

62065240

saskoil MEMO

TO: David Cadrin

November 18, 1988

FROM: Wayne Petovello

RE: Operating Manuals

Enclosed for your reference are two sets of operating manuals for each of the Marsden Treater and Beacon Hill Compressor packages.

Please retain one copy of each for the Maidstone Office and forward the other to the appropriate site office.

Thanks.


Wayne Petovello

WP/by

Enc.

Elaine file in Marsden Unit Correspondence.

88-12-12

→ Copy to Ernest for Marsden Unit 88-12-6
Second Copy in Reference Library

DSC

MANUAL

MODEL # HTI-TD-1030-3.0

10' x 30' S/S x 75 PSIG 3.0 MM BTU/HR

SASK OIL MARSDEN BATTERY

vessel

DESIGN CRITERIA

MODEL # HTI-TD-1030-3.0
10' x 30' x 75 PSIG 3.0 MM BTU/HR
SASK OIL / MARSDEN BATTERY

VESSEL - TREATER

FLOW -

- OIL	300 M3/D	1887 NET BPD
- WATER	130 M3/D	.200 MMSCFD
- GAS	5600 M3/D	818 BPD
- INLET TEMP [MIN]	10 DEG C	50 DEG F

MINIMUM OPERATING PRESSURE

- 30 PSI

MAXIMUM OPERATING TEMPERATURE -

- 185 DEG F

MAXIMUM HEAT LOAD -

- 3.0 MM BTU/HR

FUEL REQUIRED -

- 4286 SCFH

POWER REQUIRED -

- 120V/1/60

INTERNAL COAT -

- "INTERGUARD FAST-DRY 2"

QUESTIONS/ANSWERS ABOUT CRUDE OIL TREATING

WHAT DOES A TREATER DO?

IT REMOVES IMPURITIES FROM PRODUCED CRUDE OIL.

WHAT ARE THE IMPURITIES?

THE MOST PREVALENT IMPURITY IS WATER WHICH USUALLY CONTAINS DISSOLVED SALTS. OTHER IMPURITIES ARE SAND, SILT, METALLIC OXIDES, HYDROGEN SULPHIDE, MERCAPTAINS, AND OTHER MINERALS.

WHY MUST THESE IMPURITIES BE REMOVED?

ALL OF THESE CONSTITUENTS WILL DEPOSIT IN THE STORAGE TANKS, PIPELINES, AND FINALLY IN THE EQUIPMENT USED TO REFINER CRUDE OIL. THE IMPURITIES TAKE UP VALUABLE SPACE AND WORSE; CAUSE CORROSION, EROSION, AND PLUGGING OF IMPLEMENTS. AND EQUIPMENT USED IN TRANSPORTING, STORING, AND REFINING OF THE CRUDE OIL.

IS NATURAL GAS PRODUCED WITH CRUDE OIL CONSIDERED AN IMPURITY?

NOT GENERALLY. THE GAS CAN CONTAIN HYDROGEN SULPHIDE, CO₂, MERCAPTANS, OR OTHER ELEMENTS THAT ARE CONSIDERED IMPURITIES. THE NATURAL GAS IS USUALLY A VALUABLE PRODUCT IN ITSELF BUT MUST STILL BE SEPARATED FROM THE OIL IN ORDER TO SUCCESSFULLY CARRY OUT THE OTHER TREATING PROCESSES. GAS PROCESSING OCCURS OUTSIDE OF THE TREATER BY OTHER MEANS.

QUESTIONS/ANSWERS - CONCLUDED

HOW DOES A TREATER WORK?

ALL TREATERS UTILIZE THE LAWS OF GRAVITY TO SEPARATE THE LIGHTER FROM THE HEAVIER COMPONENTS; GAS IS THE LIGHTEST, OIL THE NEXT, THEN WATER, AND FINALLY THE SOLIDS WHICH ARE GENERALLY THE HEAVIEST COMPONENTS. TIME AND GRAVITY WILL GENERALLY ALLOW THE VARIOUS COMPONENTS TO SEPARATE, HOWEVER, THE CLOSER THE VARIOUS COMPONENTS ARE TO THE SAME WEIGHT, THE LONGER IT WILL TAKE FOR GRAVITY SEPARATION TO OCCUR. OIL OFTEN COATS AND SATURATES THE OTHER COMPONENTS CHANGING THEIR COMBINED WEIGHT. IT CAN BE READILY SEEN THAT THE WEIGHT OF SMALL WATER DROPLETS COATED WITH OIL WILL BE MORE AFFECTED THAN LARGER DROPLETS COATED WITH OIL. ANOTHER MAJOR DETERRENT TO GRAVITY SEPARATION IS HIGH VISCOSITY OF THE CRUDE OIL. THE THICKER THE OIL, THE LONGER THE SEPARATION PROCESS WILL TAKE. WHILE GRAVITY SEPARATION IS THE BASIC METHOD USED TO REMOVE THE IMPURITIES FROM CRUDE OIL, IT IS GENERALLY NECESSARY TO APPLY ADDITIONAL METHODS TO SPEED UP THE SEPARATION PROCESS, INCLUDING CHEMICALS TO BREAK EMULSIONS, HEATERS TO REDUCE VISCOSITY OF THE OIL, AND COALESCING ELEMENTS TO ENLARGE THE WATER DROPLETS. TREATERS INCORPORATE SOME OR ALL OF THESE MEANS TO SPEED UP THE SEPARATION PROCESS.

IN SUMMARY A TREATER WORKS WITH ENHANCED GRAVITY SEPARATION BY ENLARGING DROPLETS AND/OR REDUCING VISCOSITIES AND WITH THE INTRODUCTION OF CHEMICALS THAT HELP BREAK EMULSIONS.

ALL OF THESE SEPARATION PROCESS ELEMENTS MUST BE APPLIED IN A SYSTEMATIC METHOD THAT WILL CONSERVE ENERGY, MINIMIZE COSTS, AND GET THE JOB DONE AS QUICKLY AND EFFICIENTLY AS POSSIBLE.

THE FOREGOING HYPOTHETICAL QUESTIONS AND ANSWERS ARE USED TO SIMPLY ILLUSTRATE THAT CRUDE OIL TREATING IS NOT A MYSTICAL OR NEBULOUS PROCESS, HOWEVER, THE PRACTICAL IMPLEMENTATION OF THE PROCESS HAS PROVEN TO BE ELUSIVE, PARTICULARLY RELATIVE TO THE TREATMENT OF LOW GRAVITY VISCOUS CRUDE OILS. HTI CANADA'S PERSONNEL HAVE MANY YEARS OF FIELD INVOLVEMENT WHICH HAVE CULMINATED IN THE DEVELOPMENT OF CRUDE OIL TREATING AND DESALTING EQUIPMENT PRESENTED IN THIS MANUAL.

THEORY OF OPERATION FOR HEAVY DUTY TREATERS

HTI TREATERS APPLY THE BEST PRINCIPLES OF GRAVITY SEPARATION BY MAINTAINING A HORIZONTAL FLOW PATTERN THROUGHOUT THE ENTIRE PROCESSING SCHEME. THE CONSTANT FORCE OF FLOW RESISTING THE SETTLEMENT OF WATER DROPLETS IS MINIMIZED AS OPPOSED TO TREATERS WITH VERTICAL FLOW PATTERNS. EFFICIENT UNIFORM HEATING IS ASSURED BY THE STREAMFLOW DISTRIBUTION OF THE FLUID AROUND THE HEATING ELEMENTS. THE STREAMFLOW HEATING PATTERN ACCOMPLISHES MAXIMUM HEATING EFFICIENCY AND ATTAINS POSITIVE EQUILIBRIUM AT THE OIL/GAS AND WATER/OIL INTERFACES. WITH THE STREAMFLOW PATTERN, FREE WATER IS SEPARATED AND BYPASSED AROUND THE HEATING ELEMENTS. THE CRUDE OIL EMULSION IS HEATED SEQUENTIALLY WITH ENTRAINED GAS AND WATER BEING REMOVED AT THE EARLIEST POSSIBLE MOMENT IN THE HEATING PROCESS. THIS INSURES A MINIMUM ENERGY LOSS FROM HEATING CONSTITUENTS MORE THAN NECESSARY TO EFFECT SEPARATION.

THE CRUDE OIL EMULSION IS HEATED DIRECTLY BY THE HEATING ELEMENT BEING IMMersed IN THE OIL CONSTANT PHASE. HEATING IN THE OIL CONSTANT PHASE REDUCES SCALING AND COKING OF THE HEATING ELEMENT. FREE GAS AND ENTRAINED GAS RELEASED BY THE HEATING PROCESS IS REMOVED AHEAD OF THE COALESCING AND SETTLING SECTION SEPARATION IN THE SETTLING AREA.

THE GAS-FREE CRUDE OIL EXITS THE HEATING SECTION INTO A COALESCING SECTION THAT CONTAINS LOUVERED PLATES TO EFFECT COALESCENCE AND INSURES UNIFORM DISTRIBUTION THROUGHOUT THE COALESCING/SETTLING SECTION. THE LOUVERED PLATES IMPART A SLIGHT PRESSURE DROP THAT CAUSES THE OIL TO DISTRIBUTE ACROSS THE FULL CROSS SECTION OF THE VESSEL. THE BAFFLES ARE DESIGNED TO FORCE A CHANGE OF DIRECTION THAT IMPACTS THE WATER ONTO THE PLATE. ALSO, THE CUTTING EDGES OF THE LOUVERES BREAK THE OIL FILM AROUND THE WATER DROPLETS ALLOWING THE WATER TO ESCAPE. THE HORIZONTAL FLOW REDUCES THE RESISTANCE TO SEPARATION / SETTLEMENT. ALL CONTRIBUTE TO THE EFFECT OF DELIVERING THE MAXIMUM VOLUME OF CLEAN OIL WITH THE MINIMUM EXPENDITURE OF ENERGY AND CHEMICAL COSTS.

KNOW YOUR VESSEL ON THE INSIDE

THIS UNIT INCORPORATES [2] FIRETUBES WHICH ARE IMMERSSED IN THE OIL PHASE DIRECTLY HEATING THE OIL. THE FREE WATER AND GAS IS SEPARATED AND THE TEMPERATURE OF THE OIL IS THEN RAISED TO THE TEMPERATURE REQUIRED TO OBTAIN THE PROPER VISCOSITY LEVEL FOR FINAL COALESCENCE AND SEPARATION. A VERTICAL BAFFLE TRANSVERSING THE VESSEL CROSS SECTION PARTITIONS THE HEATING/SETTLING SECTIONS. THE OUTLET END OF THE VESSEL CONTAINS A COMPARTMENT THE FUNCTIONS TO DISTRIBUTE THE OIL FLOW AND PROVIDE AN OIL LEVEL RESERVOIR. THE WATER IS TAKEN OUT THRU THE CONTROL STATION AT THE END OF THE TREATER.

THE GAS LEAVES THE HEATING COMPARTMENT THROUGH AN OPENING AT THE TOP OF THE TRANSVERSE BAFFLE AND THEN PASSES THROUGH A STAINLESS STEEL WIRE MESH FOAM BREAKER BEFORE EXITING THE VESSEL AT THE TOP OF THE VESSEL.

THE SETTLING SECTION OF THE VESSEL CONTAINS A LOUVERED BAFFLE THAT DIFFUSES THE OIL FLOW AND CAUSES THE WATER DROPLETS TO COALESCE. THE BAFFLES ARE DESIGNED TO IMPART A SLIGHT PRESSURE DROP THAT CAUSES THE OIL TO SPREAD ACROSS THE FULL DIAMETER OF THE VESSEL. THE EDGE OF THE LOUVERS CUT THE OIL FILM AROUND THE WATER DROPLETS AND ALLOW THE WATER TO IMPACT ON THE PLATES.

BASICS OF CONTROL AND INSTRUMENTS

THE PRIMARY ELEMENTS BEING CONTROLLED ARE PRESSURE, TEMPERATURE, AND THE LIQUID LEVEL -

PRESSURE CONTROL - ON THIS UNIT, THE PRESSURE IS ESTABLISHED BY THE SETTING ON THE GAS BACK PRESSURE REGULATOR LOCATED ON THE GAS OUTLET LINE [SUPPLIED BY OTHERS]

TEMPERATURE CONTROL - THE TEMPERATURE IS CONTROLLED BY A PNEUMATIC SYSTEM THERE ARE [3] TEMPERATURE SENSORS [THERMOSTATS], [1] FOR CONTROLLING OPERATING TEMPERATURES, ON EACH FIRETUBE, THE OTHER IS A HIGH TEMPERATURE SAFETY SHUTDOWN. THE CONTROL SENSOR SENDS A PNEUMATIC SIGNAL TO THE FUEL GAS SHUTDOWN VALVE.

LIQUID LEVEL CONTROL - THE WATER LEVEL CONTROL IS AN ELECTRIC/PNEUMATIC SYSTEM w/ A RADIO FREQUENCY TYPE LEVEL SENSOR

THE OIL LEVEL CONTROLLER IS A PNEUMATIC DISPLACEMENT TYPE

THE WATER CONTROL VALVE IS A DIAPHRAGM-ACTUATED NORMALLY CLOSED VALVE ON A RISE IN WATER LEVEL, THE WATER LEVEL SENSOR DELIVERS AN AIR SIGNAL TO THE CONTROL VALVE ACTUATOR CAUSING THE VALVE TO OPEN

THE OIL CONTROL VALVE IS DIAPHRAGM ACTUATED CONTROL VALVE A RISE OF THE OIL LEVEL ACTUATES THE CONTROLLER WHICH SENDS AN AIR SIGNAL TO THE DIAPHRAGM CAUSING THE VALVE TO OPEN

TREATER START-UP PROCEDURE

- MAKE SURE ALL OPENINGS ARE PLUGGED OR CLOSED
- PURGE ENTIRE VESSEL WITH GAS [OR NITROGEN]
- ALL INLET PIPING TO VESSEL TO BE PURGED
- SET GAS BACK PRESSURE VALVE TO 10 PSI LOWER THAN RELIEF VALVE PRESSURE
- CHECK AND SET ALL ASSOCIATED INSTRUMENTATION
- FILL VESSEL WITH PRODUCED WATER UNTIL THE LOW OIL LEVEL SWITCH ACTIVATES
- DO NOT OPERATE WATER DUMP VALVE UNTIL VESSEL IS UP TO TEMPERATURE [BLOCK VALVE CLOSED]
- START-UP BURNER AND RAISE WATER TEMPERATURE SLIGHTLY [80 DEG F - 100 DEG F; REFER TO BURNER START-UP SECTION]
- BRING IN PRODUCTION OIL KEEPING THE OIL LEVEL ABOVE THE OIL LOW LEVEL SWITCH BUT JUST BELOW THE OIL WIER HEIGHT. DUMP WATER AT THE SAME RATE AS INCOMING PRODUCTION UNTIL DESIRED OIL/WATER INTERFACE LEVEL IS REACHED
- RAISE BURNER TEMPERATURE TO DESIRED OPERATING TEMPERATURE AND ALLOW OIL LEVEL TO RAISE TO PROPER INTERFACE HEIGHT
- SET THE GAS BACK PRESSURE VALVE AND OIL AND WATER LEVEL CONTROL TO NORMAL OPERATING RANGE
- ONCE OPERATION IS ESTABLISHED, THERE ARE A FEW CRITICAL PARAMETERS TO BE MAINTAINED

PRESSURE MAINTENANCE IS ESSENTIAL TO THE SUCCESSFUL ACCOMPLISHMENT OF THE PROCESS PURPOSE. THE CORRECT PRESSURE IS NECESSARY TO DELIVER THE FLUIDS FROM THE UNIT AND MAINTAIN THE PROPER LIQUID LEVELS INSIDE THE VESSEL. IF THE PRESSURE IS TOO LOW AT A GIVEN TEMPERATURE, IT WILL ALLOW THE WATER TO BOIL AND VAPORIZE RESULTING IN A TREATER UPSET AND CREATING A WORSE EMULSION. IF THE PRESSURE IS ALLOWED TO RISE TO A POINT HIGHER THAN THE MAXIMUM DESIGN PRESSURE OF THE VESSEL, IT WILL CAUSE THE SAFETY VALVE TO OPEN DISCHARGING GAS AND POSSIBLE LIQUIDS THROUGH THE SAFETY VALVE.

BURNER START-UP PROCEDURE

- CLOSE ALL FUEL BLOCK VALVES
- OPEN FLAME ARRESTOR AND SWING OUT TO EXPOSE PILOTS, BURNER, ETC.
- MAKE VISUAL CHECK FOR LOOSE COUPLINGS OR ANY DAMAGE
- LOOSEN SECONDARY AIR PLATE AND SET TO APPROXIMATELY 1" OPENING AND LOCK IN PLACE
SLIGHT CHANGES IN THIS ADJUSTMENT WILL BE MADE LATER, AS REQUIRED
- OPEN ALL PRIMARY AIR OPENINGS TO APPROXIMATELY 1/4" PRIMARY AIR ADJUSTERS ARE THE 1/4" CASTING WITH 6" - 8-1/4" LUGS ON THE REAR OF AIR GAS MIXERS
- WITH ALL STAGE FIRED 1" VALVES CLOSED, OPEN MAIN GAS FUEL TO REGULATOR
- SET REGULATOR @ 15 PSIG IF UNIT IS TO OPERATE AT LOW LOADS [THIS MAY BE SET AS LOW AS 12 PSIG]

LIGHT PILOT LIGHT [BASO THERMOCOUPLE]

- IF BASO IS USED, HOLD "RED BUTTON" DOWN 30 - 60 SECONDS; IF PILOT GOES OUT, LIGHT THE PILOT AND WHILE HOLDING DOWN RED BUTTON, ADJUST THE AIR MIXER ON PILOT TO A HARD STEADY BUT MAXIMUM FLAME. IF PILOT GOES OUT AGAIN, CHECK POSITION OF BASO ELEMENT, CLEAN AND CHECK THE TERMINAL AT THE BASO, TRY AGAIN.

WITH PILOT PROVED AND OPERATING SATISFACTORILY [HARD STEADY BLUE FLAME] CHECK PILOT LINES FOR LEAKS. TURN OPEN 1" MAIN GAS BLOCK VALVE AND SET MAIN GAS FLAME TO BLUE WITH YELLOW TIPS AT END.

OPERATING PROCEDURE - CONCLUDED

TO INITIATE OPERATION, UTILIZE THE FOLLOWING PROCEDURE -

- KEEP TRANSFORMER POWER "OFF"
- ADJUST GRID SPACING TO WIDEST SETTING
- ENSURE VESSEL IS FULL OF OIL
- INITIATE FLOW THROUGH VESSEL
- ESTABLISH PRESSURE AND LIQUID LEVEL SETTINGS
- ESTABLISH VESSEL TREATING TEMPERATURE
- KEEP FLOW RATES LOW WHILE ESTABLISHING BEST TREATING RESULTS WITHOUT ELECTRICAL COALESCENCE
- ONCE OIL IN GRID AREA IS INDICATING LOW WATER PERCENTAGES [5% OR LESS] TURN ON TRANSFORMER POWER
- NARROW GRID SPACING TO INCREASE AMPERAGE TO A LEVEL THAT WILL ACCOMPLISH THE TREATING REQUIREMENT
- GRADUALLY INCREASE FLOW RATE WHILE MAINTAINING THE AMPERAGE SETTING THAT WILL ACCOMPLISH THE DESIRED TREATING RESULT
- ONCE REQUIRED FLOW RATE IS ESTABLISHED, THE GRID SHOULD BE INCREASED TO THE WIDEST SPACING [LOWEST AMPERAGE DRAW] THAT WILL STILL ACCOMPLISH THE DESIRED TREATING RESULT

ELECTRICAL COALESCING SYSTEM [PROVISIONS FOR FUTURE
INSTALLATION]

THE ELECTRICAL COALESCING SYSTEM IN THE HTI ELECTRIC TREATER CONSISTS OF A STEP-UP TRANSFORMER AND SEVERAL ELECTRICAL GRIDS [DIPOLES]. THE GRIDS ARE SUSPENDED VERTICALLY IN THE OIL PHASE OF THE VESSEL COALESCING AND SETTLING SECTION WITH THEIR CROSS SECTION AREAS PERPENDICULAR TO THE OIL FLOW.

THE GRID SYSTEM IS CONNECTED TO THE SECONDARY OUTPUT OF THE TRANSFORMER AND ENERGIZED TO APPROXIMATELY 18,000 VOLTS. THE ELECTRICAL ACTIVITY CAN BE REGULATED BY VARYING THE GRID SPACING. THE GRID SPACING CAN BE REGULATED WHILE THE UNIT IS IN OPERATION. THIS IS ACCOMPLISHED BY ONE POINT ADJUSTMENT OF AN EXTERNAL CRANK AS EASILY AS OPENING OR CLOSING A GATE VALVE. THIS PERMITS PRECISE EYE LEVEL REGULATION OF THE ELECTRICAL ACTIVITY WHILE OBSERVING THE AMPERAGE AND VOLTAGE METERS.

ALL COMPONENTS ARE CONSTRUCTED FOR HIGH VOLTAGE SERVICE. THE INSULATORS, ENTRANCE PROBE, AND ALL ELECTRICAL COMPONENTS ARE SPECIAL HTI DESIGNS RESISTANT TO THE CRUDE OIL ENVIRONMENT TO WHICH THEY ARE EXPOSED. AN EXCLUSIVE HTI FEATURE IS A SAFETY RELIEF VALVE INCLUDED IN THE CONNECTION BETWEEN THE TRANSFORMER AND ENTRANCE PROBE TO PREVENT OVER PRESSURING THE TRANSFORMER HOUSING IN THE EVENT OF VESSEL PRESSURE LEAKAGE BEYOND THE PROBE BUSHING. A FLOAT OPERATED SAFETY SWITCH GROUNDS THE SECONDARY VOLTAGE SHOULD THE LIQUID LEVEL DROP LOW ENOUGH TO UNCOVER THE GRIDS.

THE SYSTEM INCLUDES A 100% REACTANCE TRANSFORMER WITH POWER REACTANCE CAPABILITY TO PROTECT THE TRANSFORMER FROM HIGH AMPERAGE AND CONTROLS THE VOLTAGE TO PREVENT HIGH ELECTRICAL FORCE DISPERSION. IT PERMITS THE TREATING UNIT TO REMAIN ON LINE IF A LOW VOLTAGE RETURNS TO NORMAL.

PREVENTIVE MAINTENANCE

ROUTINE PREVENTIVE MAINTENANCE IS GOOD INSURANCE AGAINST SHUTDOWNS AND MALFUNCTIONS.

THE BEST METHOD OF KEEPING A GOOD RECORD OF MAINTENANCE IS TO SPOT IT IN YOUR OPERATING LOG. OTHERWISE, NORMAL ROUTINE CHECKS MAY BE MISSED. GOOD RECORD KEEPING IS A GREAT ASSET TO THE OPERATOR OR TROUBLE SHOOTER.

SAND DUMP SYSTEM -

- CHECK EACH VALVE MANUALLY FOR FULL STROKING OF VALVES, USE HARD OVER-RIDE ON SIDE OF SOLENOID TO STROKE VALVES MANUALLY
- CHECK SAND DUMP PANEL TO ASSURE CLOCKS ARE OPERATING SATISFACTORILY

SAND JET SYSTEM -

- MANUALLY ACTIVATE TO CHECK PERFORMANCE OF SAND JET VALVES AND PUMP

TEMPERATURE -

- THE TEMPERATURE MUST BE MAINTAINED AT A HIGH ENOUGH TEMPERATURE TO ATTAIN THE REQUIRED OIL VISCOSITY LEVEL TO PERMIT THE WATER TO SEPARATE AND SETTLE THROUGH THE OIL PHASE
- AS MENTIONED PREVIOUSLY, IF THE TEMPERATURE IS CARRIED TOO HIGH AT A GIVEN PRESSURE, IT WILL CAUSE THE WATER TO VAPORIZE CAUSING A WORSE EMULSION
- THE TEMPERATURE SHOULD BE MAINTAINED AT ONLY THAT REQUIRED TO ACCOMPLISH THE TREATING PROCESS THUS CONSERVING FUEL
- THE TEMPERATURE SHOULD ALWAYS BE AT LEAST 30 DEG F BELOW THE BOILING POINT OF WATER AT PRESSURE ON THE TREATER

OIL BURNERS -

- CHECK FLAME VISUALLY
- CHECK OIL TEMPERATURE/PRESSURE
- CLEAN STRAINER
- CHECK PUMP FOR LEAKS AND PRESSURE OUTPUT
- CHECK INSIDE FIREBOX FOR POSSIBLE CLINKERS
- CHECK NOZZLE FOR EXCESSIVE WEAR AND GOOD FLAME PATTERN

LIQUID LEVELS -

- THE HTI TREATER IS PARTICULARLY SENSITIVE TO LIQUID LEVELS AND BY DESIGN OF THE EQUIPMENT, THE OIL/WATER INTERPHASE CAN NOT DROP BELOW A GIVEN POINT DUE TO THE DESIGN OF THE DAM
- IF FOR ANY REASON TOO MUCH WATER IS DRAWN-OFF AT THE SAND DUMPS, THIS INTERPHASE WILL DROP WHICH WILL EVENTUALLY LEAD TO MALFUNCTION OR EMULSION PAD WILL BE ALLOWED TO MIGRATE UNDER THE MAIN BAFFLE TO THE REAR OF THE TREATER
- IF WATER DUMP IS ALLOWED TO GO TOO HIGH, THE WATER WILL REACH THE FIRETUBE AND CAUSE VERY SUBSTANTIAL INCREASE IN FIRING AS IT TRIES TO HEAT ALL THE WATER
- EXTRA CARE SHOULD BE EXERCISED IN SETTING THE OIL/WATER LLC TO GIVE UNIFORM GOOD RESULTS

BURNERS -

- CHECK VISUALLY FOR PROPER FLAME
- CAN BE OUT OF ADJUSTMENT DUE TO CHANGES IN CALORIFIC VALUE OF FUEL GAS
- INADVERTENT CHANGE OF PRESSURE AT FUEL REGULATORS
- CLOGGED FLAME ARRESTOR [DUST, SALT, ETC]
- CLEAN AND RE-ADJUST AS REQUIRED

LIQUID LEVEL CONTROLLERS -

- OBSERVE PERFORMANCE OF CONTROLLERS AND CHECK LEVELS WITH SAMPLE LINES AND/OR GAUGE GLASS
- CHECK INTERFACIAL CONTROLLER; IF NORRISEAL OR FISHER LLC WITH LOADED FLOAT, CHECK CONTROLLER PERFORMANCE FOR RESPONSE. AS AN EMULSION PAD BUILDS, THE CONTROLLER TENDS TO BE MORE SLUGGISH. ADJUST SET POINT ONLY AS REQUIRED KEEPING PROPORTIONAL BAND IN THE 10-20% RANGE.
- IF THIS IS AN ELECTRONIC CONTROLLER, ADJUSTMENTS SHOULD BE MADE ONLY BY QUALIFIED TECHNICIANS [SEE DETAILS IN INSTRUMENT SECTION]
- CHECK PROFILE OF THE CUTS FROM SAMPLE IN THE FULL RANGE OF SAMPLE LINES. GOOD RECORD KEEPING WILL SHOW WHETHER THE EMULSION ENVELOPE IS GROWING, DIMINISHING, OR RECEDING. IF IT IS GROWING, IT MAY INDICATE A NEED FOR EITHER INCREASING TEMPERATURE [IN 10 DEG INCREMENTS] OR A CHECK ON CHEMICAL ADDITIVES.

BURNER OPERATION -

- BURNER OPERATION IS COVERED IN DETAIL IN SUBSEQUENT INSTRUCTIONS IN THIS MANUAL. IT IS IMPORTANT THAT BURNER CONTROLS BE SET TO ALLOW THE BURNER TO REMAIN IN A FIRING MODE EVEN ON LOW HEAT REQUIREMENT. THE BURNER SHOULD NOT BE ALLOWED TO OPERATE "FULL ON" THEN "OFF" AS THIS CAN CAUSE THERMAL STRESSING OF THE FIRETUBE WHICH COULD RESULT IN FIRETUBE FAILURE. "ON/OFF" OPERATION WILL ALSO INCREASE FUEL CONSUMPTION.

SEMI-ANNUAL/ANNUAL MAINTENANCE

AT LEAST ANNUALLY OR AT A PREDETERMINED SHUTDOWN, CERTAIN MAINTENANCE PROCEDURES ARE ADVISABLE TO AVOID COSTLY FAILURES.

FIREBOXES -

- THE FIREBOX IS A PARTICULARLY VULNERABLE PART OF THE EQUIPMENT AND SHOULD BE INSPECTED FOR UNFORSEEN BUILD-UP OF SALT, COKE, ETC.
- REMOVE FIREBOXES STRAIGHT OUT, BUT NOT NECESSARILY ALL THE WAY. BE CERTAIN YOU HAVE A NEW GASKET AVAILABLE.
- EXAMINE THE FIREBOX FOR BUILD-UP. OIL FIRED UNITS WILL SHOW MORE INDICATION OF FOULING THAN GAS FIRED; AS IT IS INEVITABLE THAT THE FLAME BURST IS SHORTER AND MORE INTENSE. THEREFORE, EXAMINE MOST CAREFULLY, THE FIRST TEN FEET ON THE BURNER SIDE OF THE FIREBOX.
- CHECK FOR STRESS CRACKING AT OR NEAR THE COVER FLANGE WELD.
- CLEAN AND REPAIR ANY DEFECTS AS REQUIRED. IN THE EVENT ANY WELDING IS REQUIRED, USE CERTIFIED WELDERS.
- REPLACE FIREBOX USING NEW GASKET AND REPLACE ANY STUDS AND NUTS AS NECESSARY [B-7 STUDS ONLY].

NOTE -

SCALING, SALT, COKE, SILT, ETC., BUILD-UP ARE INDICATORS OF HIGH SKIN TEMPERATURE. STEPS SHOULD BE TAKEN TO MODIFY FIRING [SEE BURNER INSTRUCTIONS]. AFTER THIS HAS BEEN DONE, IT MAY BE INEVITABLE DUE TO THE CHARACTER OF THE CRUDE IN WHICH EVENT THIS WILL DICTATE A MORE FREQUENT FIREBOX MAINTENANCE SCHEDULE.

TROUBLE SHOOTING

ONCE YOU HAVE THOROUGHLY ACQUAINTED YOURSELF WITH THE UNIT AND ITS' ANCILLARY COMPONENTS, TROUBLE SHOOTING WILL GENERALLY BE VERY ROUTINE. FOR THE VESSEL TO OPERATE PROPERLY AND ACCOMPLISH THE PROCESS PURPOSE, THERE ARE A FEW CRITICAL PARAMETERS THAT MUST BE CAREFULLY MAINTAINED AS DENOTED IN THE OPERATION PROCEDURES.

SOME CONCEIVABLE PROBLEMS AND THEIR CAUSES ARE AS FOLLOWS:

LOW WATER LEVEL -

- WATER CONTROL VALVE STUCK OPEN OR LEAKING.
- INTERFACE CONTROLLER MALFUNCTION. A BUILD-UP OF AN EMULSION INTERFACE BETWEEN THE OIL AND WATER PHASES CAN CAUSE THE INTERFACE SENSOR TO MALFUNCTION. THIS INTERFACE CAN BE FLUSHED FROM THE VESSEL BY ALLOWING THE WATER TO RISE UNTIL THE INTERFACE BUILD-UP IS FLUSHED THROUGH THE OIL OUTLET.

- SAND DUMP VALVE OR DRAIN VALVE LEAKING.

LOW OIL LEVEL FORWARD OF THE OIL CONTROL CHAMBER -

- PROBLEMS WITH THE WATER LEVEL CAN ALSO CAUSE THE OIL LEVEL TO LOWER. THE THINGS TO CHECK WOULD BE THE SAME AS APPLY TO A LOW WATER LEVEL.

LOW OIL LEVEL INSIDE OIL CONTROL CHAMBER -

- OIL CONTROL VALVE STUCK OPEN OR LEAKING.
- OIL LEVEL SENSOR MALFUNCTIONING.

CLOSING TREATER -

- WHEN CLOSING UP THE TREATER, RE-INSTALL THE LOADED FLOAT LLC ASSEMBLY WITH EXTREME CARE. DO NOT ALLOW THE ELEMENT TO SWING FREE FROM ITS' CRADLE OR OTHERWISE DAMAGE THE FLOAT ARM OR TORQUE TUBE. DO NOT ATTEMPT TO CHECK PILOT UNTIL THE ELEMENT IS COMPLETELY COVERED WITH FLUID. DOUBLE CHECK THIS CONTROLLER INTERNALLY FOR ANY POSSIBLE DAMAGE DUE TO ROUGH HANDLING WHEN BEING REMOVED OR HANDLED.

TROUBLE SHOOTING - CONCLUDED

PRESSURE DIMINISHING -

- GAS CONTROL VALVE STUCK OPEN OR LEAKING.

NOTE

ANY MANUAL OR CONTROL VALVE LEAKING CAN CAUSE THE VESSEL PRESSURE TO DECREASE. IF NO PROBLEM IS DISCERNED WITH THE GAS CONTROL SYSTEM, THEN A THOROUGH CHECK OF ALL OF THE OTHER VALVES FOR LEAKAGE IS WARRANTED.

TEMPERATURE FLUCTUATIONS -

- A BUILD-UP OF AN INTERFACE EMULSION AROUND THE TEMPERATURE SENSORS CAN CAUSE TEMPERATURE FLUCTUATIONS. THE INTERFACE BUILD-UP MUST THEN BE FLUSHED FROM THE VESSEL.
- THE WATER LEVEL RISING TO THE FIRETUBE LEVEL CAN CAUSE THE TEMPERATURE TO DIMINISH.
- SURGES AND ERRATIC FLOW RATES CAN CAUSE THE TEMPERATURE TO FLUCTUATE.

PRECAUTIONS -

REMEMBER THAT THE FLUIDS INSIDE THE TREATER ARE VERY HOT. DON'T GET BOILED IN OIL! DO NOT DISCONNECT ANYTHING FROM THE VESSEL WITHOUT TAKING THE NECESSARY PRECAUTIONS TO INSURE THAT NO HOT FLUIDS ARE GOING TO SQUIRT ON YOURSELF.

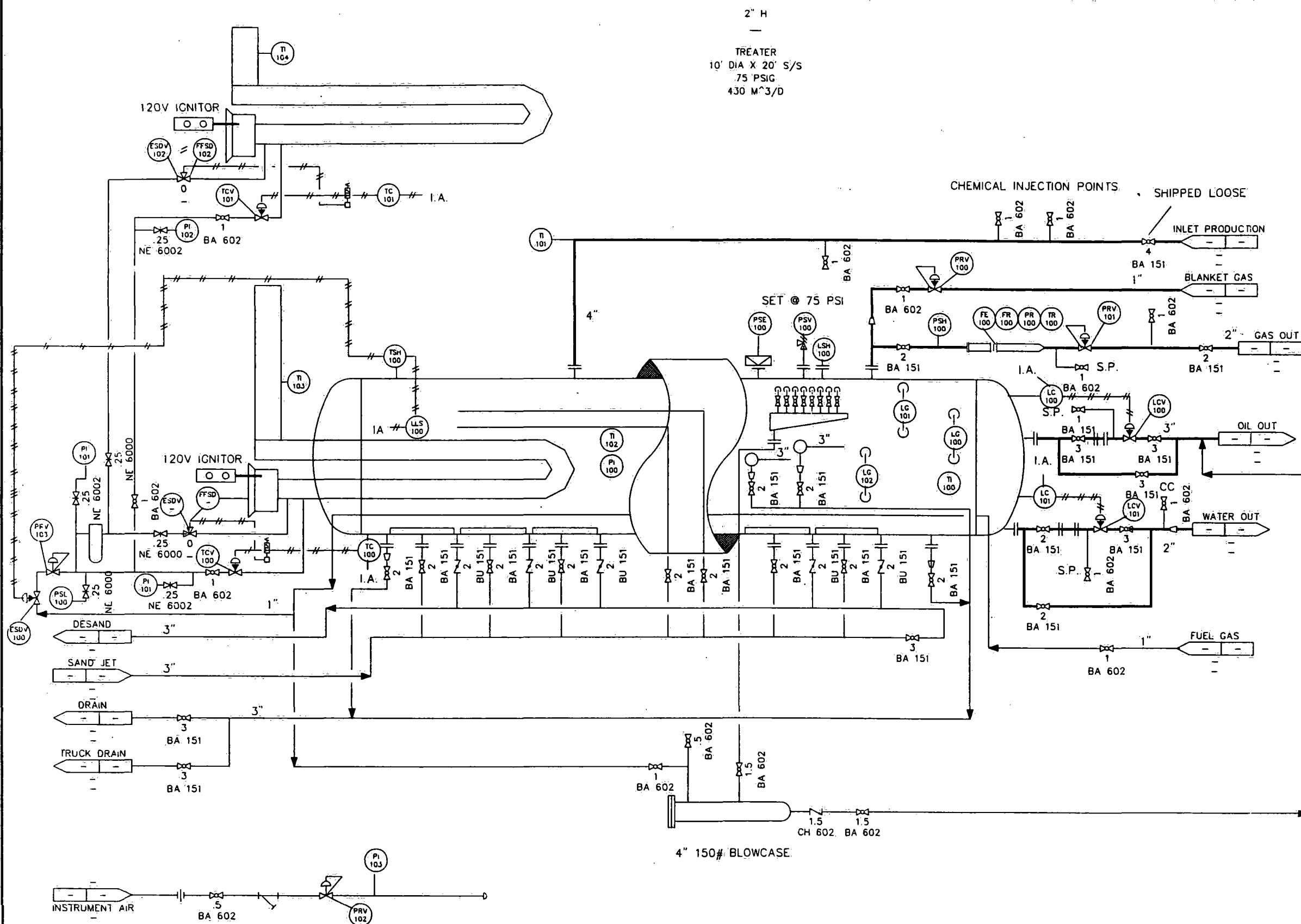
IF OIL HAS BEEN ADMITTED TO THE GAS LINE, BE SURE TO CLEAN THE GAS SYSTEM OF ALL OIL PRIOR TO RESUMING OPERATION.

WHEN MAKING ADJUSTMENTS ON THE UNIT, DO NOT FIDDLE WITH THE KNOBS. ALWAYS ALLOW PLENTY OF TIME FOR THE UNIT TO ATTAIN EQUILIBRIUM. ONCE THE UNIT IS IN EQUILIBRIUM AND OPERATING, DO NOT BE TOO QUICK TO MAKE ANY ADJUSTMENTS DUE TO SLIGHT FLUCTUATIONS.

INTERIOR CLEANING -

- CHECK FOR SAND, SILT, OR SLUDGE BUILD-UP IN BOTTOM OF VESSEL.
[DO NOT USE DETERGENTS IN YOUR CLEANING UNLESS IT IS FOLLOWED BY A METICULOUS WASHING TO REMOVE ALL REMAINING DETERGENT]
- CHECK FOR CORROSION.

Drawings



DWG No.	DWG TITLE
	REFERENCE DWGS

0 07/08	ISSUED FOR APPROVAL
1 08/17	ISSUED FOR CONSTRUCTION

No.	DATE	DESCRIPTION	APP'D.
REVISIONS			

HTI TECHNOLOGY CANADA LTD
SASKOIL

MARSDEN BATTERY
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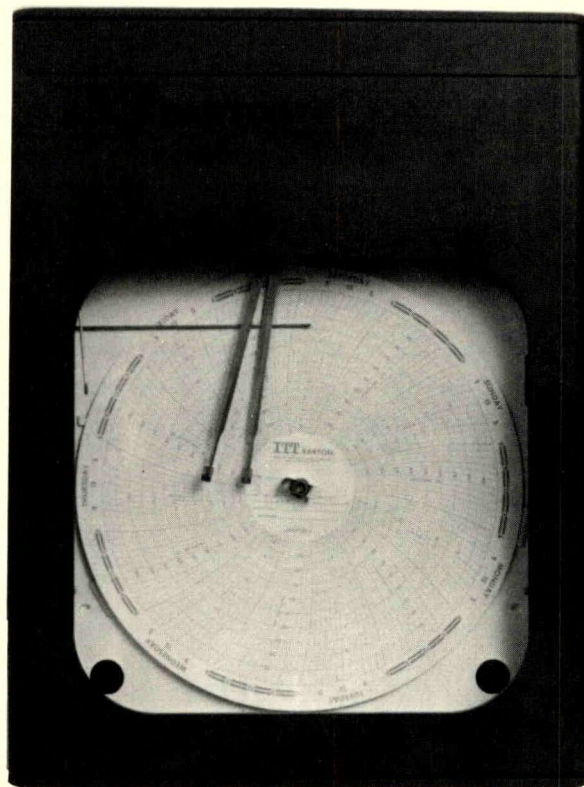
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Installation and Operation Manual

Models 202E & 208E Differential Pressure Recorders



INSTALLATION AND OPERATION MANUAL

MODEL 202E DIFFERENTIAL PRESSURE RECORDER
MODEL 208E DUAL DIFFERENTIAL PRESSURE RECORDER

ITT BARTON INSTRUMENTS
P.O. Box 1882
900 S. Turnbull Canyon Road
City of Industry, CA 91749

WARRANTY

The warranty of the Differential Pressure Unit will be voided if the following limitations are exceeded:

TEMPERATURE: Do not subject the DPU to temperatures above 200°F or below -60°F (35°F minimum for water filled units).

PRESSURE: Do not subject the DPU to operating pressure in excess of the working pressure rating stamped on the housing of the unit.

CORROSION: Do not subject the DPU to incompatible process media.

SEALED COMPONENTS: Do not loosen or remove the torque tube gland nut, the fill plug, or the torque tube housing from the center plate. To do so will cause loss of bellows fill fluid and render the unit inoperable.

VIBRATION: Do not subject the DPU to severe mechanical vibration.

SHOCK: Do not subject the DPU to hydraulic shock.

PULSATION: Do not subject the DPU to severe pulsation.

PRODUCT WARRANTY STATEMENT

The product warranty applicable to this ITT Barton instrument is as stated on the inside back cover of this manual.

Should any after-delivery problems arise, please contact ITT Barton's Consumer Affairs office during normal business hours. (818) 333-4701.

SAFETY

Before installing the instrument, become familiar with the installation instructions presented in Section 3.

DANGER notes apply where personal injury, death, or property damage **will** occur if operating instructions are not strictly followed.

WARNING notes apply where personal injury, death or property damage **could** occur if operating instructions are not strictly followed.

CAUTION notes apply where minor injury or damage could occur when operating instructions are not strictly followed.

DANGER, WARNINGS, and/or CAUTIONS appear on the following pages of this manual and should be reviewed before proceeding: Appendix pages A-2, A-11, A-12, A-20, A-23 and A-27.

RECORD OF CHANGES

CHANGE NO.	DATE	DESCRIPTION	ENTERED BY
410-1(A)	6/77	Completely revised and rewritten. Deleted Model 344 and Appendix 2.	D. Edmiston
79E2	5/79	Completely rewritten and set to new format.	J. Herrick
79E2(A)	6/81	Rewritten and set to new format.	L. Finney
83A5	1/83	Changed Model 202A to 202E. Updated Figures 1-1 & 1-3. Corrected Figure 1-5. Section 5: Revised Paragraphs 5-4 and 5-5. Deleted Paragraph 5-6. Updated Figure 6-1. Updated Parts List.	D. Evans
85B4	2/85	Page ii: Added Product Warranty Statement. Page 3-3: Corrected zero gas check procedure. Page 6-3: Revised parts list.	P. Shepherd
86D1	4/86	Re-classified safety notices. Updated warranty page. Updated 208A to 208E. Incorporated DPU warning and pressure check procedure into Appendix. Updated 202E Parts List.	M. LaGabed

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APPENDIX — Installation and Operation Manual,
Model 199 Differential Pressure Unit

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SECTION 1

INTRODUCTION

1-1. GENERAL

The ITT Barton Model 202E Differential Pressure Recorder (see Figure 1-1) and Model 208E Dual Differential Pressure Recorder (see Figure 1-2) measure and record such system operation parameters as gas and liquid flowrate, liquid level in a vessel, and other system variables that may be measured by the differential pressure and static pressure methods.

1-2. PRODUCT DESCRIPTION

The major components of ITT Barton differential recorders are the Differential Pressure Unit, the recorder mechanism, the static pressure element, and the chart drive (see Figure 1-3).

A. Differential Pressure Unit

The ITT Barton Model 199 Differential Pressure Unit (DPU) actuates the Models 202E and 208E recorders. A single DPU is used with the Model 202E (see Figure 1-1); two DPU's are used with the Model 208E (see Figure 1-2).

The DPU is a dual bellows assembly enclosed within pressure housings. The bellows are liquid-filled and will withstand overranges equal to the working pressure of the instrument housing without causing a calibration change. Movement of the bellows is transmitted through a torque tube from the DPU to the recorder mechanism (see Figure 1-3). The torque tube is hermetically sealed to eliminate friction and leakage; it does not require lubrication. Further information on the Model 199 Differential Pressure Unit is presented in the Appendix.

B. Recording Mechanism

All components of the recording mechanism are housed in a waterproof, weather-resistant case. All operative parts of the recorder mechanism are made of stainless steel for long operating life under tough field conditions. The pen mount is exceptionally rugged. All links are adjustable. Screw adjustments are provided for zero, range, and linearity — assuring fast and accurate calibration. In general, the recording mechanism is a linkage and pen system which converts mechanical inputs from the DPU and the static pressure element to ink lines on a revolving chart to permanently record the data.

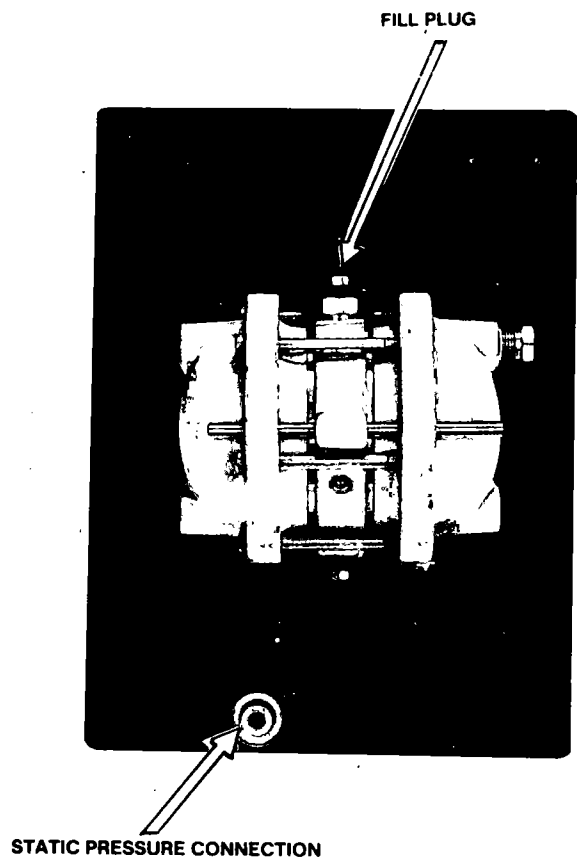
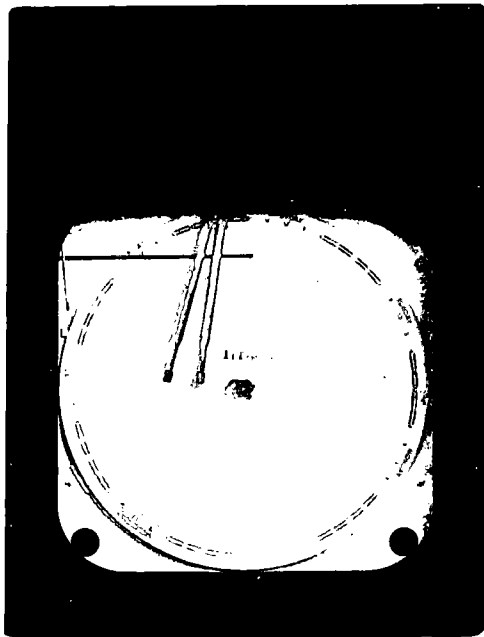


Figure 1-1. Model 202E Differential Pressure Recorder

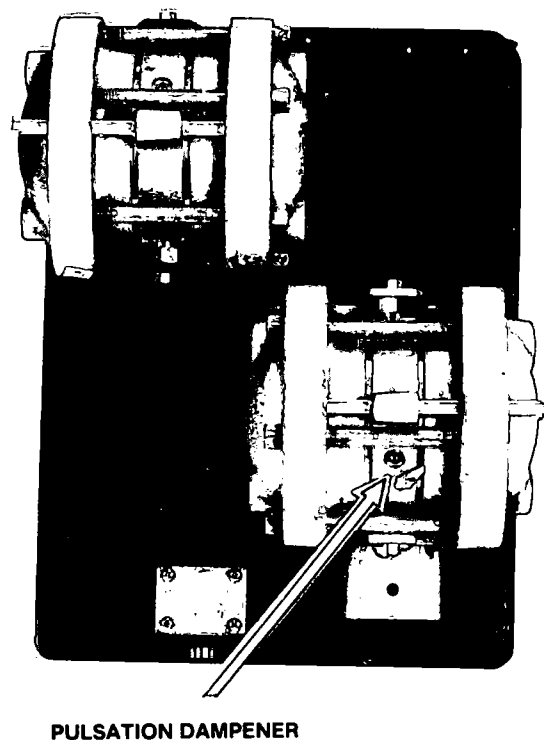
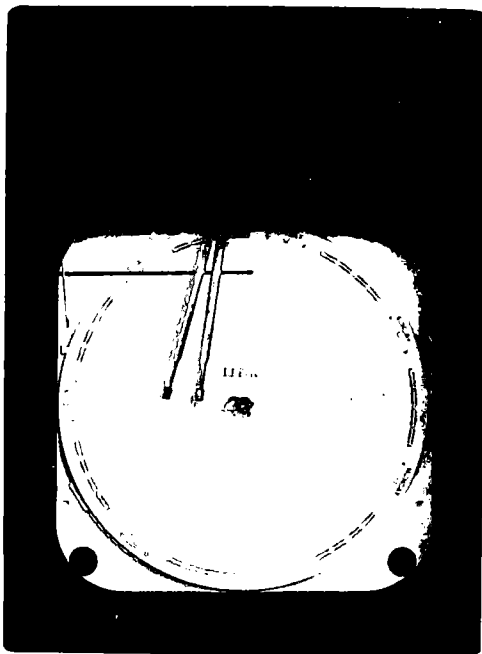


Figure 1-2. Model 208E Dual Differential Pressure Recorder

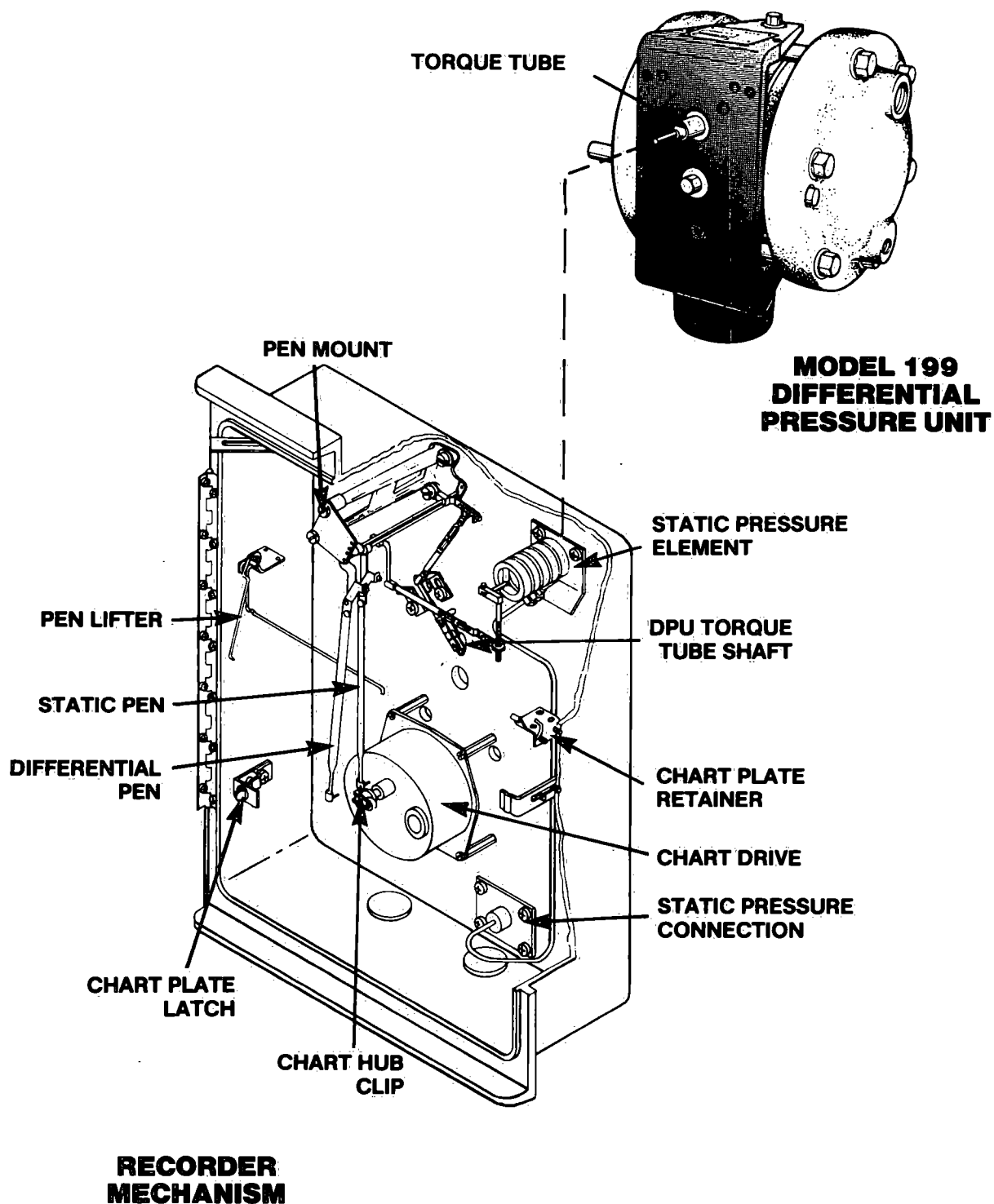


Figure 1-3. Recorder Mechanism and Differential Pressure Unit

C. Static Pressure Element

The static pressure element (see Figure 1-5) will measure the static pressure in a piping system from 0 to 30 inches of Hg (mercury) vacuum or from 0 to 10,000 psi pressure. The sensor element is a bourdon tube consisting of a slightly flattened cross-section of tubing coiled into a helix or flat spiral. The outer end of the tubing is sealed and attached to a drive arm (see Lever Arm Assembly in Figure 1-5). The open end of the tubing at the base is connected to the Tubing Connection (see Figure 1-5) to which the tubing of the Static Pressure Connection (see Figure 1-3) is attached. The Static Pressure Connection, which connects the static pressure element to the system piping, is located on the back of the recorder case (see Figure 1-1 and 1-3). Static pressure introduced through the tubing into the static pressure element will cause the spiral or helix to unwind. Conversely, a reduction of pressure within the tubing will cause the element to wind up more tightly. Sensor elements manufactured from various alloys are available to meet a variety of pressure ranges (refer to Table 1-2).

D. Chart Drive

A variety of chart drives is available. Spring-wound chart drives (electrical or mechanical) may be selected to fit a wide variety of chart speeds or time intervals that can reduce maintenance time (refer to Table 1-3). All chart drives are interchangeable and fitted with a recorder hub clip (Figure 1-4) that features a simple but positive method of locking the chart into place. Explosion-proof electrical chart drives are available.

E. Assembly

The DPU is attached to the back of the recorder case; the torque tube is inserted through the hole in the case and connected to the differential pressure drive arm of the recorder mechanism (see Figure 1-3 and 1-4). The pressure housings of the DPU are connected by pipe or tubing to the high- and low-pressure sides of the primary device located in the process system.

1-3. SPECIFICATIONS

The specifications for the Model 199 Differential Pressure Unit are presented in the Appendix.

The specifications for Models 202E and 208E Differential Pressure Recorders are presented in Tables 1-1, 1-2, and 1-3.

**Table 1-1. General Specifications,
Models 202E and 208E Recorders**

Recorder Case	Die-cast aluminum; black epoxy resin paint; waterproof; weather-resistant.
Performance Range:*	
Differential Pressure:	
From 0-20" w.c. to 0-349" w.c.	±½% of full scale
From 0-350" w.c. to 0-75" psi	±¾% of full scale
Static Pressure	±1% of full scale

* Identical on Models 202E and 208E.

Table 1-2. Static Pressure Elements

Range	Beryllium Copper	316 Stainless Steel	Ni-Span "C"
	Part Number	Part Number	Part Number
0-20 to 0-33 psi	—	—	—
0-34 to 0-65 psi	0044.0028.T	0044.0040.T	0044.0102.T
0-66 to 0-120 psi	—	0044.0035.T	0044.0103.T
0-66 to 0-132 psi	0044.0029.T	—	—
0-121 to 0-180 psi	—	0044.0099.T	0044.0104.T
0-121 to 0-183 psi	—	—	—
0-133 to 0-240 psi	0044.0101.T	—	—
0-181 to 0-272 psi	—	0044.0036.T	0044.0105.T
0-184 to 0-264 psi	—	—	—
0-241 to 0-370 psi	0044.0097.T	—	—
0-265 to 0-390 psi	—	—	—
0-273 to 0-420 psi	—	0044.0044.T	0044.0106.T
0-371 to 0-600 psi	0044.0018.T	—	—
0-391 to 0-600 psi	—	—	—
0-421 to 0-615 psi	—	0044.0041.T	0044.0107.T
0-601 to 0-850 psi	0044.0098.T	—	—
0-616 to 0-850 psi	—	0044.0100.T	0044.0108.T
0-851 to 0-1200 psi	0044.0019.T	0044.0042.T	0044.0109.T
0-1201 to 0-1870 psi	0044.0020.T	0044.0046.T	0044.0110.T
0-1871 to 0-3100 psi	0044.0022.T	0044.0048.T	0044.0111.T
0-3101 to 0-4800 psi	0044.0024.T	0044.0050.T	0044.0112.T
0-4801 to 0-6800 psi	—	0044.0054.T	—
0-4801 to 0-7200 psi	0044.0026.T	—	0044.0113.T

Table 1-3. Chart Drives

Rotation	Spring Wound		Electric * 110V, 60 Cycle
	Lux Wind	Macnick (8-Day Wind)	
	Part Number	Part Number	Part Number
96-Minute	—	—	0043.0001.T
2 Hour	0042.0022.T	—	—
3 Hour	0042.0023.T	—	—
4 Hour	0042.0024.T	Consult Factory	—
6 Hour	0042.0025.T	—	—
8 Hour	0042.0026.T	—	0043.0006.T
12 Hour	0042.0027.T	—	0043.0002.T
24 Hour	0042.0015.T	0042.0001.T	0043.0003.T
72 Hour	—	—	0043.0008.T
7 Day	0042.0016.T	Consult Factory	0043.0004.T
8 Day	0042.0030.T	Consult Factory	—
30 Day	—	—	0043.0011.T
24 Hour-96 Minute	0042.0020.T	—	—
24 Hour-7 Day	0042.0017.T	—	—
24 Hour-8 Day	0042.0031.T	—	—

* All Electric Drive Rotation can be increased 60 times by the use of a 60 RPM motor.

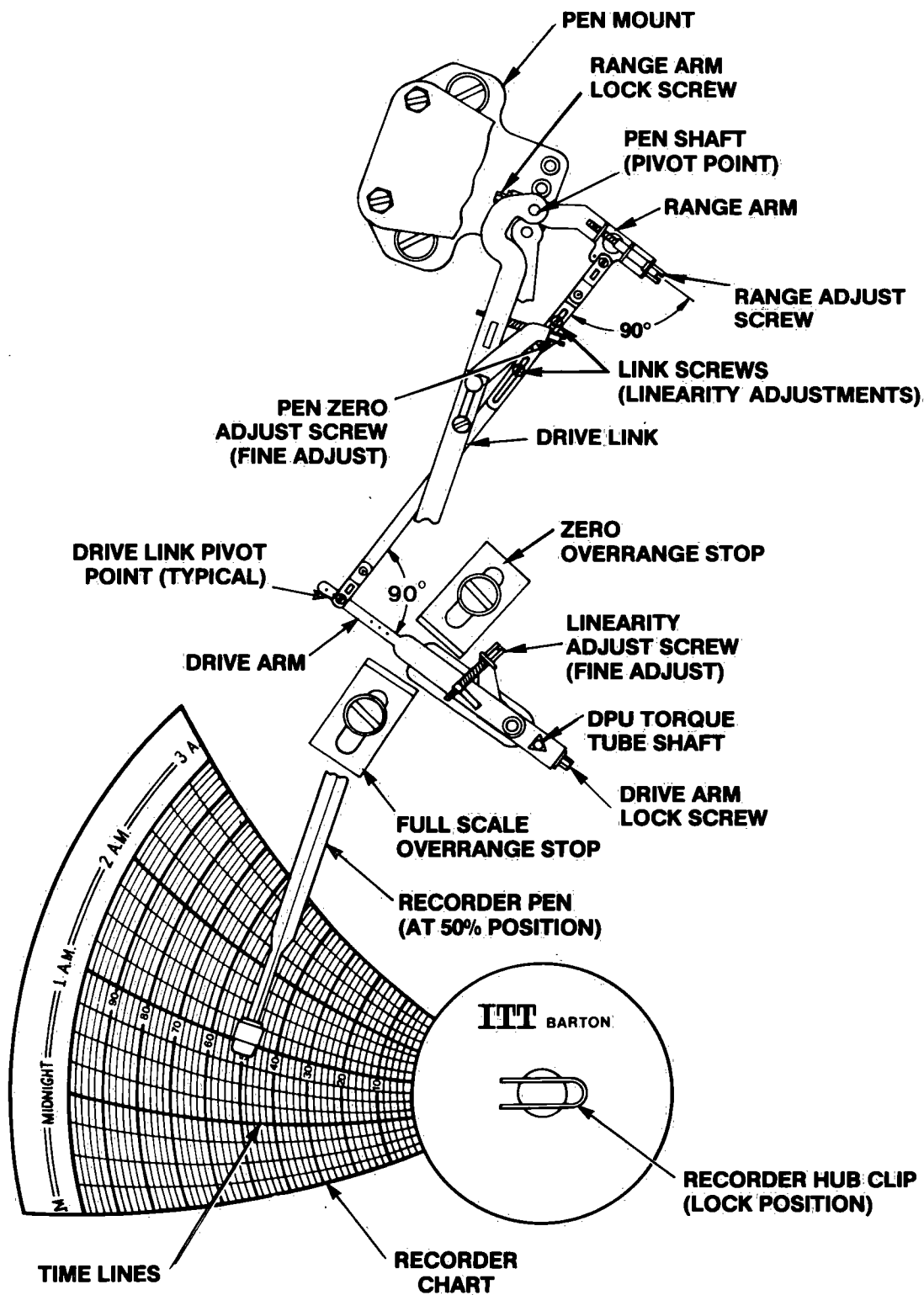


Figure 1-4. Differential Pressure Pen Linkage

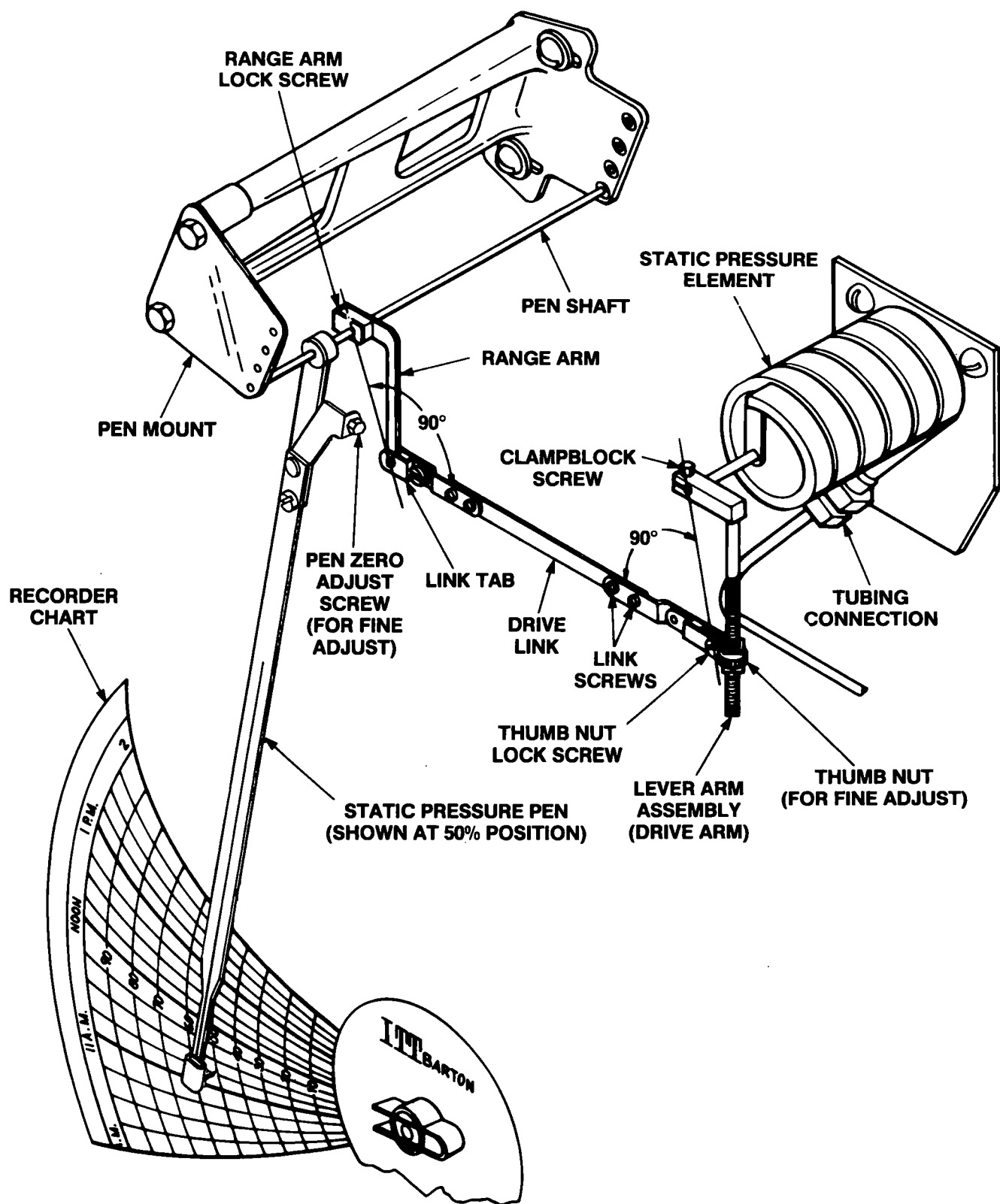


Figure 1-5. Static Pressure Pen Linkage

SECTION 2

THEORY OF OPERATION

2-1. INTRODUCTION

The ITT Barton recorder is essentially a linkage and pen system which converts mechanical inputs from the differential pressure unit and the static pressure element to a visual display on a recorder chart. The chart recording indicates specific parameters of system operation, such as flow rate through the system or liquid level in a tank.

2-2. COMPONENT FUNCTIONS

A. Differential Pressure Unit

The DPU is the actuating device which converts changes in differential pressure to mechanical motion. The theory of operation of the DPU is presented in the Appendix.

Changes in differential pressure actuate the torque tube shaft of the DPU. Rotation of the torque tube shaft moves the differential pressure drive arm (see Figure 1-4) of the recorder mechanism. Movement of the drive arm is transmitted through the differential pressure linkage to the pen shaft, which controls the movement of the recorder pen. The pen transcribes the movement onto a rotating chart to permanently record changes in differential pressure in the process system.

B. Static Pressure Element

Changes in static pressure in the piping system causes the static pressure element to expand or contract. This motion is transmitted through the lever arm assembly and its intermediate linkage (see Figure 1-5) to the pen shaft, which controls the movement of the recorder pen. The pen transcribes the motion onto a rotating chart to permanently record changes in static pressure in the process system.

C. Chart Drives

The chart drive mechanism (see Figure 1-3) turns the chart at a selected speed to obtain the recorded information. The chart drive may be either an electrical or mechanical spring-wound-type motor (refer to Table 1-3).

SECTION 3

INSTALLATION

3-1. UNPACKING

All ITT Barton instruments are tested and inspected during manufacture and prior to shipping. However, an inspection should be performed at the time of unpacking to detect any damage that may have occurred during shipment.

For applications in critical media that require special cleaning processes and precautions, a polyethylene bag is used to protect the instrument from contaminants. This protective bag should be removed only under conditions of extreme cleanliness.

The following items are included in each container:

- Model 202E or 208E Differential Pressure Recorder
- Installation and Operation Manual
- Accessories per customer order
- Mounting accessories
- 100 recording charts
- Ink set.

3-2. MOUNTING

NOTE

Prior to installation, a calibration check should be performed on the recorder. The calibration check procedure is presented in Paragraph 5-1.

NOTICE

DO NOT LOCATE THE INSTRUMENT NEAR
VENTS OR BLEED HOLES THAT DISCHARGE
CORROSIVE VAPORS OR GASES.

NOTE

The instrument must be mounted approximately level for proper operation (see appropriate outline dimension drawing, Section 7).

The recorder may be flush mounted or pipe mounted, as follows:

A. Flush Mounting

1. Cut a hole in panel as shown in the applicable outline dimension drawing.

2. Drill prespotted holes in top and bottom of recorder case using a No. 1 (0.228-inch) drill. Limit drill penetration; remove chips when finished.
3. Attach the flush mounting brackets to bottom of case, using self-threading screws included with instrument.
4. Slide case (from the front of panel) into panel cutout.
5. Attach remaining flush mounting bracket and install panel mounting screws.

B. Pipe Mounting

1. Place a suitable length of 2-inch, threaded pipe into a well-secured floor or wall flange; or attach the 2-inch threaded pipe to existing pipe with a pipe saddle fitted with a 2-inch NPT outlet.
2. Thread the DPU onto the pipe and orient the instrument with a wrench or bar applied to the DPU bracket.

NOTICE

DO NOT APPLY WRENCH OR BAR PRESSURE TO THE DPU BODY OR RECORDER CASE.

3-3. DPU AND STATIC PRESSURE ELEMENT INSTALLATION

A. Differential Pressure Unit

Connect the DPU into the system in accordance with the piping diagrams presented in the Appendix.

B. Static Pressure Element

The static pressure element should be connected into the system piping as shown in the applicable piping diagrams presented in the Appendix. The Static Pressure Connection located at the back of the recorder case (see Figures 1-2 and 1-3) will facilitate connection of the tubing.

NOTE

All fitting must be leak-tight. All tubing must be secure to minimize vibration.

3-4. ELECTRICAL CONNECTIONS

Two knockouts are located on the bottom of the recorder case and one knockout is located on the back of the recorder case to accommodate conduit clamping connectors, through which the electrical wiring can be fed to the terminal strip. The terminal strip is located beneath the chart drive motor on the same mounting plate. The standard electrical power supply requirement is 110 VAC, 60 Hz (50 Hz wiring is available upon request).

3-5. PRELIMINARY ZERO CHECK

Perform a zero check at the time of installation, and prior to operation, to ensure that the instrument will perform to the original factory calibration and accuracy requirements.

NOTICE

DO NOT PERFORM A ZERO CHECK WITH ONLY ONE BLOCK VALVE CLOSED. IF SEAL POTS ARE USED, SOME OF THE SEALING FLUID WILL BE LOST OR DISPLACED. IN GAS SERVICE, A STANDARD WAVE EFFECT MAY OCCUR WHICH WILL DISPLACE THE ZERO READING OF THE INSTRUMENT.

A. Zero Check — Gas Service

1. Verify that the instrument is mounted approximately level.
2. Tighten process connections to each DPU housing, and check the manifold and piping for leaks in accordance with the procedure outlined in Paragraph 3-6.
3. Close shut-off valves and open equalizer valve.
4. Pressurize system, slowly opening high-pressure shut-off valve.
5. Close shut-off valve when system is pressurized.
6. Observe pen position; it should indicate zero. If pen does not indicate zero, check for solids, gas, or liquid entrapment in the lines and DPU body. If no entrapment is found, set pen to zero indication, using the pen zero adjust screw.
7. Close equalizer valve and observe pen.
 - a. If pen indicates zero, no further check is required.
 - b. If pen indicates upscale, a leak may exist on the low-pressure side. Check and tighten connections.
 - c. If pen indicates downscale, a leak may exist on the high-pressure side. Check and tighten connections.
 - d. If pen is still slightly off, make fine adjustment using pen zero adjust screw.

B. Zero Check — Liquid Service

1. Fill the service lines with process fluid; vent and bleed each side of the DPU before tightening vent plugs.
2. Perform steps 1 through 7 of Paragraph A above.

NOTE

Usually, upon completion of zero check, any deviation from zero will indicate the presence of gas in a liquid service.

3. Open shut-off valve and leave equalizer valve closed; the instrument is now operational.

3-6. MANIFOLD AND PIPING CHECK

To check the integrity of the manifold and piping connections, proceed as follows:

1. Verify that the instrument is properly connected to the pressure source.
2. Open the equalizer or bypass valve(s) and one shut-off valve to pressurize the instrument.
3. Close both valves opened in step 2 above.
4. Observe pen for any movement. Pen movement indicates leakage in the manifold or instrument piping.
5. If pen movement occurs, check all manifold and instrument piping joints and tighten where necessary.
6. Repeat steps 1 through 5 until no pen movement occurs.

SECTION 4

OPERATION

4-1. STARTUP

Piping diagrams for flow and liquid level applications are presented in the Appendix. A brief startup procedure for each application is included with the piping diagram. When starting up an instrument, observe the following practices:

1. Close block valves.
2. Perform a zero check in accordance with the procedure outlined in Paragraph 3-5.
3. Check the manifold and piping for leaks in accordance with the procedure outlined in Paragraph 3-6.

NOTE

Exercise care during startup to avoid unnecessary shock or overrange of the instrument.

Avoid severe pulsative flows such as those produced by reciprocating pumps or compressors.

4. Adjust dampener valve as required.

SECTION 5

MAINTENANCE AND CALIBRATION

5-1. CALIBRATION CHECK

A. Differential Pressure Pen

Normally, all that is required to adjust the instrument to factory-set calibration levels is to perform the following calibration check procedure:

1. Verify that the instrument is positioned approximately level and is securely mounted.
2. Connect the high-pressure housing into the calibration setup shown in Figure 5-1.
3. Vent the DPU low-pressure side to the atmosphere by removing one vent plug from the low-pressure housing.
4. Remove dust cap of the pulsation dampener valve (see Figure 1-1), using a regular screwdriver; then, open the dampener valve by turning it fully counterclockwise until it stops turning, using a $\frac{1}{8}$ -inch Allen wrench.
5. Place a recording chart onto the chart plate of the recorder; lock the chart into position with the recorder hub clip (see Figure 1-4).

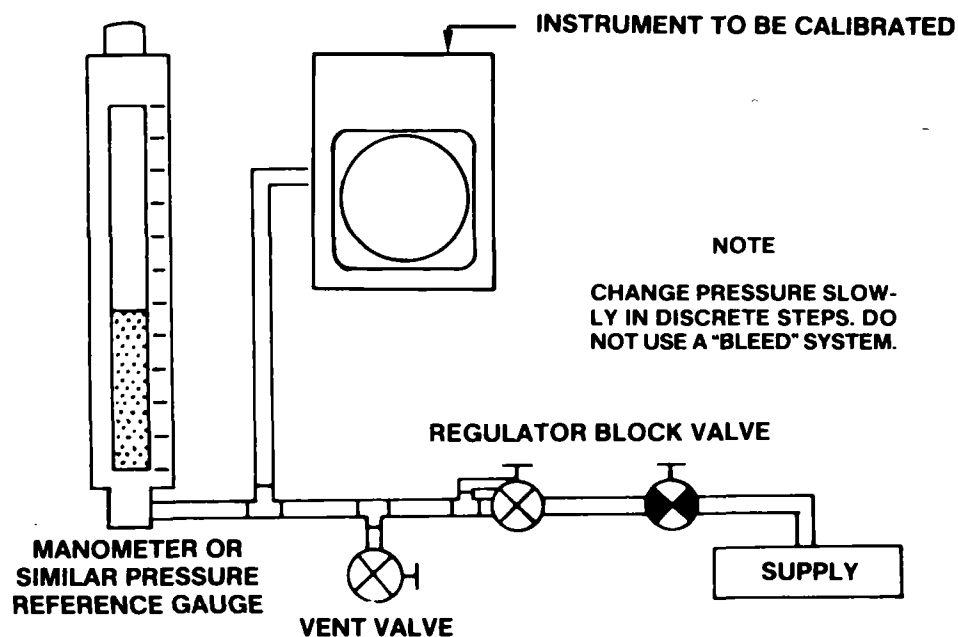
NOTE

There should be enough pen pressure on the chart to produce a continuous line. Also, the pen should spring free of the chart when the chart is pushed inward about $\frac{1}{8}$ -inch. If necessary, adjust pen pressure by bending pen arm in the required direction.

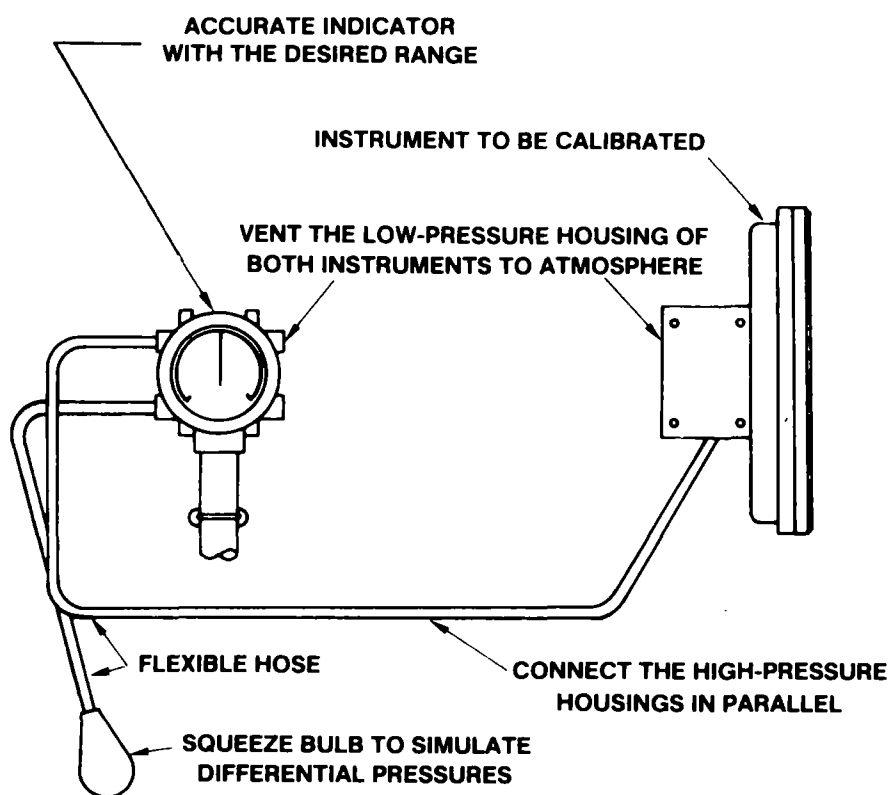
6. Set pen precisely at zero indication using pen zero adjust screw (see Figure 1-4).
7. Apply 100 percent pressure and observe position of the pen; the pen should be at the 100 percent indicating position on the chart.
8. Apply 50 percent pressure and observe position of the pen; pen should be at the 50 percent indicating position on the chart.
9. If pen does not accurately indicate pressure being applied, further adjustments are necessary. Perform calibration procedure outlined in Paragraph 5-3.

B. Static Pressure Pen

If instrument features a static pressure element, proceed as follows:



TYPICAL CALIBRATION SETUP



PORTABLE CALIBRATION SETUP

Figure 5-1. Differential Pressure Calibration Setup

1. Connect static pressure element (see Figure 1-5) into the calibration setup shown in Figure 5-2.
2. Release pressure and set pen at zero indicating position using the pen zero adjust screw (see Figure 1-5).
3. Apply 100 percent pressure and observe position of pen; pen should be at the 100 percent indicating position on the chart.
4. Apply 50 percent pressure and observe position of pen; pen should be at the 50 percent indicating position on the chart.
5. If pen does not accurately indicate pressure being applied, further adjustments are necessary; perform calibration procedure outline in either Paragraph 5-4 or 5-5, as applicable.

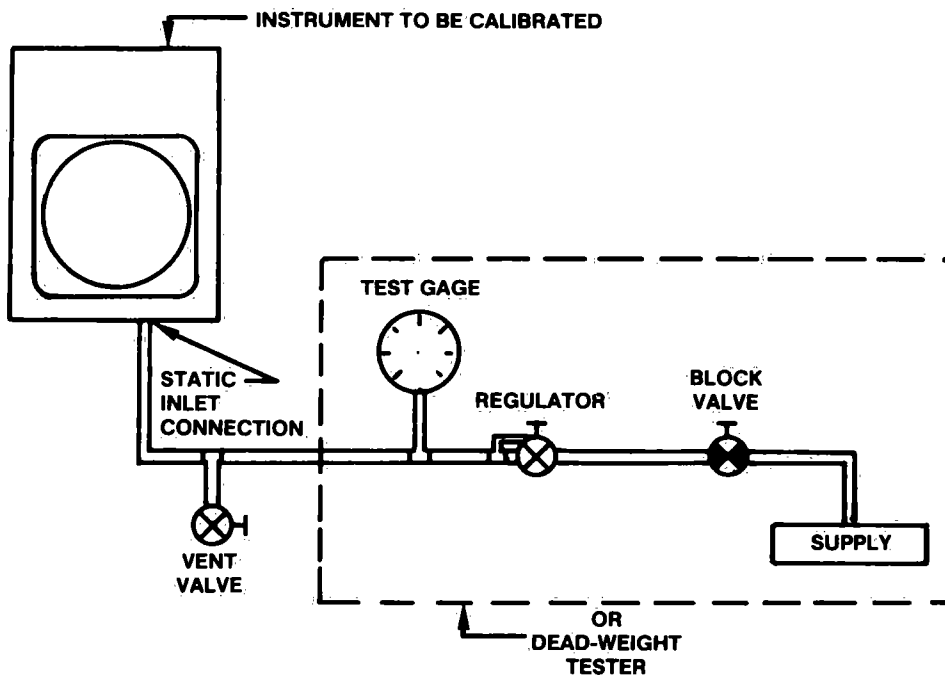


Figure 5-2. Static Pressure Calibration Setup

5-2. CALIBRATION OF DIFFERENTIAL PRESSURE UNIT

The calibration procedure for the Model 199 Differential Pressure Unit is presented in the Appendix.

