

# HUSKY OIL OPERATIONS LTD.

LSD:

## OPERATING MANUAL

**16" x 7'6" s/s, 600# ANSI, 1440 PSI, 3-PHASE  
VERTICAL MISTEX, SWEET SERVICE, SINGLE  
SEPARATOR-METERING/15,000L TANK SKID UNIT**

Manufactured By:

### **R.J.V. Gas Field Services**

4901-47<sup>th</sup> Street, Vegreville, Alberta, T9C 1C3  
Phone (780)632-7774 - Fax (780)632-6820

R.J.V JOB# NO.: 05-3412

UNIT NO.: 12285

**R.J.V. GAS FIELD SERVICES LTD.**  
**UNIT IDENTIFICATION SHEET**

|   |             |                      |   |               |          |
|---|-------------|----------------------|---|---------------|----------|
| <b>COMPANY:</b> HUSKY OIL OPERATIONS  |             | <b>JOB #</b> 05-3412 | <b>UNIT#</b> 12285                        |               |          |
| <b>PO#</b>  | <b>AFE#</b> | <b>SO#</b>           | <b>DRAWING#</b> 05-3412-1 (R1)            |               |          |
| <b>REQUESTED BY:</b>  |             | <b>LOCATION:</b>     | <b>AREA:</b>                              |               |          |
| <b>DESCRIPTION:</b> 16"x7'6" s/s, 600# ANSI, 1440 PSI, 3-PHASE VERTICAL MISTEX, SWEET SERVICE, SINGLE SEPARATOR/METERING/15,000L TANK SKID UNIT c/w 3" 600 ANSI SENIOR METER RUN, 3" 600# ANSI INLET AND OUTLET CONNECTIONS |             |                      |   |               |          |
| <b>DESCRIPTION</b>  |             | <b>MAKE</b>          | <b>MODEL</b>                              | <b>SERIAL</b> |          |
| METER RUN   |             | Nu Flo               | 3" 600# Sch 40 SR, FIG# 3D                | XJ54563-16    |          |
| SEPARATOR   |             | R.J.V. Gas Field     | 16" x 7'6"s/s 600# 3 PHASE                | 9635          | A#540836 |
| LEVEL CONTROL   |             | Fisher               | 2" NPT, Type L2                           | 17573237      | 17573239 |
| LEVEL CONTROL VALVE   |             | Fisher               | 1" NPT Type D2 FloPro                     | 6373905       | 6494205  |
| SIGHT GLASS   |             | Penburthy            | #1TM5 & 1RL5 Reflex c/w #330J GAUGE COCKS |               |          |
| PRESSURE  | VESSEL      | Taylor               | 1" x 1" NPT, Model T-8200-1               | 23955-254     | 1440 PSI |
| SAFETY VALVE  | FUEL GAS    | Taylor               | 1" x 1" NPT, Model T-8200-1               | 26922-35      | 150 PSI  |
| PRESSURE CONTROL VALVE  |             | Dyna Flo             | Type 4000R                                | 1010122       |          |
| TURBINE   |             | Nu Flo               | 1" x 1" NPT                               | 1RSTA64108    |          |
| ELECTROMAGNETIC PICK UP   |             | Nu Flo               | K-Factor                                  | K876.61       |          |
| TOTALIZER   |             | Nu Flo               | Model MCI                                 | MC-003106     |          |
| PRESSURE REGULATOR VALVE  |             | Kimray               | 3" 600# Motor Valve                       | 2051240489    |          |
| HI LO PRESSURE PILOT  |             | Fisher               | Model 4660                                | R102011       |          |
| SWITCHING VALVE   |             | Amot                 | 1/4" NPT, Model 4057D025H2                | L9207         |          |
| PNEUMATIC PRESSURE PILOT  |             | CVS                  | Model 7970                                | PP2625        |          |
| METHANOL INJECTOR   |             | Bruin                | Model BR5103                              | 51-7892       | 1500 PSI |
| METHANOL INJECTOR   |             | Bruin                | Model BR5113                              | 51-9581       | 6000 PSI |
| CHECK VALVE   |             | Wheatley             | 3" 600# ANSI RFF                          | VW-5628-22    |          |
| HEATER  |             | Catadyne             | 2 BX24X24 24,000 BTU, 12 VDC              | 310446        | 310452   |
| TANK  |             | Westeel              | 15,000L DW Above Ground                   | 63062192      |          |
| HIGHLEVEL SHUT DOWN   |             | Wellmark             | 2" NPT, Model 7400, ST2TP                 |               |          |
| FUEL GAS SCRUBBER   |             | R.J.V. Gas Field     | 8" x 30" s/s 975 PSI Design Press.        | 10232         |          |

|                                      |             |                    |   |                                |
|--------------------------------------|-------------|--------------------|---|--------------------------------|
| <b>COMPANY:</b> HUSKY OIL OPERATIONS |             |                    | <b>JOB #</b> 05-3412                                    | <b>UNIT#</b> 12285             |
| <b>PO#</b>                           | <b>AFE#</b> |                    | <b>SO#</b>  | <b>DRAWING#</b> 05-3412-1 (R1) |
| <b>REQUESTED BY:</b>                 |             |                    | <b>LOCATION:</b>  | <b>AREA:</b>                   |
| PRESSURE                             | INSTRUMENT  | Bel Gas            | 1" NPT, P627, 70-150 PSI, SPRING RANGE                  |                                |
| REGULATOR                            | INSTRUMENT  | Bel Gas            | 1/4" NPT, Type P50, 0-60 PSI, SPRING RANGE              |                                |
| VALVES                               | INSTRUMENT  | Bel Gas            | 1/4" NPT, Type P50, 0-120 PSI, SPRING RANGE             |                                |
|                                      | INSTRUMENT  | Bel Gas 5          | 1/4" NPT, Type P50, 0-60 PSI, SPRING RANGE              |                                |
| SKID                                 |             | R.J.V. Gas Field   | 10'x21'4" c/w 6"@ 8.2 CH, 6"@15 Tank Beams, 3/16" CH PL |                                |
| BUILDING                             |             | R.J.V. Gas Field   | 10' x 16' x 10' -9'6" EAVE PANEL TYPE WHITE/WHITE       |                                |
| MANUFACTURE DATE: March 8/06         |             | TESTER: DAVE HAUCA |   | TANK: 500 GAL c/w LG           |
| TESTING DATE: March 8/06             |             | SHIPPING DATE:     |   | DELIVERY:                      |

# Taylor Valve Technology, Inc

8300 Southwest 8th Street

Oklahoma City, Oklahoma

Serial Number : 26922-35      telephone: 405.787.0145      facsimile: 405.789.8198

Certificate Number: 38777.5867

CRN#: OG1316.2C      email: info@taylorvalve.com

Customer : Kings Valve Services

Date : 01-Mar-06

6785 - 52 Avenue

Red Deer, AB

T4N 4K8

Sales Order # : 26922

Customer P.O. # : 000856

## Safety Relief Valve Certification

**Taylor Valve Technology, Inc.** Safety Relief Valves are designed, manufactured and tested in accordance with the provisions of the ASME Boiler and Pressure Vessel Code, Section VIII. This Valve is certified to relieve within plus or minus 2 psi of the set pressure 70 psig or below, and plus or minus 3% of set point for pressures above 70 psig, as allowed for within the provisions of ASME. The published relieving capacities have been certified by the National Board of Boiler and Pressure Vessel Inspectors.

### Valve Specifications

|  |                         |                       |
|--|-------------------------|-----------------------|
| Model Number : Taylor Model 8200 Soft Seat | Orifice :               | E                     |
| Body Size : 1 Inch                         | Orifice Diameter :      | 0.520 Inches          |
| Part Number : 82E4351311                   | Orifice Area :          | 0.212 in <sup>2</sup> |
| Body Configuration : 1" MNPT X 1" FNPT     | Operating Temperature : | 70 °F                 |
|  | Spring Range :          | 101-225 PSI           |
|  | Set Pressure :          | 150 PSIG              |

### Materials

|   |   |
|---|---|
| Body : WCB Carbon Steel                     | Spring : 17.7 PH Stainless Steel                |
| Seat Frame : Carbon Steel                   | Guide : 304 Stainless Steel                     |
| Seat Housing : 17.4 PH H900 Stainless Steel | Adjustment Screw : Carbon Steel with EN Plating |
| Trim : Standard                             | Options : None                                  |
| Seat : FKM 90d                              |   |

### Set Pressure Specifications

|                       | Customer Units |                       | ASME Units |
|-----------------------|----------------|-----------------------|------------|
| Set Pressure :        | 150 psig       | Set Pressure :        | 150 psig   |
| ASME High Set Limit : | 155 psig       | ASME High Set Limit : | 155 psig   |
| ASME Low Set Limit :  | 146 psig       | ASME Low Set Limit :  | 146 psig   |

ASME (90%) rated capacity at set pressure for indicated fluid, specific gravity and temperature.

|                        |          |                     |              |
|------------------------|----------|---------------------|--------------|
| Certifying Fluid : Air | 582 SCFM | Spec Gravity : 1.00 | Temp : 60 oF |
|------------------------|----------|---------------------|--------------|

API 520 (100%) calculated capacity at set pressure for indicated fluid, specific gravity and temperature.

|                  |          |                     |              |
|------------------|----------|---------------------|--------------|
| Test Fluid : Air | 640 SCFM | Spec Gravity : 1.00 | Temp : 60 oF |
|------------------|----------|---------------------|--------------|

Prepared by : Jennifer Dykens

Department : Customer Service

Signed *Jennifer Dykens*

Approved by : Mason Buerger

Department : Quality

Signed *Mason Buerger*



# Taylor Valve Technology, Inc

8300 Southwest 8th Street

Oklahoma City, Oklahoma

Serial Number : 23955-254 telephone: 405.787.0145 facsimile: 405.789.8198

email: info@taylorvalve.com

Certificate Number: 38615.6189

Customer : King's Valve Services Ltd.

6785-52nd Ave.

Red Deer, Alberta, Canada

T4N 4K8

Date : 20-Sep-05

Sales Order # : 23955

Customer P.O. # : 000773

## Safety Relief Valve Certification

**Taylor Valve Technology, Inc.** Safety Relief Valves are designed, manufactured and tested in accordance with the provisions of the ASME Boiler and Pressure Vessel Code, Section VIII. This Valve is certified to relieve within plus or minus 2 psi of the set pressure 70 psig or below, and plus or minus 3% of set point for pressures above 70 psig, as allowed for within the provisions of ASME. The published relieving capacities have been certified by the National Board of Boiler and Pressure Vessel Inspectors.

### Valve Specifications

|  |                         |                       |
|--|-------------------------|-----------------------|
| Model Number : Taylor Model 8200 Soft Seat | Orifice :               | E                     |
| Body Size : 1 Inch                         | Orifice Diameter :      | 0.520 Inches          |
| Part Number : 82E8351311                   | Orifice Area :          | 0.212 In <sup>2</sup> |
| Body Configuration : 1" MNPT X 1" FNPT     | Operating Temperature : | 70 °F                 |
|  | Spring Range :          | 1201-1600 PSI         |
|  | Set Pressure :          | 1440 PSIG             |

### Materials

|   |   |
|---|---|
| Body : WCB Carbon Steel                     | Spring : 17.7 PH Stainless Steel                |
| Seat Frame : Carbon Steel                   | Guide : 304 Stainless Steel                     |
| Seat Housing : 17.4 PH H900 Stainless Steel | Adjustment Screw : Carbon Steel with EN Plating |
| Trim : Standard                             | Options : None                                  |
| Seat : FKM 90d                              |   |

### Set Pressure Specifications

|                       | Customer Units | ASME Units                      |
|-----------------------|----------------|---------------------------------|
| Set Pressure :        | 1440 psig      | Set Pressure : 1440 psig        |
| ASME High Set Limit : | 1483 psig      | ASME High Set Limit : 1483 psig |
| ASME Low Set Limit :  | 1397 psig      | ASME Low Set Limit : 1397 psig  |

ASME (90%) rated capacity at set pressure for indicated fluid, specific gravity and temperature.

|                        |            |                     |              |
|------------------------|------------|---------------------|--------------|
| Certifying Fluid : Air | 5,180 SCFM | Spec Gravity : 1.00 | Temp : 60 oF |
|------------------------|------------|---------------------|--------------|

API 520 (100%) calculated capacity at set pressure for indicated fluid, specific gravity and temperature.

|                  |            |                     |              |
|------------------|------------|---------------------|--------------|
| Test Fluid : Air | 5,698 SCFM | Spec Gravity : 1.00 | Temp : 60 oF |
|------------------|------------|---------------------|--------------|

Prepared by : Jennifer Dykens

Department : Customer Service

Signed *Jennifer Dykens*

Approved by : Mason Buerger

Department : Quality

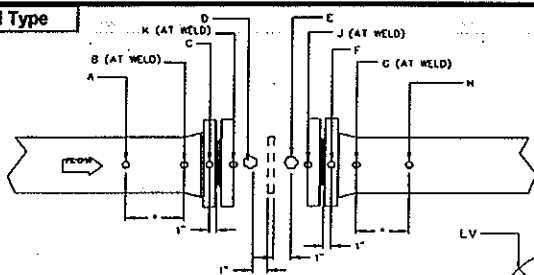
Signed *Mason Buerger*

# Meter Tube Calibration Record

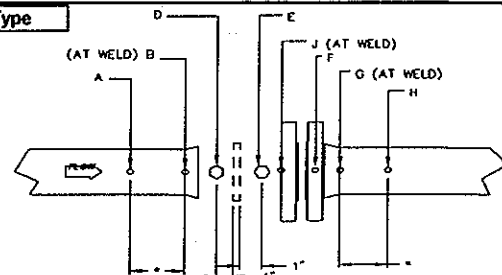
## General Specifications

|                      |                              |                     |                  |
|----------------------|------------------------------|---------------------|------------------|
| Customer:            | RJV GASFIELD SERVICES        | Date:               | JANUARY 26/ 2006 |
| Location:            | HUSKY- TAG: 3677             | P.O. Number:        | 095874           |
| Serial No.           | XJ54563-16                   | Work Order No.      | XJ54563          |
| Assembly Part No.    | 40993-000-A0074              | Part No.            | 40553-34121      |
| Orifice Fitting:     | 3" 600# SCH. 40 DUAL CHAMBER | Meter Tube Type No. | 2                |
| Straightening Vane:: |                              | Yes                 | No               |
|                      |                              |                     | X                |

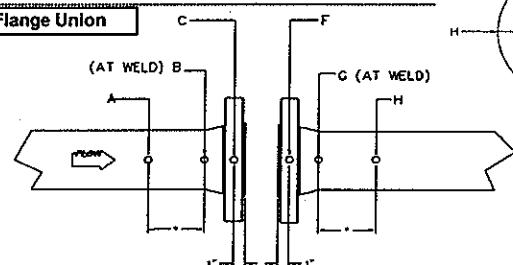
### Type 1 Flanged Type



### Type 2 Flangeweld Type



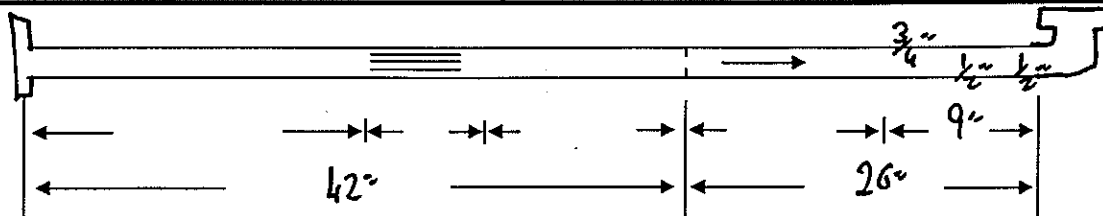
### Type 3 Orifice Flange Union




**Type 4 weldneck Type Valve or Door**  
Check Location Point A-B-D on Upstream Tube,  
Point E-G-H on Downstream Tube

\*Cross section 'A' and 'H' shall be one pipe diameter  
except if such Cross Section falls within the lifting or weld  
it shall be made 1' inside the pipe

| Location                                     | Upstream Meter Tube |       |       |       |   | Downstream Meter Tube                          |       |       |       |       |
|--|---------------------|-------|-------|-------|---|--|-------|-------|-------|-------|
|  | A                   | B     | C     | D     | K | E  | F     | G     | H     | J     |
| V  | 3.071               | 3.075 |       | 3.070 |   | 3.069  | 3.073 | 3.088 | 3.070 | 3.070 |
| LV   | 3.070               | 3.078 |       | 3.070 |   | 3.069  | 3.073 | 3.080 | 3.070 | 3.062 |
| RV   | 3.069               | 3.071 |       | 3.070 |   | 3.069  | 3.073 | 3.073 | 3.068 | 3.065 |
| H  | 3.068               | 3.070 |       | 3.070 |   | 3.069  | 3.073 | 3.060 | 3.064 | 3.063 |
| Average                                      | 3.069               | 3.073 |       | 3.070 |   | 3.069  | 3.073 | 3.075 | 3.068 | 3.065 |
| Upstream Mean Average to Stamp on I.D. Plate |                     |       | 3.070 |       |   | Downstream Mean Average to Stamp on I.D. Plate |       |       | 3.069 |       |



|                |      |      |      |                    |  |    |            |    |
|----------------|------|------|------|--------------------|--|----|------------|----|
| AGA/API Figure | 30   | BETA | 0.70 | Meter Tap Location | Upstream   | 1" | Downstream | 1" |
| Remarks:       | 68°F |      |      |                    | Inspector:  |    |            |    |

# Certificate of Authorization

## Quality Control Program

Expiry Date: **December 9, 2007**

Reg. No.: **AQP-5046**

This is to certify that:

**NUFLO MEASUREMENT SYSTEMS  
A NUFLO TECHNOLOGIES COMPANY  
9207 - 34A AVENUE  
EDMONTON, ALBERTA**

having complied with the provisions of the SAFETY CODES ACT, is hereby authorized to:

**Manufacture Category 'F' Fittings in accordance with CSA B51**

at the above SHOP address.



Dated at Edmonton, this 3rd day of March, 2005

A handwritten signature in black ink, appearing to read "Shan", written over a horizontal line.

Chief Inspector and Administrator

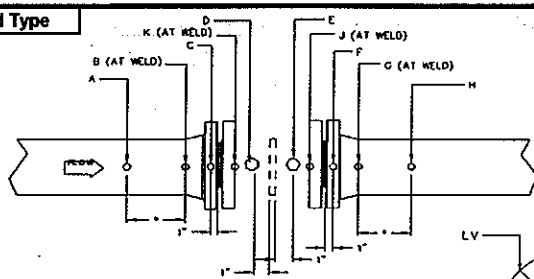
**Certificate No.: 4486**

# Meter Tube Calibration Record

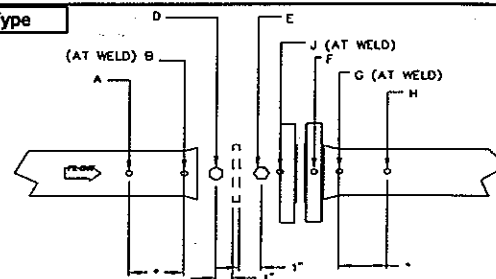
## General Specifications

|                      |                              |                     |                  |
|----------------------|------------------------------|---------------------|------------------|
| Customer:            | RJV GASFIELD SERVICES        | Date:               | JANUARY 26/ 2006 |
| Location:            | HUSKY- TAG: 3677             | P.O. Number:        | 095874           |
| Serial No.           | XJ54563-16                   | Work Order No.      | XJ54563          |
| Assembly Part No.    | 40993-000-A0074              | Part No.            | 40553-34121      |
| Orifice Fitting:     | 3" 600# SCH. 40 DUAL CHAMBER | Meter Tube Type No. | 2                |
| Straightening Vane:: |                              | Yes                 | No               |
|                      |                              |                     | X                |

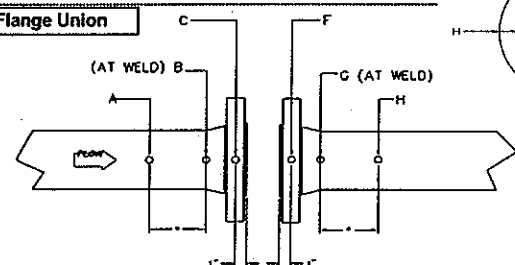
### Type 1 Flanged Type



### Type 2 Flangeweld Type



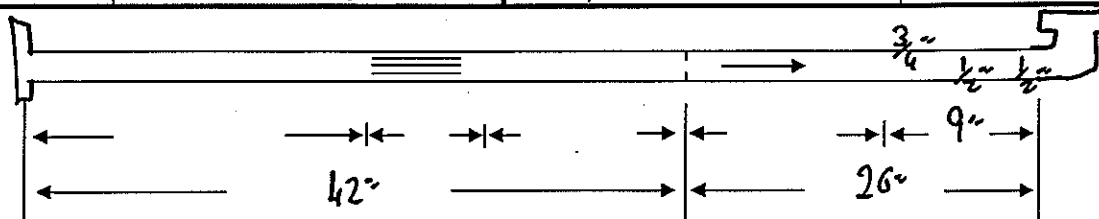
### Type 3 Orifice Flange Union




**Type 4 weldneck Type Valve or Door**  
Check Location Point A-B-D on Upstream Tube,  
Point E-G-H on Downstream Tube

\*Cross section 'A' and 'H' shall be one pipe diameter  
except if such Cross Section falls within the lifting or weld  
it shall be made 1" inside the pipe

| Location  | Upstream Meter Tube |       |   |       |   | Downstream Meter Tube                             |       |       |       |       |
|---|---------------------|-------|---|-------|---|---|-------|-------|-------|-------|
|   | A                   | B     | C | D     | K | E   | F     | G     | H     | J     |
| V   | 3.071               | 3.075 |   | 3.070 |   | 3.069   | 3.073 | 3.088 | 3.070 | 3.070 |
| LV  | 3.070               | 3.078 |   | 3.070 |   | 3.069   | 3.073 | 3.080 | 3.070 | 3.062 |
| RV  | 3.069               | 3.071 |   | 3.070 |   | 3.069   | 3.073 | 3.073 | 3.068 | 3.065 |
| H   | 3.068               | 3.070 |   | 3.070 |   | 3.069   | 3.073 | 3.060 | 3.064 | 3.063 |
| Average   | 3.069               | 3.073 |   | 3.070 |   | 3.069   | 3.073 | 3.075 | 3.068 | 3.065 |
| Upstream Mean Average<br>to Stamp on I.D. Plate |                     | 3.070 |   |       |   | Downstream Mean Average<br>to Stamp on I.D. Plate |       | 3.069 |       |       |



|                |      |      |      |                    |  |    |            |    |
|----------------|------|------|------|--------------------|--|----|------------|----|
| AGA/API Figure | 30   | BETA | 0.70 | Meter Tap Location | Upstream   | 1" | Downstream | 1" |
| Remarks:       | 68°F |      |      |                    | Inspector:  |    |            |    |

**NuFlo** Measurement Systems

PRODUCT OF CANADA

P.T. NO. **40553-34121** SIZE **3.0** BORE **3.068**

W.P. **1480** FLG. **600** SER. NO. **XJ54563-16**

C.R.N. NO. **OF1120.213** TRIM **SWEET**

**TO REMOVE PLATE FROM DUAL CHAMBER**

(1) CLOSE ORIFICE CHAMBER (INDEX ORIFICE OUT OF OPERATION)  
(2) OPEN BLEED VALVE (3) OPEN CHAMBER LID (REMOVE ONLY TWO TOP NUTS) (4) REMOVE ORIFICE PLATE (PRY ON HOLES IN RETAINER HANDLE)

**TO PLACE ORIFICE PLATE IN OPERATION**

(1) REPLACE ORIFICE WITH 'OUTLET' ON PLATE AND SEAL RETAINER FACING UPWARD (2) CLOSE LID (3) CLOSE BLEED VALVE (4) OPEN EQUALIZING VALVE (MAKES INDEXING EASY) (5) OPEN ORIFICE CHAMBER (INDEX ORIFICE INTO OPERATION) (6) CLOSE EQUALIZING VALVE

**NuFlo** Measurement Systems

EDMONTON, ALBERTA, CANADA

|                        |                        |          |                |                             |              |
|------------------------|------------------------|----------|----------------|-----------------------------|--------------|
| METER RUN<br>ASSY. NO. | <b>40993-000-A0074</b> |          |                | MAX. BORE                   |              |
| SER. NO.               | <b>XJ54563-16</b>      | U.S. (D) | <b>3.070</b>   | D.S. (D)                    | <b>3.069</b> |
| PIPE SIZE              | <b>3.0</b>             | SCH.     | <b>40</b>      | RATING                      | <b>600</b>   |
| AGA / API              | <b>3 D</b>             | d / D    | <b>0.70</b>    | CALIBRATION<br>CERTIFIED BY | <b>NuFlo</b> |
| W.O. NO.               | <b>XJ54563</b>         | DATE     | <b>01 / 06</b> |                             |              |

A schematic diagram of a vertical pipe assembly. The assembly consists of a long vertical pipe with several components: a flange at the top, a small coupling, a large square block with diagonal hatching in the middle, another large square block with diagonal hatching below it, and a 90-degree elbow at the bottom. A large arrow on the left points downwards and is labeled "FLOW".



**NuFlo Measurement Systems**  
9207 - 34A AVENUE  
EDMONTON, ALBERTA  
T6E 5T6



Grade "C" Pressure Welder's  
Certificate of Competency

ABSA

This is to Certify that **PATRICK MITCHELL**  
(Name of Welder)  
has passed a Performance Qualification Test and is permitted to engage in pressure  
welding in accordance with the prescribed Regulations while in the employment of  
**NUFLO Mgmt** at **Edmonton**  
(Name of Company) (Location of Job)  
who have complied with the provisions of The Safety Codes Act.



CERTIFICATE No  
**15980**

Dated this **NOV 15/2005**

Chief Inspector and Administrator

THIS CERTIFICATE EXPIRES **May 15/2006** Form No AB-114 Rev (02/05)

PERFORMANCE QUALIFICATION  
GRADE "C" PRESSURE WELDER

(In accordance with Section IX A S M E Code)

This qualification becomes null and void on termination of employment with the company named on  
the Certificate on the reverse side or upon the expiry date of the Certificate

Process(es) **GTAW FLAW** Material (P No) **P1**  
Max Deposited **0.2" 0.672"** Minimum **1" O.D.**  
Weld Metal Pipe Dia  
Filler Metal **F6 F6** Position(s) **1G**  
Group (F No) Qualified  
Backing **NO YES** Progression  
**NOV 15/2005** Date of Test  
Signature of Safety Codes Officer



Grade "C" Pressure Welder's  
Certificate of Competency

ABSA

This is to Certify that **PATRICK MITCHELL**  
(Name of Welder)  
has passed a Performance Qualification Test and is permitted to engage in pressure  
welding in accordance with the prescribed Regulations while in the employment of  
**NUFLO Mgmt** at **Edmonton**  
(Name of Company) (Location of Job)  
who have complied with the provisions of The Safety Codes Act



CERTIFICATE No  
**15981**

Dated this **NOV 15/2005**

Chief Inspector and Administrator

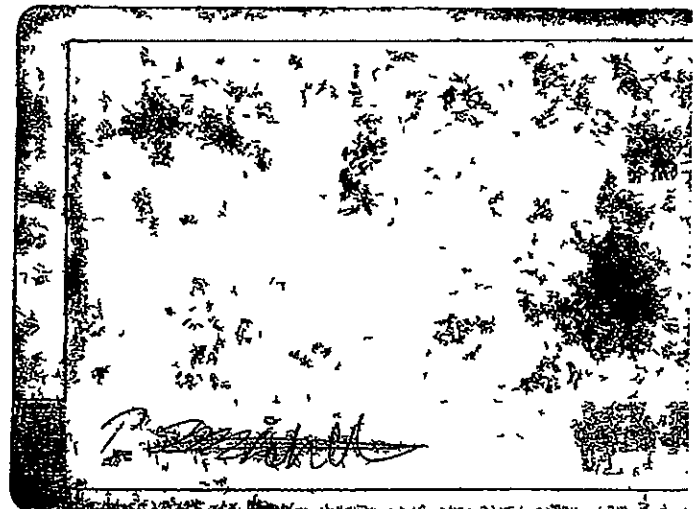
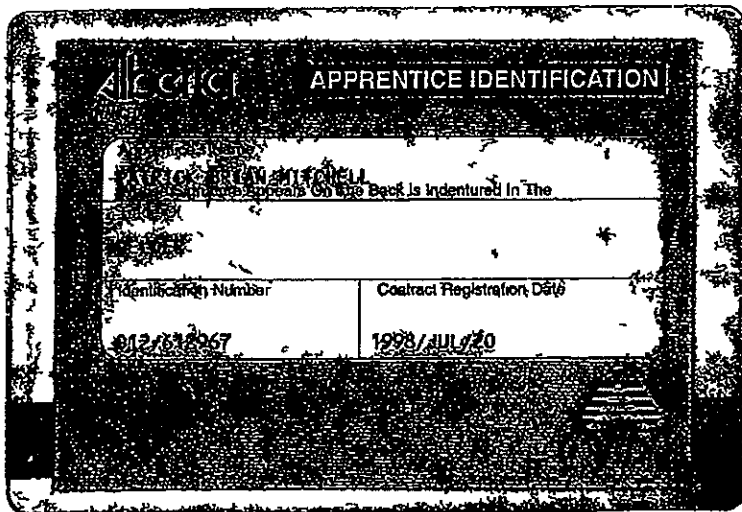
THIS CERTIFICATE EXPIRES **May 15/2006** Form No AB-114 Rev (02/05)

PERFORMANCE QUALIFICATION  
GRADE "C" PRESSURE WELDER

(In accordance with Section IX A S M E Code)

This qualification becomes null and void on termination of employment with the company named on  
the Certificate on the reverse side or upon the expiry date of the Certificate

Process(es) **GTAW SAW** Material (P No) **P1**  
Max Deposited **0.188" 0.676"** Minimum **1" O.D.**  
Weld Metal Pipe Dia  
Filler Metal **F3 F4** Position(s) **1G**  
Group (F No) Qualified  
Backing **NO YES** Progression  
**NOV 15/2005** Date of Test  
Signature of Safety Codes Officer



MST1201  
5/19/05

Highland Foundry Ltd.  
CHEMICAL AND PHYSICAL ANALYSIS

Page 1  
12:59:45

Product# . . . : 40713-001  
Customer Part#: 40713-001  
Customer . . . : NuFlo Measurement Systems  
9207 - 34A Avenue  
Edmonton AB T6E 5T6  
Canada

Order/Item# . . : 26101 / 3  
Customer P.O.#: XP50113

Prepared by:

  
Quality Assurance Technician

3" D/C BODY

Heat Treatment: NORMALIZED AND TEMPERED

| Melt#  | Quantity | Date    | Heat Treat | BATCH # | : | Specification       |
|--------|----------|---------|------------|---------|---|---------------------|
| 6-7717 | 14       | 4/26/05 |            | ZJ1     | - | ASTM A216 GRADE WCB |

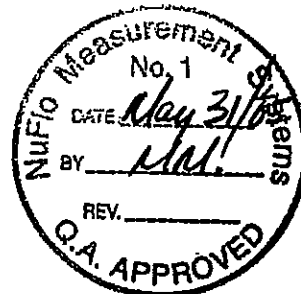
C H E M I C A L S

|          |          |          |          |
|----------|----------|----------|----------|
| C :.2200 | MN:.9000 | SI:.5200 | P :.0190 |
| S :.0150 | NI:.0500 | CR:.1600 | MO:.0400 |
| CU:.1100 | V :.0100 |          |          |

P H Y S I C A L S

|              |      |              |      |
|--------------|------|--------------|------|
| YIELD KSI    | 48.1 | TENSILE KSI  | 79.7 |
| ELONGATION % | 30   | RED OF AR. % | 56   |

CE: .4226



MATERIAL TEST REPORT

9670-187th Street, Surrey, BC Canada V4N 3N6  
Phone 604-888-8444 Fax 604-888-3634  
www.highlandfoundry.com

ISO 9001:2000




MST1201  
5/16/05

Highland Foundry Ltd.  
CHEMICAL AND PHYSICAL ANALYSIS

Page 1  
10:47:50

Product# . . . : 40703-005  
Customer Part#: 40703-005  
Customer . . . : NuFlo Measurement Systems  
9207 - 34A Avenue  
Edmonton AB T6E 5T6  
Canada

Order/Item# . . : 26101 / 2  
Customer P.O.#: XP50113

Prepared by:   
Quality Assurance Technician

3" D/C LID

Heat Treatment: NORMALIZED AND TEMPERED

| Melt#  | Quantity | Date    | Heat Treat | BATCH # | : | Specification       |
|--------|----------|---------|------------|---------|---|---------------------|
| 3-2214 | 7        | 4/27/05 |            | ZG4     | - | ASTM A216 GRADE WCB |

C H E M I C A L S

|            |            |            |            |
|------------|------------|------------|------------|
| C : .1720  | MN : .6910 | SI : .4740 | P : .0140  |
| S : .0110  | NI : .0710 | CR : .1690 | MO : .0480 |
| CU : .1260 | V : .0080  |            |            |

P H Y S I C A L S

|              |    |              |      |
|--------------|----|--------------|------|
| YIELD KSI    | 51 | TENSILE KSI  | 53.2 |
| ELONGATION % | 29 | RED OF AR. % | 56   |

CE: .3452



MATERIAL TEST REPORT

9670-187th Street, Surrey, BC Canada V4N 3N6  
Phone 604-888-8444 Fax 604-888-3634  
www.highlandfoundry.com

ISO 9001:2000

HEAT NUMBER 4154  
 TRANS AM PIPING PRODUCTS - REV'D BY  
 Shipment/Seq #: S 5 - 6034 1

3" STD LR 90 BW ELBOW  
 A234-WPB



# INSPECTION CERTIFICATE

(MILL TEST)

