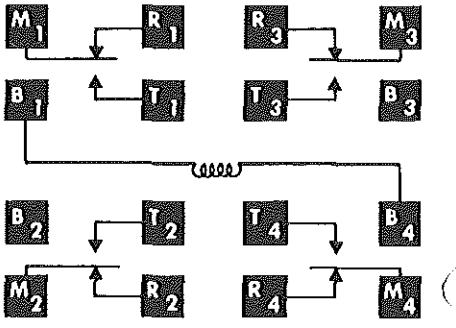
Relay complete with cover: 10.9 oz. Net.

Wiring and connections

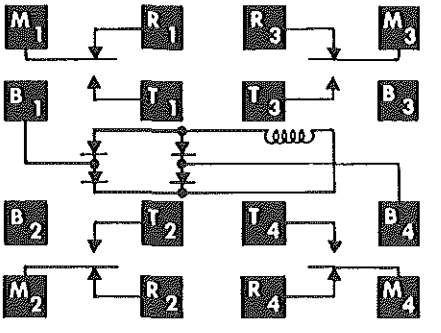
The 16 flat base pins are arranged in four symmetrical rows of four pins; the pitch in both directions being .394". Connection may be made to the relay by soldering. Sockets are available with screw terminals or quick-connect lugs.

The internal wiring of the relay *is also symmetrical as shown in* the adjacent figure, allowing the relay to be inserted into its base in either of two positions. Terminals B2 and B3 are provided as extra connections for special applications.

D.C.



A.C.



UL Recognized, CSA Certified

Agastat GP Series control relays are UL Recognized under Guide NLDX2, File No. E15631; they are CSA Certified under Guide 380-W-1.14, File No. 29186.

Agastat® control relays ML series magnetic latch

features

In some applications it is necessary to keep the relay operated even in the event of failure of the supply voltage. A typical case would be the excitation of an alternator which must not be cut off, even if there is no voltage on the accessory equipment.

In a system having a number of consecutive electromechanical cycles it may be necessary to shut down without losing the stored information, i.e. transfer machines, conveyors, lifts, etc. For position repeating relays it is often helpful to eliminate power consumption by the relay when it is in the transferred position. Finally, instead of having the circuit interrupted to make a conventional relay drop-out when it is energized, it is preferable to cause such a drop-out by a voltage impulse.

The AGASTAT ML Series relay has a single solenoid with a plunger core and characteristic GP type mechanical amplification. A magnet within the structure is polarized by the latching winding and holds the relay in the operated position after the energizing voltage is removed. Unlatching winding, which is wound in the opposite direction, neutralizes the polarity of the magnet and returns the relay to the un-operated position. Similar control may be obtained on A.C. circuits by means of built-in rectification.

The ML Relay therefore forms a magnetic storage device having contacts on both of the stable positions. Impact vibration or external stress will not cause the relay to transfer. This holding force compares favorably with similar mechanical devices and will withstand quite severe treatment.

In a D.C. circuit with a single wound coil, switching contacts would be necessary to change the current direction. This is the reason for the provision of a double wound coil, the latching winding being energized through the B1-B4 terminals and the de-magnetizing or unlatching winding through the B3-B4 terminals.

Since the double wound coil does not have a continuous duty rating, voltage pulses to the coils should not exceed a ratio of 40% on, 60% off, with maximum power-on periods not to exceed 10 minutes.

If continuous energizing only is available, a resistor/capacitor network should be connected as shown in the diagram below. In this case the shortest time between two operations must not be less than 5 seconds.

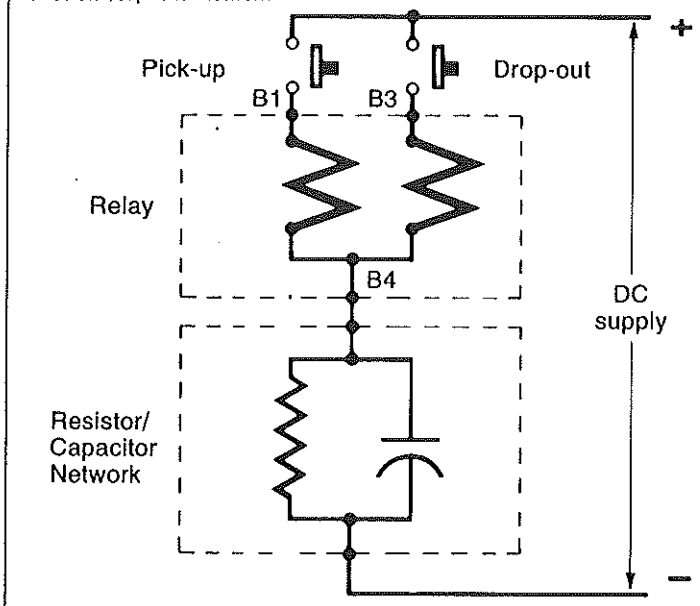
In an A.C. circuit the unlatching winding may be energized continuously; and the resulting slight hum is not loud enough to be objectionable. A latching voltage of 90% of the rated voltage is advisable, since at this figure the relay will withstand the coil being continuously energized for several hours.

The relays are normally delivered polarized so that terminal B4 carries the negative voltage. To reverse the polarity, a deenergize/energize cycle should be carried out using a voltage 50% greater than the normal rating.

In both A.C. and D.C. applications the relay will always assume the energized position in the event of both windings being energized simultaneously.

It is advisable not to put another load in parallel with the windings of the ML relay.