5-3. CALIBRATION OF DIFFERENTIAL PRESSURE PEN

To calibrate the differential pressure pen and associated linkage, proceed as follows:

1. Verify that chart plate is on the same plane and is flush with the flange on the hub. The chart must be flat with the hub locked.

Verify that pens and pen arms are connected correctly and that pens don't interface with one another (see Figure 1-5).

NOTE

Linkage may be disconnected to perform this step manually.

2. With a recorder chart locked into place, move the differential pressure pen from zero to full span and back to make certain that the pen travels along the time line of the chart. If adjustment is required, loosen the two pen mount screws and adjust pen mount position until the differential pressure pen follows the time line. Tighten pen mount screws.
3. Disconnect differential pressure drive link from range arm. Move both the differential and static pressure pens out to full span. Adjust the static pen so that pens are approximately 7-15 minutes apart by adjusting the static pen arm mounting location on the pen arm shaft assembly. Move both pens to the 50% indicating position on the chart and make sure that there is sufficient clearance between the pens to prevent any interference with one another. Adjust static pens as necessary; do not alter the differential pressure pen once it has been adjusted to the time line.
4. Make sure that there is enough pen pressure against the chart to produce a continuous line. If necessary, adjust pen pressure by bending the arm in the required direction.

NOTE

The pen should spring free of the chart when the chart is pushed inward about $\frac{1}{8}$ -inch.

5. Unlock the recorder hub clip and remove chart and chart plate.
6. Mount a calibration chart onto the recorder hub. Lock the chart in place and move overrange stops out of play. The calibration chart should be prepared beforehand by cutting a chart into the wedge shape shown in Figure 1-4 and gluing it to a piece of similarly shaped cardboard or stiffener. This special chart will allow calibration of the pens while permitting access to the recorder mechanism when linkage adjustments are necessary.

NOTICE

VERIFY THAT ALL LINKAGE IS FREE. ADJUST RANGE ARM AND DRIVE ARM AT PRECISELY THE SAME DISTANCE FROM BACK OF THE CASE. SET THE RANGE ADJUST, PEN ZERO, AND LINEARITY ADJUST SCREWS TO THEIR MIDPOINT. ALL 90° MIDSCALE LINKAGE ANGLES MUST BE MEASURED.

7. Apply 50% differential pressure to the high-pressure side and arrange the differential pressure linkage as shown in Figure 1-4. Set a 90° angle between the drive arm and link, then by varying the length of the link, set a 90° angle between the range arm and link. Slip the range arm to 50% on the chart.
8. Remove pressure and observe the pen. The pen should indicate zero. If the pen deviates less than 10% from zero in either direction, perform fine adjustment by using the pen zero adjust screw (see Figure 1-4) and then proceed to step 8.b. If the pen deviates more than 10% from zero, make adjustments as follows in step 8.a.:
 - a. Rotate pen arm and shaft by gripping the range arm and forcing (or slipping) the pen until it indicates zero. The pen arm and shaft should rotate at the range arm pivot point without loosening the range arm lock screw.
 - b. Apply 100% pressure and observe the pen. Make the necessary adjustment by turning the range arm adjust screw counterclockwise if pen is slightly underranged and clockwise if the pen is slightly overranged. Repeat zero and 100% adjustments until calibration at these two points is achieved.
 - c. Apply 50% pressure and observe pen.
 1. The pen should be on the 50% chart line.
 2. If the pen is low, lengthen the linkage to make a correction forty times as great in the low direction. Adjust the pen to 50% as in step 8.a. (see Figure 1-4).
 3. If the pen is high, shorten the linkage to make a correction forty times as great in the high direction. Adjust the pen to 50% as in step 8.a. Make sure all linkage screws are retightened.
9. Repeat step 8 until calibration of all three points (0, 50, and 100% indication) is achieved. To assure the accuracy of the unit a nine point calibration check (1, 24, 50, 74, and 100% ascending and descending) must be run.

NOTE

Calibration checks at 24% and 74% are recommended so that chart lines are utilized for reading accuracy.

10. Model 208E Recorder only: Perform steps 1 through 9 above on the remaining differential pressure pen.
11. Adjust overrange stops for 5% overtravel.
 - a. Loosen the screws on the zero and full scale overrange stops (see Figure 1-4).
 - b. With the low-pressure side vented to atmosphere, apply 105% differential full scale pressure to the high-pressure side, and position the high-pressure stop to contact drive arm. Tighten the screw.
 - c. With the high-pressure side vented to atmosphere, apply 5% differential full scale pressure to the low-pressure side. Position low-pressure stop to contact drive arm and tighten the screw. Disconnect pressure.

NOTE

On all units the drive arm must contact the stops to prevent recording pens from going off the recorder chart.

12. Unlock the recorder hub clip and remove the temporary calibration chart.
13. Replace chart plate by sliding it into the chart plate retainer brackets and engaging each side into the chart plate latches (see Figure 1-3).
14. Install a 24-hour recorder chart and engage chart hub clip into the lock position as shown in Figure 1-4.
15. Check pens to make sure they have correct pen pressure (see step 4); if necessary, straighten the pens by sliding them between two fingers and curling them in or out.

5-4. CALIBRATION OF STATIC PRESSURE PEN

To calibrate the static pressure pen and associated linkage, proceed as follows:

1. Adjust the static range arm and drive arm at precisely the same distance from the back of the case.
2. Place static drive link in the fourth hole from the pen shaft of the range arm.
3. Adjust static pressure linkage to form ninety degree angles between the drive link (see Figure 1-5) and the pivot points of the associated linkage, as follows:
 - a. Apply 50% static pressure, center the thumb nut on the drive arm, and arrange static linkage as shown in Figure 1-5.
 - b. Set a 90° angle between the drive arm and link. Tighten clamp block screw.
 - c. Vary the length of the link to obtain a 90° angle between range arm and link.
 - d. Slip the range arm on pen shaft to 50% on chart.

NOTICE

VERIFY THAT ALL LINKAGE IS FREE. ADJUST RANGE ARM AND DRIVE ARM AT PRECISELY THE SAME DISTANCE FROM BACK OF THE CASE. ADJUST THE LEVER ARM AND PEN ZERO ADJUST SCREWS TO THEIR MIDPOINTS. ALL 90° MIDSCALE LINKAGE ANGLES MUST BE MEASURED.

4. Release pressure and reset the pen to zero indication, using pen zero adjust screw for fine adjustment (10% or less). For major adjustments (more than 10%), loosen range arm lock screw and slip the pen to zero on chart and retighten lock screw.

NOTE

It may be necessary to raise or lower the pivot point of the drive link on the range arm as in step 3. If counterclockwise movement of thumb nut (step 5) does not increase span sufficiently, move the pivot pin up to next pivot hole; if clockwise movement of the thumb nut does not decrease span sufficiently, move pivot pin down to the next pivot hole.

5. Apply 100% pressure and observe the pen. Make the necessary adjustments by turning the drive arm thumb nut counterclockwise if the pen is slightly underranged and clockwise if the pen is slightly overranged. Repeat zero and 100% adjustment until calibration at these two points is achieved.
6. Repeat steps 3, 4, and 5 until full scale calibration is obtained.
7. Apply 50% pressure and observe pen indication.
 - a. If pen indication is low, shorten drive link an amount equal to approximately forty times the distance of the error reading.
 - b. Reset the pen to the 50% line by slipping the pen shaft at the range arm pivot point.
 - c. If pen indication is high, lengthen the drive link an amount equal to approximately forty times the distance of the error reading.
 - d. Perform step 7.b. above.
8. Release pressure and reset the pen to zero indication, using pen zero adjust screw for precise adjustment.
9. Repeat steps 4 through 8 until calibration of zero, linearity, and span (0%, 50%, and 100% indication) is achieved.
10. Make sure that range arm lock screws, thumb nut lock screw, and link screws are tight.
11. Reconnect differential pressure link and range arm.

12. Unlock the recorder hub clip and remove temporary calibration chart.
13. Replace the chart plate by sliding it into the chart plate retainer brackets and engaging each side into the chart plate latches (see Figure 1-3).

5-5. MAINTENANCE

Generally, ITT Barton recorders require no maintenance other than replacement of the chart, replenishment of the ink, the winding of spring-wound chart drives, and occasional calibration.

A. Differential Pressure Unit

The procedures for inspecting and cleaning, changing the range, and replacing the bellows unit assembly for the ITT Barton Model 199 DPU are presented in the Appendix.

B. Static Pressure Element Replacement

If the static pressure element needs replacement, proceed as follows:

1. Close all valves and turn off the power switch to the recorder.
2. Separate the drive link from the drive arm by opening the link tab and disengaging the pivot pin from the clamp.
3. Loosen the clamp block screw on the lever arm assembly and separate the drive arm from the static pressure element shaft.
4. Disconnect the tubing from the static pressure element at the tubing connection (see Figure 1-5).
5. Remove the mounting screws from the static pressure element and discard the damaged element.
6. Install the new element, using the old mounting screws.
7. Connect tubing to the element at the tubing connection.
8. Assemble the lever arm assembly onto the static pressure element shaft; do not tighten the clamp block screw yet.
9. Connect the drive link to the drive arm by engaging the pivot pin and locking the link tab into place.
10. Align the static pressure linkage (range arm, drive link, and drive arm) so that it lies in the same plane without binding or bending.
11. Tighten clamp block screw.
12. Calibrate in accordance with the procedure outlined in Paragraph 5-4, Calibration of Static Pressure Pen.

5-6. LINKAGE ADJUSTMENTS

A. Range Arm and Drive Arm Lock Screws

Tightening these lock screws "finger-tight" is often not tight enough; and tightening them more than a full turn will often break them. Therefore, the correct procedure is as follows:

1. Tighten the lock screw until "snug."
2. Hold drive arm (see Figure 5-3) at the clamp block by hand or with a $\frac{1}{4}$ -inch open end wrench. If a wrench is used, place it between the torque tube shaft and the lock screw, taking care not to damage the torque tube shaft or bearing. (In the case of the range arm lock screw, place the wrench between the pen shaft and lock screw.)
3. Tighten the lock screw $\frac{1}{3}$ to $\frac{1}{2}$ turn beyond "snug."
4. Test for tightness by moving the free end of drive arm approximately $\frac{1}{2}$ -inch in either direction. The drive arm should spring back with no yielding.

B. Overrange Stops Adjustment

Overrange stops (see Figure 1-4) may be adjusted to prevent the pen from excessive overtravel. Check for interference at zero and full span and set overrange stops as follows:

1. Unlock the recorder hub clip and remove recorder chart.
2. Remove the chart plate by disengaging the chart plate latches (see Figure 1-3) on both sides and sliding the chart plate from the chart plate retainer brackets (see Figure 1-3).
3. Mount a calibration chart onto the recorder hub and lock in place.

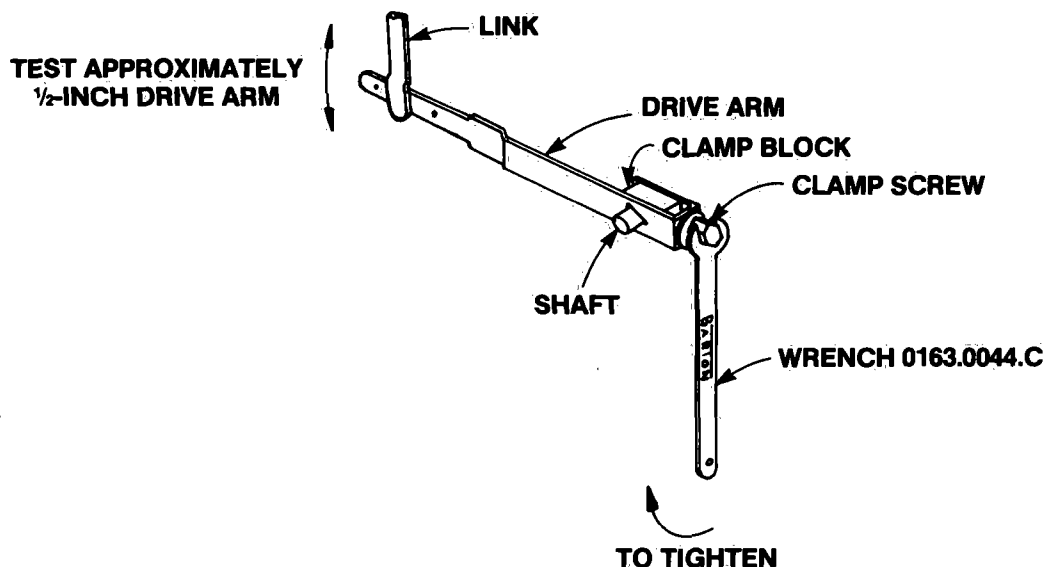


Figure 5-3. Tightening Lock Screws

NOTE

Calibration chart should be prepared beforehand by cutting a regular chart into the wedge shape shown in Figure 1-4 and gluing it to a piece of similarly shaped cardboard or stiffener.

This special chart will permit access to the recorder mechanism when linkage adjustments are necessary.

4. Loosen the screws on zero and full scale overrange stops (see Figure 1-4).
5. Vent the DPU low-pressure housing and apply sufficient pressure to the high-pressure housing to move the pen approximately $\frac{3}{8}$ -inch above full scale (100 percent indication) on chart.
6. Position the zero overrange stop (see Figure 1-4) so that it is in contact with the drive arm.
7. Tighten the zero scale overrange stop screw.
8. Apply sufficient pressure to the DPU low-pressure housing to move the pen approximately $\frac{3}{8}$ -inch below zero indication on the chart.
9. Position the full scale overrange stop (see Figure 1-4) so that it is in contact with the drive arm.
10. Tighten the full scale overrange stop screw.
11. Unlock the recorder hub clip and remove the temporary calibration chart.
12. Replace the chart plate by sliding it into the chart plate retainer brackets and engaging each side into the chart plate latches (see Figure 1-3).
13. Install a regular recorder chart and engage the chart hub clip into lock position as shown in Figure 1-4.
14. Check the pens to make sure they touch the chart; if necessary, straighten the pens by sliding them between two fingers and curling in and out.

5-7. TROUBLESHOOTING

Troubleshooting and repair procedures for the Model 199 Differential Pressure Unit are presented in the Appendix.

If recorder operation difficulties are encountered, refer to Table 5-1, Troubleshooting Chart, for corrective action.

Table 5-1. Troubleshooting Chart

Problem	Possible Source	Possible Cause	Corrective Action
Low or No Indication	Recorder Mechanism	Loose linkage or movement.	Repair or replace as required.
		Out of calibration.	Calibrate per Paragraph 5-3 or 5-4.
		Corroded or dirty mechanism.	Clean or replace.
		Loose pen arm.	Tighten pen arm screw.
High Indication	Recorder Mechanism	Loose linkage or movement.	Repair or replace as required.
		Out of calibration.	Calibrate per Paragraph 5-3 or 5-4.
Erratic Indication	Recorder Mechanism	Dirty or dragging linkage.	Clean or adjust as required.
		Excessive pen-to-chart pressure.	Adjust pen pressure.

SECTION 6

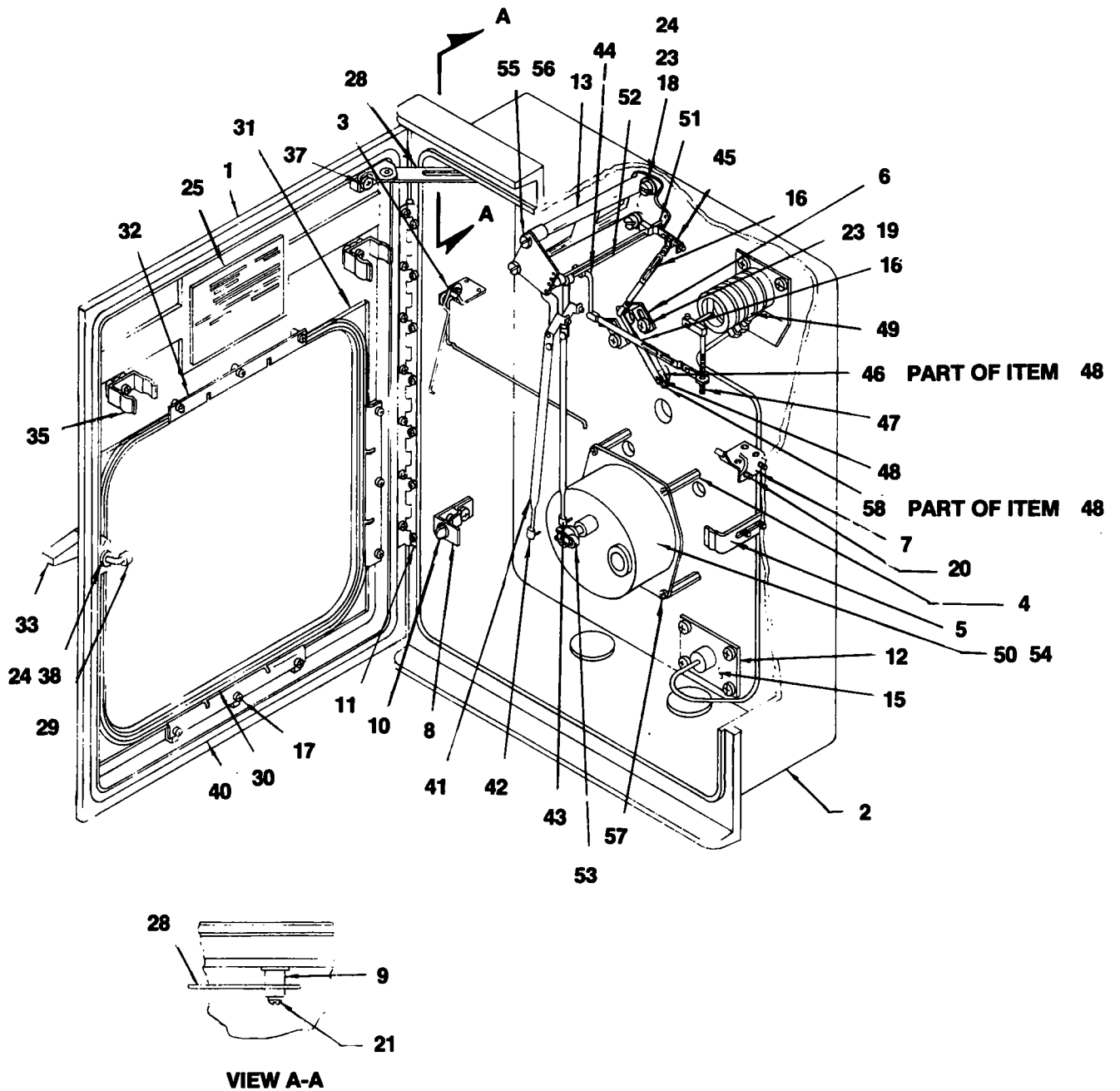
PARTS LIST

6-1. GENERAL

The parts list and its associated illustration for the Model 199 Differential Pressure Unit are presented in the Appendix.

The parts list for the Model 202E is presented in Table 6-1. The components listed in the parts list for the Model 202E are illustrated in Figure 6-1, and each part is identified with a corresponding item number.

The parts list for the Model 208E is presented in Table 6-2. The component parts for the Model 208E are illustrated in Figure 6-1.



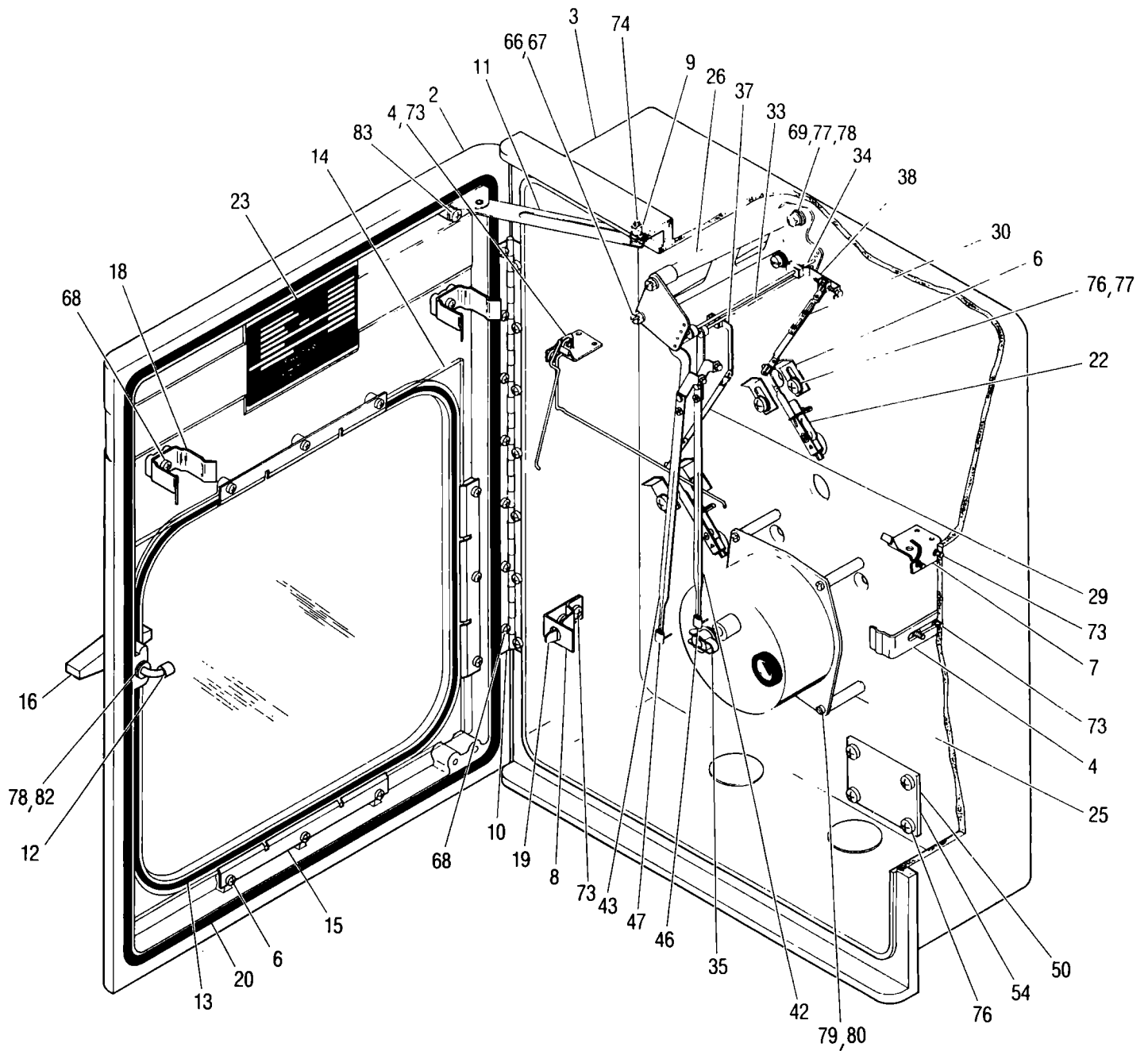
**Figure 6-1. Model 202E Differential Pressure Recorder
Parts Identification**

**Table 6-1. Parts List,
Model 202E Differential Pressure Recorder**

Item	Description	Part No.	Per Unit
1	Door Assembly, Recorder	0238.1023.B	1
2	Case, Recorder	0238.1022.C	1
3	Pen Lifter Assembly	0238.0063.B	1
4	Riser, Chart Drive	0238.0007.C	3
5	Door Latch	0238.0071.C	1
6	Overrange Stop	0238.0082.C	2
7	Bracket, Chart Plate — Right	0238.0110.C	1
8	Bracket, Chart Plate — Lower	0238.0111.C	2
9	Bushing, Door Stop	0238.1018.C	1
10	Clip, Chart Plate Bracket	0238.0119.C	2
11	Hinge, Door	0238.1034.C	1
12	Gasket, Cover Plate Connection	0238.0019.C	1
13	Pen Mount Assembly, Dual	0238.0014.B	1
14	Pen Mount Assembly, Single (Not Shown)	0238.0013.B	1
15	Static Pressure Connection Assembly	0238.1023.B	1
16	Link Assembly	0238.0015.B	2
17	Screw, Rd. Hd., Self-Tapping 6-32 x ¼	0938.0001.J	28
18	Screw, Fil. Hd., 10-32 x ½	0114.0031.J	2
19	Screw, Rd. Hd., 10-32 x 5/16	0111.0085.J	10
20	Screw, Self-Tapping, 10-24 x ¼	0946.0002.J	10
21	Screw, 10-24 x ⅝ SST	0918.1009.J	1
22	Screw, Rd. Hd., (Plug) 10-32 x ¼ (Not Shown)	0111.0086.J	1
23	Washer, No. 10 Flat	0003.0047.K	4
24	Washer, No. 10, Shakeproof	0003.0033.K	3
25	Plate, Data Recorder	0238.1026.G	1
26	Cap Screw (DPU Mounting) (Not Shown)	0240.0009.J	4
27	Not Used	—	—
28	Door Stop Assembly	0238.1019.B	1
29	Door Latch Hook Assembly	0238.0029.B	1
30	Gasket, Cover Glass	0238.0015.C	A/R
31	Glass, Cover	0238.0016.C	1
32	Clip, Cover Glass	0238.0017.C	4
33	Assembly, Handle-Door Latch	0238.1038.B	1
34	Bushing, Door Handle (Not Shown)	0238.0094.C	1
35	Clip, Bottle Mounting	0062.0007.T	2
36	Not Used	—	—
37	Screw, Self-Tapping	0946.0002.J	2
38	Flat Washer	0003.1064.K	2
39	Pin (Not Shown)	0003.0022.T	1
40	Gasket, Door	0096.1003.T	A/R
41	Arm, Fountain Pen (1st or 2nd from Chart)	0238.0088.C	A/R
42	Pen, Fountain (Static) (1st from Chart)	0014.0001.T	1
43	Pen, Fountain (Differential) (2nd from Chart)	0014.0002.T	1
44	Static Shaft Arm Assembly	0202.0034.B	1

**Table 6-1. Parts List,
Model 202E Differential Pressure Recorder (Cont)**

Item	Description	Part No.	Per Unit
45	Range Arm Assembly	0238.0012.B	1
46	Block, Clamp	0250.0003.C	1
47	Lever Arm Assembly	0238.0031.B	1
48	Drive Arm Assembly	0238.0004.B	1
49	Element, Static Pressure	See Table 1-2	1
50	Drive, Chart	See Table 1-3	1
51	Shaft, Pen Arm (1st from Chart)	0238.0006.B	1
52	Shaft, Pen Arm (2nd from Chart)	0238.0007.B	1
53	Hub, Chart	0238.0033.B	1
54	Turret, Macnick Chart Drive (Not Shown)		1
	Rotation:		
	2-Hour	0046.0005.T	
	3-Hour	0046.0006.T	
	4-Hour	0046.0007.T	
	6-Hour	0046.0008.T	
	8-Hour	0046.0001.T	
	12-Hour	0046.0009.T	
	24-Hour	0046.0010.T	
	48-Hour	0046.0003.T	
	72-Hour	0046.0011.T	
	7-Day	0046.0002.T	
	8-Day	0046.0004.T	
55	Screw, Sl. Hex Hd., 8-32 x ¼ (Pen Mount, Top Plate)	0116.0014.J	2
56	Washer, Lock #8 (Pen Mount, Top Plate)	0003.0036.K	2
57	Screw, Sl. Fil. Hd., 6-40 x ¼ (Chart Drive)	0114.0017.J	3
58	Screw, Set, 2-56 x 5/32 (Drive Arm)	0200.0040.C	3
59	Differential Pressure Unit (Not Shown)	Specify	1



**Figure 6-2. Model 208E Differential Pressure Recorder
Parts Identification**

**Table 6-2. Parts List,
Model 208E Differential Pressure Recorder**

Item	Description	Part No.	Per Unit
1	Differential Pressure Unit (Not Shown)	Specify	2
2	Assembly, Recorder Door	0238.1023.B	1
3	Case, Recorder	0208.1001.C	1
4	Assembly, Pen Lifter	0238.0063.B	1
5	Latch, Door	0238.0071.C	1
6	Stop, Overrange	0238.0082.C	4
7	Bracket, Chart Plate - Right	0238.0110.C	1
8	Bracket, Chart Plate - Lower	0238.0111.C	2
9	Bushing, Door Stop	0238.1018.C	1
10	Hinge, Door	0238.1034.C	1
11	Assembly, Door Stop*	0238.1019.B	1
12	Assembly, Door Latch-Hook*	0238.0029.B	1
13	Gasket, Cover-Glass*	0238.0015.C	1
14	Cover, Glass*	0238.0016.C	1
15	Clip, Cover Glass*	0238.0017.C	4
16	Assembly, Handle-Door Latch*	0238.1038.B	1
17	Bushing, Door Handle (Not Shown)*	0238.0094.C	1
18	Clip, Bottle Mounting	0062.0007.T	2
19	Clip, Chart Plate - Bracket	0238.0119.C	2
20	Pin, Door Handle (Not Shown)*	0003.0022.T	1
21	Gasket, Recorder Door*	0096.1003.T	A/R
22	Assembly, Drive Arm	0238.0004.B	2
23	Plate, Data-Recorder	0238.1026.G	1
24	Plate, Chart (Not Shown)	0238.0903.C	1
25	Riser, Chart Drive	0238.0007.C	3
26	Assembly, Pen Mount - Dual Pen	0262.0001.B	1
27	Assembly, Pen Mount - 3 Pen (Not Shown)	0262.0002.B	1
28	Assembly, Pen Mount - 4 Pen (Not Shown)	0262.0003.B	1
29	Assembly, Link 1st From Chart	0262.0004.B	1
30	Assembly, Link 2nd From Chart	0262.0005.B	1
31	Assembly, Link 3rd From Chart (Not Shown)	0238.0015.B	1
32	Assembly, Link 4th From Chart (Not Shown)	0238.0015.B	1
33	Assembly, Shaft-Pen Arm 1st From Chart	0238.0006.B	1
34	Assembly, Shaft-Pen Arm 2nd From Chart	0238.0007.B	1
35	Assembly, Shaft-Pen 3rd From Chart (Not Shown)	0238.0008.B	1
36	Assembly, Shaft-Pen 4th From Chart (Not Shown)	0238.0009.B	1
37	Assembly, Shaft-Arm 1st From Chart	0202.0034.B	1
38	Assembly, Shaft-Arm 2nd From Chart	0238.0012.B	1
39	Assembly, Shaft-Arm 3rd From Chart (Not Shown)	0262.0006.B	1
40	Assembly, Shaft-Arm 4th From Chart (Not Shown)	0202.0034.B	1

**Table 6-2. Parts List,
Model 208E Differential Pressure Recorder (Cont)**

Item	Description	Part No.	Per Unit
41	Assembly, Lever-Arm Pressure (Not Shown)	0238.0031.B	1
42	Arm, Fountain Pen 1st From Chart	0238.0088.C	1
	Arm, "V" Pen 1st From Chart (Not Shown)	0238.0010.B	1
	Arm, Disposable Pen 1st From Chart (Not Shown)	0014.1010.T	1
43	Arm, Fountain Pen 2nd From Chart	0238.0088.C	1
	Arm, "V" Pen 2nd From Chart (Not Shown)	0238.0011.B	1
	Arm, Disposable Pen 2nd From Chart (Not Shown)	0014.1010.T	1
44	Arm, Fountain Pen 3rd From Chart (Not Shown)	0238.0088.C	1
	Arm, Disposable Pen 3rd From Chart (Not Shown)	0014.1010.T	1
45	Arm, Fountain Pen 4th From Chart (Not Shown)	0238.0088.C	1
46	Pen, Fountain 1st From Chart	0014.0001.T	1
	Pen, "V" 1st From Chart (Not Shown)	0014.0005.T	1
	Pen, Disposable 1st From Chart (Not Shown)	0014.1006.T	1
	Pen, Chartomatic 1st From Chart (Not Shown)	0238.0022.B	1
47	Pen, Fountain 2nd From Chart	0014.0002.T	1
	Pen, "V" 2nd From Chart (Not Shown)	0014.0006.T	1
	Pen, Disposable 2nd From Chart (Not Shown)	0014.1004.T	1
	Pen, Chartomatic 2nd From Chart (Not Shown)	0238.0023.B	1
48	Pen, Fountain 3rd From Chart (Not Shown)	0014.0003.T	1
	Pen, Disposable 3rd From Chart (Not Shown)	0014.1008.T	1
	Pen, Chartomatic 3rd From Chart (Not Shown)	0238.0024.B	1
49	Pen, Fountain 4th From Chart (Not Shown)	0014.0004.T	1
	Pen, Chartomatic 4th From Chart (Not Shown)	0238.0025.B	1
50	Gasket, Connection-Static Pressure†	0238.0019.C	1
51	Gasket, Connection-Temperature (Not Shown)†	0265.0006.C	1
52	Connection, Static Pressure (Not Shown)†	0238.0046.B	1
53	Connection, Temperature (Not Shown)†	0265.0003.C	1
54	Connection, Cover Plate (Used when items 51 and 53 are not)†	0238.0084.C	1
55	Drive, Chart	See Table 1-3	
56	Hub, Chart - Lux or Bristol	0238.0033.B	1
	Hub, Chart - Macnick (Not Shown)	0009.0003.T	1
57	Turret, Macnick Chart Drive (Not Shown)		
	2 Hour Rotation	0046.0005.T	1
	3 Hour Rotation	0046.0006.T	1
	4 Hour Rotation	0046.0007.T	1
	6 Hour Rotation	0046.0008.T	1
	8 Hour Rotation	0046.0001.T	1
	12 Hour Rotation	0046.0009.T	1

**Table 6-2. Parts List,
Model 208E Differential Pressure Recorder (Cont)**

Item	Description	Part No.	Per Unit
	24 Hour Rotation	0046.0010.T	1
	48 Hour Rotation	0046.0003.T	1
	72 Hour Rotation	0046.0011.T	1
	7 Day Rotation	0046.0002.T	1
	8 Day Rotation	0046.0004.T	1
58	Assembly, Conduit-Elect. Ch. Dr. (Not Shown)	0238.0003.B	1
59	Gasket, Connection-Elec. Ch. Dr. (Not Shown)	0238.0019.C	1
60	Plug, Conduit-Elect. Ch. Dr. (Not Shown)	0606.0001.L	1
61	Element, Temperature (Not Shown)	See Table 1-2	
62	Element, Pressure (Not Shown)	Consult Factory	
63	Element, Bellows (Not Shown)	Consult Factory	
64	Riser, Element-Temperature (Not Shown)†	0265.0005.C	2
65	Union, Half-Capsule Element Only (Not Shown)†	0802.0001.M	1
66	Screw, Hex HD 8-32 x ¼ (Pen Mt. Top Plate)	0116.0014.J	2
67	Washer, Lock No. 8 (Pen Mt. Top Plate)	0003.0036.K	2
68	Screw, RD HD 6-32 x ¼	0938.0001.J	28
69	Screw, Fil. HD 10-32 x ½	0114.0031.J	2
70	Screw, RD HD 10-32 x 5/16 (Element Mtg. Press) (Not Shown)†	0111.0085.J	2
71	Screw, Hex HD 8-32 x ¼ (Element Mtg. Temp) (Not Shown)†	0116.0014.J	2
72	Screw, Self Tapping 10-24 x ¼ (Not Shown) (Temp and Press Connections)†	0946.0002.J	4
73	Screw, Self Tapping 10-24 x ¼	0946.0002.J	10
74	Screw, Self Tapping 10-24 x 5/8	0918.1009.J	1
75	Screw, RD HD 10-32 x ¼ (Not Shown)	0111.0086.J	1
76	Screw, RD HD 10-32 x 5/16	0111.0085.J	8
77	Washer, Flat No. 10	0003.0047.K	6
78	Washer, Shakeproof No. 10	0003.0033.K	3
79	Screw, Fil. HD 6-40 x ¼ (Chart Drive)	0114.0017.J	3
80	Washer, Lock No. 6 (Chart Drive)	0003.0038.K	3
81	Screw, Set 8-32 x ¼ - Handle (Not Shown)	0320.0010.J	1
82	Washer, Flat (Not Shown)	0003.1064.K	2
83	Screw, Self Tapping 10-24 x ¼ (Door Stop)	0946.0002.J	2
84	Screw, Self Tapping 10-24 x ¼ (Not Shown) (Conduit Assembly and Plug-Elect. CH DR)	0946.0002.J	4
85	Washer, Lock No. 8-Temp Element (Not Shown)†	0003.0074.K	2
86	Temperature Well - 4" (Not Shown)†	0265.0008.C	1
87	Panel Mounting (Not Shown)		
	Panel, Mounting Bracket	0238.0068.C	3
	Pad, Pressure	0238.0069.C	3
	Screw, Panel Mounting	0238.0070.C	3

**Table 6-2. Parts List,
Model 208E Differential Pressure Recorder (Cont)**

Item	Description	Part No.	Per Unit
	Screw, 1/4-20 x 5/8	0911.0004.J	6
	Nut, Hex 5/16-18	0500.0033.J	6
	Screw, Flat HD 1/4-20 x 1/2	0240.0009.J	4
88	Pipe Mounting, Slip-on (Not Shown)		
	Bracket, Pipe - Slip-on	0199.0220.B	1
	Screw, Flat HD 1/4-20 x 1/2	0240.0009.J	4
89	Pipe Mounting, Threaded (Not Shown)		
	Bracket, Pipe - Threaded	0199.0703.C	1
	Screw, Flat HD 1/4-20 x 1/2	0240.0009.J	4
90	Pipe Mounting, Threaded Exp-Proof (Not Shown)		
	Bracket, Pipe-Threaded Exp-Proof	0199.0708.C1	
	Screw, Flat HD 1/4-20 x 1/2	0240.0009.J	4

*Items with asterisk in description are part of recorder door assembly 0238.1023.B.

†Multiply quantity by number of pens.

SECTION 7

DRAWINGS

7-1. OUTLINE DIMENSION DRAWINGS

The latest revision of the following outline dimension drawings are presented in this section:

0202-1010.3
0202-1011.3
D3-208A-901-2

Figure 7-1. Model 202E Differential Pressure Recorder
Outline Dimension Drawing

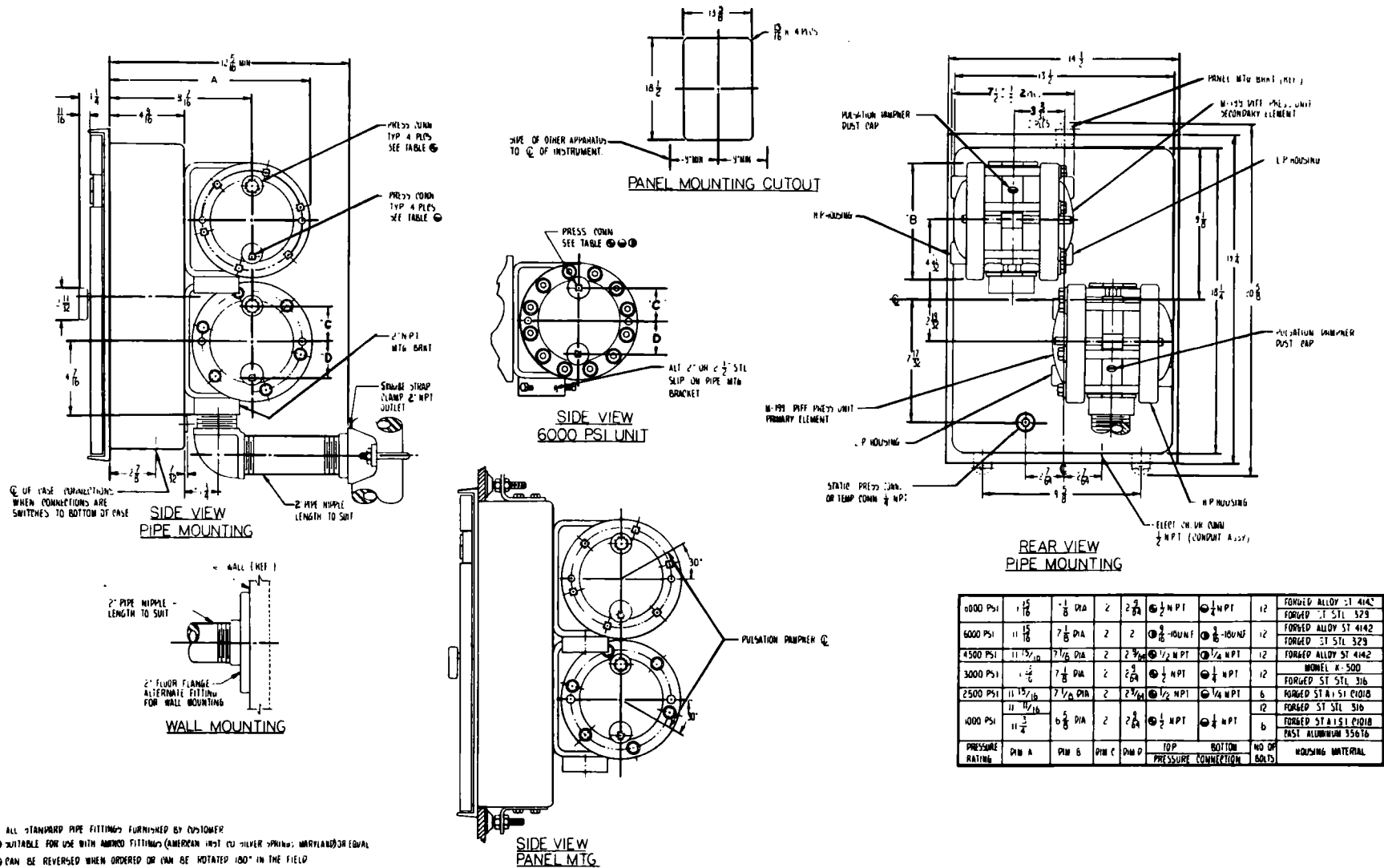
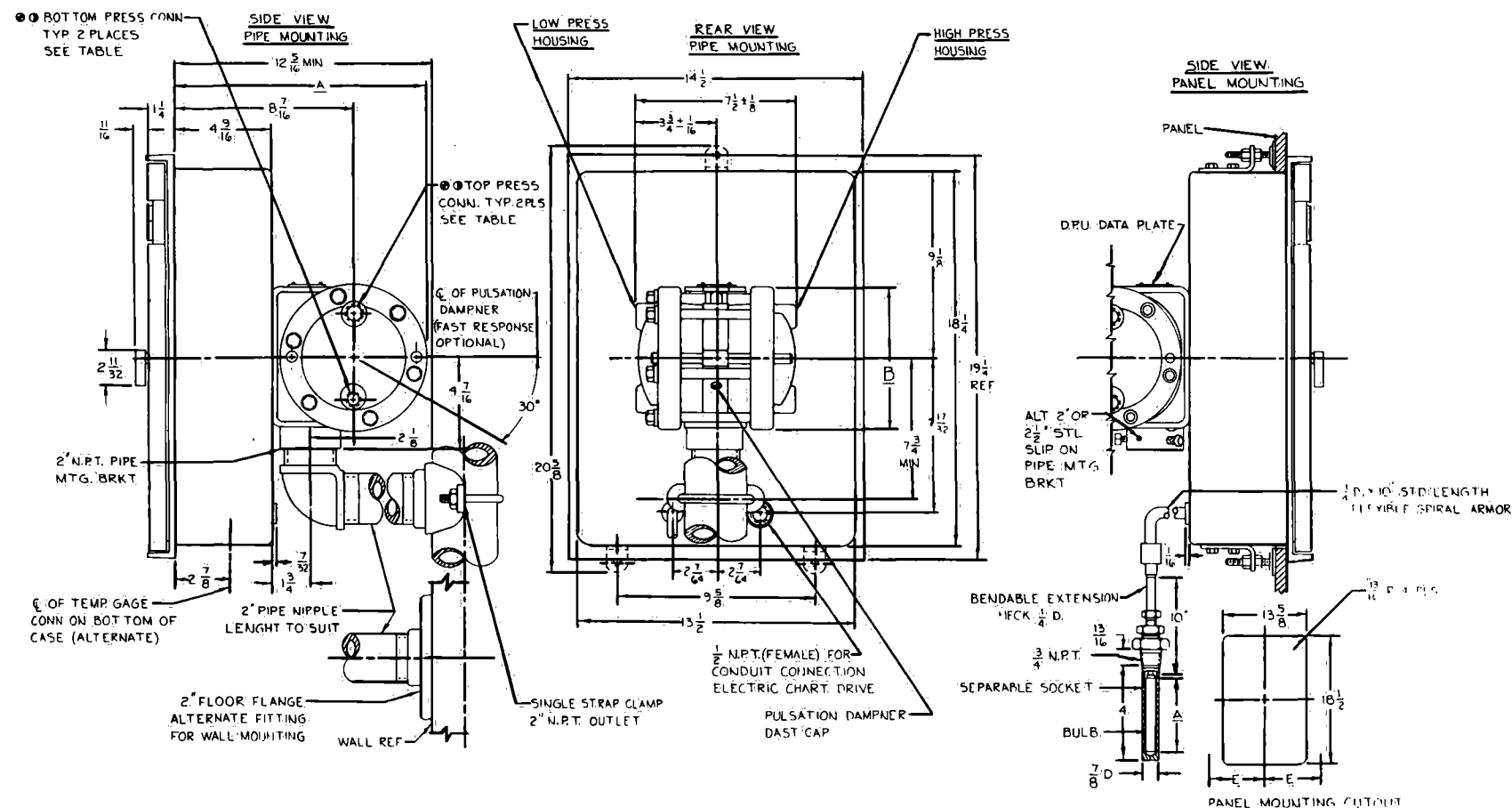


Figure 7-2. Model 202E Differential Pressure Recorder (with Temperature Element) Outline Dimension Drawing



6000 P.S.I.	11 $\frac{15}{16}$	1 $\frac{1}{8}$ DIA	2	2 $\frac{3}{64}$	● $\frac{1}{2}$ N.P.T.	● $\frac{1}{2}$ N.P.T.	12	FORGED ALLOY STL 4142 FORGED STL STL 329
4000 P.S.I.	11 $\frac{15}{16}$	7 $\frac{7}{8}$ DIA	2	2	● $\frac{3}{16}$ IN UNF	● $\frac{3}{16}$ IN UNF	12	FORGED ALLOY STL 4142 FORGED STL STL 329
4500 P.S.I.	11 $\frac{15}{16}$	1 $\frac{1}{8}$ DIA	2	2 $\frac{3}{64}$	● $\frac{1}{2}$ N.P.T.	● $\frac{1}{2}$ N.P.T.	12	FORGED ALLOY STL 4142 FORGED STL STL 316
3000 P.S.I.	11 $\frac{15}{16}$	7 $\frac{7}{8}$ DIA	2	2 $\frac{3}{64}$	● $\frac{1}{2}$ N.P.T.	● $\frac{1}{2}$ N.P.T.	12	FORGED ALLOY STL 4142 MONEL K-500
2500 P.S.I.	11 $\frac{15}{16}$	7 $\frac{7}{8}$ DIA	2	2 $\frac{3}{64}$	● $\frac{1}{2}$ N.P.T.	● $\frac{1}{2}$ N.P.T.	6	FORGED STL A.I.S.I. 304
1000 P.S.I.	11 $\frac{15}{16}$	6 $\frac{3}{8}$ DIA	2	2 $\frac{3}{64}$	● $\frac{1}{2}$ N.P.T.	● $\frac{1}{2}$ N.P.T.	6	FORGED STL A.I.S.I. 304 CAST ALUMINUM 356
D.P.U. PRESS. RATING	DIM A	DIM B	DIM C	DIM D	TOP PRESS CONNECTION	BOTTOM PRESS CONNECTION	NO. OF PORTS	HOUSING MATERIAL

4. ALL DIMENSIONS IN INCHES.

3. ALL STANDARD PIPE FITTINGS FURNISHED BY CUSTOMER.

- 2. SUITABLE FOR USE WITH AMINCO FITTINGS, (AMERICAN INST. CO. SILVER SPRING, MD.) OR EQUIV.
- 1. CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD.

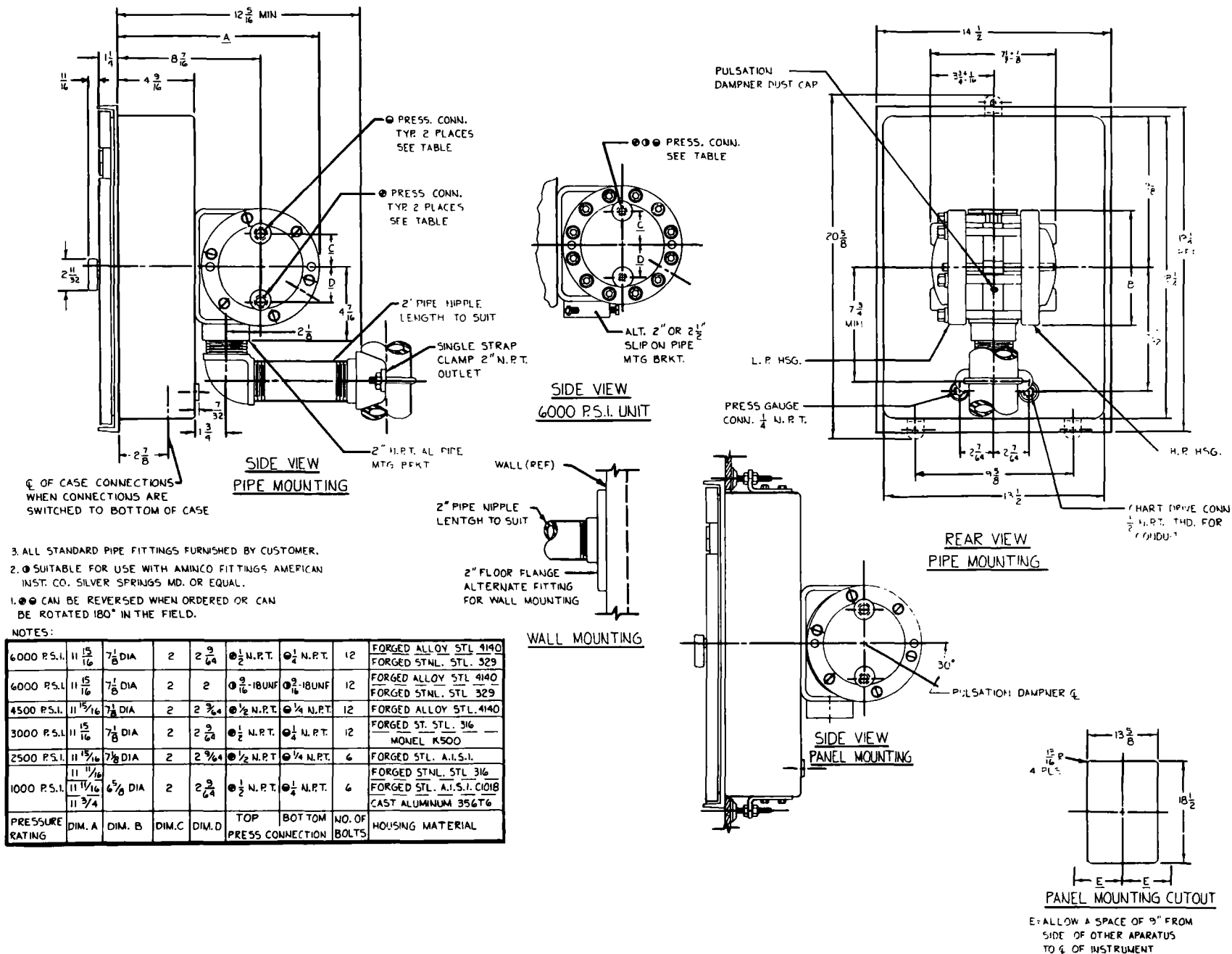
NOTES:

0-300°F	2 $\frac{1}{8}$
0-200°F	2 $\frac{3}{16}$
0-150°F	3 $\frac{3}{32}$
0-120°F	3 $\frac{1}{2}$
0-100°F	3 $\frac{5}{16}$
RANGE	DIM. A MAX.
TEMP. ELEMENT DATA	

1250 PSI	1100 PSI	1000 PSI
AT 200°F	AT 200°F	AT 200°F
AT 100°F	AT 600°F	AT 800°F
SEPARABLE SOCKET		
PRESSURE RATING		

ALLOW A SPACE OF 3" FROM SIDE OF OTHER APPARATUS TO 6" OF INSTRUMENT

Figure 7-3. Model 208E Differential Pressure Recorder
Outline Dimension Drawing



INSTALLATION AND OPERATION MANUAL

MODEL 199
DIFFERENTIAL PRESSURE UNIT

ITT BARTON INSTRUMENTS
P.O. Box 1882
900 S. Turnbull Canyon Road
City of Industry, CA 91749

© Copyright 1986, ITT Corporation

WARRANTY

The warranty of the Differential Pressure Unit will be voided if the following limitations are exceeded:

TEMPERATURE: Do not subject the DPU to temperature above 200°F or below -40°F (35°F minimum for water filled units).

PRESSURE: Do not subject the DPU to operating pressure in excess of the working pressure rating stamped on the housing of the unit.

CORROSION: Do not subject the DPU to incompatible process media.

SEALED COMPONENTS: Do not loosen or remove the torque tube gland nut, the drive arm hole plug, or the torque tube housing from the center plate. To do so will cause loss of fill fluid.

VIBRATION: Do not subject the DPU to severe mechanical vibration.

SHOCK: Do not subject the DPU to hydraulic shock.

PULSATION: Do not subject the DPU to severe pulsation.

PRODUCT WARRANTY STATEMENT

The product warranty applicable to this ITT Barton instrument is as stated on the inside back cover of this manual.

Should any after-delivery problems arise, please contact ITT Barton's Consumer Affairs office during normal business hours. (818) 333-4701.

SAFETY

Before installing the instrument, become familiar with the installation instructions presented in Section 3.

DANGER notes apply where personal injury, death, or property damage **will** occur if operating instructions are not strictly followed.

WARNING notes apply where personal injury, death or property damage **could** occur if operating instructions are not strictly followed.

CAUTION notes apply where minor injury or damage could occur when operating instructions are not strictly followed.

DANGER, WARNINGS, and/or CAUTIONS appear on the following page of this manual and should be reviewed before proceeding: A-11, A-12, A-20, A-23, and A-27.

RECORD OF CHANGES

CHANGE NO.	DATE	DESCRIPTION	ENTERED BY
81E1-1	10/1/81	New issue.	L. Finney
81E1-1(A)	4/84	Change temperature specifications. Added specifications table.	P. Shepherd
85A5	1/85	Issued new manual number.	P. Shepherd
86B1	2/85	Modified or re-classified notices pages: A-10, A-11, A-12, A-20, and A-27. Added DPU disassembly warning notice — pages A-20, A-23, and A-27. Revised Figures 1-3 through 1-16. Corrected kick-off spring assembly drawing — page A-24. Updated Parts drawing — page A-34. Reformatted Figure 3-2 — page A-37. Updated Table 1-1, page A-9.	M. La Gbed

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SECTION 1

INSTALLATION

1-1. INTRODUCTION

The ITT Barton Model 199 Differential Pressure Unit (DPU) measures differential pressure in gas or liquid flow through a process system or in liquid containment in a process vessel. The Model 199 provides a mechanical output which can be used to actuate a measurement indicator or a switch.

1-2. SPECIFICATIONS

The specifications of the Model 199 Differential Pressure Unit are presented in Table 1-1.

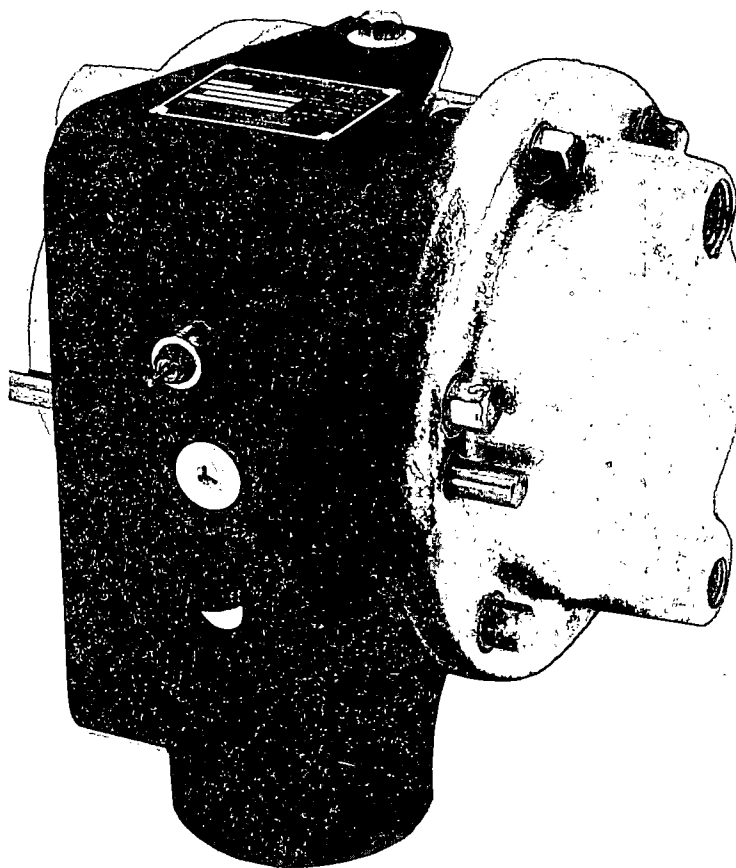


Figure 1-1. Model 199 Differential Pressure Unit

Figure 1-2. Model 199 DPU, Cutaway View

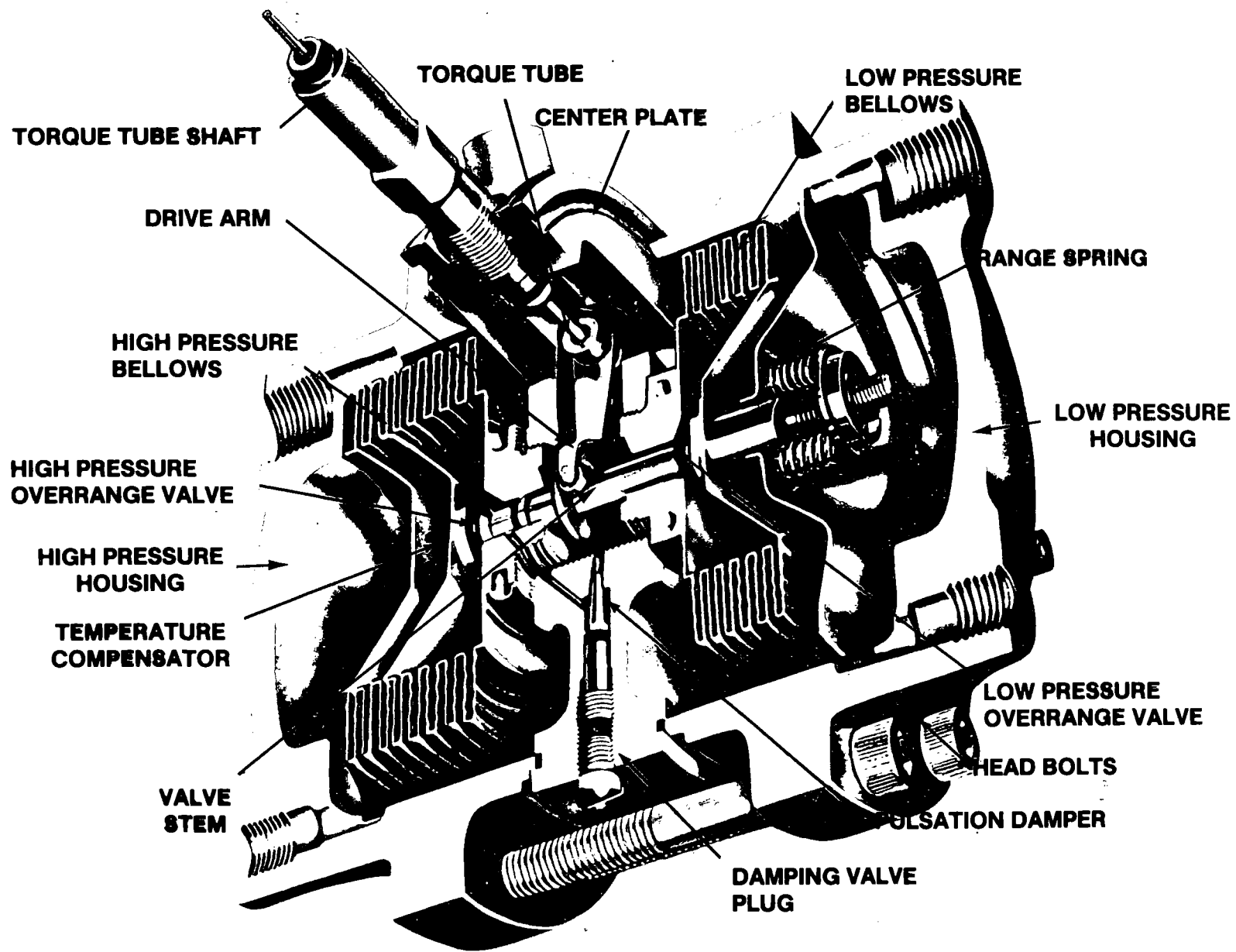


Table 1-1. Model 199 Differential Pressure Unit Specifications

General Specifications

Meter Body		Available Differential Pressure Ranges	
SWP-psi	Housing Material	3 1/4" O.D.	2 1/8" O.D.
1,000	Cast Aluminum 356T6	Stainless Steel Bellows 0-10" to 0-400" w.c. Inconel Bellows 0-20" to 0-400" w.c.	Stainless Steel or Inconel Bellows 0-15 psi to 0-75 psi
1,000	Forged Stainless Steel 316		
2,500	Forged Steel A.I.S.I. C1018		
3,000	Forged Stainless Steel 316		
3,000	Forged Monel K-500		
4,500	Forged Alloy Steel 4142		
6,000	Forged Alloy Steel 4142		
6,000	Forged Stainless Steel 329		
Net Volume in cu. in.	L.P. Head	30	35
	H.P. Head	26	31
Displacement in cu. in. for full-scale travel.		1.5	0.5

NOTE:

Can be specified to meet NACE MR-01-75 (Revised '80).

Zero center or split ranges are available on special order. For example, a 0-50" w.c. range may be ordered 25-0-25" w.c. or 10-0-40" w.c. Intermediate differential pressure ranges available from 0-20" w.c. to 0-75 psi.

Range springs are not interchangeable between the two different size bellows, between stainless steel and the Inconel bellows, or with the 10" w.c. range.

Standard pressure connections are 1/2" and 1/4" NPT.

Performance Specifications

Torque Tube Rotation8° ± 10% for full scale D.P.

Accuracy and Maximum Non-linearity
(With adequate linkage)

Range: 0-10" w.c. to 0-349" w.c.±½% of full scale D.P.

0-350" w.c. to 0-75 psi±¾% of full scale D.P.

Temperature Limits-40°F to +200°F
(+35°F min. for water filled units)

Sensitivity0.05% of F.S. D.P.

Repeatability0.10% of F.S. D.P.

DimensionsSee Outline Dimension Drawings
(Figures 3-2 and 3-3)

1-3. UNPACKING

All ITT Barton instruments are tested and inspected during manufacture and prior to shipment. However, an inspection should be performed at the time of unpacking to detect any damage that may have occurred during shipment.

NOTICE

THE DPU WAS CHECKED FOR ACCURACY AT THE FACTORY. CHANGES OF ANY SETTINGS DURING EXAMINATION WILL AFFECT THE ACCURACY OF THE INSTRUMENT.

For application in critical media requiring special cleaning processes and precautions, a polyethylene bag is used to protect the instrument from contamination. This protective wrapper should be removed only under conditions of extreme cleanliness.

The following items are included in each container:

- Model 199 Differential Pressure Unit
- Installation and Operation Manual
- Accessories per customer purchase order.

1-4. MOUNTING

A. Panel Mounting

Refer to the Installation and Operation Manual of the specific instrument for panel or flush mounting instructions.

B. Pipe Mounting

Refer to the DPU outline dimension drawings (Figures 3-2 and 3-3) for pipe mounting instructions. Mount the instrument approximately level.

1-5. PIPING — STANDARD PRACTICE

Certain practices should be followed on all flow and liquid level DPU piping. These include:

1. The distance between the primary device and the DPU should be as short as possible. Distances exceeding 100 feet are not recommended. For distances up to 50 feet use ¼-inch or ⅜-inch pipe or tubing. For runs of 50 to 100 feet use ½-inch pipe or tubing. This recommended distance limitation does not apply if an air-purge or blow-back system is used.
2. Slope all piping at least 1-inch per linear foot to avoid liquid or gas entrapment.

3. If process media exceeding 200°F (93°C) is to be measured, provide 2 feet of uninsulated piping between the primary device and the DPU for each 100°F (37.8°C) in excess of 200°F.
4. When steam tracing is necessary, the steam pressure should not exceed 5 pounds per square inch and insulation should not be used. If pressure above 5 pounds per square inch is required, limit the length of tubing around the DPU to two turns and do not insulate. The temperature of the DPU must never exceed 200°F.
5. Severe pulsation will affect the accuracy of the instrument. The installation of a pulsation damping device upstream of the meter run is recommended when flow is being measured. Reduce pulsation effect by adjusting the DPU pulsation damper.
6. Minimize vibration by mounting the instrument on a secure support.
7. Measurement errors can be caused by leaks in the pipe joints; make up all joints using a suitable pipe joint compound.
8. The DPU has two pressure connections in each housing. If necessary, rotate the housings 180 degrees to place the connections in the desired position.
9. Connect the DPU and the differential pressure source with a valve manifold to facilitate operation and checking of the DPU.
10. Locate shutoff and bypass valves to be readily accessible to the operator from the front of the instrument. The block valve should be the first valve from the process line or vessel.

1-6. PIPING

Piping diagrams and startup instructions for typical and special flow installations are presented in Figures 1-3 through 1-16. Use the diagram most applicable to the specific requirement as a guide.

A. Flow Applications (Figures 1-3 through 1-9)

Be sure to connect the DPU high-pressure housing port to the upstream tap of the primary device.

WARNING

HIGH-PRESSURE HAZARD.

**DIRECT ALL PIPING AWAY FROM THE OPERATOR
WHILE CONNECTING THE DPU TO SYSTEM
PIPING.**

NOTICE

TO PREVENT OVERHEATING DURING BLOWDOWN, OPERATOR SHOULD MONITOR TEMPERATURE BY PLACING HIS HAND ON PIPE BETWEEN DPU AND MANIFOLD PIPE IN WHICH VENT VALVES ARE LOCATED.

B. Liquid Level Applications (Figures 1-10 through 1-15)

The process media can be used as a reference leg seal fluid when it is of a type that will condense in the reference leg under all conditions.

If the process media characteristics are such that the above conditions cannot be met, a special reference leg seal fluid will be required. The special seal fluid must not be volatile and must not be miscible with the process media. Also, the difference in the densities of the special seal fluid and the process media will require compensation in calculating the differential pressure range of the DPU.

If there are any questions regarding this procedure, contact the factory.

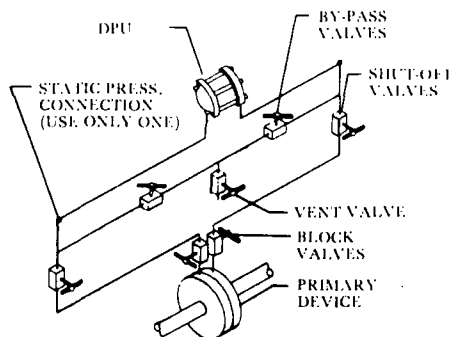
WARNING

EXPLOSION HAZARD.

NO ORGANIC COMPOUNDS, OIL, GREASE, DIRT OR SCALE OF ANY KIND CAN BE TOLERATED IN AN OXYGEN INSTALLATION.

C. Specific Gravity Applications (Figure 1-16)

This application uses differential pressure instruments to determine specific gravity changes in a process media.

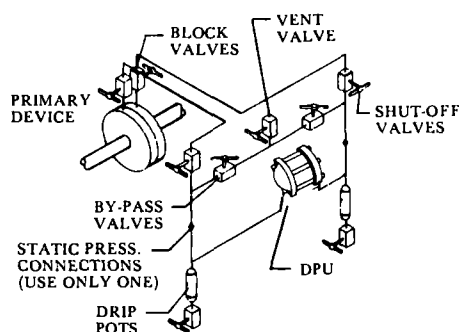


STARTUP

1. Open bypass valve(s). Close vent valve. Open both shutoff valves and one block valve to pressurize DPU, then close block valve.
2. Close one bypass valve and check system for leaks. If output travels upscale, check for low-pressure piping leak. If output travels downscale, check for high-pressure piping leak.
3. Repair piping if necessary and repeat steps 1 and 2 until output remains stationary at zero.
4. Close both shutoff valves. Open bypass valve(s). Open both block valves. Slowly open both shutoff valves.
5. Close bypass valves. If two bypass valves are used, open vent valve.

Recommended for use whenever possible, as the DPU is self-draining. NOT recommended when hydrates are present.

Figure 1-3. Gas Flow, DPU Above Run.

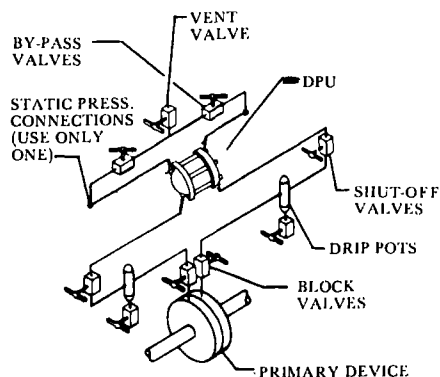


STARTUP

1. Open bypass valve(s). Close vent valve. Open shutoff and block valves to pressurize DPU. Close block valve.
2. Close one bypass valve and check for leaks. If output travels upscale, check for low-pressure piping leak. If output travels downscale, check for high-pressure piping leak.
3. Repair piping as necessary and repeat steps 1 and 2 until output remains stationary at zero.
4. Close both shutoff valves. Open bypass valve(s). Open both block valves. Slowly open both shutoff valves.
5. Close bypass valves. If two bypass valves are used, open vent valve.
6. If drip pots are used, open drip valves and blow out accumulated liquid.

Used ONLY when necessary to mount DPU below run. Drip pots required when wet gas is present.

Figure 1-4. Gas Flow, DPU Below Run.

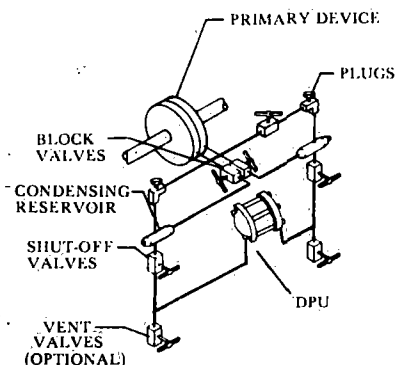


STARTUP

1. Open bypass valve(s). Close vent valve. Open both shutoff valves and one block valve to pressurize DPU. Close block valve.
2. Close one bypass valve and check for leaks. If output travels upscale, check low-pressure piping for leak. If output travels downscale, check for high-pressure piping leak.
3. Repair piping as necessary and repeat steps 1 and 2 until output remains stationary at zero.
4. Close both shutoff valves. Open bypass valve(s). Open both block valves. Slowly open both shutoff valves.
5. Close bypass valves. If two bypass valves are used, open vent valve.
6. Drain drip pots of hydrates at regular intervals.

Used if hydrates or heavy solids are present. Piping and shutoff not less than ½" diameter. Bypass manifold above, to isolate meter from connecting piping. Drip pots prevent plugging.

Figure 1-5. Gas Flow, Hydrates Present.



STARTUP

1. Close vent valves, if used: Open bypass and shutoff valves.
2. Remove condensing reservoir side and fill plugs.
3. Pour water into both reservoirs until piping and DPU housing are filled. Piping and housing chambers shall be free of bubbles. Pointer will rest at zero (or output will be 4 mA or 10 mA, as applicable) when instrument and piping are completely filled.
4. Install side and fill plugs in reservoirs.
5. Close shutoff valves. Open block valves.
6. Simultaneously, slowly open both shutoff valves. Check for leaks.
7. Close bypass valve.

Condensing reservoirs and piping to orifice taps must be level.
Reservoirs and steam line at same level. 2" pipe crosses may be used as seal pots.

NOTICE
USE PLUGS; NEVER VALVES
ON DPU.

Figure 1-6. Steam Flow, DPU Below Run.

STARTUP

1. Close both shutoff valves. Open both block valves.
2. Open bypass valve. Crack vent valves or loosen plugs from top ports of DPU body housings.
3. Crack and close shutoff valves alternately until liquid, free of bubbles, spills out of both upper DPU body ports.
4. Close vent valves or tighten plugs. Close block valves and open shutoff valves.
5. Indicator will be at zero (or output will be 4 mA or 10 mA, as applicable). If not, and no leaks are detected, the housing and/or piping are not completely filled with liquid. Repeat steps 1 through 4 until output remains stationary at lowest value.
6. Slowly open both block valves. Close bypass valve.

Recommended if sediments may be present. Periodic inspections of piping are necessary.
Not recommended for hot or gassy liquids.

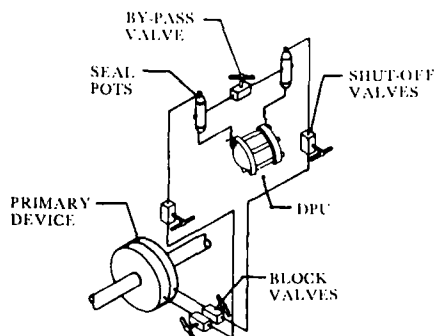
Figure 1-7. Liquid Flow, DPU Above Run.

STARTUP

1. Close both shutoff valves. Open both block valves.
2. Open bypass valve: Crack vent valves or loosen plugs from top ports of DPU pressure housings.
3. Crack and close shutoff valves alternately until liquid, free of bubbles, spills out of both upper DPU body ports.
4. Close vent valves or tighten plugs. Close block valves and open shutoff valves.
5. Indicator will be at zero (or output will be 4 mA or 10 mA, as applicable). If not, and no leaks are detected, the housing and/or piping are not completely filled with liquid. Repeat steps 1 through 4 until output remains stationary at lowest value.
6. Slowly open both block valves. Close bypass valve.
7. For service with hot or gassy liquids, fill both sides of the manifold through the fill tee, with the liquid to be measured cooled to 200°F or less, expell gas bubbles from DPU and piping.
8. Open vent valve in bypass valve. Tighten fill plug when bubble-free liquid flows.

Recommended for hot or gassy liquids. Periodic inspections of piping are recommended.

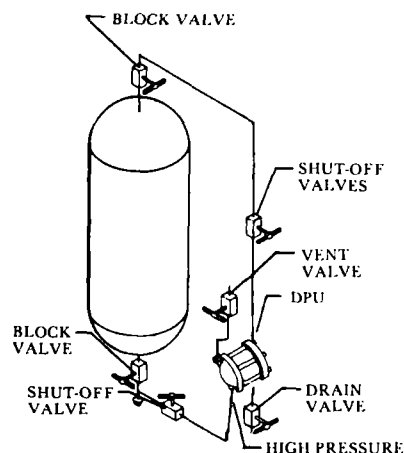
Figure 1-8. Liquid Flow, DPU Below Run.



STARTUP

1. Close shutoff valves. Open block valves. Open bypass valve. Close DPU drain plugs.
2. Remove fill and side plugs from seal pots.
3. Fill seal pots, piping and DPU housing with immiscible seal fluid by pouring into upper fill ports. DPU housing tubing, and seal pots must be filled to seal pot side ports with bubble-free liquid. Pointer will indicate zero (or 4 mA or 10 mA, as applicable) when high- and low-pressure chambers are filled with liquid.
4. Install side plugs.
5. Slowly open each shutoff valve alternately, until bubble-free line liquid spills from both upper fill plugs.
6. Replace fill plugs.
7. Open and close block valves. Check for piping leaks. Repair as needed.
8. Close shutoff valves and open block valves.
9. Slowly open both shutoff valves. Close bypass valve.

Figure 1-9. Corrosive Liquid Flow.



STARTUP

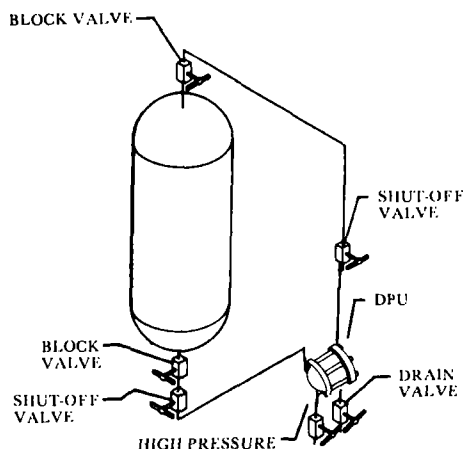
1. Close both shutoff valves. Open lower block valve and crack vent valve.
2. Slowly open lower shutoff valve. When bubble-free liquid spills from vent, close vent valve.
3. Open upper block valve. Slowly open shutoff valve.
4. Crack drain valve to remove any condensation. Close drain valve.

High-pressure side of DPU connected to bottom outlet of tank.
Low-pressure side connected to top or gas outlet of tank.

NOTICE

DO NOT SHARE FILLING OR VAPOR
RETURN LINES WITH DPU PIPING.

Figure 1-10. Cool Non-Condensing Liquid, DPU Level With Tank Bottom.



STARTUP

1. Close both shutoff valves. Open lower block valve and crack vent valve.
2. Slowly open lower shutoff valve. When bubble-free liquid spills from vent, close vent valve.
3. Open upper block valve. Slowly open shutoff valve.
4. Crack drain valve to remove any condensation. Close drain valve.

Either piping layout (Figures 1-10 or 1-11) is suitable for water, oil, or other media which will not condense in low-pressure piping.

NOTICE

DO NOT SHARE FILLING OR VAPOR
RETURN LINES WITH DPU PIPING.

Figure 1-11. Cool Non-Condensing Liquid, DPU Below Tank.

STARTUP

Cool Liquids: Use of reference leg cancels out the "dead leg" (piping from tank bottom to center line of meter body). Seal fluid in reference leg must not volatilize. Process media can be used as a reference leg seal fluid if it is such that it will condense in reference leg under all conditions. Otherwise, special, non-miscible seal fluid must be used. Difference in densities between process media and seal fluid must be considered when computing differential pressure range of DPU.

1. Partially fill reference leg by opening bottom block valve, both shutoff valves, and bypass valve.
2. Crack drain plugs on DPU housing and vent valve. Close when clear, bubble-free liquid flows.

LIQUID LEVEL APPLICATIONS

DPU Below Tank With Reference Leg. (Cont)

3. Close bypass and shutoff valve on reference leg.
4. Remove plug from top port in 2-inch pipe cross connection, and fill the reference leg manually. Open the top shutoff valve and crack vent valve until bubbles are expelled. Leave reference leg full.
5. Replace plug in pipe cross and close vent valve.
6. Slowly open upper block valve.

STARTUP

Hot Liquids: (Volatile):

1. Open both shutoff valves, bypass valve, and vent valve.
2. Remove plug from top port in 2-inch pipe cross. Fill both high and low DPU housings with liquid until it runs out of vent valve. Use liquid to be measured, cooled to below 200°F of other suitable seal liquid. Expel bubbles in DPU housing. Proceed to step 3 above.

NOTICE

DO NOT SHARE FILLING OR VAPOR RETURN LINES WITH DPU PIPING.

If bypass valve is opened at any time, the reference leg must be filled again. If no bypass is installed, disregard steps 1, 2, and 3. Open lower block valve in step 5 and shutoff valve in step 6.

Figure 1-12. DPU Below Tank With Reference Leg.

STARTUP

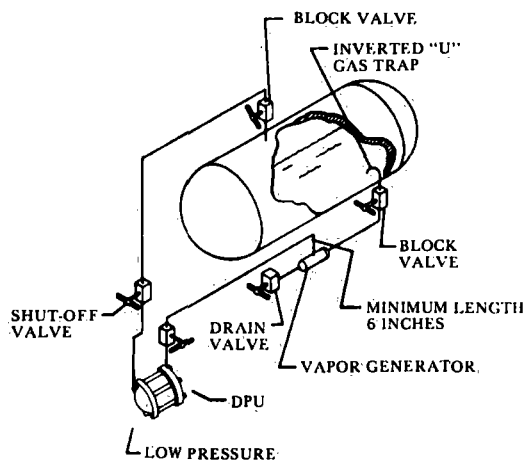
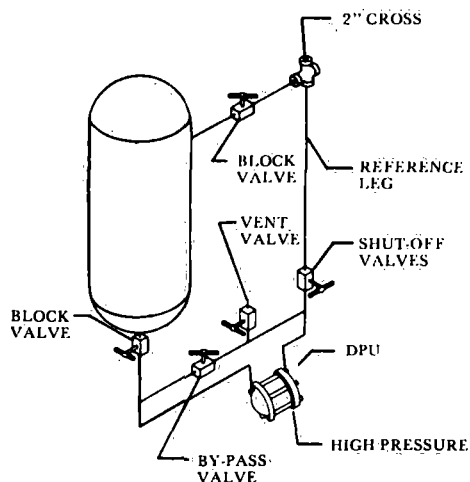
1. Close shutoff valves.
2. Open drain valve and DPU housing drain plugs to remove all liquid from system. Close drains.
3. Open bottom block valve slowly to allow liquid to enter gas generator. Vent valve must be closed.
4. Open top block valve.
5. Open shutoff valves.

NOTICE

DO NOT INSULATE PIPING BELOW LOWER BLOCK VALVE. DO NOT SHARE FILLING AND VAPOR RETURN LINES WITH DPU PIPING LINES.

Instrument may be located above or below vessel. Recommended vapor generator is a twelve-inch length of 1- to 1½-inch diameter pipe. Avoid traps or pockets between vapor generator and tank. Install inverted "U" shaped gas trap inside the vessel.

Figure 1-13. Liquid CO₂



STARTUP

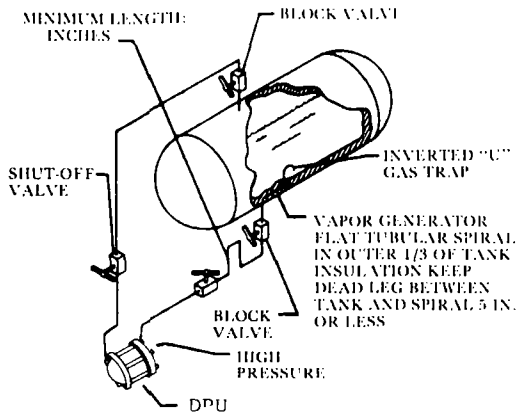
1. Close shutoff valves.
2. Open drain valve and DPU housing drain plugs to remove all liquid from system. Close drains.
3. Open bottom block valve slowly to allow liquid to enter gas generator. Vent valve must be closed.
4. Open top block valve.
5. Open shutoff valves.

Instrument may be located above or below vessel. Recommended vapor generator is a spiral of $\frac{3}{8}$ -inch tubing. Install inverted "U" shaped gas trap inside the vessel. Meters for oxygen service are specially cleaned and packaged in polyethylene bags, and must be kept extremely clean.