Customer TRANS AM PIPING PRODUCTS LTD  
 Product SEAMLESS STEEL PIPE FITTING  
 Spec ASTM/A234/A234 WPB-00  
 EN10228/DIN 50029/3.1B1

CHUP HSN ENTERPRISE CO., LTD  
 17, TUNG LI ROAD HSIAO KANG  
 KAOHSIUNG, TAIWAN R O C  
 TEL (07) 831-9157-9  
 FAX (07) 831-2942 821-7500

Certificate No 09300158 0201  
 Order No PI 04-35367  
 Date 2005/5/25

| Specification for Raw Material |                        | Specification for Inspection |         | Visual Examination |                  | Dimensional Inspection |      |      |      |              |       |      |                      |                   |                              |        |
|--------------------------------|------------------------|------------------------------|---------|--------------------|------------------|------------------------|------|------|------|--------------|-------|------|----------------------|-------------------|------------------------------|--------|
| ASTM A106 GRB                  |                        | ASME B16-9-2001              |         | GOOD               |                  | GOOD                   |      |      |      |              |       |      |                      |                   |                              |        |
| Item                           | Description            | Quantity                     | Heat ID | Heat No            | Raw Material Mfg | Raw Certificate NO     |      |      |      |              |       |      |                      |                   |                              |        |
| 1                              | 90E L/R STD            | 150                          | 4154    | 14K154             | SUMITOMO         | BYR8817                |      |      |      |              |       |      |                      |                   |                              |        |
| 2                              | 90E L/R STD            | 100                          | 4625    | 14K4625            | SUMITOMO         | BYR6606                |      |      |      |              |       |      |                      |                   |                              |        |
| 3                              | 90E L/R STD            | 8                            | 0391    | 15K0391            | SUMITOMO         | BYR10185               |      |      |      |              |       |      |                      |                   |                              |        |
| 3                              | 90E L/R STD            | 86                           | 5252    | 15K5252            | SUMITOMO         | BYR00050               |      |      |      |              |       |      |                      |                   |                              |        |
| 5                              | 90E L/R STD            | 80                           | 3688    | 15K0368            | SUMITOMO         | BYR00101               |      |      |      |              |       |      |                      |                   |                              |        |
| 6                              | 90E L/R STD            | 100                          | 633B    | 15K7633            | SUMITOMO         | WYR00205               |      |      |      |              |       |      |                      |                   |                              |        |
| 7                              | 90E L/R STD            | 3                            | 816A    | 15K0816            | SUMITOMO         | WYR00206               |      |      |      |              |       |      |                      |                   |                              |        |
| 9                              | 90E L/R STD            | 9                            | C715    | 14K0715            | SUMITOMO         | WYR06625               |      |      |      |              |       |      |                      |                   |                              |        |
| 11                             | 90E L/R STD            | 5                            | C055    | 14C055             | SUMITOMO         | WYR06627               |      |      |      |              |       |      |                      |                   |                              |        |
| 12                             | 45E L/R STD            | 20                           | 3931    | 14K3931            | SUMITOMO         | BYR7895                |      |      |      |              |       |      |                      |                   |                              |        |
| Specifi<br>cation              | Chemical Composition % |                              |         |                    |                  |                        |      |      |      | Tension Test |       |      | HARD<br>NESS<br>TEST | Heat<br>Treatment | Magnetic<br>Particle<br>Exam | Remark |
|                                | C                      | Si                           | Mn      | P                  | S                | Cu                     | Ni   | Cr   | Mo   | V            | Nb    | CE   |                      |                   |                              |        |
| MIN                            | ×100                   | ×100                         | ×100    | ×1000              | ×1000            | ×100                   | ×100 | ×100 | ×100 | ×1000        | ×1000 | ×100 | PSI                  | PSI               | %                            |        |
| MAX                            | 30                     | 10                           | 106     | 30                 | 38               | 40                     | 40   | 40   | 15   | 80           | 20    | 30   | 35000                | 60000             | 30                           | 197    |
| 1                              | 13                     | 18                           | 80      | 9                  | 2                | 10                     | 4    | 5    | 2    | 0            | 0     | 28   | 45300                | 68000             | 41                           | 137    |
| 2                              | 2                      | 13                           | 77      | 11                 | 4                | 7                      | 3    | 4    | 1    | 0            | 0     | 28   | 41200                | 64700             | 42                           | 135    |
| 3                              | 18                     | 23                           | 54      | 8                  | 5                | 19                     | 6    | 4    | 1    | 0            | 0     | 30   | 46400                | 69000             | 40.5                         | 136    |
| 3                              | 13                     | 17                           | 78      | 8                  | 3                | 7                      | 3    | 4    | 2    | 0            | 0     | 28   | 44400                | 68300             | 40.3                         | 133    |
| 5                              | 19                     | 23                           | 52      | 12                 | 6                | 5                      | 3    | 2    | 4    | 1            | 0     | 30   | 49500                | 69500             | 42                           | 140    |
| 6                              | 20                     | 21                           | 47      | 11                 | 6                | 5                      | 3    | 2    | 2    | 10           | 0     | 31   | 46700                | 71800             | 39.1                         | 141    |
| 7                              | 19                     | 21                           | 45      | 10                 | 8                | 5                      | 3    | 2    | 1    | 0            | 0     | 28   | 41500                | 65300             | 40.1                         | 140    |
| 9                              | 20                     | 8                            | 64      | 15                 | 6                | 2                      | 2    | 5    | 0    | 0            | 0     | 32   | 48700                | 68600             | 40                           | 143    |
| 11                             | 20                     | 20                           | 73      | 13                 | 5                | 2                      | 2    | 5    | 1    | 0            | 0     | 34   | 40800                | 65400             | 47                           | 145    |
| 12                             | 13                     | 16                           | 76      | 9                  | 3                | 7                      | 3    | 4    | 2    | 0            | 0     | 28   | 47400                | 70600             | 41                           | 136    |

CE=C+Mn/6+(CR+MO+V)/5+(NI+CU)/15  
 We hereby certify that the product described herein has manufactured in accordance with the specifications concerned and also with the purchaser's requirements and that the test results shown herein are correct.

Chief of Quality Assurance Section

*L. S. Jai*





# ASCOMETAL

## TEST CERTIFICATE

Usine des Dunes  
Boite postale 41  
59941 Dunkerque cedex 2

GROUPE LUCCHINI

|                                    |   |   |
|------------------------------------|---|---|
| <b>CERTIFICATE Nr</b><br>4/63136   | <b>CUSTOMER</b><br>INTEGRIS META S. LTD<br>A DIVISION OF RIO ALGOM LTD<br>7945, CORONET ROAD<br>T6E-4N7 EDMONTONALB<br>CANADA | <b>CUSTOMER Nr</b><br>13832<br>329663/178B<br><br><b>HEAT Nr</b><br>A6605 |
| <b>WORKS Nr</b><br>500/2228 /06-01 |   |   |
| <b>DESCRIPTION SIZES WEIGHTS</b>   | 20 BARS 6"250 x18'08"/20'11" =19,960 MT   |   |
| <b>GRADE</b>                       | A105  |   |

### CHEMICAL COMPOSITION %

| C     | Mn    | Si    | S     | P     | Ni    | Cr    | Mo    | Va    | Cu    | Nb    | Al    |  |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| 0.164 | 1.135 | 0.268 | 0.012 | 0.013 | 0.134 | 0.096 | 0.040 | 0.030 | 0.197 | 0.020 | 0.022 |  |

### MECHANICAL PROPERTIES

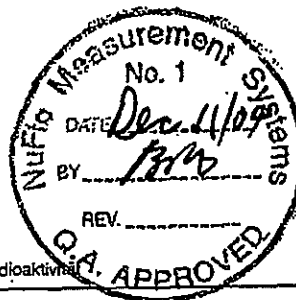
| * TC | HEAT TREATMENT | * L | Y S     | U T S | E %   | R.A. | * L | Temp. | IMPACT           | HARDNESS |
|------|----------------|-----|---------|-------|-------|------|-----|-------|------------------|----------|
| PR   |                | T   | PSI .2% | PSI   | IN 2" | %    | T   | F     | CVN* FT.LBF      | BHN      |
| PR   | Normalized     | L   | 52200   | 76560 | 32,6  | 68,6 | L   | 50    | 70.4- 70.9- 59.9 | 152/ 156 |
| PR   | Mid-radius     | L   |         |       |       |      | L   | 60    | 89.2- 52.4- 60.2 |          |
| PR   |                | T   |         |       |       |      | T   | 60    | 19.0- 26.6- 39.6 |          |

\* CHECKED ON => TC=TEST COUPON PR=PRODUCT AS DELIVERED L=LONGITUD. T=TRANSVER.

### OTHER RESULTS

Electric arc furnace - Vacuum degassed  
Grain size 7 M-quaid - CEC : 0.408 (<=0.430%)  
Conforms to ASTM A 105-95b - ASTM A 696-90A gr C  
ASTM A350-95b grade LF2 supp S6&S10  
Conforms to ASME SA 350/89 - SA 105 - SA 696 gr C  
Conforms to API 6A  
NACE MR01-75/Ultrasonic testing per ASTM A388 OK  
Lateral expansion : 0.048"-0.048-0.039" at -50F  
No weld repair - Reduction ratio : 7.04  
Heat treatment : normalized 1652 F / 3.00 hrs  
SOC-10736/CPO: 329663  
Conforms to NACE MR-01-75

Country of origin : FRANCE



Acier exempt de radioactivité anormale - Steel free from abnormal radioactivity - Stahl Frei von anormaler Radioaktivität

WE HEREBY CERTIFY THAT THE  
ABOVE-MENTIONED PRODUCTS COMPLY  
WITH THE ORDER REQUIREMENTS

DATE  
03/09/04

STAMP OF INSPECTION SUPERVISOR

G. GIROUD

GG

0114-8750/430+43523 - 4350+4340  
11211000/2228/06-01

3" 600# W/N FLANGE -RF STD  
BORE A105N



# METALFAR

**PRODOTTI INDUSTRIALI S.p.A.**  
23861 CESANA BRIANZA (LC) ITALY  
Tel. 031 656431 Fax 031 656149  
**MATERIAL TEST DEPARTMENT**  
**SALA PROVE ED ANALISI MATERIALI**

COMPANY  
WITH QUALITY MANAGEMENT  
SYSTEM CERTIFIED BY DNV  
= ISO 9001 2000 =

THAS AN PPIRG PRODIGS LN  
7025 47H STXBBT SL 92C4B8  
CNSAHT-3388RTA

INSPECTION CERTIFICATE EN 10204/3.1

**CERTIFICATO DI COLLAUDO**

|                  |       |            |
|------------------|-------|------------|
| NAME             | 2763/ | 26/07/2005 |
| INVOICE/SALICATA | 2533/ | 25/07/2005 |
| S                | 42618 |            |
| DEBIT NOTE/BOLLA | 4381/ | 25/07/2005 |

[illegible]

**MATERIAL IN ACCORDANCE WITH NACE MR-0175/2003**

QUALITY CONTROL DEPARTMENT  
DEFINIZIONE QUALITÀ

---

BRACCHI / PLAYIO

**ANALYTICAL**

RECEIVED DIRECTOR, FBI  
MAY 20 1964



HEAT NUMBER : 56539  
TRANS AM PIPING PRODUCTS - REV'D BY: 1/2X3/4-36 3000# FS THREADED PIPET  
Shipment/Seg #: S 5 - 1696 5 A105N



Manufacturer of Piping & Pressure Vessel Components  
4407 Haygood St Houston, TX 77022  
Phone 713-695-3633 Fax 713 695 3528  
A Division of **RONNEY FORGE**

SOLD TO: TRANS AM PIPING (CALGARY)  
7025 - 44TH STREET S E  
CALGARY, AB, CN T2C 4E8

This product has not come in direct contact with mercury or any of its compounds, nor with any mercury containing device employing a single boundary of containment No welding performed

MTR #: 101195

We certify that the contents of this report are correct and accurate and that all test results and operations performed by WFI or its subcontractors are in compliance with the material specification and requirements of the referenced code or standard and that the material conforms to the dimensional requirements of the order This document is in accordance with EN10204 3 1

PO #: CI-05-738

SALES ORDER #: C510977 DATE: 11/04/2005

### CERTIFIED MATERIAL TEST REPORT

MATERIAL: A/SA105N 01

HEAT CODE: 56539

| ITEM | Quantity |
|------|----------|
| 13   |          |

#### Description

36 - 3/4 X 1/2 3000 THP  
A/SA105N

#### CHEMICAL COMPOSITION:

| LADLE | C     | MN    | P     | S     | SI    | CU    | NI    | CR    |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       | 0.200 | 0.990 | 0.008 | 0.021 | 0.260 | 0.140 | 0.030 | 0.050 |
|       | 0.016 | 0.024 | 0.001 |       |       |       |       |       |

CARBON EQUIVALENCY: LADLE 0.394

|         | TENSILE PSI | YIELD PSI | ELONG % | RA %   | HARDNESS        |
|---------|-------------|-----------|---------|--------|-----------------|
| PRODUCT | 75,000      | 49,500    | 35.00%  | 66.00% | 144 BHN 147 BHN |

CHARPY V-NOTCH PROPERTIES: TEST TEMPERATURE: - 50 F

FT LBS: 75/83/114

Normalized

Marie Dehmer  
Quality Assurance Representative



HEAT NUMBER : 56593  
TRANS AM PIPING PRODUCTS - REV'D BY: 3/4X1 1/2-36 3000# FS THREADED PIPET  
Shipment/Seq #: S 5 - 1725 2 A105N



Manufacturer of Piping & Pressure Vessel Components  
4407 Haygood St Houston, TX 77022  
Phone 713 695 3633 Fax 713 695 3528  
A Division of BONNEY FORGE

Page: 1

SOLD TO: TRANS AM PIPING (CALGARY)  
7025 - 44TH STREET S E  
CALGARY, AB, CN T2C 4E8

This product has not come in direct contact with mercury or any of its compounds, nor with any mercury containing device employing a single boundary of containment No welding performed

We certify that the contents of this report are correct and accurate and that all test results and operations performed by WFI or its subcontractors are in compliance with the material specification and requirements of the referenced code or standard and that the material conforms to the dimensional requirements of the order This document is in accordance with EN10204 3.1

MTR #: 101149

PO #: CI-05-738

SALES ORDER #: C510977 DATE: 11/04/2005

### CERTIFIED MATERIAL TEST REPORT

MATERIAL: A/SA105N 01

HEAT CODE: 56593

ITEM Quantity  
14

### Description

36 - 1 1/2 X 3/4 3000 THP  
A/SA105N

### CHEMICAL COMPOSITION:

LADLE

|       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|
| C     | MN    | P     | S     | SI    | CU    | NI    | CR    |
| 0.200 | 1.050 | 0.007 | 0.021 | 0.220 | 0.070 | 0.020 | 0.030 |
| MO    | V     | NB    |       |       |       |       |       |
| 0.010 | 0.000 | 0.014 |       |       |       |       |       |

CARBON EQUIVALENCY:  
MECHANICAL PROPERTIES:

LADLE 0.389

|         | TENSILE PSI | YIELD PSI | ELONG % | RA %   | HARDNESS        |
|---------|-------------|-----------|---------|--------|-----------------|
| PRODUCT | 74,000      | 49,400    | 33.00%  | 67.00% | 144 BHN 147 BHN |

Normalized

Marie Dehmer  
Quality Assurance Representative





**vallourec**  
**précision**  
**étriage**

Vallourec Precision Littrage  
(44) 1377 ZI VITRY MAIROLLES  
51303 Vitry-le-François France  
tel: 03.26.41.23.00  
fax: 03.26.41.23.10

**MATERIAL TEST REPORT**

**INSPECTION CERTIFICATE EN 10204 3.1.B**

ISO 9001 AQ  
ISO 9002 AQ  
ISO 9001 AQ  
Ref: 45-03-350014 1/2  
N° V.L.R.: 211025

**Customer : CAPITOL PIPE & STEEL PRODUCTS**

Order n° : 702645/VR0739 DU 29.09.2003

SEAMLESS STEEL TUBES, COLD DRAWN (KILLED STEEL),  
NORMALIZED 925C

Specification : ASTM A/ASME SA 106 (last edition) - GRADE B - NACE MR 01.75 - API 5L

Marking in continuous : VF - VALLOUREC - ASA 106 - API 5L - GRADE B - SIZE - \*\*\*\* - HEAT - FRANCE  
Marking on labels :

\*\*\*\* = NPS 3 STD SCH 40 (item 01)  
\*\*\*\* = NPS 3 XS SCH 80 (item 02)

**QUANTITY PER ITEM**

| Y/R | Q/R | Size                                  | (B13)<br>single length   | (B10)<br>Quantity | length<br>ft | (B14)<br>Weight<br>lb | dispatch | (B08)<br>Heat                       |
|-----|-----|---------------------------------------|--------------------------|-------------------|--------------|-----------------------|----------|-------------------------------------|
| 1   | 01  | 88.900 X 5.490 MM<br>NPS 3 " X SCH 40 | 5486/6706 MM<br>18 to 22 | 272               | 5262.746     | 41144.906             | 20328551 | 21286 : 30 tub.<br>21496 : 242 tub. |
| 2   | 02  | 88.900 X 7.620 MM<br>NPS 3 " X SCH 80 | 5486/6706 MM<br>18 to 22 | 100               | 1963.320     | 20483.165             | 20328552 | 21493 : 82 tub.<br>21180 : 18 tub.  |

**(C1-C2)  
EADIE ANALYSIS**

| (C3: CR+CU+MO+NI+V)<br>(C70) (B08)<br>Process Heat |       |      |      |      |       |       |      |      |      |       |       |      |  |
|--|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|--|
| MIN.   | C     | Si   | Mn   | P    | S     | Cr    | Mo   | NI   | Cu   | V     | 034   |      |  |
| MAX.   | 0.30  | 0.10 | 0.29 | 1.06 | 0.035 | 0.035 | 0.40 | 0.15 | 0.40 | 0.080 | 1.00  |      |  |
|  | %     | %    | %    | %    | %     | %     | %    | %    | %    | %     | %     |      |  |
| E  | 21180 | 0.16 | 0.20 | 0.76 | 0.010 | 0.003 | 0.11 | 0.02 | 0.08 | 0.20  | 0.000 | 0.41 |  |
| E  | 21286 | 0.15 | 0.18 | 0.75 | 0.009 | 0.004 | 0.07 | 0.03 | 0.05 | 0.16  | 0.000 | 0.31 |  |
| E  | 21493 | 0.16 | 0.18 | 0.78 | 0.011 | 0.004 | 0.11 | 0.02 | 0.07 | 0.14  | 0.000 | 0.34 |  |
| E  | 21496 | 0.15 | 0.17 | 0.78 | 0.012 | 0.005 | 0.14 | 0.02 | 0.08 | 0.17  | 0.001 | 0.42 |  |

**CAPITOL PIPE**  
ISO 9003 - 1994  
Date: 12/05/2004



3" S/40 C.D.

**vallourec  
précision  
étirage**

BP77 ZI VITRY MAROLLES  
51303 Vitry-le-François France  
tél: 03.26.41.23.00  
fax: 03.26.41.23.10

**INSPECTION CERTIFICATE EN 10204 3.1.B**

9002 200 9001 200  
Norme Ref: 45-03-350014 2 / 2  
Norme N° V.R. 211025

**(C10-C02-C03)  
FULL SECTION LONGITUDINAL TENSILE TEST AT ROOM TEMPERATURE**

| (C00)<br>Test | (B08)<br>Heat | lot     | (C11)<br>Y.S. | (C12)<br>T.S. | (C13)<br>Elong. 2" |
|---------------|---------------|---------|---------------|---------------|--------------------|
| MIN.          |               |         | 35000         | 60000         | 30                 |
| MAX.          |               |         |               |               |                    |
| 01            | 21286         | ITEM 01 | 49579         | 69391         | 34                 |
| 02            | 21286         |         | 51150         | 69143         | 38                 |
| 01            | 21496         |         | 52584         | 70061         | 38                 |
| 02            | 21496         |         | 51114         | 69792         | 37                 |
| 01            | 21180         | ITEM 02 | 48852         | 68747         | 40                 |
| 02            | 21180         |         | 48980         | 68773         | 38                 |
| 01            | 21493         |         | 50077         | 69218         | 40                 |
| 02            | 21493         |         | 51012         | 69802         | 40                 |

**FLATTENING TEST**

|        |  |
|--------|--|
| result |  |
| OK     |  |

**(D04-D99)  
NON DESTRUCTIVE TESTS**

| test                    | test rate | specification | conditions | result |
|-------------------------|-----------|---------------|------------|--------|
| APPEARANCE & DIMENSIONS | 100% LOT  |               |            | OK     |
| EDDY CURRENT TEST       | 100% LOT  | E309          |            | OK     |
| ULTRASONIC TEST         | 100% LOT  | SA450         | 5% DEPTH   | OK     |

ROCKWELL C HARDNESS MAX. 22 GUARANTEED

(201) 16/12/2003

**Capitol Pipe**  
ISO 9003 - 1994  
Date: Feb 17/04

|   |   |
|---|---|
| (202)<br>Original computer copy - Authenticity is guaranteed by the Vallourec logo.<br>All the pipes/tubes conform to the requirements of the order and standard regarding the grade, quality and heat treatment throughout their whole length. | (A05)<br>The agent of the service Quality<br>MME SICARD Véronique |
|---|---|

*Sicard*



## SHIPPING DETAILS

TOTAL WIDTH- 10'-8"      TOTAL LENGTH- 21'-4"  
TOTAL HEIGHT- 12'-4"      APROX. WEIGHT- 14800 LBS

| REV | DATE       | DESCRIPTION         | BY |
|-----|------------|---------------------|----|
| 1.  | JULY 20/05 | AS BUILT DIMENSIONS | SI |

**\*AS BUILT**

*RJV*

**GAS FIELD SERVICES LTD.**

4901- BRUCE RD. VEGREVILLE, ALTA  
T9C-1C3  
PHONE (780) 632-7774  
FAX (780) 632 6820

TITLE: HUSKY OIL OPERATIONS

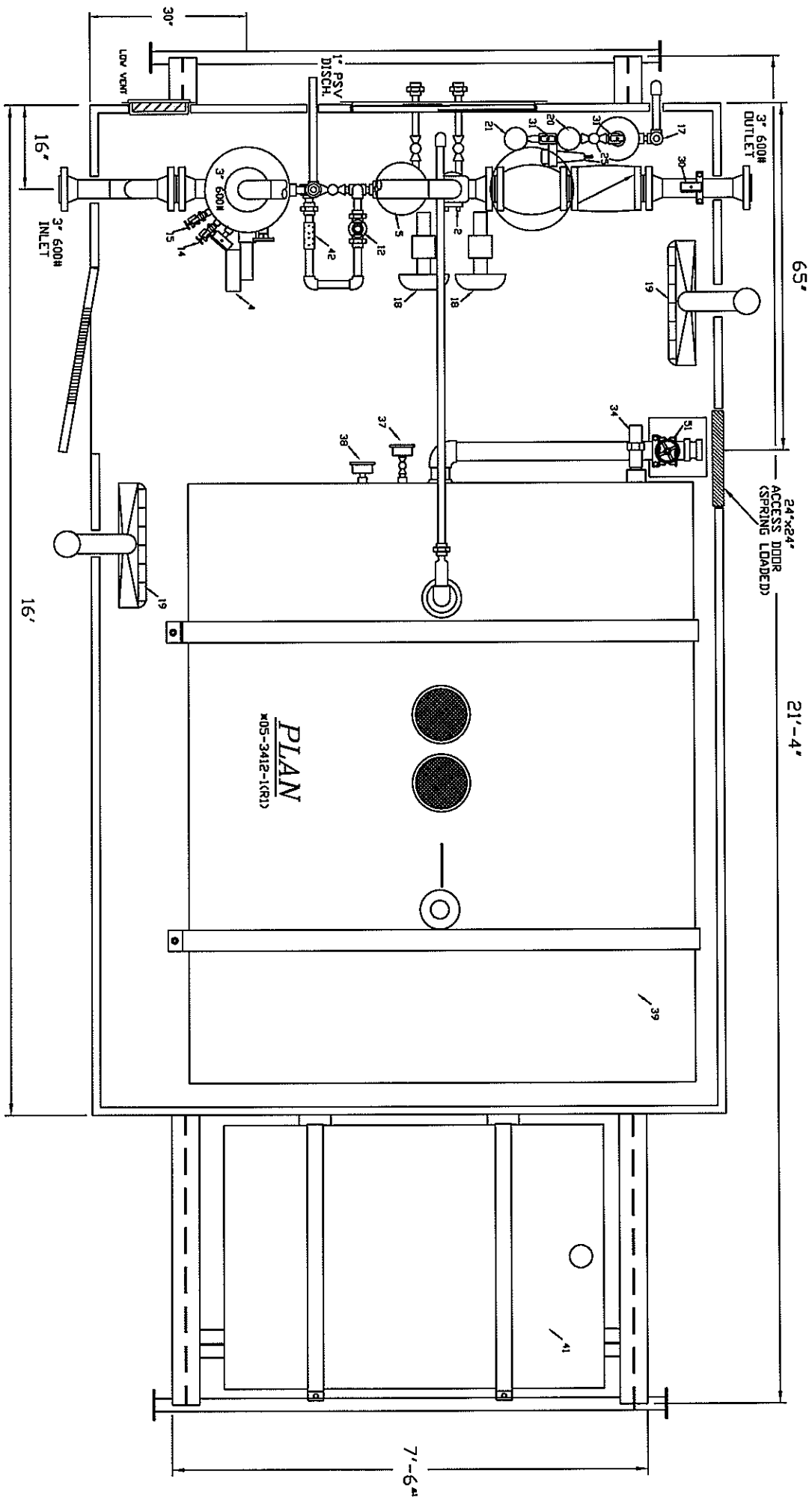
16"x7'6" S/S 600 ANSI SEPARATOR/METER  
SKID UNIT, 3 PHASE CONTROLS, STD. SERVICE  
3" SENIOR METER RUN, 15,000 LITRE TANK

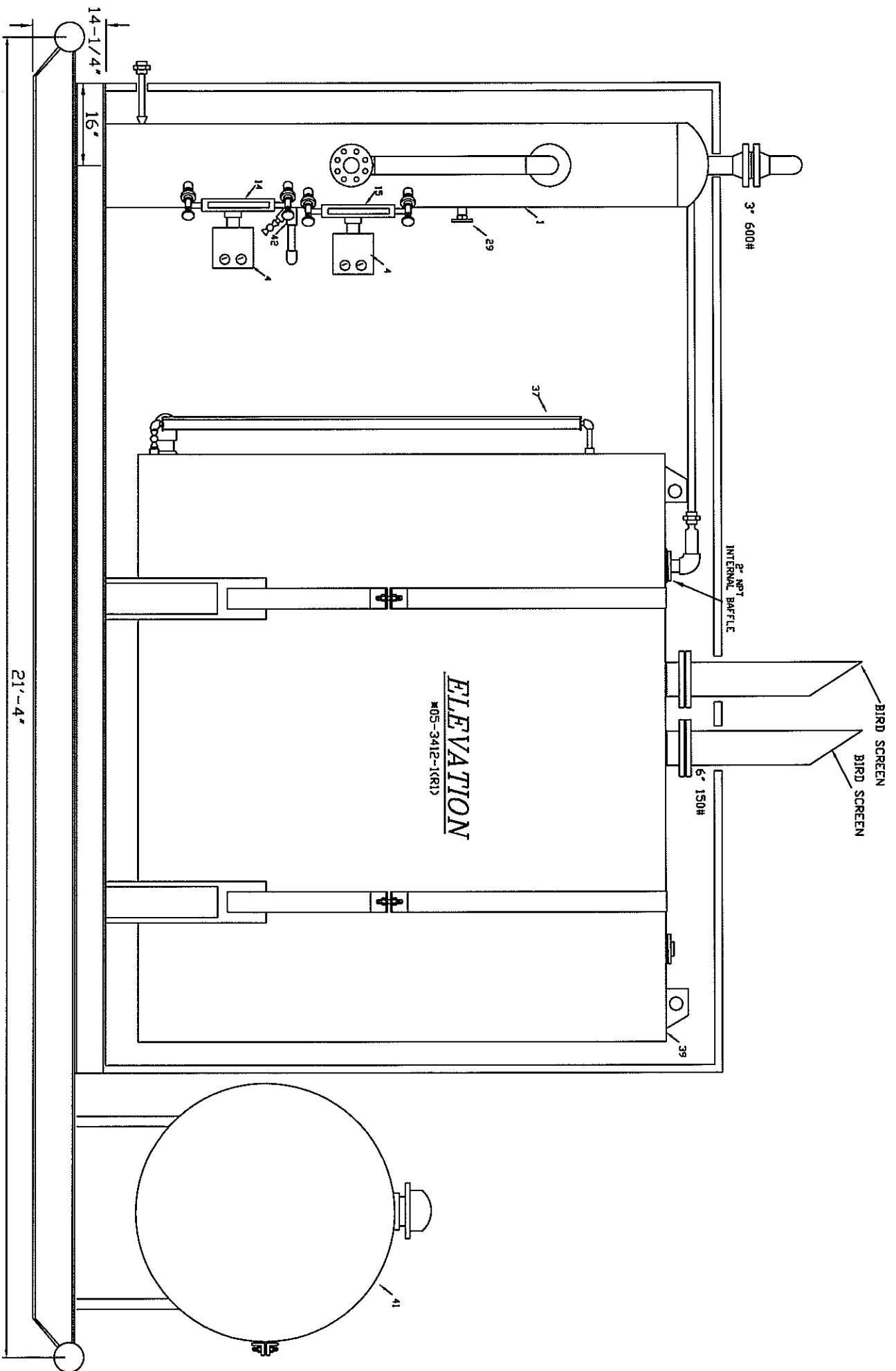
|        |        |        |                      |
|--------|--------|--------|----------------------|
| DWG. # | 3412-1 | REV. # | RJV<br>JOB # 05-3412 |
|--------|--------|--------|----------------------|

**WARNING !**

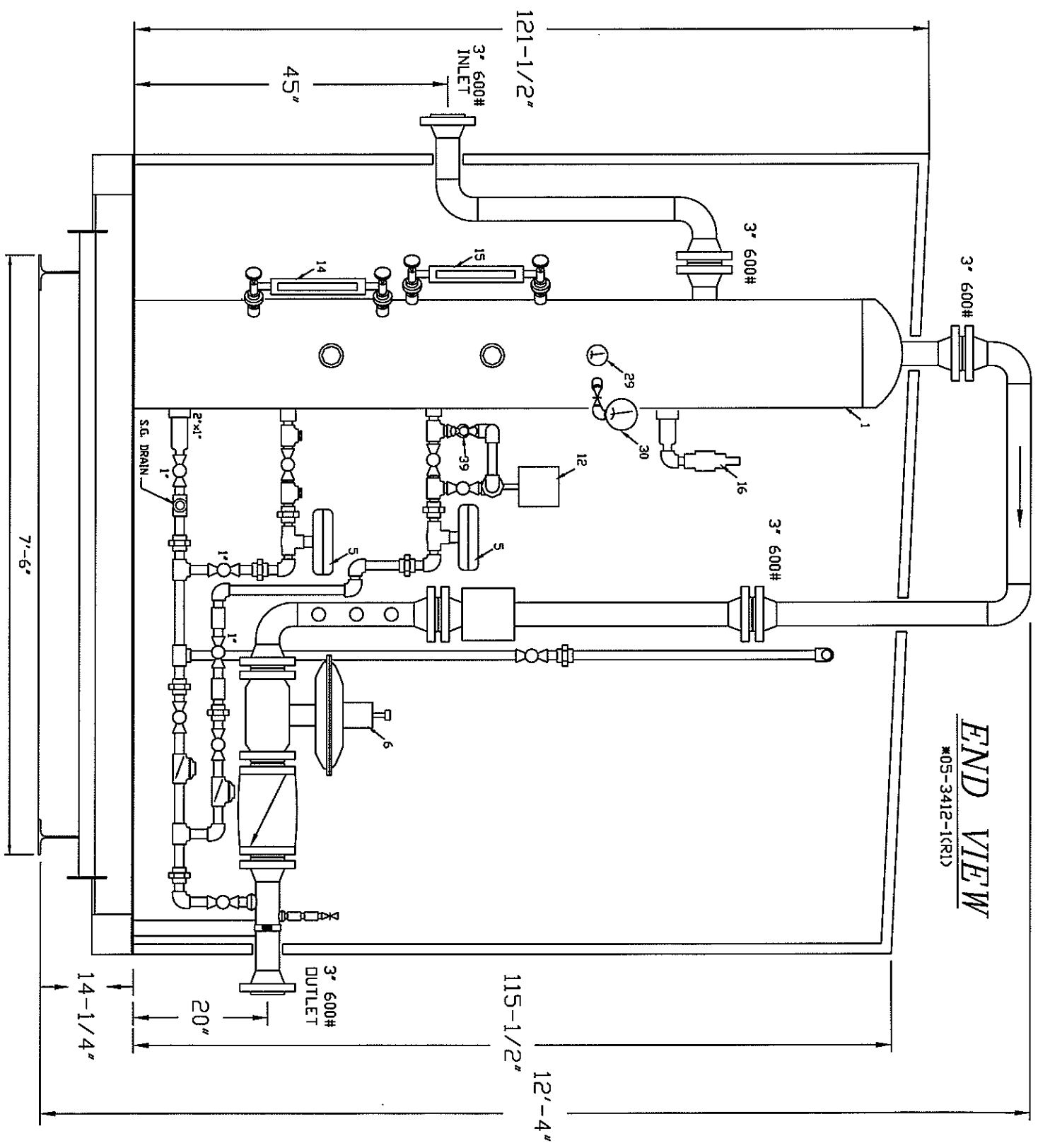
This drawing and the design it covers are confidential and shall shall not be disclosed in any manner, or used for any purpose, except with written consent of, R.J.V. Gas Field Services Ltd.