ML Series Relay for D.C. operation with a resistor/capacitor network



R-C Values

Nominal Voltage D-C	R		C	
	ohms ± 5%	watts	μf	vdc
12	62	2	5000	15
24	240	2	2000	50
48	1000	2	500	100
125	6200	2	150	150

Agastat®control relays ML series magnetic latch

specifications

Coil

Nominal rating
12 to 125 volts D.C.
24 to 220 volts A.C.

See table for coil operating voltages

Tolerance on rated voltage 15%

Latching Pulse duration is:
A.C. 80 milliseconds min.
D.C. 25 milliseconds min.

Unlatching Pulse duration is:
A.C. 40 milliseconds min.
D.C. 20 milliseconds min.

Power consumption

A.C.: 7.5W for pick-up
3W for drop-out

D.C. without R/C network
15W for pick-up
13W for drop-out

D.C. with R/C network
2W for pick-up
2W for drop-out

Operating temperature range

0°C to 60°C

Contacts

Number of contacts
4PDT

Nominal rating
10A @ 120 volts A.C.

Typical pressure between moving contact and
Normally closed contact
Min. 100 grams
Normally open contact
Min. 100 grams

Contact resistance measured at terminals
250 milliohms @ 125V D.C., 1 amp.

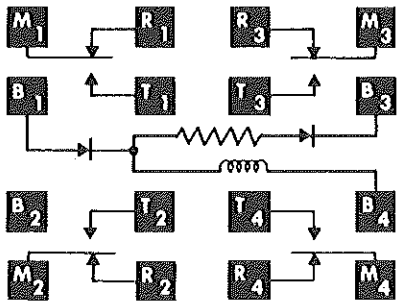
Nominal Voltage		Pickup				Drop out			
		D.C. ohms		Current (MA)		D.C. ohms		Current (MA)	
Code Letter	A.C.								
G	24	15		625		83		250	
H	48	86		312		286		125	
I	120	370		125		1470		50	
J	220	1500		68		5800		28	
	D.C.	with R-C	without R-C	with R-C	without R-C	with R-C	without R-C	with R-C	without R-C
A	12	71	9	169	1333	72	10	168	1200
B	24	275	35	87	686	285	44.5	84	540
C	48	1132	132	42	364	1178	178	41	270
D	125	7220	1020	18.2	122	7130	930	17.5	134

Wiring and connections

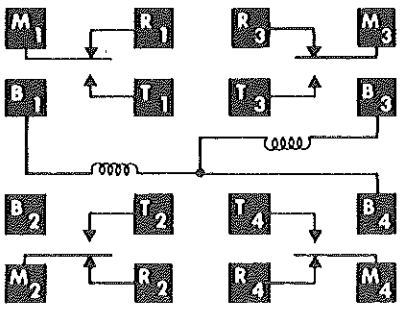
The ML relay has three terminals for the windings: latching winding between terminals B1 and B4, unlatching winding between terminals B3 and B4. On D.C. supply terminal B4 is negative. The resistor/capacitor network connects in series with terminal B4.

The ML Relay is not symmetrical due to its three coil connections. When the relay is to be used with plug-in sockets, orienting pins (Cat. No. CRO188) should be used.

A.C.



D.C.



Insulation resistance

Between all non-connected terminals as well as between non-connected terminals and the relay yoke: 1000 megohms at 500 volts D.C.

Dielectric

2000 volts RMS 60 Hz between points specified above.

Operate time

Time elapsed between energization and opening of closed contacts.

12 millisecs max. when Latching Pulse duration is:
A.C. 80 millisecs
D.C. 25 millisecs

6 millisecs max. when: Unlatching pulse duration is:
A.C. 40 millisecs
D.C. 20 millisecs

Life

10 million mechanical operations

Weight

Relay complete with cover 10.9oz. Net.

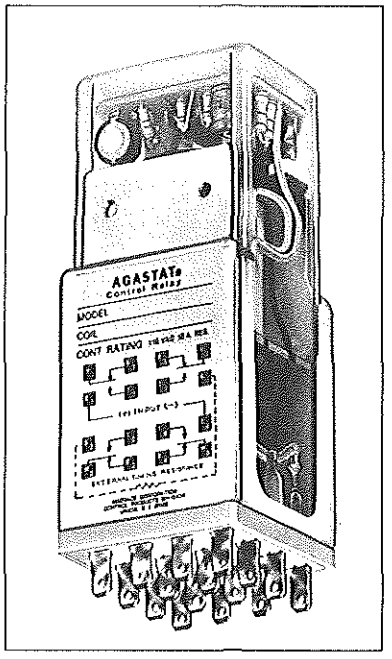
Dimensions

Same as GP Series.

UL Recognized, CSA Certified

Agastat ML Series control relays are UL Recognized under Guide NLDX2, File No. E15631; they are CSA Certified under Guide 380-W-1.14, File No. 29186.

features



This new TR Series combines the compactness of the AGASTAT GP Series relay with the traditional accuracy and dependability of AGASTAT solid state timing relays. The basic relay mechanism offers most of the features found in this unique relay series:

high contact density • 100 million mechanical operations • large contact gap • high contact pressure • short stroke, articulated mechanism

Coupled with this advanced electromechanical design is a field proven solid state timing network, an adaptation of the circuit used in the AGASTAT premium grade timer.

A new transistorized voltage-sensing circuit does away with large-value dropping resistors, reducing the internal heat which destroys the accuracy and shortens the life of conventional designs. Current drain is correspondingly minimized.

This unique circuit also obviates the need for supplementary temperature-compensation components, affording unusual stability over a realistically broad operating temperature range. It also provides transient protection and protection against premature switching of the output contacts due to power interruption during timing. Under typical industrial ambient conditions, repeat accuracy is ±2% or better.