NOTICE

DO NOT SHARE FILLING OR VAPOR RETURN LINES WITH DPU PIPING.

Figure 1-14. Cryogenic Liquids.



STARTUP

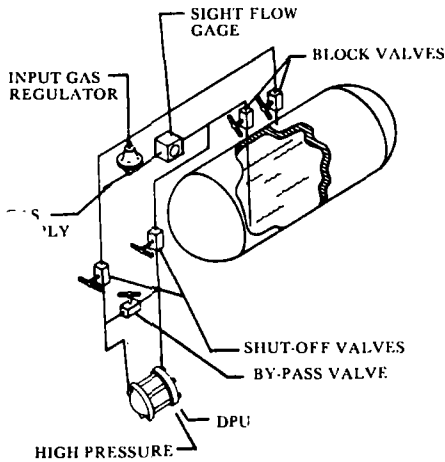
1. Set bubbler input gas regulator pressure slightly higher than process vessel pressure.
2. Open block valves and shutoff valves. Close bypass valve.
3. Check sight-flow for gas flow into bubbler tube.
4. Adjust bubbler system to minimum flow by setting regulator in Figure 3-2 Installations and Sight Flow Throttling Valves in Figure 3-3 Installations.

Recommended when piping connections must be made at the top of the tank or whenever solids or sludge are present.

NOTICE

DO NOT SHARE FILLING OR VAPOR RETURN LINES WITH DPU PIPING.

Figure 1-15. Bubbler System.



STARTUP

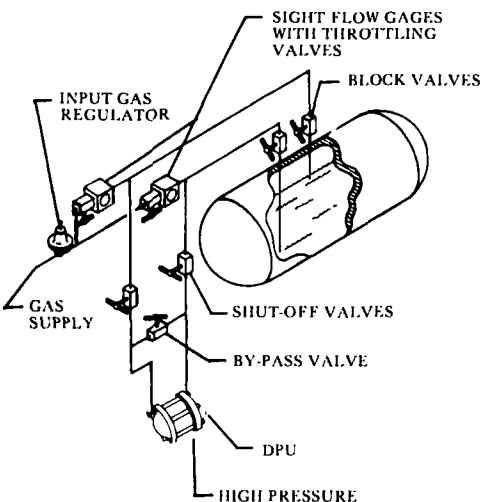
1. Set bubbler input gas regulator pressure slightly higher than process vessel pressure.
2. Open block valves and shutoff valves. Close bypass valve.
3. Check sight-flow for gas flow into bubbler tube.
4. Adjust bubbler system to minimum flow by setting regulator in Figure 3-2 Installations and Sight Flow Throttling Valves in Figure 3-3 Installations.

This method is for determining specific gravity changes in a process media using a differential pressure instrument.

NOTICE

DO NOT SHARE FILLING OR VAPOR RETURN LINES WITH DPU PIPING.

Figure 1-16. Liquid Specific Gravity.



SECTION 2

OPERATION AND SERVICE

2-1. STARTUP PROCEDURE

NOTE

Due to possible extended periods of storage prior to installation, the bellows may have taken a slight "set." Therefore, it is recommended that the first time the DPU is used, and prior to actual operation, the unit be exercised to ensure correct indications. To exercise the unit, sequentially apply maximum and minimum pressure to the high-pressure side for at least ten cycles.

The startup procedure for each installation is presented with the respective piping diagram in Figures 1-3 through 1-16.

2-2. GENERAL PRACTICE CONSIDERATIONS

Observe the following practices when starting operation of the instrument.

1. Always start with the block valves closed.
2. Perform a zero check of the instrument according to the following procedure:
 1. Open one block valve, the vent valve, and (if used) the bypass valves. This procedure equalizes the pressure between the sides of the instrument.
 2. If the instrument does not indicate zero, check for gas or liquid entrapment in the lines or in the DPU (depending on orientation of the piping layout).
 3. If necessary, adjust the pen or pointer of the instrument by turning the zero adjust on the instrument.

NOTE

For gas service, it is recommended that the zero check be performed with both block valves closed. If the gas flow is pulsating, there may be a standing wave effect in the process line which can displace the indicator and appear as a zero error.

3. Check for manifold and piping leaks:
 1. Open both block valves, one shutoff valve and the bypass valve to pressurize the instrument.

2. Close the shutoff valve and the bypass valve. Any leakage will be indicated by pen or pointer movement.

NOTICE

BE CAREFUL NOT TO SUBJECT THE DPU TO UN-NECESSARY SHOCK OR OVERRANGE PRESSURE DURING STARTUP OPERATIONS.

2-3. TOOLS REQUIRED FOR MAINTENANCE

The following tools will be required for the purpose shown during calibration or maintenance:

<u>Description</u>	<u>Purpose</u>
Screwdriver	Bracket Screws
Torque Wrench (100 Ft/Lb)	Pressure Housing Bolts
Open End Wrench (½-inch)	Pushrod-Bellows Cup Connection
Modified Box/Open End Wrench (7/16-inch)	Kickoff Spring Lock Nut

2-4. CLEANING

Instruments used in applications where solids or semi-solids can accumulate inside the pressure housings require periodic inspection and cleaning. The Model 199 DPU is inspected and cleaned according to the following procedure:

WARNING

(HIGH PRESSURE GAS INSTALLATIONS)
(PRESSURE GREATER THAN 200 PSIG)

HIGH-PRESSURE GAS HAZARD ON DISASSEMBLY OF DPU. BEFORE REMOVING DPU HOUSING BOLTS, PERFORM THE PRESSURE CHECK PROCEDURE LISTED BELOW.

NOTICE

IF ACCUMULATION OF SOLIDS OR SEMI-SOLIDS IS EXTENSIVE, REMOVE HOUSINGS CAREFULLY TO PREVENT DAMAGING THE BELLOWS.

A. Pressure Check Procedure

This procedure should be performed BEFORE removing the DPU housing bolts, if the DPU has been installed in gas applications with working pressures greater than 200 psig.

Failure to perform this procedure can result in severe injury, death or substantial property damage due to the release of internal pressure.

1. BACK OFF all housing bolts **4 turns**.
2. CHECK for internal pressure by attempting to move the housing in and out along the bolts:
 - a. If the housing moves freely - no pressure is present - servicing or repair may continue.
 - b. If the housing does NOT move freely - the bellows may be pressurized and is potentially hazardous if further disassembled.

Tighten bolts and return to factory or authorized Barton service center for repair.

Tag the unit and specify "**Gas in Bellows.**".

B. Cleaning Procedure

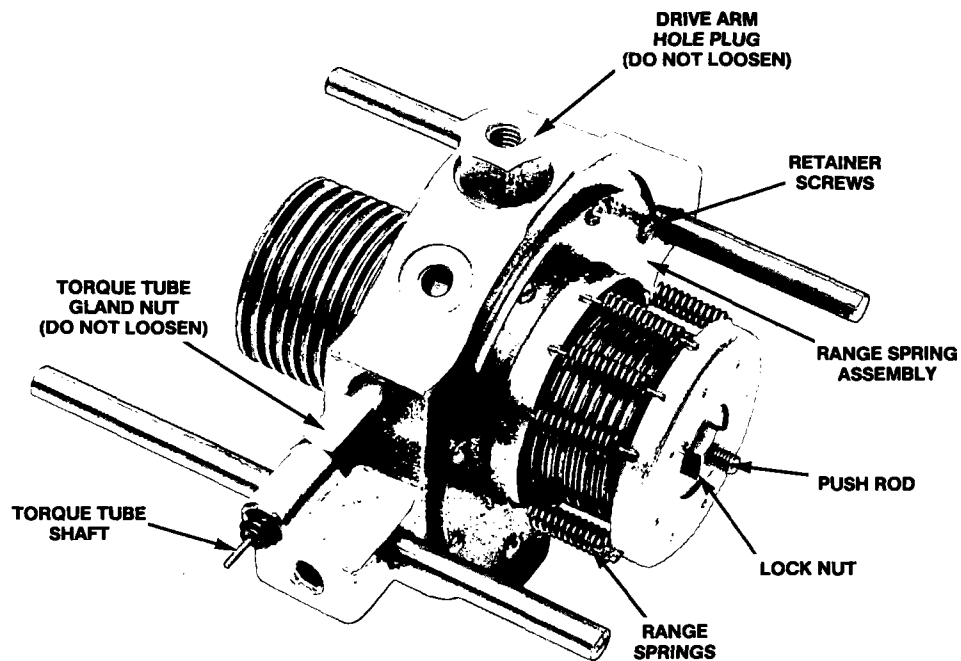
1. Remove the DPU from service and remove both pressure housings.
2. Remove accumulated material from between bellows convolutions and from inside the pressure housings. Use a solvent and brush to do this. Do not use a sharp instrument to clean between the convolutions.
3. Check for broken range springs. Replace as required.
4. Re-install the pressure housings. Use new gaskets. For pressure housing bolt torque values, see Table 2-1.

Table 2-1. Pressure Housing Bolt Torque Settings

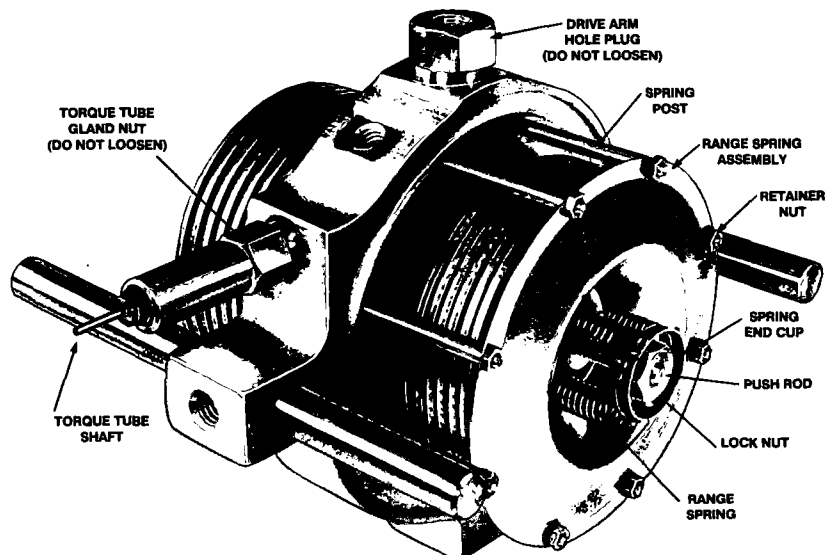
DPU SAFE WORKING PRESSURE (PSI)	HEAD BOLT SIZE (IN.)	SOCKET SIZE (IN.)	TORQUE REQUIRED (FT/LB)
1000	3/8	1/2 (12 pt.)	45
2500	1/2	5/8 (Hex)	95
3000	1/2	5/8 (Hex)	95
4500	1/2	5/8 (Hex)	95
6000	1/2	9/16 (12 pt.)	105

2-5. RANGE CHANGE

The range of the Model 199 DPU can be changed within the limits presented in Table 1-1.



2 1/8" BELLOWS UNIT ASSEMBLY



3 3/4" BELLOWS UNIT ASSEMBLY

Figure 2-1. Bellows Unit Assemblies

WARNING

**(HIGH-PRESSURE GAS INSTALLATIONS)
(PRESSURES GREATER THAN 200 PSI)**

**HIGH-PRESSURE GAS HAZARD ON DISASSEMBLY
OF DPU.**

**BEFORE REMOVING DPU HOUSING BOLTS,
PERFORM THE PRESSURE CHECK PROCEDURE
LISTED IN PARAGRAPH 2-4.**

NOTE

The calibration range of the DPU was carefully set at the factory. The following procedure maintains the original factory bellows travel setting while the range spring change is performed. This procedure must be strictly followed while changing the range spring assembly or altering the adjustment.

To replace the range spring assembly with either a new assembly of the same range or one with a different range value, proceed as follows (this procedure assumes that the DPU is either connected to an indicating instrument or fitted with a scale and pointer to measure torque tube shaft movement):

A. 2½-Inch Diameter Bellows

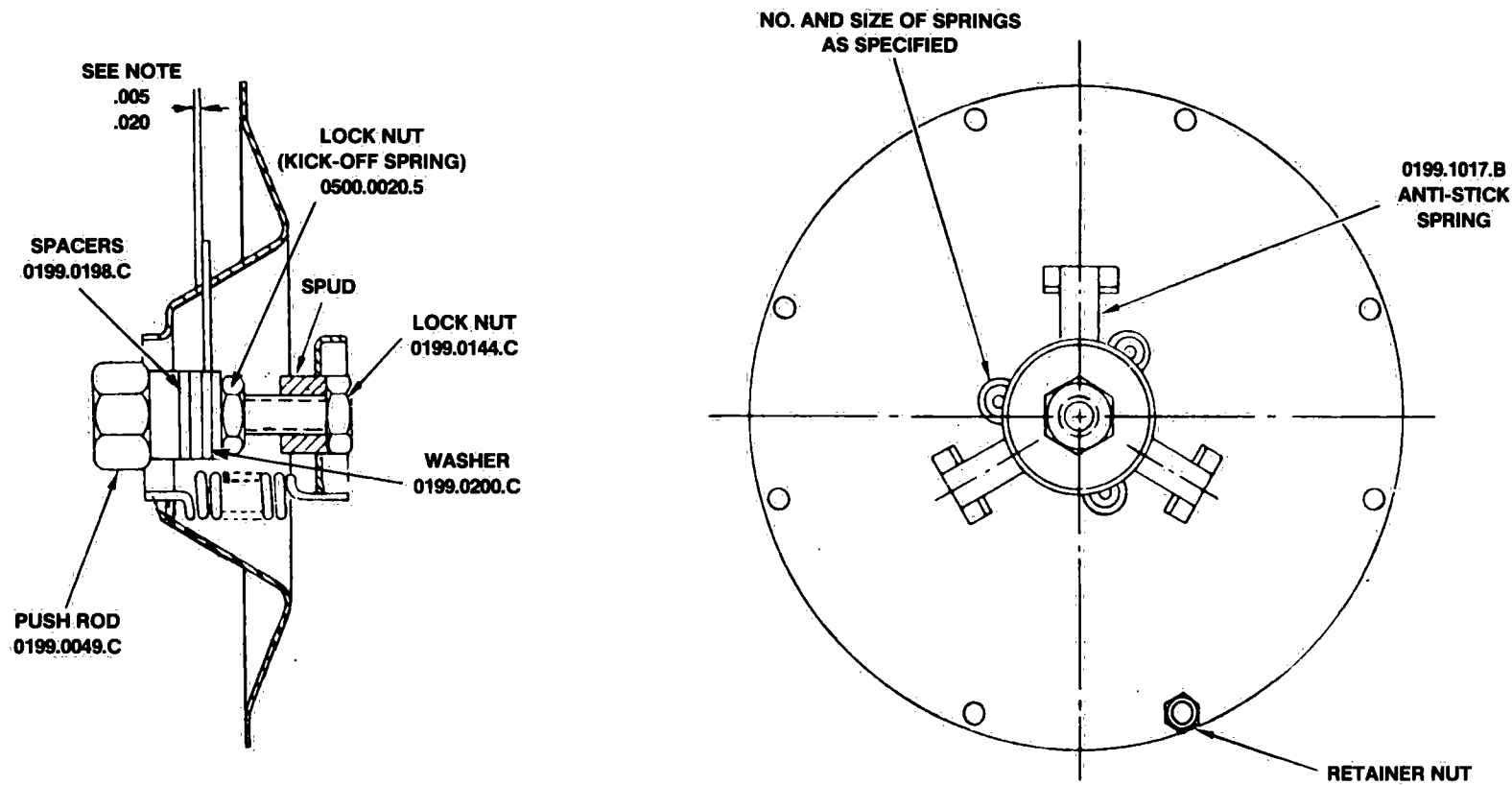
1. Remove the instrument from service.
2. Remove the pressure housing bolts and the low-pressure housing.
3. With the pointer at zero, remove the spring retainer screws, retainer springs, and the range spring assembly.

NOTE

The pointer will shift from zero. This is a normal action and the DPU should not be readjusted at this point.

4. Install the new range spring assembly onto the push rod, and replace the spring retainer screws.
5. If the pointer is set above zero, rotate the spring adjustment clockwise until the pointer is set at zero. If the pointer is below zero, rotate the spring adjustment counterclockwise until the pointer is set at zero.
6. Replace and tighten the lock nut. If the pointer shifts from zero, loosen the lock nut and reset the pointer as in step 5. Tighten the lock nut.
7. Replace the low-pressure housing and bolts (new gaskets are recommended). Use the torque values listed in Table 2-1.

Figure 2-2. Kickoff Spring Assembly



NOTE: OBTAIN $\frac{.005}{.020}$ DIM. BY ADDING SPACERS 0199.0198.C

8. Calibrate in accordance with the technical manual for the actuated instrument.

B. 3¼-Inch Diameter Bellows Without Kickoff Spring (Above 50-inches w.c.)

1. Remove the instrument from service.
2. Remove the pressure housing bolts and the low-pressure housing.
3. With the pointer set at zero, remove the lock nut, retainer nuts, and the range spring assembly. To remove the range spring assembly, rotate the assembly counterclockwise while pulling outward on the assembly.

NOTE

The pointer will shift from zero. This is a normal action and the DPU should not be readjusted at this point.

4. Thread the new assembly onto the push rod, and align the holes in the range spring assembly with the spring posts. Replace and tighten the retainer nuts.
5. Using a spanner wrench, rotate the spring adjustment until the pointer is set at **exact** zero. Replace and tighten the lock nut. The pointer must remain at the zero setting. If the pointer shifts from zero, loosen lock nut and repeat step 5.
6. Replace the low-pressure housing and bolts (new gaskets are recommended). Use the torque values listed in Table 2-1.
7. Calibrate in accordance with the technical manual for the actuated instrument.

C. 3¼-Inch Diameter Bellows With Kickoff* Spring (See Figure 2-2)

NOTE

The kickoff spring is supplied with the 0-49" w.c. and lower range DPU's as standard equipment. It is optional with 0-50" w.c. DPU's.

*Also referred to as the "anti-stick" spring.

1. Remove the instrument from service. Set the pointer (or pen) at zero, using the instrument zero adjustment.
2. Remove the pressure housing bolts and remove the low-pressure housing.
3. With the pointer set at zero, remove the lock nut, four spring retainer nuts, washer and lock nut, and range spring assembly.

NOTE

The pointer will shift from zero. This is a normal action and the pointer should not be readjusted at this time.

4. Install the range spring assembly, using a $\frac{1}{2}$ -inch open-end wrench to connect the push rod to the low-pressure bellows cup.

NOTE

The range spring assembly consists of the range springs, kickoff spring assembly, and the push rod. The assembly is furnished as a complete and assembled unit.

5. Position the range spring assembly over the retainer posts and replace the retainer nuts.
6. Insert the tubing between the range springs and tighten the inboard lock nut.
7. Zero the pointer by adjusting the spud on the push rod. Be sure that the kickoff spring is not engaged during this operation.
8. Position the kickoff spring to prevent interference with the coil springs and tighten the kickoff spring lock nut. If clearance is needed for the wrench during this operation, note the position of the spud (measure with a scale or count threads to the end of the push rod) and move the spud for the required clearance. After the lock nut is tightened, return the spud to the original position.

NOTE

The lock nut requires a special wrench for tightening. Refer to Figure 2-3 for information on how to modify a 7/16-inch, 12 point box wrench for this purpose.

9. Check the back-clearance between the kickoff spring and the slot. Use a wire feeler gage or comparable measuring device. The clearance will vary between each individual slot but must be at least 0.005-inch for any one slot to prevent interference with instrument zero. Add or remove washers as required to obtain the proper clearance. Tighten the lock nut securely.
10. Install the jam nut and lock the spud to the push rod. Hold with pliers. If spud was moved in step 9, return spud to the proper position before tightening the jam nut.
11. Apply 100 percent negative pressure to the high-pressure side of the DPU, and repeat the clearance check and adjustment of step 9.
12. Apply 100 percent positive pressure to the high-pressure side of the DPU and repeat the clearance check and adjustment of step 9.
13. Release all pressure from the instrument and replace the low-pressure housing. Use new gaskets.
14. Replace the housing bolts. Use the torque values listed in Table 2-1.

15. Calibrate in accordance with the technical manual for the actuated instrument.
16. Reattach the instrument to the mounting bracket and return to service using the applicable startup procedure (see Figures 1-3 through 1-16).

2-6. SETTING BELLOWS TRAVEL

The travel of the DPU bellows must be adjusted if one of the following occurs:

1. The range spring assembly is removed without following the procedure of Paragraph 2-5.
2. Broken range springs are replaced.
3. The indicator pointer has excessive overtravel.
4. The indicator pointer has excessive undertravel.

To set the bellows travel requires that the DPU be attached to the actuated instrument and connected to a test pressure source. The procedure for this adjustment is presented in the technical manual of the actuated instrument.

2-7. BELLOWS UNIT ASSEMBLY REPLACEMENT (See Figure 2-1)

WARNING

**(HIGH-PRESSURE GAS INSTALLATIONS)
(PRESSURES GREATER THAN 200 PSI)**

**HIGH-PRESSURE GAS HAZARD ON DISASSEMBLY
OF DPU.**

**BEFORE REMOVING DPU HOUSING BOLTS,
PERFORM THE PRESSURE CHECK PROCEDURE
LISTED IN PARAGRAPH 2-4.**

NOTICE

**IF THE DRIVE ARM HOLD PLUG IN THE TOP OF
THE ASSEMBLY CENTERPLATE IS LOOSENED,
BELLOWS FILL FLUID WILL BE LOST AND THE
UNIT WILL BE UNUSABLE. DO NOT LOOSEN THE
DRIVE ARM HOLD PLUG.**

1. Disconnect all piping connections. Loosen all pressure housing bolts and remove the instrument from service.
2. Refer to the specific instrument technical manual for components that must be removed from the actuated instrument to gain access to the bracket fasteners.
3. Loosen the actuated instrument drive arm and slide off of torque tube shaft. **Do not disconnect instrument linkage.**
4. Remove four case-retaining screws and remove case assembly.
5. *(Indicators Only)* Remove three pipe mounting bracket screws and remove bracket.
6. Remove three mounting bracket screws and remove bracket.
7. Remove pressure housing bolts and pressure housings.
8. Place pressure housings on replacement bellows unit assembly and insert and start *(only)* the pressure housing bolts.
9. Attach replacement assembly to bracket using three mounting bracket screws.
10. *(Indicators Only)* Attach pipe mounting bracket (three screws).
11. Attach case assembly using four case retaining screws.
12. Slide drive arm onto torque tube shaft and tighten locking screw.
13. Replace instrument components moved in step 2.
14. Tighten pressure housing bolts. Refer to Table 2-1 for torque values.
15. Return the instrument to service.

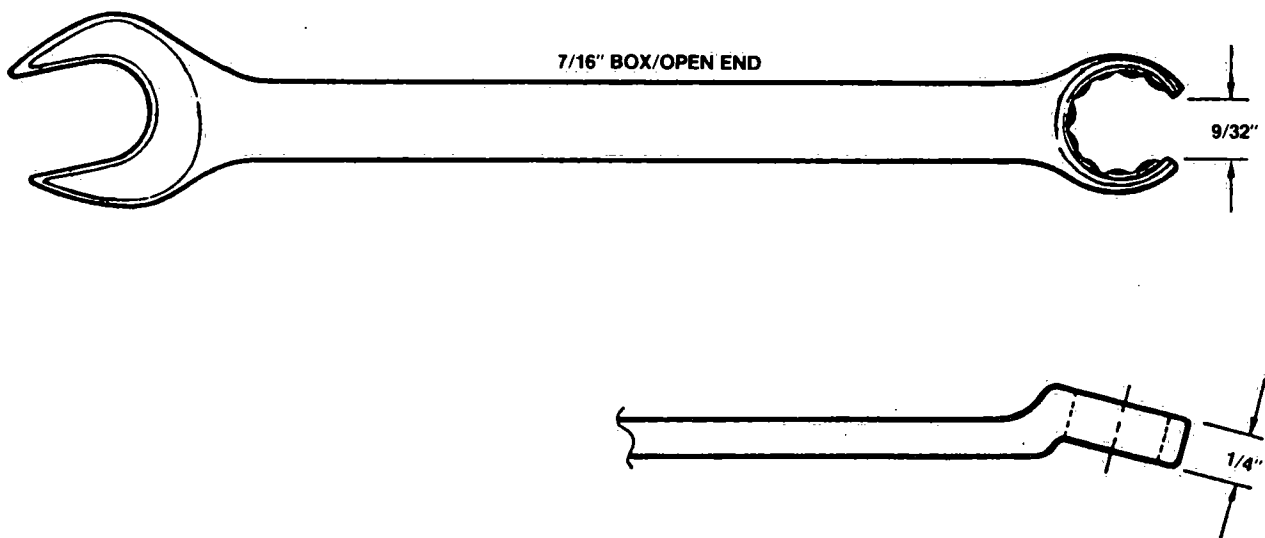


Figure 2-3. Wrench Modification (Refer to Paragraph 2-5.C.8)

2-8. CALIBRATION

All Barton instruments using the Model 199 DPU as the actuating unit are calibrated at the factory prior to shipment. All Barton differential pressure units sold as replacements or as actuators for other applications are checked for accuracy prior to shipment. Normally, a DPU is calibrated after installation as the actuating unit for an instrument. The calibration procedure to be followed is that presented in the technical manual for the actuated instrument.

The test equipment required to calibrate the DPU when attached to the actuated instrument is presented in Figure 2-4. Prior to performing any calibration procedure, exercise the unit in the manner described in Paragraph 2-1.

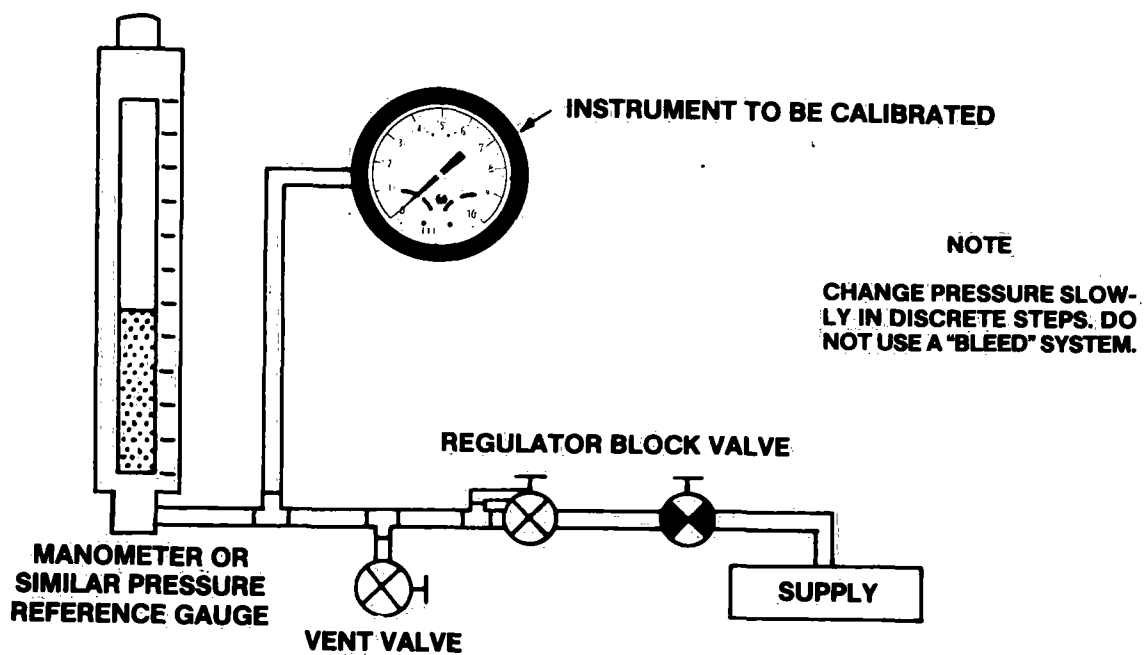
Prior to installation as a replacement unit, a DPU should be checked for proper torque tube rotation. This check is performed according to the following procedure:

1. Mount the DPU on a suitable pipe stand and connect to a standard pressure source.
2. Adapt a scale graduated by degrees to the torque tube housing.
3. Adapt a pointer to the exposed end of the torque tube shaft.
4. Apply 100 percent differential pressure to the high-pressure housing of the DPU. The pointer attached to the torque tube shaft should indicate 8 degrees of travel.

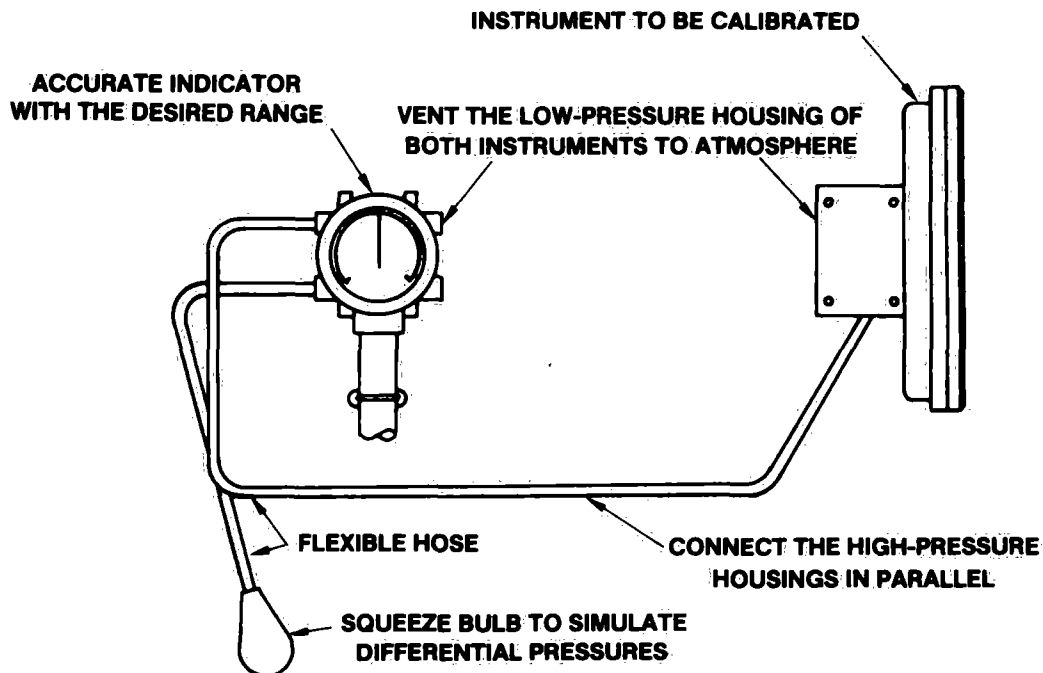
2-9. TROUBLESHOOTING

Problems associated with the operation of the DPU and its actuated instrument will usually be found to result from conditions outside of either unit. Should a problem be traced to the DPU and its actuated instrument, exercise the unit in the manner described in Paragraph 2-1 prior to performing any troubleshooting procedure. Should the problem persist following exercising of the unit, refer to Table 2-2 for suggested troubleshooting procedures.

Suggested troubleshooting procedures for the actuated instrument will be found in the Installation and Operation Manual for that unit.



TYPICAL PRESSURE CALIBRATION SETUP



PORTABLE PRESSURE CALIBRATION SETUP

Figure 2-4. Calibration Test Setup

Table 2-2. Troubleshooting Chart

Problem	Possible Source	Probable Cause	Corrective Action
Low or No Indication	Primary Element or Differential Pressure Source	Orifice installed backwards or oversized. Flow blocked upstream from run. Density changes in process media or reference leg.	Replace orifice. Clean out run or open valve. Refill reference leg with same density liquid as process media.
	Piping from Primary Element to DPU	Pressure tap holes plugged. Piping plugged. Bypass valve open or leaking. Liquids or gasses trapped in piping. Block or shutoff valves closed. Piping leaks, high-pressure side.	Clean out piping. Close bypass valve(s). Vent piping. Open block or shutoff valves. Repair leaks.
	Bellows Unit	Housing filled up with solids, restricting bellows movement. Gas trapped in housing in liquid service or liquid trapped in housing in gas service. High pressure housing leaks. DPU tampered with.	Clean out housing. Vent housing. Replace gasket. Return BUA for repair.
	Mechanism	Loose links or movements. Out of calibration. Corrosion or dirt in mechanism. Pointer loose.	Tighten or replace. Recalibrate. Clean or replace. Tighten.
Indicates High	Primary	Orifice partially restricted, or too small.	Clean out or replace.
	Piping from Primary Element to DPU	Leak in low-pressure side piping. Loss of liquid in reference leg (liquid level).	Repair. Refill reference leg.
	Bellows Unit	Gas trapped in low-pressure housing in liquid service or liquid trapped in high-pressure housing in gas service. L.P. housing gasket leaks. Range spring broken, or DPU tampered with.	Vent housing. Replace gasket. Return BUA for repair.
	Mechanism	Loose links or movements. Out of Calibration.	Repair or replace. Recalibrate.

Table 2-2. Troubleshooting Chart (Cont)

Problem	Possible Source	Probable Cause	Corrective Action
Erratic Indication	Primary	Flow pulsating.	Install dampening device upstream of DPU run.
	Piping from Primary Element to DPU	Liquid trapped in gas piping or gas bubble in liquid piping. Vapor generator incorrectly installed. Reference leg gassy or liquid vaporizing.	Remove (see startup instructions). Repipe. See piping instructions.
	Bellows Unit	Obstructed bellows travel. Gas trapped in DPU HP or LP pressure housing.	Clean bellows. Remove (see startup instructions.)
	Mechanism	Linkage dragging or dirty. Pointer dragging on scale plate.	Adjust or clean. Adjust.

SECTION 3
PARTS LIST AND DRAWINGS

3-1. COMPONENT IDENTIFICATION

The components listed in Table 3-1 are identified in Figure 3-1.

3-2. DRAWINGS

The latest revision of the following drawings are presented at the end of this section:

0199.0903.3

0199.0904.3

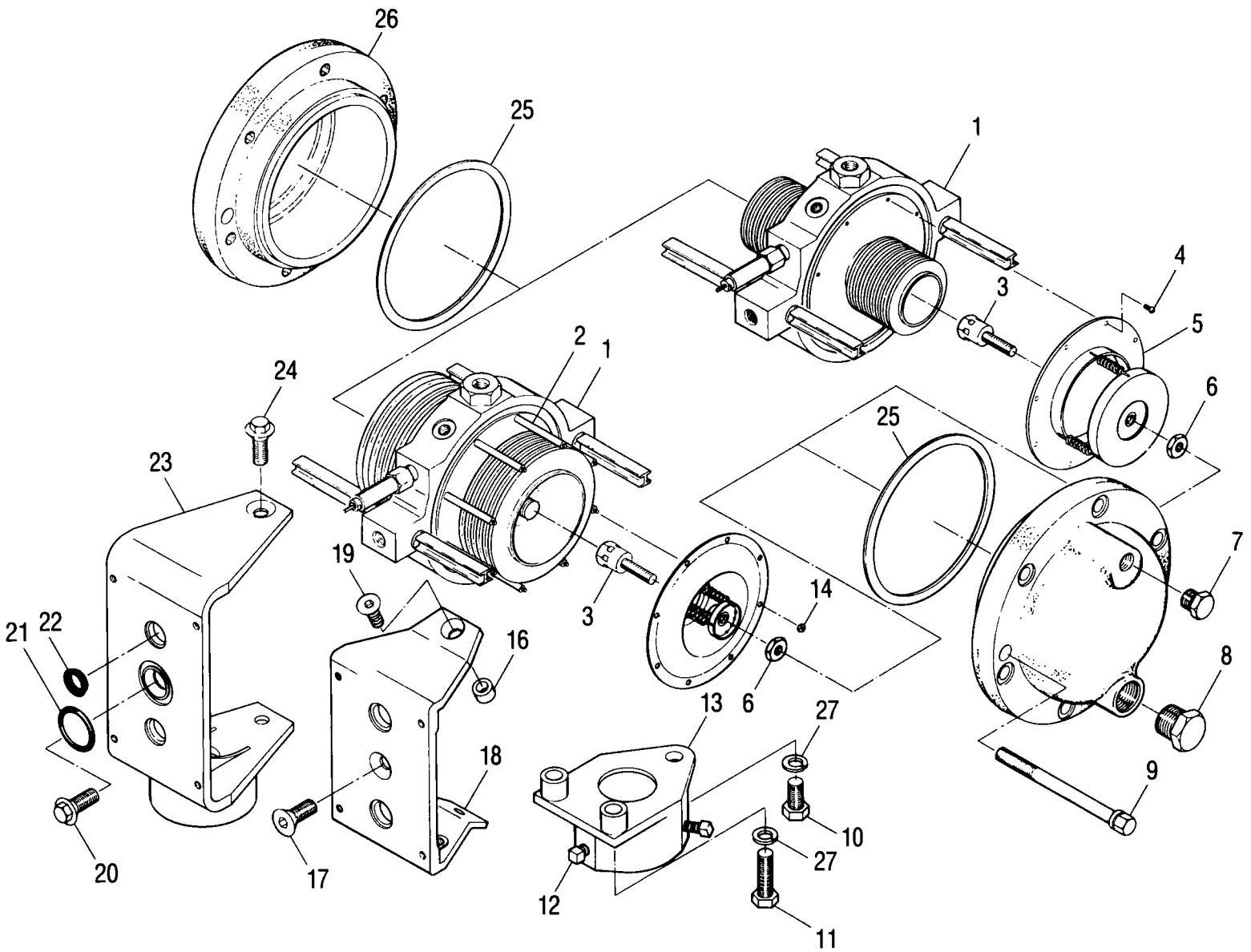


Figure 3-1. Model 199 Differential Pressure Unit Parts Identification

**Table 3-1. Parts List,
Model 199 Differential Pressure Unit**

Item	Description	Part No.	Per Unit
1	Bellows Unit Assembly	(Specify)	1
* 2	Post, Calibration Spring Retainer	0199.0019.C	8
3	Rod, Spring Push	0199.0049.C	1
* 4	Screw, Retainer, 6-32 x 5/16" (For 2 1/8" Bellows)	0111.0049.J	8
* 5	Spring Assembly, Calibration Tension (For 2 1/8" Bellows)	(Specify)	1
* 6	Nut, Lock	0199.0144.C	1
7	Plug, Pipe, 1/4" NPT, Steel	0199.0191.C	2
8	Plug, Pipe, 1/2" NPT, Steel	0199.0192.C	2
9	Bolt, Housing		A/R
	Steel, 1000 psi Units	0199.0083.C	
	Steel, 2500, 3000, and 4500 psi Units	0199.0085.C	
	Alloy Steel (Stud), 1/2-20 x 6-5/8", 6000 psi Units	0199.1001.C	
*10	Screw, Pipe Mounting Adapter	0210.0012.J	1
11	Screw, Pipe Mounting Adapter	0240.0011.J	2
*12	Screw, 3/8-16 x 5/8", Steel (For Item 13)	0310.0013.J	3
13	Adapter, Pipe Mounting	0199.0988.C	1
*14	Nut, Spring Retainer, Stainless Steel	0500.0028.J	8
*15	Assembly, Range Spring (Used with 3 3/4" Bellows Only)	(Specify)	1
16	Spacer, Indicator Bracket	0199.0006.C	2
17	Screw, Indicator Bracket	0240.0003.J	1
18	Bracket	(Specify)	1
19	Screw, Indicator Bracket	0002.1009.T	2
20	Screw, Recorder Bracket	0002.0034.T	1
*21	O-Ring (For Item 23)	0001.0033.R	1
*22	O-Ring (For Item 23)	0199.0209.C	1
23	Deleted	—	—
24	Screw, Recorder Bracket	0002.0033.T	2
*25	Gasket, Pressure Housing		2
	1000 psi Units	0199.0026.C	
	2500 and 4500 psi Units	0199.0027.C	
	1000 psi Stainless Steel Units	0199.0189.C	
	3000 and 6000 psi Stainless Steel & Monel Units	0199.0184.C	
26	Housing, Pressure	(Specify)	2
27	Washer, Lock, 3/8" (Used with Items 10 & 11)	0003.0012.K	3
28	Deleted	—	—
29	Nut, 1/2-20, 6000 and 3000 psi Monel Units (Used with Item 9)	0199.1002.C	24
*30	Plug, Dampener Valve (Not Shown)	0117.0015.J	1
31	Deleted	—	—
*32	Wrench, Range Spring Adjustment (Not Shown)	0199.0142.C	1
33	Keys, Set of Hex (Not Shown)	0202.1001.B	1

**Table 3-1. Parts List,
Model 199 Differential Pressure Unit (Cont)**

NOTES:

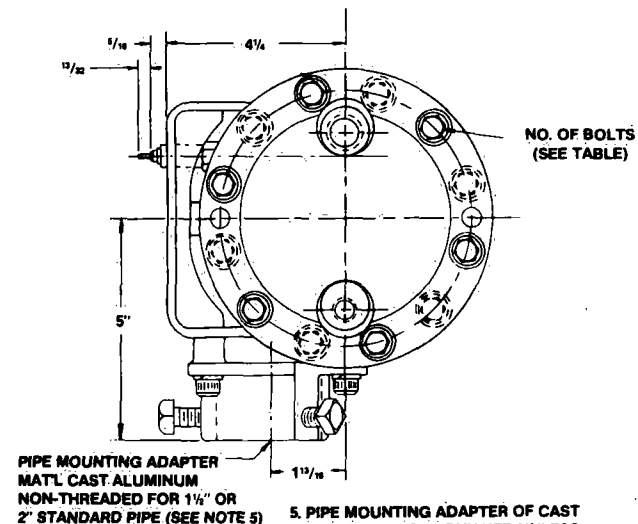
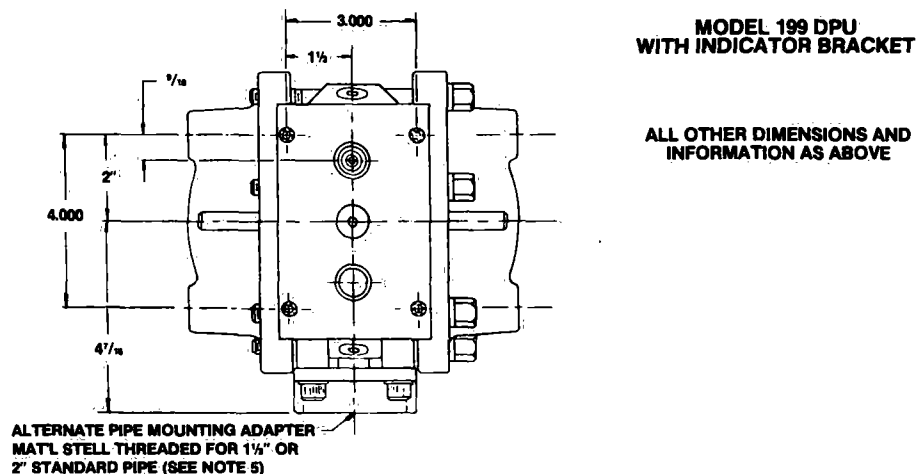
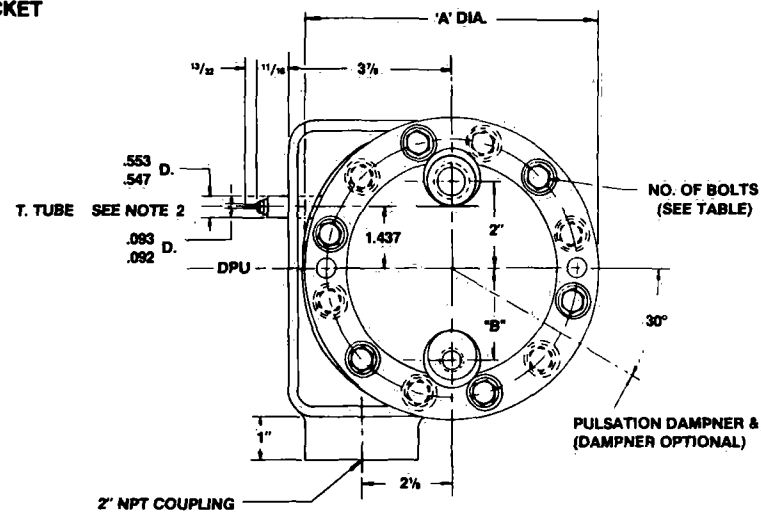
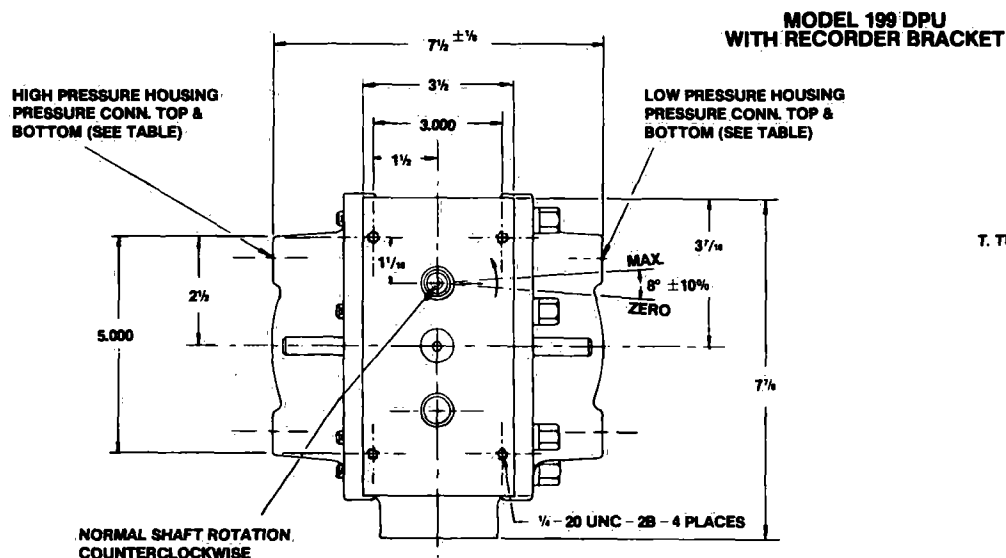
*Indicates recommended spare parts.

A/R — As Required

When ordering parts, please specify the serial number of the instrument with which they are to be used.

Figure 3-2. Model 199 DPU Outline Dimension Drawing

A-37



1000 P.S.I.	FORGED ST. ST. 316	12	6%	2 1/4	1/4 N.P.T.	1/4 N.P.T.
	CAST ALUM. 356 T8	6				
	FORGED ST. A.I.S.I. C1018	6				
2500 P.S.I.	FORGED ST. A.I.S.I. C1018					
3000 P.S.I.	CAST MONEL K 500					
4500 P.S.I.	FORGED ST. ST. 316	12	7%			
	FORGED ALLOY ST. 4142					
6000 P.S.I.	FORGED ALLOY ST. 4142			12	7%	
	FORGED ST. ST. 329					
6000 P.S.I.	FORGED ALLOY ST. 4142	12	7%			2
	FORGED ST. ST. 329					
PRESSURE RATING	HOUSING MATERIAL	NO. OF BOLTS	DIM "A"	DIM. "B"	TOP PRESS. CONNECTION	BOTTOM PRESS. CONNECTION

- PIPE MOUNTING ADAPTER OF CAST ALUM. WILL BE FURNISHED UNLESS OTHERWISE SPECIFIED. SPECIFY PIPE SIZE WHEN ORDERING THREADED STEEL ADAPTER.
- SUITABLE FOR USE WITH AMINCO FITTINGS (AMERICAN INST. CO. SILVER SPRINGS MD.) OR EQUIV.
- CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD.
- USE A 1/4 D. CLEARANCE HOLE ON CASE FOR DIMENSION MARKED
- MAXIMUM TEMPERATURE RATING 200° F

PRODUCT WARRANTY

A. Warranty:

ITT warrants that at the time of shipment the products manufactured by ITT and sold hereunder will be free from defects in material and workmanship, and will conform to the specifications furnished by or approved by ITT.

B. Warranty Adjustment:

- (1) If any defect within this warranty appears, Buyer shall notify ITT immediately.
- (2) ITT agrees to repair or furnish a replacement for, but not install, any product which within one (1) year from the date of shipment by ITT shall, upon test and examination by ITT, prove defective within the above warranty.
- (3) No product will be accepted for return or replacement without the written authorization of ITT. Upon such authorization, and in accordance with instructions by ITT, the product will be returned shipping charges prepaid by Buyer. Replacements made under this warranty will be shipped prepaid.

C. Exclusions from Warranty:

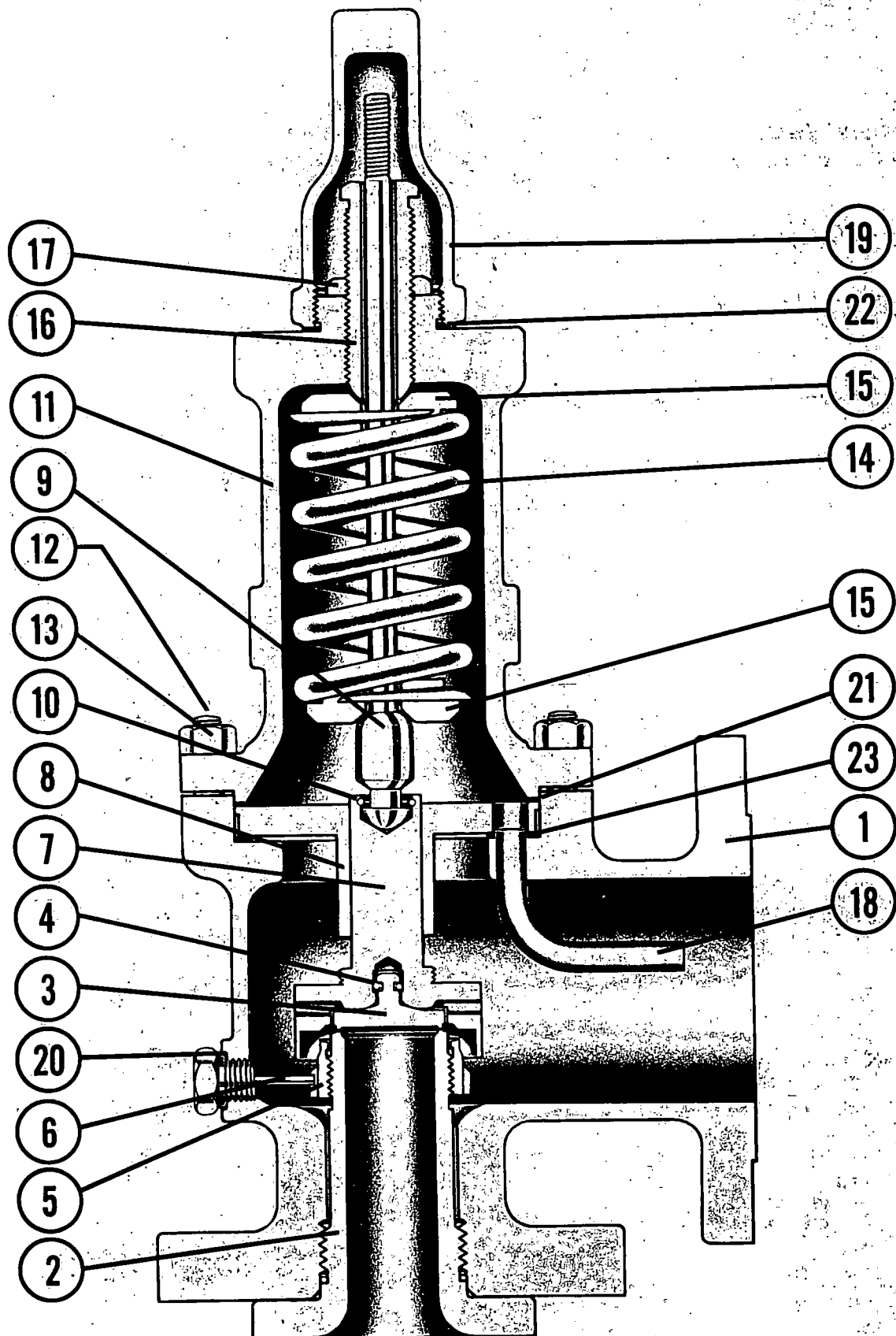
- (1) THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER EXPRESSED OR IMPLIED WARRANTIES OR MERCHANTABILITY, OR FITNESS, OR OTHERWISE.
- (2) Components manufactured by any supplier other than ITT shall bear only the warranty made by the manufacturer of that product, and ITT assumes no responsibility for the performance or reliability of the unit as a whole.
- (3) "In no event shall ITT be liable for indirect, incidental or consequential damages nor shall the liability of ITT arising in connection with any products sold hereunder (whether such liability arises from a claim based on contract, warranty, tort or otherwise) exceed the actual amount paid by Buyer to ITT for the products delivered hereunder."
- (4) The warranty does not extend to any product manufactured by ITT which has been subjected to misuse, neglect, accident, improper installation or to use in violation of instructions furnished by ITT.
- (5) The warranty does not extend to or apply to any unit which has been repaired or altered at any place other than at ITT's factory or service locations by persons not expressly approved by ITT.



Barton
ITT Fluid Technology Corporation

Barton Instruments Company 900 South Turnbull Canyon Rd., City of Industry, CA 91749
Telephone (818) 961-2547 Telex 67-7475

Consolidated® Safety Relief Valves
For Gas, Vapor, and Liquid Service—1900 Series 2-7



**Steel, Flat Seat, Top Guided,
High Capacity, Stainless Steel Trim**
Class Ratings

150, 300, 600, 900, 1500, 2500 psig (bar)

Temperature Ratings

100°F (37.8°C), 450°F (232°C),
800°F (426.7°C), 1000°F (537.8°C)

Orifice Sizes

Lettered "D" through "T"

Inlets-Outlets

1" x 2" through 8" x 10" ANSI Flanged

Accessories

Caps, lifting levers, gags.
Page 2-43.

Dimensions and Weights

Page 2-30.

Standard Specifications

Closed bonnet with screwed cap over
adjusting screw.

Valve Selection Charts

Section 5

Orifice Capacity Tables

Section 4

Part No./Name		Materials
1	Base: Types 1905/1906/1910/1912/1914/1916/1918 Base: Types 1920/1921/1922/1923/1924/1926/1928	ASTM A216 Grade WCB Carbon Steel ASTM A217 Grade WC6 Alloy Steel
2	Nozzle	ASTM A182 Grade F316 Stainless Steel
3	Disc	ASTM A479 Type 316 Stainless Steel
4	Disc Retainer	17-7 PH Stainless Steel
5	Adjusting Ring	ASTM A743 Grade CA-15 Stainless Steel
6	Adjusting Ring Pin	AISI 416 Stainless Steel
7	Disc Holder	ASTM A479 Type 304 Stainless Steel
8	Guide	ASTM A479 Type 430 Stainless Steel
9	Spindle	ASTM A276 Type 410 Stainless Steel
10	Spindle Retainer	17-7 PH Stainless Steel
11	Bonnet	ASTM A216 Grade WCB Carbon Steel
12	Stud	ASTM A193 Grade B7 Alloy Steel
13	Nut	ASTM A194 Grade 2H Steel
14	Spring—Types 1900()c Spring—Types 1900()t	Carbon Steel Tungsten Steel*
15	Spring Washer	AISI C1020 Carbon Steel
16	Adjusting Screw	ASTM A276 Type 416 Stainless Steel
17	Adjusting Screw Nut	AISI 416 Stainless Steel
18	Eductor Tube	AISI 304 Stainless Steel
19	Cap	ASTM A216 Grade WCB Carbon Steel
21	Bonnet Gasket	Soft Iron
23	Guide Gasket	Soft Iron
20	Adjusting Ring Pin Gasket	AISI 316 Stainless Steel Asbestos Filled
22	Cap Gasket	AISI 316 Stainless Steel Asbestos Filled

Note: Alternate materials available. See Section 5.

*Springs with wire size ½" & smaller will be supplied in Inconel X-750 material.



Johnson Controls, Inc.
Control Products Division

1007 South 12th Street
Watertown, WI 53094

Series H19 BASO® Valve For Use With Pressures Up To And Including 25 PSIG (172 kPa)

Application

The H19 high pressure valves are designed for commercial and industrial applications (including industrial heaters, crop dryers, etc.) with gas pressures of up to and including 25 PSIG. These valves stop gas flow to the pilot and main burner in the event of pilot flame failure. They may be used with manufactured, natural, mixed and LP gases.

NOTE: This unit should be used only in applications which are within the limitations and provisions of the applicable American National and/or U.L. standards.

Installation

CAUTION: Gas supply should be shut off at the manual shutoff valve before installing the gas valve.

The H19 valves may be mounted in any convenient position and are suitable for operation over a temperature range of -40 to 150°F (-40 to 66°C).

When installing the valve on the manifold, be sure the gas flows through the valve body in the direction indicated by the arrow on the body of the valve. If the valve is installed with the gas flow opposite the arrow, leakage can occur. When installing the valve, use a wrench only on the casting flats located at the inlet and outlet ends of the valve.

Before assembling use an approved pipe-joint sealing compound on the male threads. Take care to see that excess compound does not work into the valve and get onto the valve seats. Threads of pipe and

nipples must be smooth and free of tears and burrs.

All piping should be steam cleaned to remove foreign substances such as cutting oil or threading chips. A sediment trap should also be installed in accordance with the National Fuel Gas Code (ANSI Z223.1.) (See Fig. 2)

Attach the thermocouple securely to the pilot burner and screw the terminal end to the BASO thermocouple terminal on the valve. Be sure this electrical connection is clean and tight.

Attach the pilot gas line to the pilot burner fitting and to the pilot gas outlet of the H19 valve.

Checkout Procedure

After installation is complete, test for leaks with a soap solution.

1. Close the manual shutoff valve and wait at least five minutes for unburned gas to escape from the appliance; then reopen the manual shutoff valve.

CAUTION: During the resetting cycle, gas will flow to both the main and pilot burners on H19RA and H19TA valves.

2. Depress the reset button and light the burner being served. (If appliance is equipped with a pilot burner, light the pilot burner.)
3. Continue to hold down the reset button 30 to 45 seconds or until the burner continues to burn when the button is released.

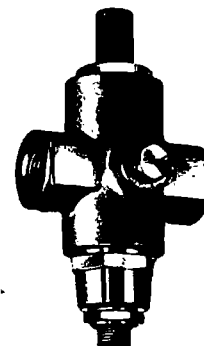


Fig. 1—H19 BASO Valve

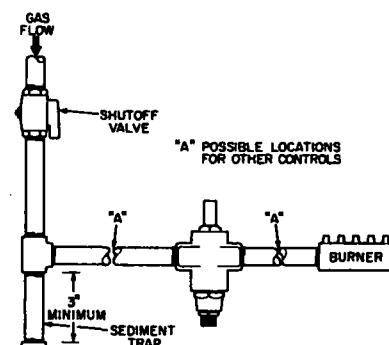


Fig. 2—Drawing showing installation of sediment trap in a manually operated system.

4. Extinguish the burner by closing the manual shutoff valve and then verify that the valve has dropped out within 90 seconds.

Before leaving the installation, observe at least three complete operating cycles to see that all components are functioning correctly.

Pilot Service

If pilot flame problems occur check the following:

1. If the pilot flame burns yellow it may be due to dirt or lint that has covered the lower portion of the pilot burner. This can be removed with a soft brush or by vacuuming.
2. A flame approximately ½ inch high, must surround the thermocouple tip.
3. Since this is an electrical connection, the thermocouple lead connection to the BASO power unit must be tight, clean and free of grease.

Repairs and Replacement

CAUTION: Turn Off gas at the manual shutoff valve next to the appliance **BEFORE** attempting to loosen any gas connections.

Non-operation may be due to thermocouple output. Before replacing the H19, check the thermocouple output and the power unit dropout.

Check the millivoltage output of the thermocouple and the milliamp dropout range at the BASO power unit to see that they meet the values given in Table 1 and Table 2. Step-by-step procedures for these checks are included with the BASO Test Kit Y99AB.

The H19 is not repairable. Any attempts to repair this assembly voids the manufacturer's guarantee. For a replacement valve contact the nearest Johnson Controls wholesaler.

Table 1

Thermocouple Output

Thermocouple Lead Type	Turn Down	mV Range	
		Normal	Not Less Than
K15D (88D)	4 mV	20 to 28	15
K16B (87D)	4 mV	25 to 35	17

Table 2

Dropout Range

mA Range of Power Unit Assembly		Thermocouple Lead Type and Lengths
Low	High	
100	300	K15D (88D) Up to 48" Incl. K16B (87D) 60" to 72" Incl.

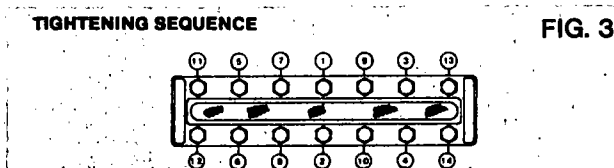
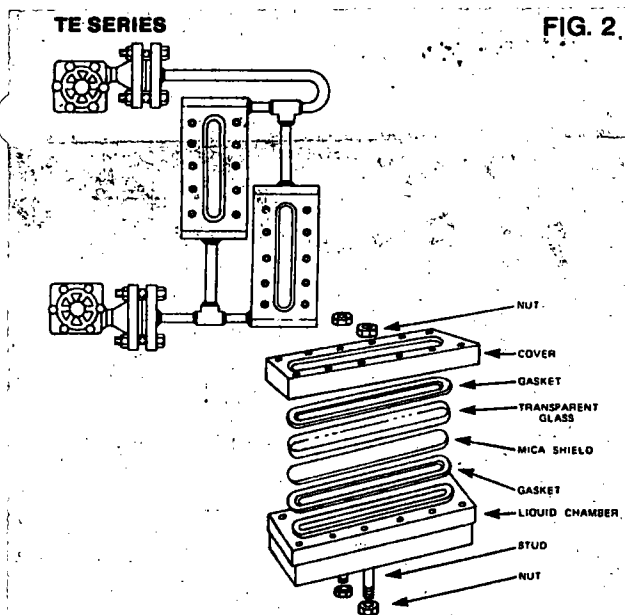
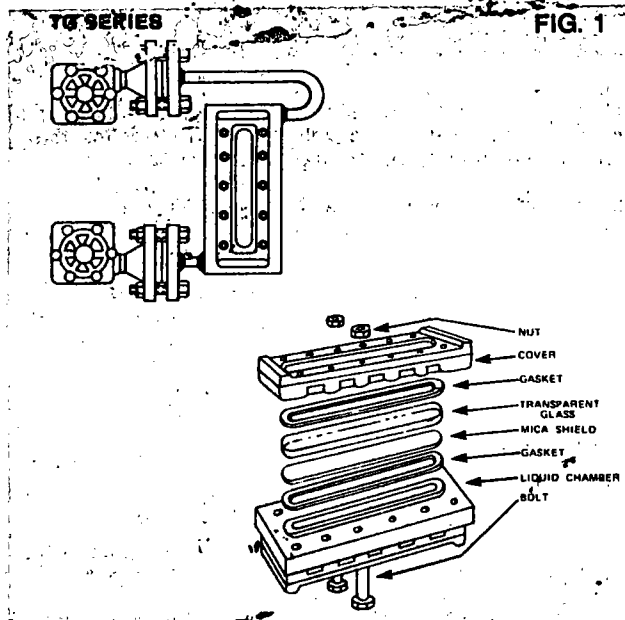
THESE DESIGNS TESTED TO ANS Z21.20 AUTO. IGNITION SYSTEMS

NOTE: This unit should be used only in applications which are within the limitations and provisions of the applicable American National and/or U.L. standards.

Gauges

Parts and maintenance

CATALOGUE	1000
SECTION	1800
PAGE	2
ISSUED	6/82



NOTES:

Components below chamber are assembled in the same sequence as those above the gauge.

- 2) When ordering replacement parts, quote model number shown on Gauge cover.
Replacement glasses and gaskets are available through our DISTRIBUTOR'S WAREHOUSES.

MAINTENANCE PROCEDURES FOR STEAM WATER GAUGES

A) DISASSEMBLY

Prior to disassembly of the gauge, ensure that the gauge is relieved of all internal pressure, and the temperature is ambient. Failure to follow this procedure may result in a sudden release of pressure and/or glass breakage. Remove parts in the reverse order of figures No. 1 or 2, i.e. bolts, cover, glass and chamber.

B) MAINTENANCE

- 1) Liquid chambers and covers must be absolutely clean, flat and free of warp. Ensure that all burrs, dirt and gasket material are removed with a soft scraper, preferably brass. Care has to be taken to avoid gouging or scratching of the gasket surface, which may result in gasket leaks or high stress points.
- 2) Use only new gaskets, glass and mica.
- 3) Before installing the new glass, inspect the glass for surface flaws which may reduce its mechanical strength and avoid bumping or sliding the polished surface across any object.
- 4) Assemble components in the sequence shown.
- 5) Tighten nuts for partial loading on first pass according to the numerical sequence detailed in Fig. 3. Make further tightening passes in the same sequence increasing bolt torque in increments of about 5 ft-lbs (69 kg-cm) until recommended torque loading of 35 to 40 ft-lbs (483 to 552 kg-cm) is reached.
- 6) Hydrostatic test for TG series — 975 PSI (6,75 MPa)
TE series — 2250 PSI (15,5 MPa)
- 7) Blow out gauge internally with air.

INSTALLATION

- 1) Warm up gauge by opening drain valve and cracking open upper gauge valve. A light flow of condensate should be circulated through the gauge for approximately (30) thirty minutes.
Caution: Excessive flow of condensate through gauge can damage mica shields.
- 2) After warm-up is completed, close upper gauge valve, and with drain valve open, re-tighten studs and nuts in sequence, except that initial re-tightening should start at approximately 25 foot-pounds (345 kg-cm)
- 3) Re-heat for additional five (5) minutes using same procedure as outlined in paragraph 1.
- 4) Cut gauge into service by closing drain valve and slowly opening both upper and lower gauge valves to fully open position.
- 5) After gauge has been in service for three (3) to twenty-four (24) hours it should be re-tightened to the original torque as outlined in paragraph (5) five of maintenance section. Re-tightening should not be attempted until both gauge valves have been closed and drain valve is opened.
- 6) For replacement of gaskets, shields and glass follow paragraphs 1 to 5 of MAINTENANCE SECTION.
- 7) Where a gauge is isolated for a period of time in a system then steps 1 thru 6 of INSTALLATION SECTION above should be repeated.
- 8) For High Temperature applications where continuous variations occur it may be necessary to re-torque bolts to the recommended torque following such fluctuations. Spring metallic disc washers could be considered under nuts which may eliminate the need for re-torquing, however special bolts may be required at additional cost.

penberthy inc.

21 Keefer Road, Group Box 11, St. Catharines, Ontario, Canada L2M 6K4 Ph: 937-3242, Telex 061-5112

Parts and maintenance

FIG. 1

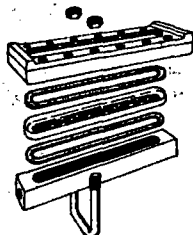


FIG. 2

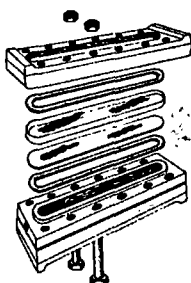
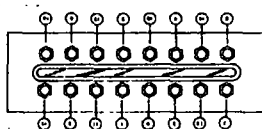


FIG. 3



MAINTENANCE PROCEDURES FOR FLAT GLASS LEVEL GAUGES

A) DISASSEMBLY

Prior to disassembly of the gauge, ensure that the gauge is relieved of all internal pressure, and the temperature is ambient. Failure to follow this procedure may result in a sudden release of pressure and/or glass breakage.

Remove parts in the reverse order of figures No. 1 or 2, i.e. bolts, cover glass and chamber.

B) MAINTENANCE

- 1) Liquid chambers and covers must be absolutely clean, flat and free of warp. Ensure that all burrs, dirt and gasket materials are removed with a soft scraper, preferably brass. Care has to be taken to avoid gouging or scratching of the gasket surface, which may result in gasket leaks or high stress points.
- 2) Use only new gaskets, glass and mica.
- 3) Before installing the new glass, inspect the glass for surface flaws which may reduce its mechanical strength and avoid bumping or sliding the polished surface across any object.
- 4) Assemble components in the sequence shown.
- 5) Tighten nuts for partial loading of first pass according to the numerical sequence detailed in FIG. 3. Make further tightening passes in the same sequence increasing bolt torque in increments of about

5 ft-lbs (60 kg-cm) until recommended torque loading is reached. See Table 1 for recommended torques.

- 6) Subject gauge assembly to hydrostatic test for pressures cited by Tables below.
- 7) Blow out gauge internally with air.
- 8) Where a gauge is isolated for a period of time in a system then step 5 above should be repeated.
- 9) For High/Low Temperature applications where continuous variations occur it may be necessary to re-torque bolts to the recommended torque following such fluctuations. Spring metallic disc washers could be considered under nuts which may eliminate the need for re-torquing, however special bolts may be required at additional cost.

TABLE 1

GAUGE TYPE		RX, TX		TC, TC		RS, TS, RP, TP RD, TD, RK, TK		RW, TW, TZ		RB, TB	
TORQUE FT.-lbs	KG-CM	30-35	414-484	37-43	511-594	45-50	621-690	60-65	828-897	30-35	414-484

TABLE 2 REFLEX GAUGES

RX GROUP			RC GROUP			RS, RD, RK GROUPS			RW GROUP			RB GROUP		
GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE	
	PSI	MPa		PSI	MPa		PSI	MPa		PSI	MPa		PSI	MPa
RX-11	3600	24,9	RC-11	4050	28,0	RS-11	4500	31,1				RB-11	1500	10,3
RX-12	3490	24,1	RC-12	3930	27,1	RS-12	4370	30,2				RB-12	1455	10,0
RX-13	3380	23,3	RC-13	3770	26,0	RS-13	4230	29,3				RB-13	1410	9,7
RX-14	3270	22,6	RC-14	3680	25,4	RS-14	4090	28,2	RW-14	5400	37,3	RB-14	1365	9,4
RX-15	3150	21,7	RC-15	3540	24,4	RS-15	3950	27,3	RW-15	5220	36,0	RB-15	1313	9,1
RX-16	3040	21,0	RC-16	3410	23,5	RS-16	3810	26,3	RW-16	5040	34,8	RB-16	1268	8,8
RX-17	2930	20,2	RC-17	3290	22,7	RS-17	3660	25,3	RW-17	4860	33,6	RB-17	1223	8,4
RX-18	2820	19,5	RC-18	3170	21,9	RS-18	3520	24,3	RW-18	4680	32,3	RB-18	1170	8,1
RX-19	2700	18,6	RC-19	3040	21,0	RS-19	3380	23,3	RW-19	4500	31,1	RB-19	1125	7,8

TABLE 3 TRANSPARENT GAUGES

TX GROUP			TC GROUP			TS, TD, TK GROUPS			TW GROUP			TB GROUP		
GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE		GAUGE MODEL	TEST PRESSURE	
	PSI	MPa		PSI	MPa		PSI	MPa		PSI	MPa		PSI	MPa
TX-11	3000	20,7	TC-11	3380	23,3	TS-11	3750	25,9				TB-11	1200	8,3
TX-12	2730	19,9	TC-12	3100	21,4	TS-12	3480	24,0				TB-12	1163	8,0
TX-13	2450	16,9	TC-13	2820	19,5	TS-13	3200	22,1				TB-13	1125	7,8
TX-14	2160	14,9	TC-14	2540	17,5	TS-14	2910	20,1	TW-14	3900	26,9	TB-14	1095	7,6
TX-15	1880	13,0	TC-15	2250	15,6	TS-15	2630	18,1	TW-15	3720	25,7	TB-15	1058	7,3
TX-16	1600	11,0	TC-16	1970	13,6	TS-16	2350	16,2	TW-16	3540	24,4	TB-16	1013	7,0
TX-17	1320	9,1	TC-17	1690	11,7	TS-17	2070	14,3	TW-17	3360	23,2	TB-17	975	6,7
TX-18	1040	7,2	TC-18	1410	9,7	TS-18	1790	12,4	TW-18	3180	22,0	TB-18	938	6,5
TX-19	750	5,2	TC-19	1130	7,8	TS-19	1500	10,4	TW-19	3000	20,7	TB-19	900	6,2

NOTE:

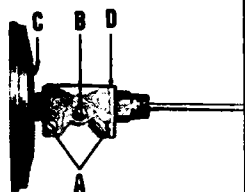
- 1) Test pressure shown above are 1-1/2 times the maximum working pressure at 100°F (40°C) and apply to all multiples of gauges shown.
- 2) Assemble Reflex Glass with prisms facing down so that prisms are in contact with process fluid.
- 3) Protector shields must not be used on Reflex Gauges as this prevents the refractive nature of the prisms.

- 4) Mica or other material as required by process.
- 5) Components below chamber are assembled in the same sequence as those above the chamber.
- 6) When ordering replacement parts, quote model number shown on Gauge cover.
- 7) Replacement glasses and gaskets are available through our DISTRIBUTOR'S WAREHOUSES.

INSTRUCTIONS FOR POSITIONING & INSTALLING SERIES B83600 & B85600 ADJUSTABLE ANGLE DIAL THERMOMETERS

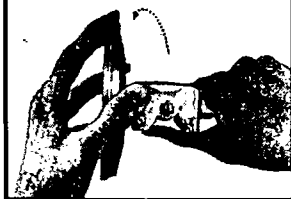
CAUTION: Thermometer head can be rotated only when in back-connected position (Fig. 2).
Never rotate head when in angled position (Fig. 3)

Fig. 1



To rotate thermometer head up to 360°, make certain thermometer is in back-connected position as shown in Fig. 1. Loosen 2 screws (A) until harness (D) revolves freely.

Fig. 2



Now hold thermometer head and adjustable harness (D) as shown in Fig. 2, and rotate head to desired position. Retighten screws (A) as shown in Fig. 1.

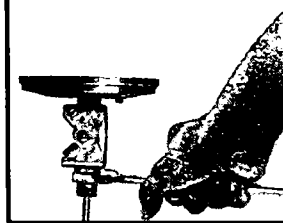
Fig. 3



To tilt thermometer head up to 90° angle, loosen 1/2 TURN ONLY, 2 screws (B) on both sides of harness as shown in Fig. 1.

Tilt to desired angle and retighten both screws (B) as shown in Fig. 1.

Fig. 4



To install thermometer into threaded connection, always tighten hex nut with wrench only as shown in Fig. 4.

NEVER USE HEAD OF THERMOMETER OR ADJUSTABLE HARNESS AS A HANDLE FOR TIGHTENING. SEVERE DAMAGE WILL RESULT.

Trerice
BI-METAL THERMOMETERS
Installation & Calibration Instructions

SERIES B83100, B83200, B83400, B83600, B85100, B85200, B85400, B85600, B82200Y, B82105P

CAUTION

Thermometers can be rendered inaccurate during shipment despite care taken in packaging. To assure the accuracy to which the thermometer was manufactured, it should be checked before use.

When installing the thermometer into a threaded connection, always tighten with a wrench on the hex nut. (Never use the head of the thermometer for tightening.)

Bi-Metal thermometers should be installed in thermowells on all pressure and velocity applications to protect the stem from corrosion and/or damage.

CALIBRATING INSTRUCTIONS

1. A very accurate master thermometer should be used for calibration.
2. Immerse Trerice thermometer together with a master thermometer into an agitated liquid for at least three minutes. Compare thermometers. **IMPORTANT – For most accurate reading, at least three inches of the stem must be immersed in the liquid.** The master thermometer should also be immersed to the same depth.
3. A slotted hex head calibrating screw is provided on the back of the thermometer case.
4. With a 1/4 inch wrench or screw driver, turn the screw until the pointer reads the exact temperature.

NOTE: Series B83100, B85100 & B82100Y - cannot be recalibrated.

H. O. TRERICE CO.

Temp. Controls

TEMPERATURE CONTROLLERS

(bi-metal)

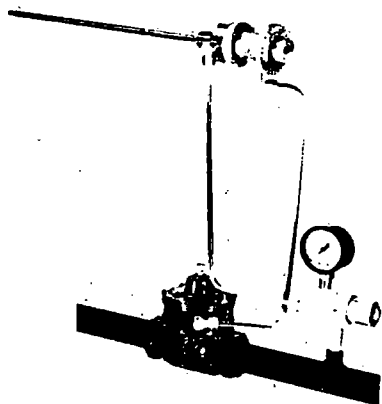
-30° to 750° F / -34° to 399° C

First choice in the field
since 1948

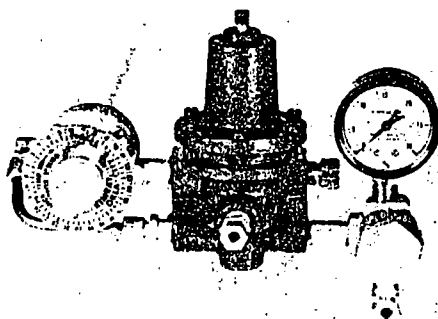
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Oil & Gas Equipment & Controls

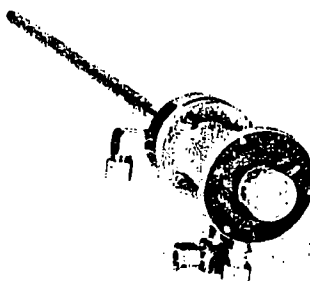
H

**TC12 or TC18 THROTTLE**

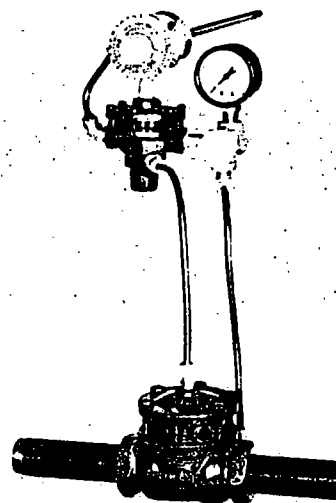
Page 5

**T12TDA or T118T DA THROTTLE**

Page 11

**HT12 or HT 18 BASE ASSEMBLY**

Page 3

**12S or T18S SNAP**

Page 7

FEATURES:

Stainless, bi-metal sensing element.
 Accurate control over full range.
 Air or gas operated non-bleed pilot.
 Single adjustment — Easy to set.
 No springs or orifices to change.
 Temperature ranges:
 —30°F to 400°F, -34°C to 204°C
 —30°F to 750°F, -34°C to 399°C

APPLICATIONS:

Indirect heaters
 Emulsion treaters
 Reboilers
 Steam generators
 Heat exchangers
 Cooler shutter controller
 Salt bath heaters

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Dual Temperature Control	2
Thermostat Base Assemblies	3
"TC" Throttle Temperature Controller	5
Separable Sockets (Thermostat Wells)	6
Snap Action Thermostat	7
Indirect Throttle Action Thermostat	9
Direct Throttle Action Thermostat	11
High Temperature Shut-Down Thermostat	13
Throttle Action Temperature Controller—All Steel	15

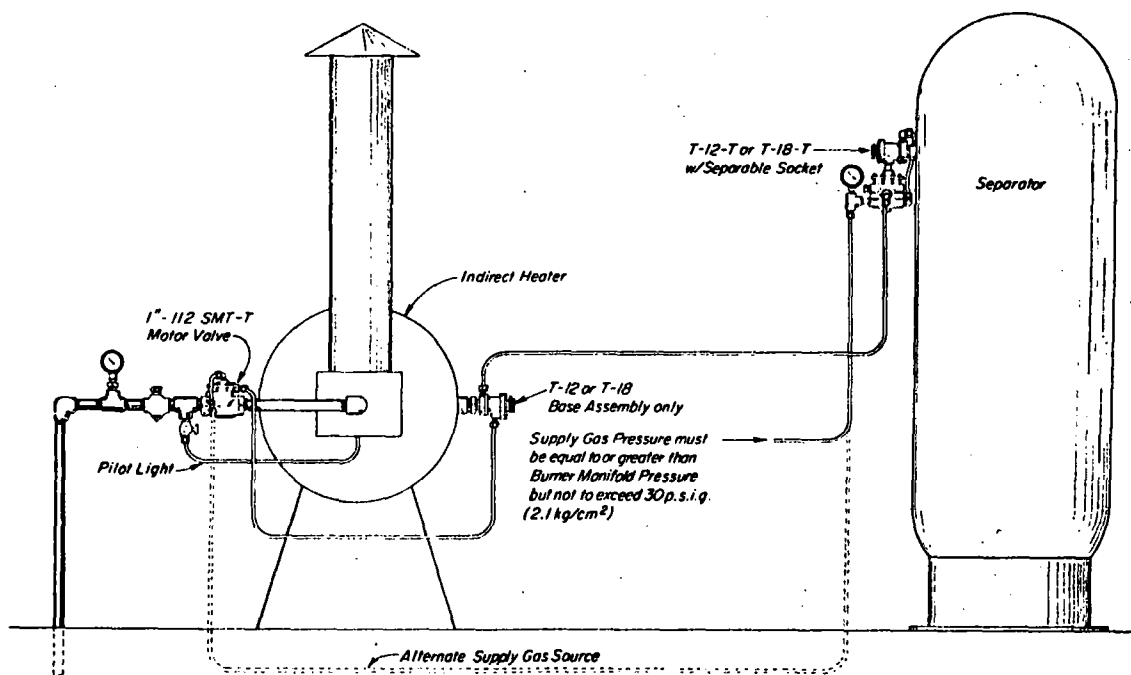
CONSTRUCTION:

The bi-metal sensing element consists of a low expansion nickel alloy inside a stainless steel tube. Other vital parts are also made of stainless steel. Diaphragms and "O"-rings are made of oil resistant synthetic rubber. All mild steel and iron casting parts are nickel plated to resist corrosion.

The maximum working pressure of the sensing element is 500 p.s.i.g. (35.15 kg/cm²). A separable socket (thermostat well) is available, at extra cost, to raise the working pressure to 10,000 p.s.i.g. (703.07 kg/cm²). See page 6 for list of available separable sockets.

DUAL TEMPERATURE CONTROL:

The installation shown and described below will maintain a uniform temperature at the separator regardless of the flow rate or ambient air temperature provided, of course, the heater is properly sized. Also the heater will be maintained at the minimum possible temperature which conserves fuel gas. The thermostat on the heater provides for high temperature safety shut-off to prevent the water boiling away.

DUAL TEMPERATURE CONTROL INSTALLATION**INSTALLATION:**

Install T12 or T18 Base Assembly in heater. Install T12T or T18T Thermostat in the separator or gas line where it is desired to maintain a constant temperature. All piping between the thermostats should be buried below the frost line.

OPERATION:

The thermostat in the separator or gas line controls the firing of the heater by sending its output signal through the T12 or T18 base assembly to the motor valve. If the temperature in the heater approaches boiling, the T12 or T18 base assembly becomes the controlling thermostat.

Thermometers should be used to accurately set temperatures. To start operation, set both thermostats to a temperature above 212° F (100°). When the heater bath reaches the maximum desired temperature (less than boiling), reduce the setting of the thermostat located on the heater until the motor valve closes, shutting off the burners. This sets the high temperature shut-off point. The thermostat on the separator or gas line can now be set for the desired gas temperature.