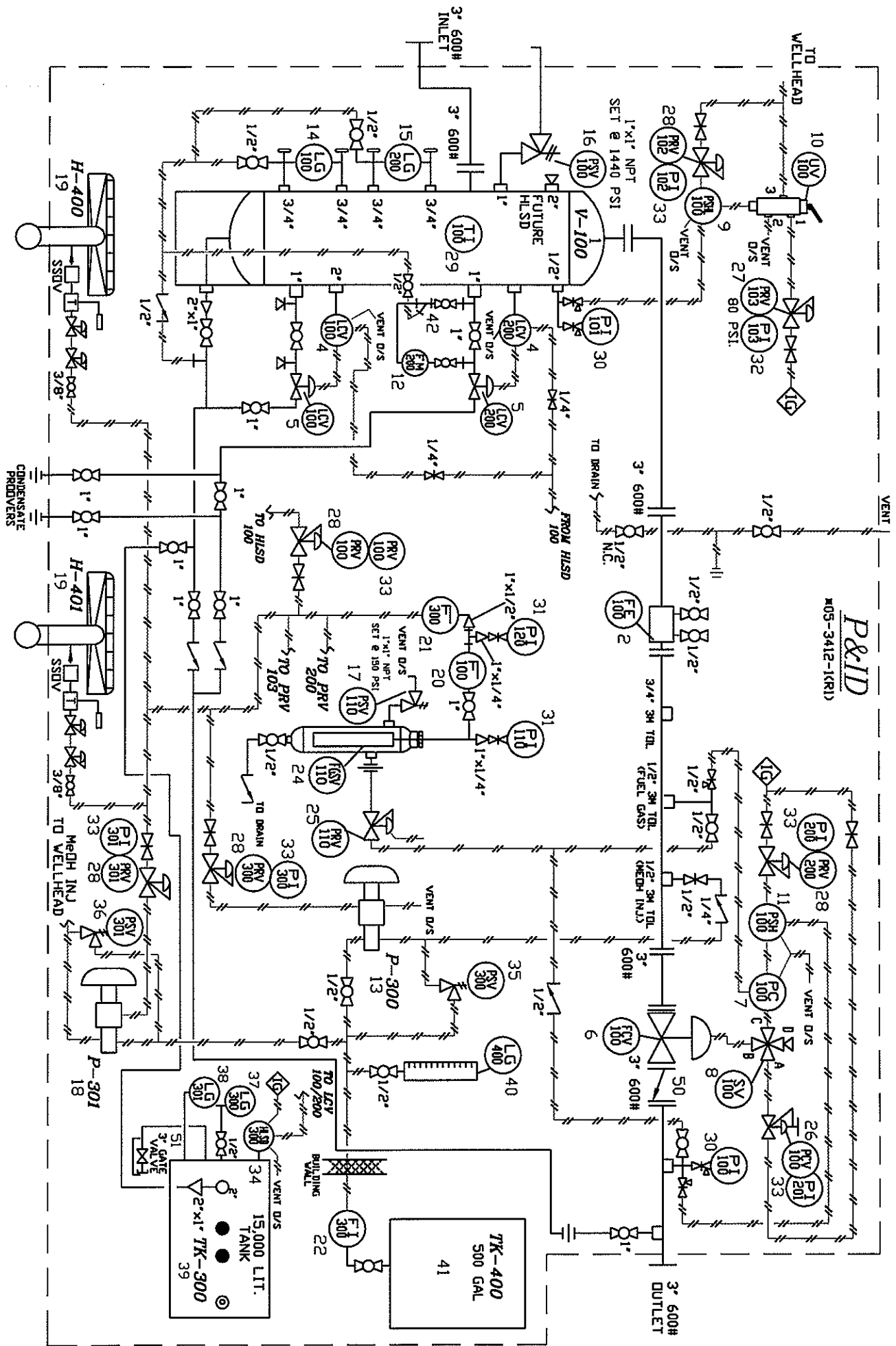
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*END VIEW*  
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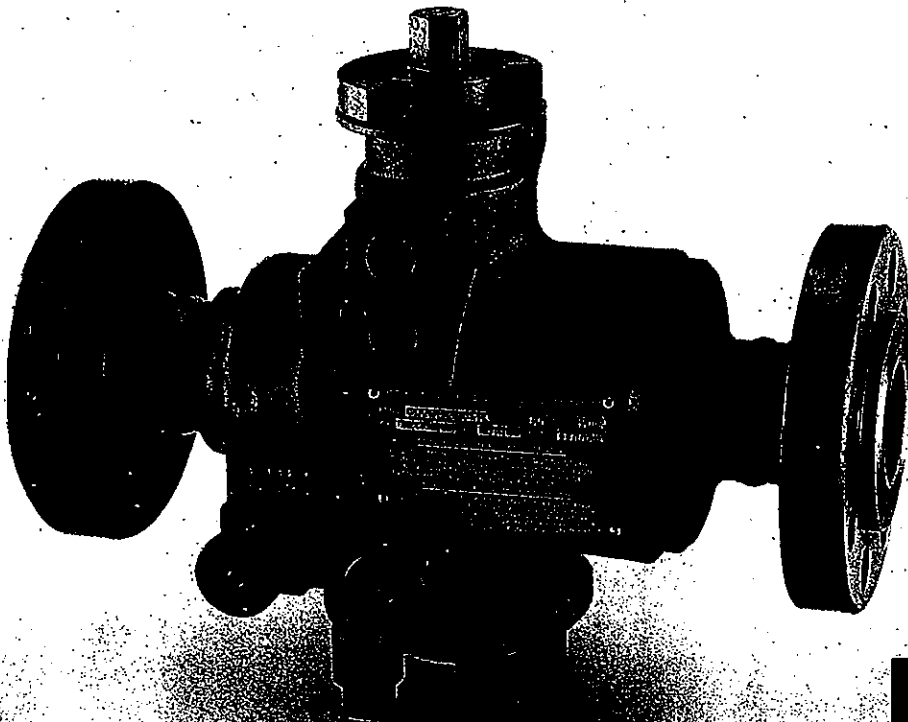
# EQUIPMENT & MATERIAL

| TAG#        | ITEM | QTY | DESCRIPTION  |
|-------------|------|-----|--|
| V-100       | 1    | 1   | RJV 16"x7'6" s/s 600 ANSI, 1440 PSI, 3 PHASE VERTICAL MISTEX SEPARATOR c/w 1/16" CORROSION ALLOWANCE.  |
| FE-100      | 2    | 1   | NORTHSTAR 3" 600 ANSI SCH 40 (SENIOR) ORIFICE FITTING AGA FIG 3D, .7 BETA RATIO, 3 TAPS- 1, 3/4" & 2, 1/2" NPT. c/w 1 304 SST ORIFICE PLATE AND PLATE RETAINER (68" O/A) NOT REQUIRED                                    |
| PR/FR-100   | 3    | 1   | FISHER 2" NPT TYPE L2 LEVEL CONTROL, LCC LOW TEMP, SNAP ACTING, FAIL CLOSED, c/w 1-7/8" x 12" PVC DISPLACER.   |
| LC-100/200  | 4    | 2   | FISHER 1" NPT TYPE D2, LCC LOW TEMP, NACE SPEC., RATED 900# ANSI, 0-35 PSI SIGNAL, ADJUSTABLE 1/4"/3/8"/1/2" TRIM.   |
| LCV-100/200 | 5    | 2   | KIMRAY 3" 600# ANSI RF, MOTOR VALVE, 1,500 PSI. MOP, STD. SERVICE, 2" INNER VALVE, CARBON STEEL BODY.  |
| FCV-100     | 6    | 1   | FISHER TYPE 4150K-R PRESSURE CONTROLLER, DIRECT ACTING, 0/1500 PSI 316 STAINLESS STEEL BOURDON TUBE, RE-CONDITION CONANT 1/4" NPT. MODEL 38361ALT MANUAL SELECTOR VALVE, 3-WAY SELECTOR/316 SST CONSTRUCTION.            |
| PC-100      | 7    | 1   | RE-COND. FISHER TYPE 4660 HI-LO PRESSURE PILOT, 0-1500 PSI. BOURDON TUBE, STANDARD, 1380 PSI RISING, 100 PSI FALLING. AMOT 1/4" NPT SWITCHING VALVE, MODEL #4057D025H2, STD. SERVICE, 125 PSIG. ALL PORTS, STD. SERVICE. |
| SV-100      | 8    | 1   | CVS 7970 PNEUMATIC PRESSURE PILOT, HIGH PRESSURE SET @ 700 RISING SENSOR, TWO POSITION, 3-WAY PILOT, AUTO RESET.   |
| PSHL-100    | 9    | 1   | NUFLO 1" x 1" NPT, TURBINE METER 5-50 USGPM FLOW RANGE, DIGITAL RATE FLOW TOTALIZER, ELECTROMAGNETIC PICKUP COIL.  |
| UV-100      | 10   | 1   | BRUIN MODEL BR5103 METHANOL INJECTION PUMP, 3/8" PLUNGER. c/w PNEUMATIC MICRO VALVE, 16.0 GPD, 1,500 PSI. MWP.   |
| PSH-100     | 11   | 1   | PENBURTHY MODEL 1TMS TRANSPARENT GAUGE GLASS, c/w 303J GAUGE COCKS, C/W 1/2" NPT DRAIN BALL VALVE.   |
| FM-200      | 12   | 1   | PENBURTHY MODEL 1RLS REFLEX GAUGE GLASS, c/w 303J GAUGE COCKS, C/W 1/2" NPT DRAIN BALL VALVE.  |
| P-300       | 13   | 1   | HYDROSEAL 1" FNPT x 1" FNPT MODEL 14E3MOV00, SST BODY, CS BONNET & CAP, .128" ORIFICE, SET @ 1440 PSIG.  |
| LG-100      | 14   | 1   | HYDROSEAL 1" FNPT x 1" FNPT MODEL 14E3MOV00, SST BODY, CS BONNET & CAP, .128" ORIFICE, SET @ 150 PSIG.   |
| LG-200      | 15   | 1   | TEXSTEAM 5103 METHANOL INJECTION PUMP, 3/8" PLUNGER. PNEUMATIC MICRO VALVE, 7.9 GPD, HARD PACKING. 6000 PSI MWP.   |
| PSV-100     | 16   | 1   | CATADYNE BX24X24 24,000 BTU, 12 VDC, NATURAL GAS HEATER c/w STANDS, SSOV, REGULATORS, 25 FT CABLES, THERMOSTAT, GRILL, VENT HOOD & ELECTRICAL AS PER CEC REGULATIONS.  |
| PSV-110     | 17   | 1   | F-100 WATERGUARD 1" NPT MODEL WGF12100 FILTER HEAD ASSEMBLY, MODEL VG40510SP WATER REMOVING FILTER.  |
| P-301       | 18   | 1   | F-300 HEADLINE 1/2" NPT. MODEL #360A c/w P/N 25-64-70C ELEMENTS  |
| H-400/401   | 19   | 2   | F-300 1" NPT. FLEET GUARD METHANOL FILTER/SPIN ON CARTRIDGE.   |
| F-100       | 20   | 1   | V-100 RJV 8"x30" s/s FUEL GAS SCRUBBER 975 PSI DESIGN PRESS.   |
| F-300       | 21   | 1   | FGSV-110 RJV 2"x1" FUEL GAS SHUT OFF VALVE, MODEL FGSV 5200.   |
| FI-300      | 22   | 1   | PRV-110 BELGAS 1" NPT TYPE P627 REG. CARBON STEEL CONST.   |
| V-100       | 23   | 1   | 1/8" ORIFICE, 70-150 PSI SPRING RANGE, SET @ 100 PSIG.   |
| FGSV-110    | 24   | 1   | BELGAS 1/4" NPT TYPE P50 REGULATOR, STD SERVICE, 0-60 PSI SPRING RANGE. MANUAL HAND WHEEL.   |
| PRV-110     | 25   | 1   | BELGAS 1/4" NPT TYPE P50 REGULATOR, STD SERVICE, 0-120 PSI SPRING RANGE. SET @ 90 PSI. (UV-100 SUPPLY)   |
| PRV-100/102 | 26   | 1   | BELGAS 1/4" NPT TYPE P50 REGULATOR, STD SERVICE, 0-60 PSI. RANGE (P-300/301, PSHL-100, HUSD-300, PSH-100)  |
| 200/300/301 | 27   | 5   | TREND MOD 33, 3" DIAL, DS, -40/120°F, c/w 304 SST TOW, 4" STEM ON SEPARATOR.   |
| TI-100      | 28   | 1   | PI-100/101 WIKA #233.54 4" DIAL 1/2" NPT BOT CONN. LIQUID FILLED, DS, 0/15000 PSI c/w AGCO M918C-44 1/2" NPT ISOLATION/BLEED VALVES, (SEPARATOR & OUTLET PIPING).  |
| PI-100/101  | 29   | 2   | PI-110/120 WIKA #233.53 2 1/2" DIAL 1/4" NPT BOT CONN. LIQUID FILLED, DS, c/w AGCO HSRDC-2 1/4" ISOLATION/BLEED VALVES 0/200 PSI (FUEL GAS SCRUBBER/ON DOWNSTREAM OF FILTER).  |
| PI-110/120  | 30   | 2   | PI-103 WIKA #233.53 2 1/2" DIAL 1/4" NPT BOT CONN. LIQUID FILLED, 0/200 PSI (UV-100 IG REGULATOR).   |
| PI-103      | 31   | 1   | PI-100/102/200 WIKA #233.53 2 1/2" DIAL 1/4" NPT BOT CONN. LIQUID FILLED, 0/60 PSI.  |
| 201/300/301 | 32   | 6   | HUSD-300 WELLMARK 2" NPT SHAPTRON 7400 SERIES PNEUMATIC LEVEL SWITCH, STANDARD SERVICE, c/w PNEUMATIC MICRO VALVE.   |
| HLSD-300    | 33   | 1   | PSV-300 NUPRO 1/4" #SS-4R3A5-EP/177-R3A-KI-C, SET @ 1,440 PSIG.  |
| PSV-300     | 34   | 1   | PSV-301 NUPRO 1/4" #SS-4R3A5-EP/177-R3A-KI-C, SET @ 3,700 PSIG.  |
| LG-300      | 35   | 1   | RJV 5700-84-CVR METH. TANK METERING/LEVEL GAUGE, 7FT.  |
| TK-300      | 36   | 1   | RJV 5700-4-CVR METH. TANK METERING/LEVEL GAUGE, 4IN.   |
| LG-400      | 37   | 1   | WESTEEL 15,000 LITRE DOUBLE VALLED ABOVE GROUND TANK c/w 2-6" 150 ANSI VENT STACKS AND 3" NPT PUMP OUT/DRAIN   |
| TK-400      | 38   | 1   | RJV #5428 METERING/LEVEL GAUGE, 48" VISIBLE LENGHT.  |
|             | 39   | 1   | WESTEEL 500 GAL SINGLE WALL METH. STORAGE TANK.  |
|             | 40   | 1   | ALBERTA STRAINER 1" NPT. FIG# YS600, 1,480 PSI. WP.  |
|             | 41   | 1   | FLOMORE 1/4" NPT #A-676 BALL CHECK (METHANOL INJ. POINT).  |
|             | 42   | 1   | PLAINSMAN 1/2" NPT 3000# CB-50 BALL CHECK.   |
|             | 43   | 3   | NAVCO 1" FNPT 3,000# MODEL CSP10S08AB, SWING TYPE CHECK.   |
|             | 44   | 16  | NAVCO 1/2" NPT 2000# MH1-F05S20-B BALL VALVES.   |
|             | 45   | 12  | NAVCO 1" NPT 2000# MH1-R10S20-B BALL VALVES.   |
|             | 46   | 8   | AGCO 1/4" NPT 6000# MHSRDC-2 NEEDLE VALVES.  |
|             | 47   | 5   | AGCO 1/2" NPT 6000# MH7VC-440 NEEDLE VALVES.   |
|             | 48   | 1   | WHEATLEY 3" 600# ANSI RF, FIG# 910-035 144101 SWING CHECK  |
|             | 49   | 1   | 3" CLIP GATE VALVE   |
|             | 50   | 1   | TUBING- 3/8" & 1/2" OD .035 WT STAINLESS STEEL.  |
|             | 51   | 1   | TUBE FITTINGS- SWAGelok STAINLESS STEEL  |
|             |      |     | FR PRESSURE SENSING LINES & FG TAKE-OFFS SHALL BE 1/2" OD  |
|             |      |     | SKID- RJV 10"x21'4" c/w 6"BB2 CHANNEL IRON(PERIPHERY), 6"815   |
|             |      |     | TANK BEAMS) 6"815 CHANNEL IRON(CHECKER FLOORING SUPPORTS)  |
|             |      |     | 8"815 WF BEAM FLOOR RUNNERS  |
|             |      |     | 3/16" CHECKERED PLATE(FLOORING), 3" POLYURETHANE   |
|             |      |     | UNDERSKID INSULATION AND 3 1/2" PULL BARS EACH END   |
|             |      |     | BUILDING- 10'x16'x10'-9'6" URETHANE INJECTED PANEL TYPE c/w  |
|             |      |     | SHED ROOF, 30 GAUGE PREPAINTED STEEL EXTERIOR WHITE WALLS  |
|             |      |     | R12 INSULATION VALUE 30 GAUGE WHITE STEEL INTERIOR   |
|             |      |     | DOOR- 3'x7' URETHANE INJECTED PANEL TYPE, c/w PANIC LOCK   |
|             |      |     | WEATHER STRIPPING, 1WG WINDOW, DOOR SWEEP, DOG DOOR.   |
|             |      |     | WINDOW- 1, 36"x36" DG SLIDER c/w SCREENS. 1WG WINDOW   |
|             |      |     | VENTS- 2, 12"x12" INSULATED ALUMINUM LOUVRED c/w SCREENS.  |
|             |      |     | FLANGES: SA-105N 600 ANSI: 2" SCH 80, & 3" SCH 40.   |
|             |      |     | WELD FITTINGS: SA-234-WPB 2" SCH 80 & 3" SCH 40.   |
|             |      |     | SCREWED FITTINGS: SA-105N 3000# FS.  |
|             |      |     | SCREWED UNIONS: SA-105N 3000# FS.  |
|             |      |     | O-LETS: SA-105N 3000# FS.  |
|             |      |     | PIPE AND NIPPLES: SA-106 GR B SEAMLESS.  |
|             |      |     | WELDED: 2" SCH 80, & 3" SCH 40.  |
|             |      |     | THREADED PIPE/NIPPLES/SWAGES: 150#- SCH 80, 600#- SCH 160  |
|             |      |     | BOLTING: ASTM A193 GR B7 STUDS/ASTM A194 GR 2H NUTS.   |
|             |      |     | GASKETS: 304 SST FLEXATALLIC GRAPHITE.   |
|             |      |     | ALL PIPING DESIGNED TO B31-3 CODE  |
|             |      |     | WELDED PIPING SHALL BE SUBJECTED TO 10% RADIOGRAPHY.   |
|             |      |     | WELDED PIPING SHALL BE HYDRO-TESTED TO 2160 PSI.   |
|             |      |     | ALL VENTING CONTROLS AND INSTRUMENTS SHALL BE VENTED TO  |
|             |      |     | SKID EDGE AND ALL CONTROLS OPERATIONALLY AIR TESTED.   |
|             |      |     | ALL METAL SURFACES SHALL BE MECHANICALLY CLEANED TO  |
|             |      |     | SSPC-SP-2, 1 COAT OF ZINC CHROMATE PRIMER AND 1 FINISH   |
|             |      |     | COAT OF ENAMEL PAINT SHALL BE APPLIED AS FOLLOWS-  |
|             |      |     | CHECKERED PLATE FLOORING: WARM GREY  |
|             |      |     | STEEL SKIDS, EQUIPMENT, PIPING & TANKS: WARM GREY  |

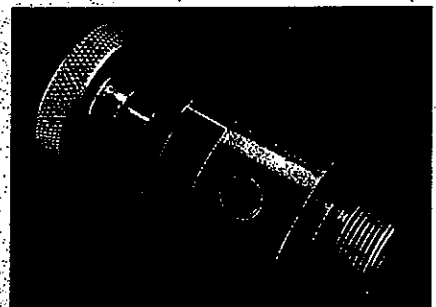
#04-3412-1(R1)

# DUAL CHAMBER

FLANGED TYPE



2. Model 48532



Optional Bleed Off Extension

## INSTALLATION

It is recommended that the North Star Dual Chamber orifice fitting be placed in the line with the two 1/2" N.P.T. flange taps and instruction plate facing upward. The Flow arrow cast on the

body must correspond with flow direction of line. The orifice fitting is shipped with an orifice plate installed in operating position. It is suggested that the orifice plate be removed before flushing or purging the flow line.

## MAINTENANCE

The spring-loaded, self-lubricated Molyfilled Teflon® ball seals eliminate any need for periodic lubrication. ***"THE USE OF GREASE AS A SEALING AGENT IS NOT REQUIRED."***

## OPERATING INSTRUCTIONS

### To Remove Orifice Plate

1. Close main orifice fitting. This rotates the orifice plate out of operation and places the bypass section into the orifice fitting bore.
2. Insure "EQUALIZER" valve is closed.
3. Open the "BLEED" valve. This vents the pressure around the orifice plate and chamber lid.
4. Open the chamber lid by loosening the hinge bolt cap nuts and removing the two top cap nuts. This will allow the chamber lid to open freely.
5. Remove orifice plate and retainer with the wrench supplied with unit.

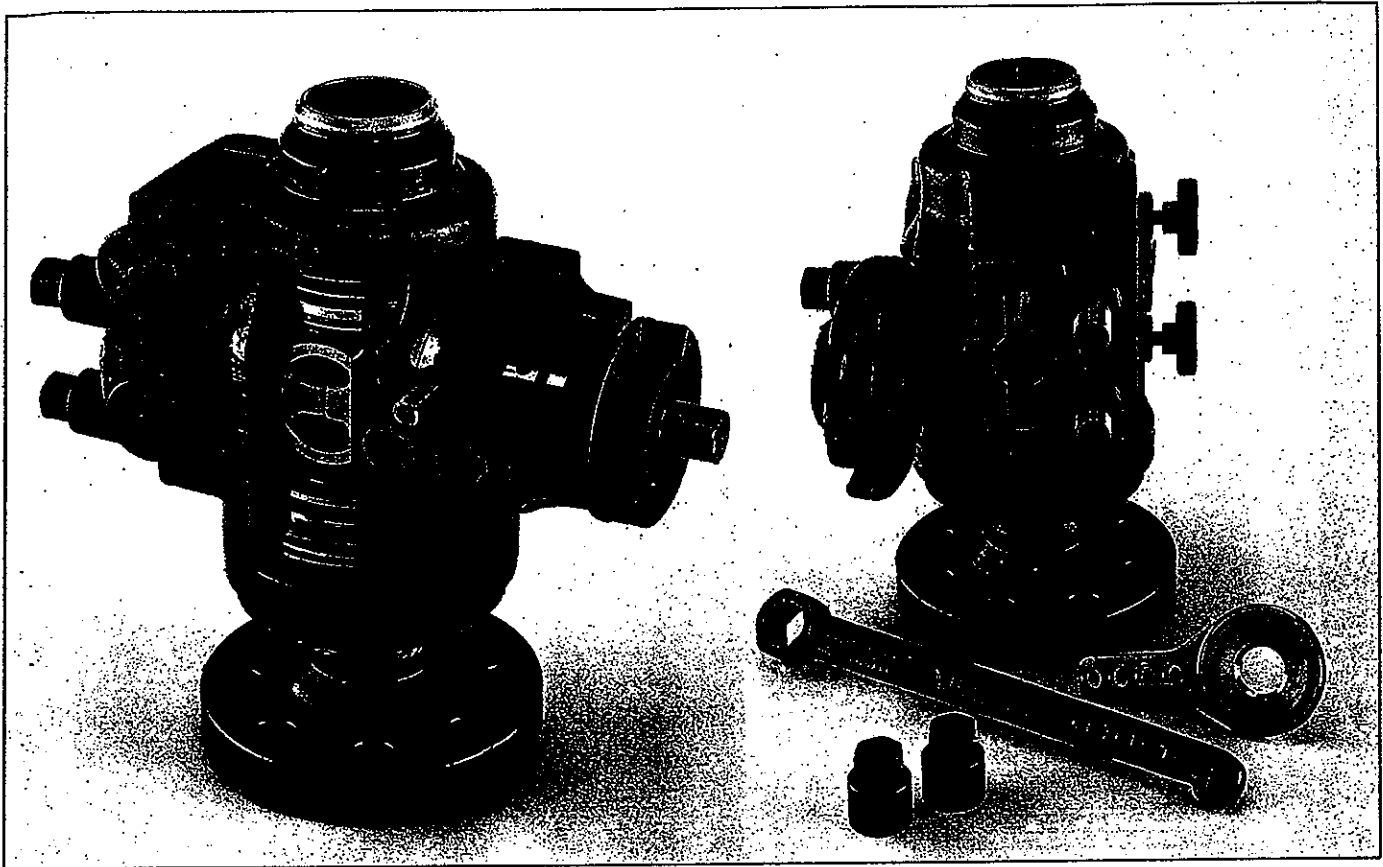
### To Replace Orifice Plate

1. Place orifice plate and retainer into the ball slot with "OUTLET" on plate holder facing "OUTLET" stamped on body casting.
2. Close chamber lid and tighten the four cap nuts.
3. Close "BLEED" valve.
4. Open "EQUALIZER" valve to equalize ball seal pressure.
5. Open main orifice fitting. This places orifice plate into operation and removes bypass section from the bore.
6. Close "EQUALIZER" valve.



# CUT-AWAY FLANGEWELD DUAL CHAMBER

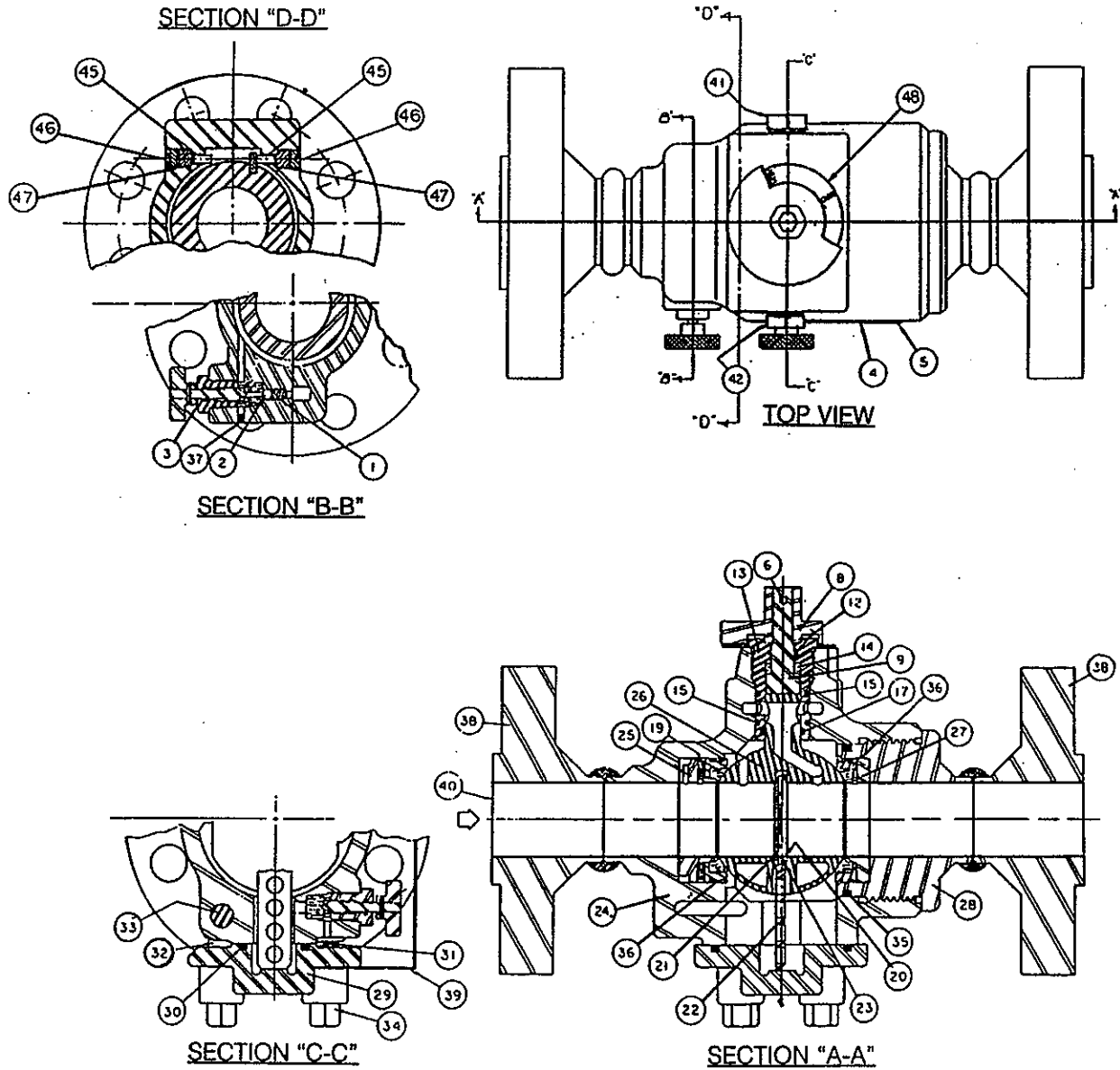
2, 3 and 4 Inch



| ORIFICE FITTING SIZES              | 2"                           | 3"                           | 4"                           |
|------------------------------------|------------------------------|------------------------------|------------------------------|
| ASSEMBLY PART NUMBER               | 40552                        | 40553                        | 40554                        |
| ANSI FLANGE<br>PRESSURE<br>RATINGS | 150<br>THROUGH<br>1500       | 150<br>THROUGH<br>1500       | 150<br>THROUGH<br>1500       |
| INTERNAL<br>DIAMETERS              | SCH 40<br>THROUGH<br>SCH 160 | SCH 40<br>THROUGH<br>SCH 160 | SCH 40<br>THROUGH<br>SCH 160 |