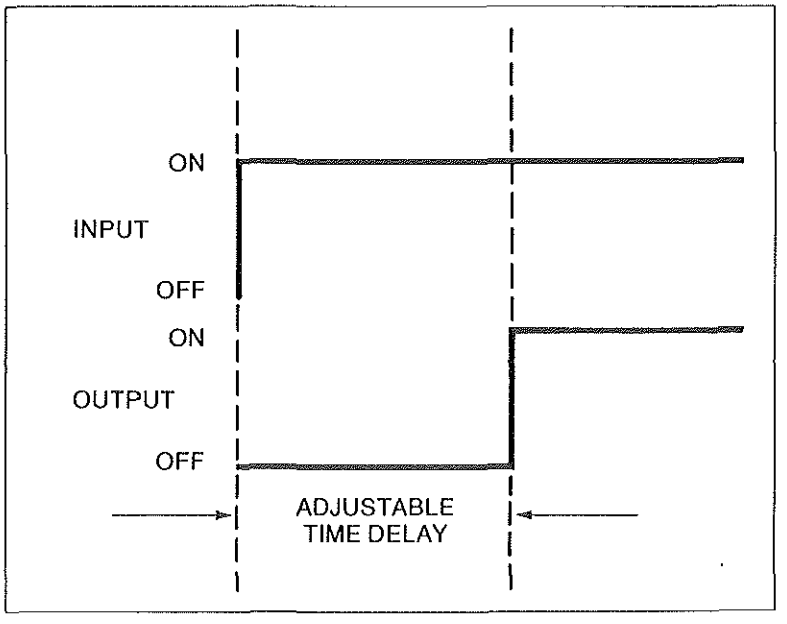
operation

Delay on energization (On Delay)

Applying line voltage initiates the time delay, at the expiration of which the output relay contacts transfer.

Recycle Time

To recycle the timer, input voltage must be removed and reapplied. Voltage must be removed for at least:
.075 second during timing
.075 second after time-out.



specifications

Operating voltage

+10% −15%

D.C.	A.C.
24 VDC	120V 50 – 60 Hz
125 VDC	

Timing ranges

.15 to 3 Sec.	4 to 120 Sec.
.55 to 15 Sec.	10 to 300 Sec.
1 to 30 Sec.	2 to 60 Min.
2 to 60 Sec.	1 to 30 Min.

Repeat Accuracy

Repeat accuracy at any fixed temperature is defined as:

*The repeat accuracy deviation (A_R) of a time-delay relay is a measure of the maximum deviation in the time-delay that will be experienced in 100 successive operations at any particular time setting of the relay and for any particular operating voltage or current.

Repeat accuracy is obtained from the following formula:

$$A_R = 100 \frac{(T_1 - T_2)}{(T_1 + T_2)}$$

Where —

T_1 = Maximum observed time.

T_2 = Minimum observed time.

*NEMA part ICS 2-218 .07

Repeat Accuracy ±2% at fixed temperature, voltage, and off-time.

Overall Accuracy ±5% over combined rated extremes of temperature and voltage.

Contacts

Relay 4 PDT 10 amps

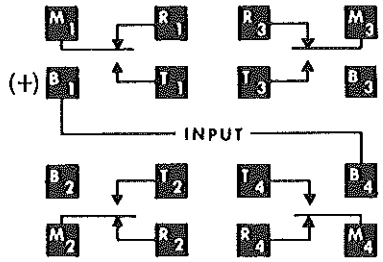
See GP series specifications: "Contacts."

Operating temperature range

0°C to 50°C

Wiring Diagram

A.C. and D.C.



Timing Adjustment

Internal Fixed.

Internal potentiometer.

Mounting/terminals

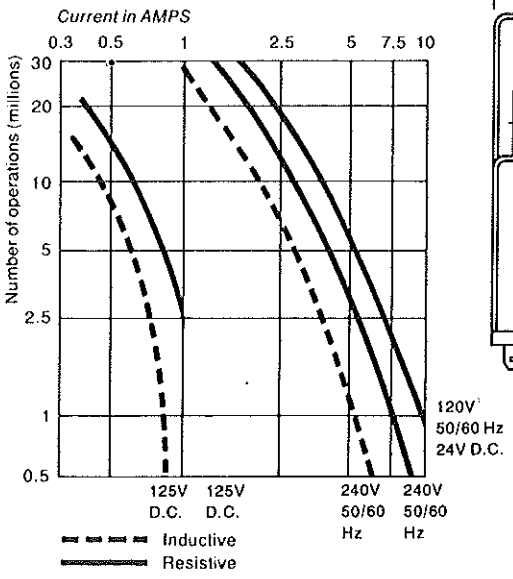
16 flat base pins which may be soldered. Screw terminal or quick-connect sockets are available.

Life

Load life — see chart

Mechanical life — 100 million operations.

Load life characteristics



Transient Protection

A 1500 volt transient of less than 100 microseconds, or 1000 volts of less than 1 millisecond will not affect timing accuracy.

Insulation Resistance

Between all non-connected terminals as well as between non-connected terminals and the relay yoke: 1,000 megohms at 500 volts D.C.

Power Consumption

Typical power consumption at rated voltage is:

6VA for A.C. coils.

6 Watts for D.C. coils.

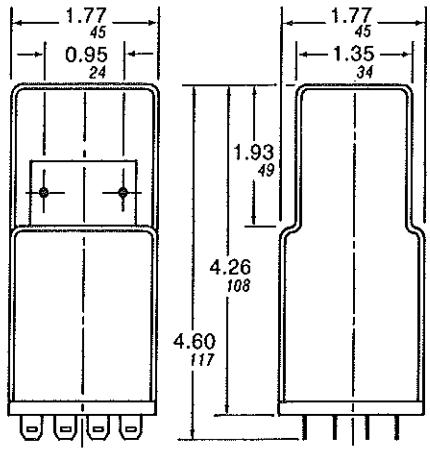
Dielectric

2000 VAC between terminals and case and between mutually-isolated contacts.

Weight

11 oz. Net.