BASE ASSEMBLIES

ACTION:

Indirect throttle; Pilot Output Pressure (Yellow)
decreases with temperature rise.

WORKING PRESSURE (sensing element):

psi	kg/cm ²	
500	35.15	max. without Separable Socket
4000	281.22	max. with Separable Socket
10000	703.77	max. with Special Separable Socket

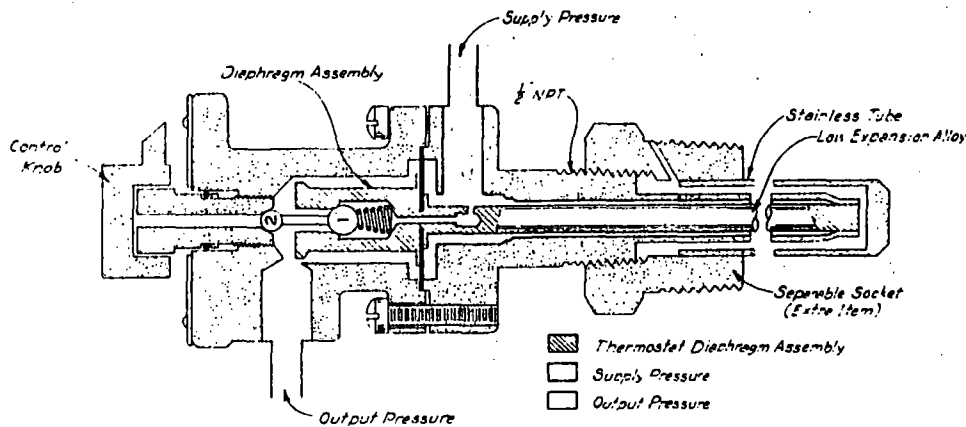
Separable Socket is an extra price item and must be specified on order, if desired. See page 6 for available sockets.

THROTTLING RANGE:

T12—1¼ lbs./°F, .22 kg/cm²/°C
T18—2½ lbs./°F, .31 kg/cm²/°C
HT12—2½ lbs./°F, .31 kg/cm²/°C
HT18—3¼ lbs./°F, .47 kg/cm²/°C

SUPPLY PRESSURE:

5 lb. min. to 30 lb. max.
.35 kg/cm² to 2.11 kg/cm² max.



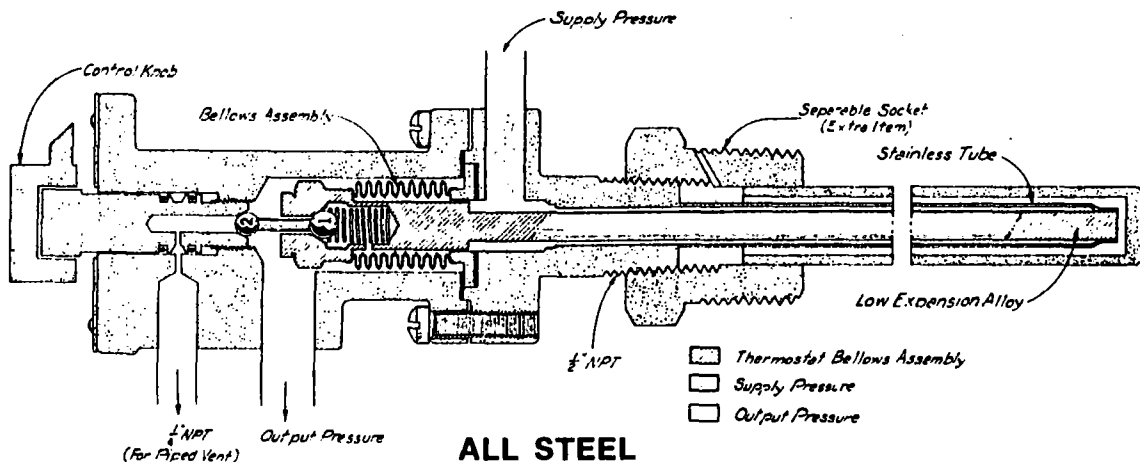
T12 or T18 BASE ASSEMBLY (for temperatures -30°F to 400°F, -34°C to 240 °C)

OPERATION (Either Assembly):

Assume the set temperature of the Thermostat is above that of the system. The Vent at Ball 2 is closed and the Inlet at Ball 1 is open. Output Pressure (Yellow) is being sent to any Pilot or Motor Valve.

As the temperature rises in the system, the Stainless Tube increases in length to move the Thermostat Diaphragm (or Bellows) Assembly in a direction to first close the seat at Ball 1 (Red to Yellow) and open the seat at Ball 2 (Yellow to Atmosphere). Output Pressure (Yellow) decreases to cause the desired Pilot or Motor Valve action.

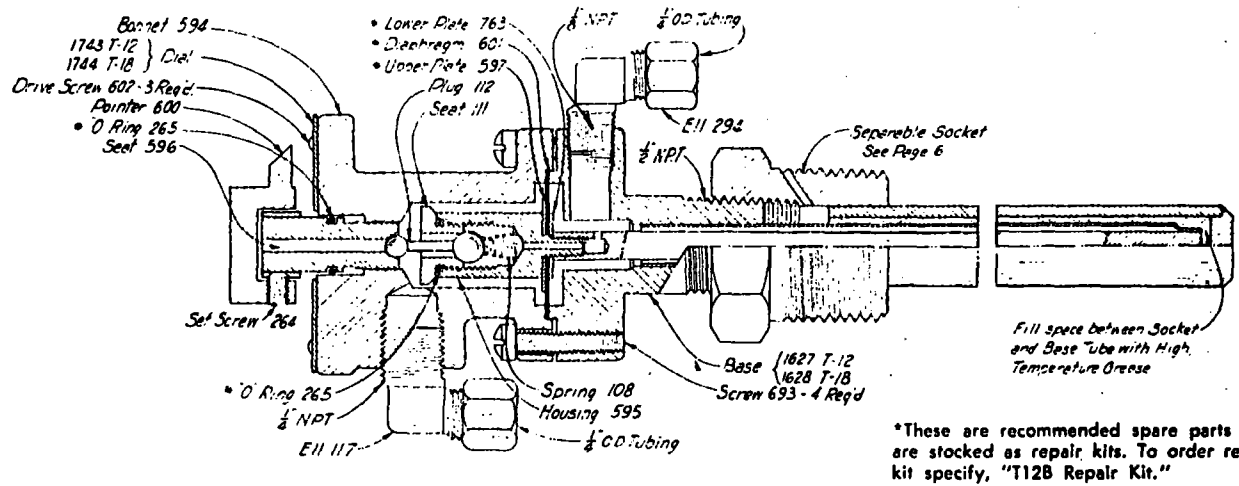
As the temperature decreases, the action is reversed to increase Output Pressure (Yellow).



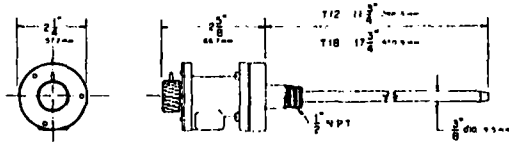
ALL STEEL

HT12 or HT18 BASE ASSEMBLY (for temperatures -30°F to 750°F, -34°C to 399°C)

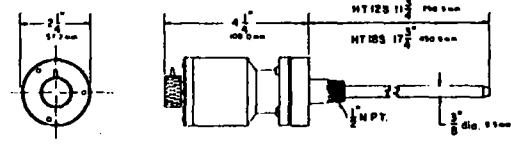
PARTS REFERENCE



T12 or T18 BASE ASSEMBLY

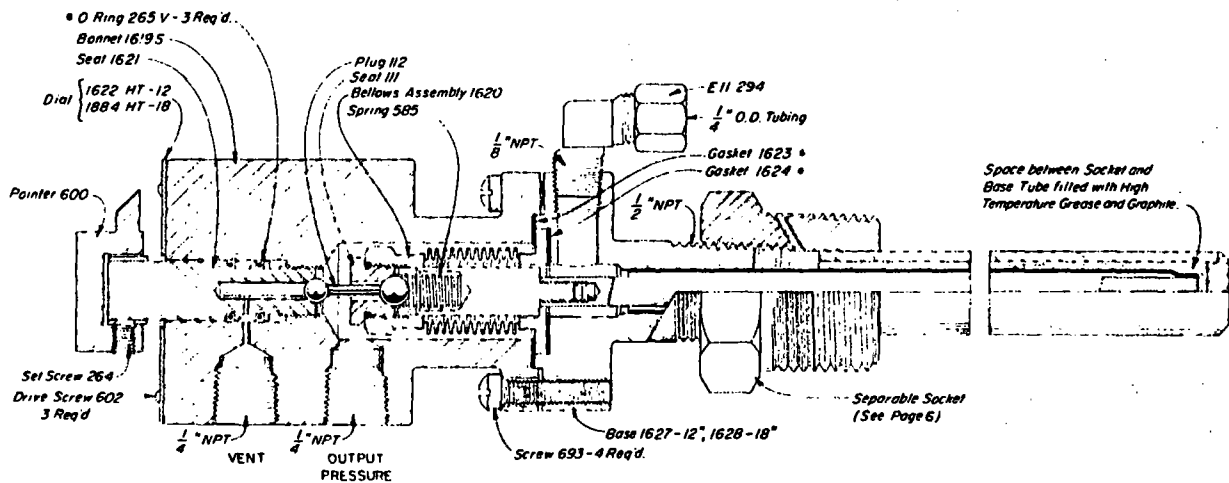


T12 & T18



HT12 & HT18

BASE ASSEMBLY DIMENSIONS



* These are recommended spare parts and are stocked as repair kits. To order, Specify, "HT" Repair Kit.

ALL STEEL

HT12 or HT18 BASE ASSEMBLY

ACTION:

Indirect throttle; Pilot Output Pressure (Yellow) decreases with temperature rise.

SUPPLY PRESSURE:

5 to 25 p.s.i.g.
.35 to 1.76 kg/cm²

WORKING PRESSURE (sensing element):

p.s.i.	kg/cm ²	
500	35.15	max. without separable socket
4000	281.22	max. with separable socket
10,000	703.06	max. with special separable socket

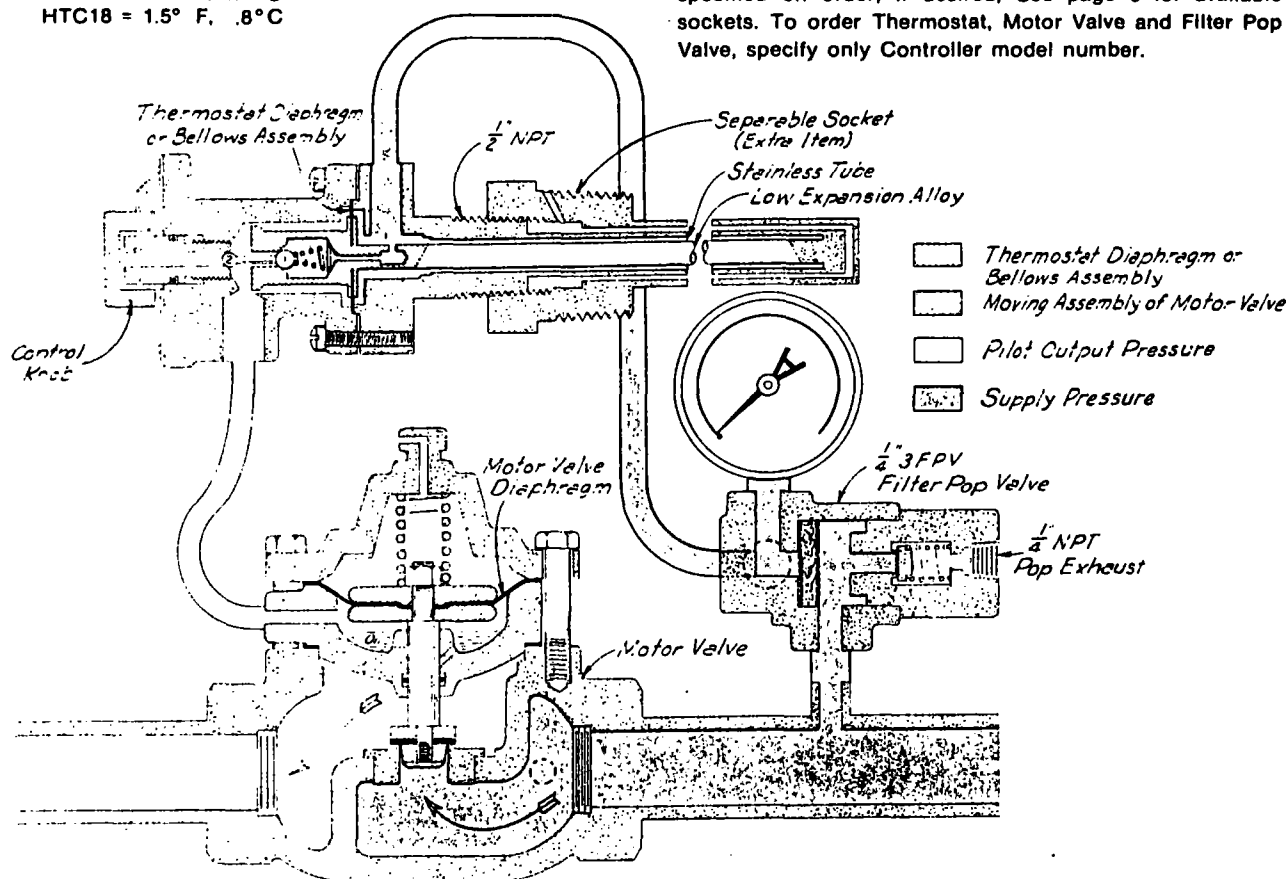
CONTROLLERS AVAILABLE:

Max. Temperature		Motor Valve	
400° F, 204° C	750° F, 399° C	Connection	Max. Temp.
1" TC 12	1" HTC 12	1" Screwed 25.4 mm Scr.	150° F 65.5° C
1" TC 18	1" HTC 18	1" Screwed 25.4 mm Scr.	150° F 65.5° C

THROTTLING RANGE:

TC12 = 2.5° F, 1.4° C
TC18 = 1.75° F, 1.0° C
HTC12 = 2° F, 1.1° C
HTC18 = 1.5° F, .8° C

Separable Socket is an extra price item and must be specified on order, if desired, See page 6 for available sockets. To order Thermostat, Motor Valve and Filter Pop Valve, specify only Controller model number.

**OPERATION:**

Assume the set temperature of the Thermostat is above the temperature of the system being controlled and the MOTOR VALVE is open. When the MOTOR VALVE is open, (Yellow) pressure under the Motor Valve Diaphragm opposes the spring.

As the temperature rises in the system, the STAINLESS TUBE increases in length to move the Thermostat Diaphragm

(or Bellows) Assembly in a direction to first close the seat at BALL 1 (Red to Yellow) and open the seat at BALL 2 (Yellow to Atmosphere). As Yellow pressure decreases, the Spring on the Motor Valve Stem Assembly moves the inner valve toward a closed position.

As the temperature decreases, the action is reversed to increase Yellow pressure and move the inner valve to an open position.

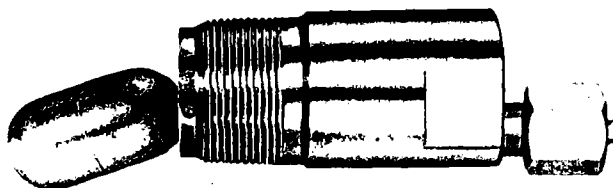
Level Controls

SDR MAGNETIC
SENSING WAVES

MODEL ES-1500

STAINLESS SIDE MOUNT
ELECTRIC LEVEL SWITCH

INSTALLATION & OPERATION

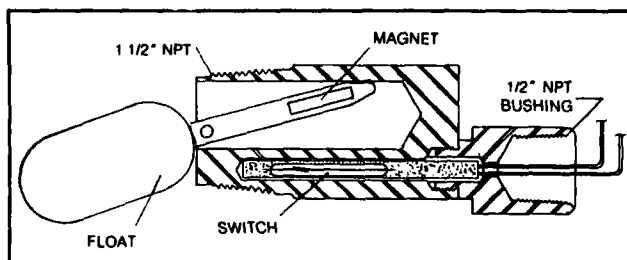


1. FUNCTION

This unit mounts directly into the side of a vessel and provides an electric output signal for either a high or low level condition.

Electric switching action is provided by the float moving a magnet into the field of a Hermetically Sealed Reed Switch Capsule.

The unit may be mounted for either high or low liquid level alarm by rotating the switch body to the proper position. The body wrench flats provide for ease of rotation and proper positioning.



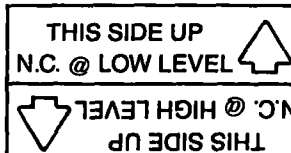
3. CONNECTIONS

The unit may be mounted in any of the following installation arrangements.

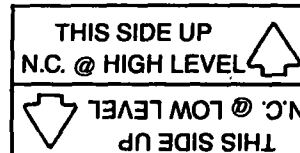
- 1 1/2" NPT half coupling (No full coupling)
- 2" NPT full coupling (Use in conjunction with 2" x 1 1/2" NPT bushing)
- 2" NPT pipe tee (Use in conjunction with 2" x 1 1/2" NPT bushing)
- Optional Flanged Mounting
- Optional Chamber Mounting

2. INSTALLATION

- Before installing the level switch, inspect the unit for any shipment damage.
- Check for mechanical clearance of the float. Float must move freely without binding throughout its stroke.
- Use an acceptable thread compound when installing unit to vessel to avoid thread galling.
- To achieve required function, install unit in accordance with the nameplate instructions shown below.



Nameplate Position
For Low Level Alarm



Nameplate Position
For High Level Alarm

*N.C.—Indicates Electrical Signal is generated.

4. ELECTRICAL

Electrical connection is free leads with a 1/2" NPT (F) conduit connection. Use two wrenches: one to hold hex conduit connection, the other to tighten conduit fitting. Switching element is a hermetically sealed reed switch. Consequently, external seal fittings are not required between the level switch and junction box of external electrical circuit. For wiring schematic for DPDT relays see reverse side of this instruction.

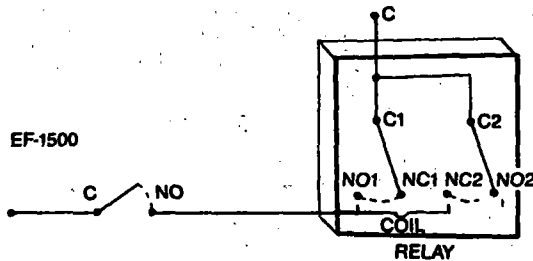
CAUTION

Do not exceed 100 VA, 250 V. max or 3 amp inrush current rating of switch. High current input to switch will cause permanent damage to contacts.

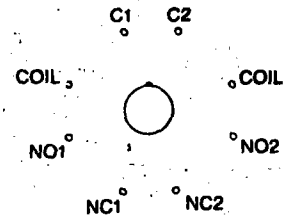
WIRING FOR DPDT RELAY

For ES-1500 Flow Switches equipped with DPDT relays a wiring schematic & pin position schematic is shown below. The output (NO) wire of the ES-1500 is connected to either coil pin while a second independent power supply is connected to both C1 & C2 of the relay. When the ES-1500 is actuated the coil will energize and "make" both NO1 & NO2 while it will "break" NC1 & NC2's circuits. This provides the equivalent of a DPDT circuit.

DPDT RELAY SCHEMATIC



PIN LOCATION SCHEMATIC



5. FIELD SERVICE

Symptom

Probable Cause

- | | |
|--|---|
| <p>1. Float in actuated position but no output signal</p> | <p>A. Switch damaged (Replace)
B. No power supply</p> |
| <p>2. Float in de-actuated position but still receiving an output signal</p> | <p>A. Switch damaged (Replace)</p> |
| <p>3. Control will not function when installed but operates when removed from vessel</p> | <p>A. Inadequate float travel (Float travel restricted by mounting nozzle—See Mounting Requirements)</p> |
| <p>4. Liquid in vessel at the actuation level but unit does not respond</p> | <p>A. Leaky or collapsed float (Replace)
B. Liquid S.G. too low
C. Float stem bound up or dirty (Clean)</p> |

REPAIR PARTS

PART NUMBER	DESCRIPTION
M-1075-01	Switch Capsule
J-1000-22	Float

NOTE: Repair procedure outlined in Repair Parts Kit instruction

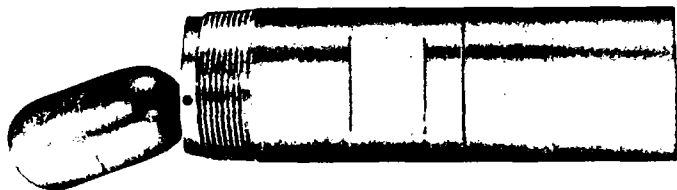
All information and specifications in this bulletin are current at the time of printing. Changes in product design and specifications may occur without notice. Contact your area factory representative or the factory for the current revision of this bulletin.

SDR LEVEL CONTROLS

MODEL PS-1500

STAINLESS SIDE MOUNT
PNEUMATIC LEVEL SWITCH

INSTALLATION & OPERATION



1. FUNCTION

This unit mounts directly into the side of a vessel and provides a pneumatic output signal for either a high or low level condition.

Pneumatic switching action is provided by the float moving a magnet into the field of a magnetically actuated pneumatic valve. The pneumatic valve is pilot operated and provides fast speed of response by use of an amplifying relay.

The Unit may be mounted for either high or low liquid level alarm by rotating the switch body to the proper position. The body wrench flats provide for ease of rotation and proper positioning. (See Steps 4 & 5 Under Installation)

Direct Acting

Direct Acting is defined as an output pressure signal being generated at High Level.

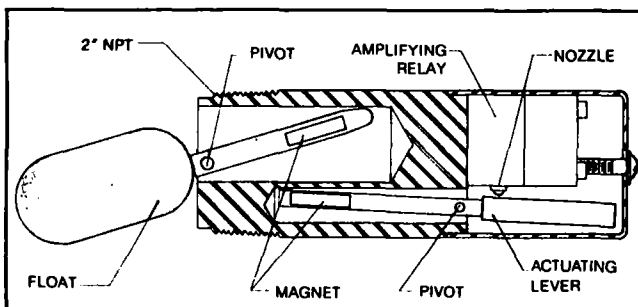
For this mode of control, the unit is positioned with the piping connections on the upper side of body.

Pneumatic action takes place when a rising liquid moves the float upward, inturn driving its magnet (Located on the Float Stem) closer to the actuating lever magnet. The magnetic force generated by the two magnets moves the actuating lever closer to the nozzle. This movement results in a pilot pressure build-up at the nozzle which triggers the amplifying relay, inturn developing the output signal.

Reverse Acting

Reverse Acting is defined as output pressure being generated at Low Level.

Action takes place in the reverse manner as indicated above. The unit must be positioned with the connections on the lower side of body.



2. INSTALLATION

1. Before installing the level switch, inspect the unit for any shipment damage.
2. Check for mechanical clearance of the float. Float must move freely without binding throughout its stroke.
3. Use an acceptable thread compound when installing unit to vessel to avoid thread galling.
4. For **Direct Acting** (generation of output pressure on level increase), supply connection must be on upper side of body when unit is tightened into position.
5. For **Reverse Acting** (no output pressure generation on level increase), supply connection must be on lower side of body when unit is tightened into position.
6. Connect supply line to the 1/8" NPT connection stamped "Supply". Do not use pipe compound on first two threads on pneumatic fittings. Supply media must be filtered and oil free. Air is the usual media; however, any dry filtered gas can be used.
7. Connect output port, stamped "Output" to unit to be controlled. Note: If controlled device has a volume of less than 15 cubic inches, the small volume may cause the output to fluctuate. The addition of output volume will stop this fluctuation.

3. CONNECTIONS

The unit may be mounted in any of the following installation arrangements.

- A. 2" NPT full or half coupling
- B. 3" NPT full coupling (Use in conjunction with 2" x 3" NPT bushing)
- C. Optional flanged mounting
- D. Optional chamber mounting

4. SUPPLY

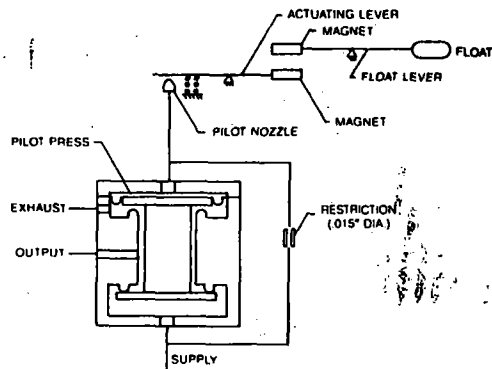
Clean dry gas must be used as the supply media so as not to plug critical internal restrictions and nozzles.

SUPPLY PRESSURE RANGE

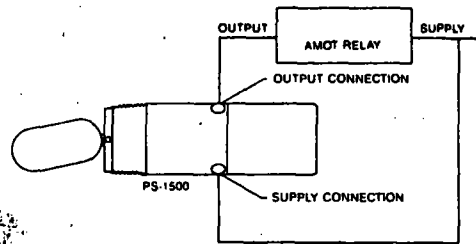
20 PSIG TO 60 PSIG

VENTING CAUTION

Note the position of the vent connection on the body. It is positioned on a horizontal axis either on the right or the left side of the body. This connection must not be plugged. It is used for either local atmospheric venting or remote atmospheric venting through a suitable line run to the designated venting area. "Supply" or "Output" connections must not be connected to the "Vent" port.



PS-1500 OPERATING PRINCIPLE SCHEMATIC



"AMOT" PIPING SCHEMATIC

5. FIELD SERVICE

Symptom

1. Float in actuated position but no output signal
2. Float in de-actuated position but still receiving an output signal
3. Control will not function when installed but operates when removed from vessel
4. Liquid in vessel at the actuation level but unit does not respond
5. Slow Response
6. Fluttering output

Probable Cause

- A. Pilot nozzle-seat worn or damaged (No seating of flapper) (Return to factory or replace switch)
- B. Actuating lever bound up or dirty (Clean or return to factory)
- C. Damaged relay diaphragm (Replace)
- D. Relay orifice plugged (Clean)
- E. Insufficient supply pressure
- F. Output line clogged (Clean)
- A. Pilot Nozzle plugged (Clean)
- B. Actuating lever bound up or dirty (Remains on pilot nozzle) (Clean or return to factory)
- C. Vent screen clogged (Clean)
- A. Inadequate float travel (Float travel restricted by mounting nozzle—See Mounting Requirements)
- A. Leaky or collapsed float (Replace)
- B. Liquid S.G. too low
- C. Float stem bound up or dirty (Clean)
- A. Excessive volume in output leg
- B. Leaky output line
- A. Inadequate volume in output leg

REPAIR PARTS

PART NUMBER	DESCRIPTION
J-1000-22	Float
M-1094-01	Relay Assm'y

NOTE: Repair procedure outlined in Repair Parts Kit instruction

All information and specifications in this bulletin are current at the time of printing. Changes in product design and specifications may occur without notice. Contact your area factory representative or the factory for the current revision of this bulletin.

506-6900-LM
EDO 1-84-245

Installation & Operating Instructions for Drexelbrook Series 506-6900

**Single Point Interface Control for Oil/Water
Separation**

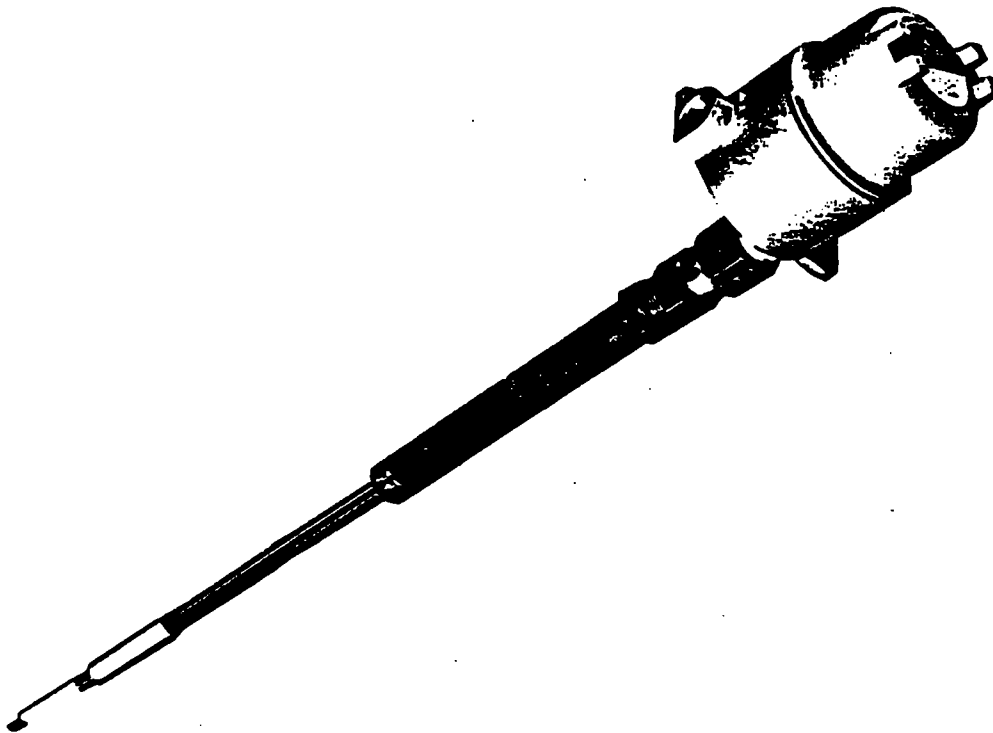


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 - 1.2 Models Available
 - 1.3 Specifications
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 - 2.2 Mounting
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- 4.0 Troubleshooting
 - 4.1 Introduction
 - 4.2 Testing the 406-6000 Electronics
 - 4.3 Testing the Relay Circuits
 - 4.4 Testing the Sensing Element
- 5.0 Factory and Field Service Assistance
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 - 5.2 Equipment Return
 - 5.3 Field Service
 - 5.4 Customer Training

1.0 Introduction

The instructions in this manual are for the Drexelbrook 506-6900-9X single point interface control for use in oil/water separation. Although this unit is calibrated and optimized for measuring the level of an oil/water interface, it is also suitable for other applications, if proper attention is given to calibration procedures. (See Section 3.0).

1.1 System Description

The Drexelbrook 506-6900 Series point level controls include a special 700 Series retractable sensing element and integral 406-6000 electronics for easy installation.

The 406-6000 electronic unit is a precision, RF (radio frequency), relay output instrument. It provides double-pole double-throw relay contact closure when the interface being measured reaches a preset point in the separator. The relay contacts may be used to operate alarms, solenoid valves, or other low power devices.

This control features Cote-Shield™ design which enables the instrument to ignore the effects of build-up or coating of material on the sensing element when properly installed and applied.

The sensor portion is mounted in the material being measured, and provides a change of RF impedance, indicating presence of water (conducting) or oil (insulating). It consists of three sections; center, ground, and Cote-Shield which compliment the Cote-Shield electronics. The Cote-Shield terminal guards against the transmission of RF current through any conductive coating on the sensing element, from the center element to ground, that would indicate water even when oil was present.

1.2 Models Available

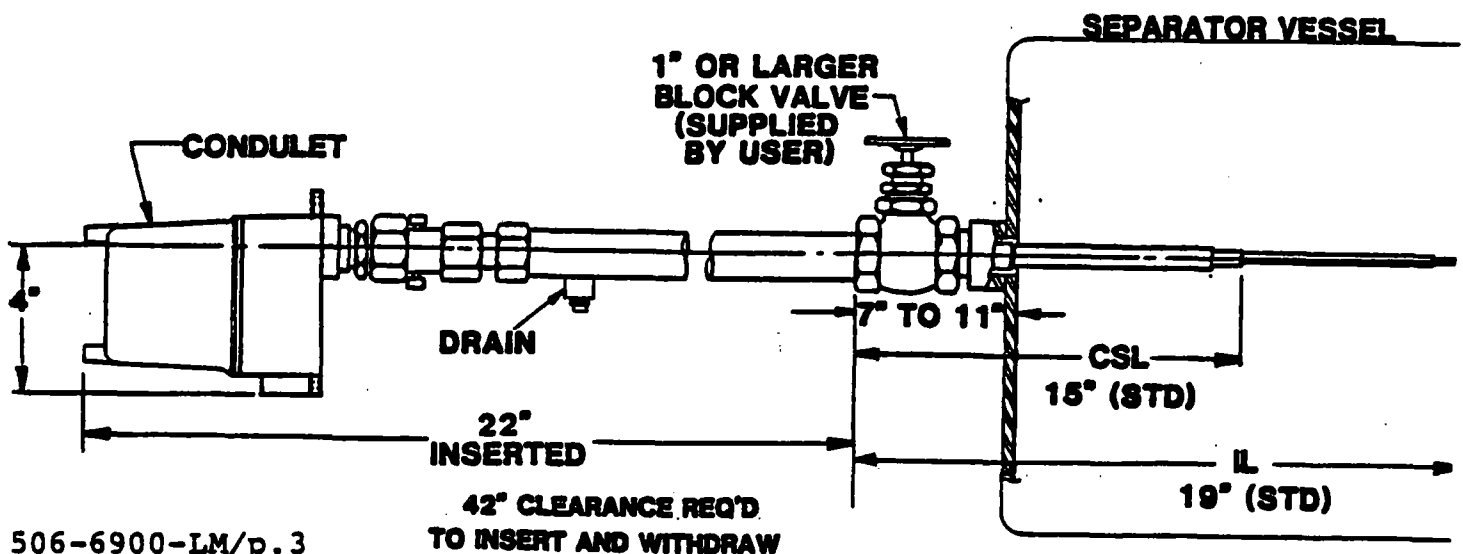
A. 506-6900-90 (See Figure 1-1)
Clearance required to install and withdraw: 42 inches from the face of the block valve.

Insertion Length: 19 inches less the length of the block valve and nipple.

Cote-Shield Length: 15 inches less the length of the block valve and nipple.

Fig. 1-1

506-6900-90
Point Level Control



Introduction

B. 506-6900-91 (See Figure 1-2)
Clearance required to install
and withdraw: 52 inches from
the face of the block valve.

Insertion Length: 29 inches
less the length of the block
valve and nipple.

Cote-Shield Length: 25 inches
less the length of the block
valve and nipple.

1.3 Specifications

A. Power requirement:
120± 25 Vac, 50/60 Hz, 1 watt

B. Level Output: DPDT relay

C. Time delay: Field adjust-
able 0-90 sec.

D. Contact rating: 5A Non-
inductive, 3A inductive (28 Vdc
or 120 Vac)

E. Operating temperature:
ambient: -40°F to 140°F
process: 0-300°F

F. Temperature Effect:
1"/100°F

G. Sensitivity: .01"

H. Process Pressure Rating:
150 PSIG

RFI protection (Built-in):
Less than .01" shift in operat-
ing point from 5 W field @27,
150, or 450 MHz at a distance
of 5 ft from exposed output
cable or power line.

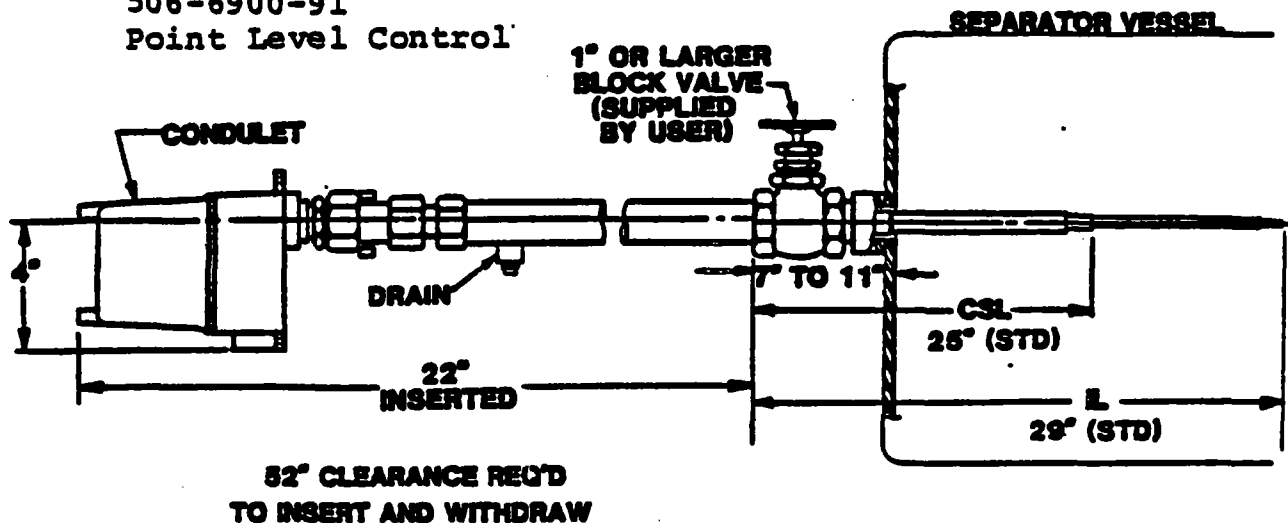
J. Fail-Safe: Factory set for
Low-Level Fail-Safe (LLFS) in
oil/water interface applica-
tions. Field changeable to
High-Level Fail-Safe (HLFS)
(LLFS is mandatory for oil/
water interface application).

K. Sensing Element Mat. of
Const.: 304 SS, and TFE insula-
tion

L. Mounting Dimensions:
1" NPT (optional flange mount
available) Max valve & nipple
lengths 11" (See Figure 2-2)

M. Min valve I.D.: 7/8"

Fig. 1-2
506-6900-91
Point Level Control



N. Standard Housing meets the following classifications:

Nema 1 General Purpose
Nema 2 Driptight
Nema 3 Weatherproof
Nema 4 Waterproof
Nema 5 Dust Tight
Nema 12 Industrial Use

Explosionproof for:
Class I, Groups A, B, C, D,
Div. 1 or 2, Class II, Groups
E, F, G Div. 1 or 2.

O. Options: DrexelcoteTM corrosion resistant housing.

2.0 Installation

2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing slip before destroying any packing materials. If there is any shortage or damage, report it immediately to the factory.

2.2 Mounting

The Drexelbrook 506-6900 Series single point interface control was designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage.

The actual mounting location depends on the placement of nozzles or openings into the vessel and the level at which the oil/water interface is to be maintained. Do not mount the sensing element through a valve and nozzle longer than 11 inches.

To install the retractable 506-6900 control through a 1 inch block valve, follow the steps below. (See Figure 2-1)

A. Loosen the packing nut at the slider gland so that the sensing element will slide out easily.

B. Back out the retention screws and retract the sensing element until the blow-out stop is reached.

C. Thread the sensing element into the block valve. (Min. valve I.D. is 7/8".)

D. Tighten the packing nut into the slider gland just enough so that the sensing element will still slide, but to prevent excess product leakage from the valve.

E. Open the block valve.

F. Insert the sensing element into the vessel, making sure that the retaining groove slides into the packing nut.

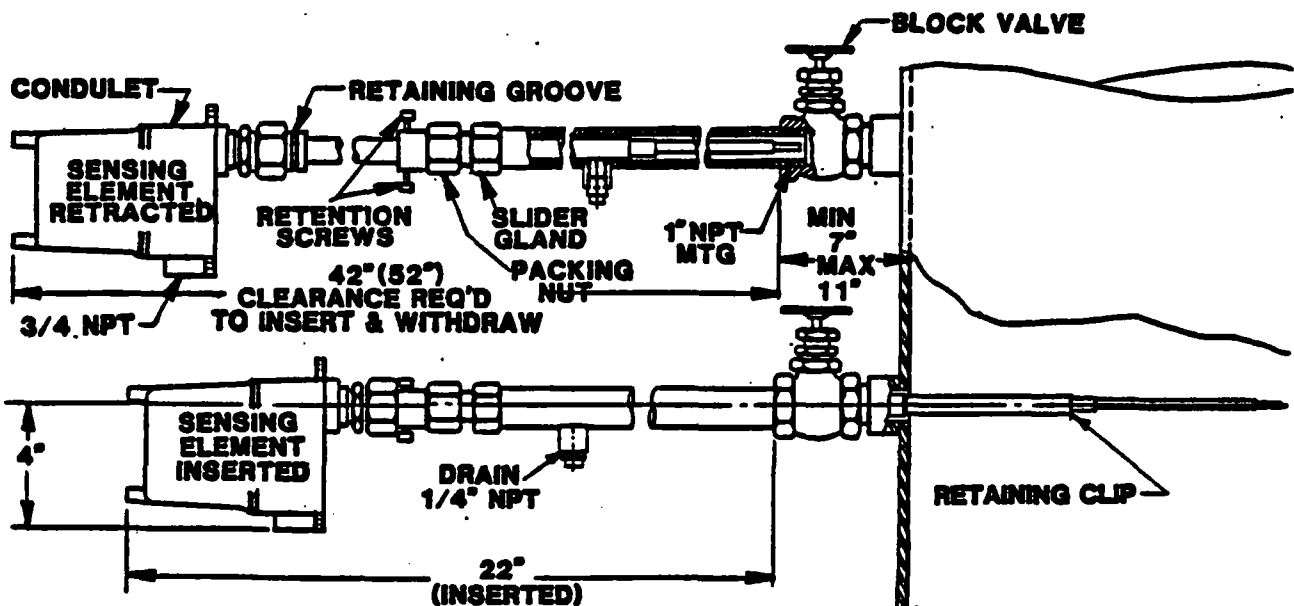


Fig. 2-1
Mounting the Unit

Installation

G. Tighten the retention screws snugly into the retaining groove.

H. Finally, tighten the packing nut again sufficiently to prevent any leakage.

Installation is complete.

To retract the sensing element, follow the steps below.

Note: Before removing the level control, disconnect the power to the input and relay terminals.

A. Loosen the packing nut at the slider gland.

B. Standing clear of the instrument, backout the retention screws.

Caution: It is possible that vessel pressure can push the instrument out to the retaining clip.

C. Withdraw the sensing element until contact is felt with the retaining clip.

D. Close the block valve.

E. Slowly unscrew the mounting threads in the block valve and uncap the drain plug to relieve pressure.

Caution: Flammable liquid can escape at this point. Take suitable precautions.

F. Continue to back control out of the block valve threads and withdraw the unit.

2.3 Wiring

2.3.1 Sensing Element Wiring

The sensing element connections to the integral electronics have been factory wired. However, if it is necessary to check these connections, see Figure 2-2. All of the sensing element connec-

tions are made on the back of the electronic unit.

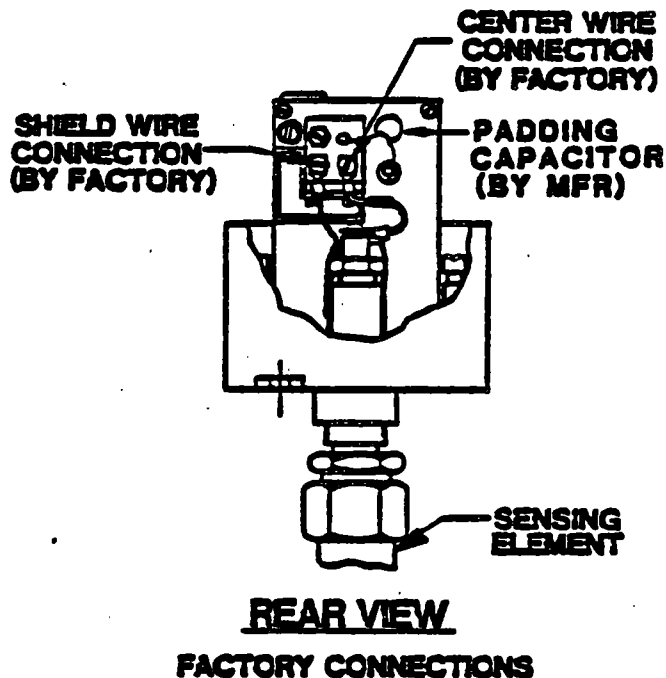


Fig. 2-2
Sensing Element Wiring

2.3.2 Power Wiring

All power connections are made to the terminal strips on the front of the electronic chassis. See Figure 2-3. Due to the low power consumption of the instrument (1 watt), the wiring need only follow local electrical codes. It is important to keep the power wiring separate from the sensing element connections in order to maintain the intrinsic safety of the sensing element.

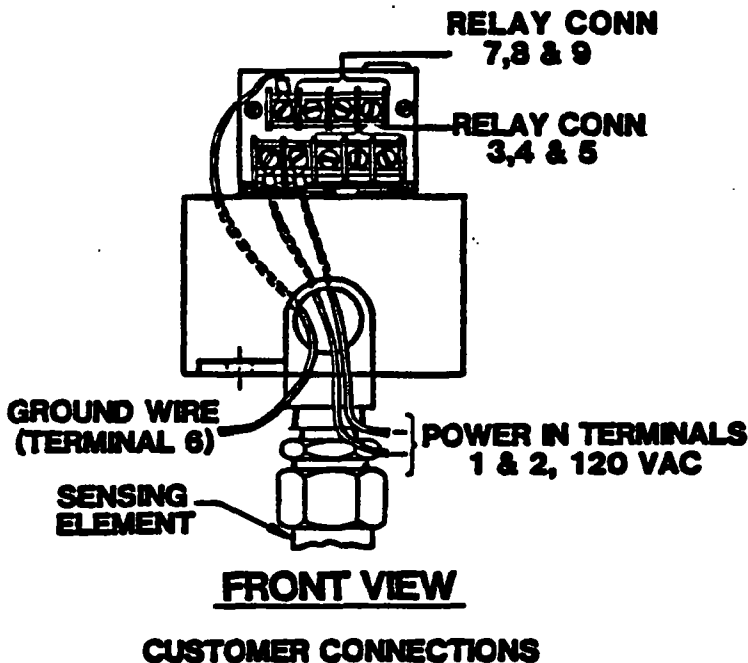


Fig. 2-3
Power and Relay Wiring

2.3.3 Relay Wiring

The relay used in this control has double-pole double-throw contact closure. All relay connections are also made to the terminal strips on the front of the electronic chassis. See Figure 2-3. The relay serves as a low power switch and does not provide power to activate motors or other heavy equipment (for non-inductive loads, see contact ratings in Section 1.2). Contact closures for low-level fail-safe are shown in Figure 2-4.

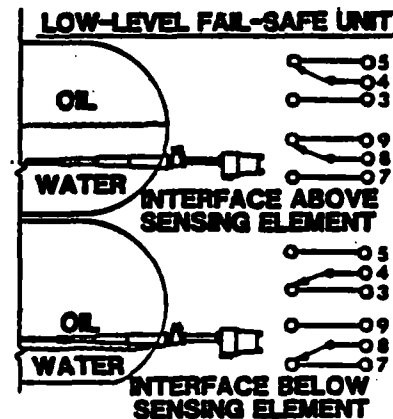


Fig. 2-4
Relay Contact Chart
for LLFS (Contacts
reverse for HLFS. See
Fig. 4-3.)

3.0 Calibration/Operation

This section contains the calibration and operation information for the 506-6900-9X Series point level control.

3.1 Start-Up

Before applying power to the instrument, be sure that the output and power wiring is correct. See Section 2.3.2 and 2.3.3.

Warning: Units in hazardous areas Before the explosionproof housing cover is removed to calibrate the instrument, the area must be checked and known to be non-hazardous. When calibration is complete, the cover must be replaced.

Each conduit from the explosion-proof case must be equipped with an approved seal fitting.

3.2 Controls

Note:

The 506-6900-9X point level control is factory calibrated for oil/water interface applications. Do not disturb the operating adjustment unless you intend to calibrate to your own specific requirements. See Section 3.3.

3.2.1 Setpoint Adjustment

There is a single adjustment located on top of the instrument that controls the level at which the relay operates. A lighted LED indicates that the relay is energized. The unit is in alarm or "failed" condition when the LED is out. See Section 3.3 for calibration of the setpoint adjustment. Be sure to use the insulated tuning wrench provided with the instrument. See Figure 3-1.

3.2.2 Time Delay Adjustment

The 506-6900 Series controls come standard with 0-90 sec time delay. The time delay adjustment is located on top of the instrument, across from the setpoint adjustment. Use a small screwdriver to adjust the time delay. See Figure 3-1. Time delay is used to help stop a "chattering" relay output due to waves in the interface.

The delay applies only to recovery from the alarm condition. On the Low-Level Fail-Safe unit, the delay will be effective only on rising interface. The output will indicate low level as long as waves continue to contact the sensing element. The unit will stop indicating low level only after the waves are completely above the sensing element.

To calibrate the instrument with time delay, see Section 3.3.4.

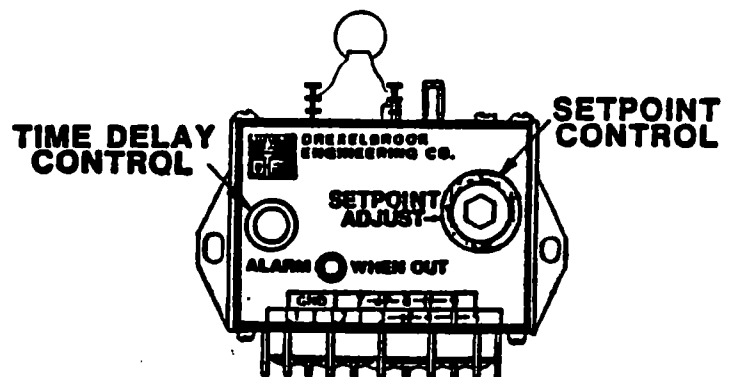


Fig. 3-1

Setpoint and Time Delay Controls

Calibration/Operation

3.2.3 Fail-Safe Selector

Fail-safe describes the level condition which causes the output relay to de-energize.

Low-Level Fail-Safe (LLFS) means the relay will de-energize under low interface conditions, or upon loss of power. The instrument is supplied in the low-level fail-safe state.

High-Level Fail-Safe (HLFS) means the relay will de-energize under high level conditions, or upon loss of power. This mode should not be used on any oil/water interface.

The fail-safe state of the instrument may be field selected by a slide switch, accessible through a hole in the side of the electronic chassis. See Figure 3-2.

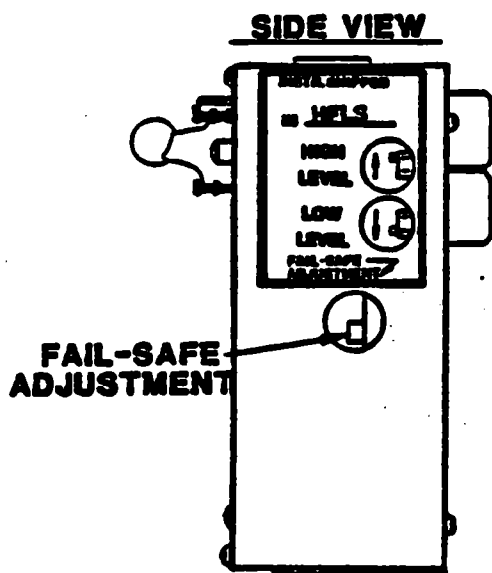


Fig. 3-2
Fail-Safe Selector

3.3 Calibration Procedures

Note:

This instrument is shipped from the factory with a calibration that is sufficient for 90% of all oil/water interface applications. If a more precise calibration is desired, or the factory calibration has been disturbed, follow one of these procedures.

To measure the interface between gases and insulating liquids like oil, it is necessary to switch the unit to high-level fail-safe and remove the padding capacitor.

When calibrating the instrument, be sure to use the red insulated tuning wrench provided with the instrument. For correct calibration, this tool must be used. See Figure 3-3. Note that the LED indicates relay energized, or normal condition (not alarm).

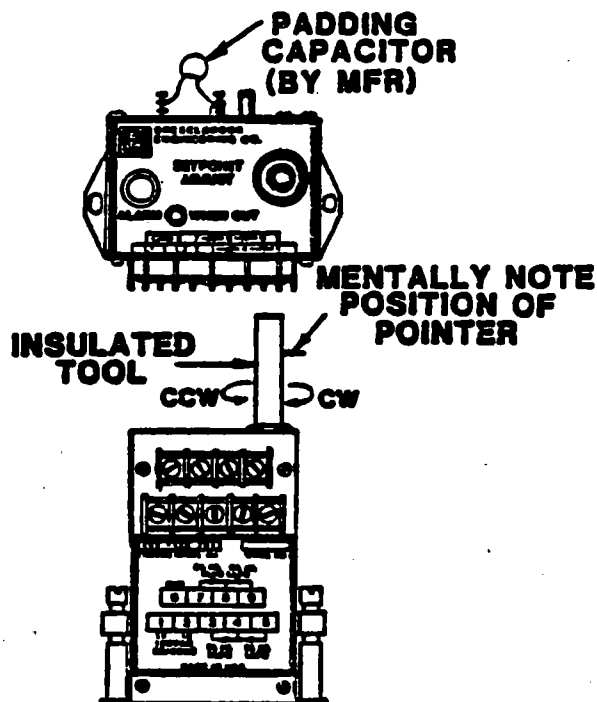


Fig. 3-3
Insulated Tuning Wrench for
Calibration Adjustments

3.3.1 Adjustment of the Factory Calibration

Typically, the factory calibration for this instrument (LLFS) will cause the unit to trip somewhere near the bottom of the emulsion layer. The LED will come on when the probe "sees" water and go out when it "sees" oil. If an adjustment in the setpoint is required, see the following chart.

Note:

Before changing the factory calibration, be sure to verify that the probe actually "sees" is oil or WATER. Appearances can be deceptive, so it is best to take a test sample.

Calibration Adjustment Chart

Control switches too low in emulsion layer.
(Figure 3-4)

Control switches too high in emulsion layer.
(Figure 3-5)

1. With the interface at the desired level, slowly turn the setpoint adjustment counterclockwise (CCW) until the indicator LED just lights or you come to the full CCW position. Do not force.
2. If the full CCW position is reached before the LED lights up, remove the padding capacitor from the electronic unit. See Figure 3-3. LED will now light.
3. Turn the setpoint adjustment slowly clockwise (CW) until the LED just goes out.
4. Adjustment is complete.

1. Add a 20pF NPO-type capacitor in parallel with the existing padding capacitor on the electronic unit. See Figure 3-3.
2. With the interface at the desired level, the indicator LED should be out. If the LED is still lit, change to a 40pF NPO-type capacitor in Step 1.
3. With the LED out, slowly turn the setpoint adjustment counterclockwise (CCW) until LED just lights.
4. Adjustment is complete.

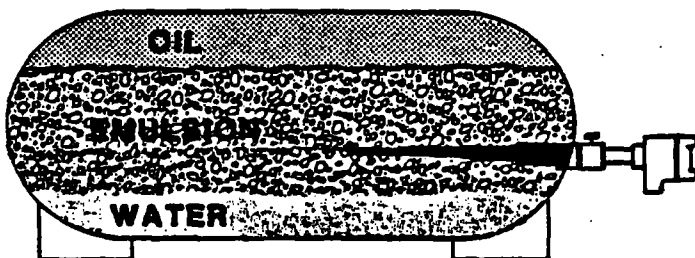


Fig. 3-4
Control Switches Too Low in Emulsion Layer

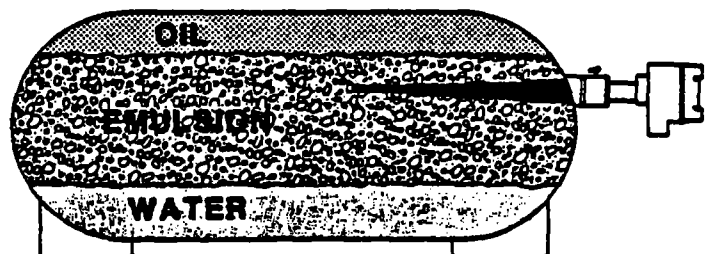


Fig. 3-5
Control Switches Too High in Emulsion Layer

3.3.2 Field Calibration Procedure

This procedure is for a horizontally mounted sensing element in an organic/water interface (low level fail safe). Caution: Do not turn the operating adjustment past its mechanical stops. Damage to the unit can occur.

A. Be sure the water (conducting lower phase material) level is well below the sensing element. See Figure 3-6.

B. Using the insulated tool supplied with the instrument, turn the tuning adjustment to the full counterclockwise (CCW) position. See Figure 3-3.

C. Counting the number of turns, turn the adjustment slowly clockwise (CW) until the relay just operates. (LED goes out). Record the number of turns.

D. Turn the adjustment slowly clockwise (CW) five more turns.

E. For recalibration purposes, record the total number of turns counted from the full counterclockwise position. See Section 3.4.

Calibration is now complete.

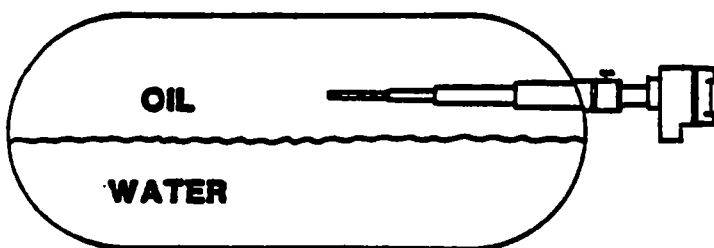


Fig. 3-6
Water Level Below the
Sensing Element

3.3.3 Emergency (Blind) Method of Calibration

This method is only recommended when the standard methods of calibration are not practical. The unit should be recalibrated using the standard procedure when possible. The correct insulated calibration tool is still required.

A. Gently turn the adjustment to the full counterclockwise (CCW) position. Do not force.

B. Turn the adjustment 15 turns clockwise (CW) and record this number.

3.3.4 Calibration with Time Delay

A. Turn the time delay adjustment to the extreme counterclockwise position (minimum time delay). See Figure 3-1.

B. Proceed with appropriate calibration procedure.

C. After the instrument is adjusted to the desired operating point, use a screwdriver to turn the time delay adjustment clockwise (CW) until you reach the required delay.

Standard units are adjustable over a range of 0-90 seconds delay. When the instrument is in Low-Level Fail-Safe, the delay will be with increasing level.

Note: With the interface level well below the sensing element, you can observe the time delay by shorting the sensing element center wire connection (blue) to ground, at the electronic unit. Note the time required for switching to occur.

3.4 Recalibration .

If the number of turns from full counterclockwise position was recorded at the time of initial calibration, it will be possible to replace the instrument without experimentally determining the capacitance in oil. Start from the full counterclockwise (CCW) position and count the same number of turns clockwise (CW).

Note: If the unit being replaced has a padding capacitor, the padding capacitor should be transferred to or duplicated on the replacement unit.

4.0 Troubleshooting

4.1 Introduction

The 506-6900 Series point level controls are designed to give years of unattended service. No periodic or scheduled maintenance is required. There are no specific recommended spare parts to be stocked by the user. However, it is best to keep a spare electronic unit on hand in the event of a component failure. The defective chassis should be returned to the factory for repair.

The following troubleshooting procedures should be followed in checking out your level control. If attempts to locate the difficulty fail, notify your local Drexelbrook representative, or call the factory direct and ask for the service department.

4.2 Testing the Electronics

A. See Figure 4-1. Disconnect the sensing element connections from the electronic unit by

removing the wires from the center and Shield terminals. Leave the power connected. If the unit has a padding capacitor attached, remove one end of the capacitor as shown in Figure 4.1.

B. Starting with the adjustment in the extreme counter-clockwise (CCW) position, turn the insulated tuning wrench clockwise (CW) until the relay operates. (Adjust only with the insulated tool supplied.) Note: Do not turn the adjustment past its stops. This can damage the unit.

C. Rotate the adjustment back and forth about this point, observing the travel of the pointer between relay pull-in and relay drop-out. The pointer should travel less than 1/8 turn to operate the relay. If so, the electronic unit is working properly.

D. If the instrument is not functioning properly, consult the factory service department for assistance.

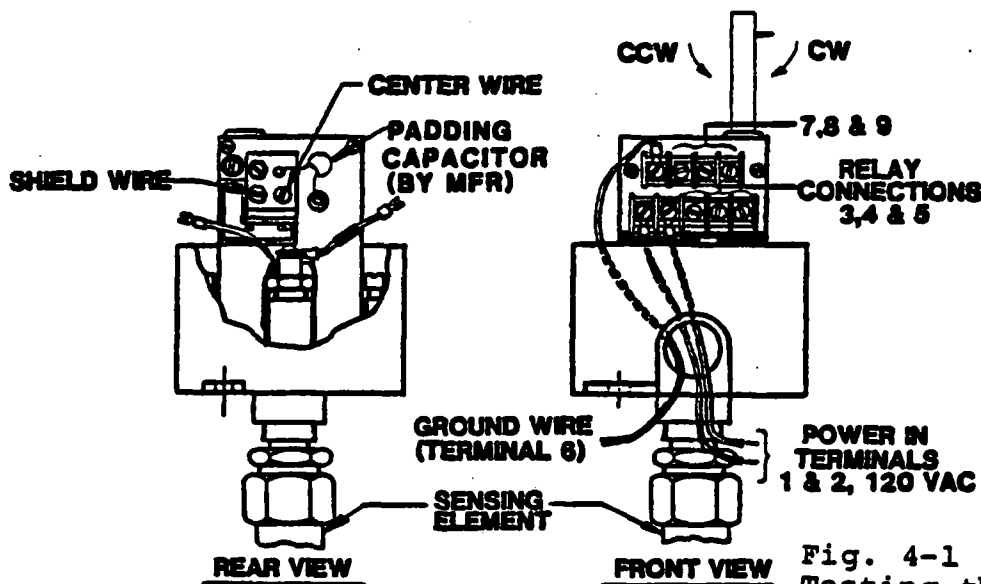


Fig. 4-1
Testing the Electronic Unit

Troubleshooting

4.3 Testing the Relay Circuits

A. The relay circuit consists of two sets of single-pole, double-throw relay contacts brought out to a terminal strip. When the instrument is properly adjusted, one contact from each set will be open and the other contact in each set will be closed. Both sets will reverse when the level condition changes.

B. Tune the instrument as described in the electronics checkout Section 4.2.

C. Relay operation may generally be heard as an audible click when the background noise is not too high. Use one of the methods shown in Figure 4-3 to determine if the relay contacts are switching.

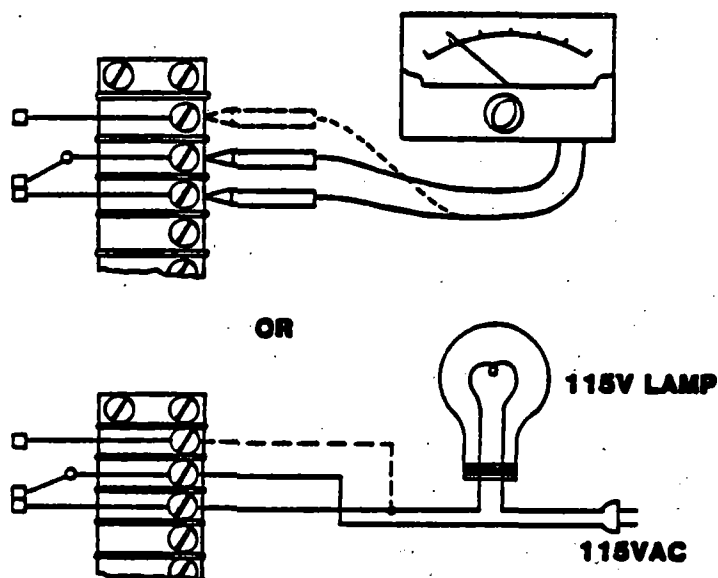


Fig. 4-2
Testing the Relay
Circuits

D. Difficulty in calibration can often be traced to improper wiring of the relay terminals to an annunciator or other panel device. Check the wiring against the relay chart in Figure 4-3. Be sure to use the diagram for the fail-safe in which the instrument is connected.

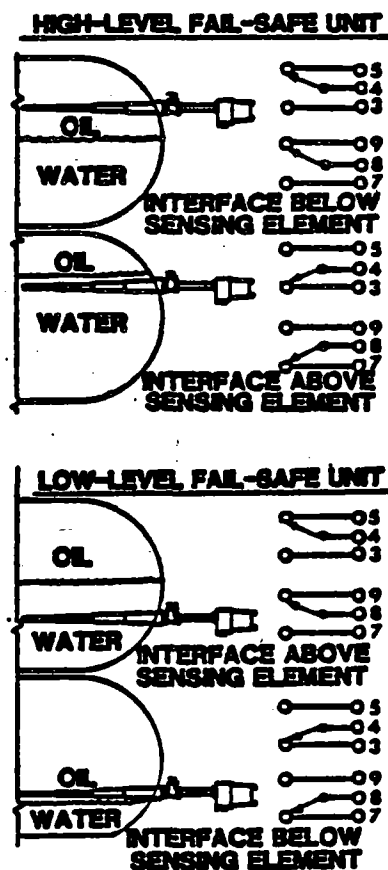


Fig. 4-3
Relay Contact Chart

4.4 Testing the Cote-Shield Sensing Element

A. See Figure 4-4. Disconnect the center wire (CW) and Shield (SH) wire from the electronic unit.

B. With an analog (non-digital) ohmmeter, measure the resistance between the sensing element terminals for the following values:

- a. Resistance, center wire to Shield
- b. Resistance, Shield to ground
- c. Resistance, center wire to ground

C. With the sensing element in air and no coating, the resistance values should be 1 megohm or greater in all three cases. If all three readings are not above 1 megohm, consult the factory service department.

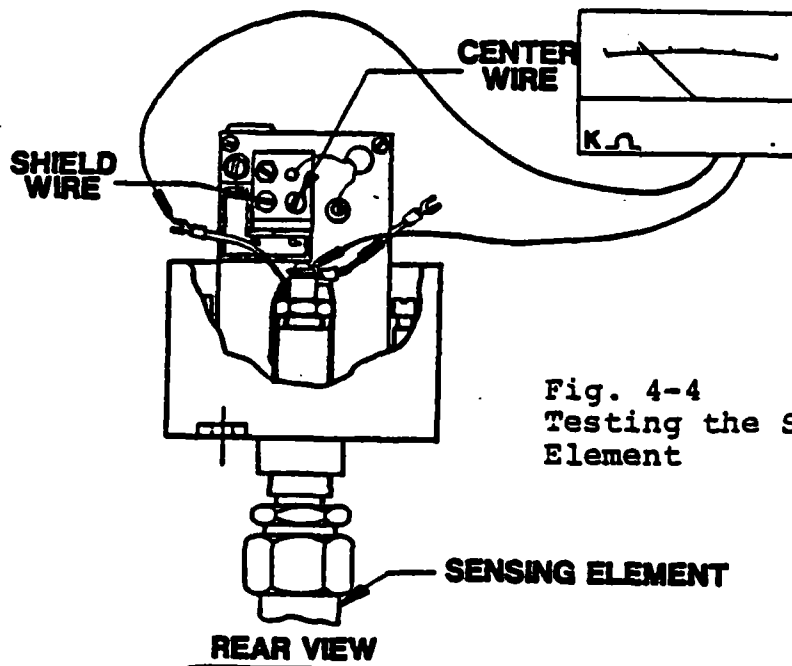


Fig. 4-4
Testing the Sensing
Element

5.0 Factory and Field Service Assistance

5.1 Telephone Assistance

If you are having difficulty with your Drexelbrook equipment, and attempts to solve the problem have failed, notify your local Drexelbrook representative, or call the factory direct and ask for the service department. Drexelbrook Engineering Company is located at 205 Keith Valley Road, Horsham, Pa. 19044. The telephone number is (215) 674-1234. To help us solve your problem quickly, please have as much of the following information as possible when you call:

Instrument Model #506-6900-9X

P.O.# _____

& Date _____

Application _____

Temperature _____

Pressure _____

Agitation _____

Brief description of the problem _____

Checkout procedures that failed _____

5.2 Equipment Return

Do not return equipment without first contacting the factory for a return authorization number. Any equipment being returned must include the following information:

Reason for return _____

Return Authorization # _____

Person to contact at your company _____

"Ship To" address _____

If available, please include the original P.O.# and the original Drexelbrook # also.

To keep the paperwork in order, you must include a purchase order with returned equipment, even though it may be coming back for warranty repair. You will not be charged if the equipment is covered under warranty. Please return your equipment with freight charges prepaid. We regret that we cannot accept collect shipments.

Drexelbrook frequently has exchange units available for quicker turn around of repair units. If you prefer your own unit to an exchange unit, please mark clearly on the return unit, "Do Not Exchange".

Standard electronic units are generally in factory stock. If the application is critical, a spare chassis should be kept on hand.

5.3 Field Service

Trained field servicemen are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Contact the service department for further details.

5.4 Customer Training

Periodically, Drexelbrook instrument training seminars for customers are held at the factory. These sessions are guided by Drexelbrook engineers and specialists, and provide detailed

Service

information on all aspects of
level measurement, including
theory and practice of instrument
operation. For more information
about these valuable workshops,
write to Drexelbrook Engineering,
attn: Communications/Training
Group, or call direct (215) 674-
1234.

Fisher Controls

Instruction Manual

**2900-244V and 2900-279V
Series Liquid Level
Controllers**
FISHER®

July 1987

Form 2134

INTRODUCTION

Scope of Manual

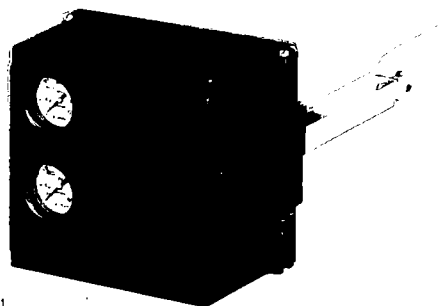
This instruction manual includes installation, adjustment, maintenance, and parts ordering information for Type 2900, 2900A, 2901, and 2901A pneumatic liquid level controllers and Type 244V, 279V, and 279VBU displacer-type sensors. Refer to separate instruction manuals for information covering accessories.

Description

These controllers (see figure 1) consist of a Type 244V, 279V, or 279VBU displacer-type sensor and a Type 2900, 2900A, 2901, or 2901A pneumatic controller. Displacer movement, caused by changes in liquid level, is transmitted through a flexure tube assembly to a flapper-nozzle assembly in the 2900 Series controller. The flapper and nozzle operate a pneumatic relay, which transmits a pneumatic on-off or proportional signal to a control valve.

Specifications

Specifications for these controllers are shown in table 1.



W1302-1

Figure 1. 2900 Series Controller with Type 244V Sensor

the sensor temperature and pressure limits listed in tables 1 and 2. Use pressure-limiting or pressure-relieving devices to prevent service conditions from exceeding these limits.

Type 244V and 279V Sensors

1. Be sure there are no obstructions inside the tank that will interfere with displacer installation or operation.
2. Provide the appropriate connection in the tank wall to match the sensor connection. Locate the tank wall connection such that the displacer (key 5; figure 9 or 10) will be at the desired control level.
3. If necessary, reinforce the tank connection so that it will be capable of supporting the sensor and controller.
4. For screwed connections, insert the displacer end of the controller-sensor assembly into the tank connection, and screw the sensor threads into the tank connection threads. Tighten sufficiently to seal the threads and to position the controller as shown in the appropriate view of figure 3. Also, make sure that the controller case is level.

INSTALLATION

WARNING

To avoid personal injury or property damage caused by the sudden release of process fluid, be certain the service conditions do not exceed

Table 1. Specifications

AVAILABLE CONFIGURATIONS	<p>Type 2900: Pneumatic on-off or proportional controller</p> <p>Type 2900A: Pneumatic on-off controller with minimum bleed relay</p> <p>Type 2901: Pneumatic on-off or proportional controller with intermittent bleed nozzle</p> <p>Type 2901A: Pneumatic on-off controller with minimum bleed relay and intermittent bleed nozzle</p> <p>Type 244V: Displacer-type liquid level sensor for mounting on the side of a tank</p> <p>Type 279V: Similar to the 244V sensor except with shorter flexure tube for use with small-diameter tanks</p> <p>Type 279VBU: Displacer-type liquid level sensor with displacer enclosed in a cage for mounting outside a tank</p>	SUPPLY PRESSURE REQUIREMENTS	<p>Type 2900 and 2901 Controllers</p> <p>On-Off: Any desired pressure between 20 and 50 psig (1.4 and 3.4 bar)</p> <p>Proportional: 20 psig for 3 to 15 psig output signal (1.4 bar for 0.2 to 1.0 bar output signal) and 35 psig for 6 to 30 psig output signal (2.4 bar for 0.4 to 2.0 bar output signal)</p> <p>Type 2900A and 2901A Controllers: Any desired pressure between 20 and 75 psig (1.4 and 5.2 bar)</p>
INPUT SIGNAL*	<p>Type: Liquid level or liquid-to-liquid interface</p> <p>Level Change Required for Full Change in Output Signal Range 3 to 15 Psig (0.2 to 1.0 Bar) Output Signal: ■ 1/4 in. (6 mm) with horizontal displacer or ■ 2 in. (51 mm) with vertical displacer</p> <p>6 to 30 Psig (0.4 to 2.0 Bar) Output Signal: ■ 1/2 in. (12 mm) with horizontal displacer or ■ 4 in. (102 mm) with vertical displacer</p>	MAXIMUM SUPPLY PRESSURE TO PREVENT PART RUPTURE†	<p>Type 2900 and 2901 Controllers: 50 psig (3.4 bar)</p> <p>Type 2900A and 2901A Controllers: 75 psig (5.2 bar)</p>
MINIMUM SPECIFIC GRAVITY DIFFERENTIAL	<p>For interface applications, specific gravity of high-density liquid must be at least 0.25 greater than specific gravity of low-density liquid</p>	MAXIMUM DISPLACER WORKING PRESSURE†	<p>Plexiglass Displacer: 6000 psig (414 bar)</p> <p>Stainless Steel Displacer: 1440 psig (99 bar)</p>
OUTPUT SIGNAL*	<p>Type: Pneumatic ■ on-off or ■ proportional pressure signal</p> <p>Ranges</p> <p>On-Off: 0 (off) or full supply pressure (on)</p> <p>Proportional: ■ 3 to 15 psig (0.2 to 1.0 bar) or ■ 6 to 30 psig (0.4 to 2.0 bar)</p> <p>Action: Field-reversible between direct (increasing level increases output signal) and reverse (increasing level decreases output signal)</p>	MAXIMUM SENSOR WORKING PRESSURE†	<p>See table 2</p>
		OPERATIVE AMBIENT TEMPERATURE LIMITS*†	<p>Controller: -20 to 180°F (-29 to 82°C)</p> <p>Plexiglass Displacer: -20 to 175°F (-29 to 79°C)</p> <p>Stainless Steel Displacer: -20 to 200°F (-29 to 93°C)</p>
		STANDARD SUPPLY, NOZZLE, AND OUTPUT PRESSURE GAUGE INDICATIONS††	<p>Supply, nozzle, and output pressure gauges available in 0 to 60 psig or 0 to 100 psig ranges</p>
		CONNECTIONS	<p>Supply and Output: 1/4 in. NPT female located on the side of the case with optional connections on the back (see figure 2); plug the unused connections</p> <p>Case Vents and Relay Exhaust: 1/4 in. NPT female with vent screen assemblies located on the back of the case</p>

*This term is defined in ISA Standard 51.1-1976.

†The pressure and temperature limits in this manual and any applicable code limitations should not be exceeded.

††Gauges also available in kPa and dual-scale psi/kPa units. Consult your Fisher sales office or sales representative about gauges in other units.

Table 2. Maximum Sensor Working Pressure

Sensor Type	Connection Size	Connection Type	Maximum Working Pressure*, Psig (Bar)
244V	2	Screwed (NPT)	6000 (414)
		Grooved End	Consistent with rating of coupling used, up to a maximum pressure of 1440 (99)
	3	Screwed (NPT)	3000 (207)
		Grooved End	Consistent with rating of coupling used, up to a maximum pressure of 1440 (99)
	4	Grooved End	Consistent with rating of coupling used, up to a maximum pressure of 1440 (99)
		Flanged	Consistent with ANSI B16.34-1981
279V	2	Screwed (NPT)	6000 (414)
	4	Flanged	Consistent with ANSI B16.34-1981
279VBU	1	Screwed (NPT)	2000 (138)

*The maximum working pressure of the displacer and the temperature limits of the displacer and/or the controller must not be exceeded.

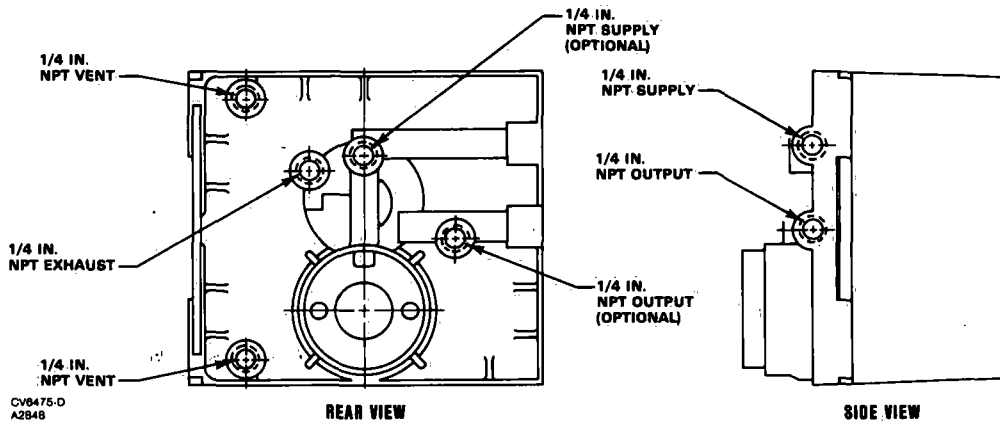


Figure 2. Controller Pressure Connections

5. For either a flanged or grooved connection:

a. Remove the machine screw and the flapper insert (keys 43 and 22; figure 7 or 8). Unscrew the nozzle (key 23; figure 7 or 8).

b. Loosen machine screw (key 28, figure 7 or 8), and slide the flapper carrier (key 42, figure 7 or 8) off the flexure tube (key 2; figure 9 or 10).

c. Remove the two cap screws (key 21, figure 7 or 8), and pull the sensor straight away from the controller.

d. Provide a suitable flange gasket. Insert the displacer end of the sensor into the tank connection, and complete the sensor-to-tank connection.

e. Position the controller as shown in the appropriate view of figure 3. While making sure that the controller case is level, secure the controller to the sensor with two cap screws (key 21, figure 7 or 8).

f. Slide the flapper carrier (key 42, figure 7 or 8) onto the flexure tube, and install the nozzle (key 23, figure 7 or 8).

g. Install the flapper insert (key 22, figure 7 or 8), and secure with the machine screw (key 28, figure 7 or 8).

h. Position the flapper connection so that the surface of the flapper insert (key 22, figure 7 or 8) is parallel with the nozzle opening; then, tighten the machine screw (key 28, figure 7 or 8). To prevent controller from malfunctioning, make certain that the flapper insert is parallel with the nozzle opening.

6. Proceed to the Pressure Connections portion of this section.

Type 279VBU Sensor

1. Provide equalizing connections in the tank wall at the desired control level.

PROPORTIONAL MODE		ON-OFF MODE			
TYPE 2900		TYPE 2900		TYPE 2900A	
DIRECT-ACTING	REVERSE-ACTING	DIRECT-ACTING	REVERSE-ACTING	DIRECT-ACTING	REVERSE-ACTING
TYPE 2901		TYPE 2901		TYPE 2901A	
DIRECT-ACTING	REVERSE-ACTING	DIRECT-ACTING	REVERSE-ACTING	DIRECT-ACTING	REVERSE-ACTING

NOTE: FOR TYPE 2900 AND 2901 CONTROLLERS, THE LETTER T VISIBLE ON THE SWITCHING BLOCK INDICATES PROPORTIONAL (THROTTLING), AND THE S INDICATES ON-OFF (SNAP-ACTING). FOR THE TYPE 2900A AND 2901A CONTROLLERS, THE T IS ALWAYS VISIBLE.

33A9889-A
33A9805-A
B1543

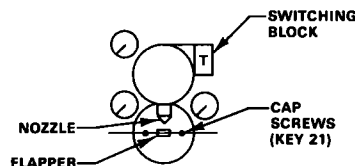


Figure 3. Schematic of Nozzle, Flapper, and Switching Block Orientation

2. Provide suitable piping to connect the 1-inch NPT sensor equalizing connections to the tank wall. Equalizing piping must be of sufficient strength to support the controller and sensor. If desired, install shutoff and drain valves in the equalizing piping.

3. Connect the displacer cage (key 8, figure 11) to the tank using the equalizing piping. The controller-sensor assembly must be installed with the cage in a horizontal position and the controller positioned as shown in the appropriate view of figure 3. After installing, make sure the controller case is level.

4. Proceed to the Pressure Connections instructions below.

Pressure Connections

1. Provide a source of clean, dry air as the operating medium. Refer to table 1 to determine supply pressure.

2. Connect the supply pressure to the 1/4-inch NPT female connection on the side or back of the controller (see figure 2). Plug the unused supply pressure connection.

3. Connect the output signal line to the equipment being operated and to the 1/4-inch NPT output connection on the side or back of the controller (see figure 2). Plug the unused output connection.

4. Position the three vent assemblies (key 27, figure 7 or 8) on the back of the controller so that the vent openings will face downward. The vent openings must be checked periodically to see that they are kept free of any obstructions.

ADJUSTMENT

Except where indicated, key numbers referenced in the following procedures are shown in figure 7 for Type 2900 and 2901 controllers and in figure 8 for Type 2900A and 2901A controllers.

Preliminary Checks

1. Check the supply pressure gauge (key 31) to be sure that the supply pressure is at the desired value. Adjust supply pressure source as needed.

2. Check to be sure that the surface of the flapper insert (key 22) is smooth, flat, and parallel with the opening of the nozzle (key 23).

If the surface of the flapper insert is not flat and smooth, remove machine screw (key 43), and install a new flapper insert.

If the surface of the flapper insert is not parallel with the nozzle opening, loosen the machine screw (key 28), and reposition the flapper carrier (key 42) so that the flapper surface is parallel with the nozzle opening. Then, retighten the machine screw.

3. Check figure 3 to be sure that the orientation of parts is correct for the controller type, action, and mode desired. If necessary, refer to the Changing Controller Action or Mode section.

4. For level control, lower the level so that the liquid is below the displacer (key 5, figure 9, 10, or 11).

For interface control, fill the vessel with the lighter fluid so that the displacer is completely submerged in the lighter liquid.

5. Complete the appropriate adjustment procedure below.

Type 2900 and 2901 Direct-Acting Proportional Controllers

After completing the preliminary checks above, adjust the nozzle until the output pressure is 3 psig (0.2 bar).

Type 2900 and 2901 Reverse-Acting Proportional Controllers

After completing the preliminary checks above, adjust the nozzle until the output pressure is 3 psi (0.2 bar) less than supply pressure.

Type 2900 Direct-Acting and 2901 Reverse-Acting On-Off Controllers

1. After completing the preliminary checks above, screw the nozzle away from the flapper until pressure on the nozzle pressure gauge (key 32) is zero and output pressure is equal to full supply pressure.