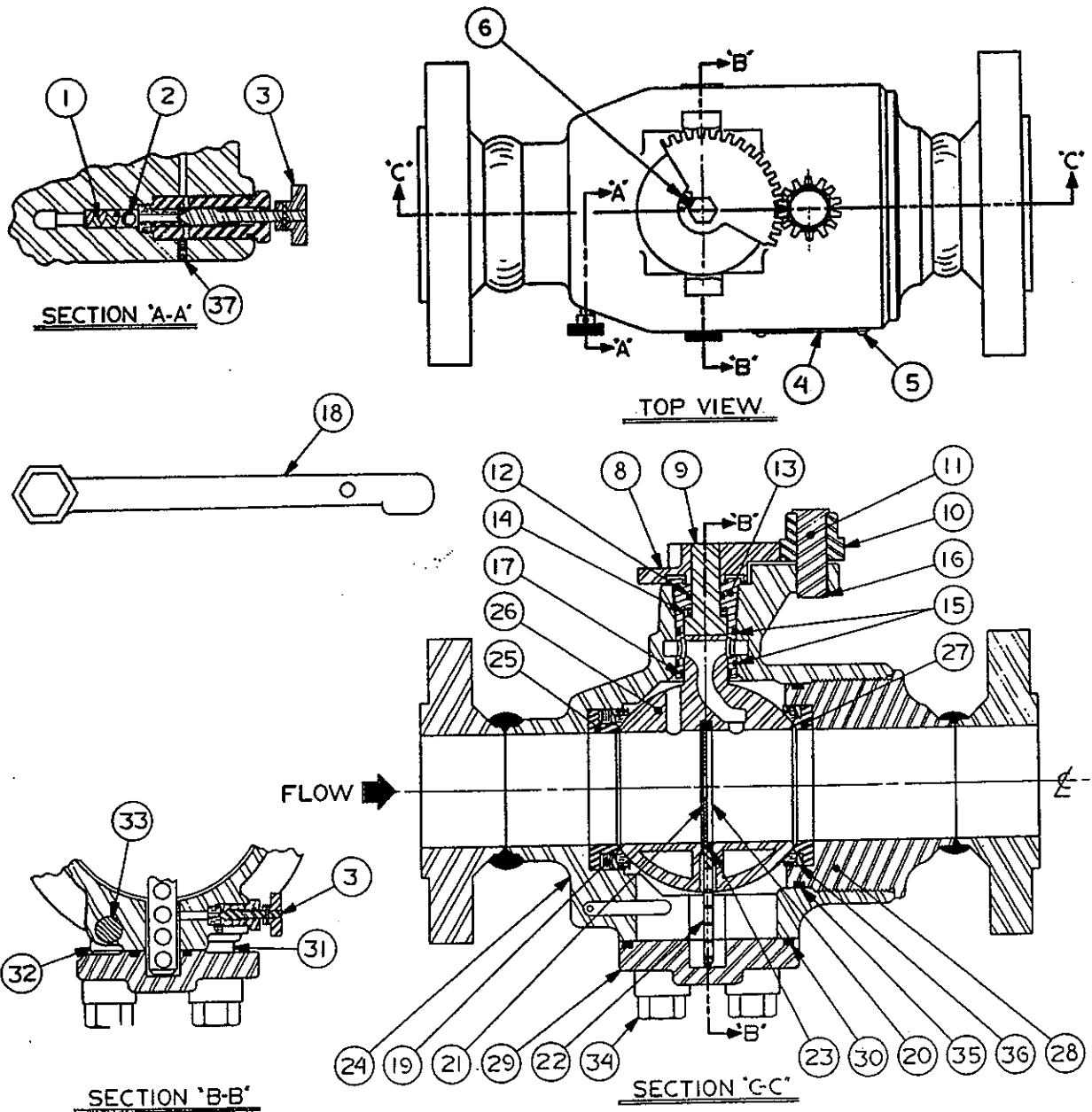
# COMPOSITE DRAWING

FOR 2" and 3" DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP



# COMPOSITE DRAWING

## FOR 4" DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP



# COMPOSITE PARTS LIST

FOR 2", 3" and 4" DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP

| ITEM | DESCRIPTION   | QTY. | ASSY. NO. 40552<br>(2") PART NO.      | ASSY. NO. 40553<br>(3") PART NO. | ASSY. NO. 40554<br>(4") PART NO. |
|------|---|------|---------------------------------------|----------------------------------|----------------------------------|
| 1    | SPRING  | 1    | 40701-053-04000                       | 40701-053-04000                  | 40701-053-04000                  |
| 2    | T. C. BALL 0.250  | 1    | 01001-030-04300                       | 01001-030-04300                  | 01001-030-04300                  |
| 3    | BLEED VALVE ASSY.   | 2    | 40701-J00-06000                       | 40701-J00-06000                  | 40701-J00-06000                  |
| 4    | INSTRUCTION PLATE   | 1    | 40701-009-04000                       | 40701-009-04000                  | 40701-009-04000                  |
| 5    | DRIVE SCREW   | 4    | 40701-077-04000                       | 40701-077-04000                  | 40701-077-04000                  |
| 6    | SET SCREW   | 2    |                                       | 40553-047-04000                  | 40554-043-04000                  |
| 7    | N/A   |      |                                       |                                  |                                  |
| 8    | BALL STOP   | 1    | 40552-119-04000                       | 40553-130-04000                  | 40554-138-04000                  |
| 9    | BALL STEM   | 1    | 40552-046-04000                       | 40553-048-04000                  | 40554-042-04000                  |
| 10   | SPUR GEAR   |      |                                       |                                  | 40704-004-04000                  |
| 11   | SPUR GEAR STEM  | 1    |                                       |                                  | 40704-046-04000                  |
| 12   | O-RING  | 1    | 40700-060-06000                       | 40713-035-06000                  | 40714-046-06000                  |
| 13   | STEM RETAINER   | 1    | 40552-027-04000                       | 40703-016-04000                  | 40704-033-04000                  |
| 14   | STEM RING   | 1    | 40701-014-04000                       | 40703-018-04000                  | 40704-034-04000                  |
| 15   | O-RING  | 2    | 40700-061-06000                       | 40714-047-06000                  | 40714-048-06000                  |
| 16   | STEM LOCK   | 1    |                                       |                                  | 40704-050-04000                  |
| 17   | O-RING  | 1    | 40700-059-06000                       | 40713-036-06000                  | 40714-047-06000                  |
| 18   | ORIFICE FITTING WRENCH  | 1    | 40701-075-00000                       | 40703-045-00000                  | 40704-031-00000                  |
| 19   | WAVE SPRING (STANDARD)  | 5    | 40700-009-03000                       | 40703-088-03000                  | 40704-082-04000                  |
| 20   | DOVETAIL RING   | 1    | 40712-001-04000                       | 40713-006-04000                  | 40714-010-04000                  |
| 21   | STANDARD ORIFICE PLATE, 316 S.S.  | 1    | 40552-052-00000                       | 40553-055-00000                  | 40554-049-00000                  |
| 22   | STANDARD ORIFICE PLATE RETAINER<br>ORIFICE PLATE RETAINER               | 1    | 40552-062-04000                       | 40553-062-04000                  | 40554-063-04000                  |
|      | ORIFICE PLATE RETAINER (TEFLON)   |      | 40552-069-04000                       | 40553-065-04000                  | 40554-065-04000                  |
| 23   | O-RING  | 1    | 40700-005-06000                       | 40702-025-06000                  | 40714-052-06000                  |
|      | O-RING (TEFLON)   |      | 40552-059-06000                       | 40553-060-06000                  | 40554-059-06000                  |
| 24   | ORIFICE FITTING BODY<br>SCH - 40  | 1    | 40552-023-04000                       | 40553-023-04000                  | 40554-017-04000                  |
|      | SCH - 80  |      | 40552-024-04000                       | 40553-034-04000                  | 40554-025-04000                  |
|      | SCH - 160   |      | 40552-025-04000                       | 40553-035-04000                  | 40554-026-04000                  |
| 25   | UPSTREAM SEAL RETAINER<br>SCH - 40 BORE                                 | 1    | 40552-031-04000                       | 40553-025-04000                  | 40554-019-04000                  |
|      | SCH - 80 BORE   |      | 40552-032-04000                       | 40553-028-04000                  | 40554-021-04000                  |
|      | SCH - 160 BORE  |      | 40552-033-04000                       | 40553-031-04000                  | 40554-023-04000                  |
| 26   | BYPASS BALL<br>SCH - 40   | 1    | 40552-115-04000                       | 40553-124-04000                  | 40554-135-04000                  |
|      | SCH - 80  |      | 40552-116-04000                       | 40553-125-04000                  | 40554-136-04000                  |
|      | SCH - 160   |      | 40552-117-04000                       | 40553-126-04000                  | 40554-137-04000                  |
| 27   | DOWNSTREAM SEAL RETAINER<br>SCH - 40                                    | 1    | 40552-035-04000                       | 40553-026-04000                  | 40554-020-04000                  |
|      | SCH - 80  |      | 40552-036-04000                       | 40553-029-04000                  | 40554-022-04000                  |
|      | SCH - 160   |      | 40552-037-04000                       | 40553-032-04000                  | 40554-024-04000                  |
| 28   | DOWNSTREAM WELDNECK<br>SCH - 40   | 1    | 40552-038-03000                       | 40553-024-03000                  | 40554-027-03000                  |
|      | SCH - 80  |      | 40552-039-03000                       | 40553-027-03000                  | 40554-028-03000                  |
|      | SCH - 160   |      | 40552-040-03000                       | 40553-030-03000                  | 40554-029-03000                  |
| 29   | CHAMBER LID   | 1    | 40552-043-04000                       | 40553-033-04000                  | 40554-018-04000                  |
| 30   | O-RING  | 1    | 40552-051-06000                       | 40553-051-06000                  | 40714-059-06000                  |
| 31   | STUD BOLT   | 2    | 40726-006-04000                       | 40703-026-04000                  | 40704-019-04000                  |
| 32   | HINGE BOLT  | 2    | 40726-005-04000                       | 40703-027-04000                  | 40704-018-04000                  |
| 33   | HINGE PIN   | 1    | 40726-008-04000                       | 40703-024-04000                  | 40704-020-04000                  |
| 34   | HEX NUT   | 4    | 40701-021-04000                       | 40703-025-04000                  | 40704-021-04000                  |
| 35   | O-RING  | 1    | 40552-054-06000                       | 40553-052-06000                  | 40714-060-06000                  |
| 36   | BALL SEAL ASSY.<br>FOR 150# AND 300# RATING<br>FOR 600# TO 1500# RATING | 2    | 40552-C00-04000                       | 40703-D00-04000                  | 40704-D00-04000                  |
|      |   |      | 40552-A00-04000                       | 40703-P00-04000                  | 40704-P00-04000                  |
| 37   | PIPE PLUG 1/16"   | 1    | NCN                                   | NCN                              | NCN                              |
| 38   | FLANGES<br>FLANGED  | 2    | SPECIFIED BY TYPE AND PRESSURE RATING |                                  |                                  |
|      | FLANGEWELD  | 1    |                                       |                                  |                                  |
|      | BLEED - OFF EXTENSION (H <sub>2</sub> S) SOUR                           | 1    | 40701-S00-06000                       | 40701-S00-06000                  | 40701-S00-06000                  |

# COMPOSITE PARTS LIST

## FOR 2", 3" and 4" DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP

(cont'd)

| ITEM | DESCRIPTION   | QTY. | ASSY. NO. 40552<br>(2") PART NO. | ASSY. NO. 40553<br>(3") PART NO. | ASSY. NO. 40554<br>(4") PART NO. |
|------|---|------|----------------------------------|----------------------------------|----------------------------------|
| 39   | ORIFICE FITTING GUARD<br>W/O BLEED-OFF-EXTENSION (STANDARD) | 1    | 40700-039-04000                  | 40702-013-04000                  | 40702-013-04000                  |
|      | W/BLEED-OFF-EXTENSION                                       |      | 40701-101-04000                  | 40701-102-04000                  | 40701-102-04000                  |
| 40   | PLASTIC BORE PLUG   | 2    | NCN                              | NCN                              | NCN                              |
| 41   | PIPE PLUG 1/2"  | 2    | 35365-004-04000                  | 35365-004-04000                  | 35365-004-04000                  |
| 42   | PLASTIC PIPE PLUG 1/2"                                      | 2    | NCN                              | NCN                              | NCN                              |
| 43   | NOT USED  |      |                                  |                                  |                                  |
| 44   | NOT USED  |      |                                  |                                  |                                  |
| 45   | SET SCREW 1/2" - 20 UNF                                     | 2    | 40700-068-04000                  | 40700-068-04000                  | 40700-070-04000                  |
| 46   | PLUG 1/2" - 20 UNF  | 2    | 40700-069-04000                  | 40700-069-04000                  | 40700-069-04000                  |
| 47   | NYLON LOCKING PELLET  | 4    | 10008-006-04000                  | 10008-006-04000                  | N/A                              |
| 48   | BALL STOP PLATE   | 1    | 40552-118-04000                  | 40553-127-04000                  |                                  |
| 49   | WAVE SPRING (H <sub>2</sub> S) SOUR                         | 5    | 40700-020-06000                  | 40703-093-06000                  | 40704-087-06000                  |

### WHEN ORDERING SPARE PARTS, SPECIFY:

- NOMINAL SIZE - SCHEDULE
- TYPE OF SERVICE (SWEET, (H<sub>2</sub>S) SOUR)
- SERIAL NUMBER

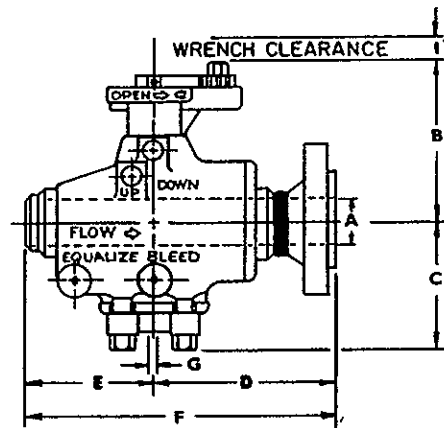
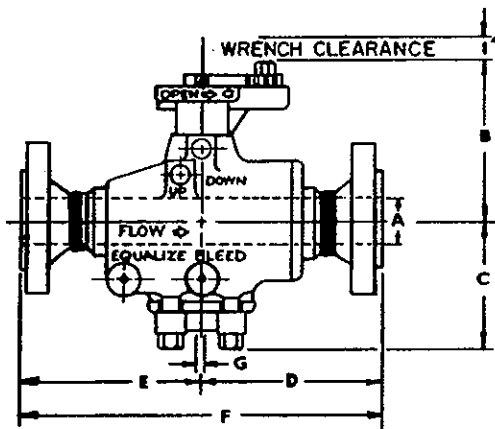
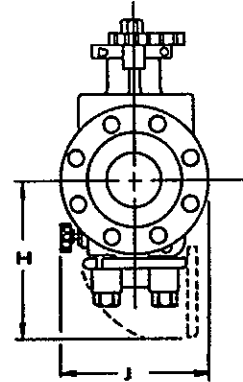
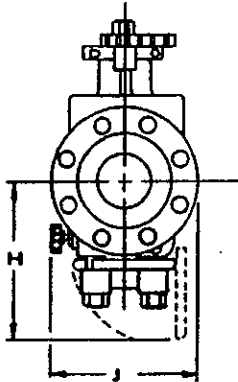
## REDRESS KITS FOR NORTH STAR DUAL CHAMBER ORIFICE FITTINGS

| Size  | Description   | Part No.                   |
|---|---|----------------------------|
| 2"  | Orifice Fitting, Pt. No. 40552, Standard (Sweet) Service<br>(H <sub>2</sub> S) Sour Service | 40837-03000<br>40837-06000 |
| 3"  | Orifice Fitting, Pt. No. 40553, Standard (Sweet) Service<br>(H <sub>2</sub> S) Sour Service | 40838-03000<br>40838-06000 |
| 4"  | Orifice Fitting, Pt. No. 40554, Standard (Sweet) Service<br>(H <sub>2</sub> S) Sour Service | 40839-03000<br>40839-06000 |
| NOTE: Specify pressure rating when ordering redress kits. |   |                            |

## RECOMMENDED SPARE PARTS LIST FOR NORTH STAR DUAL CHAMBER ORIFICE FITTINGS

| Size | Description   | Part No.        | Quantity |
|------|---|-----------------|----------|
| 2"   | Dovetail Ring<br>O-Ring for Orifice Plate<br>O-Ring for Chamber Lid | 40712-001-04000 | 1        |
|      |   | 40700-005-06000 | 2        |
|      |   | 40552-051-06000 | 2        |
| 3"   | Dovetail Ring<br>O-Ring for Orifice Plate<br>O-Ring for Chamber Lid | 40713-006-04000 | 1        |
|      |   | 40702-025-06000 | 2        |
|      |   | 40553-051-06000 | 2        |
| 4"   | Dovetail Ring<br>O-Ring for Orifice Plate<br>O-Ring for Chamber Lid | 40714-010-04000 | 1        |
|      |   | 40714-052-06000 | 2        |
|      |   | 40714-060-06000 | 2        |

# DIMENSIONAL DATA FOR NORTH STAR DUAL CHAMBER ORIFICE FITTINGS



**FLANGED TYPE**

**FLANGEWELD TYPE**

# Type L2 Liquid Level Controller

Snap-Acting or Throttling Control

Vent-Away Case

Field-Reversible Output

NACE Service Ready

Low-Bleed Environmentally Friendly Relay

ASME Class 1500 Pressure Rating

Field-Configurable Vertical or Horizontal Displacer

**NOW....ONE PNEUMATIC LIQUID LEVEL CONTROLLER  
THAT MEETS A WIDE RANGE OF APPLICATIONS**

Figure 1. Features





Figure 2. Type L2 Liquid Level Controller

The rugged Type L2 liquid level controller uses a displacer type sensor (see figures 1 and 2) to detect liquid level or the interface of two liquids of different specific gravities. This controller is ideal for controlling level on gas separators and scrubbers. The reliability of the Type L2 design makes it well suited for high pressure liquid level applications in natural gas production, compression, and processing. The device delivers a pneumatic output signal to a control valve. The sensor uses a threaded 2-inch NPT connection to the vessel.

## Features

- **Snap-Acting or Throttling Control**—One standard controller available as either throttling or snap-acting.
- **Field-Reversible Output**—The controller can be adjusted in the field for direct or reverse action without additional parts. The controller also has adjustable gain sensitivity.
- **NACE Service Ready**—Standard construction uses materials that comply with the recommendations of NACE MR0175 (National Association of Corrosion Engineers).
- **Low-Bleed Environmentally Friendly Relay**—Low-bleed relays conserve operating medium and reduce the impact on the environment.
- **Vent-Away Case**—The ability to pipe away exhaust permits using natural gas as the operating medium.
- **ASME Class 1500 Pressure Rating**—Sensor assembly is designed and specified for ASME B16.34 Class 1500 service.
- **Field-Configurable Vertical or Horizontal Displacer**—Displacer may be adjusted in the field for vertical or horizontal operation without additional parts.
- **Easy Maintenance**—Both the controller and the sensor can be easily disassembled to inspect the process seals and for maintenance.
- **Vibration Resistant Sensor Dynamics**—O-Ring friction and process pressure sensitivity are minimal. Performance stays constant with process pressure changes and controller remains vibration resistant.



## Specifications

### Available Configurations

**Controllers:** Snap-acting or throttling.

**Sensor:** Displacer-type liquid level sensor for mounting to side of tank. Displacer travel is transmitted to controller by pivotal movement of displacer rod.

### Input Signal<sup>(1)</sup>

**Type:** Liquid level or liquid-to-liquid interface

**Level Change Required for Full Change in Output Signal in a 1.0 Specific Gravity Liquid, with 1.4 bar (20 psig) Supply, Direct Action, and Standard 1-7/8 X 12-Inch (48 x 305 mm) Vertical Displacer with Standard Lever Arm Length:**

| Control Mode | Minimum Proportional Band Level Change, mm (Inches) <sup>(2)</sup> | Maximum Proportional Band Level Change, mm (Inches) <sup>(2)</sup> |
|--------------|--|--|
| Throttling   | 102 (4)  | 305 (12)   |
| On-off       | 127 (5)  | 305 (12)   |
| Snap-acting  | 13 (0.5)   | 20 (0.8)   |

### Minimum Specific Gravity<sup>(3)</sup>

**Throttling Controller:** Minimum specific gravity, or specific gravity differential for interface applications, is 0.1 (See note 4).

**Snap-Acting Controller:** Minimum specific gravity, or specific gravity differential for interface applications, is 0.1

### Output Signal<sup>(1)</sup>

Pneumatic ■ on-off or ■ proportional pressure signal

**Ranges:**

**Throttling:** ■ 0.2 to 1.0 bar (3 to 15 psig) or ■ 0.4 to 2.0 bar (6 to 30 psig)

**On-Off:** 0 (off) or full supply pressure (on)

**Action:** Field-reversible between direct (increasing level increases output signal) and reverse (increasing level decreases output signal)

### Supply Pressure Requirements

**Throttling Controller:**

**Throttling:** 1.4 bar (20 psig) for 0.2 to 1.0 bar (3 to 15 psig) output signal and 2.4 bar (35 psig) for 0.4 to 2.0 bar (6 to 30 psig) output signal

**On-Off:** Any desired pressure between 1.4 and 3.4 bar (20 and 50 psig)

**Snap-Acting Controller:** Any desired pressure between 1.4 and 5.2 bar (20 and 50 psig) direct, and 1.4 and 2.4 bar (20 and 35 psig) reverse

Do not use supply pressure below 1.4 bar (20 psig).

### Steady-State Air Consumption<sup>(5)</sup>

**Throttling Controller:** ≤0.03 normal m<sup>3</sup>/hr (1.0 scfh) at 1.4 bar (20 psig) supply pressure

**Snap-Acting Controller:** ≤0.03 normal m<sup>3</sup>/hr (1.0 scfh) at 1.4 bar (20 psig) supply pressure or ≤0.04 normal m<sup>3</sup>/hr (1.5 scfh) at 2.4 bar (35 psig) supply pressure in tripped condition; air consumption increases during trip

### Standard Displacer Size

48 x 305 mm, 541 cm<sup>3</sup> (1-7/8 x 12 inches, 33 in<sup>3</sup>)

### Maximum Displacer Working Pressure<sup>(6)</sup>

258 bar (3750 psig)

### Maximum Displacer Insertion Length<sup>(7)</sup>

Standard lever arm length plus one 6-inch extension, horizontal or vertical

### Maximum Sensor Working Pressure<sup>(6)</sup>

Consistent with Class 1500 pressure temperature ratings per ASME B16.34 up to maximum pressure of 258.5 bar (3750 psig)

### Construction Materials

**Controller:**

*Case and Cover:* Marine grade aluminum

*Relay Body:* Thermoplastic

*Fasteners:* Stainless steel

*Diaphragm:* Nitrile

*O-Rings:* Nitrile

*Case and Cover Gasket:* Neoprene

*Sensor Gasket:* Composition

*Relay Gasket:* Nitrile

*Throttling Levers:* Stainless steel

**Sensor:**

*Pivot Assembly:* Stainless steel

*Sensor Spring:* Stainless steel

*Sensor Body:* LCC

*O-Rings:* Highly saturated Nitrile<sup>(8)</sup> or fluorelastomer

*Displacer:* Polyvinylchloride (PVC)

-Continued-

# L2 Liquid Level Controller

## Product Bulletin

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### Specifications (continued)

#### Operative Ambient Temperature Limits<sup>(1)(6)</sup>

**Controller:** -29 to 71°C (-20 to 160°F)

#### Sensor Temperature Limits<sup>(1)(6)</sup>

**Displacer:** -29 to 79°C (-20 to 175°F)

**O-Rings:** -40 to 204°C (-40 to 400°F)

#### Sensor to Vessel Connection

2-inch (51 mm) screwed (NPT)

#### Controller Connections

**Supply:** 1/4 in. NPT female located on the bottom of the case

**Output:** 1/4 in. NPT female located on the top of the case

**Case Vent:** 1/4 in. NPT female with vent screen assembly located on the back of the case

#### Standard Supply, and Output Pressure Gauge Indications

Triple scale gauges in 0 to 60 psig/0 to 0.4 MPa/0 to 4.0 bar

#### Dimensions

Refer to Figure 3

1. This term is defined in ISA Standard 51.1.
2. Any deviation from the standard construction described in the input signal specification above requires special sizing considerations. Contact the Fisher sales office for information.
3. Minimum specific gravity values apply to both horizontal and vertical displacers with standard lever arm length (see dimension in figure 3).
4. Minimum specific gravity differential with standard displacer is 0.4. Minimum specific gravity differential of 0.1 is possible with special displacer. Consult your Fisher sales office for displacer sizing information.
5. Normal m<sup>3</sup>/hr--Normal cubic meters per hour (0°C and 1.01325 bar, absolute). Scfh--Standard cubic feet per hour (60°F and 14.7 psia).
6. The pressure and temperature limits in this document and any applicable code limitations shall not be exceeded.
7. Standard lever arm length. See figure 3.
8. Highly saturated Nitrile (H-NBR) has exceptional resistance to swelling in sour applications.

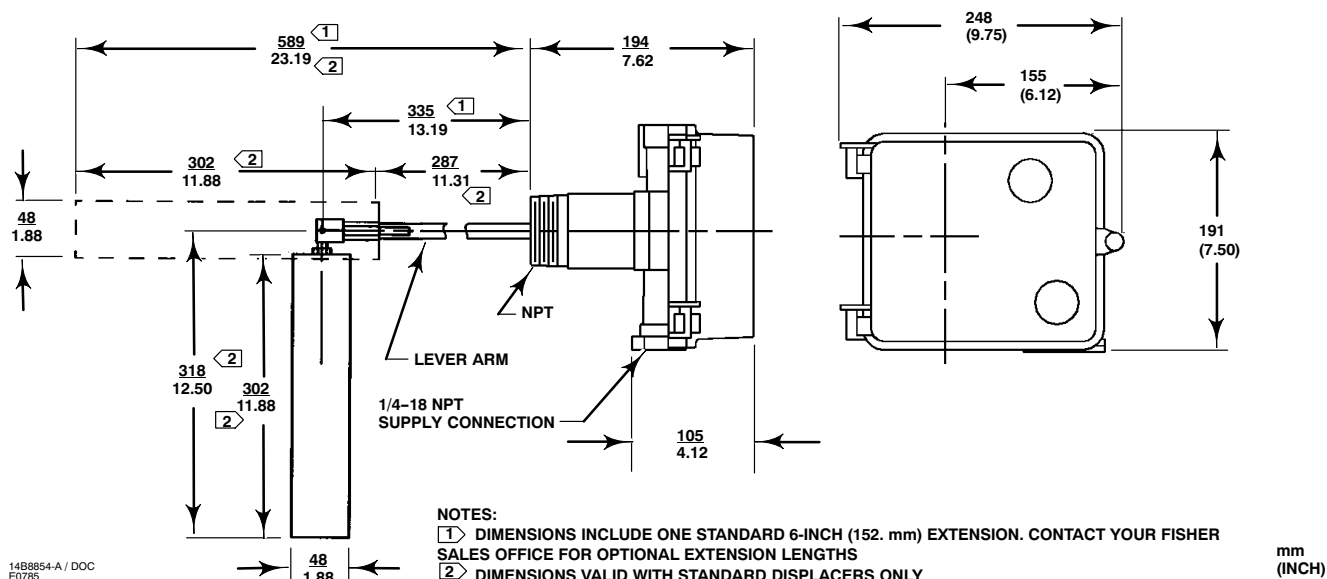


Figure 3. Dimensions

**Note**

**Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.**

# L2 Liquid Level Controller

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## Product Bulletin

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# Type D2 FloPro™ Control Valve

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Figure 1. Type D2 FloPro Control Valve

## Introduction

### Scope of Manual

This instruction manual provides installation, maintenance, and parts information for the 1-inch Type D2 FloPro control valve and actuator.

No person may install, operate, or maintain a Type D2 FloPro control valve without first (1) being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and (2) carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher sales office before proceeding.

### Description

The Type D2 FloPro control valve (patents pending) (figures 1 and 2) is a compact, rugged valve designed for on-off control of a variety of fluids at

pressures up to 155 bar (2250 psig). This valve is ideal for use as a dump valve on gas separators and scrubbers. It is also well suited for other high pressure applications in natural gas production, compression, and processing. The Type D2 FloPro valve has threaded end connections and is available in a 1-inch globe style body.

### Note

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## Specifications

Table 1 lists specifications for the Type D2 FloPro control valve. Some of the specifications for a given control valve as it originally comes from the factory are stamped on a nameplate located on the upper diaphragm casing flange.



Table 1. Specifications

|  |   |
|--|---|
| <b>Valve Assembly Pressure Class</b><br>ASME B16.34 Class 900  | <b>Port Diameter</b><br>13 mm (1/2 inch)  |
| <b>Maximum Inlet Pressure and Temperature<sup>(1)</sup></b><br>155 bar from –46 to 93°C, and 150 bar at 149°C.<br>(2250 psig from –50 to 200°F, and 2185 psig at 300°F)  | <b>Maximum Travel</b><br>13 mm (1/2 inch)   |
| <b>Maximum Allowable Pressure Drop<sup>(1)</sup></b><br><b>Spring-to-Close - Flow Down<sup>(2)</sup>:</b> 155 bar (2250 psig)<br><b>Spring-to-Open - Flow Down<sup>(2)</sup>:</b> 103 bar (1500 psig)<br><b>Spring-to-Close - Flow Up:</b> 103 bar (1500 psig)<br><b>Spring-to-Open - Flow Up:</b> 103 bar (1500 psig)   | <b>Approximate Weight</b><br>7.7 kg (17 lb)   |
| <b>Shutoff Classification</b><br>ANSI Class IV ANSI/FCI 70-2 and IEC 60534-4   | <b>Material Temperature Capabilities</b><br><b>Valve Body Assembly:</b> –46 to 149°C<br>(–50 to 300°F)<br><b>Actuator Assembly:</b> –46 to 93°C (–50 to 200°F)  |
| <b>Construction Materials</b><br><b>Valve Body and Bonnet:</b> ASME SA 352 LCC<br>Stress relieved<br><b>Valve Plug and Seat:</b> (R0006) Alloy 6<br><b>Valve Stem:</b> (S31600) 316 SST<br><b>O-Rings:</b> (HNBR) Hydrogenated Nitrile<br><b>Packing:</b> PTFE/Carbon PTFE<br><b>Packing Springs:</b> (N07718) Inconel 718<br><b>Stem Bushing:</b> (Ryton) PPS<br><b>Actuator Diaphragm:</b> Nitrile/Polyester<br><b>Actuator Springs:</b> Zinc-plated steel | <b>Bonnet/Body Connection</b><br>Threaded with leakoff bleed  |
| <b>Flow Characteristic</b><br>FloPro Characterized   | <b>Actuator Configuration</b><br>The D2 FloPro actuator is an on-off spring-and-diaphragm. Actuator action is Spring-to-Close from the factory.<br>For Spring-to-Open actuator action, a Spring-to-Open Spring Kit (10C1998X012) must be used |
|  | <b>Maximum Actuator Casing Pressure</b><br>2.4 bar (35 psig)  |
|  | <b>Minimum Required Actuator Casing Pressure</b><br>2.1 to 2.4 bar (30 to 35 psig)  |
|  | <b>Actuator Diaphragm Effective Area</b><br>194 cm <sup>2</sup> (30 square inches)  |
|  | <b>Actuator Pressure Connections</b><br>1/4 inch NPT female   |

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.

2. Standard flow direction.

## Installation



### WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

Personal injury or equipment damage caused by sudden release of pressure may result if the valve assembly is installed where service conditions could exceed the limits given in table 1 or on the appropriate nameplates. To avoid such injury or damage, provide a relief valve for overpressure protection as required by accepted industry or local, state, and Federal codes and good engineering practices.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

### CAUTION

This valve is intended for a specific range of pressures, temperatures, and other service conditions (see table 1). Applying different pressure, temperature, and other conditions to the valve could result in parts damage, malfunction of the valve, or loss of control of the process. *Do not expose this valve to service conditions or variables other than those for which this valve is intended.* If you are not sure what these conditions are, you should contact Fisher for more complete specifications. Provide the product serial number (shown on the nameplate) and all other pertinent information.

1. Before installing the valve, inspect it to be certain that the valve body cavity is free of foreign material. Clean out all pipelines to remove scale, welding slag, and other foreign materials.
2. The control valve assembly may be installed in any orientation unless limited by seismic criteria. However, the normal method is with the actuator vertical above the valve body.

The standard flow direction is indicated by the arrow on the valve body.

3. Use accepted piping practices when installing the valve in the pipeline.
4. If continuous operation is required during inspection or maintenance, install a three-valve bypass around the control valve assembly.

#### Note

**The 1-inch Type D2 FloPro valve is equipped with ENVIRO-SEAL® D2 packing.**

The actuator, as shipped from the factory, is spring-to-close. If spring-to-open action is required, see the Changing Actuator Action section in this manual.

Additionally, the actuator as shipped from the factory, has the FloPro flow adjuster set at a 3/8 inch port flow rate position. If some other flow rate is desired, see the Setting Valve Flow Rate section in this manual.

## Setting Valve FloPro Flow Adjuster

### Spring-to-Close Actuator Action

1. To change the valve flow rate, loosen the flow adjuster socket head cap screws (key 29), and reposition the flow adjuster halves (key 14 and 15) to the desired flow rate position. See figure 4 for flow rate settings.

### Spring-to-Open Actuator Action

1. Attach a pressure line to the actuator. Supply pressure to the actuator to seat the plug in the seat ring.
2. To change the valve flow rate, loosen the flow adjuster socket head cap screws (key 29), and reposition the flow adjuster halves (key 14 and 15) to the desired flow rate position. See figure 4 for flow rate settings.

## Changing Actuator Action from (Spring-to-Close) to (Spring-to-Open)

Key numbers are referenced in figures 6 and 7.

#### Note

**The following procedure requires use of Spring Kit 10C1998X012.**

1. Remove the six **short** actuator casing cap screws (key 22) first. Once these have been removed from the actuator assembly, carefully remove the two **long** actuator cap screws (key 30).

### Note

**Be aware as you loosen and remove the actuator cap screws that the actuator springs are under compression.**

2. Remove the upper casing (key 21) and the springs (key 27).

3. Do not turn the valve stem (key 4) while removing the diaphragm hex nut (key 26). Use an appropriate tool on the machined flats located on the valve stem above the flow adjuster for this procedure. Continue the actuator disassembly by removing the washer (key 24) diaphragm plate (key 25), diaphragm (key 19), and washer (key 24). Inspect the diaphragm for any wear or damage. Replace with a new one if necessary.

4. Unscrew the socket head cap screws (key 29), and remove the flow adjuster halves (key 14 and 15). Position the stem (key 4) to its most upward position.

5. Place the 3 springs (key 27) from the Spring Kit in their approximate, equally spaced, locations in the bottom casing (key 20). Place the washer (key 24) over the valve stem. Then install the diaphragm plate (key 25) and, using the diaphragm plate, correctly position the actuator springs.

6. Place the diaphragm (key 19) over the stem, along with washer (key 24). Position the diaphragm so the holes in the diaphragm align with the holes in the bottom casing.

7. Insert a 1/8 inch diameter drift punch, or other suitable device through the 5/32 diameter hole in the valve stem located below the bottom of the previously removed flow adjuster. Install hex nut (key 26) and tighten to 11 N•m (95 lbf•in). Remove the 1/8 inch drift punch or other holding device.

8. Attach the upper casing by first installing the two **long** cap screws (key 30) opposite one another. Begin tightening the two long screws evenly until the remaining six shorter cap screws (key 22) can be installed with their hex nuts. Continue tightening the actuator casing cap screws evenly using a cross-tightening procedure. Torque to 14 N•m (10 lbf•ft).

9. Connect a pressure line to the top actuator pressure connection, and apply pressure to the

actuator. Stroke the actuator until the valve plug is seated on the seat ring. Install the flow adjuster, positioning it to the desired travel. Tighten the flow adjuster socket head cap screws to 3 N•m (26 lbf•in).

10. Release the actuator pressure, and install the vent plug (key 28) into the bottom casing pressure connection.

## Maintenance

Valve parts are subject to normal wear and must be inspected and replaced as necessary. Inspection and maintenance frequency depends on the severity of service conditions. This section includes instructions for packing and trim maintenance, reversing the action, and replacing actuator parts.

All maintenance operations can be performed with the valve in the line.

### Note

**Whenever a gasket seal or O-ring is disturbed by removing or shifting gasketed parts, a new gasket should be installed upon reassembly. This is necessary to ensure a good gasket seal, since the used gasket or O-ring will not seal properly.**



## WARNING

**Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:**

- **Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.**
- **Disconnect any operating lines providing air pressure or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.**
- **Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve. Drain the process media from both sides of the valve.**



- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

- The valve packing box may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline.* Process fluids may spray out under pressure when removing the packing hardware or packing rings.

- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

## Valve Trim Maintenance

### Note

The following maintenance procedures apply to both spring-to-close and spring-to-open actuator configurations, except for steps 2 and 8 as noted.

Key numbers are referenced in figures 6 and 7.

1. Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve.

2. **For spring-to-close actuator action only**, apply pressure to the actuator to fully stroke it open. This will raise the plug off its seat so that the valve stem serrations are visible inside the flow adjuster window (see figure 5). Loosen the socket head screws (key 29) and lower the flow adjuster (key 14 and 15) to its lowest position on the valve stem. Retighten the socket head screws (key 29) to 3 N•m (26 lbf•in). Relieve pressure to the actuator, shut off all pressure lines to the actuator, and disconnect. Use lockout procedures to be sure that the above measures stay in effect while you work on the equipment.