Dimensions



ordering information

Catalog Number Code/GP and ML series

GP — A — N

Model Series

GP — Power Relay
ML — Magnetic latch

Coil voltage

A — 12 VDC
B — 24 VDC
C — 48 VDC
D — 125 VDC
F — 250 VDC*
G — 24 V 60 Hz
H — 48 V 60 Hz
I — 120 V 60 Hz
J — 220 V 60 Hz

*GP Series Only.

Options

N — Magnetic Blow-out Device
Q — Light to indicate coil energization (Not available on all models, consult factory)
R — Internal diode to suppress coil deenergization transient *

Catalog Number Code/TR series

TR — 1 — 4 — A — 1 — A — N

Model Series
TR — Time delay

Operation
1 — "On" Delay

Output
4–4 PDT

Operating voltage
B — 24 VDC
D — 125 VDC
I — 120V 50 - 60 Hz

Timing adjust.
1 — Internal Fixed
3 — Internal Potentiometer

Timing range
A — .15 to 3 Sec.
B — .55 to 15 Sec.
C — 1 to 30 Sec.
D — 2 to 60 Sec.
E — 4 to 120 Sec.
G — 10 to 300 Sec.
I — 2 to 60 Min.
N — 1 to 30 Min.

Options
N — Magnetic Blow-out Device

GP, ML and TR models are available which conform to 10CFR50 Appendix B, and which have been tested to IEEE 323-1974 and IEEE 344-1975. Consult factory for details and special ordering information.

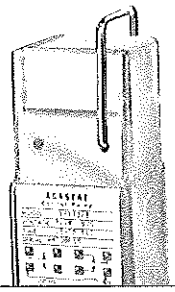
See pages 10, 11 for sockets and other accessories.

Control Products Division of Amerace Corporation cannot recommend the use of its products in the containment areas of nuclear power generating stations.

accessories

Extracting handle

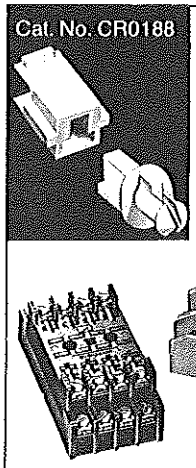
Cat. No. CR0179



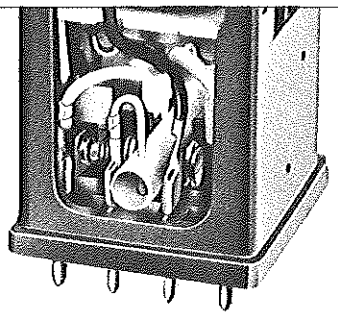
Plug-in orienting pins (1Set)

Cat. No. CR0188

For sockets:
CR0001
CR0002
CR0067



Magnetic blow-out device
(for GP, ML & TR Series)

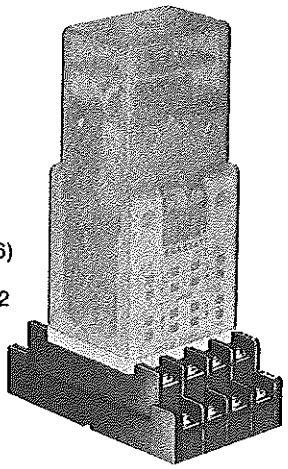


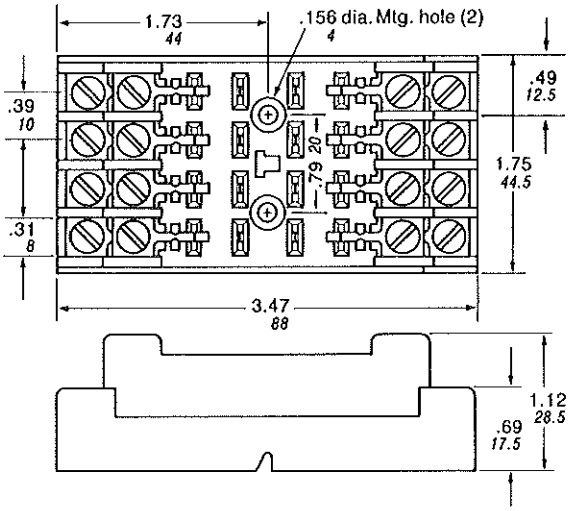
Cat. No. CR0190

Front connected sockets

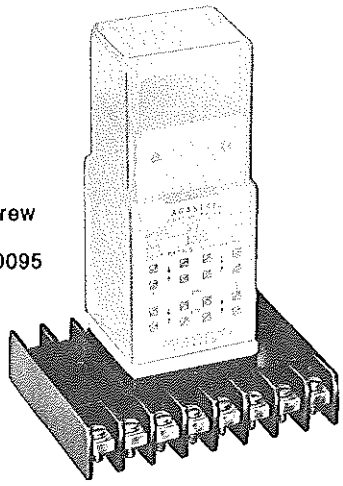
With captive clamp terminals
Cat. No. CR0001