2. Screw the nozzle toward the flapper until relay snaps and vents output; note snap pressure on the nozzle pressure gauge.

3. Adjust the nozzle pressure to this snap pressure plus 2 psi (0.1 bar). Output should be zero.

Type 2900 Reverse-Acting and 2901 Direct-Acting On-Off Controllers

1. After completing the preliminary checks above, screw the nozzle toward the flapper until pressure on the pressure nozzle gauge (key 32) nearly equals the supply pressure and the output pressure is zero.

2. Screw the nozzle away from the flapper until relay snaps and output goes to full supply pressure; note snap pressure on nozzle pressure gauge.

3. Adjust nozzle pressure to this snap pressure less 2 psi (0.1 bar). Output should equal full supply pressure.

Type 2900A Direct-Acting On-Off Controllers

1. After completing the preliminary checks above, screw the nozzle toward the flapper until the snapping point is reached (the point at which output signal pressure increases rapidly to full supply pressure). Note the pressure indicated on the nozzle pressure gauge (key 32) when snapping occurs.

2. Screw the nozzle away from the flapper until nozzle pressure is 2 psi (0.1 bar) lower than the pressure noted at snapping. Output signal pressure should now be zero.

Type 2900A Reverse-Acting On-Off Controllers

1. After completing the preliminary checks above, screw the nozzle toward the flapper until the reset point is reached (the point at which output signal pressure increases rapidly to full supply pressure). Note the pressure indicated on the nozzle pressure gauge (key 32) when reset point is reached.

2. Screw the nozzle toward the flapper until nozzle pressure is 2 psi (0.1 bar) higher than the pressure noted at reset. Output signal pressure should now be equal to full supply pressure.

Type 2901A Direct-Acting On-Off Controllers

1. After completing the preliminary checks above, screw the nozzle away from the flapper until the snapping point is reached (the point at which output signal pressure increases rapidly to full supply pressure). Note the pressure indicated on the nozzle pressure gauge (key 32) when snapping occurs.

2. Screw the nozzle toward the flapper until nozzle pressure is 2 psi (0.1 bar) lower than the pressure noted at snapping. Output signal pressure should now be zero.

Type 2901A Reverse-Acting On-Off Controllers

After completing the preliminary checks above, adjust the nozzle until pressure indicated on the nozzle pressure gauge (key 32) is 2 psi (0.1 bar) lower than supply pressure. Output signal pressure should now be equal to full supply pressure.

CHANGING CONTROLLER ACTION OR MODE

WARNING

To avoid personal injury caused by a sudden release of pressure, shut off the supply pressure and bleed pressure from the supply lines before performing any procedure in this section.

Except where indicated, key numbers used in these procedures are shown in figure 7 for Type 2900 and 2901 controllers and in figure 8 for Type 2900A and 2901A controllers.

Changing Action

The action of all four controller types can be changed from direct to reverse or vice versa. As shown in table 3, action can be changed by inverting the controller on the sensor or by changing the nozzle (key 23) from a standard-bleed to an intermittent-bleed nozzle or vice versa. If action is changed by inverting the controller, it is necessary to make new piping connections.

If action is changed by installing a different nozzle, the piping connections need not be disturbed. However, changing the nozzle also changes the air consumption rate of the controller and the controller type number. For example, changing to a standard-bleed nozzle changes a Type 2901 controller to a Type 2900 controller and changes a Type 2901A controller to a Type 2900A controller.

If a Type 2900 controller is changed to a Type 2901 controller or vice versa, remove the four hex nuts (key 46) and nameplate (key 29). Turn the nameplate over, and attach it with the hex nuts. The nameplate has Type 2900 information printed on one side and Type 2901 information on the other side. The Type 2900A and Type 2901A

Table 3. Guide for Changing Controller Action or Mode

Desired Change	Controller Type	Invert Controller	Rotate Switching Block	Install Different Nozzle
Action Only	All	Yes	No	No
	All*	No	No	Yes*
Mode Only	2900	Yes	Yes	No
	2901 †	Yes	Yes	Yes †
Action & Mode	2900	No	Yes	No
	2901 †	No	Yes	Yes †

*When using this procedure to change the action, it is necessary to change from a standard-bleed to intermittent-bleed nozzle or vice versa.

†The Type 2901 controller requires different nozzles for proportional and on-off control modes.

nameplate (key 50) has all required instructions on one side, and it is not necessary to invert the nameplate for these types.

Changing Mode

The operating mode of Type 2900 and 2901 controllers can be changed from on-off to proportional or vice versa. As shown in table 3, the procedure to be used depends on controller type number and on whether the mode only or the mode and action are to be changed.

The Type 2901 controller requires different nozzles for proportional and on-off control. The proportional nozzle is stamped with the letter "T" (throttling), and the on-off nozzle is stamped with the letter "S" (snap-acting). This change of nozzle does not change the type number or nozzle bleed characteristic.

Procedures for Changing Controller Action or Mode

Select the desired procedure from table 3, and use the appropriate sections below to change the action or mode.

Inverting the Controller

1. Refer to figure 3 to determine the required orientation of the nozzle (key 23) and flapper (key 22) for the controller type, action, and mode desired. Figure 3 illustrates the controller schematically as viewed from the cover opening.

2. Disconnect pressure lines from the controller.

3. Open the cover (key 35A). Remove the machine screw and flapper insert (keys 43 and 22).

4. Unscrew the nozzle (key 23).

5. Loosen the machine screw (key 28), and remove the flapper carrier (key 42).

6. Remove the two cap screws (key 21), and rotate the entire controller 180 degrees on the sensor. Reinstall the cap screws.

7. Slide the flapper carrier onto the flexure tube (key 2, figure 9, 10, or 11).

8. Install a new O-ring (key 24) on the nozzle if needed. Install the nozzle.

9. Inspect the surface of the flapper insert. If the surface is not smooth and flat, replace with a new flapper insert. Install the flapper insert, and secure with the machine screw.

10. Position the flapper carrier so that the surface of the flapper insert is parallel with the nozzle opening, and tighten the machine screw (key 28). If the flapper insert surface is not parallel with the nozzle opening, the controller will malfunction.

11. Compare the controller to figure 3 to be sure the orientation of the nozzle and flapper is correct.

12. Connect supply and output piping to the controller. If necessary, refer to the Installation section for assistance.

13. Position the vents (key 27) so that the vent openings face downward.

14. If table 3 indicates that the switching block (key 26A) is to be rotated, proceed to the following section.

15. Adjust the controller by following the Adjustment section.

Rotating the Switching Block

For Type 2900A and 2901A controllers, the "T" on the switching block (key 26A) should always face the cover opening.

For Type 2900 and 2901 controllers, the "T" on the switching block should face the cover opening for the proportional (throttling) control mode, and the "S" should face the cover opening for the on-off (snap-acting) control mode (see figure 3). To rotate the switching block, proceed as follows:

1. Open the controller cover (key 35A). Remove the two machine screws and washers (keys 33 and 25).

2. Rotate the switching block 180 degrees on the relay (key 1). (The same switching block surface should contact the relay before and after rotating.) Reinstall the washers and machine screws (keys 25 and 33).

3. Compare the controller to figure 3 to be sure the correct switching block letter is visible.

4. If the nozzle (key 23) is to be changed, complete steps 3, 4, 8, 9, and 10 of the Inverting the Controller section.

5. Adjust the controller by following the Adjustment instructions.

Changing the Nozzle

If table 3 indicates that the nozzle is to be changed, complete steps 3, 4, 8, 9, and 10 of the Inverting the Controller section.

PRINCIPLE OF OPERATION

The operation of each 2900 Series liquid level controller and its sensor is based on Archimede's Principle, which states that a body immersed in a liquid will be buoyed up by a force equal to the weight of the liquid displaced. Movement of the displacer in the liquid is transmitted to the controller and causes a pneumatic signal to be delivered to a control valve as described in the following paragraphs. Typical sensors are shown in figures 9, 10, and 11.

Type 2900 and 2901 Controllers (Proportional Mode)

Refer to figure 4, which shows a direct-acting Type 2900 controller. As the liquid level rises, the flapper moves to restrict the nozzle and causes nozzle pressure to build up on the bottom of the diaphragm assembly. This pressure buildup overcomes the spring force and moves the diaphragm assembly upward to close the exhaust port and open the supply port to the control valve. Output pressure registers on top of the diaphragm assembly in opposition to supply pressure and provides proportional control. As the liquid level falls, the flapper moves off the nozzle, reducing supply pressure on the bottom of the diaphragm assembly. The diaphragm assembly begins to move downward, closing the supply port, with further downward travel opening the exhaust port and allowing pressure on the control valve to bleed to atmosphere.

Operation of the Type 2901 controller (with intermittent bleed) is the same as described for the Type 2900 controller except that, when the flapper is not in contact with the nozzle, a plug in the nozzle blocks supply pressure from venting to atmosphere.

With reverse-acting proportional control, the principle of operation remains the same as that for direct-action; however, the controller assembly is mounted on the top of the flexure tube assembly. As a result, the controller delivers an increasing signal to the control valve when the liquid level falls.

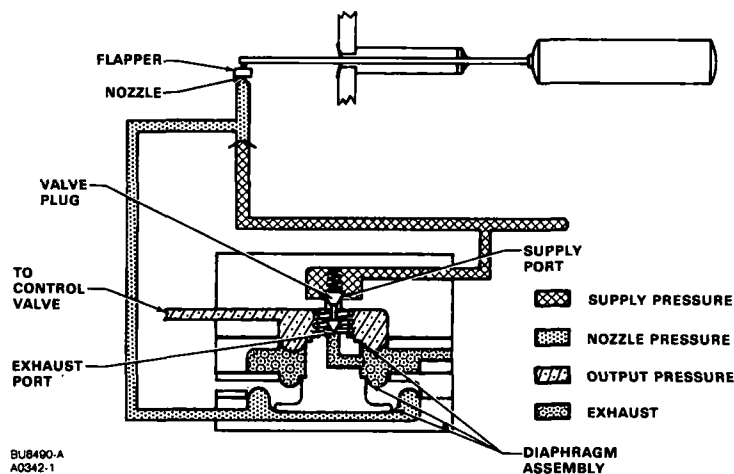


Figure 4. Operational Schematic of Type 2900 Controller in Proportional Mode, Direct Action

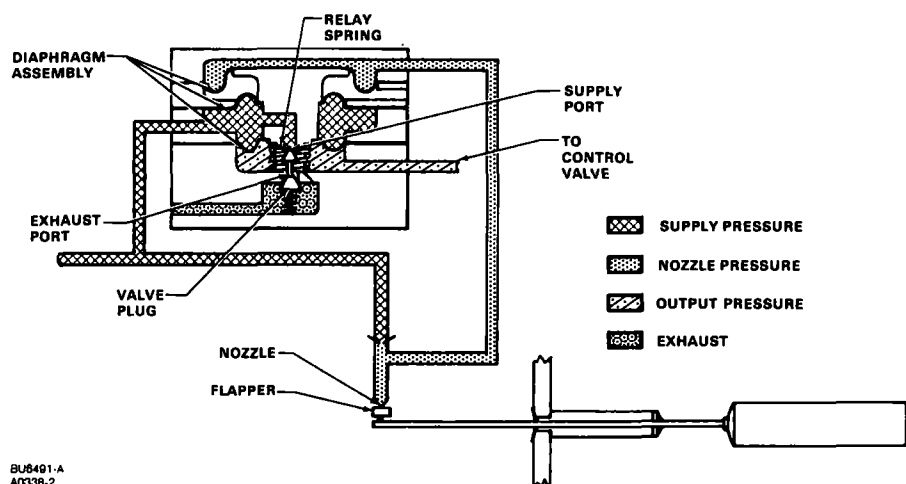


Figure 5. Operational Schematic of Type 2900 Controller in On-Off Mode, Direct Action

Type 2900 and 2901 Controllers (On-Off Mode)

Refer to figure 5, which shows a direct-acting Type 2900 controller. As the liquid level rises, the flapper moves off the nozzle, bleeding pressure from the top of the diaphragm assembly. The relay springs close the exhaust port and open the supply port to the control valve. As the liquid level decreases, the flapper covers the nozzle and supply pressure builds on the top of the diaphragm assembly. This pressure buildup overcomes the relay spring force, moving the diaphragm assembly downward, closing the supply port and opening the exhaust port. Because there is no opposing force, the diaphragm assembly moves fully downward, and the control valve loading pressure is vented to the atmosphere.

Operation of the Type 2901 controller (with intermittent bleed) is the same as described for the Type 2900 controller, except that, when the flapper is not in contact with the nozzle, a plug in the nozzle blocks supply pressure from venting to atmosphere.

With reverse-acting on-off control, the principle of operation remains the same as for direct action; however, the controller assembly is mounted below the flexure tube assembly. As a result, the controller delivers an increasing signal to the control valve when the liquid level falls.

Type 2900A and 2901A Controllers

Refer to figure 6, which shows a reverse-acting Type 2901A controller. As the liquid level rises, the flapper pushes the plug away from the nozzle and onto the

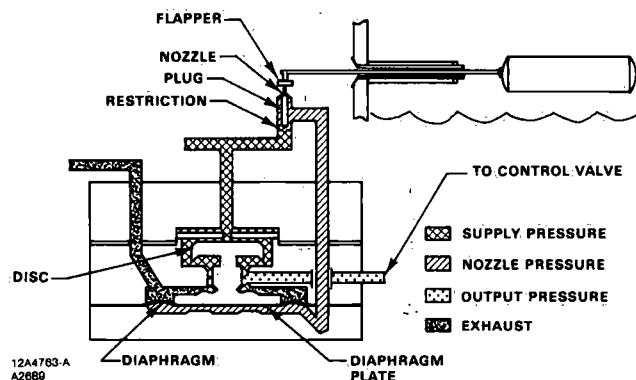


Figure 6. Operational Schematic of Type 2901A Controller with Reverse Action

restriction, allowing pressure to bleed from beneath the diaphragm. Supply pressure on top of the diaphragm plate moves the diaphragm plate and disc downward, opening the output to exhaust. The disc now blocks the supply pressure from entering the output port. As the level decreases, the flapper is not in contact with the plug, and the plug blocks flow through the nozzle. Nozzle pressure registers under the diaphragm through the restriction. This pressure on the diaphragm holds the disc open to provide full supply pressure to the output, while the exhaust port is blocked by the diaphragm plate.

Operation of the Type 2900A controller (with continuous bleed) is the same as described for the Type 2901A except that the nozzle assembly does not contain a plug. The nozzle is blocked by the flapper, requiring increased pressure to stroke the disc and diaphragm plate and provide an output signal.

With direct-acting control, the operation remains the same as that for reverse-action, except that the relay and nozzle are above the flapper so that increasing liquid level allows the plug to block the nozzle.

MAINTENANCE

Parts are subject to normal wear and must be inspected periodically and replaced if necessary. The frequency of parts inspection and replacement depends upon the severity of service conditions.

Instructions are given below for complete disassembly and assembly for parts replacement. Except where indicated, key numbers used in these procedures are shown in figure 7 for Type 2900 and 2901 controllers and in figure 8 for Type 2900A and 2901A controllers.

WARNING

To avoid personal injury caused by the release of process fluid or supply pressure, perform the following steps before starting disassembly:

- Lower the liquid level in the tank to a level below the sensor tank connection,
- Carefully release pressure from the tank and from the Type 279VBU cage (key 8, figure 11), and
- Shutoff and bleed controller supply and output pressure lines.

Controller Disassembly

1. Disconnect the supply and output pressure lines from the controller.
2. Open the cover (key 35). Remove the machine screw and flapper insert (keys 43 and 22).
3. Unscrew the nozzle (key 23), and remove the O-ring (key 24).
4. Loosen the machine screw (key 28), and slide the flapper carrier (key 42) off the flexure tube (key 2, figure 9, 10, 11).
5. Unscrew the two cap screws (key 21), and slide the controller straight away from the sensor.

Type 2900 and 2901 Relay Disassembly

Note

If relay repair is necessary, it is recommended that the relay be returned to the factory for service. If the relay must be serviced in the field, disassemble it using the following steps:

1. Unscrew the relay mounting screws (key 9), and remove the relay assembly.
2. Remove the six machine screws (key 17). Insert the mounting screws (key 9) to maintain alignment of the relay sections.
3. Lift the relay body (key 1) and relay spring (key 12) from the assembly.
4. Remove O-rings (keys 13, 14, and 15) from the relay body.

5. Remove the valve plug (key 4) by unscrewing the two machine screws (key 18) and lifting off the spring seat (key 5) and spring (key 11). Inspect the plug and seat for nicked seating surfaces.

6. Lift off the diaphragm assembly (key 6) as a unit, and remove casing spacers (keys 2 and 19) by folding the diaphragms and sliding the casing spacers over the diaphragm assembly.

7. Remove the upper diaphragm (key 7) from the relay casing (key 3).

Type 2900A and 2901A Relay Disassembly

1. Unscrew the relay mounting screws (key 9), and remove the relay assembly.

2. Remove the gasket (key 49).

3. Components of the relay assembly are not field-repairable. Purchase a new body assembly as a replacement part if necessary.

Sensor Disassembly

Except where indicated, key numbers used in this procedure are shown in figure 9 for Type 244V sensors, figure 10 for Type 279V sensors, and figure 11 for Type 279VBU sensors.

If a stainless steel displacer (key 5, figure 9) bottoms or causes output drift, it may have been penetrated by the process fluid. If it is necessary to remove the displacer for any reason, be sure the tank level has been lowered below the sensor connection and that all pressure has been released from the tank and from the Type 279VBU cage (key 8, figure 11).

WARNING

The stainless steel displacer in this unit is a sealed container and, if penetrated by the process fluid, may retain pressure or fluid for an extended period. Such a displacer may contain pressure as a result of being in a pressurized vessel, may contain fluid that becomes pressurized due to a change in temperature, and

may contain fluid that is hazardous or flammable. Sudden release of pressure, contact with hazardous fluid, fire, or explosion resulting in personal injury or property damage can occur if a displacer that is retaining pressure or fluid is punctured, subjected to heat, or repaired. Handle the displacer with care in removing, storing, or disposing, taking into consideration the characteristics of the process fluid.

1. If the controller has not been removed from the sensor, disconnect supply and output pressure lines.

2. Disconnect the mounting adaptor (key 1) from the tank connection or from the Type 279VBU cage (key 8, figure 11).

3. Carefully pull the sensor and attached displacer out of the tank or cage.

4. Disconnect the displacer by following the appropriate step:

For horizontally mounted Type 244V displacers, loosen the hex jam nuts (key 7), and unscrew the displacer from the connecting rod (key 9).

For vertically mounted Type 244V displacers, remove the cotter pin (key 8), and pull the displacer off the flexure tube (key 2).

For Type 279V and 279VBU displacers, loosen the set screws (key 5A), and pull the displacer off the flexure tube (key 2).

5. If removal of the flexure tube is required and the controller has not been removed from the sensor,

a. Open the cover (key 35, figure 7 or 8), and remove the machine screw and flapper insert (keys 43 and 22, figure 7 or 8).

b. Unscrew the nozzle (key 23, figure 7 or 8), and remove the O-ring (key 24, figure 7 or 8).

c. Loosen the machine screw (key 28, figure 7 or 8), and slide the flapper carrier (key 42, figure 7 or 8) off the flexure tube (key 2).

d. Unscrew the cap screws (key 21, figure 7 or 8), and slide the controller straight away from the mounting adaptor (key 1).

e. Unscrew the retainer (key 3). Remove the flexure tube and pivot washer (key 4, figure 9) or gasket (key 4, figures 10 or 11) from the mounting adaptor.

Type 2900 and 2901 Relay Assembly

Note

When assembling, be sure to align all holes in the relay casing (key 3), casing spacers (keys 2 and 19), relay body (key 1), upper diaphragm (key 7), and exhaust port (located in the diaphragm assembly, key 6). Failure to do so will cause the controller to malfunction.

1. Insert the mounting cap screws (key 9) through the relay casing (key 3) and upper diaphragm (key 7). The cap screws will serve as guides when replacing the relay parts.
2. Slide the diaphragm assembly (key 6) through the flat finished casing spacer (key 2). Place this assembly on the relay casing (key 3) with the diaphragm head against the diaphragm.
3. Align the tabs on the two casing spacers and the relay casing (key 3).
4. Place the relay spring (key 12) on the spring seat of the diaphragm assembly, and carefully slide the relay body (key 1) over the mounting screws into position.
5. Insert the six machine screws (key 17) and tighten.
6. Insert the valve plug (key 4) through the relay body (key 1). Place the spring (key 11) on the valve plug followed by the spring seat (key 5). Secure the spring seat in place by the two machine screws (key 18).
7. Replace O-rings (keys 13, 14, and 15).
8. Replace the O-ring (key 16) on the restriction plug (key 8), and screw the restriction plug into the relay.
9. Secure the relay assembly to the base plate (key 20) with mounting screws (key 9).

Type 2900A and 2901A Relay Assembly

Note

When assembling the relay, be sure to align all holes in the relay body, upper diaphragm and relay casing (keys 1, 7, and 3). Failure to do so will cause the relay to malfunction.

1. The upper diaphragm and relay casing have tabs to aid alignment. The relay body is stamped with the word TABS and an arrow indicating the side of the body that is to be adjacent to the diaphragm.

2. With all holes and tabs aligned, secure the body, upper diaphragm, and relay casing with the six machine screws (key 17).

3. Install a new gasket (key 49). Be certain gasket holes are in line with the holes in the base plate (key 20) and relay body. The word NOZZLE and an arrow are stamped on the relay body. Be certain this arrow points to the nozzle connection in the base.

4. Secure the relay to the base with the relay mounting screws (key 9).

Sensor Assembly

Key numbers used in this procedure are shown in figure 9 for Type 244V sensors, figure 10 for Type 279V sensors, and figure 11 for Type 279VBU sensors.

1. Slide the flexure tube (key 2) through the mounting adaptor (key 1).
2. Install the pivot washer (key 4, figure 9) or the flexure tube gasket (key 4, figure 10 or 11).
3. Secure with the flexure tube retainer (key 3).
4. Install the displacer (key 5) by following the appropriate steps:

For horizontally mounted Type 244V displacers, screw the displacer onto the connecting rod (key 9), and secure with the hex jam nuts (key 7).

For vertically mounted Type 244V displacers, place the displacer spud (key 12) onto the spud adaptor (key 6), and install the cotter pin (key 8).

For Type 279V and Type 279VBU displacers, install the displacer (key 5) on the flexure tube (key 2), and secure with set screws (key 5A).

Controller Assembly

1. Slide the controller onto the sensor.
2. Secure with two cap screws (key 21).
3. Slide the flapper carrier onto the flexure tube assembly (key 2, figure 9, 10, or 11).
4. Install the O-ring (key 24) onto the nozzle (key 23).
5. Screw the nozzle assembly into the base plate (key 20).
6. Install the flapper insert (key 22) into the flapper carrier (key 42). Secure with machine screw (key 43).

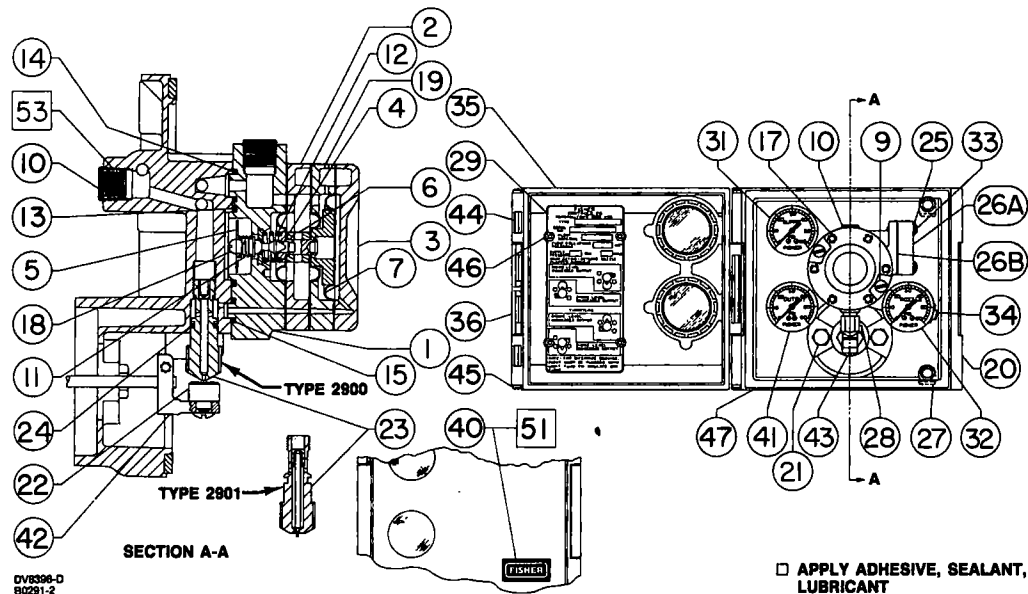


Figure 7. Type 2900 and 2901 Controllers

7. Align the flapper carrier so that the surface of the flapper insert is parallel with the nozzle opening. Secure the flapper carrier with the machine screw (key 28).

8. Install the controller-sensor assembly, and make pressure connections by following the Installation section. Then, adjust the controller by following the Adjustment section.

PARTS ORDERING

When corresponding with the Fisher sales office or sales representative about this equipment, always mention the serial number that is stamped on the nameplate inside the controller cover. When ordering replacement parts, also specify the complete 11-character part number of each part required from the following parts list.

Parts List

Note

In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the National Association of Corrosion Engineers (NACE) standard MR-01-75.

Parts Kits

Key	Description	Part Number
	Types 2900 and 2901 (includes keys 6, 7, 11-16, 22-24, 42, 43)	
Type 2900		R2900 X00012
Type 2901		
On-off		R2901 X00012
Proportional		R2901 X00022

Key	Description	Part Number	Key	Description	Part Number
	Types 2900A and 2901A (includes keys 7, 22-24, 42, 43, 49)		9	Mounting Screw, cd pl steel (2 req'd)	
	Type 2900A	R2900A X0012		Types 2900 & 2901	1U1463 24102
	Type 2901A	R2901A X0012		Types 2900A & 2901A	1A8576 28982
			10	Pipe Plug, steel (2 req'd)	1C3335 28992
			11	Valve Plug Spring, stainless steel	
				Types 2900 & 2901	1U1484 37022
			12	Relay Spring, stainless steel	
				Types 2900 & 2901	1U1466 37022
1	Relay Body Ass'y, aluminum		13*	O-Ring, nitrile	
	Types 2900 & 2901	3U1485 47052		Types 2900 & 2901	1P4206 06992
1	Relay Assembly		14*	O-Ring, nitrile (2 req'd)	
	Types 2900A & 2901A	35A4654 X012		Types 2900 & 2901	1P4207 06992
2	Casing Spacer, aluminum		15*	O-Ring, nitrile	
	Types 2900 & 2901	2P4193 47052		Types 2900 & 2901	1D6875 06992
3	Relay Casing, aluminum		17	Machine Screw, pl steel (6 req'd)	
	Types 2900 & 2901	2P4194 47052		Types 2900 & 2901	1U1468 28982
4	Valve Plug, stainless steel		18	Machine Screw, cd pl steel (2 req'd)	
	Types 2900 & 2901	1U1462 35072		Types 2900 & 2901	1V7435 28982
5	Spring Seat, stainless steel		19	Casing Spacer, aluminum	
	Types 2900 & 2901	1U9997 36022		Types 2900 & 2901	1U1486 47052
6*	Diaphragm Assembly, aluminum/nitrile		20	Base Plate, aluminum	4V8601 08012
	Types 2900 & 2901	1U1483 X0012	21	Cap Screw, cd pl steel (2 req'd)	1C5958 24052
7*	Upper Diaphragm, nitrile/Dacron				
	Types 2900 & 2901	26A5657 X012			

*Recommended spare part.

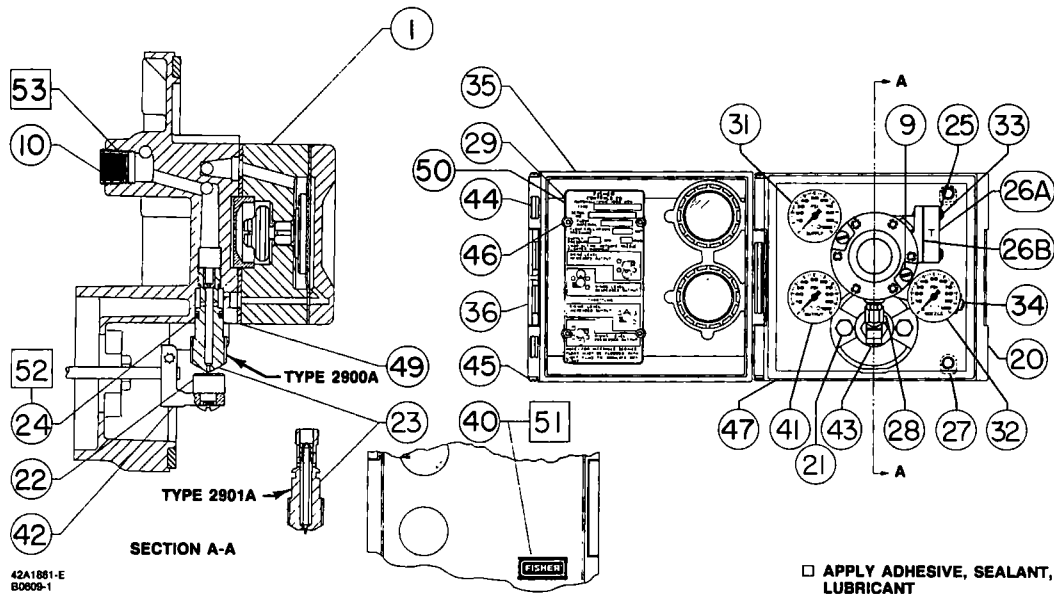


Figure 8. Type 2900A and 2901A Controllers

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
22*	Flapper Insert, nylon	1U9641 06162		(Types 2900 & 2901) 19A6896 X012		48	Socket, ni pl brass (not shown)	1V8610 15162
23	Nozzle Assembly, stainless steel	1U1494 000A2		0-700 kPa (Types 2900A & 2901A) 13A6341 X012		49*	Gasket, neoprene	Types 2900A & 2901A 12A1852 X012
	On-off	1U1491 000A2		Dual scale 0-60 psig & 0-400 kPa (Type 2900 & 2901) 13A1720 X012		50 ⁽²⁾	Nameplate, aluminum foil	Types 2900A & 2901A
	Proportional	1V2153 000A2					Psig units	32A4038 X012
24*	O-Ring, fluoroelastomer	1C8538 X0042	33	Machine Screw, cd pl steel (2 req'd)	1P3017 28982		kPa units	33A9905 X012
25	Washer, cd pl steel (2 req'd)	1C3329 28982	34	Pipe Plug, cd pl steel	1J7973 28982	51	Adhesive (not furnished with controller)	1M5959 X0012
26	Switch Block Ass'y	1U1471 X0012	35	Cover Ass'y	1V8603 X0012	52	Lubricant (not furnished with controller)	1M5282 06992
26A	Switching Block, nylon	1U1476 06992	36	Cover Handle, aluminum	1V8605 08012	53	Sealant (not furnished with controller)	1M5240 06992
26B	Gasket, neoprene	1U1478 06992	40	Nameplate Ass'y, stainless steel	1U9070 38982			
27	Vent Ass'y (3 req'd)	27A5516 X012	41	Output Pressure Gauge 0-60 (Types 2900 & 2901) 1R1904 000C2				
28	Machine Screw, cd pl steel	1H3697 28982		0-100 psig (Types 2900A & 2901A) 12A8616 X012				
29 ⁽¹⁾	Nameplate, stainless steel	3V1336 38982		0-400 kPa (Types 2900 & 2901) 12A4789 X012				
31	Supply Pressure Gauge 0-60 psig (Types 2900 & 2901) 1R1902 000C2			0-700 kPa (Types 2900A & 2901A) 13A6335 X012				
	0-100 psig (Types 2900A & 2901A) 12A8614 X012			Dual scale 0-60 psig & 0-400 kPa (Type 2900 & 2901) 13A6027 X012				
	0-400 kPa (Types 2900 & 2901) 12A4790 X012		42	Flapper Carrier, aluminum	1U9640 10042			
	0-700 kPa (Types 2900A & 2901A) 13A6340 X012		43	Machine Screw, cd pl steel	1U9642 28982			
	Dual scale 0-60 psig & 0-400 kPa (Type 2900 & 2901) 13A6026 X012		44	Closure Rod, stainless steel (3 req'd)	1V8608 37022			
32	Nozzle Pressure Gauge 0-60 psig (Types 2900 & 2901) 1U1469 99012		45	Machine Screw, cd pl steel (6 req'd)	1H2675 28992			
	0-100 psig (Types 2900A & 2901A) 12A8615 X012		46	Hex Nut, pl steel (4 req'd)	1V8609 X0012			
	0-400 kPa		47	Gasket, urethane poron 10B0673 X012				

Type 244V Sensor

1	Mounting Adaptor, steel	
	Standard	
2	in. NPT	1U1502 24492
2	in. grooved end	1U1503 X0012
3	in. NPT	2U1506 24492
3	in. grooved end	1U1504 24492
4	in. grooved end	2U1508 24492
4	in. weld hub	2U1507 24492
4	in. flanged	
	Class 150RF	2U1510 000A2
	Class 300RF	2U1511 000A2
	Class 600RF	2U1513 000A2
	Class 900RTJ	2U1531 X0012
	Class 1500RTJ	2U1532 X00A2
	NACE	
2	in. NPT	1U1502 X0052
2	in. grooved end	1U1503 X0022
3	in. NPT	2U1506 X0022
3	in. grooved end	1U1504 X0012
4	in. grooved end	2U1508 X0012
4	in. weld hub	2U1507 X0042

*Recommended spare part.

- Nameplate (key 29) is used on all four controller types. In the Type 2900 and 2901 controllers, it is the only nameplate used. In the Type 2900A and 2901A controllers, this nameplate is present, but it is used as a backing for the Type 2900A and 2901A nameplate (key 50), which is an adhesive-backed aluminum foil nameplate.
- Nameplate (key 50) has an adhesive backing and is applied over the stainless steel nameplate (key 29) in Type 2900A and 2901A controllers only.

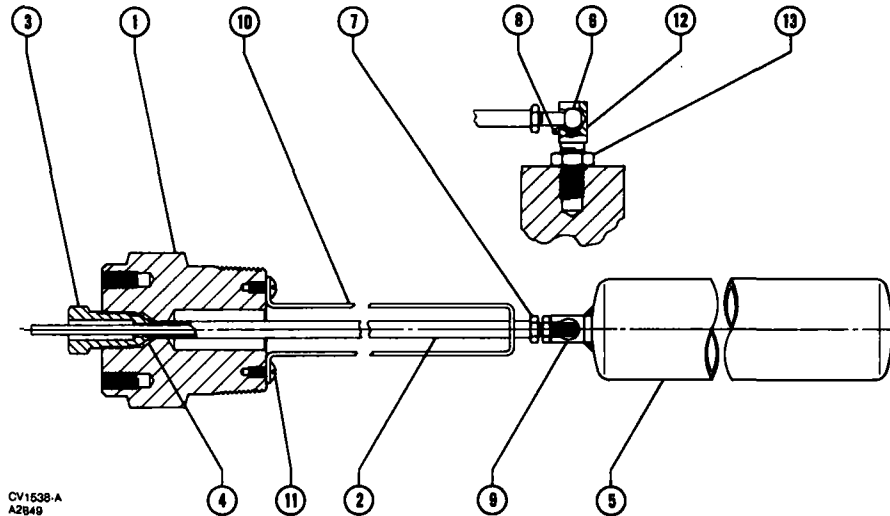


Figure 9. Type 244V Sensor

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
	4 in. flanged Class 150RF	2U1510 X0042	9	Connecting Rod (horizontal mounting only)			Type 279V Sensor	
	Class 300RF	2U1511 X0022		Standard, stainless steel	1U1518 35072	1	Mounting Adaptor	
	Class 600RF	2U1513 X0022		NACE, 316L stainless steel	1U1518 X0012		Standard Steel	
	Class 900RTJ	2U1531 X0022		Class 150-1500 flanged and weld hub	1U1529 24152	2 in. NPT	1V6454 24492	
	Class 1500RTJ	2U1532 X0012		NACE, 316 stainless steel	1U1528 X0012	4 in. grooved end	1V8269 X00A2	
2	Flexure Tube Assembly		10	Flexure Tube Protector, cd pl steel			Steel	
	Standard, Monel ⁽³⁾ , stainless steel			NPT adaptor	1U1528 24152		NACE	
	& K-Monel	1V6131 000A2		Grooved end	1U1527 24152	2 in. NPT	1V6454 X0022	
	NACE, K-Monel	1V6131 X0022		Class 150-1500 flanged and weld hub	1U1529 24152	3 in. grooved end	1V8404 X0022	
3	Retainer, cd pl steel	1U1501 31162		NACE, 316 stainless steel	1U1528 X0012	4 in. grooved end	1V8269 X0012	
4	Pivot Washer, stainless steel	1U1500 38992		NPT adaptor	1U1528 X0012	4 in. Class 150RF	11A1949 X022	
5	Displacer			Class 150-1500 flanged and weld hub	1U1529 X0012	2	Flexure Tube Assembly	
	1-7/8 x 9 in. (48 x 229 mm)		11	Machine Screw, stainless steel			Standard	
	Plexiglass	1U5322 X00B2		(2 req'd)			Monel & K-Monel	1H6987 000A2
	1-7/8 x 12 in. (48 x 305 mm)			Standard	1U1548 38982		316 stainless steel	1H6987 X0012
	Stainless steel, standard	1U1515 000A2		NACE	1U1548 X0022	3	Flexure Tube Retainer, stainless steel	1F1273 35072
	316L stainless steel, NACE	1U1515 X0012	12	Displacer Spud		4*	Flexure Tube Gasket, composition	1F5720 04022
	Plexiglass	1U1523 05032		Standard, stainless steel	1U1514 35072	5	Displacer, plexiglass	1V6457 05032
	2-3/4 x 8 in. (70 x 203 mm)			NACE, 316L stainless steel	1U1514 X0012	5A	Set Screw (3 req'd)	
	Stainless steel, standard	1U1516 000A2	13	Hex Jam Nut,			Standard	
	316L stainless steel, NACE	1U1516 X0042		Standard, cd pl steel	1E3960 28982		Cd pl steel	1K9082 28992
	Plexiglass	1U1524 05032		NACE, 316 stainless steel	1E9445 35252		Stainless steel	1K9082 X0012
6	Spud Adaptor (vertical mounting only)		24	Reducing Flange, cast iron (not shown)		6	Flexure Tube Protector	
	Standard, stainless steel	1U1517 35072		4 in. Class 125FF x 2 in. NPT	1N8264 21992		Standard	
	NACE, 316L stainless steel	1U1517 X0012		4 in. Class 250RF x 2 in. NPT	1L6287 21992		2 in. NPT, steel	1V6456 25072
7	Hex Jam Nut			Nameplate, stainless steel (NACE only) (not shown)	19A6034 X012		4 in. grooved end, steel	1U1529 24152
	(2 req'd for horizontal mounting, 1 req'd for vertical mounting)		25	Seal Wire, stainless steel (NACE only) (not shown)	1U7581 X0022		NACE, 316 stainless steel	
	Standard, cd pl steel	1A4997 24122	26				2 in. NPT	1V6456 X0012
	NACE, steel	1A3915 35252					3 & 4 in. grooved end	1U1529 X0012
8	Cotter Pin, stainless steel (vertical mounting only)						4 in. Class 150RF	1V6456 X0012
	Standard	1A5179 37012				11	Machine Screw (2 req'd)	
	NACE	1A5179 X0022					Standard	
							Cd pl steel	1U1548 38982
							316 stainless steel	1U1548 X0012
							NACE, stainless steel	1U1548 X0022

*Recommended spare part.
3. Trademark of International Nickel Co.

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Fisher Controls

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Regulators





APPLICATION:

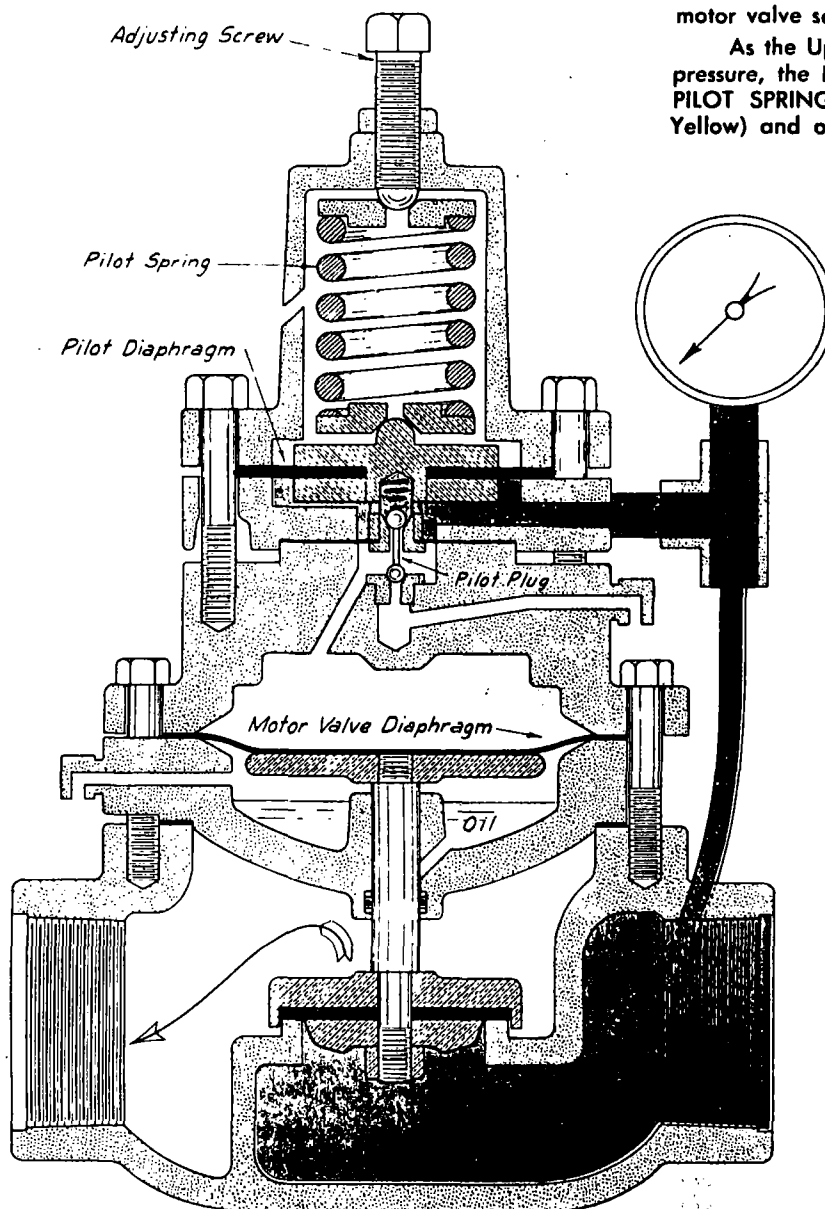
Vent lines on oil and gas separators, flow treaters, compressor stations, gas gathering systems.

PRESSURE RANGE:

5 p.s.i. to 300 p.s.i.

CAPACITY: Refer to Table of Contents

-  Pilot Assembly
-  Motor Valve Stem Assembly
-  Upstream Pressure
-  Motor Valve Diaphragm Pressure



OPERATION

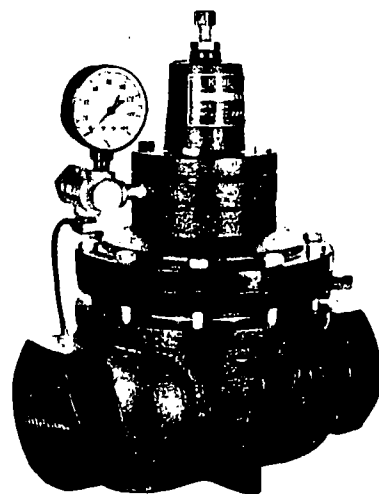
The Pilot Assembly and Motor Valve Stem Assembly (Cross-Hatched) are the only moving units in the regulator. The PILOT PLUG consists of two stainless balls rigidly connected together. The upper seat for the PILOT PLUG is the Motor Valve Diaphragm Pressure inlet (Red to Yellow). The lower seat for the PILOT PLUG is the pressure vent (Yellow to Atmosphere).

The PILOT SPRING in the bonnet loads the upper side of the Pilot Assembly and is opposed on the under side by Upstream Pressure (Red).

Assume the PILOT SPRING is compressed with the ADJUSTING SCREW for a set pressure greater than the Upstream Pressure (Red). The Pilot Assembly is forced downward by the PILOT SPRING. The lower seat for the PILOT PLUG (Yellow to Atmosphere) is closed and the upper seat for the PILOT PLUG (Red to Yellow) is open. This lets full Upstream Pressure (Red) load the MOTOR VALVE DIAPHRAGM to close the motor valve. The area of the MOTOR VALVE DIAPHRAGM is twice the area of the motor valve seat assuring a positive shut-off.

As the Upstream Pressure (Red) increases to the set pressure, the Pilot Assembly moves upward against the PILOT SPRING to first close the upper seat (Red to Yellow) and open the pressure vent (Yellow to Atmosphere). As the Motor Valve Diaphragm Pressure (Yellow) is decreased, the Upstream Pressure (Red) acting under the motor valve seat, opens the valve. With relief of Upstream Pressure (Red) through the motor valve, the Pilot Assembly assumes a position in which both seats of the PILOT PLUG are closed.

The non-bleed three-way valve action of the PILOT PLUG against its seats adjusts the Motor Valve Diaphragm Pressure (Yellow) to reposition the Motor Valve Stem Assembly to accommodate any rate of flow. The rapid but stable repositioning produces a true throttling action.



KIMRAY, Inc.

GAS BACK PRESSURE REGULATORS

2", 3" & 4" FGT BP-S

STEEL

275 lbs. W.P.

KIMRAY, INC.

Oklahoma City, Okla.

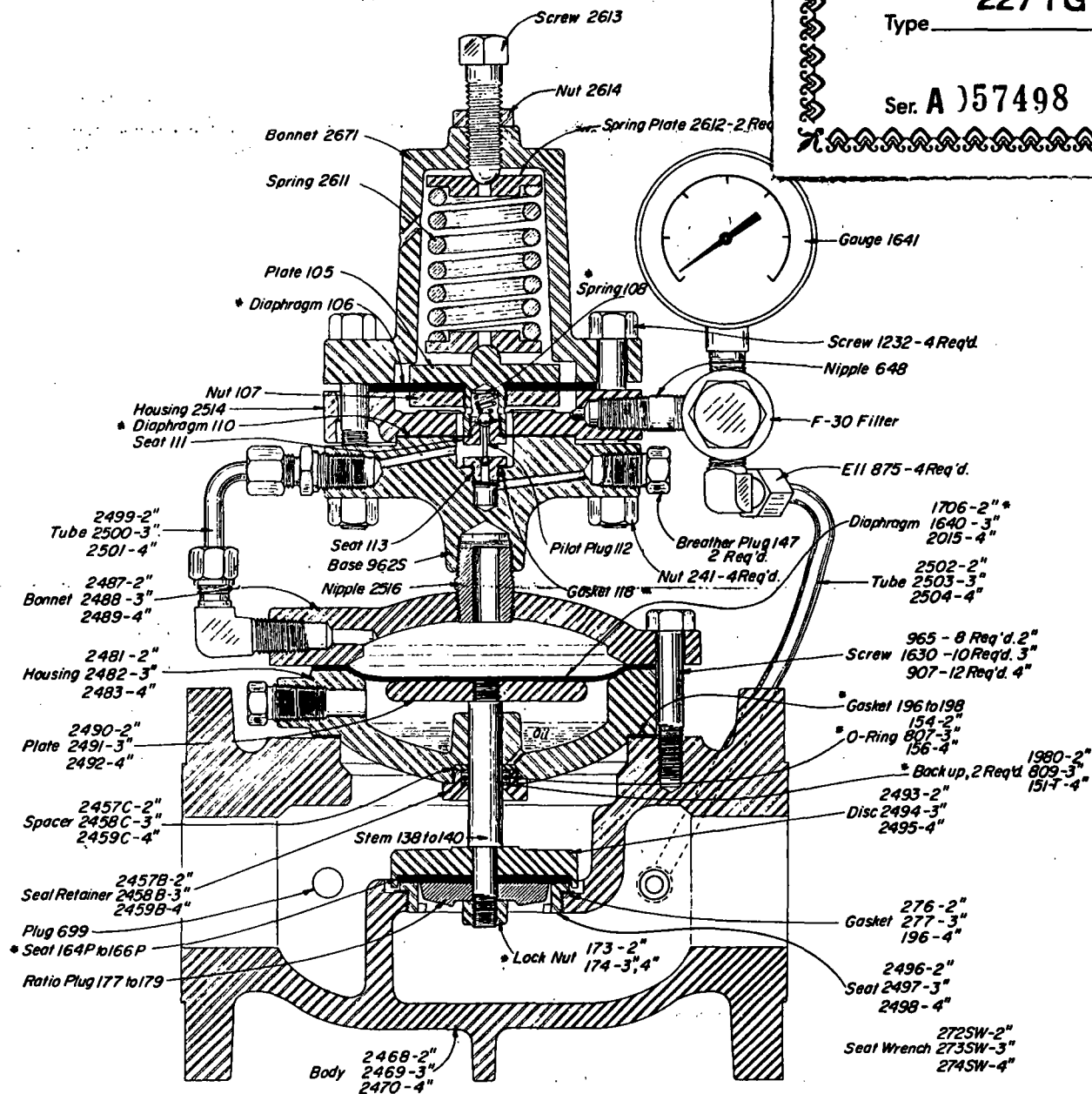
Warranty

"Kimray products are guaranteed against defect in material and workmanship for 90 days from date of installation by end-user. No claims for damages or charges for labor or other expenses in making repairs or adjustment will be allowed. In any case, Kimray will be liable only to the extent of defective material F.O.B. distributor's warehouse."

227 FGT BP-S

Type

Ser. A 157498



Dimensions, refer to Table of Contents

*These parts are recommended spare parts and are stocked as repair kits. To order repair kit, specify size of regulator. Thus: 2" 227G Repair Kit, 3" 327 G Repair Kit, 4" 427 G Repair Kit.

NOTE: The numbers of a series assigned to a part indicate different line sizes. For example: Stem 138-2", 139-3", 140-4".

VALVES AVAILABLE: STEEL

CAT. NO.	SIZE	TYPE	REG. NO.	DES. PRES.	OPER. PRES.
AGB	2"	FLGD.	227 FGT BP-S	275	275
AGC	3"	FLGD.	327 FGT BP-S	275	275
AGD	4"	FLGD.	427 FGT BP-S	275	275

Issued May 18, 1983

Fisher Controls

Instruction Manual

64 Series Regulators



April 1981

Form 1245

Incorporates Errata Sheets Dated November 1985 and April 1986

INTRODUCTION

Scope of Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering for 64 Series regulators. These regulators usually are shipped separately for line or panel mounting, although sometimes they are shipped installed on other equipment. However, instructions and parts lists for other equipment are found in separate manuals.

Product Description

The 64 Series regulators (figure 1) are spring-loaded, self-operated devices typically used to deliver constant reduced pressure of gaseous fluids. These regulators have a body side outlet that is drilled and tapped. This outlet may be plugged or used as a gauge connection.

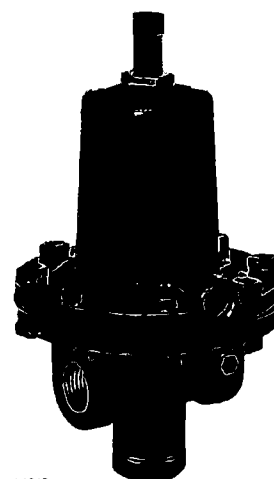
A description of the regulator configurations covered in this instruction manual is as follows:

Type 64—Basic regulator with seven spring ranges.

Type 64R—Internal relief version of the Type 64 regulator.

Type 64B—Anhydrous ammonia (NH_3) service version of the Type 64 regulator with five spring ranges.

Regulators with an R suffixed to the type number have integral low-capacity relief valves. In these constructions, the valve stem seats against a drilled hole in the diaphragm



W1943

Figure 1. 64 Series Regulator

plate. If the reduced pressure in any of these regulators should exceed the set pressure, the diaphragm will automatically be lifted off the valve stem so that a limited amount of excess pressure can flow into the spring case and bleed out through a screened vent.

A 64 Series regulator is also available with a handwheel, and if it is desired, a handwheel for panel mounting can be included.

Specifications

Table 1 lists specifications for the 64 Series regulators.

Table 1. Specifications

CONNECTIONS	End: 1/2 in. NPT screwed Body Side: 1/4 in. NPT screwed	MATERIAL TEMPERATURE CAPABILITIES	−20 to +150°F (−29 to 66°C)
MAXIMUM ALLOWABLE PRESSURES	Inlet: 250 psig (17.3 bar) Operating Outlet: 200 psig (13.8 bar) Emergency Outlet: 220 psig (15.2 bar)	PRESSURE REGISTRATION	Internal
OUTLET PRESSURE RANGES	See table 2	SPRING CASE VENT	1/4 in. NPT with screen
PORT DIAMETER	1/4 in.	WEIGHT	2.25 lb (1.01 kg)
OUTLET PRESSURE ADJUSTMENT	May be adjusted throughout each spring range by turning ■ adjusting set screw ■ handwheel or ■ panel-mounted handwheel	OPTIONS	<ul style="list-style-type: none"> ■ Closing cap for adjusting cap screw ■ Pressure gauges ■ TFE diaphragm protector
		ADDITIONAL SPECIFICATIONS	Construction materials are given in the parts list

Table 2. Outlet Pressure Ranges and Spring Selections

OUTLET PRESSURE RANGE*		SPRING PART NUMBER	SPRING COLOR
Psig	Bar		
3-15	0.2-1.0	1D8923 27022	Red
3-20	0.2-1.4	1D7515 27022	Cadmium-Plated
5-35	0.3-2.4	1D6659 27022	Blue
30-60	2.1-4.1	1D7455 27142	Green
35-100	2.4-6.9	1E5436 27142	Yellow
80-150†	5.5-10.3†	1P9013 27142	Brown
130-200†‡	9-13.8†‡	1P9013 27142	Brown

*All springs can be backed off to 0 psig. However, for the highest capacity and most accurate control, use the lowest-range spring that can be adjusted to the required set point.
†Cannot be used in anhydrous ammonia (NH₃) applications.
‡Uses small diaphragm plate.

1. Use qualified personnel when installing, operating, and maintaining these regulators. Before installation, make sure there is no damage to or foreign material in the regulator and that all tubing and piping are clean and unobstructed.

2. If installing the regulator at an outside location, point the spring case vent in the downward direction to protect it from getting plugged or from collecting moisture, corrosive chemicals, or other foreign materials. For inside installations, the spring case vent can be pointed towards the side of the spring case if it is mounted in a horizontal line. Spring case vent orientation may be changed by rotating the spring case with respect to the regulator body.

3. After applying pipe compound to the pipeline threads, connect inlet piping or tubing to the connection marked "A" and outlet piping or tubing to the connection marked "C."

INSTALLATION

WARNING

Overpressuring a regulator or associated equipment may cause leakage, part damage, or personal injury due to bursting of pressure containing parts or explosion of accumulated gas. To avoid overpressure, provide an appropriate overpressure protection device (i.e., a relief valve) to ensure that the ratings listed in table 1 will not be exceeded. A regulator should be inspected immediately for damage after any overpressure condition.

WARNING

If using this regulator on hazardous gas or flammable fluid, make sure that the vented gas is piped to a safe, well-ventilated area. Do not install a regulator so that the gas will be vented into a closed space. This could result in a fire or explosion which could cause personal injury or equipment damage.

4. To remotely vent the spring case, remove the screen, if present, and connect 1/4-inch NPT piping or tubing to the spring case connection. The piping or tubing should vent

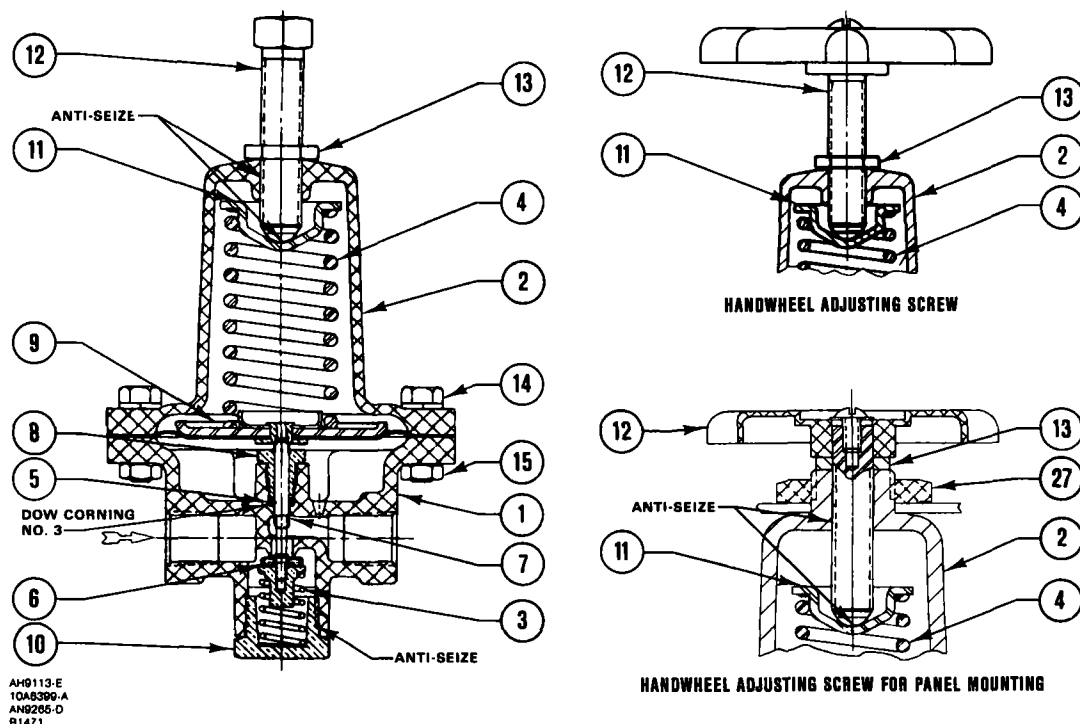


Figure 2. Type 64R Regulator

PARTS LIST

Key	Description	Part Number	Key	Description	Part Number
1	Body, aluminum	T10637 08012	7	Stem For sour gas corrosion resistance capability, 316 stainless steel	1D9638 X0012
2	Spring Case Aluminum For use w/adj screw	2P9015 08012	8	Stem Guide Types 64 and 64R For sour gas corrosion resistance capability, 316 stainless steel	1D6669 X0012
	For use w/handwheel	1F8095 000A2		For other than sour gas applications, brass	1D6669 14092
	Cast Iron			Type 64B, brass	T11083 X0012
	For panel mounting	2E5429 19042	9	Diaphragm Assy, for specified spring ranges Type 64 3 to 150 psig (0.2 to 10.3 bar) (steel, aluminum, rubber)	1D6662 000A2
3	Valve Plug Spring Types 64 and 64R For sour gas corrosion resistance capability ⁽¹⁾ , heat-treated Inconel ⁽²⁾	19A2859 X012		130 to 200 psig (9.0 to 13.8 bar) (aluminum/nitrile)	1D6662 X0012
	For other than sour gas applications, steel	1D6668 27222		Type 64R 3 to 150 psig (0.2 to 10.3 bar) (steel/brass/rubber)	1H9112 000A2
4	Control Spring	See following table		130 to 200 psig (9.0 to 13.8 bar) (brass/nitrile)	1H9112 X0012
5	O-Ring, nitrile	1D6825 06992	10	Body Plug, aluminum	1D6652 09012
6	Disk Holder Assy Types 64 and 64R For sour gas corrosion resistance capability, nitrile rubber/316 stainless steel	1D6656 X0032	11	Upper Spring Seat For sour gas corrosion resistance capability, pl heat-treated low-carbon steel	1D6671 X0012
	For other than sour gas applications, nitrile/brass	1D6656 000A2		For other than sour gas applications, pl steel	1D6671 25072
	Type 64B, nitrile/aluminum	T11137 000A2	12	Adjusting Screw or Handwheel Assy For aluminum spring case Adj. screw	1D9954 48702
				Handwheel assembly	1J4965 000A2
				For cast iron spring case Panel mounting	1N2005 000A2
			13	Locknut, steel	1D6677 28982
			14	Cap Screw, plated steel (8 req'd) For aluminum spring case	T10760 24052
				For cast iron spring case	1K7646 24052
			15	Hex Nut, pl steel (8 req'd)	1A3457 24122
			16	Vent or Screen, stainless steel (not shown)	0L0783 43062
			17	Label	See following table
			19	Closing Cap, brass (for cast iron spring case only—not shown)	
			23	Nameplate, aluminum	1E2401 11992
			24	Drive Screw, pl steel (4 req'd) (for cast iron spring case)	1E5017 28982
			25	Gauge	see following table
			27	Locknut, aluminum (for cast iron spring case only)	1N9360 09012
			42	NACE Tag, 18-8 stainless steel (not shown)	19A6034 X012
			43	Tag Wire, 304 stainless steel (not shown)	1U7581 X0022

1. As detailed in National Association of Corrosion Engineers (NACE) standard MR-01-75.

2. Trademark of International Nickel Co.

4. Remove the diaphragm assembly (key 9).
5. Unscrew and remove the stem guide (key 8) from the body.
6. Remove the stem seal O-ring (key 5) from the body. If the O-ring is to be replaced, it should be lubricated with Dow Corning* No. 3 grease or equivalent.
7. Unscrew the body plug (key 10). This permits removal of the valve plug spring (key 3) and the disk holder assembly (key 6).

Assembly

This procedure assumes that the regulator is completely disassembled. If not, start these instructions at the appropriate step. Key numbers are referenced in figure 2.

1. Insert the disk holder assembly (key 6) into the bottom of the regulator body (key 1).
2. Place the valve plug spring (key 3) so that it is resting against the bottom of the disk holder assembly (key 6), and screw the body plug (key 10) into the body.
3. Insert the stem seal O-ring (key 5) inside the body (key 1).
4. Screw the stem guide (key 8) into the regulator body.
5. Place the diaphragm assembly on top of the regulator stem (key 7).

6. Place the control spring (key 4) on the diaphragm head.

7. Place the upper spring seat (key 11) on the top of the control spring (key 4).

8. Position the spring case (key 2) over the control spring and onto the regulator body (key 1). Orient the spring case vent as necessary.

9. Insert the cap screws (key 14) and hex nuts (key 15), and tighten them only finger tight.

10. Thread the adjusting screw and locknut (keys 12 and 13) into the spring case just far enough to slightly compress the spring.

11. Securely tighten the cap screws (key 14), and refer to the Startup section for adjustment procedures.

PARTS ORDERING

When corresponding with the Fisher sales office or sales representative about this regulator, include the type number and all other pertinent information stamped on the bottom cap and on the label. Specify the complete 11-character part number from the following parts list when ordering replacement parts.

the spring case to a safe location, have as few bends as possible, and have a screened vent on its exhaust end that is weather resistant and always pointed in the downward direction.

5. Like most regulators, 64 Series regulators have outlet pressure ratings lower than inlet pressure ratings. Although types with internal relief include limited downstream overpressure protection, all types may require additional relief protection for some service conditions if the actual inlet pressure can exceed the regulator outlet pressure rating or the pressure ratings of any downstream equipment. Inspect a regulator periodically and after any overpressure condition.

6. Each regulator is factory-set for the pressure setting specified on the order. If no setting is specified, outlet pressure is factory-set at the midrange of the control spring.

STARTUP

Key numbers are referenced in figure 2.

1. First, make sure that the downstream equipment is adjusted according to the proper specifications.

2. Slowly open the upstream and downstream shut-off valves while monitoring the outlet pressure with a gauge installed at some point downstream from the regulator. Pressure may also be monitored by installing a pressure gauge in the unused outlet connection.

3. If it is necessary to adjust the regulator:

- Remove the closing cap (key 19, not shown), if one is used.
- Loosen the locknut (key 13).
- Turn the adjusting screw (key 12) while monitoring the pressure. Turn clockwise to increase the set pressure; turn counterclockwise to decrease the set pressure.
- Tighten the locknut after adjustment is made.
- Replace closing cap, if one is used.

SHUTDOWN

1. Close the upstream shutoff valve.
2. Close the downstream shutoff valve.

3. If vent valves are installed, open the vent valve between the regulator and the downstream shutoff valve. Then, open the vent valve between the regulator and the upstream shutoff valve.

4. If vent valves are not installed, safety bleed off both inlet and outlet pressures, and check that the regulator contains no pressure.

MAINTENANCE

Regulator parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement of parts depends upon the severity of service conditions as well as the requirements of local, state, and federal regulations.

WARNING

To avoid personal injury or equipment damage from sudden release of pressure or explosion of accumulated gas, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure from the regulator.

Disassembly

Note

If sufficient clearance exists, the body assembly (key 1) may remain mounted in a line or panel or on other equipment during disassembly as long as the entire regulator does not have to be replaced.

The following procedure describes how to completely disassemble the regulator. When part replacement or inspection is required, complete only those steps necessary to accomplish the task, and then start the assembly at the appropriate step.

Key numbers are referenced in figure 2.

1. Remove closing cap (key 19, not shown), if one is used.
2. Loosen locknut (key 13), and turn adjusting screw (key 12) counterclockwise so that spring tension is relieved.
3. Remove the cap screws and hex nuts (keys 14 and 15) that hold the spring case (key 2) on the body (key 1). Then, remove the spring case, control spring (key 4), and upper spring seat (key 11).

Optional 657 or 667 Series Actuator Mounting Parts— (not shown)

Key	Description	Part Number
	Mounting Bracket	
	Casing mounting for size 80, steel/Zn pl	1E4568 25062
	Casing mounting for smaller sizes, steel	1H9255 25022
	Yoke mounting for all sizes, steel	1E2042 25092
	Cap Screw	
	Casing mounting for all sizes, plated steel (2 req'd)	1L9366 24052
	Yoke mounting, plated steel	1C2752 24052

Keys 4 and 17 Control Spring, and Label (if used)

TYPE NUMBER	SPRING RANGE		SPRING	LABEL (FOR ALUMINUM SPRING CASE ONLY)
	Psig	Bar		
64, 64R, or 64B	3 to 15	0.2 to 1.0	1D8923 27022	1D9032 06032
	3 to 20	0.2 to 1.4	1D7515 27022	1C3763 06032
	5 to 35	0.3 to 2.4	1D6659 27022	1C3764 06032
	30 to 60	2.1 to 4.1	1D7455 27142	1C3766 06032
	35 to 100	2.4 to 6.9	1E5436 27142	1C3765 06032
64 or 64R only	80 to 150	5.5 to 10.3	1P9013 27142	1P9018 06032
	130 to 200	9.0 to 13.8	1P9013 27142	1P9019 06032

Key 25 Bottom-Connected Gauge

CALIBRATION		PART NUMBER
Psig	Bar	
0 to 15	0 to 1.0	1J9760 99012
0 to 30	0 to 2.0	1J9761 99012
0 to 60	0 to 4.1	1J9762 99012
0 to 100	0 to 6.9	1J9763 99012
0 to 100†	0 to 6.9†	1F2556 99012
0 to 160	0 to 11.0	1J9764 99012
0 to 200	0 to 13.8	1J9765 99012
0 to 300	0 to 20.7	1J9766 99012

† This is only gauge design for ammonia service; all others not recommended for this service.

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Control valves

Fisher Controls

Instruction Manual

128-PQ Series Control Valves

January 1988

Form 5086

Introduction**Scope of Manual**

This manual provides installation, maintenance, and parts information for 128-PQ Series control valves. Instructions and parts lists for Fisher pneumatic instrumentation and other equipment used with this control valve will be found in separate manuals.

Product Description

PQ Series valve body assemblies provide on-off dump valve service for such oil production applications as separators, scrubbers, and treaters, even under sour gas conditions. They also may be used in general on-off high-pressure control of a wide variety of liquids and gases, including those which are sticky or erosively gritty. All of these bodies have single ports, unbalanced stem-guided valve plugs, and push-down-to-close valve plug action. They are operated by a Type 128 yokeless spring-and-diaphragm actuator, which can be reversed in the field to provide either a normally open or a normally closed configuration without requiring additional parts.

Type 128-PQC: 1-inch combination control valve (figure 1) with a pipe plug standard installation in the bottom connection for straight-through globe valve flow. However, the pipe plug may be field-changed to the left-hand end connection as shown in figure 3 for angle flow.

Type 128-PQF: 1-inch angle-style control valve with 2-inch threaded connection on body. This style of control valve is designed for vessel mounting and uses the warming effects of gases at the top of the vessel to resist formation of hydrocarbon hydrates at high pressure drops.

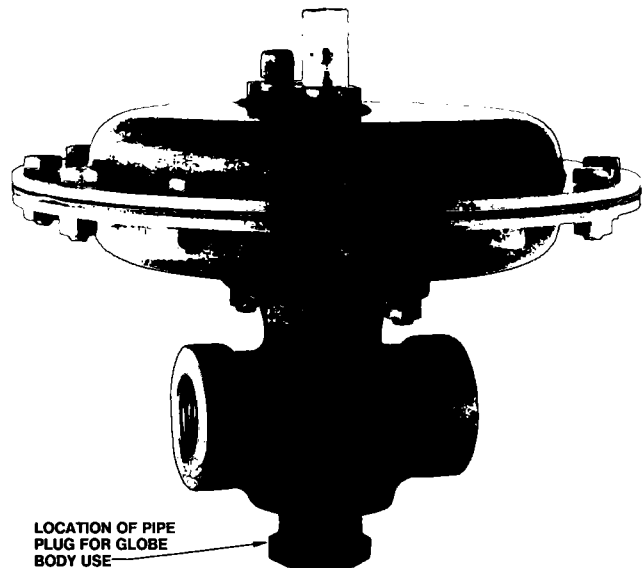


Figure 1. Type 128-PQC Control Valve

Type 128-PQ: 2-inch globe-style control valve.

Specifications

Table 1 lists specifications for 128-PQ Series constructions. Some of the specifications for a given control valve as it originally comes from the factory are stamped on a nameplate (figure 2) located on the upper diaphragm casing flange.

Table 1. Specifications

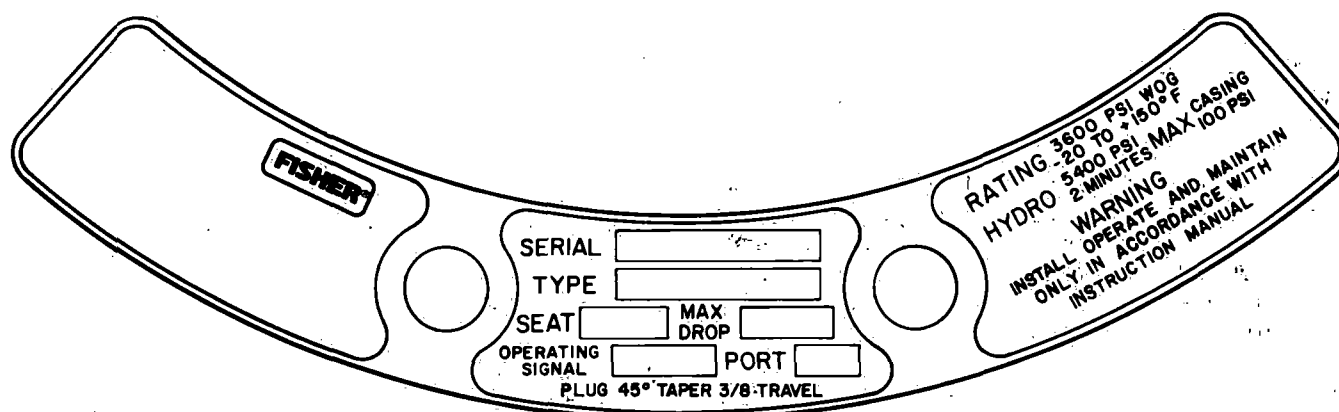
Available Configurations	Material Temperature Capabilities⁽¹⁾								
Type 128: Yokeless, on-off spring-and-diaphragm actuator with action field-reversible between spring-open and spring-close Design PQ, PQC, and PQF Valve Bodies: See table 2	Metal Seat: – 20 to 180°F (– 29 to 82°C) Soft Seat: – 20 to 150°F (– 29 to 66°C)								
Body Sizes and End Connection Styles	Flow Characteristic								
See table 2	Quick-opening with 45-degree taper valve plug								
Maximum Inlet Pressures and Temperatures⁽¹⁾	Flow Direction								
3600 psig from – 20 to 100°F, 3550 psig at 150°F, and 3520 psig at 180°F (248 bar from – 29 to 38°C, 245 bar at 66°C, and 243 bar at 82°C)	Either way								
Maximum Pressure Drops⁽¹⁾	Port Diameters								
See table 3	See table 2								
Actuator Input Signal	Maximum Travel								
0 or 20 psig (0 or 1.4 bar) or 0 or 35 psig (0 or 2.4 bar)	3/8-inch (10 mm)								
Maximum Actuator Casing Pressure	Actuator Diaphragm Effective Area								
100 psig (6.9 bar)	33 inches (213 cm ²)								
Shutoff Classifications	Actuator Pressure Connections								
Metal Seats: ANSI Class IV ANSI/FCI 70-2-1986 (1982)—0.01% of maximum valve capacity using air at service ΔP or 50 psi (3.4 bar) drop, whichever is lower, and between 50 and 125°F (10 and 52°C) Soft Seats: ANSI Class VI ANSI/FCI 70-2-1986 (1982)—one bubble (0.15 ml) per minute using air at service ΔP or 50 psi (3.4 bar) drop, whichever is lower, and between 50 and 125°F (10 and 52°C)	1/4 inch NPT female								
1. The pressure and temperature limitations in this manual, and any applicable code limitation, should not be exceeded.	Valve Travel Indication								
	Scale divisions for each 25% of travel are provided on plastic travel indicator cover								
	Approximate Weight								
	<table> <tr> <th>Valve Type</th><th>Weight Pounds (kg)</th></tr> <tr> <td>128-PQ</td><td>21 (9.5)</td></tr> <tr> <td>128-PQC</td><td>17 (7.7)</td></tr> <tr> <td>128-PQF</td><td>19 (6.6)</td></tr> </table>	Valve Type	Weight Pounds (kg)	128-PQ	21 (9.5)	128-PQC	17 (7.7)	128-PQF	19 (6.6)
Valve Type	Weight Pounds (kg)								
128-PQ	21 (9.5)								
128-PQC	17 (7.7)								
128-PQF	19 (6.6)								

Table 2. End Connections and Port Diameters

DESIGN		PQ	PQC		PQF
BODY STYLE		Globe	Combination globe and angle body; common end and bottom connections and pipe plug allow conversion between globe and angle styles		Angle
END CONNECTIONS		2 inch NPT female	1 inch NPT female		1 inch NPT female with additional 2 inch NPT male threads that allow optional installation directly into vessel
SEATING		Metal or soft	Metal	Soft	Metal
PORT DIAMETERS	Inch	1/4, 3/8, 1/2, 3/4 ⁽¹⁾	1/4, 3/8, 1/2	1/4, 3/8, 1/2, 3/4 ⁽²⁾	1/4, 3/8, 1/2
	mm	6.4, 9.5, 12.7, 19.1 ⁽¹⁾	6.4, 9.5, 12.7	6.4, 9.5, 12.7, 19.1 ⁽²⁾	6.4, 9.5, 12.7
C _v AT MAX TRAVEL FOR LARGEST PORT WITH FLOW TENDING TO CLOSE VALVE		8.19	8.32 (angle-style body)		6.75
1. Caged construction for metal or soft seat. 2. Cageless construction with seat cut into body for soft seat only.					

Table 3. Maximum Allowable Shutoff Pressure Drops

SEATING	ACTUATOR ACTION	FLOWING PRESSURE DROP TENDS TO:	PORT DIAMETER		CADMIUM COLORED MAIN SPRING 14A8831 X012				RED MAIN SPRING 14A9077 X012			
					0 or 20 Psig (0 or 1.4 Bar) Actuator Input Signal (2 Springs Required)		0 or 35 Psig (0 or 2.4 Bar) Actuator Input Signal (4 Springs Required)		0 or 20 Psig (0 or 2.4 Bar) Actuator Input Signal (2 Springs Required)		0 or 35 Psig (0 or 2.4 Bar) Actuator Input Signal (4 Springs Required)	
			Inches	mm	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar
Metal (all types)	Spring closes valve	Open Valve	1/4	6.4	1510	104	3370	232	3380	233	3600	248
			3/8	9.5	520	36	1340	92	1340	92	3120	215
			1/2	12.7	220	15	690	47	700	48	1720	118
			3/4	19.1	30	2.1	240	16	240	16	710	49
	Close valve	Close valve	1/4	6.4	940	65	1860	128	1370	94	2920	201
			3/8	9.5	1130	78	2450	169	1540	106	3300	227
			1/2	12.7	1330	92	2920	201	1710	118	3600	248
			3/4	19.1	2030	140	3600	248	2320	160	3600	248
	Spring opens valve	Close valve	1/4	6.4	170	12	350	24	Valve will not shut off with this combination of spring and application			
			3/8	9.5	530	36	610	42				
			1/2	12.7	540	37	1150	79				
			3/4	19.1	1400	96	2910	200				
Soft (except Type 128-PQF)	Spring closes valve	Open valve	1/4	6.4	1000	69	1000	69	1000	69	1000	69
			3/8	9.5	710	49	1000	69	1000	69	1000	69
			1/2	12.7	400	28	830	57	830	57	1000	69
			3/4	19.1	160	11	350	24	360	25	790	54
	Close valve	Close valve	1/4	6.4	940	65	1000	69	1000	69	1000	69
			3/8	9.5	1000	69	1000	69	1000	69	1000	69
			1/2	12.7	1000	69	1000	69	1000	69	1000	69
			3/4	19.1	1000	69	1000	69	1000	69	1000	69
	Spring opens valve	Close valve	1/4	6.4	560	39	660	45	Valve will not shut off with this combination of spring and application			
			3/8	9.5	480	33	960	66				
			1/2	12.7	540	37	1000	69				
			3/4	19.1	1000	69	1000	69				



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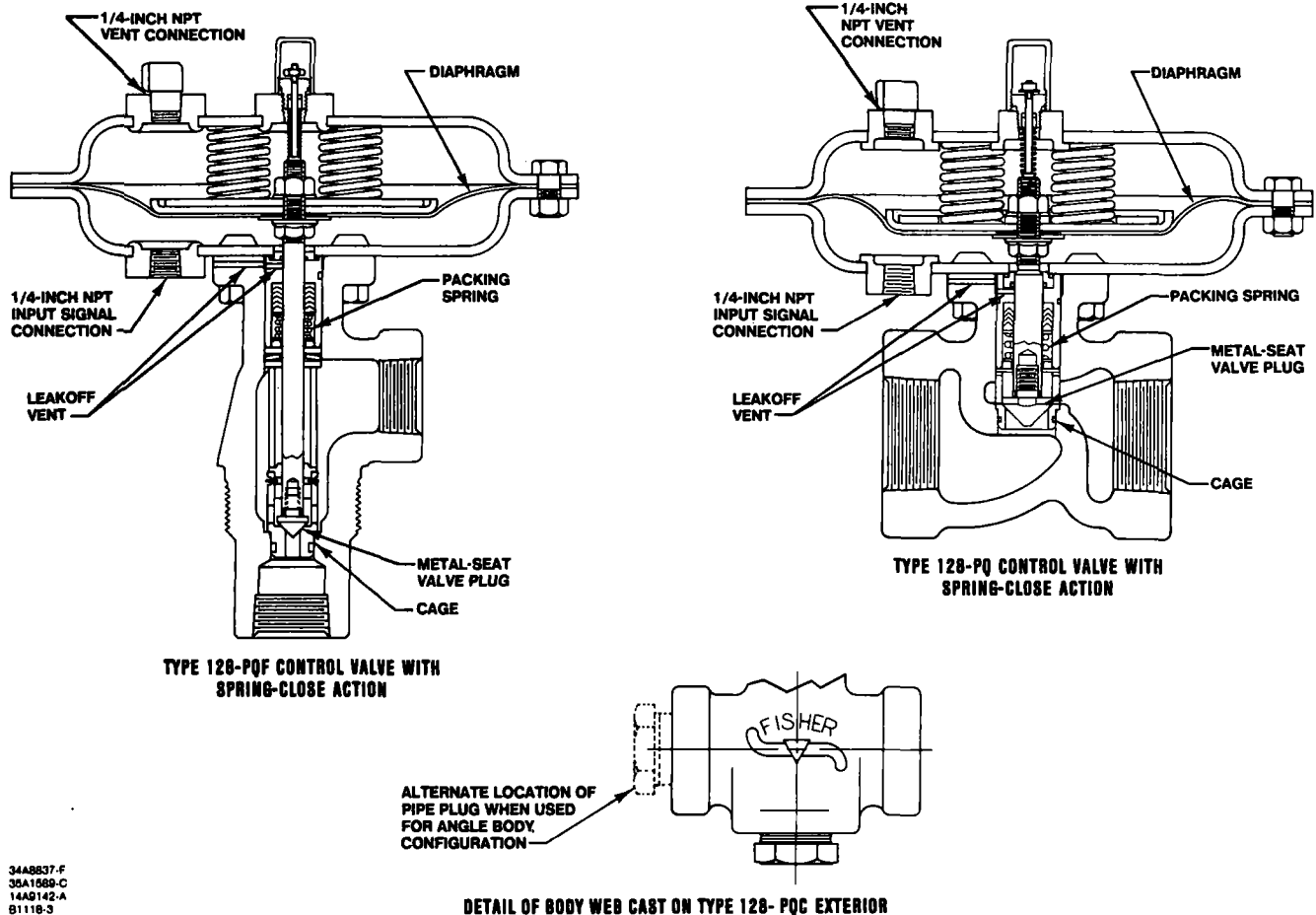
Figure 2. Typical Nameplate

Installation

WARNING

To avoid personal injury or property damage caused by bursting of pressure-retaining parts or by uncontrolled process fluid,

be certain the service conditions do not exceed the limits shown on the valve nameplate and in tables 1 and 3. The leakoff and spring case vents must be kept open. Avoid danger of fire or explosion from venting of flammable or otherwise hazardous fluid into a closed or poorly vented location by providing adequate ventilation.



DETAIL OF BODY WEB CAST ON TYPE 128-PQC EXTERIOR

Figure 3. Typical Constructions

1. Before installing the valve, inspect the valve body and associated equipment for damage and any foreign material.

2. Follow local, state, national, or other applicable codes when installing the valve in the pipe line. Also, use pipe thread compound on all male threads when installing the valve. If continuous operation is required during inspection and maintenance, install a three-valve bypass around the control valve.