### Note

The preceding step is intended to prevent damage to the valve plug (key 3) and seat ring (key 5) during the removal of the bonnet and actuator.

3. Unscrew the bonnet from the valve body.



## WARNING

Avoid personal injury from sudden release of process pressure. If the process media starts to escape from the safety vent (see figure 4) located in the bonnet neck of the valve body,

### STOP DISASSEMBLY IMMEDIATELY!

The escape of process media indicates that the valve has NOT been isolated from the process media, or process pressure is trapped in the valve body.

4. Once the bonnet has been removed from the valve body, inspect the seat ring (key 5) for wear or damage. If the seating surface has been damaged, remove it from the valve body. Also remove the seat ring gasket (key 6). Clean and inspect the valve body gasket surface for damage. Visually inspect the valve body interior below the seat ring for erosion. Replace the valve body if necessary.

To replace the seat ring, first install a new seat ring gasket. Install the new seat ring and tighten to 230 N•m (170 lbf•ft).

Cover the opening in the valve body to prevent foreign material from getting into the valve body cavity.

5. Inspect the valve stem for scratches or wear, and valve plug for wear or damage. Replace if necessary.

6. If the valve plug requires replacement, use an appropriate tool on the machined flats located on the valve stem above the flow adjuster and unscrew the valve plug from the valve stem. Replace it with a new valve plug. Screw the valve plug into the valve stem, being careful not to damage the plug seat or plug contour. Tighten to 18 N•m (13 lbf•ft).

7. Lubricate a new O-ring (key 13) with Dow Corning 111 compound or equivalent and place it into the valve body as shown in figure 6 or 7. Ensure that no foreign material blocks the safety vent hole. Screw the bonnet into the valve body, and torque to a range of 542.3 to 677.9 N•m (400 to 500 lbf•ft).

8. **For spring-to-close actuator action only**, attach the pressure line to the actuator, and supply pressure to the actuator. Move the flow adjuster to approximately midpoint on the valve stem serration. Release the pressure to the actuator. This allows the plug to find its seated position.

9. Set the flow adjuster to the desired travel position (see figure 4), and tighten the flow adjuster socket head cap screws to 3 N•m (26 lbf•in).

## Packing and Valve Trim Maintenance

### Note

The following maintenance procedures apply to both spring-to-close and spring-to-open actuator configurations, except for steps 2, 23, and 26 as noted.

Key numbers are referenced in figures 6 and 7.

1. Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve.

2. **For spring-to-close actuator action only**, apply pressure to the actuator to fully stroke it open. This will raise the plug off its seat so that the valve stem serrations are visible inside the flow adjuster window (see figure 5). Loosen the socket head screws (key 29) and lower the flow adjuster (key 14 and 15) to its lowest position on the valve stem. Retighten the socket head screws (key 29) to 3 N•m (26 lbf•in). Relieve pressure to the actuator, shut off all pressure lines to actuator, and disconnect. Use lockout procedures to be sure that the above measures stay in effect while you work on the equipment.

### Note

The preceding step is intended to prevent damage to the valve plug (key 3) and seat ring (key 5) during the removal of the bonnet and actuator.

3. Unscrew the bonnet from the valve body.



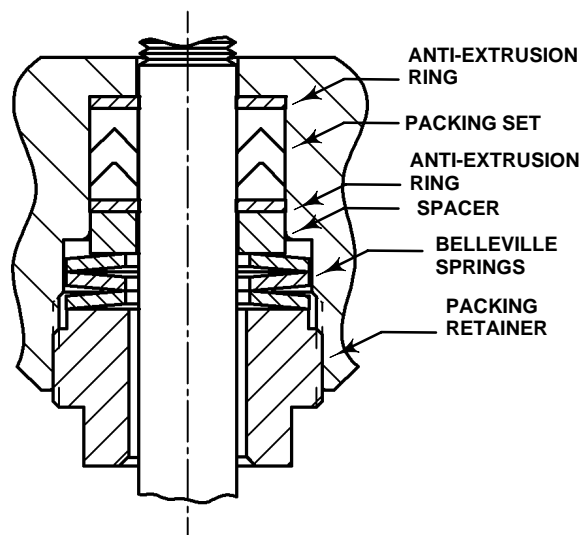
## WARNING

Avoid personal injury from sudden release of process pressure. If the process media starts to escape from the safety vent (see figure 4) located in the bonnet neck of the valve body,

**STOP DISASSEMBLY IMMEDIATELY!**

The escape of process media indicates that the valve has NOT been isolated from the process media, or process pressure is trapped in the valve body.

4. Once the bonnet has been removed from the valve body, inspect the valve seat (key 5) for wear or



E0784-1

Figure 2. Packing and Belleville Spring Stacking Order

damage. If the seating surface has been damaged, remove it from the valve body. Also remove the seat ring gasket (key 6). Clean and inspect the valve body gasket surface for damage. Visually inspect the valve body interior below the seat ring for erosion. Replace the valve body if necessary.

To replace the seat ring, first install a new seat ring gasket. Install the new seat ring and tighten to 230 N•m (170 lbf•ft).

Cover the opening in the valve body to prevent foreign material from getting into the valve body cavity.

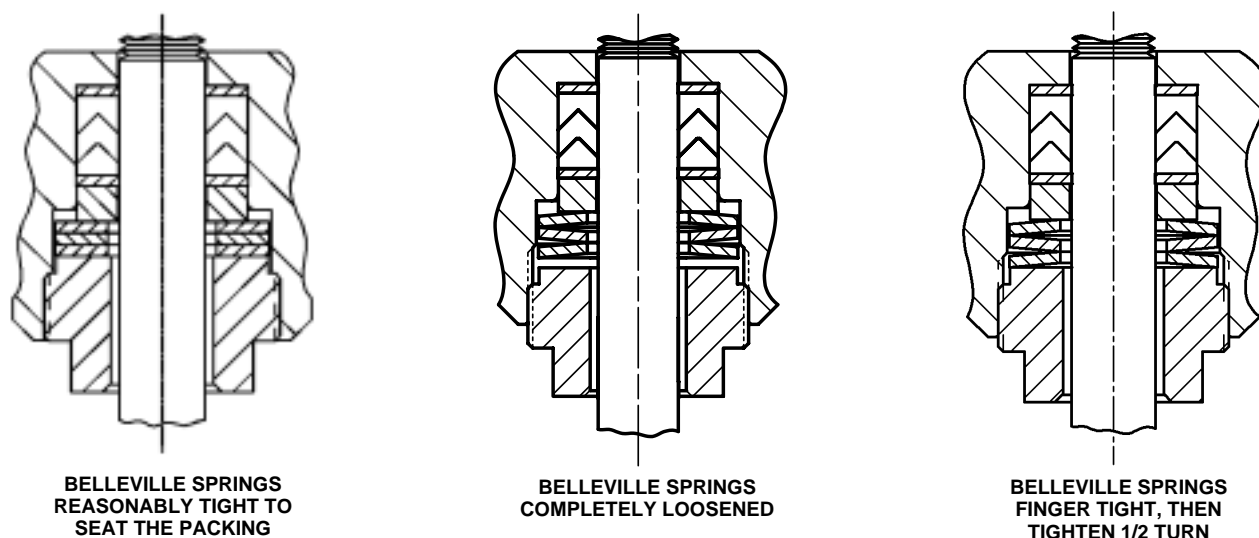
5. Remove the six **short** actuator casing cap screws (key 22) first. Once these have been removed from the actuator assembly, carefully remove the two **long** actuator cap screws (key 30).

### Note

Be aware as you loosen and remove the actuator cap screws that the actuator springs are under compression.

6. Remove the upper casing (key 21) and the springs (key 27).

7. Do not turn the valve stem (key 4) while removing the diaphragm hex nut (key 26). Use an appropriate tool on the machined flats located on the valve stem above the flow adjuster for this procedure. Continue the actuator disassembly by removing the washer (key 24) diaphragm plate (key 25), diaphragm (key 19), and washer (key 24 for spring-to-open or key 36



*Figure 3. Belleville Spring Procedure*

for spring-to-close). Inspect the diaphragm for any wear or damage. Replace with a new one if necessary.

If you wish to inspect/replace the bonnet to actuator casing O-ring (key 16), mark the orientation of the actuator pressure connection to the bonnet for later reference (see figure 5). Unscrew the hex nut (key 18) from the bonnet. Remove the bottom casing (key 20).

8. Unscrew the flow adjuster socket head cap screws (key 29), and remove the flow adjuster halves.

9. Unscrew the packing retainer (key 7) from the bonnet (key 2). After the packing retainer has been unscrewed from the bonnet, pull the valve stem and plug out of the bonnet.

10. Remove the three Belleville springs (key 9), packing spacer (key 10), packing (key 11), and two anti-extrusion rings (key 12) from the bonnet. See figure 2.

11. Clean and inspect the packing box wall to ensure that the packing surfaces are not damaged. If the surface condition is damaged, and cannot be improved by light sanding, replace the bonnet by contacting your Fisher sales office.

12. Inspect the valve stem for scratches or wear, and valve plug for wear or damage. Replace if necessary.

13. If the valve plug requires replacement, use an appropriate tool on the machined flats located on the valve stem above the flow adjuster and unscrew the

valve plug from the valve stem. Replace it with a new valve plug. Screw the valve plug into the valve stem, being careful not to damage the plug seat or plug contour. Tighten to 18 N•m (13 lbf•ft).

14. Inspect the valve stem bushing (key 8) located in the upper end of the bonnet. If damaged, remove and replace it with new bushing (key 8). Replace the valve stem bushing by inserting the bushing, flange end first, into the bore located at the top of the bonnet flow adjuster window. Insert until the flange snaps into the groove provided for it.

15. Remove the O-ring (key 17) from the upper end of the bonnet. Replace it with a new one, and lubricate it with Dow Corning 111 compound or equivalent.

16. Install new packing according to the packing arrangement shown in figure 2. Slide the valve stem through the packing retainer. Place the Belleville springs over the valve stem, positioned as shown in figure 2. Carefully slide the stem through the packing to a point where the serration extends completely into the flow adjuster window of the bonnet (see figure 5).

17. Apply a light film of Dow Corning 111 lubricant or equivalent (key 33) to the threads of the packing retainer (key 7).

18. Install the packing retainer into the bonnet and tighten until the Belleville springs (key 9) are reasonably tight to seat the packing. See figure 3.

19. Completely loosen the packing retainer to relieve all Belleville spring compression. See figure 3.

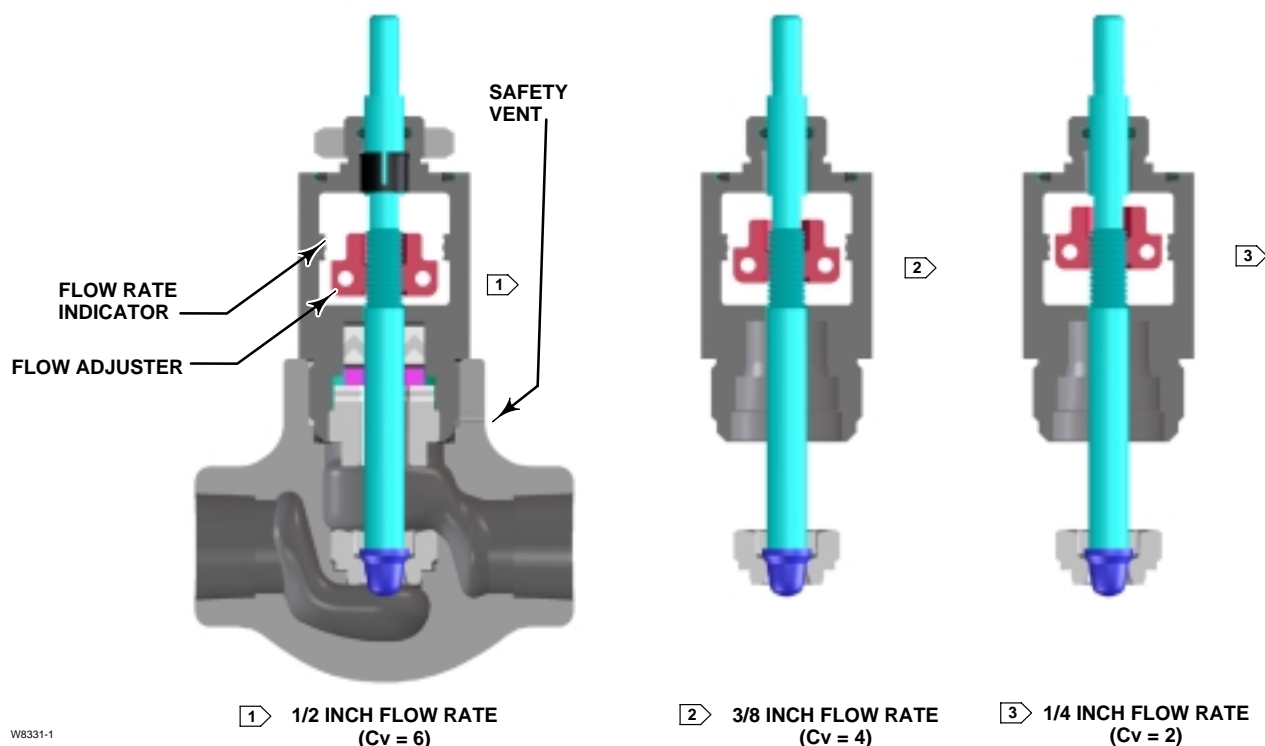


Figure 4. Flow Rate Adjustments

20. Retighten the packing retainer with your fingers until the packing retainer contacts the Belleville springs. See figure 3.

21. Tighten the packing retainer 1/2 turn clockwise. See figure 3.

22. If the bottom casing (key 20) has been removed, place O-ring (key 16) into the groove provided in the top of the bonnet. Place the bottom casing on the bonnet, oriented in the same position as marked in step 7 on page 7. Screw the hex nut (key 18) onto the bonnet, and tighten to 203 N•m (150 lbf•ft).

23. **For spring-to-close actuator action only**, assemble the actuator by first placing the washer (key 24) over the valve stem. Then place the diaphragm (key 19) over the valve stem, and position it so the holes in the diaphragm match the holes in the casing. Place the diaphragm plate (key 25) over the valve stem. Install the washer (key 24), diaphragm hex nut (key 26). Tighten the diaphragm hex nut to 11 N•m (95 lbf•in), while holding the stem by the flats. Install the springs (key 27) and attach the upper casing (key 21) by first installing the two **long** cap screws (key 30) opposite one another.

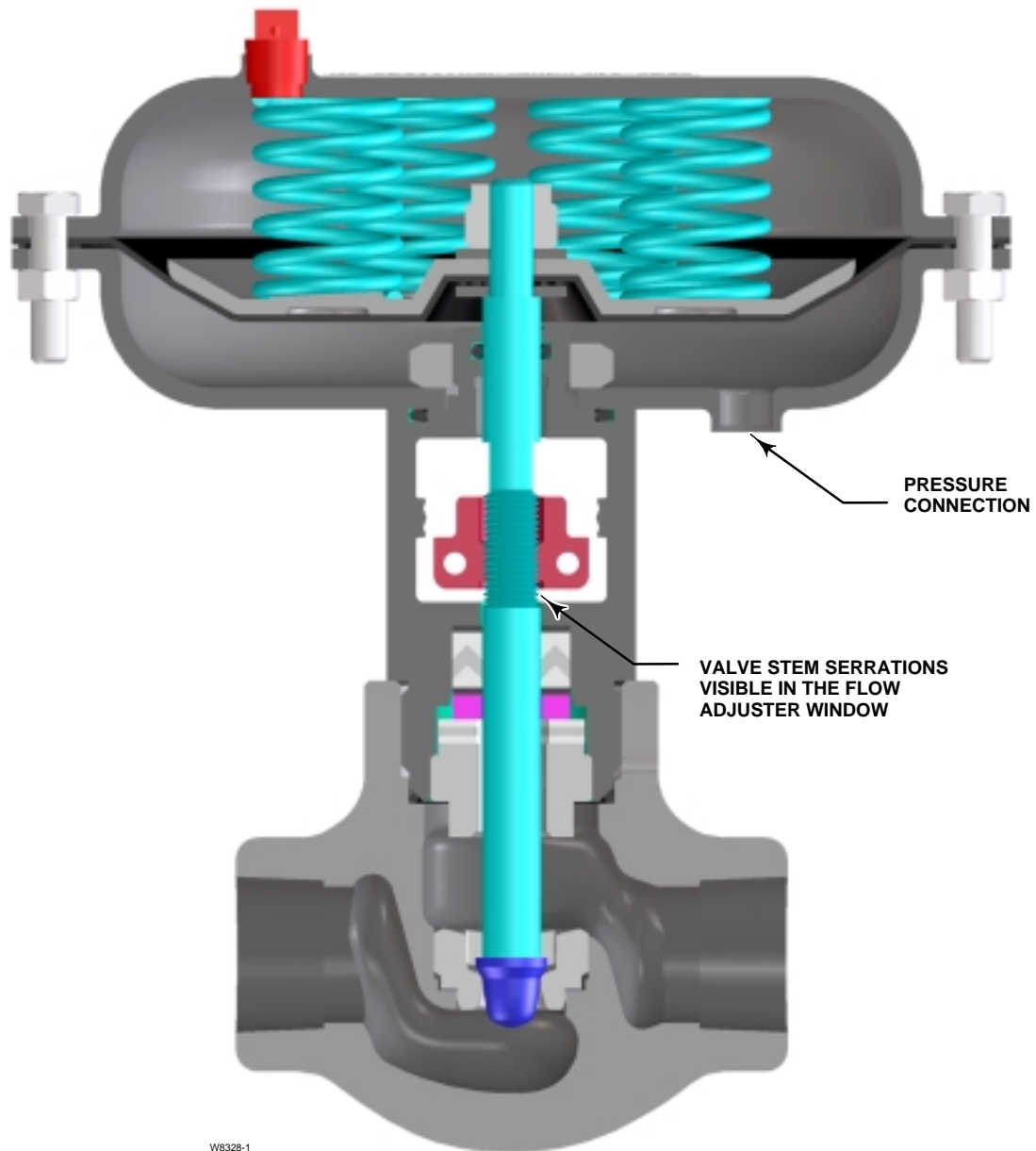
24. Begin tightening the two long screws evenly until the remaining six shorter cap screws (key 22)

can be installed with their hex nuts. Continue tightening the actuator casing cap screws evenly using a cross-tightening procedure. Torque to 14 N•m (10 lbf•ft).

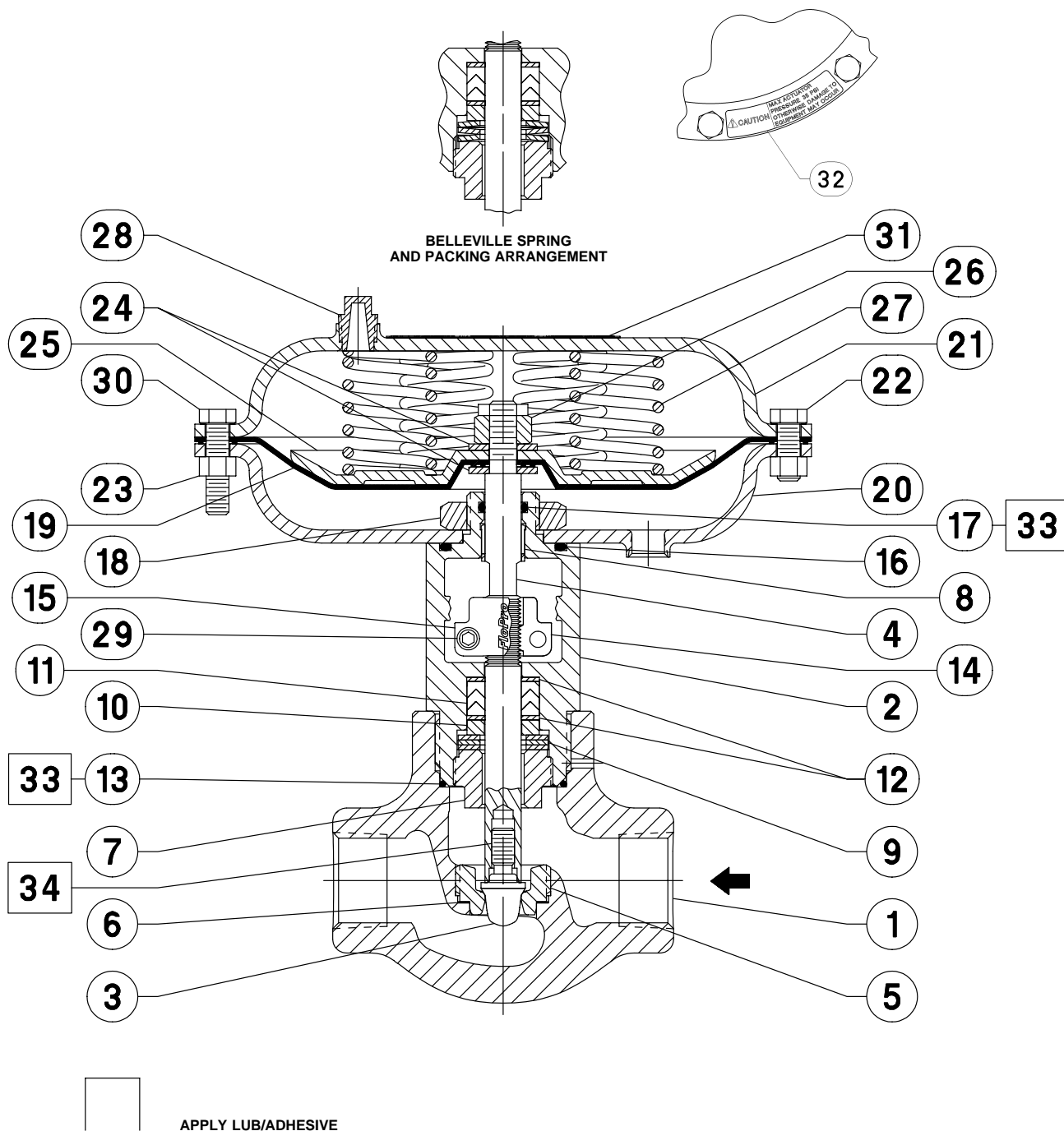
25. Lubricate a new O-ring (key 13) with Dow Corning 111 compound or equivalent and place it into the valve body as shown in figure 6 or 7. Ensure that no foreign material blocks the safety vent hole. Screw the bonnet into the valve body, and torque to a range of 542 to 678 N•m (400 to 500 lbf•ft).

26. **For spring-to-close actuator action only**, attach the pressure line to the actuator, and supply pressure to the actuator. Move the flow adjuster to approximately midpoint on the valve stem serration. Release the pressure to the actuator. This allows the plug to find its seated position.

27. Set the flow adjuster to the desired travel position (see figure 4), and tighten the flow adjuster socket head cap screws to 3 N•m (26 lbf•in).



*Figure 5. Type D2 FloPro Interior Detail*



39B5892-F

Figure 6. Type D2 FloPro Assembly—Spring-to-Close

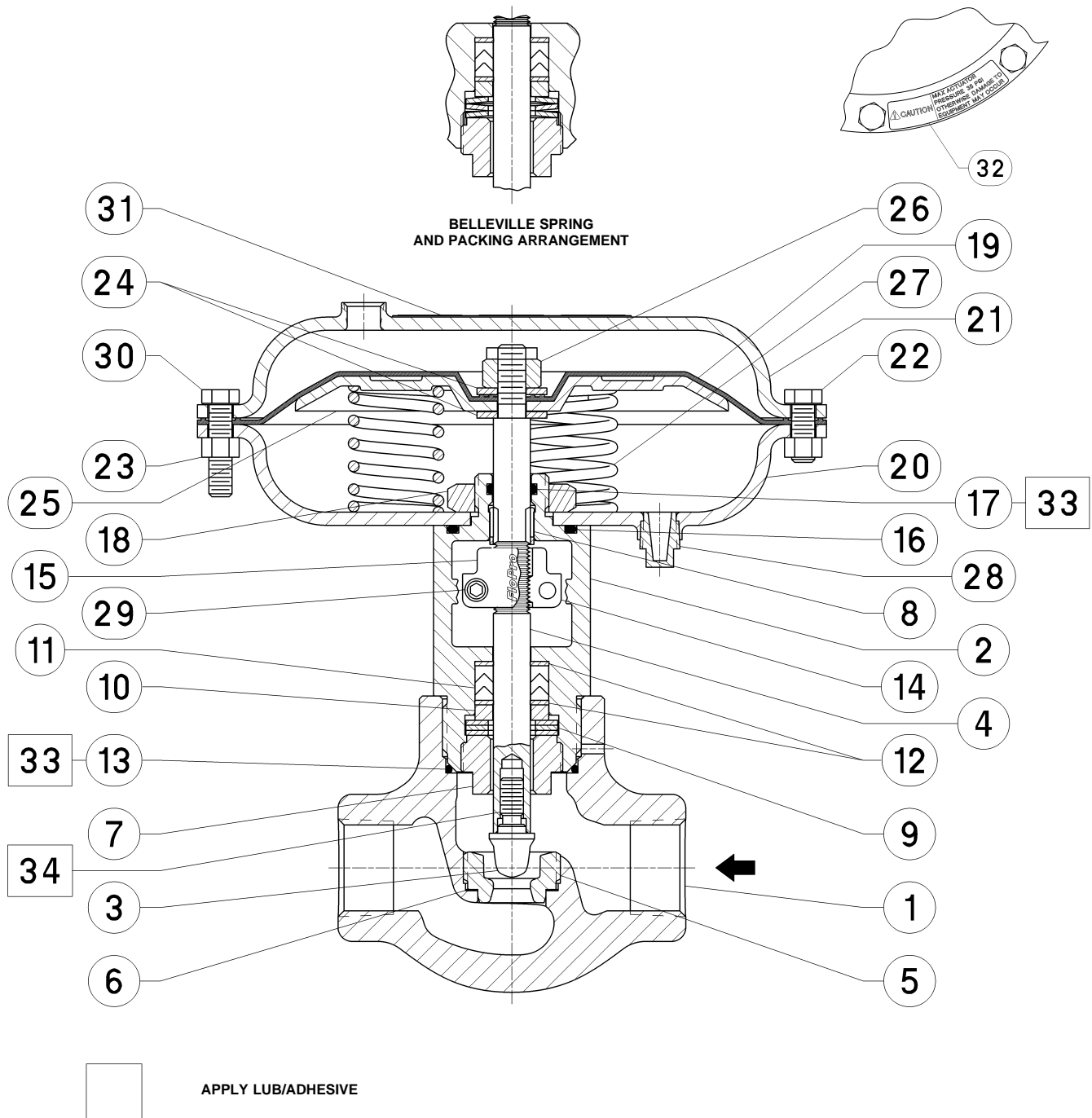


Figure 7. Type D2 FloPro Assembly—Spring-to-Open

## Parts Ordering

Components that are not manufactured by Fisher should not, under any circumstances, be used in any Fisher valve. The use of parts not manufactured by Fisher may adversely affect the performance of the valve as well as worker and workplace safety.

### Note

**Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.**

## Parts Kits

|   | Description   | Part Number |
|---|---|-------------|
| * | Valve Trim Kit<br>Includes key numbers 3, 5, 6, and 13                        | 19B8485X012 |
| * | Valve Packing Kit<br>Includes key numbers 8, 11, 12 (2 req'd), 13, 16, and 17 | 19B8486X012 |
| * | Spring-to-Open Spring Kit<br>Includes key number 27 (3 springs)               | 10C1998X012 |

## Parts List

### Note

**Part numbers are shown for recommended spares only. For part numbers not shown, contact your Fisher sales office.**

| Key | Description   | Part Number |
|-----|---|-------------|
| 1   | Valve Body  |             |
| 2   | Bonnet  |             |
| 3   | Valve Plug  |             |
| 4*  | Valve Stem  | 39B5914X012 |
| 5   | Seat Ring   |             |
| 6*  | Seat Ring Gasket  | 19B5887X012 |
| 7   | Packing Retainer  |             |
| 8   | Valve Stem Bushing  |             |
| 9   | Belleville Springs (3 req'd)  |             |
| 10  | Packing Spacer  |             |
| 11  | ENVIRO-SEAL D2 Packing Set  |             |
| 12  | Anti-Extrusion Ring (2 req'd)   |             |
| 13  | Valve Body O-ring   |             |
| 14  | Flow Adjuster Half  |             |
| 15  | Flow Adjuster Half  |             |
| 16  | Casing O-ring   |             |
| 17  | Valve Stem O-ring   |             |
| 18  | Hex Nut   |             |
| 19* | Diaphragm   | 39B3849X012 |
| 20  | Bottom Casing   |             |
| 21  | Upper Casing  |             |
| 22  | Short Actuator Casing Cap Screws (6 req'd)  |             |
| 23  | Nut   |             |
| 24  | Washer (2 req'd for spring-to-open, 1 req'd for spring-to-close)                          |             |
| 25  | Diaphragm Plate   |             |
| 26  | Diaphragm Hex Nut   |             |
| 27  | Springs<br>Spring-to-Close (6 springs)<br>Spring-to-Open (Spring Kit, 3 springs included) |             |
| 28  | Vent Plug   |             |
| 29  | Flow Adjuster Socket Head Cap Screws (2 req'd)  |             |
| 30  | Long Actuator Casing Cap Screws (2 req'd)   |             |
| 31  | Nameplate   |             |
| 32  | Caution Label   |             |
| 33  | Lubricant, Dow Corning 111 Compound or equivalent   |             |
| 36  | Washer (spring-to-close)  |             |

\*Recommended spare parts

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### Emerson Process Management

#### Fisher

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Singapore 128461

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# Assembly of 1" Safety Relief Valve 8200

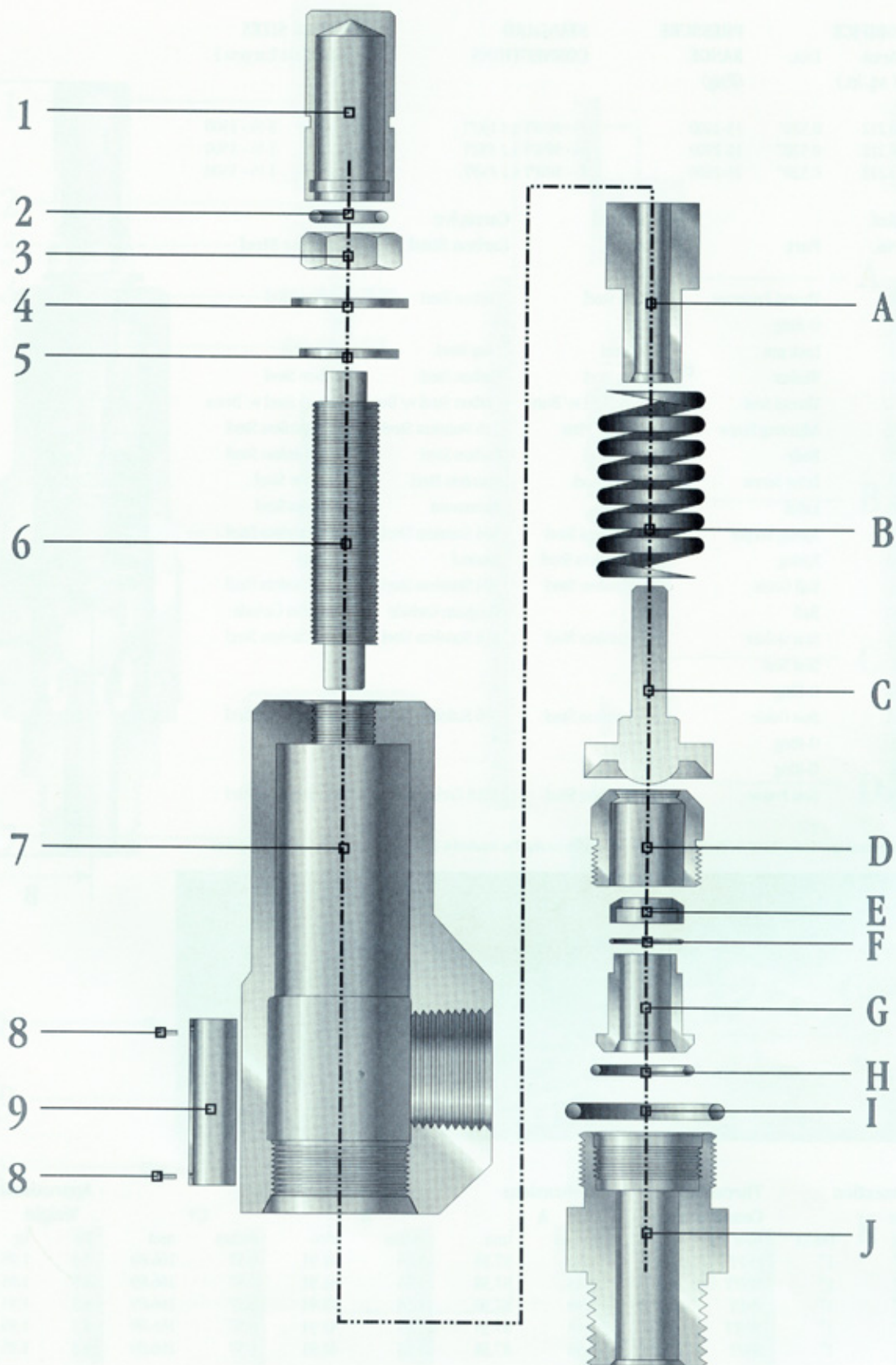
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TAYLOR VALVE TECHNOLOGY, INC.