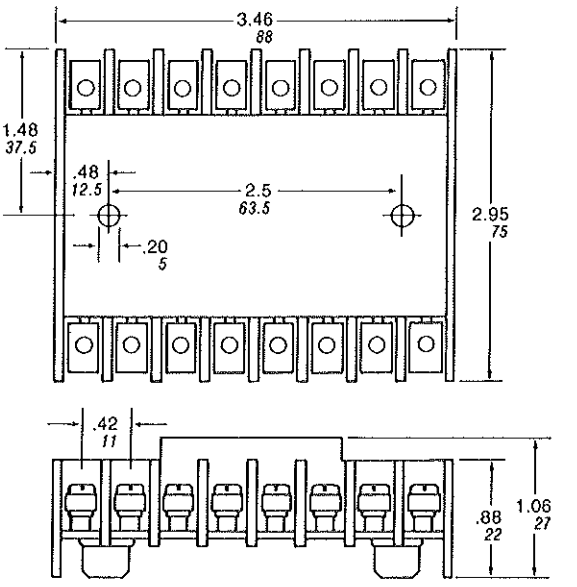
With binding (#6) head screws
Cat. No. CR0002





With (#6) Screw Terminals
Cat. No. CR0095

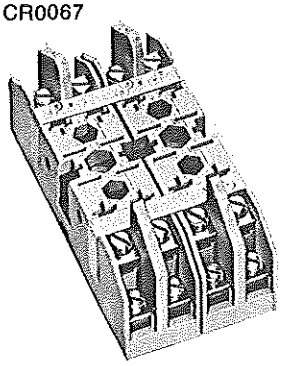


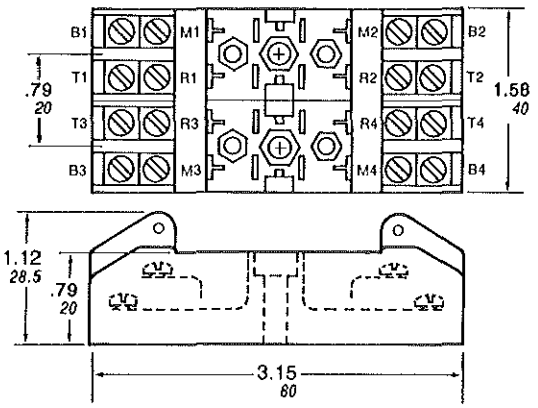


accessories

Front connected sockets

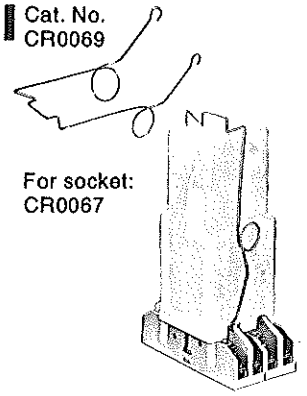
With (#6) Screw Terminals
Cat. No. CR0067





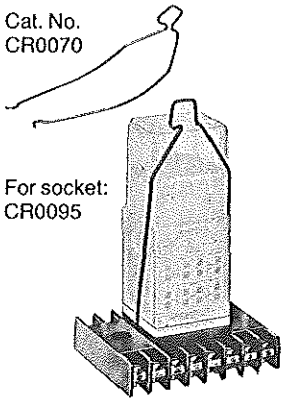
Locking springs

Cat. No. CR0069



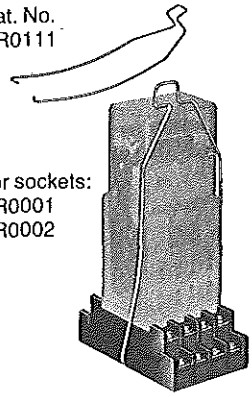
For socket: CR0067

Cat. No. CR0070



For socket: CR0095

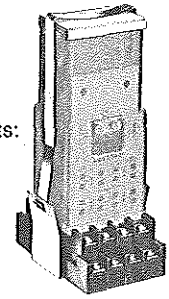
Cat. No. CR0111



For sockets: CR0001 CR0002

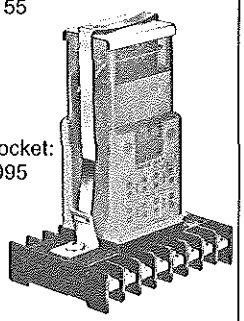
Heavy Duty Locking Straps

*Cat. No. CR0133



For sockets: CR0001 CR0002

* Cat. No. CR0155



For socket: CR0095

* Catalog number includes strap, strap plate and necessary brackets.

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CONTROL PRODUCTS DIVISION

Amerace Corporation, Control Products Division
2330 Vauxhall Road, Union, New Jersey 07083, U.S.A.
Telex 138978

▌= Revised Since Last Printing

September 1980
Supersedes 10/79.

Printed in U.S.A.

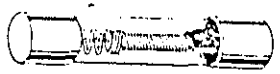
1191187

DESCRIPTION: FUSE. 1 AMP. DUAL-ELEMENT. 250V. OR LESS.
SLOW BLOWING TYPE. FUSETRON
GLASS TUBE, 1/4 x 1-1/4 INCH.

VENDOR PC. NO MDL-1 AMP.

VENDOR: BUSSMANN MFG. DIV.
MC GRAW-EDISON CO.
ST. LOUIS, MO. 63178

FUSETRON GLASS TUBE FUSES,
1/4 x 1 1/4 Inch



1/16 to 2 amp. MDL

DUAL-ELEMENT — SLOW BLOWING TYPE

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REV NO	CHANGE ORDER NO	DATE	DESCRIPTION	CHK'D. BY

TITLE
FUSE 1 AMP
DUAL ELEMENT 250V
SLOW BLOW FUSETRON

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. C.O. 11515	8/2 '79	ASSY. OR LO.	
DR. BY GRANTOW	7/13 '79	SCALE	
CHK'D. BY RT CALUD	7/27/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

SHEET SIZE A | DWG. NO. 1191187 | SHEET 1 OF 1

11911188

DESCRIPTION: FUSE. 3 AMP. 250V. OR LESS.
TYPE AGC. GLASS TUBE. SIZE 1/4 x 1 1/4 INCH.