3. The control valve may be installed in any orientation. However, the normal method is with the actuator above the body, especially for an angle body or angle configuration.

4. Make sure that the valve is oriented so that flow is in the desired direction. If angle flow is desired with the Type 128-PQC control valve, switch the pipe plug to the left-hand end connection as shown in figure 3.

5. Connect the input signal line to the 1/4-inch NPT connection (figure 3) in the lower diaphragm casing of a spring-close control valve or in the upper diaphragm casing of a spring-open control valve.

Principle of Operation

All the 128-PQ Series control valves have push-down-to-close valve plug action (figure 3). In the caged soft-seat and all metal-seat constructions, the valve plug shuts off against the integral seat ring in the cage. In the cageless soft-seat construction, the valve plug shuts off against the seat cut into the web of the valve body.

A nylon insert in the valve plug thread is used to help keep the valve plug from rotating.

A leakoff vent passes through the packing box and out the valve body. This permits any process leakage through the packing to escape before passing along the stem into the actuator, and it permits loading pressure leakage from the lower diaphragm case to escape before passing along the stem into the valve body.

WARNING

The leakoff vent must be kept open. Avoid danger of fire or explosion from venting of flammable or otherwise hazardous fluid into a closed or poorly vented location by providing adequate ventilation.

Maintenance

Valve parts are subject to normal wear and must be inspected and replaced as necessary. Inspection and maintenance frequency depends upon severity of service conditions. Instructions are given in this section for replacing packing and trim, changing main spring range, and reversing action or replacing actuator parts. The valve body (key 1, figure 7) may remain in the line or on the vessel unless it must be removed for maintenance or replacement.

WARNING

To avoid personal injury or property damage caused by sudden release of pressure or uncontrolled process fluid, isolate the control valve from the pressure system, and release all pressure from the valve body and actuator before performing maintenance operations.

Replacing Packing and Trim

These procedures are to be performed either when using a complete replacement packing and trim assembly (figure 4) or when individually replacing packing and trim parts. Replacement packing and trim assembly numbers are listed in the table in the parts list. Packing and trim assembly key numbers are referenced in figure 5. Control valve assembly key numbers are shown in figure 7 for the valve body and in figure 8 for the actuator except where indicated. Most packing and trim assembly key numbers are duplicated in both figure 5 and figure 7.

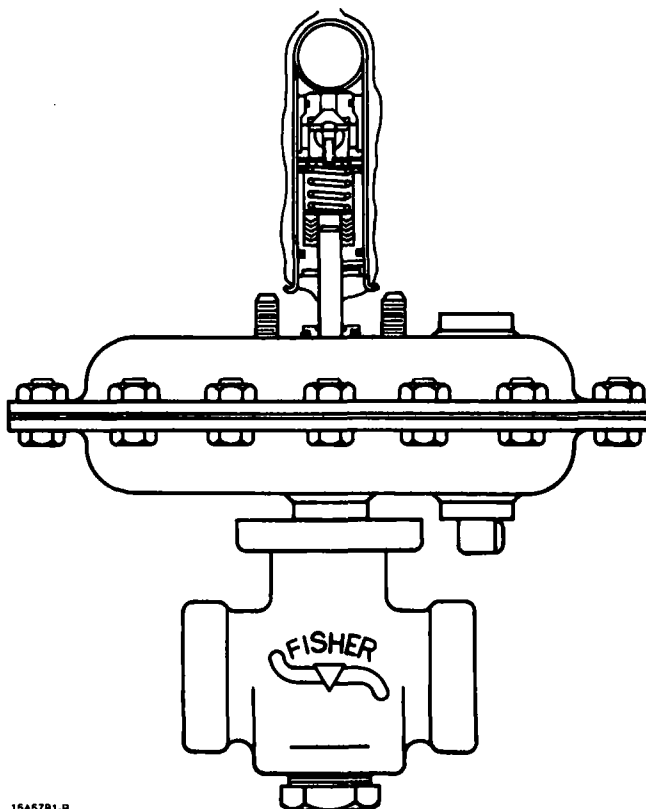
1. Isolate the control valve from all pressure, and release pressure from the valve body and actuator.

If the valve is equipped with an optional handjack, be sure the handjack assembly is not restricting the valve from closing. Rotate the handles or handjack body (key 48 or 47, figure 9) if necessary to allow the main springs (key 19) to close the valve.

2. Remove four nuts (key 14) from the integral screws of the lower diaphragm casing. Disconnect the input signal line, and lift the actuator and attached trim parts out of the valve body. Cleaning or other necessary maintenance may be performed on any accessible areas. The actuator and attached trim parts may be turned over and the valve body used to hold them (figure 4) as an aid in further maintenance.

3. To disassemble trim and gain access to packing parts or seal O-rings, perform one of the following disassembly sequences to the extent required.

For a Type 128-PQC or 128-PQ valve, unscrew the valve plug (key 3A) and remove the packing box washer (key 4).



15A5781-B

Figure 4. Installing Replacement Packing and Trim Assembly on Valve Stem

For a Type 128-PQF valve, remove the spring clip (key 38) and cage (key 2), and unscrew the valve plug (key 3A). Remove the bushing (key 40), spacer (key 34), packing box washer (key 4), spring washer (key 37), and other packing box washer.

4. Pull the packing box (key 9), O-ring retainer (key 39), stem O-ring (key 11), and diaphragm casing O-ring (key 35) off the stem.

5. Install the packing and trim assembly or individual parts over the stem as shown in figure 4. With a packing and trim assembly, remove the assembly from the tube (key 42), but do not remove the web sleeve (key 43) from the assembly. The sleeve will help keep the assembly parts in place during installation; roll back the sleeve as necessary during installation of the assembly.

If nitrile/cotton packing is being installed, lubricate the packing rings (key 8) with Dow-Corning[®] No. 3 silicon-base lubricant or equivalent.

6. If installing a packing and trim assembly, continue pushing the assembly onto the stem until the stem pushes the valve plug and cage (key 2) away from the packing box washer (key 4) or separate wiper ring (key 5, if included). Then, roll the sleeve back just past the packing box (key 9).

7. Push the packing box all the way onto the stem until the packing box, the stem O-ring (key 11), the O-ring retainer (key 39), and the diaphragm casing O-ring (key 35) are sealed against the diaphragm casing. Make sure the O-rings are positioned properly so that they will not be cut when the other parts are compressed against them. Then, push the packing spring washer (key 6), packing spring (key 7), other packing spring washer, wiper ring, and packing box washer (key 4) or separate wiper ring (key 5, if included in the assembly) down on the stem.

8. If installing a packing and trim assembly, remove the sleeve, cage puller (key 44, if included in the assembly), cage, and spring clip (key 38, if included in the assembly) from the valve plug.

9. Proceed as appropriate.

For a Type 128-PQ or 128-PQC valve, install the valve plug into the stem.

Note

Rotate the valve plug until the shoulder on the plug contacts the stem snugly. Further tightening is not needed.

To replace the cage (if used) or to gain access to the cage O-ring (key 12), use the cage puller or a wire hook to remove the cage from the body (key 1). Then, install replacement parts as necessary.

For a Type 128-PQF valve, install a packing box washer (key 4) and the spring washer (key 37) on the packing box, followed by the other packing box washer, spacer (key 34), and bushing (key 40). Install the valve plug into the stem.

Note

Rotate the valve plug until the shoulder on the plug contacts the stem snugly. Further tightening is not needed.

Secure the cage to the spacer with the spring clip (key 38).

CAUTION

To avoid damaging the cage O-ring during the following step, be careful during the installation procedure.

10. Install the actuator and attached trim parts back into the valve body (key 1), and secure with four nuts (key 14) attached to the lower diaphragm casing assembly screws. Tighten the nuts to 15 foot-pounds (20 newton-meters).

11. Connect the input signal line to the 1/4-inch NPT connection of the appropriate diaphragm casing.

Changing Main Spring Range

Key numbers used in this procedure are shown in figure 8 except where indicated.

1. Isolate the control valve from all pressure, and release pressure from the valve body and actuator.

If the valve is equipped with an optional handjack, be sure the handjack assembly is not restricting the valve from closing. Rotate the handles or handjack body (key 48 or 47, figure 9) if necessary to allow the main springs (key 19) to close the valve. Unscrew the handles or pipe plugs, and remove the indicator cover (key 41, figure 9). Drive out the groove pin (key 50, figure 9), and remove the stem nut and thrust washer (keys 49 and 51, figure 9).

2. Disconnect the input signal line if necessary, and remove the diaphragm casing nuts (key 14), cap screws (key 21), and upper diaphragm casing (key 20).

3. With spring-close action, install main springs (key 19) of the correct quantity and description as listed in table 3, making sure that the springs rest in the spring plate holes, and will not ride on the upper diaphragm casing vent boss.

Note

Do not loosen the stem nut (key 14) because disturbing its position in the following step may keep the valve either from shutting off or from opening completely at the correct input signal pressure, thus requiring complete reassembly of the stem and diaphragm assembly.

4. With spring-open action, remove the locknut (key 46), flat washer (key 15), diaphragm (key 16), diaphragm plate (key 17), spring plate (key 18), and main springs (key 19). Install main springs of the correct quantity and description as listed in table 3, and reinstall the removed parts (keys 18, 17, 16, 15, and 46) so that the lower ends of the main springs rest over the weld stud heads of the lower diaphragm casing and the spring plate holes fit over the upper ends of the springs. Tighten the locknut (key 46) to 12 foot-pounds (16 newton-meters).

5. Install the upper diaphragm casing cap screws and casing nuts. To avoid crushing the diaphragm, tighten the cap screws and nuts evenly in a crisscross pattern to 15 foot-pounds (20 newton-meters).

6. Connect the input signal line if necessary to the 1/4-inch NPT connection of the upper diaphragm casing.

7. If an optional handjack is used, reinstall the handjack parts. Be sure to secure the stem nut (key 49, figure 9) with the groove pin (key 50, figure 9).

Reversing Action or Replacing Actuator Parts

Key numbers used in this procedure are shown in figure 8 except where indicated.

1. Isolate the control valve from all pressure, and release pressure from the valve body and actuator.

If the valve is equipped with an optional handjack, be sure the handjack assembly is not restricting the valve from closing. Rotate the handles or handjack body (key 48 or 47, figure 9) if necessary to allow the main springs (key 19) to close the valve. Unscrew the handles or pipe plugs, and remove the indicator cover (key 41, figure 9). Drive out the groove pin (key 50, figure 9), and remove the stem nut and thrust washer (keys 49 and 51, figure 9).

The optional handjack is used only with spring-close valves. If changing the action of a spring-close valve with a handjack to spring-open action, the only function the handjack can perform is to restrict the valve from closing.

2. Disconnect the input signal line, and remove the diaphragm casing nuts, cap screws, and upper diaphragm casing (keys 14, 21, and 20).

3. Remove the main springs, stem nut, locknut, lock washer, spring plate, diaphragm plate, diaphragm, and flat washer (keys 19, 14, 46, 29, 18, 17, 16, and 15).

4. Remove four nuts (key 14) from the integral screws of the lower diaphragm casing. Lift this casing and the attached trim parts off the valve body.

5. Perform one of the following disassembly sequences as required.

For a Type 128-PQC or 128-PQ valve, unscrew the valve plug (key 3A), and remove the packing box washer (key 4).

For a Type 128-PQF valve, remove the spring clip (key 38) and cage (key 2), and unscrew the valve plug (key 3A). Remove the bushing (key 40), spacer (key 34), packing box washer (key 4), spring washer (key 37), and other packing box washer.

6. Pull the packing box (key 9), O-ring retainer (key 39), stem O-ring (key 11), and diaphragm casing O-ring (key 35) off the stem.

7. Remove the stem, and replace it or the bottom stem nut or locknut (key 14 or 46) as necessary.

8. Make sure the bottom shoulder of the bottom stem nut (key 14) or locknut (key 46) is the correct distance from the plug end of the stem, when reinstalled on the stem as shown in figure 6.

9. To achieve the desired control valve action (spring-close or spring-open), start where appropriate in one of the following assembly sequences:

For spring-close action, install the flat washer (key 15), diaphragm (key 16), diaphragm plate (key 17), spring plate (key 18), lock washer (key 29), and stem nut (key 14). Tighten the stem nut to 12 foot-pounds (16 newton-meters).

For spring-open action, install the lock washer (key 29), spring plate, diaphragm plate, diaphragm, flat washer (key 15), and locknut (key 46). Tighten the locknut to 12 foot-pounds (16 newton-meters).

10. For spring-open action only, install the main springs (key 19) into the lower diaphragm casing so that the lower ends of the springs rest over the weld stud heads of the lower diaphragm casing.

11. Install the stem and diaphragm assembly into the lower diaphragm casing. With spring-open action, make sure that the assembly is oriented so that the spring plate holes fit over the upper ends of the springs.

12. Secure the stem by installing the packing and trim parts according to steps 5 through 9 of the Replacing Packing and Trim section.

13. If reversing action from what it was previously, remove the vent assembly (key 31), and install it in the 1/4-inch NPT connection of the lower diaphragm casing for spring-open action or the upper diaphragm casing for spring-close action.

14. For spring-close action only, install the main springs, making sure they rest in the spring plate holes and will not ride on the upper diaphragm casing vent boss.

15. Install the upper diaphragm casing, cap screws, and casing nuts. To avoid crushing the diaphragm, tighten the cap screws and nuts evenly in a crisscross pattern to 15 foot-pounds (20 newton-meters).

16. Install the actuator and attached trim parts back into the valve body (key 1), and secure with four nuts (key 14) attached to the lower diaphragm casing assembly screws. Tighten the nuts to 15 foot-pounds (20 newton-meters).

17. Connect the input signal line to the 1/4-inch NPT connection of the appropriate diaphragm casing.

18. If an optional handjack is used, reinstall the handjack parts. Be sure to secure the stem nut (key 49, figure 9) with the groove pin (key 50, figure 9).

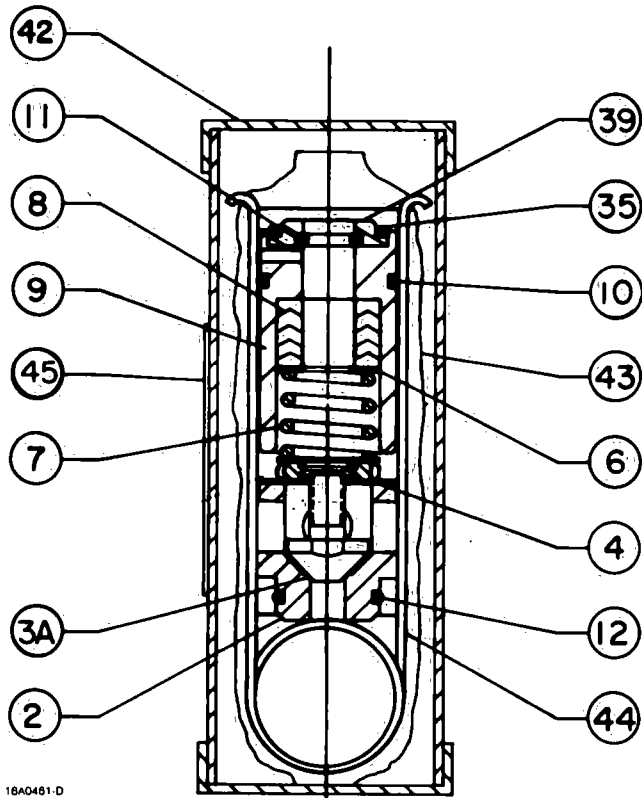
sentative for assistance, or when ordering replacement parts.

When ordering replacement parts, also be sure to include the complete 11-character part number from the following parts list.

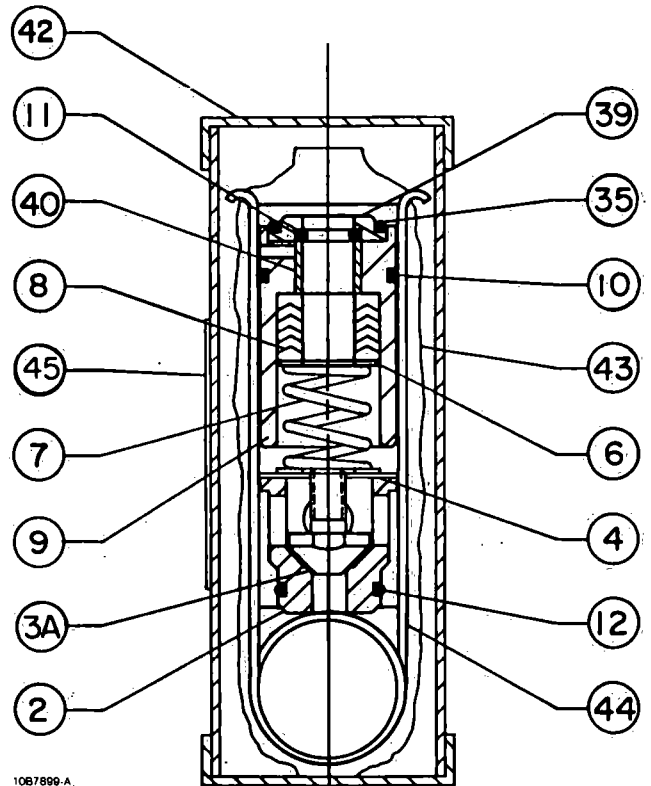
Parts Kits

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
			2	Cage (cont'd)		3A	Valve Plug (cont'd)	
	128-PQ Series Repair Kits (soft parts only. Kit includes key 5, 8, 10, 11, 12, and 35)			Design PQF			Nitronic 50 stainless steel ⁽¹⁾	16A2087 X022
				440C stainless steel, heat-treated ⁽¹⁾			Austenitic stainless steel w/tungsten carbide seating surface ⁽³⁾	15A6804 X012
				1/4 in. (6.4 mm) port	14A8826 X022		1/2 inch (12.7 mm) port	
	Type 128-PQ w/PTFE V-ring packing	RPQ X0000012		3/8 in. (9.5 mm) port	15A0720 X022		440C stainless steel, heat-treated ⁽¹⁾	14A6618 X012
	Type 128-PQC and PQF w/PTFE V-ring packing	RPQC X000012		1/2 in. (12.7 mm) port	15A0721 X022		Nitronic 50 stainless steel ⁽¹⁾	14A6618 X022
	Type 128-PQ w/Nitrile/cotton packing	RPQ X0000022		Nitronic 50 stainless steel ⁽¹⁾			Design PQ	
	Type 128-PQC and PQF w/Nitrile/cotton packing	RPQC X000022		1/4 in. (6.4 mm) port	14A8826 X032		1/4 inch (6.4 mm) thru 1/2 inch (12.7 mm) ports	
				3/8 in. (9.5 mm) port	15A0720 X032		440C stainless steel, heat-treated ⁽¹⁾	16A4353 X012
				1/2 in. (12.7 mm) port	15A0721 X032		Nitronic 50 stainless steel ⁽¹⁾	16A4353 X022
				Austenitic stainless steel w/tungsten carbide seating surface ^(1,3)			Austenitic stainless steel w/tungsten carbide seating surface ⁽³⁾	16A4602 X012
				1/4 in. (6.4 mm) port	15A6802 X012		3/4 in. (19.1 mm) port	
				3/8 in. (9.5 mm) port	15A6803 X012		440C stainless steel, heat-treated ⁽¹⁾	15A9633 X012
	For additional kit information, see following Replacement Packing and Trim Assembly Part Number table.			Design PQ			Nitronic 50 stainless steel ⁽¹⁾	15A9633 X022
	Replacement Packing and Trim Assembly	See following table		440C stainless steel, heat-treated ^(1,3)			Soft Seat	
	Travel Indicator Assembly	35A1588 X0A2		1/4 in. (6.4 mm) port	15A9876 X012		Design PQ	
				3/8 in. (9.5 mm) port	15A9878 X012		1/4 in. (6.4 mm) thru 1/2 in. (12.7 mm) ports	
1	Valve Body, WCB steel			1/2 in. (12.7 mm) port	15A9880 X012		Austenitic stainless steel/nitrile	15A7551 X022
	1 in. NPT			3/4 in. (19.1 mm) port	15A9632 X022		Austenitic stainless steel/polyethylene	15A7551 X012
	Design PQC	24A8802 X012		Nitronic 50 stainless steel ⁽¹⁾			3/4 in. (19.1 mm) port	
	Design PQF	24A8804 X012		1/4 in. (6.4 mm) port	15A9876 X022		Austenitic stainless steel/nitrile	15A7549 X022
	2 in. NPT			3/8 in. (9.5 mm) port	15A9878 X022		Austenitic stainless steel/polyethylene	15A7549 X012
	Design PQ w/o side			1/2 in. (12.7 mm) port	15A9880 X022		Design PQC	
	tappings	25A9630 X012		3/4 in. (19.1 mm) port	15A932 X032		1/4 in. (6.4 mm) thru 1/2 in. (12.7 mm) ports	
	Design PQ w/tapped side connections	27A4712 X012		Austenitic stainless steel w/tungsten carbide seating surface ^(1,3)			Austenitic stainless steel/nitrile	15A3199 X022
				1/4 in. (6.4 mm) port	16A4603 X012		3/4 in. (19.1 mm) port	
				3/8 in. (9.5 mm) port	16A4604 X012		Austenitic stainless steel/nitrile	15A3197 X022
				1/2 in. (19.1 mm) port	16A4605 X012		Austenitic stainless steel/polyethylene	15A3197 X012
2	Cage		3A	Valve Plug				
	Design PQC			Metal Seat				
	440C stainless steel, heat-treated ^(1,3)			Design PQC & PQF				
	1/4 in. (6.4 mm) port	14A8823 X022		1/4 in. (6.4 mm) & 3/8 in. (9.5 mm) ports				
	3/8 in. (9.5 mm) port	14A8805 X022		440C stainless steel, heat-treated ⁽¹⁾	16A2087 X012			
	1/2 in. (12.7 mm) port	14A7157 X022						
	Nitronic ⁽²⁾ 50 stainless steel ⁽¹⁾							
	1/4 in. (6.4 mm) port	14A8823 X032						
	3/8 in. (9.5 mm) port	14A8805 X032						
	1/2 in. (12.7 mm) port	14A7157 X032						
	Austenitic stainless steel w/tungsten carbide seating surface ^(1,3)							
	1/4 in. (6.4 mm) port	15A6800 X012						
	3/8 in. (9.5 mm) port	15A6801 X012						

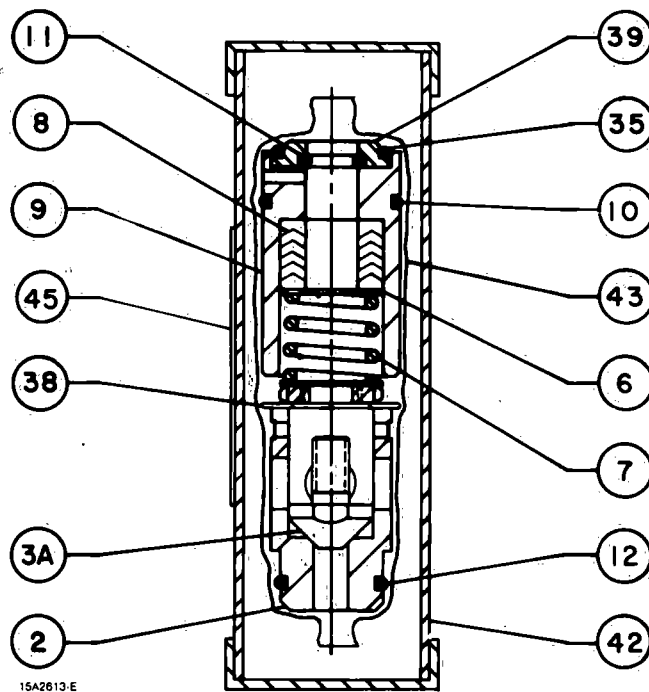
1. May also be ordered from the Replacement Packing and Trim Assembly Part Numbers table.
2. Trademark of Armco Steel Corp.
3. May also be ordered as part of the cage/plug/stem assembly (key 52).



DESIGN PQ



DESIGN PQC



DESIGN PQF

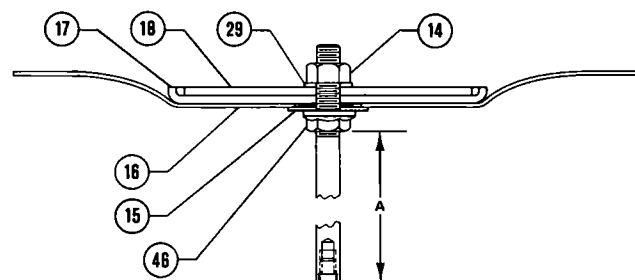
NOTE:
SEE THE PARTS LIST TABLE FOR
REPLACEMENT ASSEMBLY PART NUMBERS

Figure 5. Replacement Packing and Trim Assemblies
for Metal-Seated Constructions

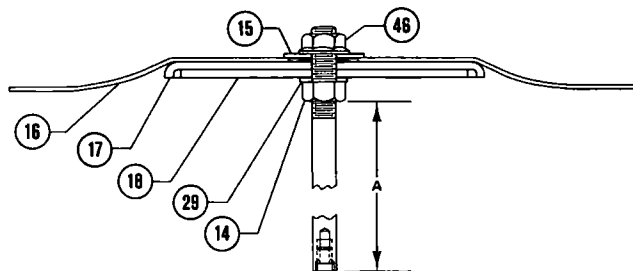
Replacement Packing and Trim Assembly Part Numbers

PORT DIAMETER		TFE V-RING PACKING AND HEAT-TREATED 440C STAINLESS STEEL VALVE PLUG AND CAGE			TFE V-RING PACKING, NITRONIC 50 STAINLESS STEEL VALVE PLUG AND CASE AND INCONEL X750 PACKING SPRING		
		Inconel X750 Packing Spring	17-7PH Stainless Steel Packing Spring				
Inches	mm	2 inch Type 128-PQ	1 inch Type 128-PQC	1 inch Type 128-PQF	2 inch Type 128-PQ	1 inch Type 128-PQC	1 inch Type 128-PQF
1/4	6.4	16A0461 X012	15A2611 X012	15A2613 X012	16A0461 X052	15A2611 X042	15A2613 X042
3/8	9.5	16A0461 X022	15A2611 X022	15A2613 X022	16A0461 X062	15A2611 X052	15A2613 X052
1/2	12.7	16A0461 X032	15A2611 X032	15A2613 X032	16A0461 X072	15A2611 X062	15A2613 X062
3/4	10.1	16A0461 X042	---	---	16A0461 X082	---	---

Key	Description	Part Number
3B	Stem, ⁽³⁾ 316 stainless steel	
	Design PQC w/o handjack	14A8806 X012
	Design PQC w/ handjack	26A1765 X012
	Design PQF w/o handjack	14A8829 X012
	Design PQF w/ handjack	26A1766 X012
	Design PQ w/o handjack	15A9634 X012
	Design PQ w/ handjack	26A1767 X012
4	Packing Box Washer, stainless steel	
	Design PQC ⁽¹⁾ (1 req'd)	
	1/2 in. (12.7 mm) or smaller ports	14A6617 X012
	3/4 in. (19.1 mm) port	14A8807 X012
	Design PQF (2 req'd)	14A8807 X012
	Design PQ ⁽¹⁾ (1 req'd)	15A9636 X012
5*	Wiper Ring, TFE (for nitrile/cotton packing only)	
	Design PQ	15A9637 X012
6 ⁽¹⁾	Washer, stainless steel (2 req'd)	
	Designs PQC & PQF	14A8808 X012
	Designs PQ	16A3631 X012
7 ⁽¹⁾	Packing Spring	
	Designs PQC & PQF	
	17-7PH stainless steel	10B7429 X012
	Inconel X750 ⁽⁴⁾	10B7430 X012
	Design PQ, Inconel X750	15A3183 X012
8 ⁽¹⁾	Packing Set, PTFE V-Ring	
	Designs PQC & PQF	10B7279 X012
	Design PQ	15A9883 X012
8*	Packing Ring, nitrile/cotton (6 req'd)	
	Designs PQC & PQF	14A9057 X012
	Design PQ	15A9882 X012
9 ⁽¹⁾	Packing Box, stainless steel	
	Designs PQC & PQF	10B7278 X022
	Design PQ	15A9631 X012
10 ⁽¹⁾	Stem O-Ring, fluoroelastomer	
	Designs PQC & PQF	1U8418 06382
	Design PQ	10A8217 X012



SPRING-CLOSE ASSEMBLY



SPRING-OPEN ASSEMBLY

34A8839-F
34A8838-F
A2223-1

VALVE DESIGN	DIMENSION A			
	mm		Inches	
	Spring-Close Assembly	Spring-Open Assembly	Spring-Close Assembly	Spring-Open Assembly
PQ	63.9	71.9	2.52	2.83
PQC	62.5	69.1	2.46	2.72
PQF	123	130	4.86	5.12

Figure 6. Stem and Diaphragm Assembly Dimensions

*Recommended spare part.

1. May also be ordered from the Replacement Packing and Trim Assembly Part Numbers table.

3. May also be ordered as part of the cage/plug/stem assembly (key 52).

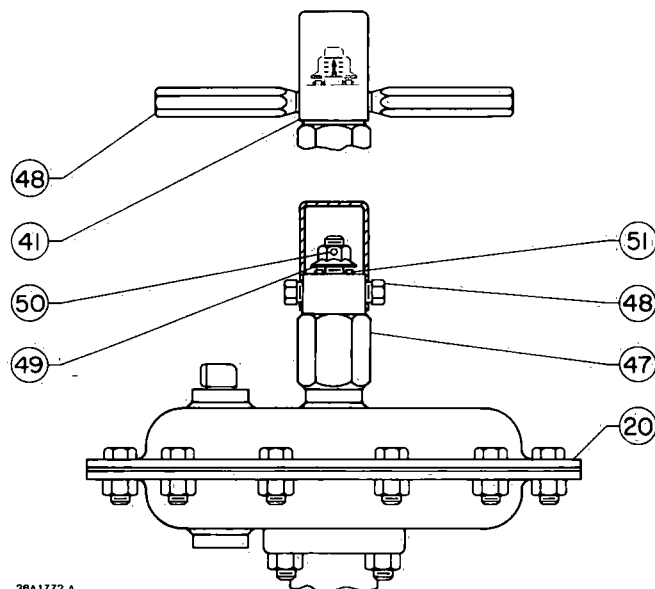
4. Trademark of International Nickel Co.

Key	Description	Part Number
11 ⁽¹⁾	Stem O-Ring, nitrile Designs PQ & PQF	1P4207 06992
	Design PQ	1J4888 06992
12 ⁽¹⁾	Cage O-Ring, fluoroelastomer Designs PQ & PQF	11A8741 X012
	Design PQ	1U8418 06382
13	Lower Diaphragm Casing, steel	24A8810 X012
14	Hex Nut, zn pl steel (17 req'd)	1A3465 24122
15	Flat Washer, zn pl steel	14A9770 X012
16*	Diaphragm, neoprene w/nitrile insert	14A8813 X012
17	Diaphragm Plate, zn pl steel	14A8814 X012
18	Spring Plate, zn pl steel	14A8819 X012
19	Main spring, pl steel	See table 3
20	Upper Diaphragm Casing, steel w/o handjack	24A8816 X012
	w/handjack	26A1770 X012
21	Cap Screw, pl steel (12 req'd)	1E7603 24052

Note

Key numbers 22 through 27 are
not req'd with a handjack.

22 ⁽⁵⁾	Travel Indicator Disc Nut, plastic	1F7305 06992
23 ⁽⁵⁾	Indicator Fitting, stainless steel	15A0726 X012
24 ⁽⁵⁾	Indicator Bushing, 316 stainless steel	13A2323 X012
25 ⁽⁵⁾	O-Ring, nitrile	1H2926 06992
26 ⁽⁵⁾	Machine Screw stainless steel	14A8818 X012
27 ⁽⁵⁾	Spring, stainless steel	16A0431 X012
28	Pipe Plug, steel for Design PQC only	1A7947 28992
29	Lock Washer, steel	1A7423 28992
31	Vent Assembly	27A5516 X012
32	Namplate aluminum	24A7156 X012
34	Spacer, stainless steel (for Design PQF only)	20B7478 X012
35 ⁽¹⁾	Diaphragm Casing O-Ring, nitrile	13A1584 X012
37	Spring Washer, 416 stainless steel (for Design PQF only)	14A8828 X012
38	Spring Clip, stainless steel (for Design PQC only)	14A8824 X012
39	O-Ring Retainer Design PQC & PQF, polyethylene	14A9053 X012
	Design PQ, stainless steel	17A2110 X012



36A1772-A

Figure 9. Optional Handjack Assembly

Key	Description	Part Number	Key	Description	Part Number
40	Bushing, 17-4PH stainless steel (for Design PQF only)	14A8825 X012	52	Cage/Plug/Stem Assembly, (cont'd) w/handjack	
41	Indicator Cover, plastic	26A1764 X012		1/4 in. (6.4 mm) port	16A4601 X022
42 ⁽¹⁾	Paper Tube	---		3/8 in. (9.5 mm) port	16A4601 X042
43 ⁽¹⁾	Web Sleeve	---		Design PQF w/o handjack	
44 ⁽¹⁾	Cage Puller, steel (not req'd for Design PQF)	15A2525 X012		1/4 in. (6.4 mm) port	16A4601 X052
45 ⁽¹⁾	Paper Label	---		3/8 in. (9.5 mm) port	16A4601 X072
46	Locknut, pl steel	15A7591 X012		w/handjack	
Note				1/4 in. (6.4 mm) port	16A4601 X062
Key numbers 47 through 51 are handjack parts.				3/8 in. (9.5 mm) port	16A4601 X082
47	Handjack Body, steel	16A1769 X012		Design PQ w/o handjack	
48	Pipe Plug or Handle, steel (2 req'd) Pipe Plug	1A5008 28992		1/4 in. (6.4 mm) port	16A4601 X092
	Handle	16A1768 X012		3/8 in. (9.5 mm) port	16A4601 X112
49	Stem nut, pl steel	16A1763 X012		1/2 in. (12.7 mm) port	16A4601 X132
50	Groove Pin, 316 stainless steel	1B5991 35072		w/handjack	
51	Thrust Washer, steel	16A1508 X012		1/4 in. (6.4 mm) port	16A4601 X102
52	Cage/Plug/Stem Assembly, austenitic stainless steel w/tungsten carbide seating surface (for 1 in. valve bodies only) (not shown)			3/8 in. (9.5 mm) port	16A4601 X122
	Design PQC w/o handjack			1/2 in. (12.7 mm) port	16A4601 X142
	1/4 in. (6.4 mm) port	16A4601 X012	53	Pipe Plug, pl steel (2 req'd) (for Design PQ w/tapped side connections only) (not shown)	1D7548 28982
	3/8 in. (9.5 mm) port	16A4601 X032			

*Recommended spare part.

1. May also be ordered from the Replacement Packing and Trim Assembly Part Numbers table.

5. This part is included in part number 35A1588 X0A2. Parts are omitted when handjack is used.

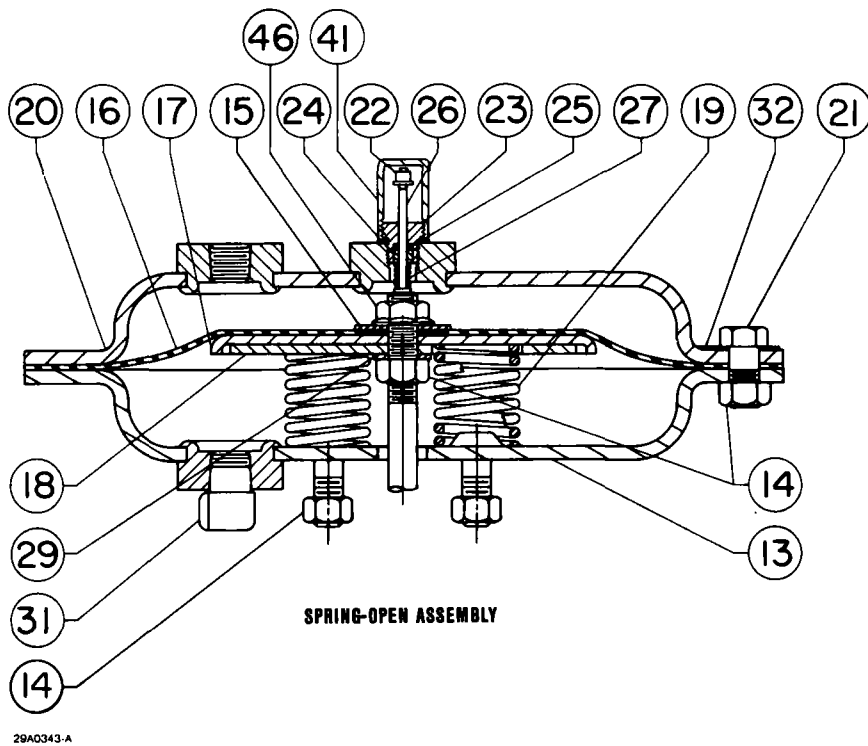
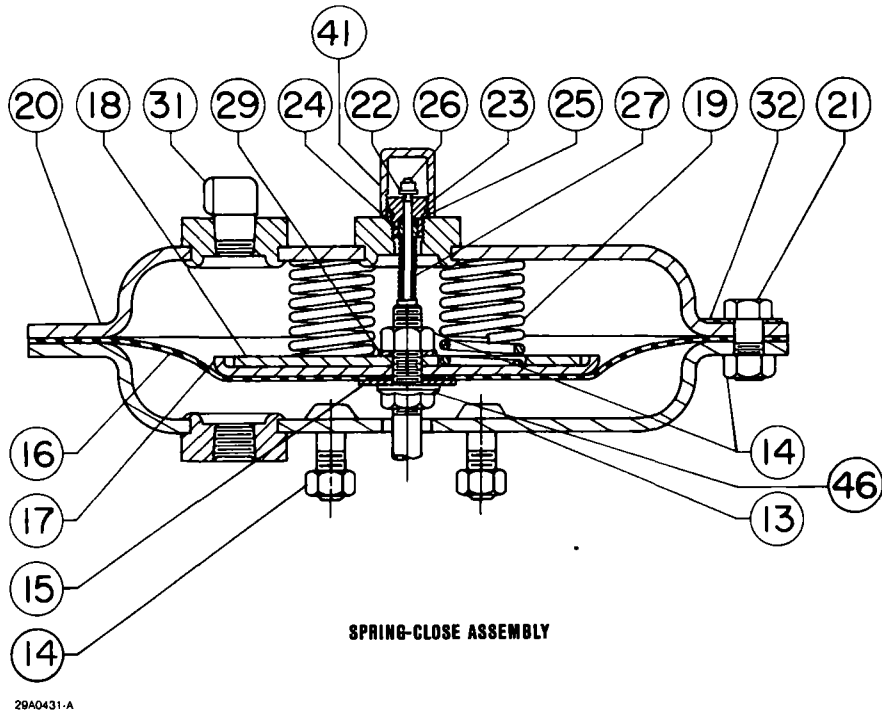
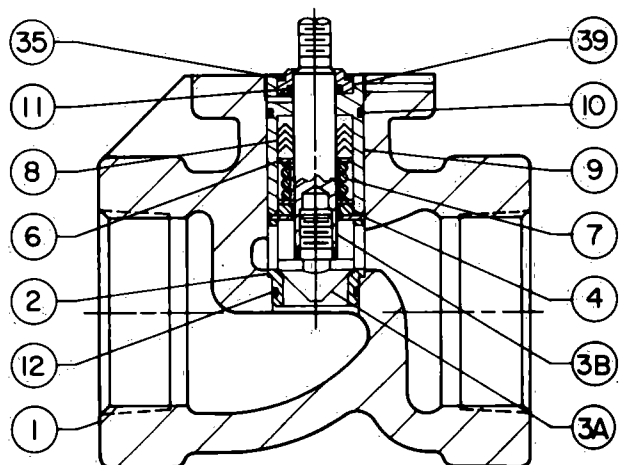
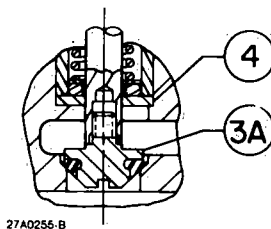


Figure 8. Type 128 Actuator



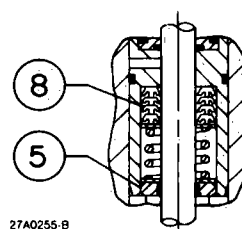
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**DESIGN PQ VALVE BODY WITH
METAL SEAT AND TFE V-RING PACKING**



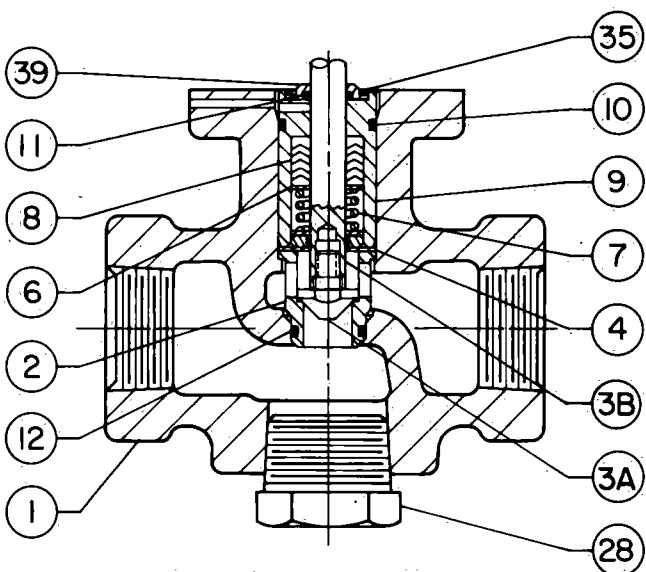
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**DESIGN PQC CAGELESS
SOFT-SEAT DETAIL**



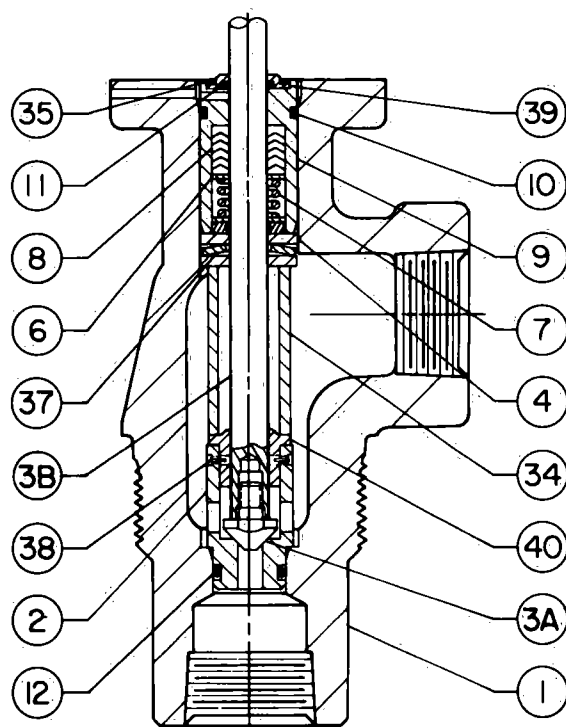
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**NITRILE/COTTON
PACKING DETAIL**



27A0255-B

**DESIGN PQC VALVE BODY WITH CAGE-STYLE
METAL SEAT AND TFE V-RING PACKING**



27A0257-B

**DESIGN PQF VALVE BODY
WITH TFE V-RING PACKING**

Figure 7. PQ Series Valve Bodies

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Fisher Controls

Instruction Manual

Type 1051 & 1052 Rotary Actuators, Size 30 & Larger


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May 1983

Form 5062

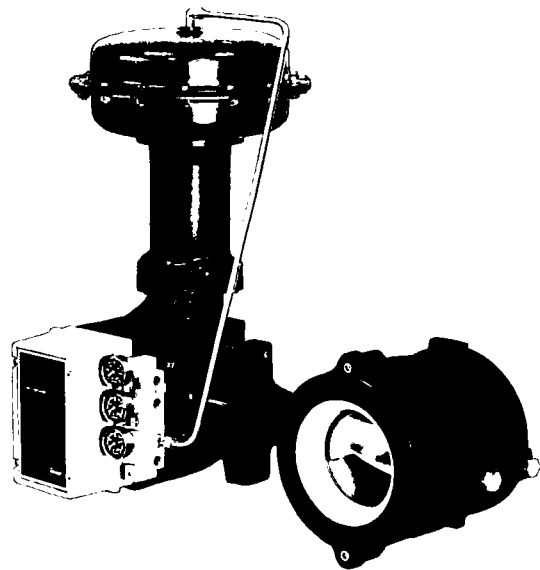
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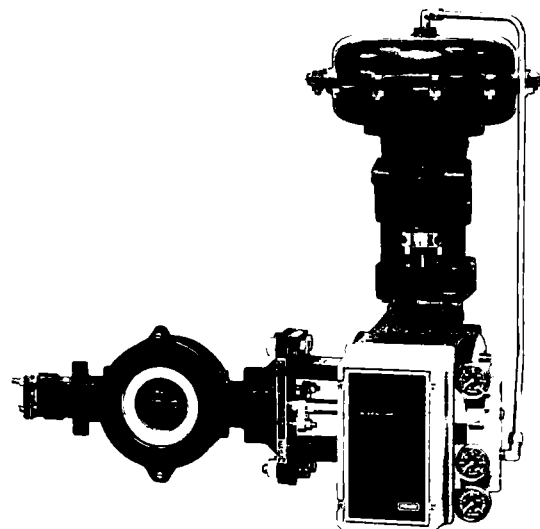
Introduction

Scope of Manual

This instruction manual includes installation, adjustment, operation, maintenance, and parts ordering information for the Type 1051 (sizes 30, 40, and 60) and Type 1052 (sizes 30, 40, 60, and 70) diaphragm rotary actuators (see figure 1), the optional top-mounted handwheel, and both



TYPE 1051 ACTUATOR WITH TYPE 3610J POSITIONER AND DESIGN V100 VEE-BALL® VALVE



TYPE 1052 ACTUATOR WITH TYPE 3610J POSITIONER AND TYPE 8510 Edisc® VALVE

Figure 1. Type 1051 and 1052 Actuators Mounted on Control Valves

Table 1. Type 1051 and 1052 Actuator Specifications

OPERATING PRINCIPLE	Action: Direct—Increasing loading pressure extends the diaphragm rod out of the spring barrel Service: ■ On-off without positioner, ■ throttling with positioner for Type 1051 actuators and throttling with or without positioner for Type 1052 actuator	Size 70: ■ 1-1/4 (31.8), ■ 1-1/2 (38.1), ■ 1-3/4 (44.5), or ■ 2 (50.8)
ACTUATOR SIZES	Type 1051: ■ 30, ■ 40, and ■ 60 Type 1052: ■ 30, ■ 40, ■ 60, and ■ 70 A size 20 actuator is available but is covered in a separate instruction manual.	STROKING TIME Dependent on actuator size, rotation, spring rate, initial spring compression, and supply pressure. If stroking time is critical, consult the Fisher sales office or sales representative
MAXIMUM DIAPHRAGM CASING PRESSURE	Size 30: 80 psig (5.5 bar) Size 40: 65 psig (4.5 bar) Size 60: 40 psig (2.8 bar) Size 70: 55 psig (3.8 bar)	MATERIAL TEMPERATURE CAPABILITIES Nitrile Diaphragm or O-Rings¹: -40 to 180°F (-40 to 82°C) Silicone Diaphragm: -40 to 300°F (-40 to 149°C)
MAXIMUM VALVE SHAFT ROTATION	■ 90, ■ 75, or ■ 60 deg with optional stops	TRAVEL INDICATION Graduated disk and pointer combination located on actuator end of valve shaft
ACCEPTABLE VALVE SHAFT DIAMETERS, IN. (mm)	Size 30: ■ 1/2 (12.7), ■ 5/8 (15.9), or ■ 3/4 (19.1) Size 40: ■ 1/2 (12.7), ■ 5/8 (15.9), ■ 3/4 (19.1), ■ 7/8 (22.2), ■ 1 (25.4), or ■ 1-1/4 (31.8) Size 60: ■ 3/4 (19.1), ■ 7/8 (22.2), ■ 1 (25.4), ■ 1-1/4 (31.8), ■ 1-1/2 (38.1), ■ 1-3/4 (44.5), or ■ 2 (50.8)	PRESSURE CONNECTIONS 1/4 in. NPT female
		MOUNTING POSITIONS See figures 3 and 4
		APPROXIMATE WEIGHTS See table 2
		ADDITIONAL SPECIFICATIONS For casing pressure ranges and for material identification of the parts, see the parts list

1. Nitrile O-rings are used in optional top-mounted handwheel, adjustable down travel stop, and adjustable up travel stop assemblies.

the optional up and down travel stops. The Type 1052, size 20 actuator is covered in a separate instruction manual. Instructions for the control valve body, the positioner, and accessories are also covered in separate manuals.

Description

The Type 1051 and 1052 diaphragm rotary actuators are pneumatic spring-return actuators for use with rotary-shaft control valves. The Type 1051 actuator can be used for on-off service, or it can be used for throttling service when equipped with a valve positioner. The Type 1052 actuator can be used for on-off service, or it can be used for throttling service when equipped with or without a valve positioner. The Type 1052 actuator spring is adjustable.

The top-mounted handwheel can be applied for infrequent service as a manual handwheel actuator with Type 1051 and 1052 actuators. Also, an adjustable up travel stop can be added to the actuator to limit its stroke in the upward direction, or an adjustable down travel stop can be added to limit actuator stroke in the downward direction.

Specifications

Specifications are shown in table 1 for Type 1051 and 1052 actuators. Specifications for a given Type 1051 or 1052 actuator as it originally comes from the factory are stamped on a nameplate (figure 2 and key 42, figures 7 and 8) attached to the actuator.

Table 2. Approximate Actuator Weights

SIZE	TYPE 1051				TYPE 1052				TOP-MOUNTED HANDWHEEL	
	Cast Iron Construction ¹		Aluminum Construction ²		Cast Iron Construction ¹		Aluminum Construction ²			
	Lb	Kg	Lb	Kg	Lb	Kg	Lb	Kg	Lb	Kg
30	65	29	55	25	59	27	58	26	11	5.0
40	94	43	86	39	99	45	90	41	16	7.3
60	197	89	175	79	203	92	180	82	24	11
70	---	---	---	---	272	123	252	114	47	21.3

1. Cast iron spring barrel and housing.
2. Sizes 30, 40, and 60—aluminum spring barrel, housing, and housing cover. Size 70—cast iron spring barrel and aluminum housing and housing cover.

Installation

When an actuator and valve body are shipped together, the actuator is normally mounted on the valve. Follow the valve body instructions when installing the control valve in the pipeline, and then perform the procedures presented in the Loading Connections portion of this Installation section. If the actuator is shipped separately or if it is necessary to mount the actuator on the valve, perform the procedures presented in the Actuator Mounting portion of this section.

WARNING

To avoid personal injury or property damage caused by bursting of pressure-retaining parts, be certain the diaphragm casing pressure does not exceed the diaphragm casing pressure limits listed in table 1. Use pressure-limiting or pressure-relieving devices to prevent the diaphragm casing pressure from exceeding these limits.

Actuator Mounting

Use the following steps to connect a valve body and an actuator that have been ordered separately. Key numbers refer to figure 7 for Type 1051 actuators and to figure 8 for Type 1052 actuators.

1. Unscrew cap screws and washers (keys 34 and 63), and remove cover (key 33).
2. Consult figures 3 and 4 for available mounting styles and positions. The actuator is normally positioned vertically with the valve in a horizontal pipeline.

Note

Due to its weight, the Type 1052 size 70 actuator must be externally supported if mounted in the horizontal position.

Figure 2. Nameplate Used on Type 1051 and 1052 Actuators

3. Slide the mounting yoke (key 22) over the valve shaft, and secure it to the valve with the valve mounting cap screws. For butterfly valves, use a bolting torque of 30 foot-pounds (41 newton•meters) for 1/2 through 1-inch (12.7 through 25.4 mm) diameter valve shafts and 100 foot-pounds (135 newton•meters) for 1-1/4 and 1-1/2 inch (31.8 and 38.1 mm) diameter valve shafts. For other valve types, refer to the appropriate valve body instruction manual for bolting torques for these cap screws.

CAUTION

Refer to table 3 for actuator bolt torque requirements. Exceeding any torque requirement may impair the safe operation of this actuator.

4. Screw the left-hand threaded locknut (key 58) onto the diaphragm rod (key 10) as far as possible.
5. Screw the turnbuckle (key 57) as far as it will go onto the actuator rod.
6. Screw the locknut (key 16) as far as it will go onto the rod end bearing (key 17). Thread this assembly completely into the turnbuckle (key 57).

Table 3. Recommended Bolting Torques

KEY NUMBER	ACTUATOR SIZE							
	30		40		60		70	
	Ft-Lb	N•m	Ft-Lb	N•m	Ft-Lb	N•m	Ft-Lb	N•m
6	15	20	15	20	15	20	15	20
7 & 8	30	41	30	41	30	41	75	102
9	25	34	25	34	75	102	75	102
16	10	14	25	34	45	61	75	102
18	16	22	60	81	120	163	200	271
21	7	9	7	9	16	22	50	68
23	25	34	25	34	60	81	60	81
28	25	34	60	81	120	163	200	271
34	25	34	25	34	60	81	60	81
40	7	9	7	9	7	9	7	9
54 (handwheel)	25	34	25	34	25	34	25	34
54 (down stop)	15	20	20	27	49	66	51	69
58	35	47	75	102	120	163	120	163
141	30	41	30	41	30	41	30	41

7. If the lever (key 27) is attached to the rod end bearing, remove the cap screw and hex nut (keys 18 and 19).

8. If the Type 1052 spring adjustment has been changed, complete the Initial Compression portion of the Adjustment section before proceeding.

9. Consult the appropriate valve body instruction manual for lever/valve shaft orientation marks, and slide the lever into place, see figure 5. Clamp with the cap screw (key 28).

10. Rotate the lever (key 27) to align with the rod end bearing (key 17). This connection can be aided by moving the actuator off its up travel stop with a regulated air source and adjusting the turnbuckle (key 57) slightly.

11. Apply Loctite¹ 271 or equivalent thread-locking compound (key 77) to the threads of the cap screw (key 18).

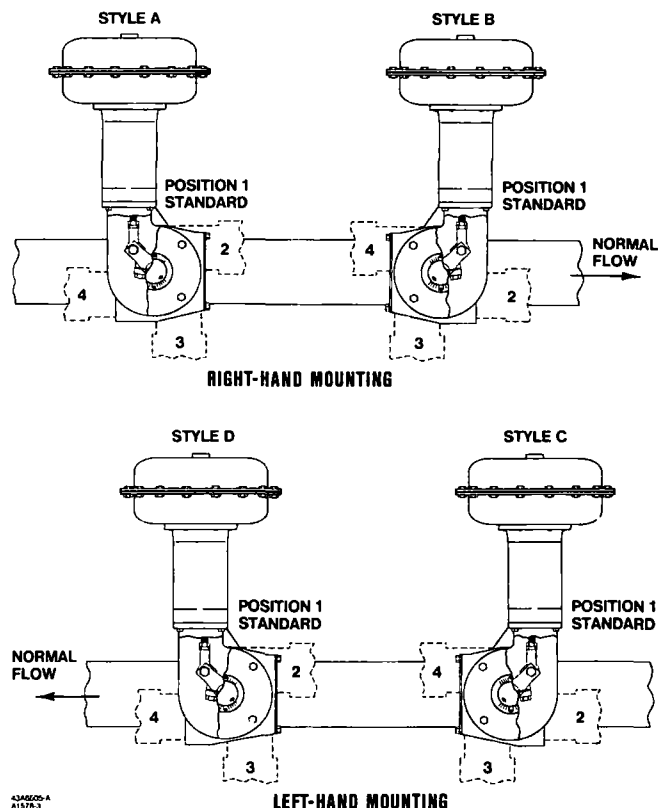
12. Connect the lever (key 27) and the rod end bearing (key 17) with the cap screw and hex nut (keys 18 and 19).

Note

Tighten the cap screw (key 18) to the recommended bolt torque shown in table 3.

13. Note the valve position and direction of rotation. Position the travel indicator (key 37) accordingly.

a. If no handwheel actuator is to be used, position travel indicator (key 37) according to the valve position just noted. Replace the cover (key 33), and secure with washers and cap screws (keys 34 and 63). If holes in the cover and housing (key 20) do not align, temporarily



MOUNTING	ACTION ¹	STYLE		
		Design V100	disc Valves	Butterfly Valves ²
Right-hand	PDTC	A	B	B
	PDTO	B	A	A
Left-hand	PDTC	C	C	C
	PDTO	D	D	D

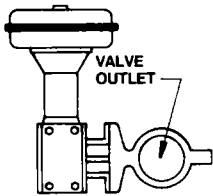
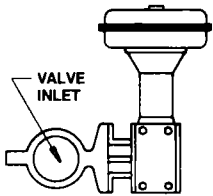
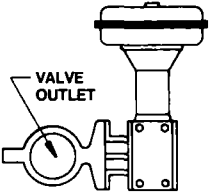
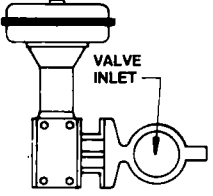
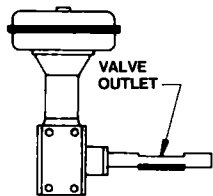
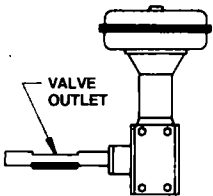
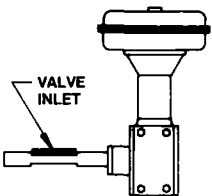
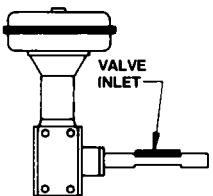
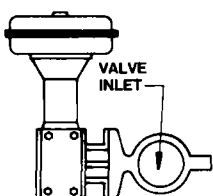
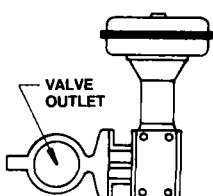
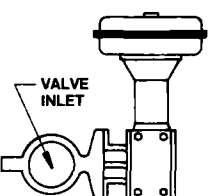
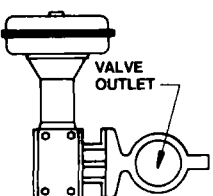
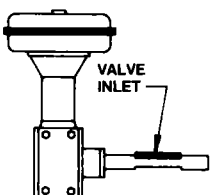
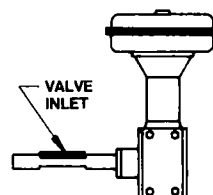
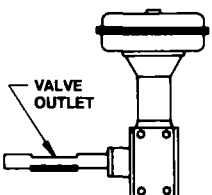
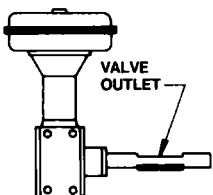
1. PDTC—Push-down-to-close; PDTO—Push-down-to-open.
2. 7600, 7800, and 9500 Series valves.

Figure 3. Mounting Styles and Positions for Type 1051 and 1052 Actuators

loosen cap screws (key 23), and shift the housing slightly. Do not stroke the actuator while the cover is off.

b. If a manual handwheel actuator is to be used, refer to the separate handwheel actuator instruction manual for mounting instructions.

14. Replace the cover (key 33), and secure with cap screws and washers (keys 34 and 63). If the holes in the cover and housing (key 20) do not align, use a regulated air source to move the actuator slightly off the up travel stop. If the hole alignment cannot be obtained in this manner, temporarily loosen the cap screws (key 23), and shift the housing slightly. Do not stroke the actuator while the cover is off.

MOUNTING POSITION	RIGHT-HAND MOUNTING		LEFT-HAND MOUNTING	
	STYLE A	STYLE B	STYLE C	STYLE D
	$\bar{a}disc = PDTO$ $V100 = PDTC$ BUTTERFLY VALVE = PDTO	$\bar{a}disc = PDTC$ $V100 = PDTO$ BUTTERFLY VALVE = PDTC	$\bar{a}disc = PDTC$ $V100 = PDTC$ BUTTERFLY VALVE = PDTC	$\bar{a}disc = PDTO$ $V100 = PDTO$ BUTTERFLY VALVE = PDTO
1				
2				
3				
4				

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Figure 4. Actuator-Valve Mounting

15. Follow the instructions given in the Adjustment section for correct actuator turnbuckle adjustment before proceeding to the Loading Connection portion of this section.

Loading Connection

1. Connect the loading pressure piping to the pressure connection in the top of the diaphragm casing.

For size 30 through 60 actuators, run either 1/4-inch pipe or 3/8-inch tubing between the 1/4-inch pressure connection and the instrument.

For size 70 actuators, run either pipe or tubing between the pressure connection and the instrument. If neces-

sary, remove the 1/4-inch bushing in the pressure connection to increase connection size.

2. Keep the length of pipe or tubing as short as possible to avoid transmission lag in the control signal. If an accessory (such as a volume booster or a valve positioner) is used, be sure that the accessory is properly connected to the actuator. If a valve positioner is part of the assembly, the pressure connection to the actuator will normally be made at the factory.

3. When the control valve is completely installed and connected to the instrument, check for correct action (air-to-open or air-to-close) to match the controlling instrument. For successful operation, the actuator stem and valve shaft must move freely in response to the loading pressure change on the diaphragm.

Types 1051 & 1052

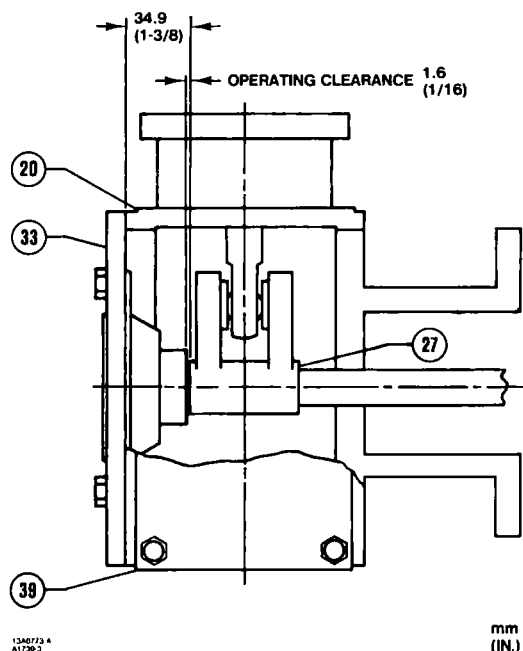


Figure 5. Lever Operating Clearance

Adjustment

WARNING

Avoid personal injury or damage to property from sudden release of process fluid. Before starting adjustment:

- Isolate the valve from the process,
- Release process pressure, and
- Vent the actuator loading pressure.

Type 1051 and 1052 Turnbuckle Adjustment

Correct turnbuckle adjustment ensures that the valve is correctly closed when the actuator is against its travel stops. The turnbuckle adjustment is the only adjustment necessary on the Type 1051 actuator. Key numbers used in this procedure are shown in figure 7 for Type 1051 actuators and in figure 8 for Type 1052 actuators.

For accurate adjustment to the zero-degree valve disk or ball position, remove valve from pipeline. Refer to the valve body instruction manual for instructions.

A regulated air supply will be required to stroke the actuator. Consult table 4 for the sizes of the three open-end wrenches required for this procedure.

Table 4. Wrench Sizes Required for Turnbuckle Adjustment, In.

ACTUATOR		TURN- BUCKLE (KEY 57)	LOWER LOCKNUT (KEY 16)	UPPER LOCKNUT (KEY 58)
Type	Size			
1051 & 1052	30	15/16	1/2	7/8
	40	1-1/8	3/4	1-1/8
	60	1-5/16	15/16	1-5/16
1052	70	1-5/16	1-1/8	1-5/16

1. Remove the access plate (key 59). Also remove the machine screws (key 60), if present.

Note

For the most accurate adjustment of the actuator, do not remove cover (key 33) during this procedure.

2. Loosen the lower locknut (key 16).

3. Make sure the actuator housing (key 20) is clear of any tools or other instruments that could obstruct the actuator stroke path. Pressure diaphragm casing enough to stroke the actuator down so that the left-hand threaded upper locknut (key 58) is accessible through the access opening. Loosen the locknut.

4. Use one of the following:

a. **Push-down-to-close**—Slowly stroke the actuator to the down travel stop. Consult the appropriate valve body instruction manual for determining the closed position of the valve. Adjust the turnbuckle (key 57) until the valve is in the closed position. Lock this adjustment with the left-hand threaded locknut (key 58). Stroke the actuator to the mid-travel position, and tighten the locknut (key 16).

b. **Push-down-to-open**—Consult the appropriate valve body instruction manual for determining the closed position. Release all pressure from the diaphragm casing, making sure the diaphragm is against its up travel stop. Be sure that the optional handwheel is adjusted to its topmost position so that the zero position of the actuator and valve can be reached simultaneously. Check the valve position. Stroke the actuator so the turnbuckle (key 57) is accessible through the access opening. Adjust the linkage. Release pressure to the actuator, and check the new adjustment. Continue this procedure until the valve is in the closed position when the actuator is resting on its up travel stop. Tighten locknut (key 16). Stroke the actuator, and tighten left-hand threaded locknut (key 58).

5. Replace the access plate (key 59).

6. Loosen the self-tapping screws (key 38), and adjust the travel indicator (key 37). Retighten the self-tapping screws.

Type 1052 Spring Adjustment

Initial Compression

The Type 1052 nameplate (figure 2) specifies a spring set, which is the initial compression adjusted into the actuator spring. Initial compression is the casing pressure at which the diaphragm and diaphragm rod begin to move away from the up travel stop with the actuator disconnected from the valve. (With the actuator connected to the valve and pressure applied to the valve, a higher pressure will be required to start actuator travel). The initial compression was selected (based upon the service conditions specified when the actuator was ordered) so that, when the actuator and valve are in service, the valve will seat properly and full travel will be obtained within a diaphragm casing range of 0 to 18, 0 to 33, 0 to 40, or 0 to 55 psig (0 to 1.2, 0 to 2.3, 0 to 2.8, or 0 to 3.8 bar) depending on specific actuator size and construction.

If the actuator has been disassembled or if the spring adjustment was changed, and it is desired to match the initial compression stated on the nameplate, make sure the rod end bearing (key 17, figure 8) has been disconnected from the lever (key 27, figure 8). Adjust the spring so that the diaphragm rod just starts to travel at the spring set pressure specified on the nameplate. Be sure the rod end bearing does not hit the lever as the diaphragm and diaphragm rod move away from the up travel stop. To adjust the spring, insert a round rod into one of the holes in the lower bearing seat (key 73, figure 8). Hole diameter is 3/8-inch (9.5 mm) for size 30 and 40 actuators, 5/8-inch (15.9 mm) for size 60 actuators, and 3/4-inch (19.1 mm) for size 70 actuators. Rotate the bearing seat to move it toward the casings (keys 1 and 2, figure 8) to increase initial compression or away from the casings to decrease initial compression.

Stroking Range

The initial spring set listed on the nameplate has been determined to be the optimum setting, and it is not recommended to make spring adjustments that will cause this value to change or be exceeded. For push-down-to-open valve action, the initial spring set is the maximum allowable to provide the maximum spring closing force. Any increase of this setting will overstress the spring at full travel. For push-down-to-close valve action, the initial spring set has been determined to be the optimum balance between the air to close and the spring to open breakout torque.

If the Type 1052 actuator is to be changed from one valve action to another (i.e., push-down-to-close to push-down-to-open); first, refer to the initial spring compression values listed in the parts list table (key 11) of this manual to determine the proper initial spring setting; then, adjust

the unit according to the procedures in the Initial Compression portion of the Type 1052 Spring Adjustment section.

Principle of Operation

The diaphragm rod moves down as loading pressure is increased on top of the diaphragm. As the loading pressure is decreased, the spring forces the diaphragm rod upward.

The spring and diaphragm have been selected to meet the requirements of the application and, in service, the actuator should produce full travel of the valve with the diaphragm pressure as indicated on the nameplate (shown in figure 2).

Consult the separate positioner instruction manual for actuator principle of operation with positioner.

Maintenance

Actuator parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions. Instructions are given below for adjustment, disassembly, and assembly of parts. Key numbers referenced in the following steps are shown in figure 7 for Type 1051 actuators and in figure 8 for Type 1052 actuators.

WARNING

Avoid personal injury or property damage from sudden release of pressure or uncontrolled process fluid. Before starting disassembly:

- Isolate the valve from the process,
- Release process pressure, and
- Vent the actuator loading pressure.

Disassembly

The following procedure describes how the actuator can be completely disassembled. When inspection or repairs are required, perform only those steps necessary to accomplish the procedure. Do not under ordinary circumstances remove the cap screws (keys 7, 8, and 21).

CAUTION

Cap screw (key 18) must be disengaged from the lever (key 27) before removing the diaphragm casing (key 1). Failure to do so will allow the spring precompression to rotate the valve beyond its fully open or closed position. This could cause damage to the valve seal.

1. Bypass the control valve. Relieve all loading pressure, and remove the tubing or pipe from the top of the actuator.
2. Remove the positioner, if one is used.
3. Unscrew the cap screws and washers (keys 34 and 63), and remove the cover (key 33).
4. Remove the retaining ring (key 30), and then remove the hub (key 29) from the cover.
5. Check the condition of the bushing (key 31). If replacement of the bushing is necessary, the travel indicator scale (key 35) must be removed by unscrewing the self-tapping screws (key 36).
6. Remove the cap screw and hex nut (keys 18 and 19).
7. Make note of the lever/valve shaft orientation, and then loosen the cap screw (key 28).

CAUTION

Do not use a hammer or similar tool to drive the lever (key 27) off the valve shaft. On some valve types, driving the lever could move the valve disk and bearings away from the centered position. This could cause damage to valve parts as the valve is being operated.

If necessary, use a wheel puller to remove the lever. It is permissible to tap the wheel puller screw lightly to loosen the lever, but hitting the screw with excessive force could also damage valve parts or disrupt the centered position of the valve disk and bearings.

8. Rotate the handwheel (if one is used) counter-clockwise until the handwheel is not compressing the spring (key 11).

WARNING

To avoid personal injury from precompressed spring force suddenly thrusting the upper diaphragm casing (key 1) away from the actuator, relieve Type 1052 spring compression, or carefully remove Type 1051 casing cap screws by following the instructions presented in the next two steps before proceeding further.

9. To relieve Type 1052 spring compression, insert a round rod into one of the holes in the lower bearing seat (key 73). Hole diameter is 3/8 inch (9.5 mm) for size 30 and 40 actuators, 5/8 inch (15.9 mm) for size 60 actuators, and 3/4 inch (19.1 mm) for size 70 actuators. Use the rod to rotate the lower bearing seat, and move it away from the actuator casings. Continue rotating the lower bearing seat until spring compression is completely removed.

10. Loosen, but do not remove, all casing cap screws (key 5). Make sure there is no spring force on the Type 1051 upper diaphragm casing. Unscrew and remove the cap screws and hex nuts (keys 5 and 6), and then remove the upper diaphragm casing and the diaphragm (key 3).

11. Proceed as appropriate:

For Type 1051 actuators,

- a. Read and follow the warning printed on the nameplate (key 56) located on the diaphragm plate (key 4).

- b. Pull the diaphragm plate (key 4) and attached parts out of the actuator. The spring (key 11), diaphragm rod (key 10), cap screw (key 9), spring seat (key 13), hex nut (key 58), turnbuckle (key 57), hex nut (key 16), and rod end bearing (key 17) will be attached to the diaphragm head.

WARNING

For Type 1051 actuators, the diaphragm plate (key 4) may be wedged against the diaphragm rod (key 10), thereby preventing the spring compression from being relieved as the cap screw (key 9) is loosened. Dislodge the diaphragm head from the diaphragm rod by loosening the cap screw (key 9) one full turn and tapping the underside of the diaphragm head until it follows the cap screw disassembly. Failure to check for this situation before removing the cap screw (key 9) could cause personal injury due to the sudden release of spring compression as the cap screw is disengaged.

c. Slowly remove the cap screw (key 9) while making sure that the diaphragm head is following the cap screw disassembly. Note that spring load will be zero before the cap screw is completely removed. Then separate the remaining parts of the assembly.

For Type 1052 actuators,

a. Remove the hex nut (key 16), the turnbuckle (key 57), and the hex nut (key 58) from the diaphragm rod (key 10).

b. Pull the diaphragm plate (key 4) and attached parts out of the actuator. Then remove the cap screw (key 9) to separate the diaphragm plate and the diaphragm rod.

c. Proceed as appropriate:

- For actuator designs without a set screw in the spring barrel (key 12), remove the actuator spring (key 11) from the actuator. If it is necessary to remove the adjuster (key 74) from the spring barrel during this procedure, heat the base of the adjuster to 350°F (177°C) long enough for the Loctite 271 thread-locking compound (key 77) to lose its holding strength. Then, unscrew the adjuster from the spring barrel. If the spring seat and the lower bearing seat (keys 13 and 73) are to be replaced, unscrew the lower bearing seat from the adjuster, and then remove the thrust bearing and the bearing races (keys 71 and 72) from the lower bearing seat.

- For actuator designs with a set screw (key 75), remove the actuator spring (key 11) from the actuator. If it is necessary to remove the spring adjustment parts, loosen the set screw (key 75), and unscrew the spring adjuster (key 74) from the spring barrel (key 12).

12. Unscrew the cap screws (key 23), and remove the actuator housing assembly (key 20).

13. Unbolt the mounting yoke (key 22) from the valve body.

14. Check the bushing (key 67) in the mounting yoke. Press out and replace the bushing if necessary.

Assembly

This procedure assumes that the actuator was completely disassembled. If the actuator was not completely disassembled, start these instructions at the appropriate step. Key numbers used are shown in figure 7 for Type 1051 actuators and in figure 8 for Type 1052 actuators.

1. If the Type 1052 spring barrel (key 12) was removed from the housing (key 20), align the spring barrel to the

housing as described below to ensure that the offset hole in the base of the spring barrel will be located properly.

For size 30 actuators, note the accessory mounting bosses on opposite sides of the spring barrel. Place the spring barrel on the housing with one of the spring barrel bosses on the same side as the boss located on the housing (see figure 8). Check to be sure that the threaded hole in the base of the spring barrel is offset toward the positioner, or toward the cover plate (key 39) if no positioner is used. The hole is offset 7/8-inch (22 mm) from the center of bolt circle of the four mounting holes in the base of the spring barrel. If the direction of offset is incorrect, rotate the spring barrel 180 degrees. Secure with the cap screws (key 21).

For Size 40 and 60 actuators, note that one of the accessory mounting bosses on the spring barrel is closer to the diaphragm end of the spring barrel. Place the spring barrel on the housing with the upper boss (the one closer to the diaphragm end) on the same side as the boss located on the housing (see figure 8). This will ensure proper positioning of the offset hole. Secure the spring barrel with cap screws (key 21).

For size 70 actuators, the spring barrel need not be aligned in any particular position when placing it on the housing.

Note

Replacement mounting yokes (key 22) for use with *ēdisc* and Design V100 valves are available only as assemblies that also include the bushing (key 67). However, replacement bushings are also available separately (see the parts list; keys 22 and 67).

2. If the bushing (key 67) was removed, press in the new bushing. The end of the bushing should be flush with the bottom of the recess in the mounting yoke (key 22).

3. Slide the mounting yoke (key 22) over the valve shaft, and secure it to the valve with the valve mounting cap screws. For butterfly valves, use a bolting torque of 30 foot-pounds (41 newton•meters) for 1/2 through 1-inch (12.7 through 25.4 mm) diameter valve shafts and 100 foot-pounds (135 newton•meters) for 1-1/4 and 1-1/2 inch (31.8 and 38.1 mm) diameter valve shafts. For other valve types, refer to the appropriate valve body instruction manual for bolting torques for these cap screws.

CAUTION

Refer to table 3 for bolting torques for actuator bolts and cap screws. Exceeding any torque requirement may impair the safe operation of the actuator.

4. Refer to figures 3 and 4 for the desired orientation of the housing (key 20). Secure the housing to the yoke with cap screws (key 23).

5. Proceed as appropriate:

For Type 1051 actuators,

a. Coat the thread of the cap screw (key 9) and the tapered end of the diaphragm rod (key 10) with Lubriplate¹ MAG-1 or equivalent lubricant.

b. Assemble the diaphragm rod, spring seat (key 13), spring (key 11), and diaphragm plate (key 4), and secure with the cap screw (key 9). Tightening the cap screw will compress the spring. Be certain the tapered end of the diaphragm rod is seated in the corresponding hole in the diaphragm plate, that the spring is seated in the spring seat, and that the cap screw is tightened to the torque specified in table 3.

c. Install the hex nut (key 58), turnbuckle (key 57), hex nut (key 16), and rod end bearing (key 17) onto the diaphragm rod.

d. Be certain the travel stops (key 8) are located as shown in figure 6.

e. Install the diaphragm plate and attached parts into the actuator.

f. Be sure the warning nameplate (key 56) is in place. Install the diaphragm (key 3) and the upper diaphragm casing (key 1). Install the cap screws and hex nuts (keys 5 and 6). Tighten the cap screws evenly in a crisscross pattern to compress the spring and secure the upper diaphragm casing.

For Type 1052 actuators,

a. Proceed as appropriate:

- For actuator designs without a set screw in the spring barrel (key 12), if the adjustor and attached parts were removed, first clean and then lubricate the upper threads of the adjustor (key 12) with Lubriplate MAG-1 or equivalent lubricant (key 76) as shown in figure 8. Install the lower bearing seat (key 73), the thrust bearing (key 71), the thrust bearing races (key 72), and the spring seat (key 13) onto the adjustor. Then, first clean and then coat the lower end of the adjustor with Loctite 271 or equivalent thread-locking compound (key 77) as shown in figure 8, and install the entire assembly into the spring barrel (key 12). Let the adjustor stand undisturbed for at least two hours after installation to allow the thread-locking compound to cure.

CAUTION

When applying lubricant to the upper threads and thread-locking compound to the lower threads of the adjustor, do not overlap the coat of lubricant with the coat of thread-locking compound since this will adversely affect the performance quality of both substances.

- For actuator designs with a set screw (key 75), if the adjustor (key 74) and attached parts were removed, lubricate the threads of the adjustor with Lubriplate MAG-1 or equivalent lubricant (key 76). Install the lower bearing seat (key 73), the thrust bearing (key 71), the thrust bearing races (key 72), and the spring seat (key 13) onto the adjustor. Install this assembly into the spring barrel (key 12). Secure the adjustor with the set screw (key 75).

b. Coat the tapered end of the diaphragm rod (key 10) and the threads of the cap screw (key 9) with Lubriplate MAG-1 or equivalent lubricant (key 76). Bolt the diaphragm plate to the diaphragm rod.

c. Be certain the travel stops (key 8) are located as shown in figure 6.

d. Install the spring (key 11) into the spring barrel. Install the diaphragm plate and diaphragm rod into the actuator. Attach the hex nut (key 58), turnbuckle (key 57), hex nut (key 16), and rod end bearing (key 17) to the diaphragm rod.

e. Install the diaphragm (key 3).

f. Place the upper diaphragm casing (key 1) on the lower diaphragm casing (key 2). If necessary, rotate the lower bearing seat (key 73) so that the upper diaphragm casing travel stop will not contact the diaphragm when the casing cap screws (key 5) are tightened. Secure the upper diaphragm casing with the cap screws and hex nuts (keys 5 and 6). Be sure the warning nameplate is in place on the casing.

6. For Type 1052 actuators, complete the Initial Compression portion of the Adjustment section before proceeding.

7. Consult the appropriate valve body instruction manual for lever/valve shaft orientation marks, and slide the lever (key 27) into place; see figure 5 for correct lever operating clearance. Clamp with the cap screw (key 28).

8. Rotate the lever (key 27) to align with the rod end bearing (key 17). This connection can be aided by stroking the actuator off its up travel stop with a regulated air source.

9. Apply Loctite 271 or equivalent thread-locking compound (key 77) to the threads of the cap screw (key 18).

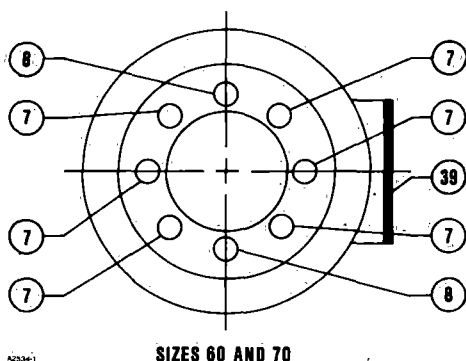
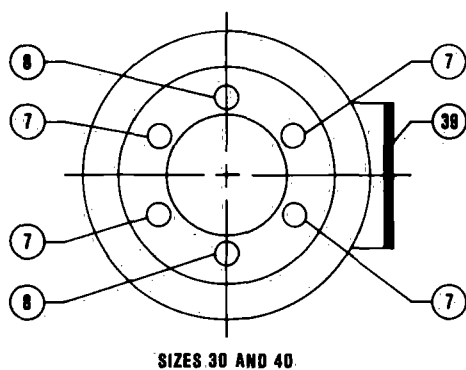


Figure 6. Travel Stop Orientation

10. Connect the lever (key 27) and the rod end bearing (key 17) with the cap screw and hex nut (keys 18 and 19). Tighten the cap screw to the torque recommended in table 3.

11. If a valve positioner is to be used, consult the separate valve positioner instruction manual for proper positioner installation.

12. Coat the bearing surfaces of the hub (key 29), and cover (key 33) with Lubriplate MAG-1 or equivalent lubricant (key 76). Install the bushing (key 31) and hub into the cover. Secure with the retaining ring (key 30).

13. Install the travel indicator scale (key 35), and secure it with the self-tapping screws (key 36). Then install the travel indicator (key 37), and secure it with the self-tapping screws (key 38).

14. Note the valve position and direction of rotation. Position the travel indicator (key 37) accordingly. Replace the cover (key 33), and secure with cap screws and washers (keys 34 and 63). If the holes in the cover and housing (key 20) do not align, use a regulated air source to move the actuator slightly off the up travel stop. If hole alignment cannot be obtained in this manner, temporarily loosen cap screws (key 23), and shift the housing slightly. Do not stroke the actuator while the cover is off.

15. Follow the instructions in the Adjustment section for correct actuator turnbuckle adjustment.

Changing Actuator Mounting

The actuator is normally positioned vertically in a horizontal pipeline. However, there are four possible mounting styles and four possible positions for each style. See figures 3 and 4.

Note

Due to its weight, the Type 1052, size 70 actuator must be externally supported if mounted in the horizontal position.

Correct lever/valve shaft positioning is important to ensure proper valve action. Consult the appropriate valve body instruction manual.

WARNING

Avoid personal injury or damage to property from sudden release of pressure or uncontrolled process fluid. Before starting disassembly:

- Isolate the valve from the process,
- Release process pressure, and
- Vent the actuator loading pressure.