EXPLODED VIEW OF A 1" SAFETY RELIEF VALVE

SRV-98

Exploded View of 1" Safety Valve



✕

8300 SW 8th Street \* Oklahoma City, Oklahoma 73128

Tel (405) 787 0145 \* Fax (405) 789-8198 \* Email: info@taylorvalve.com



# Bill of Material 1" Safety Relief Valve 8200

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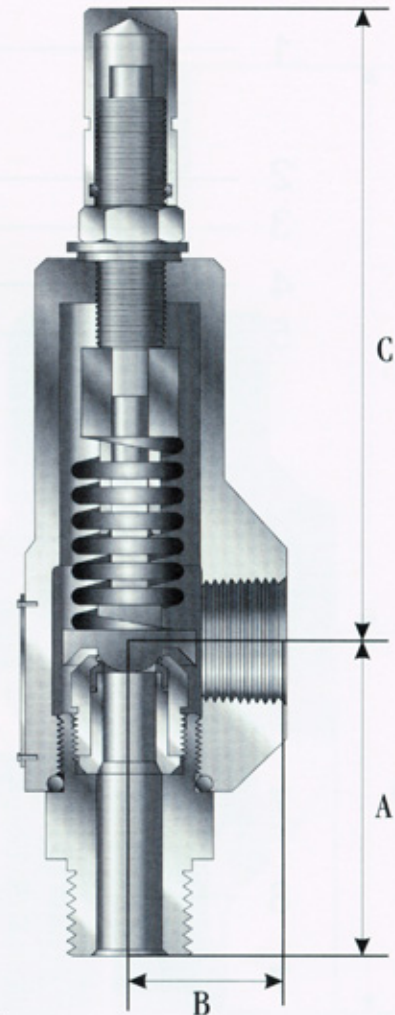
TAYLOR VALVE TECHNOLOGY, INC.

## BILL OF MATERIALS 1 INCH SAFETY RELIEF VALVE

SRV-98

| ORIFICE<br>Area<br>(sq. In.) | Dia. | PRESSURE<br>RANGE<br>(psig) | STANDARD<br>CONNECTIONS | FLANGE SIZES<br>(Smallest/Largest) |            |
|------------------------------|------|-----------------------------|-------------------------|------------------------------------|------------|
|                              |      |                             |                         |                                    |            |
| 0.128                        | D    | 15-4000                     | ½ - MNPT x 1 FNPT       | ½ - 150                            | 1 ½ - 1500 |
| 0.128                        | D    | 15-4000                     | ¾ - MNPT x 1 FNPT       | ¾ - 150                            | 1 ½ - 1500 |
| 0.128                        | D    | 15-4000                     | 1 - MNPT x 1 FNPT       | 1 - 150                            | 1 ½ - 900  |
| 0.212                        | E    | 15-2500                     | ½ - MNPT x 1 FNPT       | ½ - 150                            | 1 ½ - 900  |
| 0.212                        | E    | 15-2500                     | ¾ - MNPT x 1 FNPT       | ¾ - 150                            | 1 ½ - 900  |
| 0.212                        | E    | 15-2500                     | 1 - MNPT x 1 FNPT       | 1 - 150                            | 1 ½ - 900  |
| 0.357                        | F    | 1500-2000                   | ¾ - FNPT x 1 FNPT       | ¾ - 150                            | 1 ½ - 600  |
| 0.357                        | F    | 1500-2000                   | 1 - FNPT x 1 FNPT       | 1 - 150                            | 1 ½ - 600  |

| Ref.<br>No. | Part             | Standard<br>Service  | Corrosive<br>Carbon Steel | NACE<br>Stainless Steel |
|-------------|------------------|----------------------|---------------------------|-------------------------|
| 1.          | Thread Protector | Carbon Steel         | Carbon Steel              | Carbon Steel            |
| 2.          | O-Ring           | *                    | *                         | *                       |
| 3.          | Lock nut         | Alloy Steel          | Alloy Steel               | Alloy Steel             |
| 4.          | Washer           | Carbon Steel         | Carbon Steel              | Carbon Steel            |
| 5.          | Thread Seal      | Carbon Steel w/ Buna | Carbon Steel w/ Buna      | Carbon Steel w/ Buna    |
| 6.          | Adjusting Screw  | CS /w Zinc Plate     | 316 Stainless Steel       | 316 Stainless Steel     |
| 7.          | Body             | Carbon Steel         | Carbon Steel              | 316 Stainless Steel     |
| 8.          | Drive Screw      | Stainless Steel      | Stainless Steel           | Stainless Steel         |
| 9.          | Label            | Aluminum             | Aluminum                  | Stainless Steel         |
| A.          | Spring Keeper    | 304 Stainless Steel  | 304 Stainless Steel       | 304 Stainless Steel     |
| B.          | Spring           | 17.7 Stainless Steel | Inconel                   | Inconel                 |
| C.          | Disc             | 17.4 Stainless Steel | 316 Stainless Steel       | 316 Stainless Steel     |
| D.          | Seat Holder      | 303 Stainless Steel  | 316 Stainless Steel       | 316 Stainless Steel     |
| E.          | Seat Seal        | *                    | *                         | *                       |
| F.          | O-Ring           | *                    | *                         | *                       |
| G.          | Seat Guide       | 303 Stainless Steel  | 316 Stainless Steel       | 316 Stainless Steel     |
| H.          | O-Ring           | *                    | *                         | *                       |
| I.          | O-Ring           | *                    | *                         | *                       |
| J.          | Seat Frame       | 1018 Carbon Steel    | 1018 Carbon Steel         | 316 Stainless Steel     |



\* per customer specification based on *Elastomer Chart* provided in this catalog. The Standard is a 75 or 90 durometer fluorocarbon compound.

| Connection<br>Size |        | Threaded<br>Connections |        | Dimensions<br>A |       | B      |       | C*     |        | Approximate<br>Weight |      |
|--------------------|--------|-------------------------|--------|-----------------|-------|--------|-------|--------|--------|-----------------------|------|
| Inlet              | Outlet | Inlet                   | Outlet | inches          | mm    | inches | mm    | inches | mm     | lbs                   | kg   |
| 1/2"               | 1"     | FNPT                    | FNPT   | 3.44            | 87.38 | 1.65   | 41.91 | 6.57   | 166.89 | 4.3                   | 1.95 |
| 1/2"               | 1"     | MNPT                    | FNPT   | 3.44            | 87.38 | 1.65   | 41.91 | 6.57   | 166.89 | 4.3                   | 1.95 |
| 3/4"               | 1"     | FNPT                    | FNPT   | 3.44            | 87.38 | 1.65   | 41.91 | 6.57   | 166.89 | 4.3                   | 1.95 |
| 3/4"               | 1"     | MNPT                    | FNPT   | 3.44            | 87.38 | 1.65   | 41.91 | 6.57   | 166.89 | 4.3                   | 1.95 |
| 1"                 | 1"     | FNPT                    | FNPT   | 3.44            | 87.38 | 1.65   | 41.91 | 6.57   | 166.89 | 4.3                   | 1.95 |

\* With a lift lever the "C" dimension is 7.66" or 194.56 mm

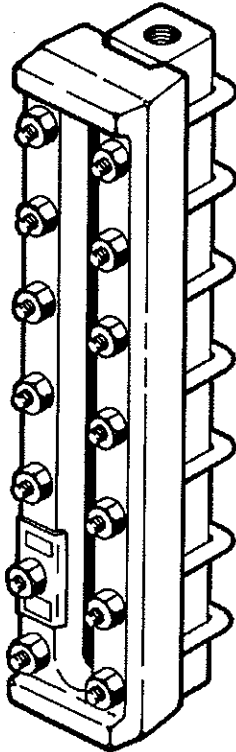


Bill of Materials for Safety Valve

**tyco**

Flow Control

PENBERTHY



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**Product Warranty**

Penberthy Inc., warrants its products as designed and manufactured by Penberthy to be free of defects in material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. Penberthy will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to Penberthy and obtain written authorization to return the product. Thereafter, the product shall be returned to Penberthy in Prophetstown, Illinois, with freight prepaid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or altered outside of the Penberthy factory, or if it has been subjected to misuse, neglect or accident.

Penberthy's responsibility hereunder is limited to repairing or replacing the product at its expense. Penberthy shall not be liable for loss, damage, or expenses directly or indirectly related to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that Penberthy is not responsible for damage or injury caused to other products, building, property or persons, by reason of the installation or use of its products.

This is Penberthy's sole warranty and in lieu of all other warranties, expressed or implied which are hereby excluded, including in particular all warranties of merchantability or fitness for a particular purpose.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of Penberthy unless modified or made in writing and signed by the President or a Vice President of Penberthy.

# Installation & Maintenance Instructions

## Flat Glass Gages, Series M

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance. Failure to follow any instruction could possibly result in a malfunction of the gage or glass breakage with resulting sudden release of pressure, property damage or physical injury to personnel.

### Safety instructions

Penberthy does not have any control over the manner in which its liquid level gage is handled, installed or used. Penberthy cannot and will not guarantee that a liquid level gage is suitable or compatible for the user's specific application.



### Warning

Contained fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a liquid level gage. Failure to do so could result in serious physical injury to personnel.

## 2.0 Introduction

Penberthy liquid level gages are used to allow direct visualization of liquid level in vessels. By peering through the glass, it is possible to monitor color, clarity, and level of a gas/liquid interface. Gages are available in varying lengths and configurations (end connect, side connect, multiple sections, NPT or flange connections, etc.). Visual indication can be enhanced by using reflex glass or illuminators (accessory).

### 2.1 System description

Penberthy gages are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gage. Use the exploded parts view in Section 11 as additional reference material.

|                   |   |
|-------------------|---|
| Chamber           | - provides a pressure retaining metallic channel for the liquid to enter and be viewed. Slot(s) are machined into the chamber to provide direct visualization of the process fluid. |
| Gaskets           | - seal the gap and prevent leakage between the chamber and the glass. Gaskets are available in a variety of materials for compatibility with the media in the gage.                 |
| Glass             | - glass allows for visual observation of the process fluid in the chamber   |
| Cushion           | - acts as a protective buffer between the glass and the cover. For proper sealing cushions must be as hard as or harder than the gasket material.                                   |
| Cover             | - protects the glass assembly from external hits and provides a flat, rigid surface that is used to evenly compress the gage assembly.  |
| Bolting           | - compresses the components between the covers (transparent gages) or cover and chamber (reflex gages).   |
| Shield (optional) | - used to prevent the process media from contacting the glass.  |

## 2.2 Application

Penberthy medium (Series M) pressure liquid level gage are designed for applications other than steam/water: 1) requiring pressure ratings lower than that of Penberthy Series H liquid level gages, 2) where pressure ratings are greater than those possible using low pressure (Series L) liquid level gages, or 3) for Series L pressure ranges where iron covers are not allowed.

# Installation & Maintenance Instructions

## Flat Glass Gages, Series M

### 3.1 Design ratings at maximum and minimum operating temperatures

| Gasket material                              | Glass size | Model RM reflex  |                       |
|--|------------|--|-----------------------|
|  |            | Wetted parts material steel or stainless steel w/B7 bolting  |                       |
|  |            | -20°F (-29°C) to 100°F (37°C)  | 600°F (315°C)         |
| Grafoil®<br>(standard)<br>or<br>non-Asbestos | 1          | 3000 PSIG (20685 KPa)  | 2220 PSIG (15305 KPa) |
|  | 2          | 2910 PSIG (20065 KPa)  | 2150 PSIG (14825 KPa) |
|  | 3          | 2820 PSIG (19445 KPa)  | 2080 PSIG (14340 KPa) |
|  | 4          | 2725 PSIG (18790 KPa)  | 2040 PSIG (14065 KPa) |
|  | 5          | 2630 PSIG (18135 KPa)  | 1950 PSIG (13445 KPa) |
|  | 6          | 2535 PSIG (17480 KPa)  | 1875 PSIG (12930 KPa) |
|  | 7          | 2440 PSIG (16825 KPa)  | 1805 PSIG (12445 KPa) |
|  | 8          | 2345 PSIG (16170 KPa)  | 1740 PSIG (12000 KPa) |
|  | 9          | 2250 PSIG (15515 KPa)  | 1660 PSIG (11445 KPa) |
| PTFE/<br>Top-Chem<br>2000®                   | 1-9        | 3000 PSIG (20685 KPa) at -20°F (-29°C) to 500°F (260°C)<br>reference Application Report for gage pressure limitation<br>at specific temperatures |                       |
| 25% glass<br>filled PTFE                     | 1-9        | 900 PSIG (6205 KPa) at -20°F (-29°C) to 100°F (37°C)<br>450 PSIG (3105 KPa) at 500°F (260°C)   |                       |
| NBR/Buna N®                                  | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>225 PSIG (1550 KPa) at 250°F (121°C)   |                       |
| FKM/Viton®                                   | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>180 PSIG (1240 KPa) at 400°F (204°C)   |                       |
| PTFE/Teflon®                                 | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>150 PSIG (1035 KPa) at 500°F (260°C)   |                       |

**Note:** Lower temperatures are possible with metallic material variation. (e.g., 316 Stainless construction, Grafoil® gaskets/cushions useable to -325°F (198°C))

| Gasket material                                  | Glass size | Model TM Transparent   |                       |
|--|------------|--|-----------------------|
|  |            | Wetted parts material steel or stainless steel w/B7 bolting  |                       |
|  |            | -20°F (-29°C) to 100°F (37°C)  | 600°F (315°C)         |
| Grafoil®<br>(standard)<br>or<br>non-Asbestos     | 1          | 2500 PSIG (17235 KPa)  | 1850 PSIG (12755 KPa) |
|  | 2          | 2315 PSIG (15960 KPa)  | 1720 PSIG (11860 KPa) |
|  | 3          | 2130 PSIG (14685 KPa)  | 1575 PSIG (10860 KPa) |
|  | 4          | 1940 PSIG (13375 KPa)  | 1435 PSIG (9895 KPa)  |
|  | 5          | 1750 PSIG (12065 KPa)  | 1295 PSIG (8930 KPa)  |
|  | 6          | 1565 PSIG (10790 KPa)  | 1160 PSIG (8000 KPa)  |
|  | 7          | 1375 PSIG (9480 KPa)   | 1015 PSIG (7000 KPa)  |
|  | 8          | 1190 PSIG (8205 KPa)   | 880 PSIG (6070 KPa)   |
|  | 9          | 1000 PSIG (6895 KPa)   | 740 PSIG (5100 KPa)   |
| PTFE/<br>Top-Chem<br>2000®                       | 1-9        | 2500 PSIG (17235 KPa) at -20°F (-29°C) to 500°F (260°C)<br>reference Application Report for gage pressure limitation<br>at specific temperatures |                       |
| 25% glass<br>filled PTFE                         | 1-9        | 900 PSIG (6205 KPa) at -20°F (-29°C) to 100°F (37°C)<br>450 PSIG (3105 KPa) at 500°F (260°C)   |                       |
| NBR/Buna N®                                      | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>225 PSIG (1550 KPa) at 250°F (121°C)   |                       |
| FKM/Viton®                                       | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>180 PSIG (1240 KPa) at 400°F (204°C)   |                       |
| PTFE/Teflon®                                     | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>150 PSIG (1035 KPa) at 500°F (260°C)   |                       |
| PCTFE/Kel-F®<br>Shields 0.063"<br>(1.6 mm) thick | 1-9        | 300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F (37°C)<br>180 PSIG (1240 KPa) at 400°F (204°C)   |                       |

**Note:** Lower temperatures are possible with metallic material variation. (e.g., 316 Stainless construction, Grafoil® gaskets/cushions useable to -325°F (198°C))

# Installation & Maintenance Instructions

## Flat Glass Gages, Series M

The pressure and temperature ratings may deviate from the above tables if the gasketing materials of construction and/or bolting are other than those specified. Higher and/or lower temperature ratings are available with different materials of construction.

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in the tables, the user should refer to Penberthy dimension sheets, or when provided, the specifically stated design limits on a Penberthy product proposal.

Note: under no circumstances should shields be used in reflex style gages. Installation of shields in reflex style gages will keep the liquid from coming in contact with the refractive prisms, thereby prohibiting visualization of the liquid level in the gage.



### **Danger**

Never exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gage components resulting in death, serious personal injury and property damage.

## **4.0 Inspection**

Upon receipt of a liquid level gage, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

Penberthy's standard 1 section TM gage consists of: (1) chamber, (2) gaskets, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (1) washer, (1) nameplate, and (6 - 14) bolting sets, depending on the size.

### **4.1 Glass inspection**

The self stick caution tape was applied at the factory to protect the glass during shipping, handling, and installation. Do not remove the tape from the glass until all installation procedures have been completed, except during receiving inspection to momentarily inspect glass for shipping damage.

Glass that is not protected will be vulnerable to dust, grit, tools and any other objects which may scratch, chip, or break the glass.



### **Warning**

Do not use glass that is chipped or even slightly scratched. Glass surface defects weaken the glass which may result in glass breakage and fluid loss under pressure resulting in serious personal and property damage.

### **4.2 User rating inspection**

The user should confirm that:

1. the Series M liquid level gage model and assembly number stamped on the nameplate conforms to the description on the user's purchase order,
2. the operating conditions described in the purchase order agree with the actual operating conditions at the installation site,
3. the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above, and
4. the materials of construction of the liquid level gage are compatible with both the contained media and surrounding atmosphere in the specific application.

### **Safety Instructions**

If the size, model, or performance data of the liquid level gage as received does not conform with any of the criteria above, do not proceed with installation.

Contact an authorized Penberthy distributor for assistance. The incorrect gage can result in unacceptable performance and potential damage to the gage.



Installation should only be undertaken by qualified personnel who are familiar with equipment of this type. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model liquid level gage.

Penberthy recommends that all liquid level gage installations be provided with gage valve sets equipped with ball check shut-off. Gage valve sets are designed to isolate the gages from the pressure vessel when it becomes necessary to drain or service the gages. The ball check shut-off is designed to retard leakage of the contained fluid in the event of gage glass breakage. Ball checks are available for both positive and negative vessel pressures.

The number of different types of gage and valve installations is too great to adequately detail in an installation manual. It is, therefore, the user's responsibility to assure that the knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the installation guidelines that should be employed.

### 5.1 Piping strain

The gage should be mounted and connected so that it does not support any piping weight. Piping not properly supported, independent of the gage, may subject the gage to stresses that can cause leaks or glass breakage. Support brackets are available as an accessory.

### 5.2 Differential thermal expansion

High mechanical loads may be imposed on a gage by expanding and contracting pipes due to hot or cold service. Such mechanical loads on the gage must be minimized by the use of expansion loops in the system. Failure to allow for expansion or contraction can result in leaks or glass breakage.

### 5.3 Mirror viewing

For added safety, a system of indirect viewing by means of mirrors should be installed to protect personnel from the hazards of possible gage failure.

### 5.4 Nut retorquing (not applicable for gages with Belleville washers) - see Section 5.5

Nut retorque is vital to the operation of a liquid level gage because gaskets take permanent set under initial bolt loading at assembly. Tightening of nuts before installation to values specified in Table 3 is necessary to insure pressure retaining capabilities of liquid level gage to specific design ratings. The user must refer to the liquid level gage model and assembly number and to the purchase order or tag to determine materials of construction.

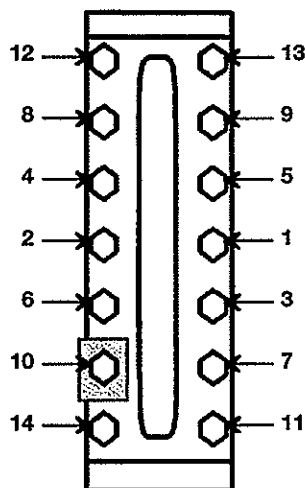


Figure 1: Nut tightening sequence

| Gage models and gasket material                        | ft-lb    |
|--|----------|
| RM, TM w/Grafoil® (standard)                           | 25 to 30 |
| RM/TM w/non-Asbestos (optional)                        | 30 to 35 |
| PTFE/Top-Chem 2000®                                    | 25 to 30 |
| 25% glass filled PTFE                                  | 20       |
| All models w/Teflon®, Viron® or elastomeric (optional) | 10       |
| TM with PCTFE/(Kel-F®) Shields (optional) 0.063"       | 10       |

Using a torque wrench, tighten nuts in five ft-lb increments following the "Z" pattern sequence in Figure 1, until the torque values shown in Table 3 above for the specific liquid level gage are reached. For multiple section gages, torque the center section(s) and progressively work toward the ends of the gage.

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued if necessary.



### Warning

Failure to comply with the proper torquing sequence or force/height value can lead to leakage, gasket blow-out or glass breakage resulting in gage failure, serious injury and/or property damage.

Note: depending on gage size there may be less bolting than shown or force/height value can lead to leakage, gaskets blow-out or glass breakage resulting in gage failure, serious injury and/or property damage.

# Installation & Maintenance Instructions

## Flat Glass Gages, Series M

### 5.5 Belleville washers

Belleville washers are used to reduce or eliminate the need to retorque nuts. This is especially important for gages subject to pressure and/or thermal cycling and also in offshore applications where use of wrenches often cracks or chips the protective coat. The conical washers allow for material expansion and contraction while maintaining axial bolt loading and, therefore, compression on the gasket.

The effective range of a Belleville washer is measured in height (or compression distance) of the washer not torque. Refer to Figure 2 and Table 4 for proper compression height. Do not tighten nuts until the washers are flat. Belleville washers cannot absorb expansion when flat.

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and stack height, if necessary.

Table 4: Conical spring height for Belleville washers

| Gage models | No. of washers per nut | Spring height (top of cover to bottom of nut) inch (mm) |
|-------------|------------------------|---|
| RM          | 4                      | 0.264 (6.7)   |
| TM          | 2                      | 0.136 (3.5)   |

### 6.0 Operation

Before initializing liquid level gage operation, check that all installation procedures have been completed. Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight. Assure that nuts have been retorqued to their proper values as specified in Table 5. Remove self stick caution tape from the glass and inspect to be sure that glass is clean and free of any damage such as cracks, scratches, pits, and chips.

### 6.1 Hydrostatic test



#### Danger

Liquid level gage installations should be brought into service slowly to avoid excessive shock or stress on the glass. Rapid pressurization or sudden changes in temperature may cause glass breakage. To avoid excessive thermal shock or mechanical stress on glass, the connecting valves should be opened slightly, and the gage temperature and pressure allowed to slowly equalize. If the valves are equipped with ball checks, the valves must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball checks in the event of failure. Failure to follow the recommended operating procedures can result in death, severe personal injury and/or property damage.

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatically pressure test all installations to at least 100 PSIG but less than design pressure and correct any leakage before proceeding.



#### Warning

Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Do not proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

The rate at which components degrade is dependent upon a variety of conditions. Pressure, temperature and process media all influence the rate at which gage components deteriorate. Higher temperatures can accelerate the deterioration of gaskets, cushions, glass, and metals. Acids and similar chemicals can break down the integrity of almost any material. Concentration of chemicals can accelerate the corrosion rate. Penberthy cannot create a blanket maintenance schedule for every application.

The end user is the most familiar with the process media and conditions and must be responsible for creating a maintenance schedule. The user must create maintenance schedules, safety manuals, and inspection details for each liquid level gage. Realistic maintenance schedules can only be determined with full knowledge of: the services and application situations involved. These will be based upon the user's own operating experience with their specific application.

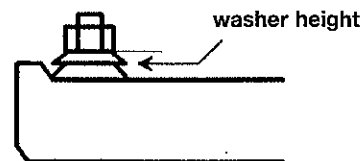


Figure 2: Belleville washer height



# Installation & Maintenance Instructions

## Flat Glass Gages, Series M

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued or repaired as necessary.

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

1. glass, for cleanliness and signs of damage or wear,
2. shields, if used, for signs of clouding, wear or deterioration,
3. gage, for signs of leakage around gaskets or at connections and
4. gage, for signs of internal or external corrosion.

### 7.1 Maintenance procedures

Glass should be given regular and careful attention. Keep glass clean using a commercial glass cleaner and a soft cloth. Inspect the surface of the glass for any clouding, etching or scratching or physical damage such as bruises, checks or corrosion. Glass that is damaged is weakened and may break under pressure. Shining a light at approximately a 45° angle will aid in detecting some of these conditions. Typical damaged areas will glisten more brightly than the surrounding glass because the light is reflected.

Detection of any damage, problem areas or surface wear is sufficient evidence to take the liquid level gage out of service. Do not proceed with operation of the liquid level gage until the glass has been replaced with a glass replacement kit following the assembly instructions in Section 8.

Shields showing any signs of clouding, wear, or deterioration are an indication that the gage glass has been exposed, or could soon be exposed to the contained fluid. Immediately take liquid level gage out of service. Do not proceed with operation of the liquid level gage until shields and glass have been replaced by following the disassembly-reassembly instructions in Section 8.

Gasket leaks must be repaired immediately. Do not proceed with operation of a liquid level gage until gaskets have been replaced by following Section 8 assembly instructions.

Connection leaks at a flanged or threaded connection should be corrected by tightening the bolting at the connection or by taking the liquid level gage out of service and wrapping the connection threads with Teflon® tape on all male pipe threads.

Corrosion may occur if the user has selected an improper material for the liquid level gage application. It is the responsibility of the user to choose a material of construction compatible with both the contained fluid and the surrounding environment. If internal or external corrosion is present, an investigation must immediately be performed by the user. It may be necessary to contact an authorized Penberthy distributor to better determine the origin of the corrosion.

### 7.2 Troubleshooting

|          |  |
|----------|--|
| Problem  | glass becomes prematurely etched or clouded in service   |
| Cause    | fluid being handled is not compatible with the glass or shields  |
| Solution | replace the glass and install shields which will not be affected by contained fluid  |
| Problem  | glass continually breaks in service despite careful attention to maintenance procedures  |
| Cause    | thermal shock, hydraulic shock, mechanical loads, exceeding design ratings or a combination of these   |
| Solution | check entire system to determine possible sources of loads. Check application to determine actual operating conditions and contact an authorized Penberthy distributor for how to proceed. |



### Warning

Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Do not proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

### 8.1 Disassembly

Secure workbench longer than the liquid level gage, and sufficiently wide to lay out parts as they are removed.

1. Lay gage on bench so nut side of fastener is up.
2. Hold gage firmly, and loosen nuts starting at both ends of each section and then proceeding from both ends to the center of each section as shown in Figure 3.
3. Nut loosening sequence
  - remove nuts, washer, and nameplate
  - tap covers with rubber hammer as needed to loosen
  - for Belleville washer assemblies: to remove covers, and remove studs may need to be removed by laying the assembly on its side and knocking the studs/U-bolts through the cover with a hammer and punch
  - remove cushions, glass, shields (if any), and gaskets
  - tap liquid chamber or remaining covers as necessary with rubber hammer to break loose, and remove remaining components
  - remove, destroy, and dispose of all glass, cushions, gaskets, and shields. Under no circumstances should these components be re-used or installed on a gage.

Note: if size of gage is smaller than shown, follow spiraling sequence from the ends until all bolting is loosened.



#### Warning

Once used cushions, gaskets, and shields are permanently deformed by compression and if re-used, may cause leaks and high stress points resulting in glass breakage. Glass may contain hidden damage and internal stresses caused by previous usage. If re-used, the glass may break under pressure causing personal and property damage.

### 8.2 Inspection of glass seating surfaces

Clean the glass seating surfaces on the liquid chamber and cover with a soft metal scraper (preferably brass) to remove all burrs, rust, and remnants of the previous gaskets and cushions. Exercise extreme care to avoid gouging or scarring gasket and cushion seating surfaces.

Use a known flat piece of metal the same approximate length as the glass or a new piece of glass and a thickness gage to check flatness of each glass seating surface on liquid chamber and under cover. Surface must be flat within 0.002 inch. If any one surface is found to be beyond a tolerance of 0.002 inch, the entire gage must be disposed of and replaced. Gasket seating surface must have a final surface finish of 450 to 500 AARH.



#### Warning

Flatness of glass seating surfaces outside 0.002 inch tolerance specified is an indication of the gage having been overstressed through repeated exposure to mechanical, thermal, or hydraulic shock during its previous service. Operation of a liquid level gage which has been overstressed will result in abnormal stresses on the glass which may cause glass to break. If surface finish is not in the 450 - 500 AARH range, gasket may extrude under pressure with resulting sudden release of pressure, leakage of contained fluid, serious personal injury, or property damage.

Glass seating surfaces should not be machined to achieve seating tolerance. The chamber and cover are designed for a critical thickness to achieve the pressure/temperature ratings. Machining glass seating surfaces may result in non-compliance to the necessary critical thickness due to material removal.

### 8.3 Reassembly

If all glass seating surfaces are found to be within the 0.002 inch (0.051mm) tolerance described in the previous section, proceed to obtain new glass, gaskets, cushions and shields (if used) and proceed to reassemble as follows (refer to exploded parts view in Section 11 if needed):

1. clean threads on bolt and nuts to remove all paint, rust, and scale. Apply a light coat of oil to the threads.
2. for transparent gages, insert bolts through half the cover and lay out covers along bench, side by side, with the liquid chambers. Use chambers to space covers and line them up with vision slots.
3. for reflex style and Belleville reflex style gages, lay out covers along bench, side by side, with liquid chambers. Use chambers to space covers and line them up with vision slots.

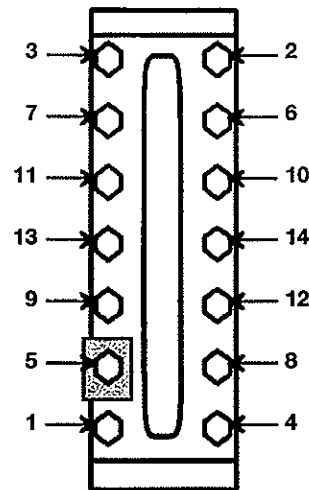


Figure 3: Loosening sequence

## Installation & Maintenance Instructions

### Flat Glass Gages, Series M

4. for transparent Belleville style gages, thread nuts on stud, place two Belleville washers under nut with pointed end toward the nut (see Figure 2), insert stud through each cover and lay out covers along bench, side by side, with liquid chambers. Use chambers to space covers and line them up with vision slots.
5. install one cushion inside each cover.



#### Warning

Separate installation instructions are supplied with replacement glass. All instructions supplied with the glass must be followed as there are precautions to be taken when handling gage glass. Among the precautions is avoidance of bumping or sliding glass against any surface and inspection of individual pieces. Failure to follow any of the replacement gage glass installation instructions could result in glass breakage with resulting sudden release of pressure, personal or property damage.

6. install rubber band around each piece of glass, then place glass centered inside each cover.
7. install shields, if used, and gasket on glass being careful to keep components centered.
8. place liquid chamber on the gaskets (shields - if used) making sure all components are aligned with vision slot.
9. for reflex gage, install U-bolts in place by tapping as needed with rubber hammer, being careful not to lose alignment with vision slot.
10. for reflex gage, quickly turn over assembly onto back side of U-bolts. Assemble nameplate, washer, and nuts to U-bolts. Tighten nuts with fingers. Using a torque wrench, tighten nuts in five ft-lb increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.  
Note: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.
11. for transparent gage, install gaskets in place, and shields if used.
12. install one cushion on each piece of glass
13. install rubber band around each piece of glass, then place glass centered inside each cover
14. install covers in place being careful to maintain components alignment inside.
15. install nameplate, washer, and nuts to studs. Tighten nuts with fingers. Using a torque wrench, tighten nuts in five ft-lb increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.
- 15A. for transparent Belleville style gages: install nameplate and two Belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.  
Note: The following procedure is to be done on only one side of the gage
- 15B. for reflex Belleville style gages: install nameplate and four Belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.
- 16A. Using a torque wrench, tighten nuts in five ft-lb increments, following the sequence in Figure 1. Once 20 ft-lb is reached, begin measuring stack height. Tighten nuts in five ft-lb increments until stack spring height is within 0.008" (0.2 mm) of proper height. Individually tighten each nut until stack height is achieved (see Table 5). To estimate washer height, add the thickness of the nut to the compressed height requirement and use this value to compare to the measurement from the top of the nut to the face of the cover.

Refer to Section 5 for installation and Section 6 for operation of liquid level gage when returning to service.

Penberthy gages are used in a variety of fluid applications. By following the appropriate governmental and industry regulations, the user must determine the extent of preparation and treatment the gage must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metals, glass, and polymers should be recycled whenever possible. Refer to order and Penberthy's Material Specification sheets for materials of construction.

# Installation & Maintenance Instructions

## Flat Glass Gages, Series M

If you are having difficulty with your liquid level gage, notify your local Penberthy distributor. You may also contact the factory direct at +1 815 537 2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information as possible when you call:

- Model #
- Name of the company from whom you purchased your liquid level gage
- Invoice # and date
- Process fluid
- Operating pressures
- Operating temperatures
- A brief description of the problem
- Troubleshooting procedures that failed

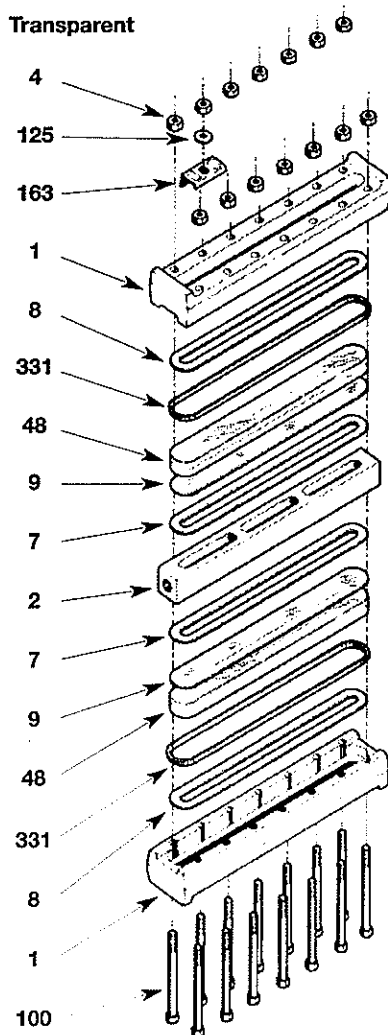
If attempts to solve your problem fail, you may be requested to return your liquid level gage to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from Penberthy prior to returning anything. Failure to do so will result in the unit being returned to you, without being tested, freight collect. To obtain a R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- "Ship To" address

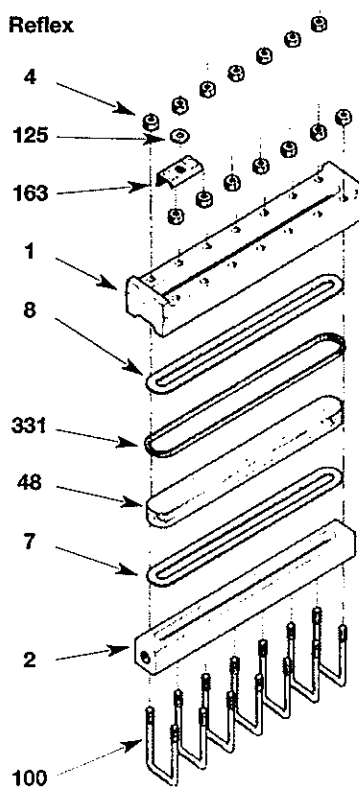
We recommend that you return the entire unit for testing. There is a minimum charge of \$75.00 for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit that is covered by the warranty, but is not defective, the minimum charge will apply.