VENDOR PC NO. AGC-3 AMP

VENDOR: BUSSMANN MFG. DIV.
MC GRAW-EDISON CO.
ST. LOUIS, MO. 63178

BUSS GLASS TUBE FUSES, ¼ x 1¼ Inch



AGC 3

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REV	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: FUSE 3 AMP 250V. AGC-3

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL NO. C.O. 11515	8/2/79	ASSY. OR LO.	
DR. BY GRANEOW.	7/13/79	SCALE	
CHK'D. BY RTCALWD	7/27/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

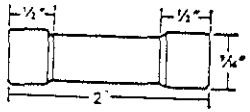
SHEET SIZE A | DWG. NO. 11911188 | SHEET 1 OF 1

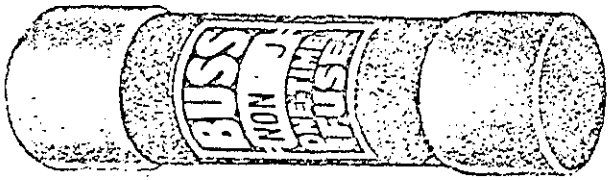
11911189

DESCRIPTION: FUSE. 10 AMP. 250V. OR LESS.
TYPE NON. ONE TIME.

VENDOR PC NO.: NON10

VENDOR: BUSSMANN MFG. DIV.
MC GRAW-EDISON CO.
ST. LOUIS, MO. 63178





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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: FUSE 10 AMP 250V. NON10

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. C.O 11515	8/2 /79	ASSY. OR LO.	
DR. BY GRANTOW	7/13/79	SCALE	
CHK'D. BY R. CALUD.	7/27/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L.	
APPV. MACH.		ENGR.	
APPV. WELD.			

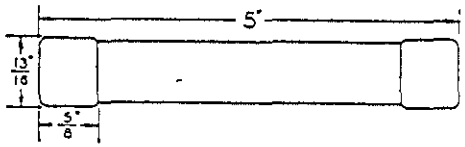
SHEET SIZE A | DWG. NO. 11911189 | SHEET 1 OF 1

11911190

DESCRIPTION: FUSE. 15AMP. 600V. OR LESS.
TYPE NOS. ONE TIME.

VENDOR PC. NO. NOS15

VENDOR: BUSSMANN MFG DIV.
MC GRAW-EDISON CO.
ST. LOUIS, MO. 63178.



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE
FUSE 15AMP
600V NOS15

TOLERANCES
(Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0.- ± .060 0.0- ± .030 0.00- ± .010

Colt Industries — Fairbanks Morse Engine Division

REL NO. C.O. 11515	8/2 [illegible]	ASSY. OR LO.
DR. BY GRANROW	7/13/79	SCALE
CHK'D. BY RJCALUD	7/27/79	HEAT TR.
MAT'L		
APPV. CAST.		MAT'L.
APPV. MACH.		ENGR.
APPV. WELD.		

SHEET SIZE A | DWG. NO. 11911190 | SHEET 1 OF 1

BF3009-2

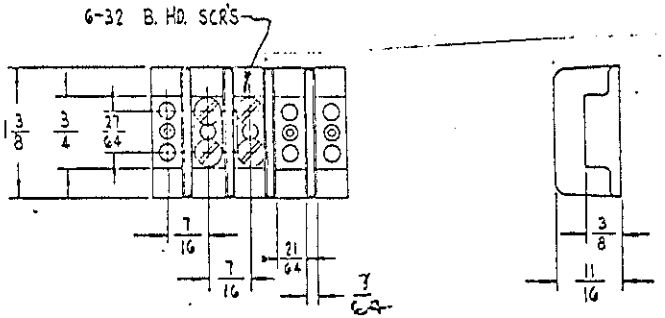
N58754 TELEDYNE POST

11911 857

DESCRIPTION: TERMINAL BLOCK 4 POINT. 541 SERIES. STANDARD TERMINAL, 6-32 x 1/4 B.H. SCREWS NICKEL PLATED. MAX. VOLTS RMS 2,800. MAX. CURRENT IN AMPS 20. MAX. WATTS PER TERMINAL 5,000. APPROX SIZE 2.5 LG., 1 3/8 WIDE, 11/16 DEEP.