Style A is right-hand mounted, while style D is left-hand mounted. In all other ways, the styles A and D are identical.

Style B is right-hand mounted, while style C is left-hand mounted. In all other ways, the styles B and C are identical.

Use the following procedure along with figures 7 and 8, for key number references, to convert from styles A and D to styles B and C or vice versa or to change the mounting position.

1. Remove the cover (key 33) by unscrewing and removing the cap screws and washers (keys 34 and 63).
2. Unscrew cap screw (key 18). Loosen cap screw (key 28).

CAUTION

When removing lever (key 27), do not use a hammer or similar tool to drive the lever off the valve shaft. Driving the lever could damage internal valve parts. On some valve types, driving the lever could move the valve disk and bearings away from the centered position, causing subsequent damage to valve parts as the valve is operated.

If necessary, use a wheel puller to remove the lever. It is permissible to tap the wheel puller screw lightly to loosen the lever, but hitting the screw with excessive force could also damage valve parts or disrupt the centered position of valve disk and bearings.

3. If changing styles,

a. Unscrew cap screws (key 23), and remove the actuator housing (key 20) from the mounting yoke (key 22).

b. Rotate the housing 180 degrees, maintaining the appropriate position (1, 2, 3, or 4), and place the actuator onto the mounting yoke (key 22).

4. If changing positions, unscrew cap screws (key 23), and rotate the actuator housing to the desired position.

Note

Consult table 3 for appropriate bolt torques.

5. Secure actuator housing (key 20) to the mounting yoke (key 22) with cap screws (key 23).

6. Consult the appropriate valve body instruction manual for lever/valve shaft orientation marks, and slide the lever (key 27) into place; see figure 5 for correct lever operating clearance. Clamp with the cap screw (key 28).

7. Rotate the lever (key 27) to align with the rod end bearing (key 17). This connection can be aided by stroking the actuator off its up travel stop with a regulated air source.

8. Apply Loctite 271 or equivalent thread-locking compound (key 77) to the threads of the cap screw (key 18).

9. Connect the lever (key 27) and the rod end bearing (key 17) with the cap screw and hex nut (keys 18 and 19). This connection can be aided by stroking the actuator from its up travel stop with a regulated air source.

Note

Tighten cap screw (key 18) to the recommended bolt torque shown in table 3.

10. Note the valve position and direction of rotation. Position the travel indicator (key 37) accordingly. Replace the cover (key 33), and secure it with cap screws and washers (keys 34 and 63). If the holes in the cover and housing (key 20) do not align, use a regulated air source to move the actuator slightly off the up travel stop. If hole alignment cannot be obtained in this manner, temporarily loosen cap screws (key 23), and shift the housing slightly. Do not stroke the actuator while the cover is off.

11. Follow the instructions given in the Adjustment section for correct actuator turnbuckle adjustment.

Top-Mounted Handwheels and Adjustable Travel Stops

Principle of Operation

Note

If repeated or daily manual operation is expected or desired, the unit should be equipped with a manual handwheel actuator. Refer to the separate manual handwheel actuator instruction manual for mounting instructions.

The top-mounted handwheel assembly is attached to a special upper diaphragm casing (key 1, figures 7 and 8) with cap screws (key 141, figure 9). A hex nut (key 137, figure 9) locks the handwheel in position.

Turning the handwheel (key 51, figure 9) clockwise into the upper diaphragm casing forces the pusher (key 135, figure 9) against the diaphragm and diaphragm plate (keys 3 and 4, figures 7 and 8) to compress the spring (key 11, figures 7 and 8) and move the diaphragm rod downward. Turning the handwheel counterclockwise allows the actuator spring to move the diaphragm rod upward. If the valve is push-down-to-close, full opening can be restricted by positioning the handwheel at the desired position. If the valve is push-down-to-open, full closing of the valve can be restricted by use of the handwheel.

The adjustable up travel stop (figure 10) limits the actuator stroke in the upward direction. To make adjustments, first relieve actuator loading pressure before removing the closing cap (key 187) as it is a pressure retaining part. Also, for size 70 actuators, the hex nut (key 137) must be loosened. Then turn the stem (key 133)

clockwise into the diaphragm case to move the actuator stem downward or counterclockwise to allow the spring to move the actuator stem upward. If the valve has push-down-to-close action, full opening can be restricted; or on a push-down-to-open valve, full closing can be restricted by the position of the adjustable travel stop. Tighten the hex nut (for size 70), and replace the closing cap after adjustment.

The adjustable down travel stop (figure 11) limits the actuator stroke in the downward direction. To make adjustments, first relieve actuator loading pressure before removing the closing cap (key 187) as it is a pressure retaining part. After removing the closing cap, loosen the hex jam nut (key 189) and either turn the hex nut (key 63 for size 30, 40, and 70 actuators; or key 54 for size 60 actuators) down on the stem (key 133) to limit travel, or up on the stem to allow more travel. Lock the jam nut against the hex nut, and replace the closing cap after the adjustment has been made.

Maintenance

WARNING

Avoid personal injury or damage to property from sudden release of pressure or uncontrolled process fluid. Before starting disassembly:

- Isolate the valve from the process,
- Release process pressure, and
- Vent the actuator loading pressure.

If loading pressure seems to be leaking from either the handwheel or adjustable up stop, the O-rings (key 138 and 139, figures 9 and 10) may need replacement. If the adjustable down stop leaks, the O-ring (key 139, figure 11) may need replacement or possibly the closing cap (key 187, figure 11) is not tight. To tighten the closing cap, apply a good grade of thread sealant to the closing cap threads.

For ease of operation, the stem (key 133, figures 9, 10, and 11) threads may need an occasional application of Lubriplate MAG-1 or equivalent lubricant. A grease fitting (key 169, figures 9 and 10) is provided for this purpose in the size 70. The size 70 may also need to have the thrust bearing (key 175, figures 9 and 10) packed with Lubriplate MAG-1 or equivalent. Travel stops for the smaller casings can be lubricated between the stem and pusher (key 135, figures 9 and 10) with Lubriplate MAG-1 or equivalent.

The following disassembly procedures are separated where appropriate between the top-mounted handwheel and adjustable up travel stop assemblies (figures 9 and 10) and the adjustable down travel stop assembly (figure 11).

1. Bypass the control valve, reduce loading pressure to atmospheric, and remove the tubing or pipe from the body (key 142, figures 9, 10, and 11).

WARNING

To avoid personal injury from the precompressed spring force thrusting the upper diaphragm casing (key 1, figures 7 and 8) away from the actuator, either relieve Type 1052 spring compression, or carefully remove Type 1051 casing cap screws by following the instructions that are referenced in the steps below before removing the casing.

2. Relieve all actuator spring compression by following the procedures presented in the disassembly portion of the actuator maintenance section. Then, rotate either the handwheel (key 51, figure 9) or the travel stop stem (key 133, figures 10 and 11) counterclockwise until the handwheel or travel stop assembly is no longer compressing the spring.

CAUTION

For Type 1051 actuators with *ed/disc* valves and push-down-to-open action, the cap screw (key 18, figure 7) should be disengaged from the lever (key 27, figure 7) before removing the diaphragm casing (key 1, figure 7) as specified in the following steps. Failure to do so will allow the spring precompression to rotate the valve beyond its closed position. This could cause damage to the valve seal.

3. Proceed as appropriate:

For Top-Mounted Handwheel and Adjustable Up Travel Stops.

- a. Remove the upper diaphragm casing (key 1, figures 7 and 8) by following steps 1, 3, 7, 9, 10, and 11 of the Disassembly portion of the Actuator maintenance section.
- b. Remove the cap screws (key 141, figures 9 and 10), and separate the assembly from the upper casing.
- c. Loosen the locknut (key 137, figure 9), or remove the closing cap (key 187, figure 10).
- d. Turn the stem (key 133, figures 9 and 10) clockwise out of the body. On handwheel assemblies, the hex nut and washer (keys 54 and 134, figure 9) will have to be removed so that the handwheel (key 51, figure 9) and locknut can be taken off the stem first.

Types 1051 & 1052

e. Remove and inspect the O-rings (keys 138 and 139, figures 9 and 10); replace them if necessary.

f. To complete disassembly for sizes 30, 40, and 60, drive out the groove pin (key 140, figures 9 and 10), and slide the pusher (key 135, figures 9 and 10) off the stem. The pusher of a size 70 unit is held to the stem by a retaining screw (key 174, figures 9 and 10). Removing the retaining screw and pusher exposes the thrust bearing (key 175, figures 9 and 10) for inspection.

For Adjustable Down Travel Stops.

Refer to figure 11 for appropriate key numbers unless otherwise stated.

a. Remove the closing cap (key 187), and unscrew the jam nut and hex nut (keys 189 and 63 for size 30, 40, and 70 actuators; or keys 189 and 54 for size 60 actuators) off the stem (key 133).

b. Remove the upper diaphragm casing (key 1, figures 7 and 8) and travel stop body (key 142) by following steps 1, 3, 7, 9, 10, and 11 of the Disassembly portion of the Actuator maintenance section.

c. Unscrew cap screws (key 141), and remove the body from the diaphragm case.

d. Check the condition of the O-ring (key 139), and replace it if necessary.

e. Loosen the hex nut (key 54), and then unscrew the travel stop stem (key 133) out of the actuator stem. The lower diaphragm plate (key 82) can now be removed and the rest of the actuator disassembled.

4. Reassemble in the reverse order of the disassembly steps being sure to apply lubricant as previously mentioned and as shown by the lubrication boxes (key 241) in figures 9 and 10. For size 70 handwheels or up travel stop assemblies, coat the threads of the retaining screws (key 174, figures 9 and 10) with Loctite 271 or equivalent thread-locking compound (key 242).

5. Readjust the spring to obtain the appropriate travel stop restriction by following the procedures presented in the introductory portion of this section, and then return the unit to operation.

Parts Ordering

When corresponding with your Fisher sales office or sales representative about this equipment, refer to the serial number found on the actuator nameplate (figure 2 and key 41, figures 7 and 8). Also, specify the complete 11-character part number from the following parts list when ordering replacement parts.

Parts List

Type 1051 & 1052 Actuators

Parts List			Key	Description	Part Number	Key	Description	Part Number
Type 1051 & 1052 Actuators			3*	Diaphragm		4	Diaphragm Plate, cast iron	
				W/ or w/o handwheel or w/adjustable up travel stop			Size 30	2F6493 19042
				Nitrile (standard)			Size 40	2V9399 19042
				Size 30	2E7919 02202		Size 60	20A1336 X012
				Size 40	2E6700 02202		Size 70	2N1270 19042
Key	Description	Part Number		Size 60	2E8597 02202	5	Cap Screw, pl steel	
			Size 70	2N1269 02202	Size 30 (12 req'd)		1A6751 24052	
1	Upper Diaphragm Casing, zn pl steel			Silicone			Size 40 (16 req'd)	1A6751 24052
	W/o handwheel			Size 30	2E7919 X0022		Size 60 (24 req'd)	1A6751 24052
	Size 30	2J7138 28992		Size 40	2E6700 X0012		Size 70 (28 req'd)	1A5828 24052
	Size 40	2L4418 28992		Size 60	2E8597 X0032	6	Hex Nut, zn pl steel	
	Size 60	30A0055 X012		Size 70	2N1269 X0012		Size 30 (12 req'd)	1A3465 24122
	Size 70	2N1266 28992		W/adjustable down travel stop			Size 40 (16 req'd)	1A3465 24122
	W/handwheel, w/adjustable up travel stop or w/adjustable down travel stop			Nitrile (standard)			Size 60 (24 req'd)	1A3465 24122
	Size 30	2E7922 25062		Size 30	2E8000 02202		Size 70 (28 req'd)	1A3465 24122
	Size 40	2E8063 25062		Size 40	2E6699 02202	7	Cap Screw, pl steel	
	Size 60	2E8474 25062		Size 60	2E8598 02202		Sizes 30 & 40	
Size 70	2N1310 25062		Size 70	2N1309 02202	(4 req'd)		1A3684 24052	
			Silicone		Size 60 (6 req'd)		1A3684 24052	
			Size 30	2E8000 X0022	Size 70 (10 req'd)		1N1293 28992	
2	Lower Diaphragm Casing, zn pl steel			Size 40	2E6699 X0042			
	Size 30	2E7922 25062		Size 60	2E8598 X0012			
	Size 40	2E8063 25062		Size 70	2N1309 X0012			
	Size 60	2E8474 25062						
	Size 70	2N1271 25062						

Types 1051 & 1052

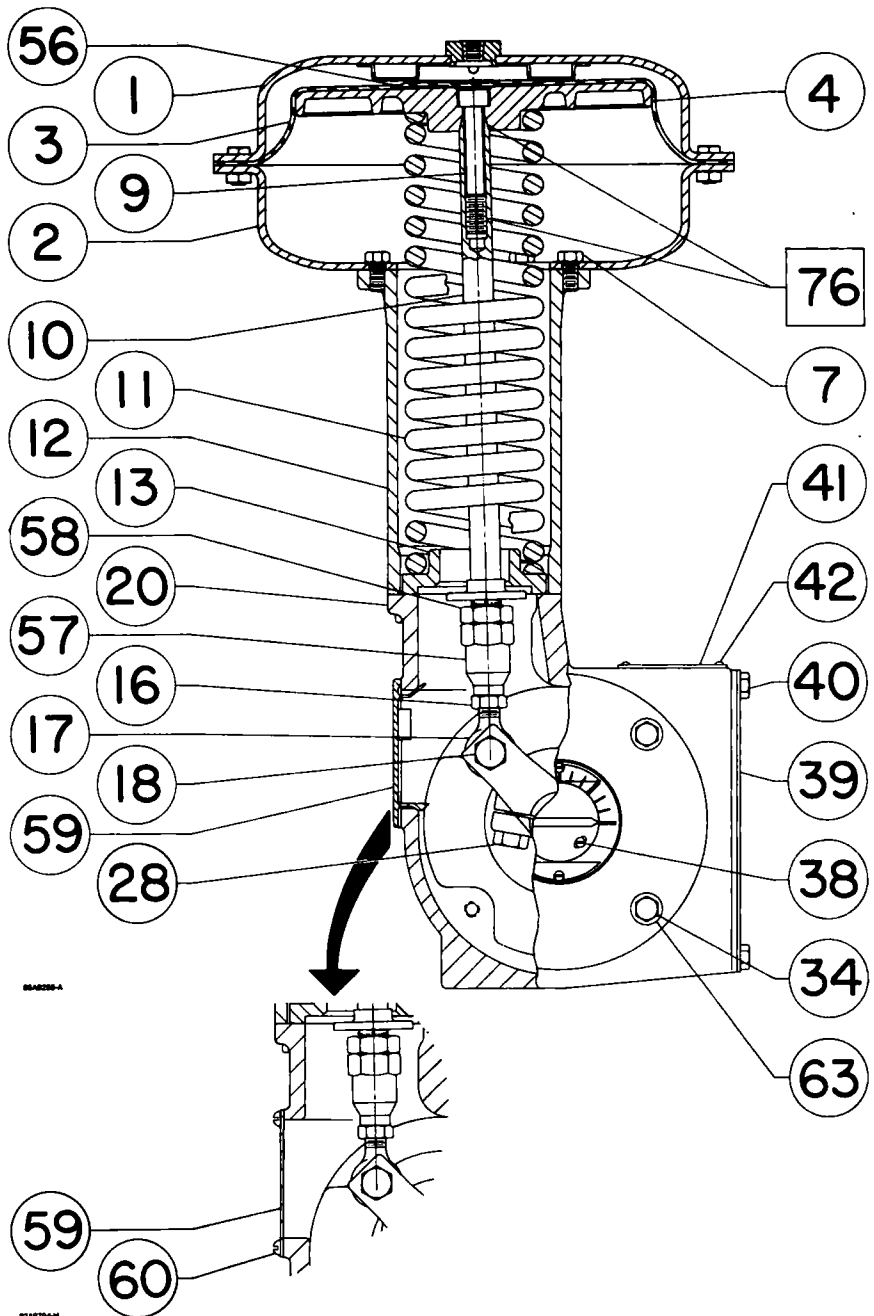
Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
8	Travel Stop, steel (2 req'd)		18	Cap Screw, pl steel		34	Cap Screw (Continued)	
	Size 30			Size 30	1A5534 24052		Two Switches (4 req'd)	
	60 degree rotation	1F5367 24092		Size 40	1A3615 24052		Sizes 30 & 40	1A7820 24052
	90 degree rotation	15A8382 X012		Size 60	12A9519 X012		Sizes 60 & 70	18A8737 X012
	Size 40			Size 70	12A9458 X012		Use w/Types 304 & 3552 (4 req'd)	
	60 degree rotation	1E8067 24092	19	Hex Nut, pl steel			Sizes 30 & 40	1C4038 24052
	90 degree rotation	1H5917 24092		Size 30	1A3527 24122		Sizes 60 & 70	1A4533 24052
	Size 60			Size 40	1A3412 24122		Use w/GO ³ - 713760 switch	
	60 rotation	16A6535 X012		Size 60	1A3433 24122		(3 req'd for one switch; 2 req'd for	
	75 degree rotation (Type 1052			Size 70	1A5993 24122		two switches)	
	only)	16A7829 X012	20	Housing			Sizes 30 & 40	1A3369 24052
	90 degree rotation	16A4120 X012		Aluminum			Sizes 60 & 70	1A3409 24052
	Size 70			Size 30			W/Type 1076 handwheel	
	60 degree rotation	16A9183 X012		Type 1051	46A0463 X022		Use w/o switches or w/Micro switches	
	75 degree rotation	16A5631 X012		Type 1052	42A9306 X062		BZE6-2RN, DTE6-2RN, OP-AR, OPD-	
	90 degree rotation	1P4066 24092		Size 40	42A9306 X062		AR, EX-AR & EXD-AR (4 req'd)	
9	Cap Screw, steel (not req'd w/adjustable			Sizes 60 & 70	42A9309 X062		Sizes 30 & 40	1A3369 24052
	down travel stop)			Cast iron			Sizes 60 & 70	1A3409 24052
	Type 1051			Size 30			Use w/NAMCO switches or w/Micro	
	Size 30	12A9459 X012		Type 1051	48A5247 X012		switches LSA & LSX	
	Size 40	12A9460 X012		Type 1052	48A5245 X012		One Switch	
	Size 60	12A9461 X012		Size 40	48A5245 X012		Sizes 30 & 40	
	Type 1052			Sizes 60 & 70	48A5246 X012		2 req'd	1A7820 24052
	Sizes 30 & 40	1E7604 32992	21	Cap Screw, pl steel (4 req'd)			2 req'd	1A3369 24052
	Sizes 60 & 70	1E7754 32982		Size 30			Sizes 60 & 70	
10	Diaphragm Rod, pl steel			(Type 1052 only)	1A3526 24052		2 req'd	1A3444 24052
	Type 1051			Size 40	1A3526 24052		2 req'd	1A3409 24052
	Size 30	12A9652 X042		Sizes 60 & 70	1A4186 24052		Two Switches (4 req'd)	
	Size 40	12A9652 X022	22	Mounting Yoke	See following table		Sizes 30 & 40	1A7820 24052
	Size 60	12A9652 X032					Sizes 60 & 70	1A3444 24052
	Type 1052		23	Cap Screw, pl steel (4 req'd)			Use w/GO-713760 switch	
	Size 30	25A6967 X012		Sizes 30 & 40	1A3369 24052		(3 req'd for one switch; 2 req'd for	
	Size 40	25A6968 X012		Sizes 60 & 70	1A3409 24052		two switches)	
	Size 60	25A6969 X012	27	Lever, ductile iron	See following table		Sizes 30 & 40	1A3369 24052
	Size 70	26A9173 X012	28	Cap Screw, pl steel			Sizes 60 & 70	1A3409 24052
11	Spring	See following tables		Size 30	1A3531 24052	34	Stud Post, zn pl steel (4 req'd) (not shown)	
12	Spring Barrel			Size 40	1A3409 24052		W/o handwheel	
	Type 1051			Size 60	12A9405 X012		Use w/Type 3555T only	
	Aluminum			Size 70	1A4302 24052		Sizes 30 & 40	12A9694 X012
	Size 40	32A9325 X012	29	Hub	See following table		Sizes 60 & 70	12A9697 X012
	Size 60	42A9327 X012				35	Travel Indicator Scale,	
	Cast iron						stainless steel	
	Size 40	32A9325 X022	30	Retaining Ring, zn pl steel			W/o handwheel	
	Size 60	42A9327 X022		Sizes 30 & 40	12A9409 X012		Use w/ or w/o switches or w/Type 3552	
	Type 1052			Sizes 60 & 70	12A9455 X012		Sizes 30 & 40	28A8533 X012
	Aluminum		31	Bushing, fiberglass			Sizes 60 & 70	28A8492 X012
	Size 30	37A6619 X022		Sizes 30 & 40	12A9373 X012		Use w/Type 3555T	12A9692 X012
	Size 40	48A2485 X022	33	Cover		36	Self Tapping Screw, steel	
	Size 60	48A2484 X022		Aluminum			(2 req'd)	1B5615 28982
	Cast iron			Sizes 30 & 40	32A9533 X012	37	Travel Indicator, stainless steel	
	Size 30	37A6619 X012		Sizes 60 & 70	32A9532 X012		W/o handwheel	
	Size 40	48A2485 X012		Cast iron			Use w/o switches or w/Type 3555T,	
	Size 60	48A2484 X012		Sizes 30 & 40	32A9311 X012		w/GO-713760 switch, w/Micro	
	Size 70	46A9171 X012		Sizes 60 & 70	32A9313 X012		switches LSA & LSX or w/NAMCO	
13	Spring Seat		34	Cap Screw, zn pl steel			limit switches	
	Type 1051, steel	See following table		W/o handwheel			Sizes 30 & 40	28A8534 X012
	Type 1052, zn pl steel			Use w/o switches or w/Micro			Sizes 60 & 70	28A8495 X012
	Size 30	18A2472 X012		Switches ¹ BZE6-2RN, DTE6-2RN,			Use w/Types 304 & 3552	
	Size 40	18A2483 X012		OP-AR, OPD-AR, EX-AR, & EXD-AR			Sizes 30 & 40	28A8489 X012
	Size 60	18A2477 X012		(4 req'd)			Sizes 60 & 70	28A8496 X012
	Size 70	16A9174 X012		Sizes 30 & 40	1A3369 24052		Use w/Micro Switches BZE6-2RN,	
16	Hex Nut, zn pl steel			Sizes 60 & 70	1A3409 24052		DTE6-2RN, OP-AR, OPD-AR, EX-AR,	
	Size 30	1A9463 24122		Use w/NAMCO ² limit switches or			& EXD-AR	
	Size 40	1A3537 24122		W/Micro Switches LSA or LSX			Sizes 30 & 40	28A8490 X012
	Size 60	1A3540 24122		One Switch			Sizes 60 & 70	28A8494 X012
	Size 70	1A3511 24122		Sizes 30 & 40				
17	Rod End Bearing, steel/TFE			2 req'd	1A7820 24052			
	Size 30	1R5802 99012		2 req'd	1A3369 24052			
	Size 40	1E5616 99012		Sizes 60 & 70				
	Size 60	1R4408 99012		2 req'd	18A8737 X012			
	Size 70	1R5876 99012		2 req'd	1A3409 24052			

1. Trademark of Micro Switch Co.

2. Trademark of NAMCO Controls/ACME-Cleveland.

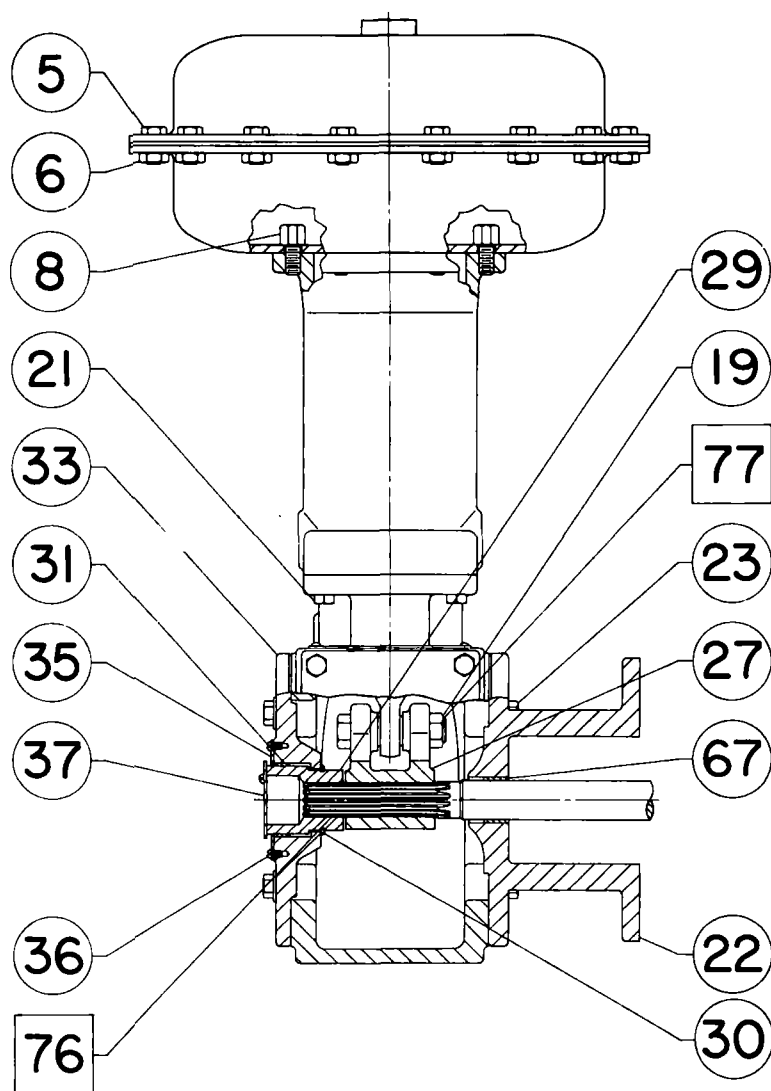
3. Trademark of General Equipment Co.

Key	Description	Part Number
38	Self-Tapping Screw, pl steel (2 req'd) W/o handwheel Use w/o switches or w/Type 3555T Use w/Types 304 & 3552 Use w/NAMCO limit switches & Micro switches LSA & LSX Use w/Micro switches OP-AR, OPD-AR, EX-AR, & EXD-AR Sizes 30 & 40 Sizes 60 & 70 Use w/Micro switches BZE6-2RN & DTE6-2RN Sizes 30 & 40 Sizes 60 & 70 Use w/GO-713760 switch	1B5615 28982 1B5613 X0012 1B2856 28982 1A5797 24052 1A3816 24052 1B2905 24052 1A3816 24052 17A8779 X012
38	Cap Screw, pl steel (2 req'd) Sizes 30 & 40 NAMCO limit switches Micro-Switches BZE6-2RN & DTE6-2RN OP-AR, OPD-AR, EX-AR, & EXD-AR Sizes 60 & 70 All switches	1A4078 24052 1B2905 24052 1A5797 24052 1A3816 24052
39	Cover Plate, steel (not req'd w/positioner)	22A9359 X012
40	Cap Screw, pl steel (4 req'd) (not req'd w/positioner)	1C2752 24052
41	Nameplate, stainless steel (specify manufacturing location, Marshalltown, Sherman, etc., from nameplate being replaced)	16A3188 X012
42	Drive Screw, stainless steel (4 req'd)	1A3682 28982
55	Vent Screen, Monel® (for aluminum constructions only) (not shown)	0L0783 43062
56	Warning Nameplate (not shown) Type 1051 Sizes 30 & 40 Size 60 Type 1052	12A9530 X012 12A9531 X012 15A6972 X012
57	Turnbuckle, zn pl steel Size 30 Size 40 Size 60 Size 70	12A9623 X012 22A9625 X012 22A9624 X012 22A9630 X012
58	Hex Nut, zn pl steel Size 30 Size 40 Sizes 60 & 70	12A9666 X012 12A9629 X012 1R4389 24122
59	Access Plate Steel (for aluminum constructions only) Polyester (for cast iron constructions only)	12A9638 X012 38A4712 X012
60	Machine Screw, pl steel (for aluminum constructions only) (4 req'd)	1A3408 28992



STEEL ACCESS PLATE (KEY 59) USED ON
ALUMINUM HOUSING CONSTRUCTIONS

Figure 7. Typical Type 1051 Actuator Assembly



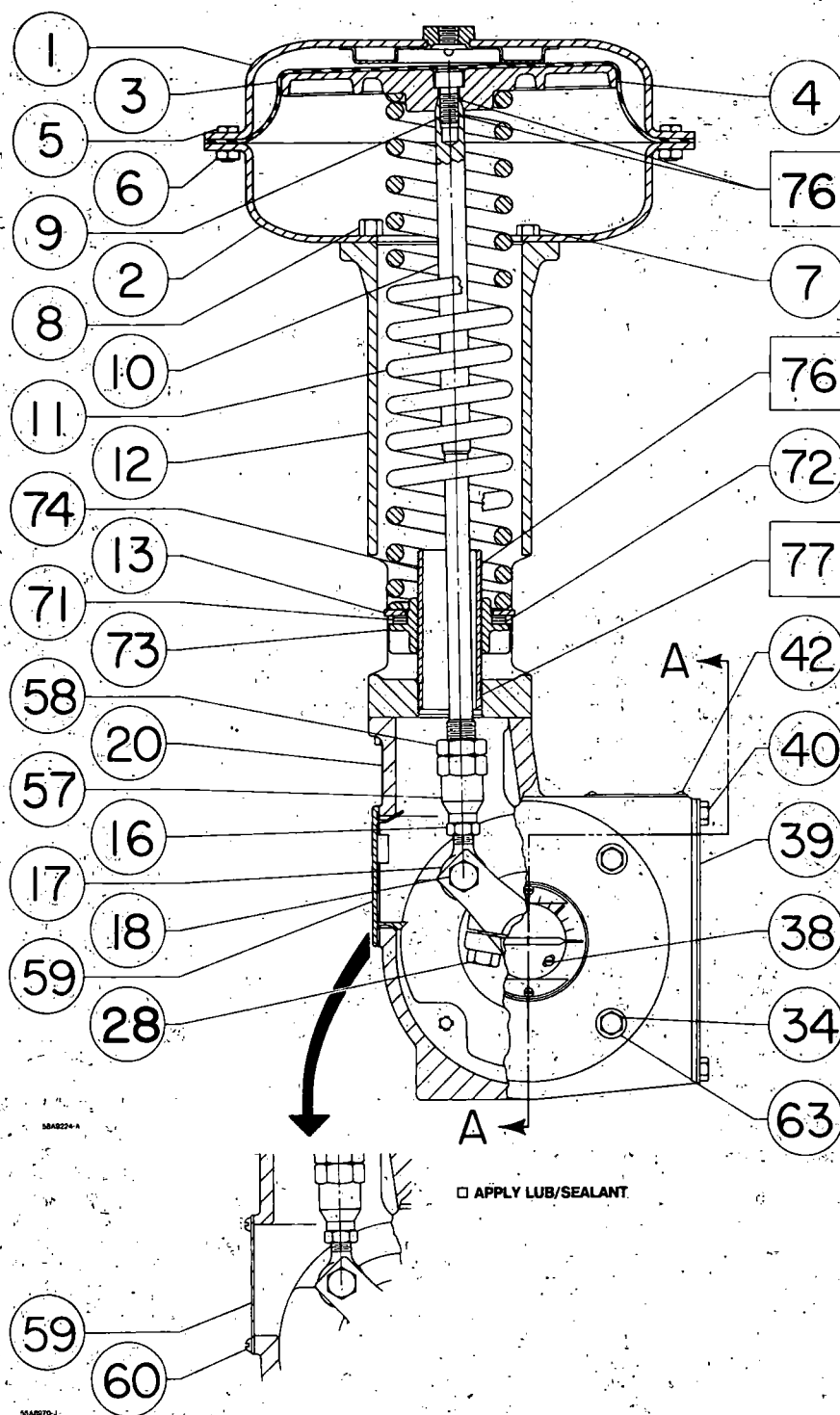
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□ APPLY LUB/SEALANT

NOTE: KEYS 12 AND 21 ARE NOT REQUIRED FOR SIZE 30 ACTUATORS

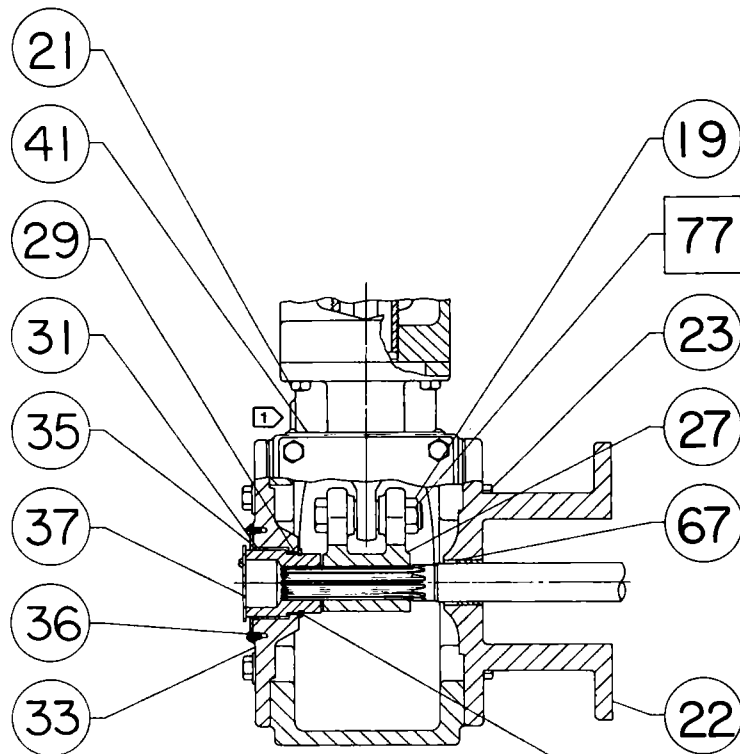
Figure 7. Typical Type 1051 Actuator Assembly (Continued)

Key	Description	Part Number
63	Washer, zn pl steel (4 req'd) Sizes 30 & 40 1H7231 25072 Sizes 60 & 70 1A5189 25072	
64	Travel Indicator, stainless steel (use w/Type 3555T only) (not shown) 12A9693 X012	
65	Machine Screw, pl steel (use w/Type 3555T only) (not shown) 1C8990 28982	
66	Travel Indicator Disc, steel (use w/Type 3555T only) (not shown) 22A9699 X012	
67	Bushing	See following table
71	Thrust Bearing, steel (for Type 1052 only) Sizes 30 & 40 10A4636 X012 Size 60 1N8887 99012 Size 70 16A9175 X012	
72	Bearing Race, steel (2 req'd) (for Type 1052 only) Sizes 30 & 40 10A4635 X012 Size 60 1N8888 99012 Size 70 16A9182 X012	
73	Lower Bearing Seat Type 1052 only Cast iron Size 30 18A2474 X012 Size 40 18A2482 X012 Size 60 18A2479 X012 Zn pl steel Size 70 16A9176 X012	
74	Adjuster (for Type 1052 only) Zn pl steel Size 30 18A2475 X012 Size 40 18A2480 X012 Size 60 18A2476 X012 Brass Size 70 26A9172 X012	
75	Set Screw, steel (for Type 1052 size 70 only) 1C3451 28992	
76	Lubriplate MAG-1 Lubricant, 14 oz (0.396 kg) can (not furnished with actuator) 1M1100 X0012	
77	Loctite 271 ⁵ Sealant, 10 cm ³ bottle (not furnished with actuator) 1M5933 X0012	
78	Cap Screw, pl steel (use w/Butterfly valves only) (not shown) 3/8 & 1/2 in. (9.5 & 12.7 mm) valve shaft diameter (2 req'd) 1A3418 24052 5/8 thru 1 in. (15.9 thru 25.4 mm) valve shaft diameter (4 req'd) 1A3418 24052 1-1/4 & 1-1/2 in. (31.8 & 38.1 mm) valve shaft diameter (4 req'd) 1A5444 24052	
82	Lower Diaphragm Head (use w/adj down stop only) (see figure 11) Sizes 30 & 40, zinc 1E6827 44022 Size 60, zinc 1E8455 44022 Size 70, steel 16A9181 X012	



STEEL ACCESS PLATE (KEY 59) USED ON ALUMINUM HOUSING CONSTRUCTIONS

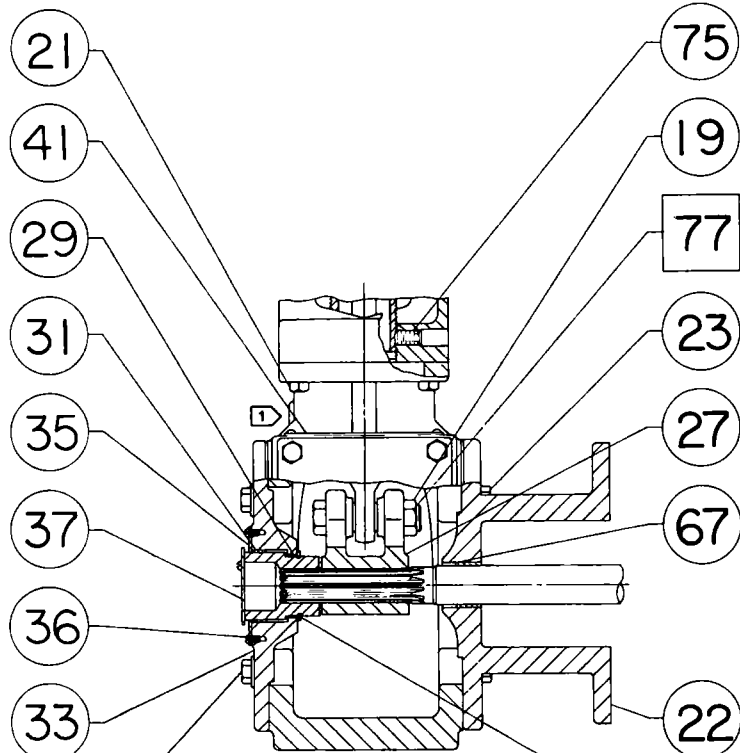
Figure 8. Typical Type 1052 Actuator Assembly



1 LOCATION OF BOSS ON HOUSING

56A322-A

SECTION A-A FOR SIZE 30, 40, AND 60 ACTUATORS



76

1 LOCATION OF BOSS (VENT) ON HOUSING

56A870-J

SECTION A-A FOR SIZE 70 ACTUATORS

C0638

Figure 8. Typical Type 1052 Actuator Assembly (Continued)

Types 1051 & 1052



Key 11 Spring¹, steel (for Type 1052 actuator only)

CASING PRESSURE		ACTUATOR SIZE	INITIAL SPRING COMPRESSION				KEY 11 SPRING PART NUMBER
			Push-down-to-open		Push-down-to-close		
Psig	Bar		Psig	Bar	Psig	Bar	
0-18	0-1.2	30	2.7	0.2	2.7	0.2	1F3616 27032
			3.1	0.2	3.0	0.2	1K5098 27032
			4.3	0.3	3.0	0.2	1N7515 27032
		40	3.0	0.2	3.0	0.2	1L2174 27042
			4.3	0.3	3.0	0.2	1P6371 27082
		60	3.7	0.3	3.0	0.2	1K1627 27082
		3.5	0.2	3.0	0.2	1N9373 27082	
0-33	0-2.3	30	4.3	0.3	4.2	0.3	1N7515 27032
			---	0.3	3.0	0.2	1F1770 27092
			3.9	0.3	3.0	0.2	1F1771 27092
			---	0.2	3.0	0.2	1F1772 27092
		40	4.3	0.3	4.3	0.3	1P6371 27082
			6.0	0.4	3.0	0.2	1L2173 27042
			4.4	0.3	3.0	0.2	1N8440 27082
		60	3.5	0.2	3.5	0.2	1N9373 27082
			7.0	0.5	3.0	0.2	1K1628 27082
			6.8	0.5	3.0	0.2	1P2702 27042
		70	10.1	0.7	3.0	0.2	1F6760 27082
		0-40	0-2.8	30	3.7	0.3	3.7
3.9	0.3				3.0	0.2	1F1771 27092
---	---				3.0	0.2	1F1772 27092
40	4.4			0.3	3.0	0.2	1N8440 27082
	6.0			0.4	3.0	0.2	1L2173 27042
60	6.8			0.5	3.0	0.2	1P2702 27042
	7.0			0.5	3.1	0.2	1K1628 27082
70	10.1			0.7	3.3	0.2	1R6760 27082
0-55	0-3.8	30	3.1	0.2	3.1	0.2	1F1772 27092
		40	4.4	0.3	3.5	0.2	1N8440 27082
		70	10.1	0.7	10.1	0.7	1R6760 27082
3-15	0.2-1.0	30	---	---	3.0	0.2	1K5098 27032
		40	---	---	3.0	0.2	1L2174 27042
		60	3.7	0.3	3.0	0.2	1K1627 27082
3-30	0.2-2.1	30	---	---	3.1	0.2	1F1770 27092
			---	---	3.0	0.2	1F1771 27092
			---	---	3.0	0.2	1F1772 27092
			4.3	0.3	4.2	0.3	1N7515 27032
		40	4.3	0.3	4.3	0.3	1P6371 27082
			6.0	0.4	3.0	0.2	1L2173 27042
			---	---	3.0	0.2	1N8440 27082
		60	3.5	0.2	3.5	0.2	1N9373 27082
			7.0	0.5	3.0	0.2	1K1628 27082
			---	---	3.0	0.2	1P2702 27042
		70	10.1	0.7	3.0	0.2	1R6760 27082

1. For more detailed ordering information concerning proper spring selection to obtain the torque required by the valve, consult your Fisher sales office or sales representative.

Key 11 Spring¹, steel (for Type 1051 actuator only)Key 13 Spring Seat¹, steel (for Type 1051 actuator only)

CASING PRESSURE		ACTUATOR SIZE	KEY 11 SPRING	KEY 13 SPRING SEAT
Psig	Bar		PART NUMBER	PART NUMBER
0-18	0-1.2	30	1K5098 27032 1F3616 27032	12A9445 X012 12A9445 X012
		40	1L2174 27042	12A9447 X012
		60	1K1627 27082 1N9373 27082 1N9373 27082	12A9450 X012 12A9448 X012 12A9449 X012
0-33	0-2.3	30	1N7515 27032	12A9445 X012
		40	1L2173 27042 1P6371 27082	12A9446 X012 12A9447 X012
		60	1K1628 27082 1K1628 27082 1N9373 27082 1N9373 27082	12A9448 X012 12A9449 X012 12A9448 X012 12A9449 X012
0-40	0-2.8	40	1L2173 27042	12A9446 X012
		60	1K1628 27082 1K1628 27082	12A9448 X012 12A9449 X012
0-55	0-3.8	40	1L2173 27042	12A9446 X012
3-15	0.2-1.0	60	1K1627 27082	12A9450 X012
3-30	0.2-2.1	30	1N7515 27032	12A9445 X012
		40	1L2173 27042 1P6371 27082	12A9446 X012 12A9447 X012
		60	1K1628 27082 1N9373 27082	12A9449 X012 12A9449 X012

1. For more detailed ordering information concerning proper spring and spring seat selection to obtain the torque required by the valve, contact your Fisher sales office or sales representative.

Keys 22 and 67 Mounting Yoke¹ Parts

VALVE DESIGN	ACTUATOR SIZE	VALVE SHAFT DIAMETER		KEY 22 YOKE- BUSHING ASSEMBLY CAST IRON & TFE	KEY 22 YOKE, CAST IRON	KEY 67 BUSHING, TFE
		In.	mm			
ēdisc®, V100, & 7800 (2-12 in.)	30 & 40	1/2	12.7	12A9799 X0A2	---	1U9025 99402
		5/8	15.9	12A9799 X0B2	---	12A9555 X012
		3/4	19.1	12A9799 X0C2	---	12A9556 X012
	40	7/8	22.2	12A9799 X0E2	---	12A9557 X012
		1	25.4	12A9799 X0G2	---	12A9775 X012
		1-1/4	31.8	12A9799 X112	---	12A9558 X012
	60	3/4	19.1	12A9799 X0D2	---	12A9556 X012
		7/8	22.2	12A9799 X0F2	---	12A9557 X012
		1	25.4	12A9799 X0H2	---	12A9775 X012
	60 & 70	1-1/4	31.8	12A9799 X0J2	---	12A9558 X012
		1-1/2	38.1	12A9799 X0K2	---	12A9559 X012
		1-3/4	44.5	12A9799 X0L2	---	10A3848 X012
2		50.8	12A9799 X0M2	---	12A9715 X012	
7600, 7800 (14-36 in.), & 9500	30 & 40	1/2	12.7	---	32A9755 X012	1U9025 99402
		5/8	15.9	---	32A9742 X012	12A9555 X012
		3/4	19.1	---	32A9743 X012	12A9556 X012
	40	1	25.4	---	32A9757 X012	12A9775 X012
		1-1/4	31.8	---	32A9746 X012	12A9558 X012
	60	3/4	19.1	---	32A9750 X012	12A9556 X012
		1	25.4	---	32A9778 X012	12A9775 X012
	60 & 70	1-1/4	31.8	---	32A9753 X012	12A9558 X012
		1-1/2	38.1	---	32A9754 X012	12A9559 X012
		1-3/4	44.5	---	35A9704 X012	12A9560 X012
		2	50.8	---	35A9705 X012	12A9561 X012

1. Yokes for use with edisc® and Design V100 valves are available only as yoke-bushing assemblies; however, the bushing is also available as a replacement part.

Types 1051 & 1052

Key 27 Lever, ductile iron

ACTUATOR SIZE	SHAFT DIAMETER		PART NUMBER
	In.	mm	
30	1/2	12.7	32A9578 X012
	5/8	15.9	32A9579 X012
	3/4	19.1	32A9672 X012
40	1/2	12.7	32A9567 X012
	5/8	15.9	32A9568 X012
	3/4	19.1	32A9569 X012
	7/8 & 1	22.2 & 25.4	32A9570 X012
	1-1/4	31.8	32A9571 X012
60	3/4	19.1	32A9589 X012
	7/8 & 1	22.2 & 25.4	32A9590 X012
	1-1/4	31.8	32A9591 X012
	1-1/2	38.1	32A9592 X012
	1-3/4 & 2	44.5 & 50.8	34A5322 X012
70	1-1/4	31.8	32A9575 X012
	1-1/2	38.1	32A9576 X012
	1-3/4 & 2	44.5 & 50.8	32A9679 X012

Key 29 Hub, aluminum or 416 stainless steel (depending on manufacturing location)

ACTUATOR SIZE	VALVE SHAFT DIAMETER		STANDARD OR W/TYPES 304 & 3552 OR W/GO-713760 SWITCH	W/TYPE 3555T, NAMCO LIMIT SWITCHES, & MICRO SWITCHES LSA & LSX	W/MICRO SWITCHES ¹
	In.	mm			
30 & 40	1/2	12.7	22A9496 X012	22A9706 X012	24A3380 X012
	5/8	15.9	22A9419 X012	22A9701 X012	24A3211 X012
	3/4	19.1	22A9497 X012	22A9704 X012	24A2188 X012
40	7/8 & 1	22.2 & 25.4	22A9486 X012	22A9705 X012	24A3245 X012
	1-1/4	31.8	22A9498 X012	22A9703 X012	---
60 & 70	3/4	19.1	22A9499 X012	22A9708 X012	23A7813 X012
	7/8 & 1	22.2 & 25.4	22A9420 X012	22A9710 X012	22A9633 X012
	1-1/4	31.8	22A9500 X012	22A9709 X012	22A9547 X012
	1-1/2	38.1	22A9501 X012	22A9707 X012	22A9550 X012
	1-3/4 & 2	44.5 & 50.4	24A6358 X012	25A1600 X012	---

1. Does not include Micro Switches LSA & LSX.

Top-Mounted Handwheels

Key	Description	Part Number	Key	Description	Part Number
51	Handwheel, cast iron		142	Body, cast iron	
	Size 30	1F1181 19042		Size 30	37A9443 X012
	Size 40	16A0956 X012		Size 40	2N1687 19012
	Size 60			Size 60	2K9494 19012
	Push-down-to-close valve	38A2309 X012		Size 70	37A9662 X012
	Push-down-to-open valve	38A2310 X012	164	Body Extension, steel	
	Size 70	2A1937 19042		Size 40	17A9658 X012
54	Hex Nut, pl steel			Size 60	17A9657 X012
	Sizes, 30, 40, & 60	1A3537 24122	169	Grease Fitting, steel (for size 70 only)	1L8478 28992
	Size 70	1A3540 24122			
133	Stem, bronze		171	Spacer, 416 stainless steel (for size 60 only)	10A0057 X012
	Size 30	27A9645 X012	174	Retaining Screw, steel (for size 70 only)	1R6797 24092
	Size 40	27A9643 X012	175	Thrust Bearing, steel (for size 70 only)	1N8380 99012
	Size 60	27A9642 X012	176	Thrust Race, steel (for size 70 only)	1N8381 99012
	Size 70	27A9664 X012			
134	Washer, pl steel		241	Lubriplate, MAG-1 Lubricant, 14 oz (0.396 kg) can (not furnished with actuator)	1M1100 X0012
	Sizes 30, 40, & 60	1A5189 25072	242	Loctite No. 271 Sealant, 10 cm ³ bottle (not furnished with actuator)	1M5933 X0012
	Size 70	1A3539 28992			
135	Pusher				
	Sizes 30 & 40, pl steel	1F1179 99012			
	Size 60, pl steel	1F1183 99012			
	Size 70, cast iron	1R6796 19022			
137	Hex Nut, zn pl steel				
	Sizes 30, 40, & 60	18A2300 X012			
	Size 70	18A2301 X022			
138*	O-Ring, nitrile				
	Sizes 30 & 40	1D2375 06992			
	Size 60	1B8855 06992			
	Size 70	1C4157 06992			
139*	O-Ring, nitrile				
	Sizes 30 & 40	1D2673 06992			
	Size 60	1D5471 06992			
	Size 70	1D2691 06992			
140	Groove Pin				
	Sizes 30 & 40, steel	1F1180 28992			
	Size 60, stainless steel	1B6270 35072			
141	Cap Screw, pl steel				
	Sizes 30 & 40 (6 req'd)	1A3684 24052			
	Size 60 (8 req'd)	1A3684 24052			
	Size 70 (12 req'd)	1N1293 28992			

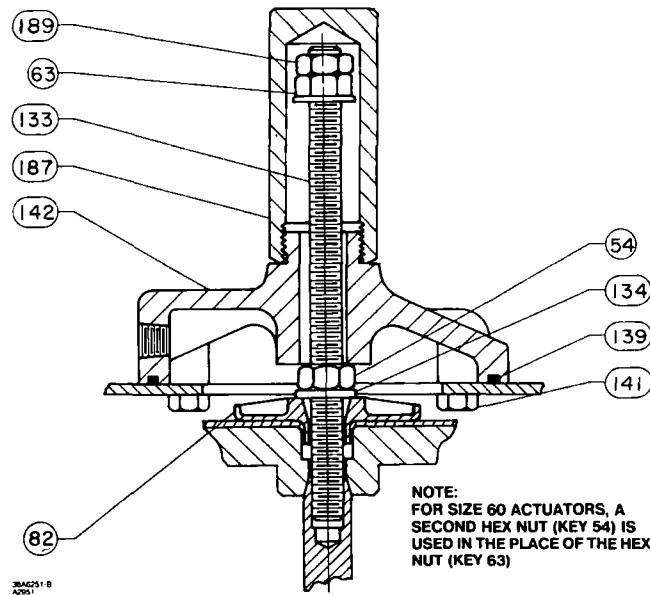
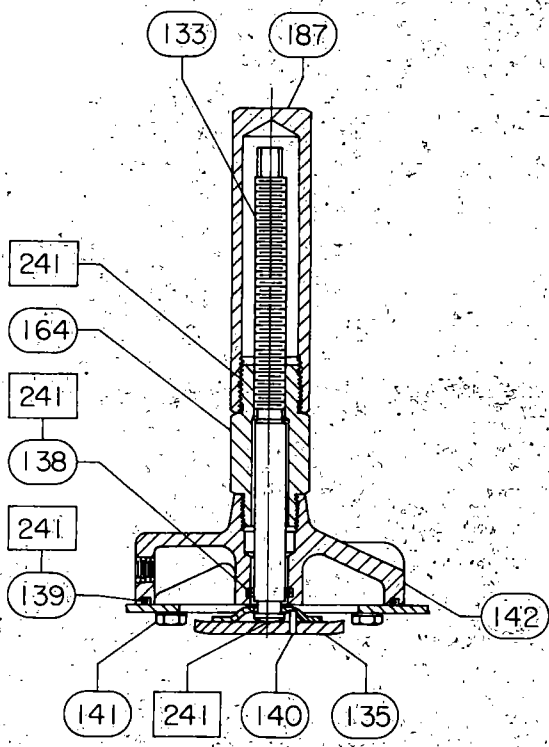


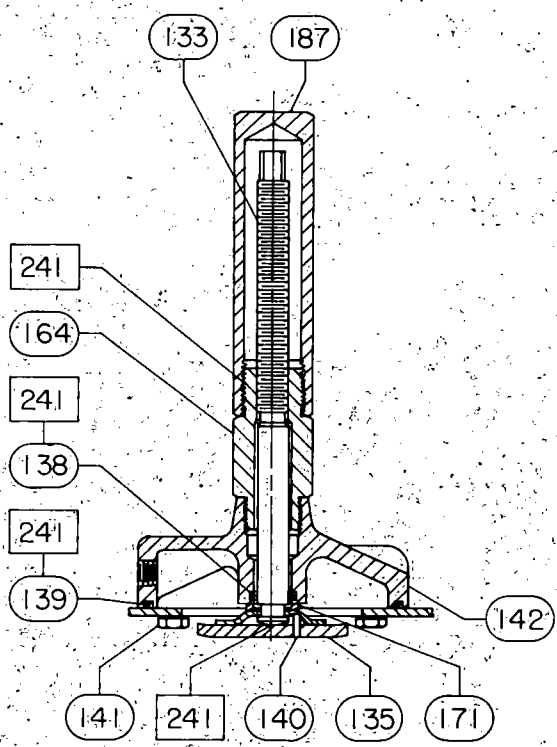
Figure 11. Adjustable Down Travel Stop

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
Adjustable Down Travel Stop			133	Stem, stainless steel		141	Cap Screw, pl steel	
				Type 1051			Sizes 30, 40, & 60	
				Size 30	17A1803 X012		(6 req'd)	1A3684 24052
				Size 40	17A1804 X012		Size 70 (12 req'd)	1N1293 28992
				Size 60	17A1805 X012	142	Body, cast iron	
54	Hex Nut, pl steel			Type 1052			Sizes 30 & 40	36A6248 X012
	Type 1051			Size 30	16A6247 X012		Size 60	36A6249 X012
	Sizes 30 & 40			Size 40	16A6692 X012		Size 70	36A9177 X012
	(1 req'd)	1A3412 24122		Size 60	16A6693 X012	187	Closing Cap, brass	
	Size 60 (2 req'd)	1A3681 24122		Size 70	16A9180 X012		Size 30	1P7254 14012
	Type 1052		134	Lockwasher, pl steel			Size 40	1P8608 14012
	Sizes 30 & 40			Sizes 30 & 40	16A1352 X012		Size 60	1U2905 14012
	(1 req'd)	1A4132 24122		Size 60	15A7932 X012		Size 70	26A9179 X012
	Size 60 (2 req'd)	1A3754 24122		Size 70	1E8336 28992	189	Jam Nut, pl steel	
	Size 70 (1 req'd)	1A3511 24122	139*	O-Ring, nitrile			Type 1051	
63	Hex Nut, pl steel			Sizes 30 & 40	1D2673 06992		Sizes 30 & 40	1A3524 24122
	Type 1051			Size 60	1D5471 06992		Size 60	1A5993 24122
	Sizes 30 & 40 only	15A9617 X012		Size 70	1D2691 06992		Type 1052	
	Type 1052						Sizes 30 & 40	1A3537 24122
	Sizes 30, 40, & 60	16A6715 X012					Sizes 60 & 70	1A3511 24122
	Size 70	16A9178 X012						



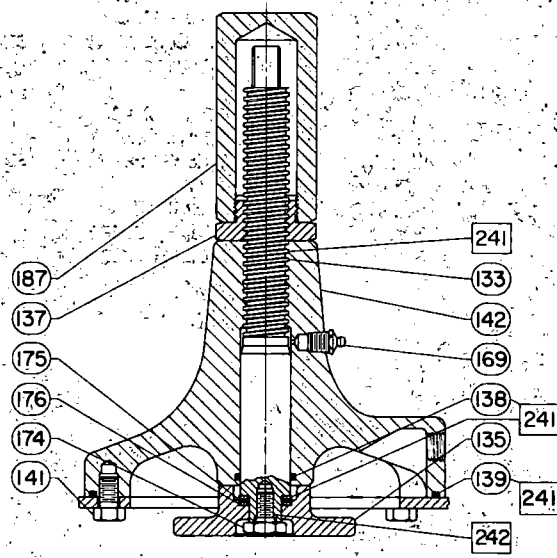
APPLY LUB

ADJUSTABLE UP TRAVEL STOP FOR
SIZE 30 AND 40 ACTUATORS



APPLY LUB

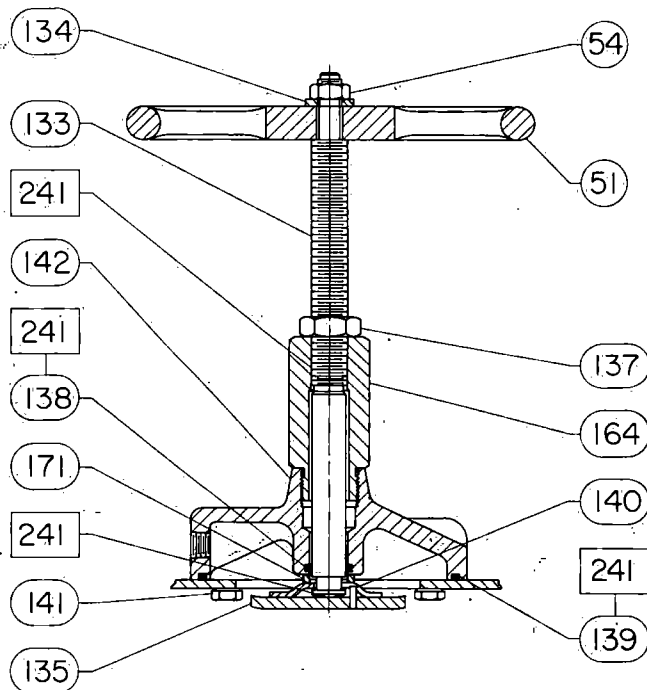
ADJUSTABLE UP TRAVEL STOP FOR
SIZE 60 ACTUATORS



APPLY LUB/SEALANT

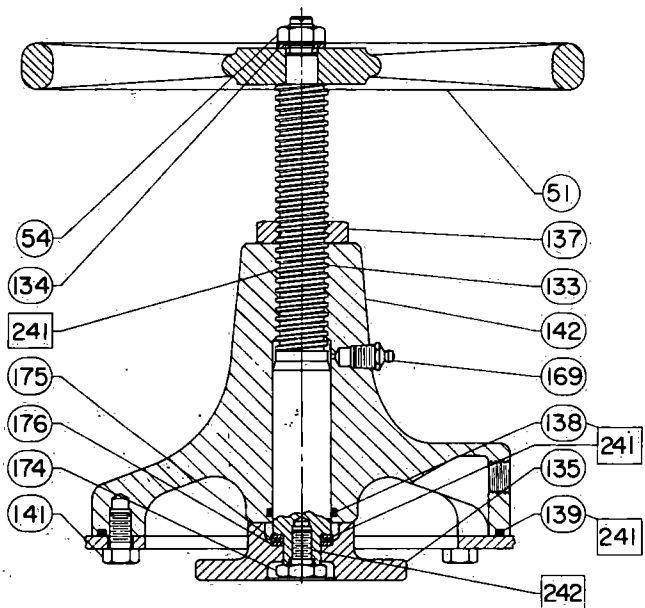
ADJUSTABLE UP TRAVEL STOP FOR SIZE 70
TYPE 1052 ACTUATORS

Figure 10. Adjustable Up Travel Stops



APPLY LUB

TOP-MOUNTED HANDWHEEL ASSEMBLY FOR
SIZE 30, 40, AND 60 ACTUATORS



APPLY LUB/SEALANT

TOP-MOUNTED HANDWHEEL ASSEMBLY FOR SIZE 70 ACTUATOR

Figure 9. Top-Mounted Handwheel Assemblies

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
Adjustable Up Travel Stop								
133	Stem, bronze Sizes 30 & 40 Size 60 Size 70	27A9651 X012 27A9647 X012 27A9666 X012	140	Groove Pin Sizes 30 & 40, steel Size 60, stainless steel	1F1180 28992 1B6270 35072	171	Spacer, 416 stainless steel (for size 60 only)	10A0057 X012
135	Pusher Sizes 30 & 40, steel Size 60, steel Size 70, cast iron	1F1179 99012 1F1183 99012 1R6796 19022	141	Cap Screw, pl steel Sizes 30 & 40 (6 req'd) Size 60 (8 req'd) Size 70 (12 req'd)	1A3684 24052 1A3684 24052 1N1293 28992	174	Retaining Screw, steel (for size 70 only)	1R6797 24092
137	Travel Stop Nut, brass (for size 70 only)	18A2304 X012	142	Body, cast iron Sizes 30 & 40 Size 60 Size 70	2N1687 19012 2K9494 19012 37A9662 X012	175	Thrust Bearing, steel (for size 70 only)	1N8380 99012
138	O-Ring, nitrile Sizes 30 & 40 Size 60 Size 70	1D2375 06992 1B8855 06992 1C4157 06992	164	Body Extension, steel Sizes 30 & 40 Size 60	17A9660 X012 17A9659 X012	176	Thrust Race (2 req'd) (for size 70 only)	1N8381 99012
139	O-Ring, nitrile Sizes 30 & 40 Size 60 Size 70	1D2673 06992 1D5471 06992 1D2691 06992	169	Grease Fitting (for size 70 only)	1L8478 28992	187	Closing Cap, brass Sizes 30 & 40 Size 60 Size 70	1V1369 14012 1U2905 14012 1U9563 14012
						241	Lubriplate MAG-1 Lubricant, 14 oz (0.396 kg) can (not furnished with actuator)	1M1100 X0012
						242	Loctite No. 271 Sealant, 10 cm ³ bottle (not furnished with actuator) (for size 70 only)	1M5933 X0012

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merchantability, fitness or any other matter with respect to the products, nor as a recommendation to use any product or process in conflict with any patent. Fisher Controls reserves the right, without notice, to alter or improve the designs or specifications of the products described herein.

Fisher Controls

Instruction Manual

Type 8510 Eccentric-Disk
Control Valve Body**FISHER®**

September 1984

Form 5174

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Introduction**Scope of Manual**

This instruction manual includes installation, maintenance, and parts information for 2 through 36-inch Type 8510 *ēdisc*® control valve bodies (figure 1) that mate with ANSI flanges. Refer to separate instruction manuals for information covering the actuator and accessories.

Description

The Type 8510 flangeless control valve body with eccentrically mounted disk self-centers in the line during installation and includes built-in electrical bonding of the

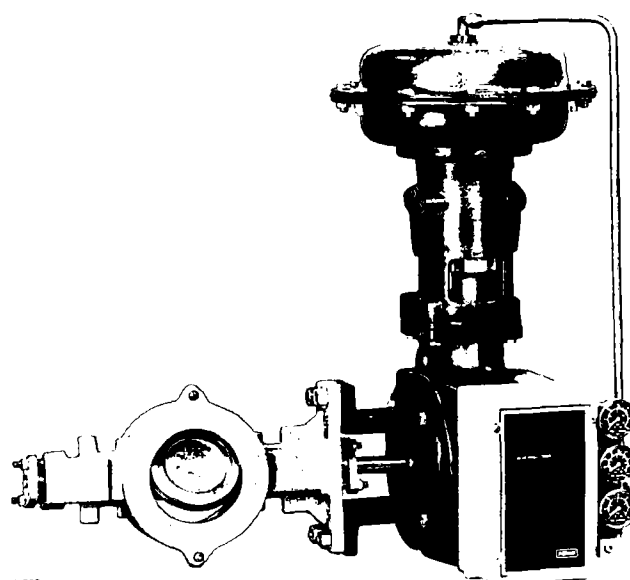


Figure 1. Type 8510 Valve Body with Type 1052 Actuator and Type 3610J Positioner

shaft to the body. This valve body has a splined shaft for use with power, handwheel, or handlever rotary actuators. It is used for throttling or on/off control of a wide variety of liquids and gases.

Specifications

Specifications for the Type 8510 valve body are shown in table 1.

Installation

Key numbers in this procedure are shown in figure 10 for 2 through 8-inch body sizes, in figure 11 for 10 through 24-inch body sizes, and in figure 12 for 30 and 36-inch body sizes.

Table 1. Specifications

BODY SIZES AND END CONNECTION STYLE	2 through 36-inch (through 12-inch with alloy materials) flangeless valve bodies; see table 2 for bodies that install between ANSI flanges	FLOW DIRECTION	Standard (forward flow) is with seal retainer (key 2, figures 10, 11, and 12) facing upstream; reverse flow is permissible but results in lower capacity
MAXIMUM INLET PRESSURES, TEMPERATURES, AND PRESSURE DROPS^(1,2)	Steel, Stainless Steel, and Alloy 20 Bodies: Consistent with applicable pressure-temperature ratings per table 2 up to the maximum material temperature capabilities listed in table 4, but do not exceed the pressure, temperature, and pressure drop conditions of the valve construction. Also see the Installation section Monel⁽³⁾ and Hastelloy C⁽⁴⁾ Bodies: Inlet pressure and temperature capabilities are shown in table 3, but do not exceed the pressure, temperature, and pressure drop conditions of the valve construction. Also see the Installation section	DISK ROTATION	Counterclockwise to open (when viewed from actuator end of valve body) through 90 degrees of disk rotation
SHUTOFF CLASSIFICATIONS PER ANSI/FC 70-2-1976 (R1982), FORMERLY ANSI B16.104-1976	TFE Seal Ring: 2 ml/min of air per inch of nominal body size at a pressure drop of 50 psi (3.4 bar) is standard; Class VI is optional 316 Stainless Steel Seal Ring: 0.001% of maximum valve capacity (1/10 of Class IV)	ACTUATOR/VALVE ACTION	With diaphragm or piston rotary actuator, field reversible between ■ push-down-to-open (extending actuator rod opens valve body) and ■ push-down-to-close (extending actuator rod closes valve body)
MATERIAL TEMPERATURE CAPABILITIES⁽¹⁾	See table 4	VALVE BODY CLASSIFICATION	Face-to-face dimensions of 2 through 6-inch sizes in ANSI Classes 150 and 300, and face-to-face dimensions of 8 through 24-inch sizes in ANSI Class 150, meet API 609 standards for face-to-face dimensions of narrow flangeless and single-flange valves
FLOW CHARACTERISTIC	Approximately linear	MATING FLANGE CAPABILITIES	All sizes compatible with welding-neck and slip-on flanges (schedule 80 or lighter for 2 through 12-inch sizes; schedule 40 or lighter for 14 through 36-inch sizes)
		SHAFT DIAMETERS	See table 2
		APPROXIMATE WEIGHTS	See table 2

1. The pressure/temperature limits in this manual and any applicable standard or code limitation should not be exceeded.
2. The maximum allowable body inlet pressure may exceed the flange joint pressure

- rating. If so, actual inlet pressure must not exceed the flange joint pressure rating.
3. Trademark of International Nickel Co.
4. Trademark of Stellite Div., Cabot Corp.

WARNING

Personal injury or property damage caused by sudden release of pressure may result if the valve assembly is installed where service conditions could exceed either the valve body rating or the flange joint rating. Use pressure-relieving or pressure-limiting devices to prevent the service conditions from exceeding these limits.

The maximum allowable inlet pressures for steel, stainless steel, and alloy 20 Type 8510 valve bodies are consistent with the applicable table 2 pressure-temperature ratings except where further limited by the trim and packing material temperature capabilities given

in table 4. Type 8510 valve bodies are also available in Monel and Hastelloy C valve body materials that are not ANSI B16.34-1981 or ASME code-approved materials. Valve bodies constructed of these materials mate with ANSI flanges but are not included in ANSI pressure-temperature ratings and must not be installed in systems requiring conformance to ANSI standards. Maximum allowable inlet pressures for Type 8510 valve bodies made of Monel and Hastelloy C construction materials are shown in table 3.

CAUTION

The valve configuration and construction materials are selected to meet particular pressure, temperature, pressure drop, and

Table 2. Body sizes, Shaft Diameters, Approximate Weights, and ANSI Rating and Flange Compatibility

BODY SIZE, INCHES	SHAFT DIAMETER		APPROXIMATE WEIGHT		ANSI RATING COMPATIBILITY—STEEL, STAINLESS STEEL, AND ALLOY 20 BODIES	BODY DESIGNATION— MONEL AND HASTELLOY C BODIES ⁽¹⁾	ANSI FLANGE COMPATIBILITY
	Inches	mm	Pounds	kg			
2	1/2	12.7	9.5	4.3	Class 150/300/600	150/300/600	Class ■ 150, ■ 300, or ■ 600
3	5/8	15.9	13	5.9			
4	3/4	19.1	20	9.1			
6	1	25.4	41	19			
8	1-1/4	31.8	69	31			
10	1-1/4	31.8	102	46	Class 150 Class 300	150 300	Class 150 Class 300
12	1-1/2	38.1	158	72	Class 150 Class 300	150 300	Class 150 Class 300
14	1-1/2	38.1	194	88	Class 150	---	Class 150
16	1-3/4	44.5	225	102			
18	1-3/4	44.5	300	136			
20	2	50.8	450	204			
24	2-1/2	63.5	610	277			
30	3	76.2	1800	816	Class 150	---	Class 150 ⁽²⁾
36	3-1/2	88.9	2250	1020			

1. Monel and Hastelloy C valve body materials are not included in ANSI B16.34-1981 or ASME pressure/temperature ratings. See table 3 for alloy body pressure/temperature information. The designations 150, 300, and 600 for these body materials are used

only to indicate relative pressure-retaining capabilities and are not ANSI pressure/temperature rating class designations.
2. This flange compatibility rating per MSS-SP44 only.

Table 3. Maximum Allowable Inlet Pressures for Monel and Hastelloy C Bodies⁽¹⁾

TEMPERATURE	MONEL 411 M35W ⁽¹⁾			HASTELLOY CW-12M-1 ⁽¹⁾		
	150 ⁽²⁾	300 ⁽²⁾	600 ⁽²⁾	150 ⁽²⁾	300 ⁽²⁾	600 ⁽²⁾
°F	Psig					
- 50 to 100	197	514	1028	290	750	1500
200	173	452	905	260	732	1465
300	162	423	847	230	693	1388
400	156	409	818	200	693	1388
450	156	409	818	185	685	1370
°C	Bar					
- 46 to 38	13.6	35.4	70.9	20.0	51.7	103
93	11.9	31.2	62.4	17.9	50.5	101
149	11.2	29.2	58.4	15.9	47.8	95.7
204	10.8	28.2	56.4	13.8	47.8	95.7
232	10.8	28.2	56.4	12.8	47.2	94.5

1. These are not ANSI B16.34-1981 or ASME code approved materials. Also see the Installation section.

2. The designations 150, 300, and 600 are used only to indicate relative pressure-retaining capabilities and are not ANSI pressure-temperature rating class designations.

controlled fluid conditions. Since some body/trim material combinations are limited in their pressure drop and temperature range capabilities, do not apply any other conditions to the valve without first contacting your Fisher sales office or sales representative.

1. Install a three-valve bypass around the control valve assembly if continuous operation is necessary during inspection and maintenance of the valve body.

2. Inspect the valve body to be certain that it is free of foreign material.

3. A Type 8510 valve body is normally shipped as part of a control valve assembly, with a power or manual actuator mounted on the body. If the body and actuator

have been purchased separately or if the actuator has been removed for maintenance, mount the actuator, and adjust actuator travel before inserting the body into the line. This is necessary due to the measurements that must be made during the actuator adjustment process. Refer to the Actuator Mounting section of this manual and to the separate actuator instruction manual for mounting and adjusting instructions before proceeding.

Note

Due to its weight, a 30 or 36-inch valve must be mounted with the shaft in the horizontal position only.

4. Be certain that adjacent pipelines are free of any foreign material, such as pipe scale or welding slag, that could damage the valve body seating surfaces.

CAUTION

Damage to the disk (key 3) will occur if any pipe flanges or piping connected to the valve body interfere with the disk rotation path. However, the disk can be rotated without interference when the valve body is installed between adjacent pipe flanges or piping that has an inside diameter equal to or greater than either schedule 80 pipe for 2 through 12-inch sizes, or schedule 40 pipe for 14 through 36-inch sizes. If piping with a smaller inner diameter than specified above is connected to the valve, measure carefully to be certain the disk rotates without interference before putting the valve into operation.

Table 4. Material Temperature Capabilities

MATERIAL						TEMPERATURE CAPABILITY	
Body	Shaft	Disk	Bearing	Seal	Packing	°F	°C
Steel	17-4PH or Nitronic ⁽¹⁾ 50 stainless steel	Chrome-plated WCB steel or 317 stainless steel	TFE/416 stainless steel	TFE or 316 stainless steel	All	-20 to 450 ⁽²⁾	-29 to 232 ⁽²⁾
			440C stainless steel, unplated CoCr-A (alloy 6), or silver-plated CoCr-A	316 stainless steel	TFE V-ring or TFE/asbestos	-20 to 450	-29 to 232
			TFE/316 stainless steel	TFE or 316 stainless steel	Graphite ribbon	-20 to 800	-29 to 427
	Monel	Monel	PTFE/Monel	TFE	All	-20 to 450 ⁽²⁾	-29 to 232 ⁽²⁾
316 stainless steel	17-4PH stainless steel	Chrome-plated 317 stainless steel	TFE/316 stainless steel	TFE or 316 stainless steel	TFE V-ring	-40 to 450 ⁽²⁾	-40 to 232 ⁽²⁾
					TFE/asbestos or graphite ribbon	-50 to 450 ⁽²⁾	-46 to 232 ⁽²⁾
			Unplated or silver-plated CoCr-A	316 stainless steel	TFE V-ring	-40 to 450	-40 to 232
					TFE/asbestos	-50 to 500	-46 to 260
	Nitronic 50 stainless steel	Chrome-plated 317 stainless steel	TFE/316 stainless steel	TFE	Graphite ribbon	-50 to 800	-46 to 427
					TFE V-ring	-40 to 450 ⁽²⁾	-40 to 232 ⁽²⁾
					TFE/asbestos or graphite ribbon	-50 to 450 ⁽²⁾	-46 to 232 ⁽²⁾
					TFE V-ring	-40 to 450 ⁽²⁾	-40 to 232 ⁽²⁾
			Unplated or silver-plated CoCr-A	316 stainless steel	TFE/asbestos	-50 to 450 ⁽²⁾	-46 to 232 ⁽²⁾
					Graphite ribbon	-50 to 450 ⁽²⁾	-46 to 232 ⁽²⁾
					TFE V-ring	-40 to 450	-40 to 232
					TFE/asbestos	-50 to 500	-46 to 260
Monel	Monel	Monel	PTFE/Monel	TFE	Graphite ribbon	-50 to 1000	-46 to 538
					TFE V-ring	-40 to 450 ⁽²⁾	-40 to 232 ⁽²⁾
Hastelloy	Hastelloy	Hastelloy	PTFE/Hastelloy	TFE	TFE/asbestos or graphite ribbon	-50 to 450 ⁽²⁾	-46 to 232 ⁽²⁾
					TFE V-ring	-40 to 450 ⁽²⁾	-40 to 232 ⁽²⁾
Alloy 20	Alloy 20	Alloy 20	PTFE/alloy 20	TFE	TFE/asbestos or graphite ribbon	-50 to 300	-46 to 149
					TFE V-ring	-40 to 300	-40 to 149

1. Trademark of Armco Steel Corp.

2. For hot water or steam service, limit maximum temperature to 405°F (207°C).

5. Flow is in the standard direction when the seal retainer (key 2) is facing upstream. Standard flow direction is also indicated by the flow direction arrows cast into the body. Flow in the reverse direction is permissible, but maximum flow capacity is obtained with the standard flow direction.

CAUTION

Rotating the disk (key 3) past either the open or closed position could damage the disk sealing surfaces or could cause the disk to jam in the body bore. Before rotating the disk, refer to the following:

- For 2 through 24-inch sizes, refer to either the packing follower (key 15) or the rotation tag (figure 2 and key 19, figures 10

and 11). Both of these parts are located on the end of the valve body that is opposite the actuator.

- For 30 and 36-inch sizes, refer to figure 3. Disk position corresponds to the marking stamped on the end of the shaft that is opposite the actuator.

If the arrow or marking stamped on the end of the valve shaft lies between the open and closed positions, the disk may be rotated in either direction. If the arrow or marking indicates that the disk has been rotated beyond the open or closed position, the disk may be rotated in one direction only. For 30 and 36-inch sizes, an internal travel stop in the valve body prevents the disk from rotating past the closed position.

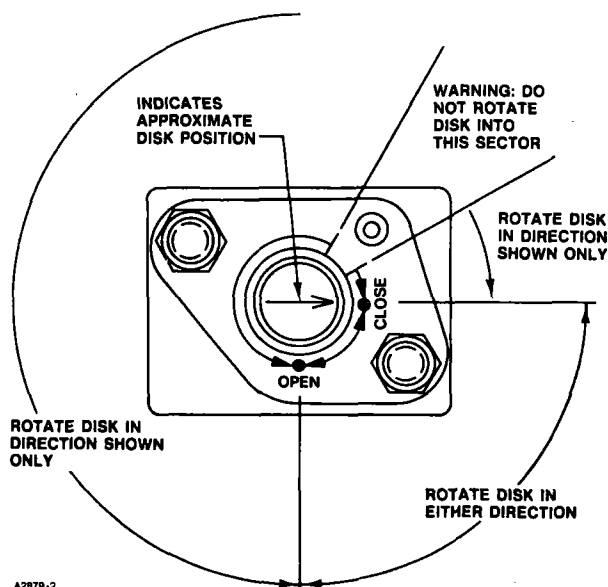


Figure 2. Disk Rotation Indication for 2 through 24-Inch Sizes

6. With the disk in the closed position, install line flange gaskets, and insert the valve between the pipeline flanges. Use either flat sheet gaskets or spiral-wound gaskets with compression-controlling centering rings. Spiral-wound gaskets without compression-controlling centering rings are not recommended for this purpose. Asbestos gaskets may be used to 650°F (343°C), and the optional FGM gaskets (key 29, not shown) available with 2 through 24-inch Type 8510 valve bodies may be used for -200 to 1000°F (-129 to 538°C) temperatures.

7. Proceed as appropriate to center the valve body on the flanges:

For 2 through 8-inch sizes, four centering lugs are cast into the valve body (key 1, figure 10) and each lug engages one corresponding line flange stud. First, install two line flange studs into the line flanges, and then insert the valve between the flanges to roughly center the valve body in the pipeline. If the actuator is attached to the valve body during installation, it may be necessary to install more than two line flange studs between the flanges to securely hold the valve body and actuator.

For 10 through 24-inch sizes, insert the valve into the pipeline, and support the valve in position. Then install the line flange studs through the pipeline flanges to roughly center and support the valve.

For 30 and 36-inch sizes, insert the valve into the pipeline, and support the valve in position. Then install four threaded cap screws through each pipeline flange to roughly center and support the valve. Be certain the flange cap screws engage the tapped holes to a depth equal to flange cap screw diameter.

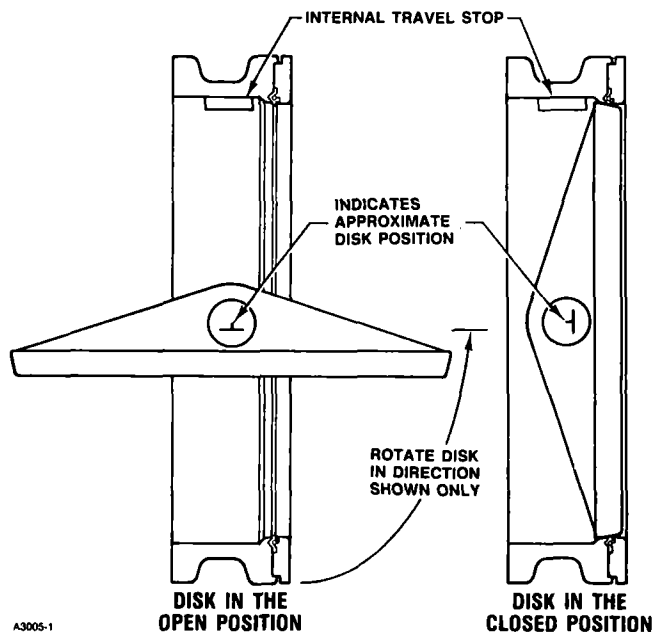


Figure 3. Disk Rotation Indication for 30 and 36-Inch Sizes (Viewed from End of Valve Body Opposite the Actuator)

8. After centering the valve body, first lubricate and then install the remaining line flange studs to secure the valve in the pipeline. Tighten the nuts to the line flange studs in a crisscross sequence to ensure proper alignment of the valve body with the flanges.

WARNING

A Type 8510 valve body is not necessarily grounded when installed in a pipeline. If the valve is used in a flammable or hazardous atmosphere or for oxygen service, an explosion could result due to a discharge of static electricity from the valve components. To avoid personal injury or property damage, always make sure that the valve body is grounded to the pipeline before putting the control valve assembly into operation in a flammable or hazardous atmosphere.

Note

Standard Type 8510 packings are composed either entirely of conductive packing rings (graphite ribbon packing) or partially of conductive packing rings (a carbon-filled TFE female adaptor with TFE V-ring packing or a graphited-asbestos packing ring with TFE/asbestos packing) in order to electrically bond the shaft to the body for hazardous area service. For oxygen ser-

vice applications, provide alternate shaft-to-body bonding according to the following step.

9. For oxygen service applications, attach the bonding strap assembly (key 131, figure 4) to the shaft with the clamp (key 130, figure 4), and connect the other end of the bonding strap assembly to the valve body with the cap screw (key 22, figures 10 and 11) for 2 through 24-inch sizes or with the packing flange nut (key 12, figure 12) for 30 and 36-inch sizes. For 2 through 8-inch sizes, secure each cap screw with a hex nut (key 30, figure 10).

Maintenance

Valve body parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions. Instructions are given in this section for: replacing packing; replacing disk, shaft, or bearing(s); changing disk rotation or valve action; and mounting and adjusting the actuator.

As used in these instructions, actuator refers to power actuators (such as pneumatic diaphragm or piston actuators) or manual actuators (such as handwheel or handlever actuators).