### Exploded view drawing

#### Transparent



#### Reflex



### Parts list

|     |             |
|-----|-------------|
| 1   | Cover       |
| 2   | Chamber     |
| 4   | Nut         |
| 48  | Glass       |
| 7   | Gasket      |
| 8   | Cushion     |
| 9   | Shield      |
| 100 | Bolt/U-bolt |
| 125 | Washer      |
| 163 | Nameplate   |
| 331 | Band        |

### Recommended spare parts

| Ref # | Item             | Quantity      |
|-------|------------------|---------------|
| 100   | Bolt/U-bolt      | 2/1 per sect. |
| 4     | Nut              | 2 per sect.   |
| 48    | Glass            | 1             |
| 7     | Gasket           | 2             |
| 8     | Cushion          | 2             |
| 9     | Shield (if used) | 2             |

### Notes

Size 9 shown - actual gage may be shorter and require fewer bolting components

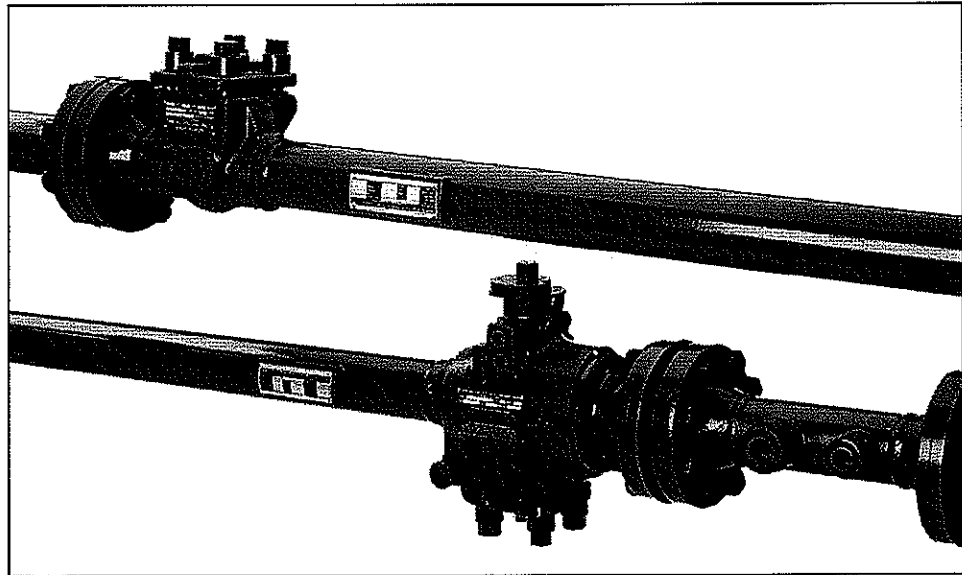
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**NuFlo™**

# ***Orifice Fittings and Equipment***

## ***User Manual***

*Dual Chamber Orifice Fittings • Single Chamber Orifice Fittings  
Orifice Flange Unions • Orifice Plates • Orifice Meter Runs*



*Sold as North Star Flow Products in Canada*

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Manual No. 25165001, Rev. A  
November 2004

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## Model 4055 Dual Chamber Orifice Fittings

NuFlo Model 4055 Dual Chamber Orifice Fittings are compact, streamlined and rugged featuring a simple and rapid method for changing or inspecting orifice plates under pressure. The orifice fittings feature a ball-type construction for opening and closing “without” a complicated gear mechanism.

The unique construction incorporating a ball closure with spring-loaded, self-lubricating, Moly-filled Teflon® floating seals eliminates any need for periodic lubrication. All NuFlo dual chamber orifice fittings are manufactured in accordance with ANSI and ATSM standards and available in 2”, 3”, 4” and 6” sizes.

### Features

- Compact construction
- Rapid method for changing orifice plates under pressure
- Self-lubricating Moly-filled Teflon® seals (periodic lubrication not required)
- Orifice plate O-ring seal provides positive seal around orifice plate
- Positive orifice plate alignment assured with closure of chamber lid and internal ball stop

### Standard Specifications

Meter Connections: All NuFlo orifice fittings are provided with two sets of flange taps located 1” on each side of the orifice plate. Flange tap meter connections are 1/2” NPT, internal tap hole sizes follow latest AGA/API recommendations. Internal edges of tap holes are free from burrs and slightly rounded.

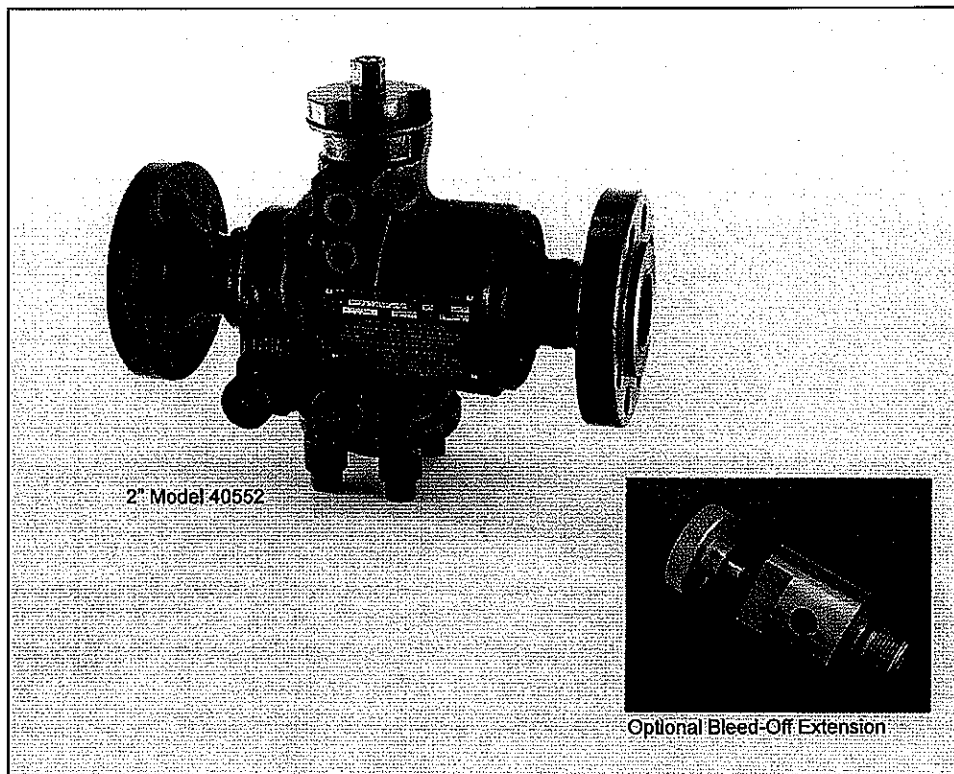
Two types of NuFlo orifice fittings are available:

- Flanged Type, either raised face or ring joint
- Flangeweld Type, having a weldneck inlet and a flanged outlet

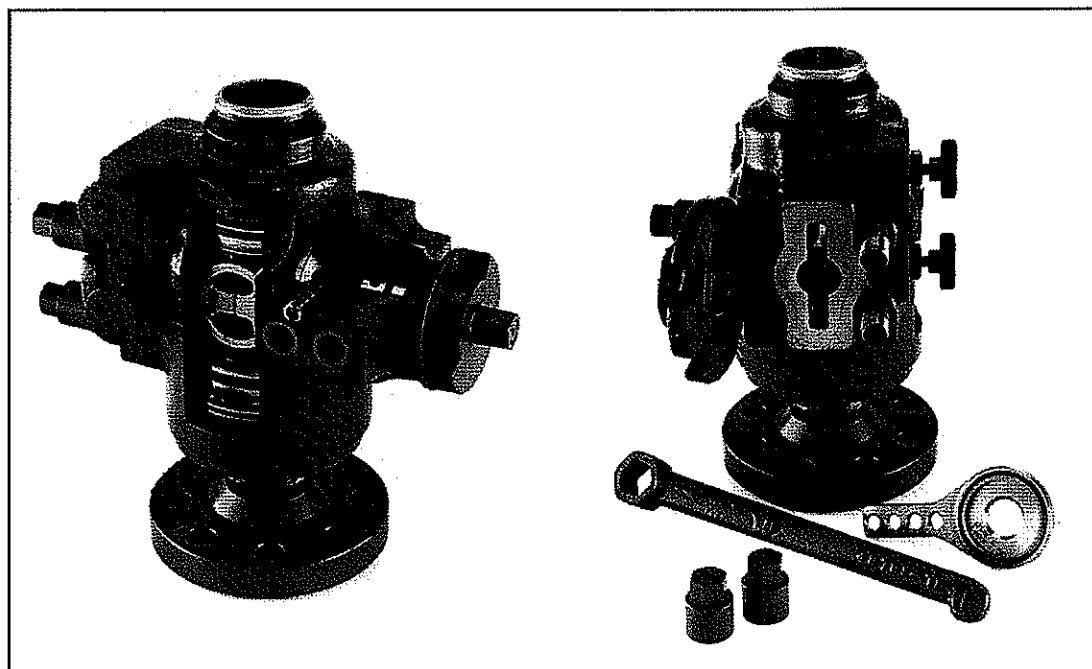
### When Ordering, Specify:

- Quantity
- Assembly part number
- Type of dual chamber orifice fitting  
(flanged, flangeweld)
- Service (sweet, (H<sub>2</sub>S) sour)
- Flange rating
- Flange type (raised face, ring type joint)
- Pipe schedule
- Orifice plate bore size(s)

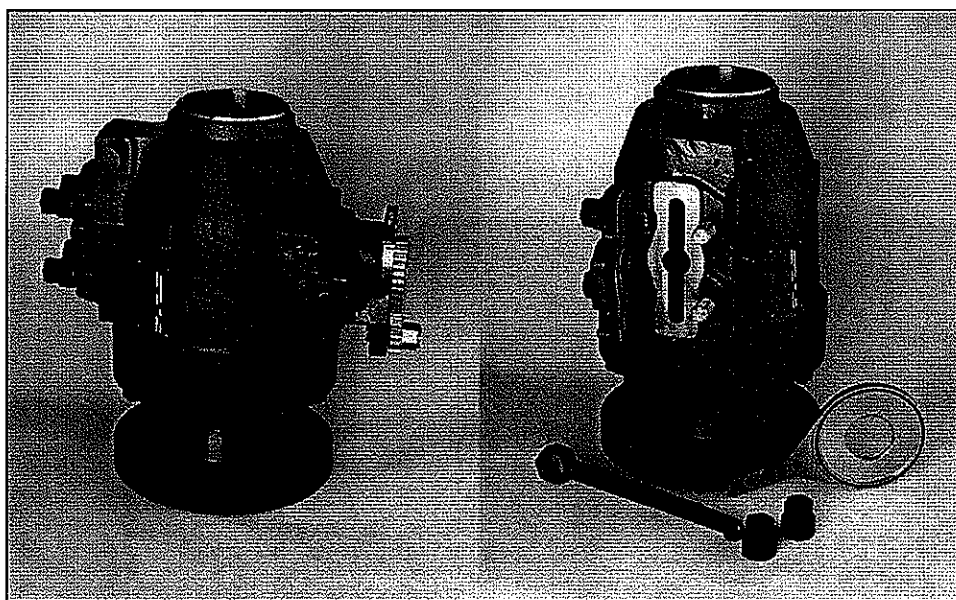
| ORIFICE FITTING SIZES              | 2"                           | 3"                           | 4"                           | 6"                          |
|------------------------------------|------------------------------|------------------------------|------------------------------|-----------------------------|
| ASSEMBLY PART NUMBER               | 40552                        | 40553                        | 40554                        | 40556                       |
| ANSI FLANGE<br>PRESSURE<br>RATINGS | 150<br>THROUGH<br>1500       | 150<br>THROUGH<br>1500       | 150<br>THROUGH<br>1500       | 150<br>THROUGH<br>600       |
| INTERNAL<br>DIAMETERS              | SCH 40<br>THROUGH<br>SCH 160 | SCH 40<br>THROUGH<br>SCH 160 | SCH 40<br>THROUGH<br>SCH 160 | SCH 40<br>THROUGH<br>SCH 80 |



*Dual chamber orifice fitting, flanged type*



*Cut-away, dual chamber orifice fitting, flangeweld type (2, 3 and 4 in.)*



*Dual chamber orifice fitting, flangeweld type (6 in.)*

## Installation and Maintenance

It is recommended that the NuFlo Dual Chamber Orifice fitting be placed in the line with the two 1/2" NPT flange taps and instruction plate facing upward. The flow arrow cast on the body must correspond with flow direction of line. The orifice fitting is shipped with an orifice plate installed in operating position. It is suggested that the orifice plate be removed before flushing or purging the flow line.

The spring-loaded, self-lubricated Moly-filled Teflon® ball seals eliminate any need for periodic lubrication. ***Grease is not required for sealing.***

## Operating Instructions

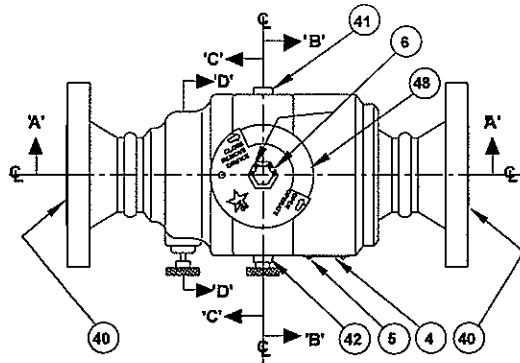
### Removing an Orifice Plate

1. Close main orifice fitting. This rotates the orifice plate out of operation and places the bypass section into the orifice fitting bore.
2. Insure "EQUALIZER" valve is closed.
3. Open the "BLEED" valve. This vents the pressure around the orifice plate and chamber lid.
4. Open the chamber lid by loosening the hinge bolt cap nuts and removing the two top cap nuts. This will allow the chamber lid to open freely.
5. Remove orifice plate and retainer with the wrench supplied with unit.

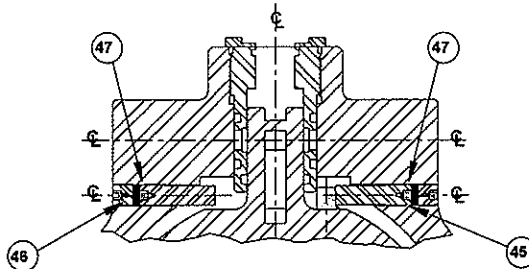
### Replacing an Orifice Plate

1. Place orifice plate and retainer into the ball slot with "OUTLET" on plate holder facing "OUTLET" stamped on body casting.
2. Close chamber lid and tighten the four cap nuts.
3. Close "BLEED" valve.
4. Open "EQUALIZER" valve to equalize ball seal pressure.
5. Open main orifice fitting. This places orifice plate into operation and removes bypass section from the bore.
6. Close "EQUALIZER" valve.

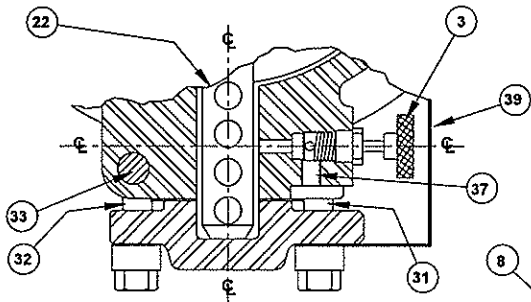
# **2" and 3" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP**



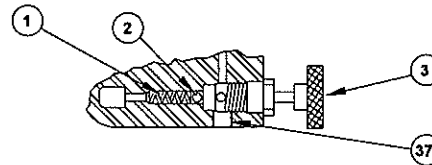
**TOP VIEW**



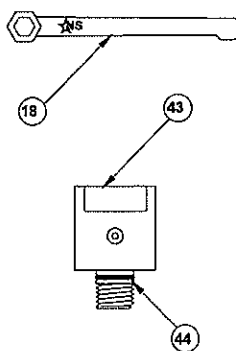
**SECTION 'C-C'**



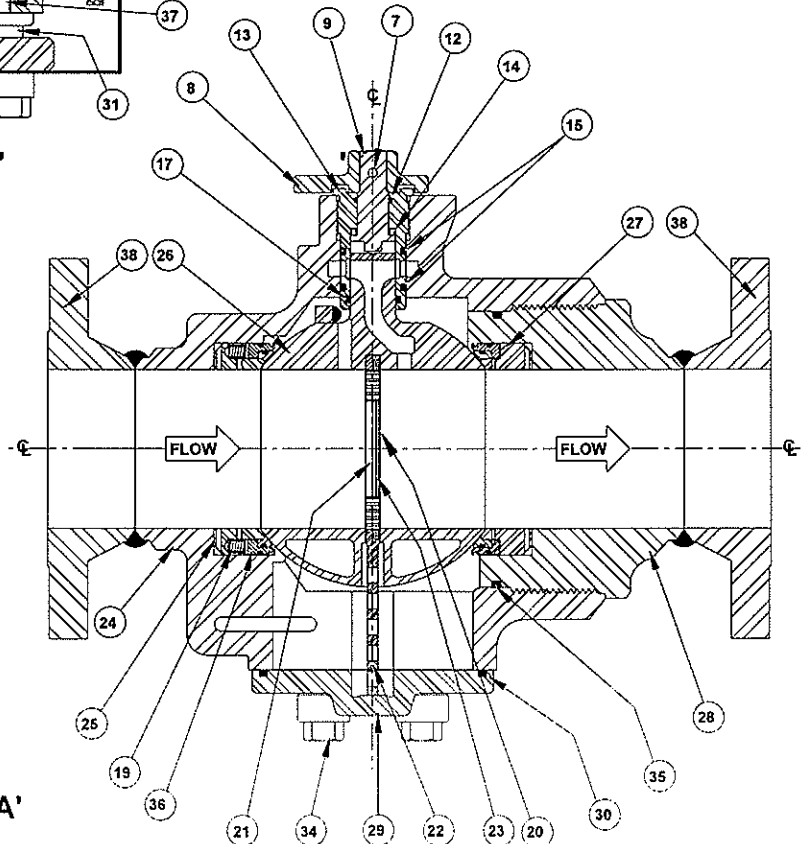
**SECTION 'B-B'**



**SECTION 'D-D'**

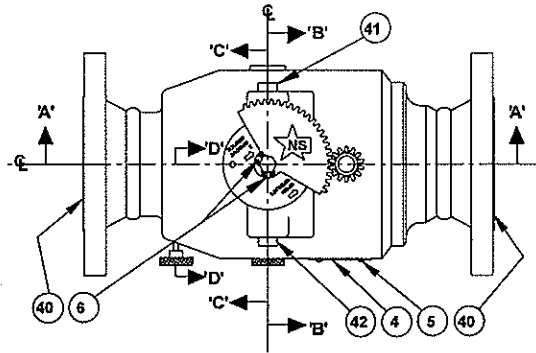


**SECTION 'A-A'**

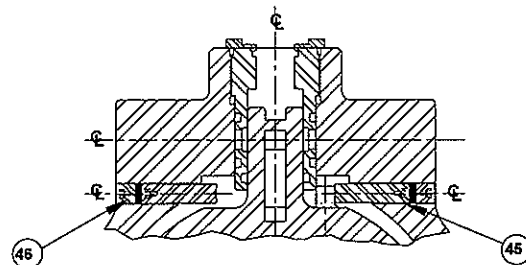


# **4" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP**

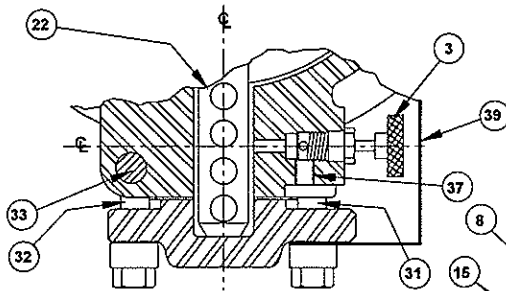
(SEE PAGE 8 FOR 6" DUAL CHAMBER FITTING DRAWING)



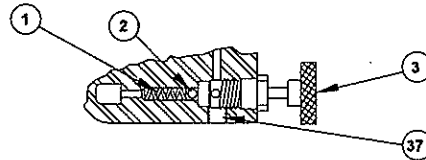
**TOP VIEW**



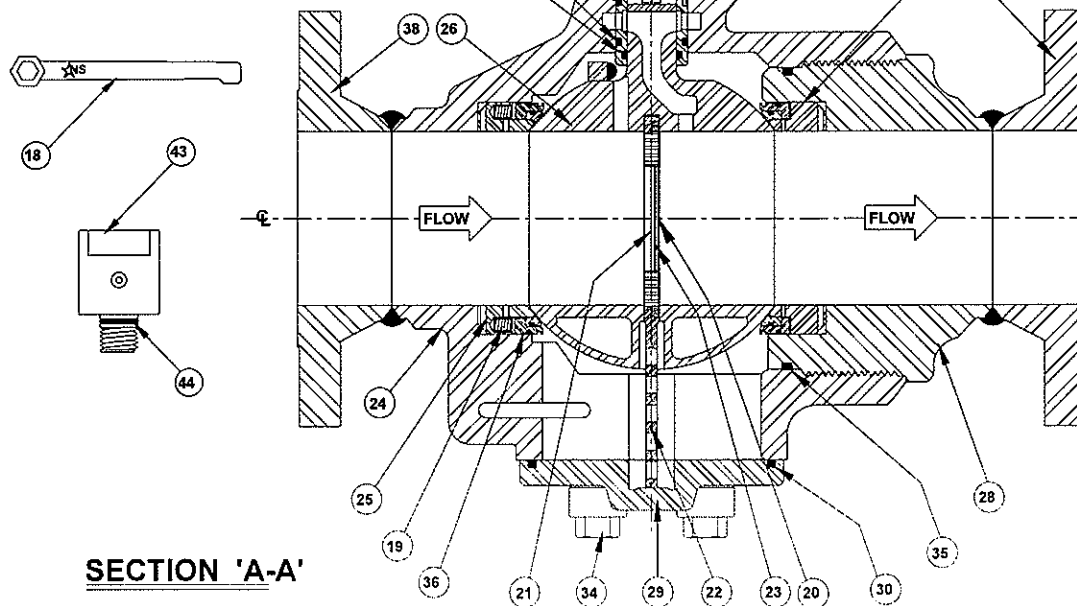
**SECTION 'C-C'**



**SECTION 'B-B'**



**SECTION 'D-D'**



**SECTION 'A-A'**

**PARTS LIST**  
**2", 3" and 4" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**  
**WITH INTERNAL BALL-STOP**

| ITEM | DESCRIPTION   | QTY. | ASSY. NO. 40552<br>(2") PART NO.  | ASSY. NO. 40553<br>(3") PART NO.  | ASSY. NO. 40554<br>(4") PART NO.  |
|------|---|------|---|---|---|
| 1    | SPRING  | 1    | 40701-053-04000   | 40701-053-04000   | 40701-053-04000   |
| 2    | 0.250 316 S.S. BALL   | 1    | 01001-030-04300   | 01001-030-04300   | 01001-030-04300   |
| 3    | BLEED VALVE ASSEMBLY  | 2    | 40701-J00-06000   | 40701-J00-06000   | 40701-J00-06000   |
| 4    | INSTRUCTION PLATE   | 1    | 40701-009-04000   | 40701-009-04000   | 40701-009-04000   |
| 5    | DRIVE SCREW #4 - 1/4" TYPE U  | 4    | NCN   | NCN   | NCN   |
| 6    | SET SCREW (ALLEN HEAD)  | 2    | NA  | 5/16" - 18 TPI X 1/4"   | 3/8" - 16 TPI X 1/2"  |
| 7    | ROLL PIN  | 1    | 1/8" X 7/8"   |   |   |
| 8    | BALL STOP   | 1    | 40552-119-04000   | 40553-130-04000   | 40554-138-04000   |
| 9    | BALL STEM   | 1    | 40552-046-04000   | 40553-048-04000   | 40554-042-04000   |
| 10   | SPUR GEAR   |      |   |   | 40704-004-04000   |
| 11   | SPUR GEAR STEM  | 1    |   |   | 40704-046-04000   |
| 12   | O-RING STEM RETAINER  | 1    | 40700-060-06000   | 40713-035-06000   | 40714-046-06000   |
| 13   | STEM RETAINER   | 1    | 40552-027-04000   | 40703-016-04000   | 40704-033-04000   |
| 14   | STEM RING   | 1    | 40701-014-04000   | 40703-018-04000   | 40704-034-04000   |
| 15   | O-RING STEM RETAINER  | 2    | 40700-061-06000   | 40714-047-06000   | 40714-048-06000   |
| 16   | STEM LOCK   | 1    |   |   | 40704-050-04000   |
| 17   | O-RING STEM RETAINER  | 1    | 40700-059-06000   | 40713-036-06000   | 40714-047-06000   |
| 18   | ORIFICE FITTING WRENCH  | 1    | 40701-075-00000   | 40703-045-00000   | 40704-031-00000   |
| 19   | WAVE SPRING (STANDARD)<br>WAVE SPRING (H <sub>2</sub> S) SOUR   | 5    | 40700-009-03000<br>40700-020-06000  | 40703-088-03000<br>40703-093-06000  | 40704-082-04000<br>40704-087-06000  |
| 20   | DOVETAIL RING   | 1    | 40712-001-04000   | 40713-006-04000   | 40714-010-04000   |
| 21   | STANDARD ORIFICE PLATE 316 S.S  | 1    | 40552-052-00000   | 40553-055-00000   | 40554-049-00000   |
| 22   | STANDARD ORIFICE PLATE RE-<br>TAINER<br>ORIFICE PLATE RETAINER<br>ORIFICE PLATE RETAINER (TEFLON)   | 1    | 40552-062-04000<br>40552-069-04000  | 40553-062-04000<br>40553-065-04000  | 40554-063-04000<br>40554-065-04000  |
| 23   | O-RING PLATE RETAINER<br>O-RING (TEFLON) PLATE RETAINER   | 1    | 40700-005-06000<br>40552-059-06000  | 40702-025-06000<br>40553-060-06000  | 40714-052-06000<br>40554-059-06000  |
| 24   | ORIFICE FITTING BODY<br>150# - 600# RATING SCH - 40<br>150# - 600# RATING SCH - 80<br>150# - 600# RATING SCH - 160<br>900 - 1500# RATING SCH - 80<br>900 - 1500# RATING SCH - 160 | 1    | 40552-023-04000<br>40552-024-04000<br>40552-025-04000<br>40552-024-04000<br>40552-025-04000 | 40553-023-04000<br>40553-034-04000<br>40553-035-04000<br>40553-036-04000<br>40553-037-04000 | 40554-017-04000<br>40554-025-04000<br>40554-026-04000<br>40554-035-04000<br>40554-030-04000 |
| 25   | UPSTREAM SEAL RETAINER<br>SCH - 40 BORE<br>SCH - 80 BORE<br>SCH - 160 BORE  | 1    | 40552-031-04000<br>40552-032-04000<br>40552-033-04000                                       | 40553-025-04000<br>40553-028-04000<br>40553-031-04000                                       | 40554-019-04000<br>40554-021-04000<br>40554-023-04000                                       |
| 26   | BYPASS BALL<br>SCH - 40<br>SCH - 80<br>SCH - 160  | 1    | 40552-115-04000<br>40552-116-04000<br>40552-117-04000                                       | 40553-124-04000<br>40553-125-04000<br>40553-126-04000                                       | 40554-135-04000<br>40554-136-04000<br>40554-137-04000                                       |
| 27   | DOWNSTREAM SEAL RETAINER<br>SCH - 40<br>SCH - 80<br>SCH - 160   | 1    | 40552-035-04000<br>40552-036-04000<br>40552-037-04000                                       | 40553-026-04000<br>40553-029-04000<br>40553-032-04000                                       | 40554-020-04000<br>40554-022-04000<br>40554-024-04000                                       |
| 28   | DOWNSTREAM WELDNECK<br>SCH - 40<br>SCH - 80<br>SCH - 160  | 1    | 40552-038-03000<br>40552-039-03000<br>40552-040-03000                                       | 40553-024-03000<br>40553-027-03000<br>40553-030-03000                                       | 40554-027-03000<br>40554-028-03000<br>40554-029-03000                                       |
| 29   | CHAMBER LID   | 1    | 40552-043-04000   | 40553-033-04000   | 40554-018-04000   |

**PARTS LIST**  
**2", 3" and 4" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**  
**WITH INTERNAL BALL-STOP (cont'd)**

(SEE PAGES 9 & 10 FOR 6" DUAL CHAMBER FITTING PARTS LIST)

| ITEM | DESCRIPTION  | QTY.   | ASSY. NO. 40552<br>(2") PART NO.      | ASSY. NO. 40553<br>(3") PART NO.   | ASSY. NO. 40554<br>(4") PART NO.   |
|------|--|--------|---------------------------------------|------------------------------------|------------------------------------|
| 30   | O-RING CHAMBER LID   | 1      | 40552-051-06000                       | 40553-051-06000                    | 40714-059-06000                    |
| 31   | STUD BOLT  | 2      | 40726-006-04000                       | 40703-026-04000                    | 40704-019-04000                    |
| 32   | HINGE BOLT   | 2      | 40726-005-04000                       | 40703-027-04000                    | 40704-018-04000                    |
| 33   | HINGE PIN  | 1      | 40726-008-04000                       | 40703-024-04000                    | 40704-020-04000                    |
| 34   | HEX NUT  | 4      | 40701-021-04000                       | 40703-025-04000                    | 40704-021-04000                    |
| 35   | O-RING DOWNSTREAM WELDNECK   | 1      | 40552-054-06000                       | 40553-052-06000                    | 40714-060-06000                    |
| 36   | BALL SEAL ASSY.<br>FOR 150# AND 300# RATING<br>FOR 600# TO 1500# RATING                    | 2      | 40552-C00-04000<br>40552-A00-04000    | 40703-D00-04000<br>40703-P00-04000 | 40704-D00-04000<br>40704-P00-04000 |
| ITEM | DESCRIPTION  | QTY    | ASSY. NO. 40552<br>(2") PART NO.      | ASSY. NO. 40553<br>(3") PART NO.   | ASSY. NO. 40554<br>(4") PART NO.   |
| 37   | PIPE PLUG 1/16" - 27 NPT   | 1      | NCN                                   | NCN                                | NCN                                |
| 38   | FLANGES<br>FLANGED<br>FLANGEWELD   | 2<br>1 | SPECIFIED BY TYPE AND PRESSURE RATING |                                    |                                    |
| 39   | ORIFICE FITTING GUARD<br>W/O BLEED-OFF-EXTENSION (STAN-<br>DARD)<br>W/ BLEED-OFF-EXTENSION | 1      | 40700-039-04000<br>40701-101-04000    | 40702-013-04000<br>40701-102-04000 | 40702-013-04000<br>40701-102-04000 |
| 40   | PLASTIC BORE PLUG  | 2      | NCN                                   | NCN                                | NCN                                |
| 41   | PIPE PLUG 1/2"   | 2      | 35364-004-04000                       | 35364-004-04000                    | 35364-004-04000                    |
| 42   | PLASTIC PIPE PLUG 1/2"   | 2      | NCN                                   | NCN                                | NCN                                |
| 43   | BLEED-OFF EXTENSION (H <sub>2</sub> S) SOUR  | 1      | 40701-S00-06000                       | 40701-S00-06000                    | 40701-S00-06000                    |
| 44   | O-RING   | 1      | 40714-061-06000                       | 40714-061-06000                    | 40714-061-06000                    |
| 45   | SET SCREW 1/2" - 20 UNF  | 2      | 40700-068-04000                       | 40700-068-04000                    | 40700-070-04000                    |
| 46   | PLUG 1/2" - 20 UNF   | 2      | 40700-069-04000                       | 40700-069-04000                    | 40700-069-04000                    |
| 47   | NYLON LOCKING PELLET   | 4      | 10008-006-04000                       | 10008-006-04000                    | N/A                                |
| 48   | BALL STOP PLATE  | 1      | 40552-118-04000                       | 40553-127-04000                    |                                    |