VENDOR PC. NO.: 354-61-04-001

VENDOR: TRW CINCH CONNECTORS,
AN ELECTRONIC COMPONENT DIVISION OF TRW INC.
1501 MORSE AVE.
ELK GROVE VILLAGE, ILL. 60007



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REV. NO.	CHANGE ORDER NO.	DATE	DESCRIPTION	CHK'D. BY

TITLE: TERMINAL BOARD 4 POINT 20 AMP

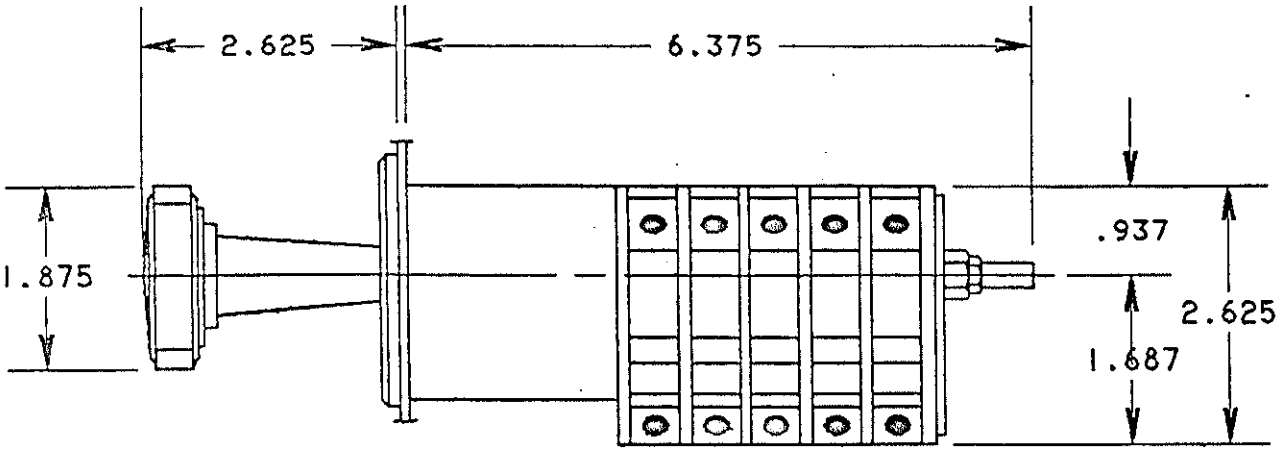
TOLERANCES (Unless Otherwise Specified)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. - ± .060 0.0 - ± .030 0.00 - ± .010

Colt Industries — Fairbanks Morse Engine Division

REL. NO. 11503	6/29/79	ASSY. OR LO.	11875300
DR. BY GRANZOW	6/27/79	SCALE	
CHK'D. BY DIMANN	6/27/79	HEAT TR.	
MAT'L			
APPV. CAST.		MAT'L	
APPV. MACH.		ENGR.	
APPV. WELD.			
SHEET SIZE A	DWG. NO. 11911857		SHEET 1 OF 1

O.P

11913068



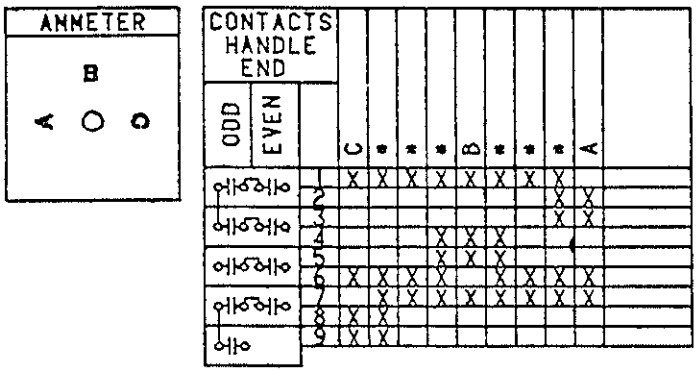
2.312 WIDE

DESCRIPTION: AMMETER TRANSFER SWITCH, THREE INDEPENDENT CIRCUITS, WITH KNURLED HANDLE.

VENDOR TYPE: SBM

VENDOR MODEL NO. SIMILAR TO MODEL NO. 10AA010, EXCEPT ESCUTCHEON TO BE AS SHOWN.

VENDOR: GENERAL ELECTRIC CO.



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REV NO.	CHANGE ORDER	DATE	DESCRIPTION	CHK. BY

TITLE
"SBM" SWITCH
AMMETER TRANSFER

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .060 0.0 ± .030 0.00 ± .010

COLT INDUSTRIES
FAIRBANKS MORSE ENGINE DIVISION

REL.NO. FS1247	9/22/82	ASSY.OR LO..	
DR.BY GRANZOW	08/26/82	SCALE 1/2	
CHK'D.BY. RJC	9/16/82	HEAT TR..	
MAT'L..			
APPV	CAST..	MATL..	
	MACH..	ENGR. RJC	
	WELD..		

SHT. SIZE A | DWG. NO. 11913068 | SHEET 1 OF 1

BF 3009-2

B/M ITEM NO.	COLT PART NO.	PARENT COLT PART NO.	INFO FROM SUPPLIER TO COLT				MANUFACTURE INFORMATION		DESCRIPTION
			SUPPLIER	BM. NO.	ITEM NO.	PART NO.	MANUFACTURE	MANUFACTURE PART NO.	
1	11913068	11908286	I C & S	1W0280	6	NONE	GENERAL ELECTRIC	TYPE SBM SIMILAR TO MODEL #10AA010	AMMETER TRANSFER SW. WITH KNURLED HANDLE, 3 INDEP. CKTS.
2	11913069	11908286	I C & S	1W0280	16	NONE	GENERAL ELECTRIC	TYPE SBM SIMILAR TO MODEL #10AA004	VOLTMETER SW. WITH KNURLED HANDLE

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11875310 IC & S PANEL MODIFICATION
11908286 GENERATOR CONTROL PANEL
REFERENCE DRAWINGS:

REV NO.	CHANGE ORDER	DATE	DESCRIPTION	CHK. BY

TITLE
ELECTRICAL PARTS REFERENCE LIST
LIMERICK700009/1 - /8

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .060 0.0 ± .030 0.00 ± .010

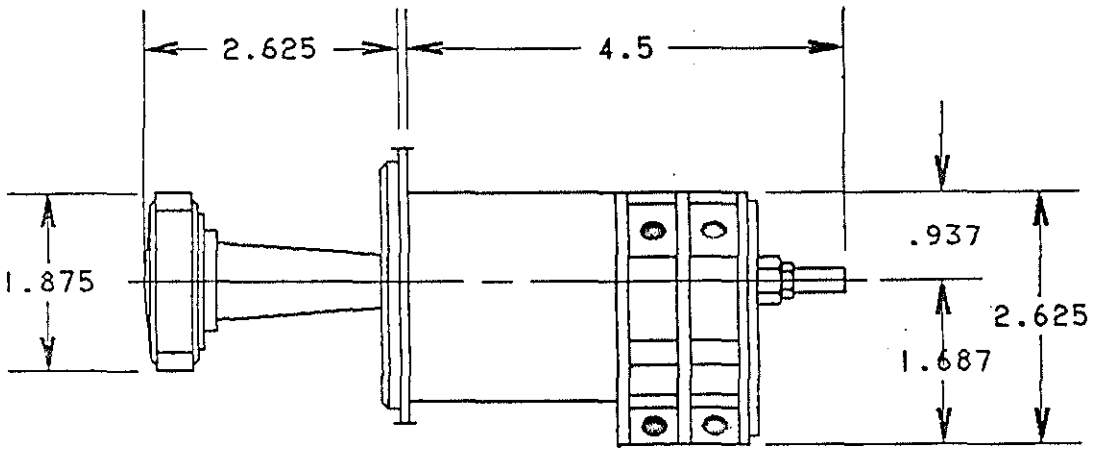
COLT INDUSTRIES FAIRBANKS MORSE ENGINE DIVISION

REL.NO. FS1247	9/22/82	ASSY.OR LO..	
DR.BY GRANZOW	08/31/82	SCALE NONE	
CHK'D.BY. RTC	9/16/82	HEAT TR..	
MAT'L..			
APPV	CAST..	MATL..	
	MACH..	ENGR. RTC	
	WELD..		

SHEET SIZE B | DWG. NO. 11876902 | SHEET 1 OF 1

O.P.

11913069



2.312 WIDE

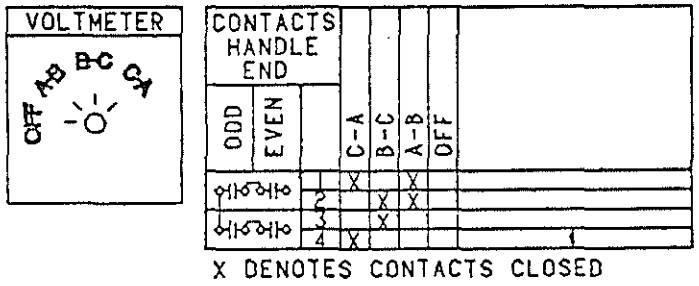
DESCRIPTION: VOLTMETER SWITCH, PHASE TO PHASE, WITH KNURLED HANDLE.

VENDOR TYPE: SBM

VENDOR MODEL NO. SIMILAR TO MODEL NO. 10AA004, EXCEPT ESCUTCHEON TO BE AS SHOWN.

VENDOR: GENERAL ELECTRIC CO.

OBSOLETE



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REV NO.	CHANGE ORDER	DATE	DESCRIPTION	CHK. BY

TITLE
"SBM" SWITCH
VOLTMETER

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .060 0.0 ± .030 0.00 ± .010

COLT INDUSTRIES
FAIRBANKS MORSE ENGINE DIVISION

REL.NO. FS1247	09/22/82	ASSY.OR LO..	
DR.BY GRANZOW	08/26/82	SCALE 1/2	
CHK'D.BY. RTC	9/16/82	HEAT TR..	
MAT'L..			
APPV	CAST..	MATL..	
	MACH..	ENGR. RTC	
	WELD..		
SHT. SIZE A	DWG. NO. 11913069		SHEET 1 OF 1

BF 3009-2

11876902

B/M ITEM NO.	COLT PART NO.	PARENT COLT PART NO.	INFO FROM SUPPLIER TO COLT				MANUFACTURE INFORMATION		DESCRIPTION
			SUPPLIER	BM. NO.	ITEM NO.	PART NO.	MANUFACTURE	MANUFACTURE PART NO.	
1	11913068	11908286	I C & S	1W0280	6	NONE	GENERAL ELECTRIC	TYPE SBM SIMILAR TO MODEL #10AA010	AMMETER TRANSFER SW. WITH KNURLED HANDLE, 3 INDEP. CKTS.
2	11913069	11908286	I C & S	1W0280	16	NONE	GENERAL ELECTRIC	TYPE SBM SIMILAR TO MODEL #10AA004	VOLTMETER SW. WITH KNURLED HANDLE
3	11913199	11908286	I C & S	1W0280	19	NONE	WESTINGHOUSE	TYPE VIY-60 STYLE NO. 7525A51G02	POTENTIAL XFMR 4200/120V TWO 1/2A FUSES (ON PRIMARY)
4									

11875310 IC & S PANEL MODIFICATION
11908286 GENERATOR CONTROL PANEL
REFERENCE DRAWINGS:

(M/F)

REV NO.	CHANGE ORDER	DATE	DESCRIPTION	CHK. BY
1	13660	11/22/83	ADD ITEM 3	BML RTC

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TITLE
ELECTRICAL PARTS REFERENCE LIST
LIMERICK 700000/1 - /8

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
FRACTIONAL MACHINING ± 1/64
TOOL DESIGN ± .002
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING ± .060
DECIMAL MACHINING TOLERANCES
0. ± .06 0.0 ± .030 0.00 ± .010

COLT INDUSTRIES FAIRBANKS MORSE ENGINE DIVISION

REL.NO.FS1247	09/22/82	ASSY.OR LO..	
DR.BY GRANZOW	08/31/82	SCALE NONE	
CHK'D.BY RTC	09/16/82	HEAT TR..	
MAT'L..			
APPV	CAST..	MATL..	
	MACH..	ENGR. RTC/VTS	
	WELD..		

SHEET SIZE B DWG. NO. 11876902 SHEET 1 OF 1

BF 3009-3

2 3 4 5 6 7 8