WARNING

To avoid personal injury and property damage, isolate the control valve from the pressure system, and release all pressure from the valve body and power actuator before beginning maintenance operations. If the shaft is broken, pressure can force a portion of the broken shaft out of the body as the actuator is being disassembled or as the packing flange or follower is being removed. Also, relieve any compressive actuator load at the shaft connection before performing any maintenance operations.

Packing Maintenance

Key numbers are referenced in figure 5 unless otherwise indicated. All maintenance operations in this section may be performed with the valve body in the line.

For packings used with Type 8510 bodies, leakage around the packing followers can be stopped by tightening the packing flange nuts (key 12, figures 10, 11, and 12).

Stopping Leakage

If the packing is relatively new and tight on the shaft, and if tightening the packing flange nuts does not stop leakage, it is possible that the shaft is worn or nicked so that a seal cannot be made. If the leakage comes from the outside diameter of the packing, it is possible that the leakage is caused by nicks or scratches around the packing box wall. Inspect the shaft and packing box wall for nicks and scratches when performing the following procedures.

Replacing Packing

This procedure may be performed without removing the actuator from the body if adding split TFE/asbestos packing rings as a temporary measure on the actuator side of the body. However, the actuator must be removed from the body if replacing any other kind of packing on the actuator side of the body.

1. Isolate the control valve, and shut off all pressure lines to the power actuator. Release pressure from the valve body and actuator, and disconnect the pressure lines from the actuator if it will be removed from the body.

2. Proceed as appropriate:

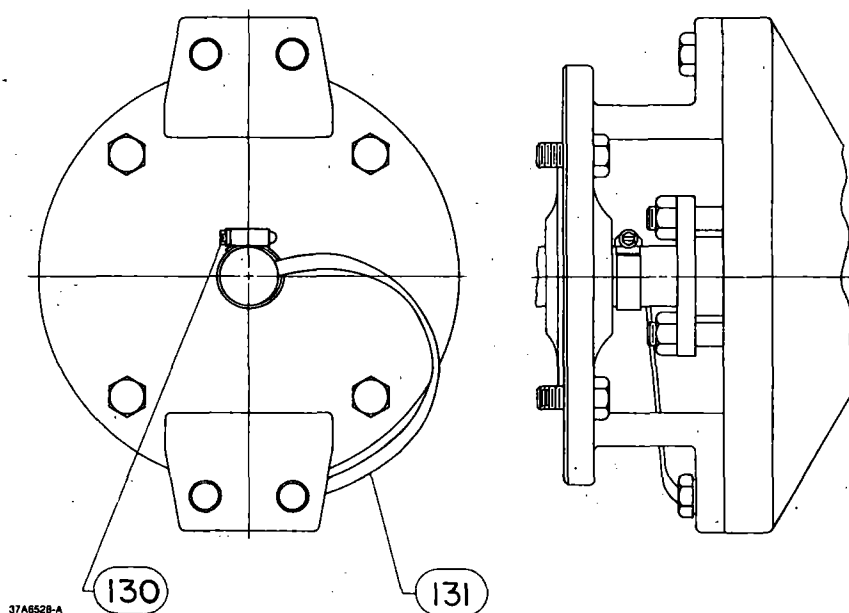
For 2 through 24-inch sizes remove the packing flange nuts (key 12) and packing follower (key 15), plus the packing flange (key 9, figures 10 and 11) if used, from the side of the body opposite the actuator.

For 30 and 36-inch sizes, remove the packing flange nuts, the packing flange, and the packing follower (keys 12, 10, and 15, figure 12) from the side of the body opposite the actuator.

CAUTION

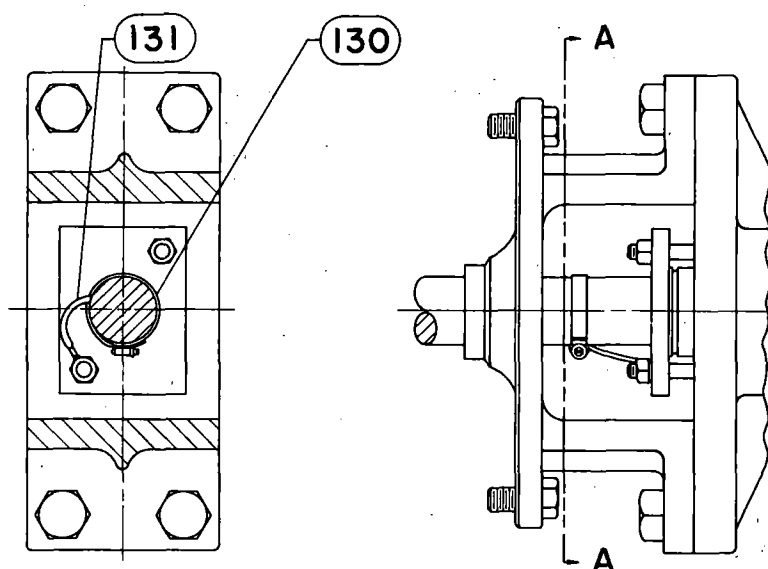
If removing the actuator in the following step, use a wheel puller to separate the actuator parts from the valve shaft. Do not drive the actuator parts off the valve shaft since this could move the valve bearings and disk away from the centered position, thereby damaging the disk and the valve body.

3. If it is necessary to remove the actuator, remove the cap screws (key 22, figures 10, 11, and 12) and, if used, the hex nuts (key 30, figure 10). Remove the clamp (key 130, figure 4) if the strap (key 131, figure 4) is used. Remove the actuator while referring to the separate actuator instruction manual for assistance.



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2 THROUGH 24-INCH BODY SIZES

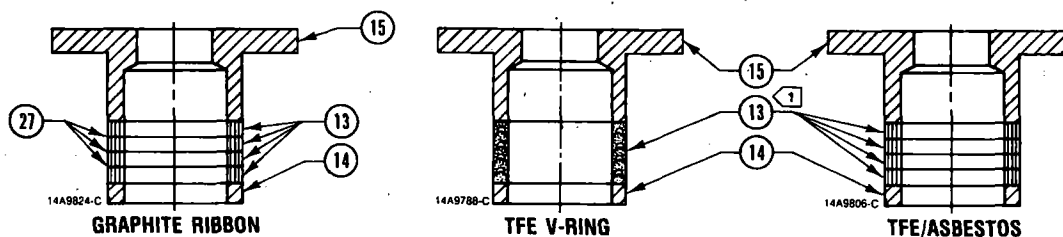


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SECTION A-A

30 AND 36-INCH BODY SIZES

Figure 4. Optional Shaft-to-Body Bonding Strap Assembly



NOTE:

① WITH CONDUCTIVE PACKING, FEMALE ADAPTOR IN TFE V-RING PACKING IS CARBON-FILLED TFE AND TOP RING IN TFE/ASBESTOS PACKING IS GRAPHITED ASBESTOS/INCONEL.

A2881-1

Figure 5. Packing Arrangement Details

4. Remove the packing flange nuts and pull out the packing follower (key 16, figures 10, 11, and 12), plus the packing flange (key 10, figures 10, 11, and 12) if used, from the actuator side of the body.

5. Remove the old packing rings (key 13) and, if used, the packing washers (key 27). Carefully avoid scratching the shaft or packing box wall to avoid damage that could cause leakage around the shaft. Clean all accessible metal parts and surfaces to remove particles that would prevent the packing from sealing.

Note

Except with oxygen service, lightly lubricate new TFE V-rings with Dow Corning 550⁽¹⁾ silicone-base lubricant to aid in assembly.

6. Install the new packing rings and, if used, the packing washers, making sure that TFE/asbestos packing rings are installed so that the ring splits do not line up to form a leak path. With graphite ribbon packing, stack the packing rings and packing washers together as shown in figure 5, and slide the stack into the packing box as far as it will go while carefully avoiding trapping air among the rings.

7. Install both packing followers, and, if used, the packing flanges.

8. Install the packing flange nuts, and tighten them only far enough to stop leakage under normal operating conditions. For oxygen service applications, perform step 9 of the Installation section.

9. Mount the actuator if it was removed from the body and adjust actuator travel before returning the valve to service. This is necessary due to the measurements that must be made during the actuator adjustment process. Refer to the Actuator Mounting section of this manual and to the separate actuator instruction manual for mounting and adjusting instructions before proceeding.

10. When the control valve is being put into operation, check around the packing follower for leakage; retighten the packing flange nuts as required according to accepted bolting procedures.

Replacing Seal Ring

This procedure is to be performed if the control valve is not shutting off properly (that is, leaking downstream). This procedure does not require removing the actuator from the valve body. Part key numbers are shown in figure 10 for 2 through 8-inch body sizes, in figure 11 for 10 through 24-inch body sizes, and in figure 12 for 30 and 36-inch body sizes.

1. Isolate the control valve from line pressure, and relieve pressure from the valve body. Shut off and disconnect all lines from the power actuator.

WARNING

The edges of a rotating disk have a shearing effect that may result in personal injury. To help prevent such injury, stay clear of the disk edges when rotating the disk (key 3).

CAUTION

Damage to the disk (key 3) may occur if the disk is not closed when the valve is being removed from the pipeline. If necessary, pressure the actuator temporarily to retain the disk in the closed position while removing the valve from the pipeline.

2. Unscrew the flange bolts, and remove the valve from the pipeline.

3. Unscrew the machine screws (key 8), and remove the seal retainer (key 2). For 6 through 24-inch sizes, also remove the retainer clip (key 34) and, if used, the washer (key 35, figure 11 only) with these parts.

4. Remove the seal ring or seal ring assembly (key 4). The spring (key 5) is removed with a TFE seal ring.

5. For 316 stainless steel seal ring assemblies, replace the gaskets (key 4C) if the entire seal ring assembly is not replaced. Scrape off the old gaskets from both sides of the seal ring and the seal ring sides of the body (key 1) and seal retainer. Clean the gasket surfaces.

6. Reconnect or mount the actuator (if it was removed) before proceeding.

For an actuator with adjustable travel, also adjust the actuator before proceeding. This is necessary due to the measurements that must be made during the actuator adjustment process.

Refer to the Actuator Mounting section of this manual and to the separate actuator instruction manual for mounting and adjusting instructions.

7. The valve should be closed during seal ring installation to permit accurate centering of the seal. To install the new seal ring:

- For a TFE seal, if the spring (key 5) was disassembled, hook the spring ends together. Work the spring into the recess in the seal ring (key 4). Install the seal ring and spring assembly into the recess in the valve body as shown in figure 10, 11, or 12.

- For a complete 316 stainless steel seal ring assembly, install the seal ring assembly as shown in figure 10, 11, or 12.

CAUTION

New seal ring gaskets (key 4C), are very fragile and must be handled very carefully to avoid gasket kinking, cracking, or breakage that can cause leakage between the seal ring, seal retainer, and body. To avoid gasket damage, make sure that the valve body is lying flat so that the gaskets do not shift before the following step and step 8 are completed.

- For a 316 stainless steel seal ring on which the gaskets will be replaced, lay the following parts down in order so that they are accurately centered on the body: one new gasket; the seal ring oriented as shown in figure 10 or 11; and the second new gasket.

8. Attach the seal retainer and, if used, the retainer clips and washers to the body and secure with the machine screws. Tighten the machine screws evenly so as not to crack or break the 316 stainless steel seal ring gaskets, if used.

9. Be certain the disk is closed before installing the valve according to the Installation section of this instruction manual.

Replacing the Disk and Shaft Assembly or the Bearings

This procedure is to be performed to replace the valve disk, shaft, and taper pin assembly if the disk does not rotate in response to rotation of the actuator end of the valve shaft. Unless otherwise indicated, part key numbers are shown in figure 10 for 2 through 8-inch body sizes, in figure 11 for 10 through 24-inch body sizes, and in figure 12 for 30 and 36-inch body sizes.

1. Remove the seal ring according to steps 1 through 5 of the Replacing Seal Ring section.

CAUTION

Use a wheel puller to separate actuator parts from the valve shaft. Driving the parts off the valve shaft could move the valve bearings and disk away from the centered position, damaging the disk and body.

2. Remove the cap screws (key 22) and, if used, the hex nuts (key 30, figure 10 only). Remove the clamp (key 130, figure 4) if the strap (key 131, figure 4) is used.

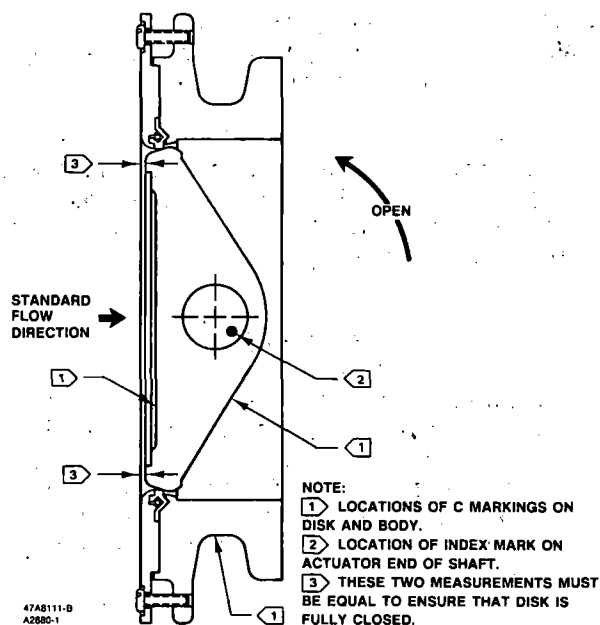


Figure 6. Sectional of Typical Valve Body Viewed from Actuator End

Remove the actuator from the valve body (key 1) while referring to the separate actuator instruction manual for assistance.

3. Rotate the disk (key 3) to the fully open position.

4. Locate the half of the disk that has two C markings cast into it as shown in figure 6. Drive the two taper pins (key 3C) out toward the C-marked side of the disk. Attempting to drive the taper pins in the opposite direction only tightens the pins.

5. Unscrew and remove the packing flange nuts (key 12), packing followers (keys 15 and 16), and packing flanges (keys 9 and 10) if used, from both sides of the body.

WARNING

Once the shaft has been removed in the following step, the disk may fall from the body. To avoid personal injury and disk damage, support the disk to prevent it from falling as the shaft is being removed.

6. Pull the shaft out through the actuator side of the body. If the shaft cannot be pulled free, carefully use a pin punch to drive the shaft out from the side opposite the actuator. Do not damage the end of the shaft with the punch.

7. Remove the disk and spacers (key 7) from the body.

8. Remove the packing rings (key 13), the packing washers (key 27, figure 5) if used, and the packing box rings (key 14) from both sides of the body.

9. If either of the bearings (key 6) require maintenance or replacement, press them out, or remove them using a bearing puller (figure 7). For constructions with a metal bearing, a bearing stop (key 25, figure 8) will also be removed with the bearing.

CAUTION

When replacing a valve disk or shaft, a new disk/shaft/taper pin assembly (key 3) should be used. Using a new disk with a used shaft requires drilling and reaming new taper pin holes in the shaft. The extra set of taper pin holes weakens the shaft and may cause it to fail in service.

10. Clean the packing boxes and metal packing box parts.

Note

Before performing the following step, lubricate the outer bearing surfaces—except on oxygen service—with Molykote⁽²⁾ 320 dry-film lubricant or equivalent to facilitate future removal. Do not lubricate the insides of TFE-lined bearings.

11. If new bearings and, if used, bearing stops (key 25, figure 8) are required, insert them through the packing boxes. Press the bearings in until the bearing end is flush with the body bore at one point and the remainder of the bearing end protrudes into the body bore, or use a bearing puller (figure 7) to properly install and locate the new bearings and the bearing stops.

12. Install spacers (key 7) into the disk (key 3). The spacers fit loosely in the disk.

Note

Do not apply grease according to the following step if it is undesirable to contaminate the process fluid with grease and the thorough cleaning in step 17 cannot be performed.

13. A small amount of heavy grease applied to the spacers will help to hold them in place during the subsequent centering procedure.

14. Insert the disk into the body. Be certain the taper pin holes in the disk are on the actuator side of the body. Also be certain the letter C stamped on either face of the disk is on the same side of the body as the letter C stamped on the outside of the body (figure 6).

15. Slide the shaft through the body and disk.

16. Rotate the disk to the closed position. Measuring carefully, center the disk in the body bore. With the disk centered, use a feeler gauge to measure the clearance between each spacer and bearing. The clearance between each spacer and bearing should be equal and should be as close as possible to the value given in figure 8. If necessary, remove the disk and shaft, and reposition the bearings. Reinstall the disk and shaft, and repeat the centering and measuring process.

17. If the grease used to hold the spacers will contaminate the process fluid, disassemble the shaft and disk, remove the spacers, and clean the disk body bore, and spacers thoroughly. Reinstall the disk and spacers into the body. Insert the shaft into the body and through the disk.

18. Slide the shaft all the way into the valve body.

19. To ensure that the direction of taper in the shaft taper pin holes matches that of the disk taper pin holes, proceed as appropriate:

For 2 through 24-inch sizes, temporarily install the packing follower (key 15) or, if used, the packing flange (key 9) with rotation tag (key 19). With the disk fully opened, rotate the shaft until the arrow on the end of the shaft points to OPEN on the disk rotation tag. Insert the taper pins (key 3C), small end first, into the taper pin holes on the C-marked side of the disk. Do not drive in the pins. Remove the packing follower or flange.

For 30 and 36-inch sizes, rotate the shaft until the marking on the end of the shaft indicates that the disk is in the fully open position (see figure 3). Insert the taper pins (key 3C), small end first, into the taper pin holes on the C-marked side of the disk. Do not drive in the pins.

20. Insert a packing box ring (key 14) into each packing box.

21. Install the packing according to the appropriate instructions presented in steps 5 through 8 of the Replacing Packing section.

22. Drive in the taper pins securely.

23. Rotate the disk to the closed position.

24. To install the seal ring and complete the assembly, follow the procedures presented in steps 5 through 9 of the Replacing Seal Ring section.

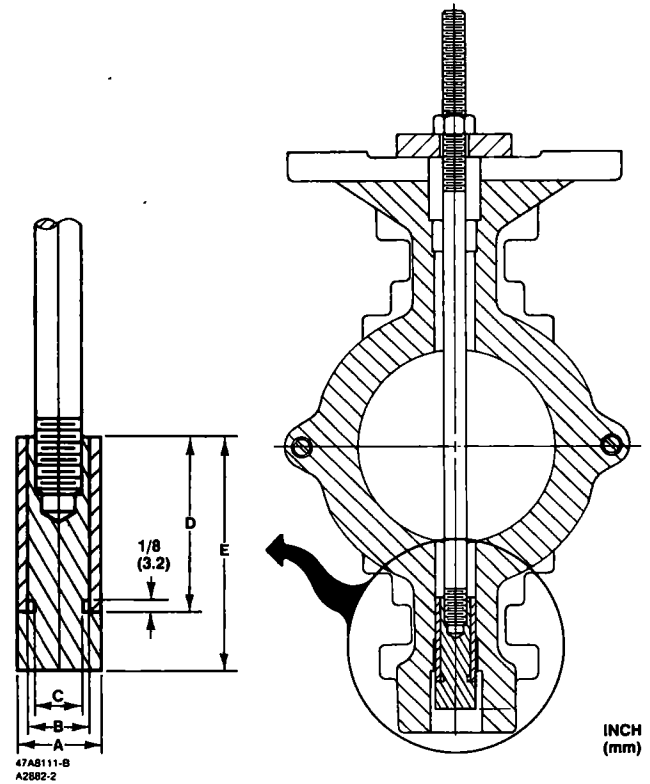
Actuator Mounting

Key numbers in this procedure are shown in figure 10 for 2 through 8-inch body sizes, in figure 11 for 10 through 24-inch body sizes, and in figure 12 for 30 and 36-inch body sizes.

Puller Dimensions for TFE Bearings⁽¹⁾

Valve Size, In.	A		B		C		D		E	
	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.
2	15.49	.610	12.65	.498	9.53	.375	33.24	1.313	50.80	2.000
	15.37	.605	12.52	.493						
3	18.67	.735	15.82	.623	12.70	.500	39.70	1.563	58.74	2.313
	18.54	.730	15.70	.618						
4	22.71	.894	19.00	.748	15.88	.625	47.63	1.875	66.68	2.625
	22.58	.889	18.87	.743						
6	29.06	1.144	25.35	.998	22.23	.875	60.33	2.375	79.38	3.125
	28.93	1.139	25.22	.993						
8 & 10	35.41	1.394	31.70	1.248	28.58	1.125	73.03	2.875	92.08	3.625
	35.28	1.389	31.57	1.243						
12 & 14	41.76	1.644	38.05	1.498	34.93	1.375	85.73	3.375	104.8	4.125
	41.63	1.639	37.92	1.493						
16 & 18	51.28	2.019	44.42	1.749	41.28	1.625	79.38	3.125	98.43	3.875
	51.16	2.014	44.30	1.744						
20	57.63	2.269	50.77	1.999	47.63	1.875	88.90	3.500	108.0	4.250
	57.51	2.264	50.65	1.994						
24	70.33	2.769	63.47	2.499	60.33	2.375	66.68	2.625	85.73	3.375
	70.21	2.764	63.35	2.494						
30	85.19	3.354	76.17	2.999	72.90	2.870	82.55	3.250	101.6	4.000
	85.04	3.348	76.05	2.994						
36	101.1	3.979	88.87	3.499	85.60	3.370	95.25	3.750	114.3	4.500
	100.9	3.973	88.75	3.494						

1. Tolerance for the A and B dimensions are indicated by showing maximum and minimum dimensions.



Puller Dimensions for Bearing Stop⁽¹⁾

Valve Size, In.	A		B		C		D		E	
	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.
2	15.49	.610	13.56	.534	10.31	.406	14.29	.563	33.34	1.313
	15.37	.605	13.44	.529						
3	18.67	.735	16.74	.659	13.49	.531	15.88	.625	34.93	1.375
	18.54	.730	16.61	.654						
4	22.71	.894	19.91	.784	16.66	.656	22.23	.875	41.28	1.625
	22.58	.889	19.79	.779						
6	29.06	1.144	26.26	1.034	23.01	.906	28.58	1.125	47.63	1.875
	28.93	1.139	26.14	1.029						
8 & 10	35.41	1.394	32.61	1.284	29.36	1.156	34.93	1.375	53.98	2.125
	35.28	1.389	32.49	1.279						
12 & 14	41.76	1.644	38.96	1.534	35.71	1.406	41.28	1.625	60.33	2.375
	41.63	1.639	38.84	1.529						
16 & 18	51.28	2.019	45.34	1.785	42.06	1.656	28.58	1.125	47.63	1.875
	51.16	2.014	45.21	1.780						
20	57.63	2.264	51.56	2.035	48.41	1.906	31.75	1.250	50.80	2.000
	57.51	2.264	51.56	2.030						
24	70.33	2.769	64.39	2.535	61.11	2.406	53.98	2.125	73.03	2.875
	70.21	2.764	64.26	2.530						
30	85.19	3.354	77.22	3.040	73.79	2.905	63.50	2.500	82.55	3.250
	85.04	3.348	76.96	3.030						
36	101.1	3.979	88.92	3.540	86.49	3.405	50.80	2.000	69.85	2.750
	100.9	3.973	89.66	3.530						

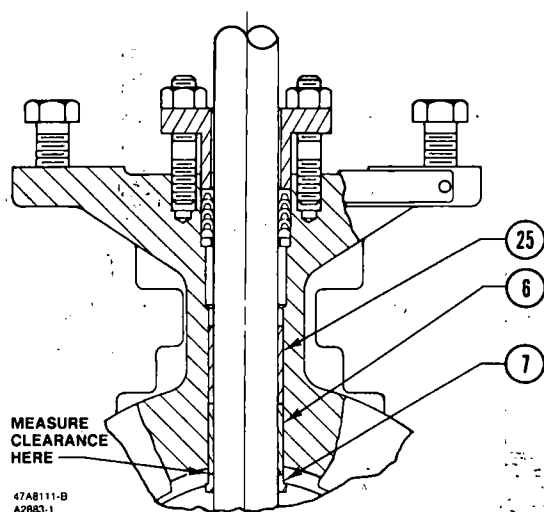
1. Tolerance for the A and B dimensions are indicated by showing maximum and minimum dimensions.

Puller Dimensions for Metal Bearings⁽¹⁾

Valve Size, In.	A		B		C		D		E	
	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.
2	15.49	.610	12.70	.500	9.53	.375	15.88	.625	34.93	1.375
	15.37	.605	12.57	.495						
3	18.67	.735	15.88	.625	12.70	.500	20.64	.813	39.69	1.563
	18.54	.730	15.72	.619						
4	22.71	.894	19.05	.750	15.88	.625	22.23	.875	41.28	1.625
	22.58	.889	18.92	.745						
6	29.06	1.144	25.40	1.000	22.23	.875	28.58	1.125	47.63	1.875
	28.93	1.139	25.27	.995						
8 & 10	35.41	1.394	31.75	1.250	28.58	1.125	34.93	1.375	53.98	2.125
	35.28	1.389	31.62	1.245						
12 & 14	41.76	1.644	38.10	1.500	34.93	1.375	41.28	1.625	60.33	2.375
	41.63	1.639	37.97	1.495						
16 & 18	51.28	2.019	44.45	1.750	41.28	1.625	47.63	1.875	66.68	2.625
	51.16	2.014	44.32	1.745						
20	57.63	2.269	50.80	2.000	47.63	1.875	53.98	2.125	73.03	2.875
	57.51	2.264	50.67	1.995						
24	70.33	2.769	63.50	2.500	60.33	2.375	66.68	2.625	85.73	3.375
	70.21	2.764	63.37	2.495						
30	85.19	3.354	76.20	3.000	72.90	2.870	82.55	3.250	101.6	4.000
	85.04	3.348	76.07	2.995						
36	101.1	3.979	88.90	3.500	85.60	3.370	95.25	3.750	114.3	4.500
	100.9	3.973	88.77	3.495						

1. Tolerance for the A and B dimensions are indicated by showing maximum and minimum dimensions.

Figure 7. Bearing Puller Dimensions



BODY SIZE, INCHES	CLEARANCE		BODY SIZE, INCHES	CLEARANCE	
	Inches	mm		Inches	mm
2, 3, & 4	0.004	0.102	16	0.016	0.406
6	0.006	0.152	18	0.018	0.457
8	0.008	0.203	20	0.020	0.508
10	0.010	0.254	24	0.024	0.610
12	0.012	0.305	30	0.021	0.533
14	0.014	0.356	36	0.026	0.660

Figure 8. Spacer-Bearing Clearance Shown with Metal Bearing Assembly

1. If using a power actuator, determine the actuator mounting style and position from figure 9.

If using a manual handwheel or handlever actuator, refer to the appropriate actuator instruction manual for mounting positions.

With the valve body out of the line, mount the actuator on the body in accordance with the instructions in the actuator instruction manual. Mount the actuator yoke to the body, and tighten the actuator-mounting cap screws (key 22) to the appropriate bolt torque from table 5. For 2 through 8-inch body sizes, the cap screws will be secured by hex nuts (key 30, figure 10).

CAUTION

For 2 through 24-inch sizes, rotating the disk (key 3) in the wrong direction will damage the seal ring (key 4). To avoid such damage, remove the seal ring according to the following step before mounting the actuator.

2. For 2 through 24-inch sizes only, mark the orientation of the seal ring with respect to the body so that the seal can be reinstalled in its original position. Remove the seal ring according to the procedure in the Replacing Seal Ring section of this instruction manual.

Table 5. Recommended Bolt Torques for Actuator-Mounting Cap Screws

BODY SIZE, INCHES	RECOMMENDED BOLT TORQUE	
	Foot-Pounds	N • m
2, 3, 4, & 6	65	87.7
8, 10, 12, & 14	100	135
16, 18, & 20	135	182
24	180	243
30 & 36	360	488

CAUTION

On actuators with an adjustable turnbuckle, such as the Type 1051, 1052, or 1061 actuator, the turnbuckle must be adjusted so that the valve is closed (determined by measuring as shown in figure 6) when the diaphragm plate or piston is against the actuator travel stop. For a manually-operated actuator or an actuator without adjustable linkage such as a Type 1066 or 1066SR actuator, make certain the actuator travel stop prevents the disk from rotating past the fully closed position.

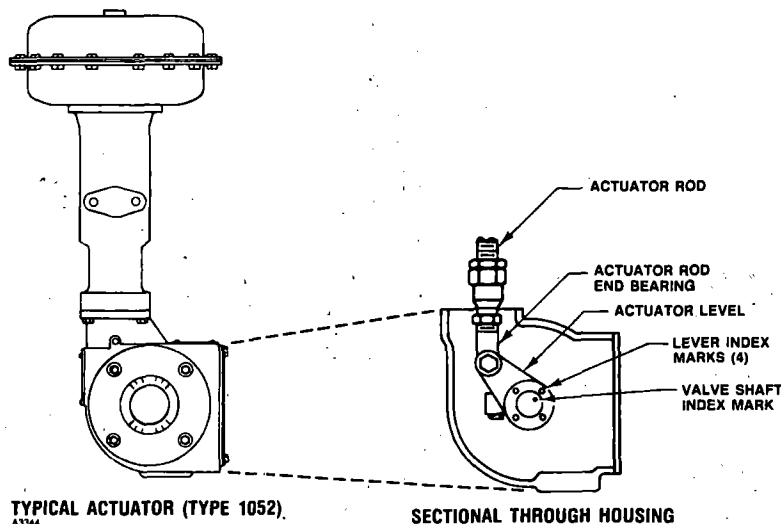
3. For actuators with an adjustable turnbuckle, adjust the turnbuckle to its minimum length. Refer to the appropriate actuator instruction manual for assistance.

4. For power actuators, refer to figure 9 to locate the view of the mounting style and position to be used. Position the index marks on the end of the valve shaft and actuator lever as shown when attaching the lever. Refer to the appropriate actuator instruction manual for instructions covering adjusting the lever and adjusting the actuator. When adjusting the actuator, be certain that the disk is rotated in the proper direction (counter-clockwise to open when viewed from the actuator side of the valve) and that the disk is not rotated beyond the limits defined in the installation section of this instruction manual.

5. For actuators with an adjustable turnbuckle, adjust the turnbuckle to bring the disk to the fully closed position at the end of the actuator stroke. Refer to the appropriate actuator instruction manual for assistance.

6. To determine the fully closed disk position (zero degrees of disk rotation), measure the distances between the disk face and the retaining ring face (or from a line from the top to the bottom of the body) at the top and bottom of the valve as shown in figure 6. When necessary, adjust the actuator to rotate the disk slightly until the two measurements are equal.

7. For 2 through 24-inch sizes only, reinstall the seal ring according to the procedure in the Replacing Seal Ring section.



ACTUATOR		VALVE CLOSED ④	MOUNTING POSITION 1 ⑤	MOUNTING POSITION 2 ⑤	MOUNTING POSITION 3 ⑤	MOUNTING POSITION 4 ⑤
MOUNTING	STYLE					
RIGHT-HAND MOUNTING ①	STYLE A PUSH DOWN TO OPEN					
	STYLE B PUSH DOWN TO CLOSE ③					
LEFT-HAND MOUNTING ②	STYLE C PUSH DOWN TO CLOSE ③					
	STYLE D PUSH DOWN TO OPEN					

NOTES:
 ① WHEN ONE IS FACING THE INLET, THE ACTUATOR IS TO THE RIGHT OF THE VALVE BODY.
 ② WHEN ONE IS FACING THE INLET, THE ACTUATOR IS TO THE LEFT OF THE VALVE BODY.
 ③ FOR 60-DEGREE OPERATION WITH PUSH-DOWN-TO-CLOSE ACTION (EXTENDING ACTUATOR ROD CLOSING VALVE), ROTATE ACTUATOR LEVER COUNTERCLOCKWISE SO THAT LEVER INDEX MARK IS OFFSET 1 SPLINE TOOTH FROM VALVE SHAFT INDEX MARK FOR 2 THROUGH 4-INCH BODY SIZES AND 2 SPLINE TEETH FROM VALVE SHAFT FOR 6 THROUGH 24-INCH BODY SIZES. CONSULT THE FISHER SALES OFFICE OR SALES REPRESENTATIVE FOR 60-DEGREE OPERATION OF 30 AND 36-INCH BODY SIZES.
 ④ CURVED ARROWS IN "VALVE CLOSED" COLUMN INDICATE ROTATION REQUIRED TO OPEN VALVE (COUNTERCLOCKWISE WHEN VIEWED FROM ACTUATOR SIDE OF VALVE).
 ⑤ ARROWS IN "MOUNTING POSITION" COLUMNS INDICATE DIRECTION OF ACTUATOR ROD TRAVEL REQUIRED TO OPEN VALVE.

Figure 9. Lever/Shaft/Disk Orientation with Valve Closed

Parts Ordering

When corresponding with the Fisher sales office or sales representative about this equipment, always men-

tion the valve serial number. When ordering replacement parts, also specify the complete 11-character part number of each part required from the following parts list.

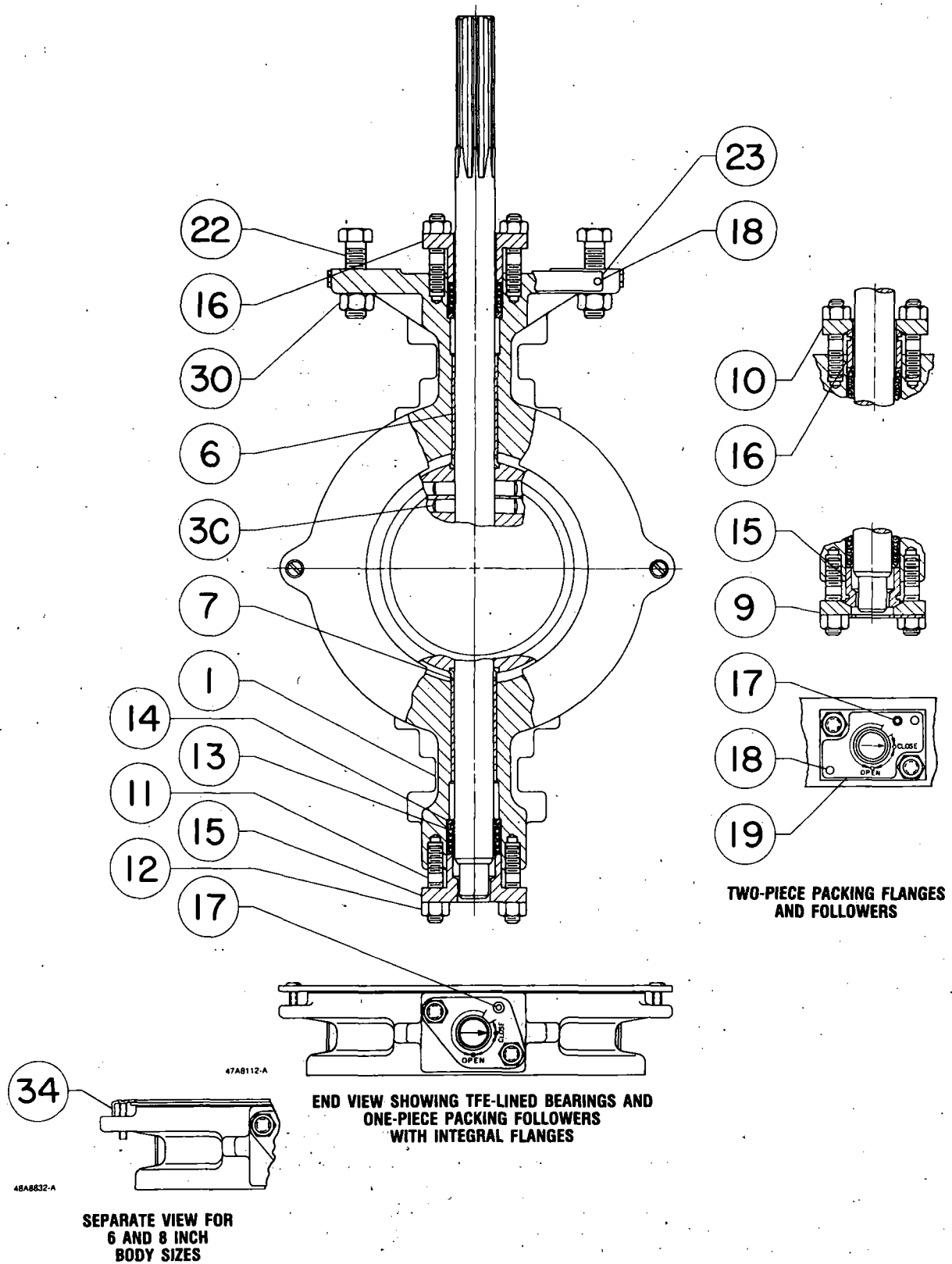


Figure 10. Type 8510 Valve Body Assemblies with TFE V-Ring Packing for 2 Through 8-Inch Body Sizes

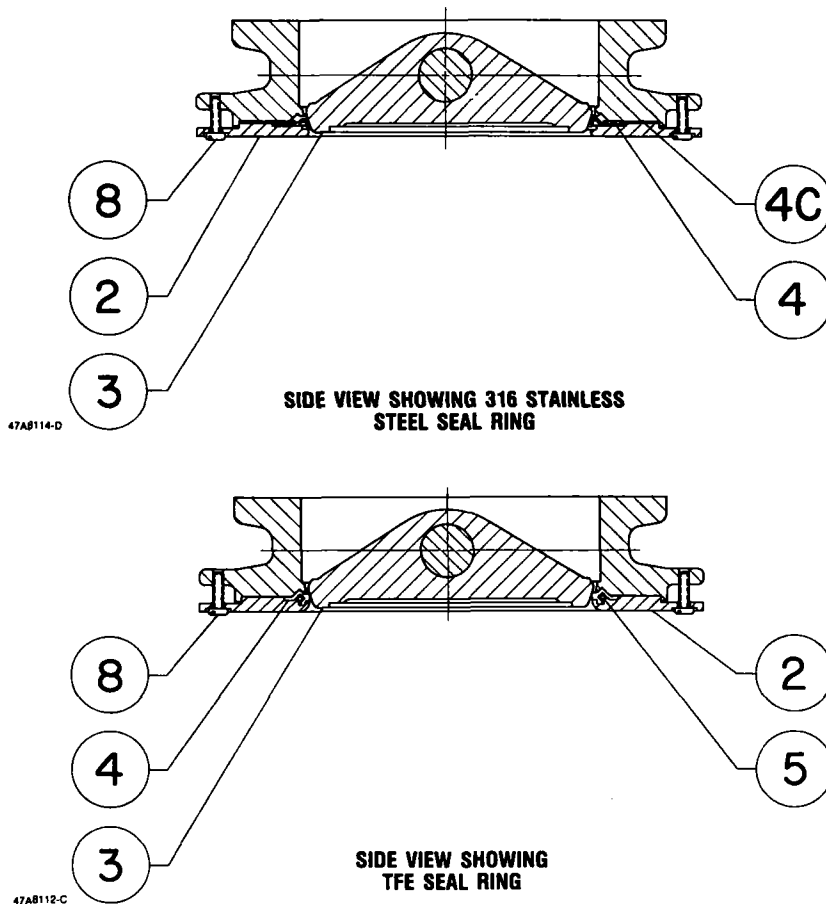


Figure 10. Type 8510 Valve Body Assemblies with TFE V-Ring Packing for 2 Through 8-Inch Body Sizes (Continued)

Parts List

Note

Except where indicated, sizes shown are valve body sizes.

Key	Description	Part Number	Key	Description	Part Number
1	Valve Body	See following table	3C	Taper Pin (Continued)	
2	Seal Retainer	See following table		K-Monel	
3	Disk, Shaft & Taper Pin Assembly	See following table		2-inch	12A9019 X032
3C	Taper Pin (3 req'd for 30 & 36-inch sizes; 2 req'd on all other sizes) included in key 3)			3-inch	12A8908 X032
	Nitronic 50 stainless steel			4-inch	12A8988 X032
	2-inch	12A9019 X072		6-inch	12A8817 X032
	3-inch	12A8908 X072		8 & 10-inch	12A8949 X042
	4-inch	12A8988 X062		12-inch	12A9029 X032
	6-inch	12A8817 X062		Hastelloy C	
	8 & 10-inch	12A8949 X082		2-inch	12A9019 X042
	12 & 14-inch	12A9029 X062		3-inch	12A8908 X042
	16, 18 & 20-inch	12A9106 X052		4-inch	12A8988 X042
	24-inch	12A9079 X032		6-inch	12A8817 X042
	30-inch	18A4182 X012		8-inch	12A8949 X052
	36-inch	18A1176 X012		Alloy 20	
				2-inch	12A9019 X052
				3-inch	12A8908 X052
				4-inch	12A8988 X052
				6-inch	12A8817 X052
				8-inch	12A8949 X062
			4*	Seal Ring ⁽³⁾ , TFE	
				2-inch	22A9023 X012
				3-inch	22A8897 X012
				4-inch	22A8986 X012
				6-inch	22A8825 X012
				8-inch	22A8961 X012
				10-inch	22A8946 X012
				12-inch	22A8920 X012
			4*	Seal Ring ⁽³⁾ , TFE (Continued)	
				14-inch	22A9032 X012
				16-inch	22A9037 X012
				18-inch	32A9066 X012
				20-inch	32A9107 X012
				24-inch	32A9078 X012
				30-inch	28A4180 X012
				36-inch	28A1174 X012
			4*	Seal Ring Assembly, 316 stainless steel & graphite laminate	
				2-inch	17A7544 X012
				3-inch	17A7550 X012
				4-inch	17A7556 X012
				6-inch	17A8171 X012
				8-inch	17A8172 X012
				10-inch	18A1129 X012
				12-inch	18A1139 X012
				14-inch	18A1148 X012
				16-inch	18A1157 X012
				18-inch	18A2013 X012
				20-inch	18A2022 X012
				24-inch	18A2031 X012
				30-inch	18A4652 X012
				36-inch	18A4657 X012
			4C*	Gasket, graphite laminate (2 req'd) (included in key 4)	
				2-inch	17A7543 X012
				3-inch	17A7549 X012
				4-inch	17A7555 X012
				6-inch	17A7561 X012
				8-inch	17A7567 X012
				10-inch	18A1128 X012
				12-inch	18A1138 X012
				14-inch	18A1147 X012
				16-inch	18A1156 X012
				18-inch	18A2012 X012
				20-inch	18A2021 X012
				24-inch	18A2030 X012
				30-inch	18A4651 X012
				36-inch	18A4656 X012
			5*	Spring (TFE seal ring only) ⁽³⁾	
				316 stainless steel	
				2-inch	12A9022 X012
				3-inch	12A8902 X012
				4-inch	12A8991 X012
				6-inch	12A8818 X012
				8-inch	12A8974 X012
				10-inch	12A8948 X012
				12-inch	12A8922 X012
				14-inch	12A9035 X012
				16-inch	12A9060 X012
				18-inch	12A9070 X012
				20-inch	12A9108 X012
				24-inch	12A9082 X012
				30-inch	18A4181 X012
				36-inch	18A1175 X012
				K-Monel	
				2-inch	12A9022 X022
				3-inch	12A8902 X022
				4-inch	12A8991 X022
				6-inch	12A8818 X022
				8-inch	12A8974 X022
				10-inch	12A8948 X022
				12-inch	12A8922 X022
				Hastelloy C	
				2-inch	12A9022 X032
				3-inch	12A8902 X032
				4-inch	12A8991 X032
				6-inch	12A8818 X032
				8-inch	12A8974 X032
				10-inch	12A8948 X032
				12-inch	12A8922 X032

*Recommended spare part.

3. To make certain that a spring is available with each seal ring, a new spring (key 5) should be ordered to be stocked with each ring ordered.

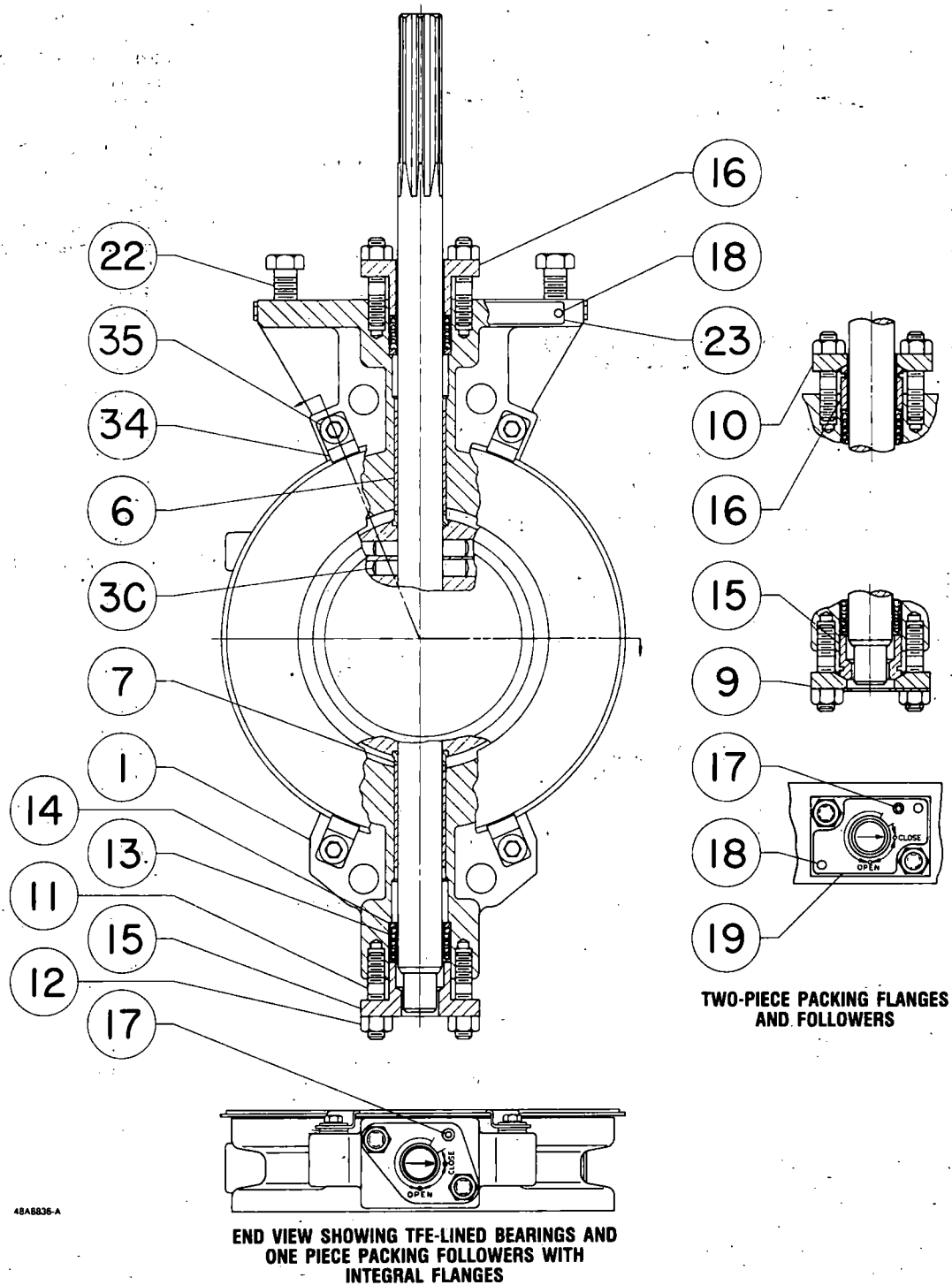


Figure 11. Type 8510 Valve Body Assemblies with TFE V-Ring Packing for 10 Through 24-Inch Body Sizes

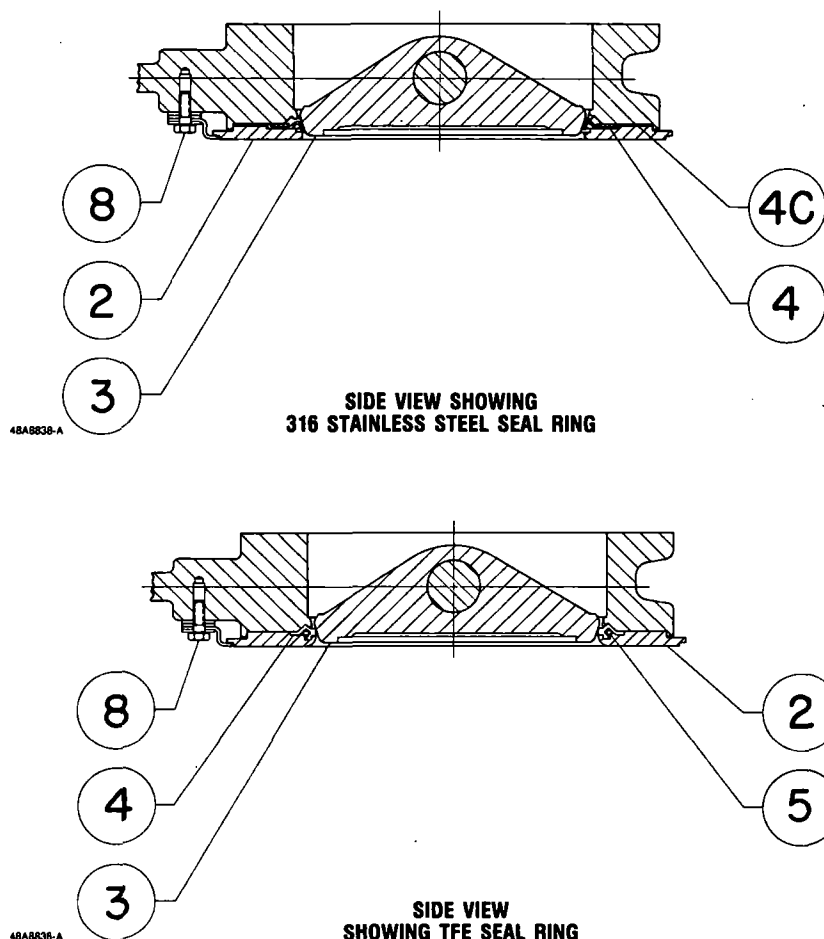


Figure 11. Type 8510 Valve Body Assemblies with TFE V-Ring Packing for 10 Through 24-Inch Body Sizes (Continued)

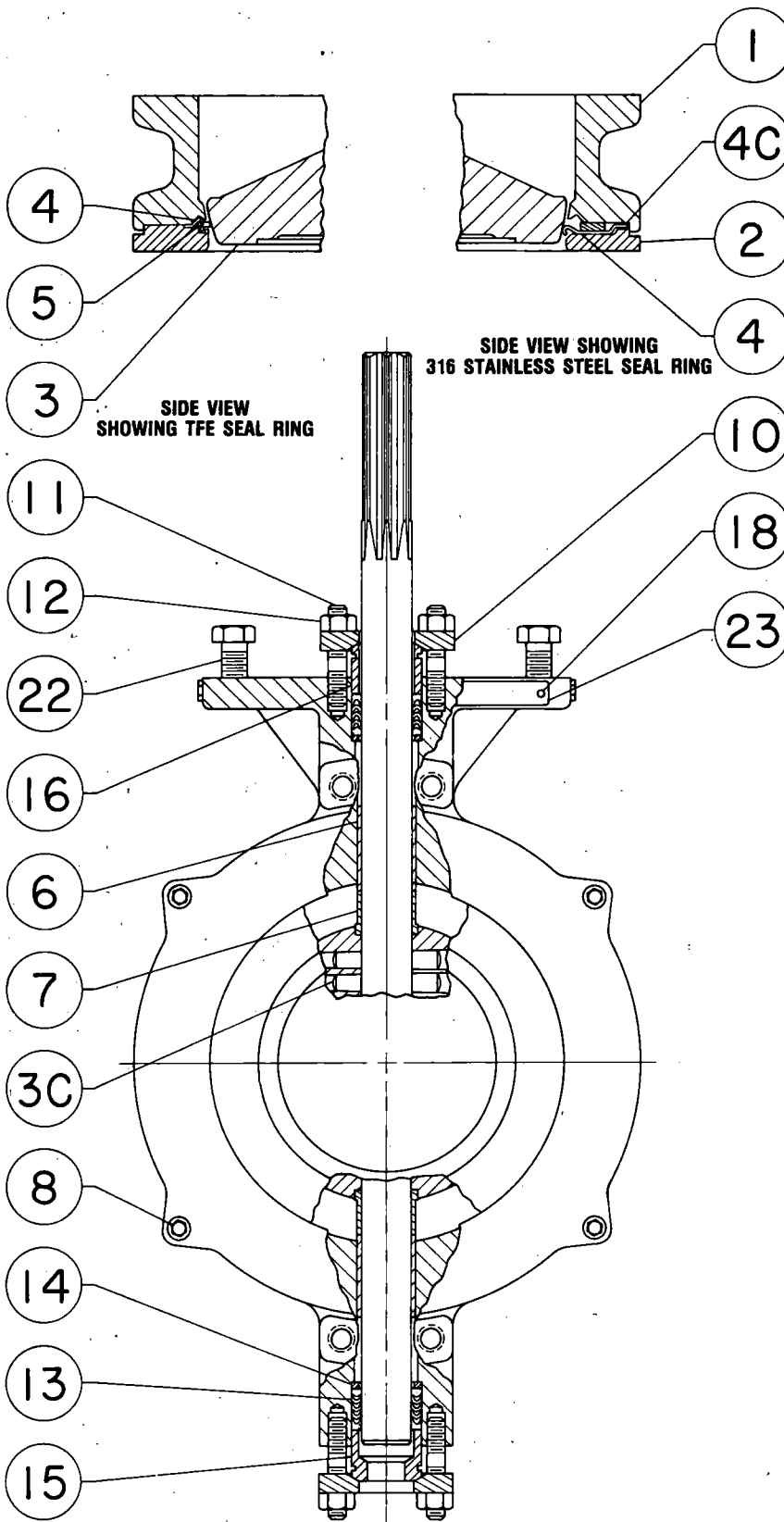
Key	Description	Part Number	Key	Description	Part Number
5*	Spring (TFE seal ring only) ⁽³⁾ (Continued)		6*	Bearing (2 req'd) (Continued)	
	Alloy 20			316 stainless steel/TFE	
	2-inch	12A9022 X042		2-inch	12A9015 X032
	3-inch	12A8902 X042		3-inch	12A8904 X032
	4-inch	12A8991 X042		4-inch	12A8985 X032
	6-inch	12A8818 X042		6-inch	12A8819 X032
	8-inch	12A8974 X042		8 & 10-inch	12A8965 X032
	10-inch	12A8948 X042		12 & 14-inch	12A8928 X032
	12-inch	12A8922 X042		16 & 18-inch	12A9043 X032
				20-inch	12A9090 X032
				24-inch	12A9087 X032
				30-inch	18A4185 X032
				36-inch	18A1179 X032
6*	Bearing (2 req'd)			316 stainless steel/PTFE	
	Lined			2-inch	12A9015 X072
	Stainless steel/TFE ⁽⁴⁾			3-inch	12A8904 X062
	2-inch	12A9015 X052		4-inch	12A8985 X072
	3-inch	12A8904 X052		6-inch	12A8819 X092
	4-inch	12A8985 X052		8 & 10-inch	12A8965 X082
	6-inch	12A8819 X052		12 & 14-inch	12A8928 X062
	8 & 10-inch	12A8965 X052		16 & 18-inch	12A9043 X072
	12 & 14-inch	12A8928 X052		20-inch	12A9090 X072
	16 & 18-inch	12A9043 X052		24-inch	12A9087 X072
	20-inch	12A9090 X052		30-inch	18A4185 X072
	24-inch	12A9087 X052		36-inch	18A1179 X072
	30-inch	18A4185 X052			
	36-inch	18A1179 X052			

*Recommended spare part.

3. To make certain that a spring is available with each seal ring, a new spring (key 5) should be ordered to be stocked with each seal ring ordered.

4. Either TFE/316 stainless steel or TFE/416 stainless steel bearing material will be supplied depending on manufacturing location.

Key	Description	Part Number
6*	Bearing (2 req'd) (Continued)	
	Monel/PTFE	
	2-inch	12A9015 X082
	3-inch	12A8904 X082
	4-inch	12A8985 X082
	6-inch	12A8819 X132
	8 & 10-inch	12A8965 X132
	12-inch	12A8928 X112
	Hastelloy C/PTFE	
	2-inch	12A9015 X092
	3-inch	12A8904 X122
	4-inch	12A8985 X122
	6-inch	12A8819 X142
	8 & 10-inch	12A8965 X142
	12-inch	12A8928 X122
	Alloy 20/PTFE	
	2-inch	12A9015 X122
	3-inch	12A8904 X132
	4-inch	12A8985 X132
	6-inch	12A8819 X152
	8 & 10-inch	12A8965 X152
	12-inch	12A8928 X132
	All-metal	
	440C stainless steel	
	2-inch	14A6543 X012
	3-inch	12A9300 X012
	4-inch	14A5698 X012
	6-inch	14A4618 X012
	8 & 10-inch	14A5699 X012
	12 & 14-inch	14A6549 X012
	16 & 18-inch	14A6551 X012
	20-inch	14A6553 X012
	24-inch	14A6555 X012
	30-inch	18A4972 X012
	36-inch	18A4976 X012
	CoCr-A	
	2-inch	14A6544 X012
	3-inch	14A6545 X012
	4-inch	14A6546 X012
	6-inch	14A6547 X012
	8 & 10-inch	14A6548 X012
	12 & 14-inch	14A6550 X012
	16 & 18-inch	14A6552 X012
	20-inch	14A6554 X012
	24-inch	14A6556 X012
	30-inch	18A4973 X012
	36-inch	18A4977 X012
	CoCr-A/silver	
	2-inch	14A6536 X012
	3-inch	12A9161 X012
	4-inch	14A6537 X012
	6-inch	14A2498 X012
	8 & 10-inch	14A6538 X012
	12 & 14-inch	14A6539 X012
	16 & 18-inch	14A6540 X012
	20-inch	14A6541 X012
	24-inch	14A6542 X012
	30-inch	18A4974 X012
	36-inch	18A4978 X012
7	Spacer (2 req'd)	
	17-4PH stainless steel	
	2-inch	12A8846 X012
	3-inch	12A8847 X012
	4-inch	12A8996 X012
	6-inch	12A8824 X012
	8 & 10-inch	12A8966 X012
	12 & 14-inch	12A8921 X012
	16 & 18-inch	12A9052 X012
	20-inch	12A9091 X012
	24-inch	12A9088 X012
	30-inch	18A4186 X012
	36-inch	18A1180 X012



48A5027-B

Figure 12. Type 8510 Valve Body Assemblies with TFE V-Ring Packing for 30 and 36-Inch Body Sizes

Key	Description	Part Number
7	Spacer (2 req'd) (Continued)	
	Nitronic 50 stainless steel	
	2-inch	12A8846 X022
	3-inch	12A8847 X022
	4-inch	12A8996 X022
	6-inch	12A8824 X022
	8 & 10-inch	12A8966 X022
	12 & 14-inch	12A8921 X022
	16 & 18-inch	12A9052 X022
	20-inch	12A9091 X022
	24-inch	12A9088 X022
	30-inch	18A4186 X022
	36-inch	18A1180 X022
	K-Monel	
	2-inch	12A8846 X032
	3-inch	12A8847 X032
	4-inch	12A8996 X032
	6-inch	12A8824 X032
	8 & 10-inch	12A8966 X042
	12-inch	12A8921 X032
	Hastelloy C	
	2-inch	12A8846 X042
	3-inch	12A8847 X042
	4-inch	12A8996 X042
	6-inch	12A8824 X042
	8 & 10-inch	12A8966 X052
	12-inch	12A8921 X042
	Alloy 20	
	2-inch	12A8846 X052
	3-inch	12A8847 X052
	4-inch	12A8996 X052
	6-inch	12A8824 X052
	8 & 10-inch	12A8966 X062
	12-inch	12A8921 X052
8	Machine Screw	
	Stainless steel	
	2, 3, & 4-inch	
	(2 req'd)	T11734 X0012
	Zn pl steel	
	6 & 8-inch (2 req'd)	18A8509 X012
	10, 12, 14, 16, & 18-inch	
	(4 req'd)	1A3526 24052
	20 & 24-inch	
	(4 req'd)	1A3418 24052
	Pl steel (4 req'd)	
	30-inch	1A7711 32982
	36-inch	1N2359 28992
9	Packing Flange	See following table
10	Packing Flange	See following table
11	Packing Flange Stud (4 req'd)	
	Zn pl steel	
	2, 3, & 4-inch	1E9441 31032
	6-inch	12A8835 X012
	8 & 10-inch	12A8950 X012
	12, 14, 16, & 18-inch	
	18-inch	12A8926 X012
	20 & 24-inch	12A9097 X012
	30-inch	1P3236 31032
	36-inch	0W0869 31032
	316 stainless steel	
	2, 3, & 4-inch	1E9441 35222
	6-inch	12A8835 X022
	8 & 10-inch	12A8950 X022
	12-inch	12A8926 X022
	K-Monel	
	2, 3, & 4-inch	1E9441 40412
	6-inch	12A8835 X062
	8 & 10-inch	12A8950 X072
	12-inch	12A8926 X052

*Recommended spare part.
5. Trademark of International Nickel Co.

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
14	Packing Box Ring (2 req'd) (Continued) Hastelloy C		25	Bearing Stop (2 req'd) (use w/metal bearing only) (not shown) (Contin- ued)		27	Packing Washer, zinc (6 req'd) (use w/graphite ribbon packing only) (not shown)	
	2-inch	12A9020 X042		316 stainless steel			2-inch	14A8362 X012
	3-inch	12A8901 X032		2-inch	14A6531 X022		3-inch	14A9771 X012
	4-inch	12A8984 X042		3-inch	12A9162 X012		4-inch	14A8363 X012
	6-inch	12A8823 X042		4-inch	14A5697 X022		6-inch	14A8365 X012
	8 & 10-inch	12A8956 X042		6-inch	14A2497 X012		8 & 10-inch	14A8366 X012
	12-inch	12A8923 X042		8 & 10-inch	14A5700 X022		12 & 14-inch	14A8367 X012
	Alloy 20			12 & 14-inch	14A6532 X022		16 & 18-inch	14A9772 X012
	2-inch	12A9020 X052		16 & 18-inch	14A6533 X022		20-inch	14A9773 X012
	3-inch	12A8901 X042		20-inch	14A6534 X022		24-inch	14A9774 X012
	4-inch	12A8984 X052		24-inch	14A6535 X022		30-inch	18A4952 X012
	6-inch	12A8823 X052		30-inch	18A4971 X022		36-inch	18A4961 X012
	8 & 10-inch	12A8956 X052		36-inch	18A4975 X022			
	12-inch	12A8923 X052						
15	Packing follower	See following table	26	Line Flange Stud (not shown) Steel (SA-193-B7)		29	Line Flange Gasket, FGM (2 req'd) (not shown)	
16	Packing follower	See following table		Class 150			Recommended for temperatures above 650°F (343°V)	
17	Groove Pin, stainless steel			2-inch (4 req'd)	1J2246 X0012		Class 150	
	2, 3, 4, 6, 8 &			3-inch (4 req'd)	1N9567 31012		2-inch	16A6224 X012
	10-inch	1D2677 35032		4-inch (8 req'd)	14A5341 X022		3-inch	16A6226 X012
	12, 14, 16, 18, 20,			6-inch (8 req'd)	1C3307 X0012		4-inch	16A6228 X012
	& 24-inch	1D2696 35032		8-inch (8 req'd)	14A9600 X012		6-inch	16A6231 X012
18	Drive Screw, stainless steel			10-inch (12 req'd)	14A5342 X022		8-inch	16A6234 X012
	(specify quantity			12-inch (12 req'd)	14A9602 X012		10-inch	16A6237 X012
	req'd)	1A3682 28982		14-inch (12 req'd)	11A7572 X032		12-inch	16A6239 X012
19	Rotation Tag, stainless steel			16-inch (16 req'd)	14A9603 X012		14-inch	16A6241 X012
	(not req'd for packing follower			18-inch (16 req'd)	14A9604 X012		16-inch	16A6242 X012
	w/integral flange)			20-inch (20 req'd)	14A9605 X012		18-inch	16A6243 X012
	2 & 3-inch	12A8903 X012		24-inch (20 req'd)	11A7576 X022		20-inch	16A6244 X012
	4-inch	12A9002 X012		30-inch (24 req'd)	18A5303 X012		24-inch	16A6245 X012
	6-inch	12A8837 X012		36-inch (28 req'd)	18A5304 X012			
	8 & 10-inch	12A8968 X012		Class 300			Class 300	
	12, 14, & 16-inch	12A8927 X012		2-inch (8 req'd)	1J2246 X0012		2-inch	16A6225 X012
	18-inch	12A9053 X012		3-inch (8 req'd)	1C3307 X0012		3-inch	16A6227 X012
	20-inch	12A9112 X012		4-inch (8 req'd)	14A9600 X012		4-inch	16A6229 X012
	24-inch	22A9089 X012		6-inch (12 req'd)	14A9601 X012		6-inch	16A6232 X012
22	Cap Screw (2 req'd for 2 & 3-inch; 4 req'd on all other sizes)			8-inch (12 req'd)	14A9602 X012		8-inch	16A6235 X012
	Standard service, zn pl steel			10-inch (16 req'd)	14A9603 X012		10-inch	16A6238 X012
	2 & 3-inch	1A3444 24052		12-inch (16 req'd)	14A9604 X012		12-inch	16A6240 X012
	4 & 6-inch	1B2612 24052		Class 600			Class 600	
	8-inch	1R4436 24052		2-inch (8 req'd)	14A5341 X022		2-inch	16A6225 X012
	10, 12 & 14-inch	1A5444 24052		3-inch (8 req'd)	14A9600 X012		3-inch	16A6227 X012
	16, 18, & 20-inch	1A4302 24052		4-inch (8 req'd)	14A9602 X012		4-inch	16A6230 X012
	24-inch	12A9114 X012		6-inch (12 req'd)	14A9603 X012		6-inch	16A6233 X012
	30 & 36-inch	12A5124 X012		8-inch (12 req'd)	14A9604 X012		8-inch	16A6236 X012
	Cryogenic service, strain-hardened			316 stainless steel (SA-193-B8M)		30	Hex Nut	
	316 stainless steel			Class 150			Standard service, steel	
	2 & 3-inch	1A3444 X0012		2-inch (4 req'd)	1J2246 X0022		2 & 3-inch (2 req'd)	1A3772 24112
	4 & 6-inch	1B2612 X0012		3-inch (4 req'd)	1N9567 35222		4 & 6-inch (4 req'd)	1A3772 24112
	8-inch	1R4436 X0012		4-inch (8 req'd)	14A5341 X012		8-inch (4 req'd)	1A3760 24112
	10 & 12-inch	1A5444 X0022		6-inch (8 req'd)	1C3307 X0022		Cryogenic service, stainless steel	
23	Nameplate, stainless steel			8-inch (8 req'd)	14A9600 X022		2 & 3-inch (2 req'd)	1A3772 35252
	USA	14A8938 X012		10-inch (12 req'd)	14A5342 X012		4 & 6-inch (4 req'd)	1A3772 35252
	Canada	14A8940 X012		12-inch (12 req'd)	14A9602 X032		8-inch (4 req'd)	1A3760 35252
25	Bearing Stop (2 req'd) (use w/metal bearing only) (not shown)			Class 300		31	Cap Screw, steel (8 req'd) (not shown)	
	Stainless steel			2-inch (8 req'd)	1J2246 X0022		30-inch	16A7957 X012
	2-inch	14A6531 X012		3-inch (8 req'd)	1C3307 X0022		36-inch	1P7549 31012
	3-inch	12A9162 X022		4-inch (8 req'd)	14A9600 X022			
	4-inch	14A5697 X012		6-inch (12 req'd)	14A9601 X022			
	6-inch	14A2497 X022		8-inch (12 req'd)	14A9602 X032	32	Nameplate, stainless steel (not req'd when actuator is furnished) (not shown)	16A3188 X012
	8 & 10-inch	14A5700 X012		10-inch (16 req'd)	14A9603 X022			
	12 & 14-inch	14A6532 X012		12-inch (16 req'd)	14A9604 X022	33	Nameplate Wire (not req'd when actuator is furnished) (not shown)	1D8847 99012
	16 & 18-inch	14A6533 X012		Class 600				
	20-inch	14A6534 X012		2-inch (8 req'd)	14A5341 X012			
	24-inch	14A6535 X012		3-inch (8 req'd)	14A9600 X022			
	30-inch	18A4971 X012		4-inch (8 req'd)	14A9602 X032			
	36-inch	18A4975 X012		6-inch (12 req'd)	14A9603 X022			
				8-inch (12 req'd)	14A9604 X022			

Key 1 Valve Body

BODY SIZE, INCHES	CLASS OR BODY DESIGNATION	MATERIAL				
		WCB Steel	316 Stainless Steel	Monel	Hastelloy C	Alloy 20
2	150/300/600	47A7218 X012	47A7218 X022	47A7218 X032	47A7218 X042	47A7218 X052
3	150/300/600	47A7220 X012	47A7220 X022	47A7220 X032	47A7220 X042	47A7220 X052
4	150/300/600	47A7222 X012	47A7222 X022	47A7222 X032	47A7222 X042	47A7222 X052
6	150/300/600	47A7223 X012	47A7223 X022	47A7223 X032	47A7223 X042	47A7223 X052
8	150/300/600	47A7225 X012	47A7225 X022	47A7225 X032	47A7225 X042	47A7225 X052
10	150/300/600	56A6246 X012	56A6246 X022	56A6246 X032	56A6246 X042	56A6246 X052
12	150/300/600	48A1121 X012	48A1121 X022	48A1121 X032	48A1121 X042	48A1121 X052
14	150/300/600	48A1122 X012	48A1122 X022	48A1122 X032	48A1122 X042	48A1122 X052
16	150/300/600	58A1131 X012	58A1131 X022	58A1131 X032	58A1131 X042	58A1131 X052
18	150/300/600	58A1132 X012	58A1132 X022	58A1132 X032	58A1132 X042	58A1132 X052
20	150/300/600	48A1141 X012	48A1141 X022	---	---	---
24	150/300/600	48A1150 X012	48A1150 X022	---	---	---
30	150/300/600	48A2006 X012	48A2006 X022	---	---	---
36	150/300/600	58A2015 X012	58A2015 X022	---	---	---
42	150/300/600	58A2024 X012	58A2024 X022	---	---	---
48	150/300/600	58A1169 X012	58A1169 X022	---	---	---
54	150/300/600	58A1172 X012	58A1172 X032	---	---	---

Key 2, Seal Retainer

BODY SIZE, INCHES	SEAL MATERIAL	SEAL RETAINER MATERIAL				
		Steel	316 Stainless Steel	Monel	Hastelloy C	Alloy 20
2	TFE	27A7546 X012	27A7546 X022	27A7546 X032	27A7546 X042	27A7546 X052
3	316 stainless steel	27A7545 X012	27A7545 X022	---	---	---
4	TFE	27A7552 X012	27A7552 X022	27A7552 X032	27A7552 X042	27A7552 X052
6	316 stainless steel	27A7551 X012	27A7551 X022	---	---	---
8	TFE	27A7558 X012	27A7558 X022	27A7558 X032	27A7558 X042	27A7558 X052
10	316 stainless steel	27A7557 X012	27A7557 X022	---	---	---
12	TFE	28A8570 X012	28A8570 X022	28A8570 X032	28A8570 X042	28A8570 X052
14	316 stainless steel	28A8568 X012	28A8568 X022	---	---	---
16	TFE	28A8571 X012	28A8571 X022	28A8571 X032	28A8571 X042	28A8571 X052
18	316 stainless steel	28A8569 X012	28A8569 X022	---	---	---
20	TFE	28A1124 X012	28A1124 X022	28A1124 X032	28A1124 X042	28A1124 X052
24	316 stainless steel	28A1125 X012	28A1125 X022	---	---	---
30	TFE	28A1134 X012	28A1134 X022	28A1134 X032	28A1134 X042	28A1134 X052
36	316 stainless steel	28A1135 X012	28A1135 X022	---	---	---
42	TFE	28A1143 X012	28A1143 X022	---	---	---
48	316 stainless steel	28A1144 X012	28A1144 X022	---	---	---
54	TFE	28A1152 X012	28A1152 X022	---	---	---
60	316 stainless steel	28A1153 X012	28A1153 X022	---	---	---
66	TFE	28A2008 X012	28A2008 X022	---	---	---
72	316 stainless steel	28A2009 X012	28A2009 X022	---	---	---
78	TFE	28A2017 X012	28A2017 X022	---	---	---
84	316 stainless steel	28A2018 X012	28A2018 X022	---	---	---
90	TFE	28A2026 X012	28A2026 X022	---	---	---
96	316 stainless steel	28A2027 X012	28A2027 X022	---	---	---
102	TFE	38A4198 X012	38A4198 X022	---	---	---
108	316 stainless steel	38A4653 X012	38A4653 X022	---	---	---
114	TFE	28A3802 X012	28A3802 X022	---	---	---
120	316 stainless steel	28A4658 X012	28A4658 X022	---	---	---

Key 3 Disk, Shaft & Taper Pin Assembly

BODY SIZE, INCHES	SHAFT SIZE		DISK MATERIAL					
			Cr PI WCB	Cr PI 317 Stainless Steel	Cr PI 317 Stainless Steel	Monel	Hastelloy C	Alloy 20
	Inches	mm	SHAFT MATERIAL					
			17-4PH Stainless Steel	Nitronic 50 Stainless Steel	17-4PH Stainless Steel	Monel	Hastelloy C	Alloy 20
2	1/2	12.7	---	22A9014 X152	22A9014 X142	22A9014 X082	22A9014 X092	22A9014 X102
3	5/8	15.9	22A8899 X192	22A8899 X202	22A8899 X212	22A8899 X102	22A8899 X112	22A8899 X122
4	3/4	19.1	22A8989 X142	22A8989 X152	22A8989 X162	22A8989 X112	22A8989 X122	22A8989 X132
6	1	25.4	22A8833 X192	22A8833 X202	22A8833 X212	22A8833 X152	22A8833 X162	22A8833 X172
8	1-1/4	31.8	22A8975 X182	22A8975 X202	22A8975 X192	22A8975 X142	22A8975 X122	22A8975 X132
10	1-1/4	31.8	22A8945 X152	22A8945 X162	22A8945 X172	22A8945 X092	22A8945 X102	22A8945 X112
12	1-1/2	38.1	22A8918 X132	22A8918 X152	22A8918 X142	22A8918 X072	22A8918 X082	22A8918 X092
14	1-1/2	38.1	22A9030 X102	22A9030 X122	22A9030 X112	---	---	---
16	1-3/4	44.5	22A9059 X112	22A9059 X132	22A9059 X122	---	---	---
18	1-3/4	44.5	22A9068 X092	22A9068 X112	22A9068 X102	---	---	---
20	2	50.8	22A9102 X072	22A9102 X092	22A9102 X082	---	---	---
24	2-1/2	63.5	22A9081 X112	22A9081 X132	22A9081 X122	---	---	---
30	2-1/2	63.5	28A5223 X012	28A5223 X032	28A5223 X022	---	---	---
30	3	76.2	28A4184 X012	28A4184 X032	28A4184 X022	---	---	---
36	2-1/2	63.5	28A5225 X012	28A5225 X032	28A5225 X022	---	---	---
36	3-1/2	88.9	28A1178 X012	28A1178 X032	28A1178 X022	---	---	---

Keys 9, 10, and 15 Packing Flange and Packing Follower for End of Body Opposite Actuator

BODY SIZE, INCHES	KEY NO.	PACKING FOLLOWER ⁽¹⁾ WITH INTEGRAL FLANGE INVESTMENT CAST 316 STAINLESS STEEL	PACKING FLANGE AND FOLLOWER				
			Zn PI Steel ⁽²⁾	316 Stainless ⁽³⁾ Steel	Monel	Hastelloy C	Alloy 20
2	9	---	12A9010 X012	12A9010 X022	12A9010 X032	12A9010 X042	12A9010 X052
	15	27A4114 X012	12A9011 X012	12A9011 X012	12A9011 X022	12A9011 X032	12A9011 X042
3	9	---	12A8905 X012	12A8905 X022	12A8905 X032	12A8905 X042	12A8905 X052
	15	27A4115 X012	12A8907 X012	12A8907 X012	12A8907 X022	12A8907 X032	12A8907 X042
4	9	---	12A9001 X012	12A9001 X022	12A9001 X032	12A9001 X042	12A9001 X052
	15	27A4116 X012	12A8981 X012	12A8981 X012	12A8981 X022	12A8981 X032	12A8981 X042
6	9	---	12A8842 X012	12A8842 X022	12A8842 X032	12A8842 X042	12A8842 X052
	15	27A4130 X012	12A8820 X012	12A8820 X012	12A8820 X032	12A8820 X042	12A8820 X052
8 & 10	9	---	22A8967 X012	22A8967 X022	22A8967 X032	22A8967 X042	22A8967 X052
	15	27A4131 X012	12A8959 X012	12A8959 X012	12A8959 X032	12A8959 X042	12A8959 X052
12	9	---	12A8931 X012	12A8931 X022	12A8931 X032	12A8931 X042	12A8931 X052
	15	27A4132 X012	12A8924 X012	12A8924 X012	12A8924 X022	12A8924 X032	12A8924 X042
14	9	---	12A8931 X012	12A8931 X012	---	---	---
	15	27A4132 X012	12A8924 X012	12A8924 X012	---	---	---
16 & 18	9	---	22A9045 X012	22A9045 X012	---	---	---
	15	---	12A9049 X012	12A9049 X012	---	---	---
20	9	---	22A9095 X012	22A9095 X012	---	---	---
	15	---	12A9093 X012	12A9093 X012	---	---	---
24	9	---	22A9076 X012	22A9076 X012	---	---	---
	15	---	12A9085 X012	12A9085 X012	---	---	---
30	10	---	38A4196 X012	38A4196 X012	---	---	---
	15	---	18A4188 X012	18A4188 X012	---	---	---
36	10	---	38A1190 X012	38A1190 X012	---	---	---
	15	---	18A1182 X012	18A1182 X012	---	---	---
30 ⁽⁴⁾	10	---	38A4196 X012	38A4196 X012	---	---	---
	15	---	18A9247 X012	18A9247 X012	---	---	---
36 ⁽⁴⁾	10	---	38A1190 X012	38A1190 X012	---	---	---
	15	---	18A9249 X012	18A9249 X012	---	---	---

1. Use with WCB steel body.

2. Packing follower is 316 stainless steel for sizes 2 through 24 in. and 316 stainless steel lined with TFE for sizes 30 and 36 in.

3. Sizes 14 through 36 in. have a zn pi steel packing flange.

4. Use with graphite ribbon packing.

Keys 10 and 16 Packing Flange and Packing Follower for Actuator End of Body

BODY SIZE, INCHES	KEY NO.	PACKING FOLLOWER ⁽¹⁾ WITH INTEGRAL FLANGE INVESTMENT CAST 316 STAINLESS STEEL	PACKING FLANGE AND FOLLOWER				
			Zn Pl Steel ⁽²⁾	316 Stainless ⁽³⁾ Steel	Monel	Hastelloy C	Alloy 20
2	10	---	12A9009 X012	12A9009 X022	12A9009 X032	12A9009 X042	12A9009 X052
	16	16A6078 X012	12A9021 X012	12A9021 X012	12A9021 X052	12A9021 X032	12A9021 X042
3	10	---	12A8900 X012	12A8900 X022	12A8900 X032	12A8900 X042	12A8900 X052
	16	16A6079 X012	12A8906 X012	12A8906 X012	12A8906 X022	12A8906 X032	12A8906 X042
4	10	---	12A8983 X012	12A8983 X022	12A8983 X032	12A8983 X042	12A8983 X052
	16	26A6080 X012	12A8982 X012	12A8982 X012	12A8982 X022	12A8982 X032	12A8982 X042
6	10	---	12A8822 X012	12A8822 X022	12A8822 X032	12A8822 X042	12A8822 X052
	16	26A6077 X012	12A8821 X012	12A8821 X012	12A8821 X032	12A8821 X042	12A8821 X052
8 & 10	10	---	12A8955 X012	12A8955 X022	22A8955 X032	22A8955 X042	22A8955 X052
	16	26A6081 X012	12A8964 X012	12A8964 X012	12A8964 X032	12A8964 X042	12A8964 X052
12	10	---	12A8930 X012	12A8930 X022	12A8930 X032	12A8930 X042	12A8930 X052
	16	26A6088 X012	12A8925 X012	12A8925 X012	12A8925 X022	12A8925 X032	12A8925 X042
14	10	---	12A8930 X012	12A8930 X012	---	---	---
	16	26A6088 X012	12A8925 X012	12A8925 X012	---	---	---
16 & 18	10	---	22A9048 X012	22A9048 X012	---	---	---
	16	---	12A9050 X012	12A9050 X012	---	---	---
20	10	---	12A9096 X012	12A9096 X012	---	---	---
	16	---	12A9094 X012	12A9094 X012	---	---	---
24	10	---	22A9083 X012	22A9083 X012	---	---	---
	16	---	12A9086 X012	12A9086 X012	---	---	---
30	10	---	38A4196 X012	38A4196 X012	---	---	---
	16	---	18A4187 X012	18A4187 X012	---	---	---
36	10	---	38A1190 X012	38A1190 X012	---	---	---
	16	---	18A1181 X012	18A1181 X012	---	---	---
30 ⁽⁴⁾	10	---	38A4196 X012	38A4196 X012	---	---	---
	16	---	18A9246 X012	18A9246 X012	---	---	---
36 ⁽⁴⁾	10	---	38A1190 X012	38A1190 X012	---	---	---
	16	---	18A9248 X012	18A9248 X012	---	---	---

1. Use with WCB steel body.

2. Packing follower is 316 stainless steel for sizes 2 through 24 in. and 316 stainless steel lined with TFE for sizes 30 and 36 in.

3. Sizes 14 through 36 in. have a zn pl steel packing flange.

4. Use with graphite ribbon packing.

Key	Description	Part Number	Key	Description	Part Number	Key	Description	Part Number
34	Retainer Clip, stainless steel		130	Clamp, stainless steel (req'd w/ nonconductive packing)		131	Bonding Strap Assembly (req'd w/ nonconductive packing)	
	6-inch (2 req'd)	18A7159 X012		2 & 3-inch	16A8717 X012		2 & 3-inch	17A6353 X012
	8-inch (2 req'd)	18A7160 X012		4, 6, 8, 10, 12, & 14-inch	16A8714 X012		4 & 6-inch	17A6532 X022
	10, 12, 14, 16, & 18-inch (4 req'd)	18A6980 X012		16, 18, 20, & 24-inch	16A8880 X012		8, 10, 12, & 14-inch	17A6532 X032
	20 & 24-inch (4 req'd)	18A6981 X012		30 & 36-inch	18A2760 X012		16, 18, & 20-inch	16A8719 X012
35	Retainer Clip Wahser, zn pl steel						24-inch	17A6532 X042
	10, 12, 14, 16, & 18-inch (8 req'd)	1D7162 28982					30-inch	17A6532 X072
	20 & 24-inch (12 req'd)	1D7163 28982					36-inch	17A6532 X082

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