NOTE: ANSI FLANGE PRESSURE RATINGS 150# THROUGH 1500#

**WHEN ORDERING SPARE PARTS, SPECIFY:**

- NOMINAL SIZE - SCHEDULE
- TYPE OF SERVICE (SWEET, (H<sub>2</sub>S) SOUR)
- SERIAL NUMBER





**PARTS LIST**  
**6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP**

| ITEM | DESCRIPTION  | QTY | ASSY. NO. 40556<br>(6") PART NO.   |
|------|--|-----|------------------------------------|
| 1    | SPRING INCONEL   | 1   | 40701-053-04000                    |
| 2    | T.C. BALL 0.250  | 1   | 01001-030-04300                    |
| 3    | BLEED VALVE ASSEMBLY   | 2   | 0701-J00-06000                     |
| 4    | INSTRUCTION PLATE  | 1   | 40701-009-04000                    |
| 5    | DRIVE SCREW #4 - 1/4" TYPE U                                     | 4   | NCN                                |
| 6    | SET SCREW (ALLEN HEAD)   | 2   | 3/8 - 16 TPI X 1/2"                |
| 7    | N/A  |     |                                    |
| 8    | BALL STOP  | 1   | 40706-055-04000                    |
| 9    | BALL STEM  | 1   | 40556-034-04000                    |
| 10   | SPUR GEAR  | 1   | 40704-004-04000                    |
| 11   | SPUR GEAR STEM   | 1   | 40704-046-04000                    |
| 12   | O-RING STEM RETAINER   | 1   | 40713-036-06000                    |
| 13   | STEM RETAINER  | 1   | 40706-032-04000                    |
| 14   | STEM RING  | 1   | 40706-033-04000                    |
| 15   | O-RING STEM RETAINER   | 2   | 40706-095-06000                    |
| 16   | STEM LOCK  | 1   | 40704-050-04000                    |
| 17   | O-RING STEM RETAINER   | 1   | 40706-094-06000                    |
| 18   | ORIFICE FITTING WRENCH   | 1   | 40704-031-00000                    |
| 19   | COIL SPRING (STANDARD)   | 16  | 40706-047-04000                    |
|      | COIL SPRING (H <sub>2</sub> S) SOUR                              |     | 40706-046-06000                    |
| 20   | DOVETAIL RING  | 1   | 40706-080-04000                    |
| 21   | STANDARD ORIFICE PLATE 316 S.S.                                  | 1   | 40556-046-00000                    |
| 22   | ORIFICE PLATE RETAINER (STANDARD)                                | 1   | 40556-076-04000                    |
|      | ORIFICE PLATE RETAINER (TEFLON)                                  | 1   | 40556-083-04000                    |
| 23   | O-RING PLATE RETAINER  | 1   | 40706-098-06000                    |
|      | O-RING (TEFLON) PLATE RETAINER                                   | 2   | 40556-074-06000                    |
| 24   | ORIFICE FITTING BODY<br>SCH 40<br>SCH 80                         | 1   | 40556-066-04000<br>40556-065-04000 |
| 25   | SEAL RETAINER<br>SCH 40<br>SCH 80                                | 2   | 40556-018-04000<br>40556-020-04000 |
| 26   | BY-PASS BALL<br>SCH 40<br>SCH 80                                 | 1   | 40556-137-04000<br>40556-138-04000 |
| 27   | DOWNSTREAM WELDNECK<br>SCH 40<br>SCH 80                          | 1   | 40556-086-03000<br>40556-087-03000 |
| 28   | CHAMBER LID  | 1   | 40706-093-04000                    |
| 29   | O-RING CHAMBER LID   | 1   | 40556-038-06000                    |
| 30   | STUD BOLT  | 2   | 40704-019-04000                    |
| 31   | HINGE BOLT   | 2   | 40704-018-04000                    |
| 32   | HINGE PIN  | 1   | 40706-018-04000                    |
| 33   | HEX NUT  | 4   | 40704-021-04000                    |
| 34   | O-RING DOWNSTREAM WELDNECK                                       | 1   | 40706-096-06000                    |
| 35   | BALL SEAL ASSEMBLY<br>FOR 150 AND 300# RATING<br>FOR 600# RATING | 2   | 40706-A00-04000<br>40706-P00-04000 |

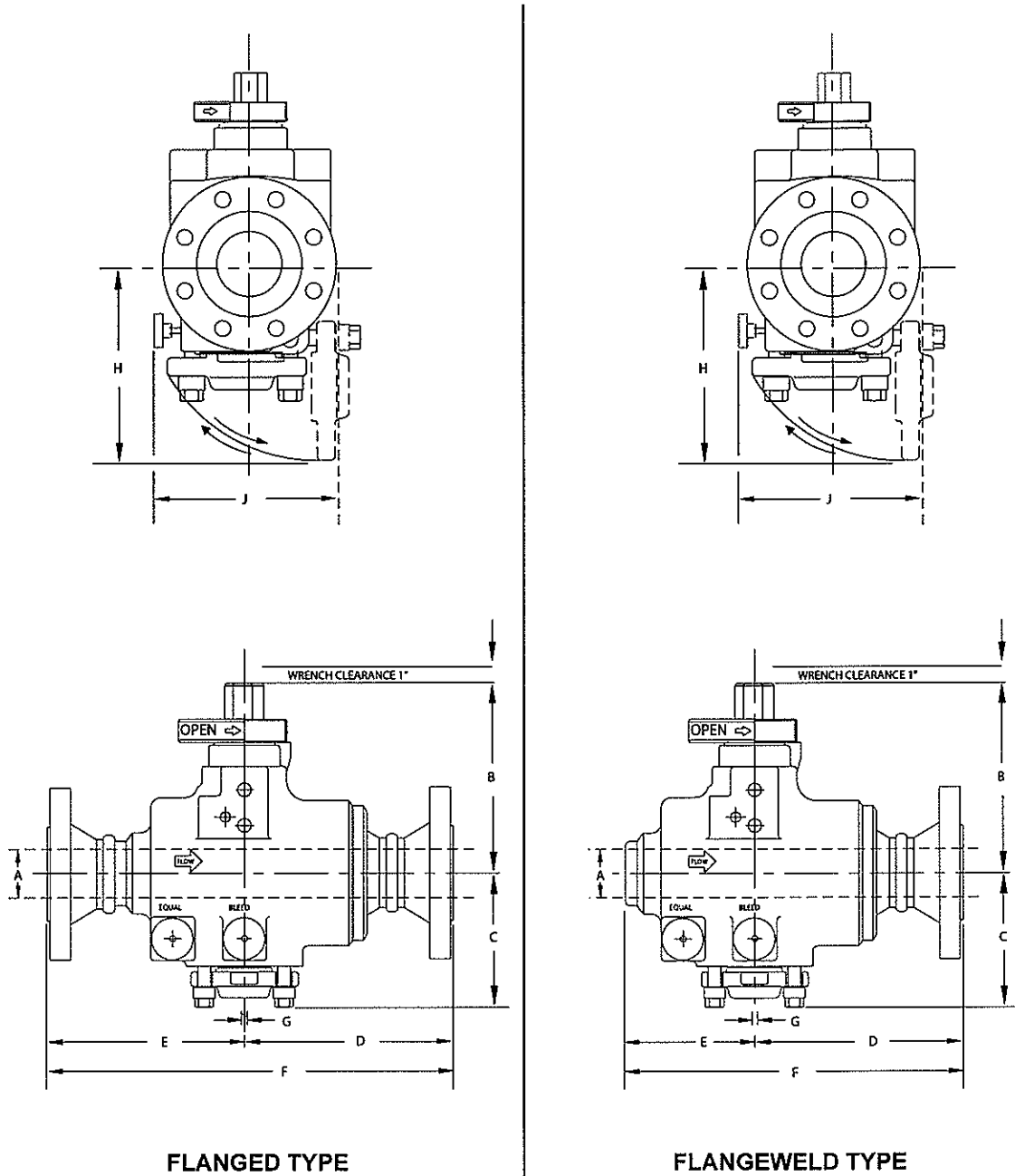
**PARTS LIST (cont'd)**  
**6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP**

| ITEM | DESCRIPTION   | QTY    | ASSY. NO. 40556<br>(6") PART NO.         |
|------|---|--------|--|
| 36   | PIPE PLUG 1/16" - 27 NPT  | 1      | NCN                                      |
| 37   | MILL STUD   | 16     | 40706-052-06000                          |
| 38   | HEX NUT   | 16     | C1408-006-06000                          |
| 39   | ORIFICE FITTING GUARD<br>W/O BLEED-OFF-EXTENSION (STANDARD)<br>W/ BLEED-OFF-EXTENSION | 1      | 40556-035-04000<br>40701-103-04000       |
| 40   | PLASTIC BORE PLUG   | 2      | NCN                                      |
| 41   | PIPE PLUG 1/2"  | 2      | 35364-004-04000                          |
| 42   | PLASTIC PIPE PLUG 1/2"  | 2      | NCN                                      |
| 43   | BLEED-OFF-EXTENSION (H <sub>2</sub> S) SOUR   | 1      | 40701 -S00-06000                         |
| 44   | O-RING  | 1      | 40714-061-06000                          |
| 45   | SET SCREW 5/8" - 18 UNF   | 2      | 40700-071-04000                          |
| 46   | PLUG 5/8"- 18 UNF   | 2      | 40700-072-04000                          |
| 47   | NYLON LOCKING PELLET  |        | N/A                                      |
| 48   | BALL STOP PLATE   |        | N/A                                      |
| 49   | FLANGES<br>FLANGED<br>FLANGEWELD  | 2<br>1 | SPECIFIED BY TYPE AND<br>PRESSURE RATING |

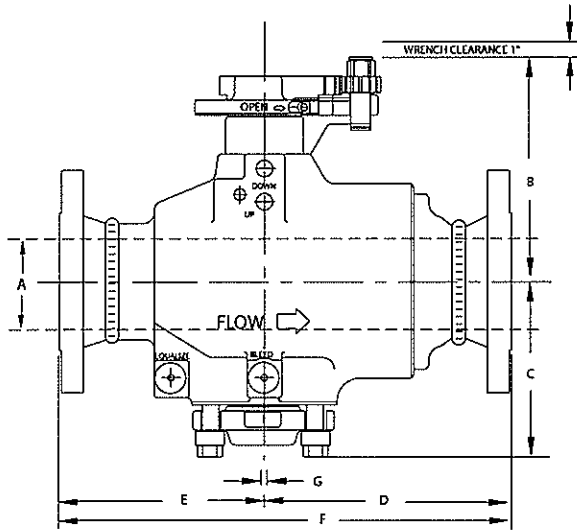
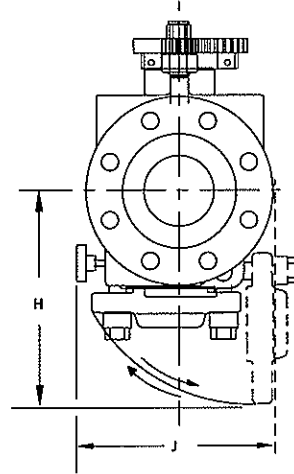
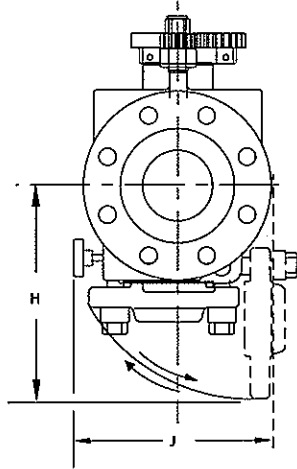
**WHEN ORDERING SPARE PARTS, SPECIFY:**

- NOMINAL SIZE - SCHEDULE
- TYPE OF SERVICE (SWEET, (H<sub>2</sub>S) SOUR)
- SERIAL NUMBER

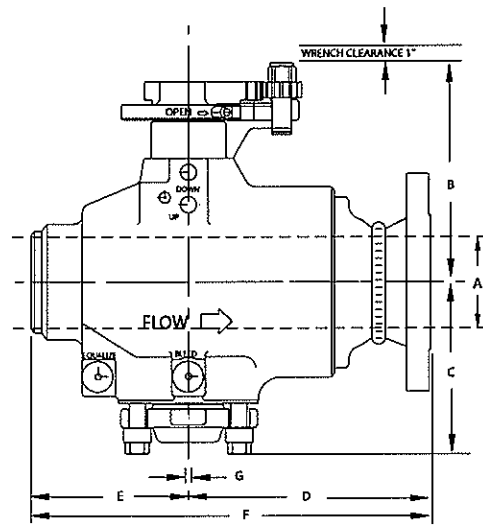
# **DIMENSIONAL DATA** **2" and 3" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**



# **DIMENSIONAL DATA** **4" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**

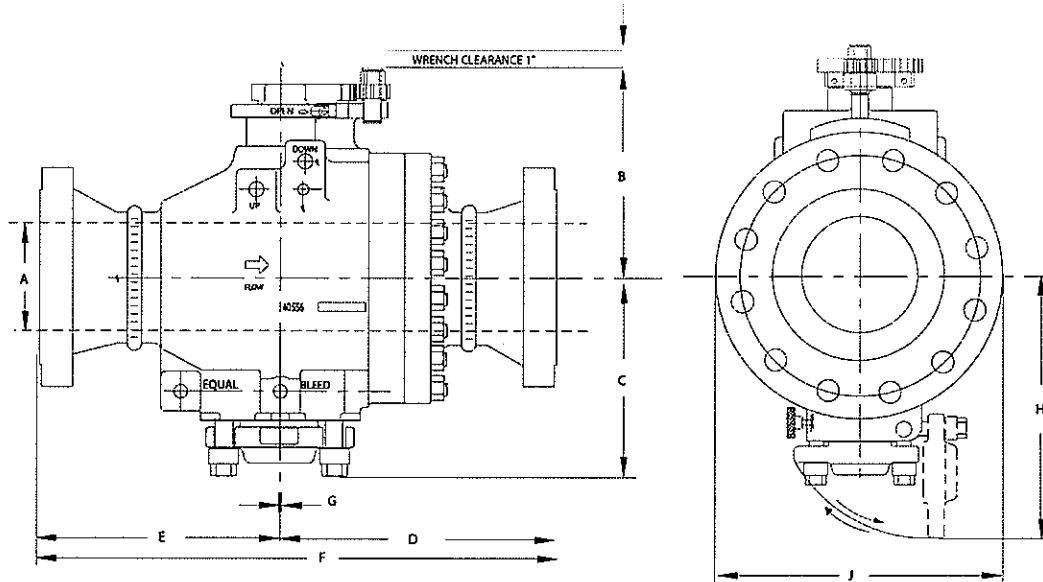


**FLANGED TYPE**

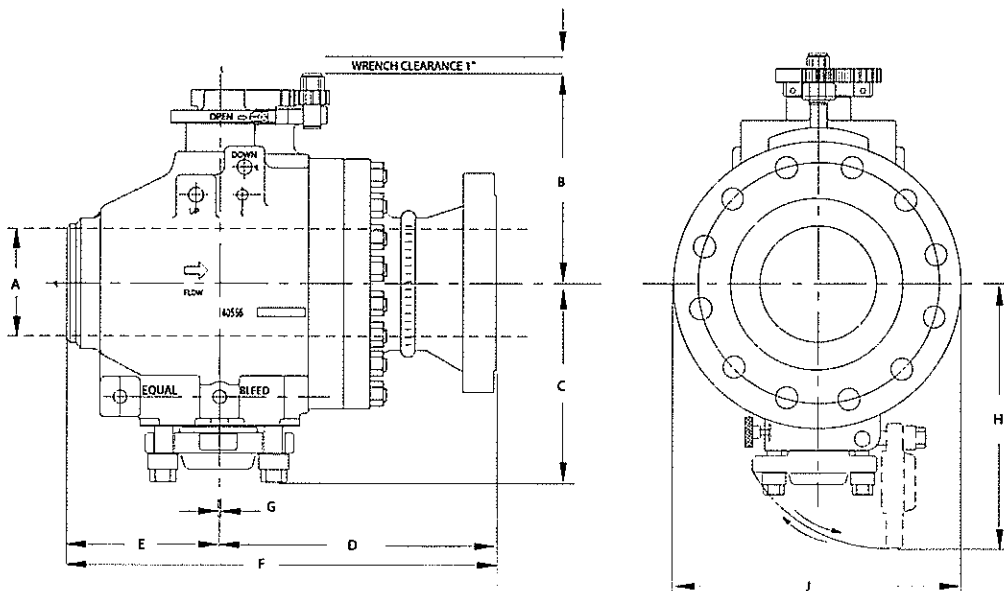


**FLANGEWELD TYPE**

# **DIMENSIONAL DATA** **6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING**



**FLANGED TYPE**



**FLANGEWELD TYPE**

**MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS  
DIMENSIONS—FLANGED TYPE WITH RAISED FACE FLANGES**

| SIZE  | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO TOP | CENTERLINE TO<br>BOTTOM | DOWNSTREAM<br>LENGTH FROM<br>CENTERLINE TO<br>FACE AT END | UPSTREAM LENGTH<br>FROM CENTERLINE<br>TO FACE AT END | OVERALL LENGTH<br>END TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | BODY CLEARANCE | APPROXIMATE<br>WEIGHT, LBS. | HYDROSTATIC TEST<br>PRESSURE, TEMP.<br>LESS THAN 125°F |
|---|------------------------------|-------------------|-------------------------|---|--|------------------------------|----------------------------|--|----------------|-----------------------------|--|
| A   | B                            | C                 | D                       | E   | F  | G                            | H                          | J  |                |                             |  |
| <b>FLANGED TYPE, 150LB. A.N.S.I. - RAISED FACE FLANGE - 285 PSI. C.W.P.</b>   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2   | 2.067*                       | 6-7/16            | 5-3/8                   | 8 5/64  | 7-7/16   | 15-33/64                     | 1/8                        | 6-7/8  | 6-1/4          | 67                          | 450 PSI  |
| 3   | 3.068*                       | 7-3/8             | 6-3/4                   | 9-1/4   | 8-5/16   | 17-9/16                      | 1/8                        | 8-5/16   | 7-3/4          | 95                          |  |
| 4   | 4.026*                       | 9-3/4             | 8                       | 11-7/8  | 10-1/16  | 21-15/16                     | 1/8                        | 10-7/8   | 8-9/16         | 182                         |  |
| 6   | 6.065*                       | 11-7/8            | 10-3/4                  | 13-3/4  | 12-3/16  | 25-61/64                     | 1/8                        | 13-1/2   | 14             | 170                         |  |
| <b>FLANGED TYPE, 300LB. A.N.S.I. - RAISED FACE FLANGE - 740 PSI. C.W.P.</b>   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2   | 2.067*                       | 6-7/16            | 5-3/8                   | 8-21/64   | 7-11/16  | 16-1/64                      | 1/8                        | 6-7/8  | 6-1/4          | 71                          | 1125<br>PSI  |
| 3   | 3.068*                       | 7-3/8             | 6-3/4                   | 9-21/32   | 8-11/16  | 18-11/32                     | 1/8                        | 8-5/16   | 8-1/2          | 105                         |  |
| 4   | 4.026*                       | 9-3/4             | 8                       | 12-1/4  | 10-7/16  | 22-11/16                     | 1/8                        | 10-7/8   | 9-1/8          | 202                         |  |
| 6   | 6.065*                       | 11-7/8            | 10-3/4                  | 14-1/8  | 12-9/16  | 26-45/64                     | 1/8                        | 13-1/2   | 14             | 420                         |  |
| <b>FLANGED TYPE, 600LB. A.N.S.I. - RAISED FACE FLANGE - 1480 PSI. C.W.P.</b>  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2   | 2.067*                       | 6-7/16            | 5-3/8                   | 8-11/16   | 8-1/16   | 16-3/4                       | 1/8                        | 6-7/8  | 6-1/4          | 75                          | 2225<br>PSI  |
| 3   | 3.068*                       | 7-3/8             | 6-3/4                   | 10-1/64   | 9-1/16   | 19-5/64                      | 1/8                        | 8-5/16   | 8-1/2          | 105                         |  |
| 4   | 4.026*                       | 9-3/4             | 8                       | 13-1/4  | 11-5/16  | 24-9/16                      | 1/8                        | 10-7/8   | 9-1/2          | 225                         |  |
| 6   | 6.065*                       | 11-7/8            | 10-3/4                  | 15-1/8  | 13-9/16  | 28-45/64                     | 1/8                        | 13-1/2   | 14             | 490                         |  |
| <b>FLANGED TYPE, 900LB. A.N.S.I. - RAISED FACE FLANGE - 2220 PSI. C.W.P.</b>  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2   | 1.939*                       | 6-7/16            | 5-3/8                   | 9-13/16   | 9-1/4  | 19-1/16                      | 1/8                        | 6-7/8  | 8-5/16         | 108                         | 3350<br>PSI  |
| 3   | 2.900*                       | 7-3/8             | 6-3/4                   | 10-3/4  | 9-7/8  | 20-5/8                       | 1/8                        | 8-5/16   | 9              | 127                         |  |
| 4   | 3.826*                       | 9-3/4             | 8                       | 13-5/8  | 11-7/8   | 25-1/2                       | 1/8                        | 10-7/8   | 9-1/2          | 251                         |  |
| <b>FLANGED TYPE, 1500LB. A.N.S.I. - RAISED FACE FLANGE - 3705 PSI. C.W.P.</b> |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2   | **                           | 6-7/16            | 5-3/8                   | 9-13/16   | 9-1/4  | 19-1/16                      | 1/8                        | 6-7/8  | 7-3/4          | 108                         | 5575<br>PSI  |
| 3   | **                           | 7-3/8             | 6-3/4                   | 11-13/32  | 10-1/2   | 22-5/16                      | 1/8                        | 8-5/16   | 9              | 165                         |  |
| 4   |                              | 9-3/4             | 8                       | 14  | 12-1/4   | 26-1/4                       | 1/8                        | 10-7/8   | 9-1/2          | 251                         |  |
| *AVAILABLE IN OTHER BORES   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| **BORE TO BE SPECIFIED  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |

**MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS  
DIMENSIONS—FLANGED TYPE WITH RING TYPE JOINT FLANGES**

| SIZE  | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO<br>TOP | CENTERLINE TO<br>BOTTOM | DOWNSTREAM<br>LENGTH FROM<br>CENTERLINE TO<br>FACE AT END | UPSTREAM LENGTH<br>FROM CENTERLINE<br>TO FACE AT END | OVERALL LENGTH<br>END TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | BODY CLEARANCE | APPROXIMATE<br>WEIGHT, LBS. | HYDROSTATIC TEST<br>PRESSURE, TEMP.<br>LESS THAN 125°F |
|---|------------------------------|----------------------|-------------------------|---|--|------------------------------|----------------------------|--|----------------|-----------------------------|--|
| <b>FLANGED TYPE, 600LB. A.N.S.I. - RING TYPE JOINT FLANGE - 1480 PSI. C.W.P.</b>  |                              |                      |                         |   |  |                              |                            |  |                |                             |  |
| 2   | 2.067'                       | 6-7/16               | 5-3/8                   | 8-3/4   | 8-1/8  | 16-7/8                       | 1/8                        | 6-7/8  | 6-1/4          | 75                          | 2225<br>PSI  |
| 3   | 3.068*                       | 7-3/8                | 6-3/8                   | 10-1/64   | 9-1/16   | 19-5/64                      | 1/8                        | 8-5/16   | 8-1/2          | 105                         |  |
| 4   | 4.026*                       | 9-3/4                | 8                       | 13-1/4  | 11-5/16  | 24-9/16                      | 1/8                        | 10-7/8   | 9-1/2          | 225                         |  |
| 6   | 6.065*                       | 11-7/8               | 10-3/4                  | 15-1/8  | 13-9/16  | 28-45/64                     | 1/8                        | 13-1/2   | 14             | 491                         |  |
| <b>FLANGED TYPE, 900LB. A.N.S.I. - RING TYPE JOINT FLANGE - 2220 PSI. C.W.P.</b>  |                              |                      |                         |   |  |                              |                            |  |                |                             |  |
| 2   | 1.939*                       | 6-7/16               | 5-3/8                   | 9-7/8   | 9-5/16   | 19-3/16                      | 1/8                        | 6-7/8  | 7-3/4          | 108                         | 3350<br>PSI  |
| 3   | 2.900*                       | 7-3/8                | 6-3/4                   | 10-29/32  | 10   | 20-29/32                     | 1/8                        | 8-5/16   | 9              | 127                         |  |
| 4   | 3.826*                       | 9-3/4                | 8                       | 13-3/4  | 12   | 25-3/4                       | 1/8                        | 10-7/8   | 9-1/2          | 251                         |  |
| <b>FLANGED TYPE, 1500LB. A.N.S.I. - RING TYPE JOINT FLANGE - 3705 PSI. C.W.P.</b> |                              |                      |                         |   |  |                              |                            |  |                |                             |  |
| 2   | **                           | 7-3/8                | 5-3/8                   | 9-7/8   | 9-1/4  | 19-1/8                       | 1/8                        | 6-7/8  | 7-3/4          | 108                         | 5575<br>PSI  |
| 3   | **                           | 7-3/8                | 6-3/4                   | 11-13/32  | 10-1/2   | 21-29/32                     | 1/8                        | 8-5/16   | 9              | 165                         |  |
| 4   | **                           | 9-3/4                | 8                       | 14  | 12-1/4   | 26-1/4                       | 1/8                        | 10-7/8   | 9-1/2          | 251                         |  |
| *AVAILABLE IN OTHER BORES   |                              |                      |                         |   |  |                              |                            |  |                |                             |  |
| **BORE TO BE SPECIFIED  |                              |                      |                         |   |  |                              |                            |  |                |                             |  |

**MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS  
DIMENSIONS—FLANGEWELD TYPE WITH RAISED FACE FLANGES**

| SIZE   | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO TOP | CENTERLINE TO<br>BOTTOM | DOWNSTREAM<br>LENGTH FROM<br>CENTERLINE TO<br>FACE AT END | UPSTREAM LENGTH<br>FROM CENTERLINE<br>TO FACE AT END | OVERALL LENGTH<br>END TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | BODY CLEARANCE | APPROXIMATE<br>WEIGHT, LBS. | HYDROSTATIC TEST<br>PRESSURE, TEMP.<br>LESS THAN 125°F |
|--|------------------------------|-------------------|-------------------------|---|--|------------------------------|----------------------------|--|----------------|-----------------------------|--|
|  | A                            | B                 | C                       | D   | E  | F                            | G                          | H  | J              |                             |  |
| <b>FLANGEWELD TYPE, 150LB. A.N.S.I. - RAISED FACE FLANGE - 285 PSI. C.W.P.</b>   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | 2.067*                       | 6-7/16            | 5-3/8                   | 8-5/64  | 4-7/8  | 12-15/16                     | 1/8                        | 6-7/8  | 6-1/4          | 61                          | 450 PSI  |
| 3  | 3.068*                       | 7-3/8             | 6-3/4                   | 9-1/4   | 5-1/2  | 14-3/4                       | 1/8                        | 8-5/16   | 7-3/4          | 81                          |  |
| 4  | 4.026*                       | 9-3/4             | 8                       | 11-57/64  | 7  | 18-57/64                     | 1/8                        | 10-7/8   | 8-9/16         | 166                         |  |
| 6  | 6.065*                       | 11-7/8            | 10-3/4                  | 13-3/4  | 8-5/8  | 22-3/8                       | 1/8                        | 13-1/2   | 14             | 350                         |  |
| <b>FLANGEWELD TYPE, 300LB. A.N.S.I. - RAISED FACE FLANGE - 740 PSI. C.W.P.</b>   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | 2.067*                       | 6-7/16            | 5-3/8                   | 8-21/64   | 4-7/8  | 13-3/16                      | 1/8                        | 6-7/8  | 6-3/4          | 63                          | 1125 PSI   |
| 3  | 3.068*                       | 7-3/8             | 6-3/4                   | 9-21/32   | 5-1/2  | 15-9/64                      | 1/8                        | 8-5/16   | 8-1/2          | 87                          |  |
| 4  | 4.026*                       | 9-3/4             | 8                       | 12-1/4  | 7  | 19-1/4                       | 1/8                        | 10-7/8   | 9-1/8          | 176                         |  |
| 6  | 6.065*                       | 11-7/8            | 10-3/4                  | 14-1/8  | 8-5/8  | 22-3/4                       | 1/8                        | 13-1/2   | 14             | 380                         |  |
| <b>FLANGEWELD TYPE, 600LB. A.N.S.I. - RAISED FACE FLANGE - 1480 PSI. C.W.P.</b>  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | 2.067*                       | 6-7/16            | 5-3/8                   | 8-11/16   | 4-7/8  | 13-37/64                     | 1/8                        | 6-7/8  | 6-3/4          | 65                          | 2225 PSI   |
| 3  | 3.068*                       | 7-3/8             | 6-3/4                   | 10-1/64   | 5-1/2  | 15-33/64                     | 1/8                        | 8-5/16   | 8-1/2          | 87                          |  |
| 4  | 4.026*                       | 9-3/4             | 8                       | 13-1/8  | 7  | 20-1/8                       | 1/8                        | 10-7/8   | 9-1/2          | 187                         |  |
| 6  | 6.065*                       | 11-7/8            | 10-3/4                  | 15-1/8  | 8-5/8  | 23-3/4                       | 1/8                        | 13-1/2   | 14             | 420                         |  |
| <b>FLANGEWELD TYPE, 900LB. A.N.S.I. - RAISED FACE FLANGE - 2220 PSI. C.W.P.</b>  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | 1.939'                       | 6-7/16            | 5-3/8                   | 9-13/16   | 4-7/8  | 14-11/16                     | 1/8                        | 6-7/8  | 8-5/16         | 84                          | 3350 PSI   |
| 3  | 2.900*                       | 7-3/8             | 6-3/4                   | 10-3/4  | 5-1/2  | 16-1/4                       | 1/8                        | 8-5/16   | 9              | 98                          |  |
| 4  | 3.826*                       | 9-3/4             | 8                       | 13-5/8  | 7  | 20-5/8                       | 1/8                        | 10-7/8   | 9-1/2          | 200                         |  |
| <b>FLANGEWELD TYPE, 1500LB. A.N.S.I. - RAISED FACE FLANGE - 3705 PSI. C.W.P.</b> |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | **                           | 6-7/16            | 5-3/8                   | 9-13/16   | 4-7/8  | 14-11/16                     | 1/8                        | 6-7/8  | 8-3/4          | 84                          | 5575 PSI   |
| 3  | **                           | 7-3/8             | 6-3/4                   | 11-13/16  | 5-1/2  | 17-5/16                      | 1/8                        | 8-5/16   | 9              | 117                         |  |
| 4  | **                           | 9-3/4             | 8                       | 14  | 7  | 21                           | 1/8                        | 10-7/8   | 9-1/2          | 200                         |  |
| *AVAILABLE IN OTHER BORES  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| **BORE TO BE SPECIFIED   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |



**MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS  
DIMENSIONS—FLANGEWELD TYPE WITH RING TYPE JOINT FLANGES**

| SIZE   | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO TOP | CENTERLINE TO<br>BOTTOM | DOWNSTREAM<br>LENGTH FROM<br>CENTERLINE TO<br>FACE AT END | UPSTREAM LENGTH<br>FROM CENTERLINE<br>TO FACE AT END | OVERALL LENGTH<br>END TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | BODY CLEARANCE | APPROXIMATE<br>WEIGHT, LBS. | HYDROSTATIC TEST<br>PRESSURE, TEMP.<br>LESS THAN 125°F |
|--|------------------------------|-------------------|-------------------------|---|--|------------------------------|----------------------------|--|----------------|-----------------------------|--|
| <b>FLANGEWELD TYPE, 600LB. A.N.S.I. - RING TYPE JOINT FLANGE - 1480 PSI. C.W.P.</b>  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | 2.067'                       | 6-7/16            | 5-3/8                   | 8-3/4   | 4-7/8  | 13-5/8                       | 1/8                        | 6-7/8  | 6-3/4          | 65                          | 2225 PSI   |
| 3  | 3.068*                       | 7-3/8             | 6-3M                    | 10-1/64   | 5-1/2  | 15-33/64                     | 1/8                        | 8-5/16   | 8-1/2          | 87                          |  |
| 4  | 4.026*                       | 9-3/4             | 8                       | 13-1/4  | 7  | 20-1/4                       | 1/8                        | 10-7/8   | 9-1/2          | 187                         |  |
| 6  | 6.065*                       | 11-7/8            | 10-3/4                  | 15-1/8  | 8-5/8  | 23-3/4                       | 1/8                        | 13-1/2   | 14             | 421                         |  |
| <b>FLANGEWELD TYPE, 900LB. A.N.S.I. - RING TYPE JOINT FLANGE - 2220 PSI. C.W.P.</b>  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | 1.939*                       | 6-7/16            | 5-3/8                   | 9-7/8   | 4-7/8  | 14-3/4                       | 1/8                        | 6-7/8  | 7-3/4          | 84                          | 3350 PSI   |
| 3  | 2.900*                       | 7-3/8             | 6-3/4                   | 10-29/32  | 5-1/2  | 16-13/32                     | 1/8                        | 8-5/16   | 9              | 98                          |  |
| 4  | 3.826*                       | 9-3/4             | 8                       | 13-3/4  | 7  | 20-3/4                       | 1/8                        | 10-7/8   | 9-1/2          | 200                         |  |
| <b>FLANGEWELD TYPE, 1500LB. A.N.S.I. - RING TYPE JOINT FLANGE - 3705 PSI. C.W.P.</b> |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| 2  | **                           | 7-3/8             | 5-3/8                   | 9-15/16   | 4-7/8  | 14-13/16                     | 1/8                        | 6-7/8  | 7-3/4          | 84                          | 5575 PSI   |
| 3  | **                           | 7-3/8             | 6-3/4                   | 11-13/32  | 5-1/2  | 16-29/32                     | 1/8                        | 8-5/16   | 9              | 117                         |  |
| 4  | **                           | 9-3/4             | 8                       | 14  | 7  | 21                           | 1/8                        | 10-7/8   | 9-1/2          | 251                         |  |
| *AVAILABLE IN OTHER BORES  |                              |                   |                         |   |  |                              |                            |  |                |                             |  |
| **BORE TO BE SPECIFIED   |                              |                   |                         |   |  |                              |                            |  |                |                             |  |

**RECOMMENDED SPARE PARTS  
MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**

| SIZE | DESCRIPTION              | PART NO.        | QTY. |
|------|--------------------------|-----------------|------|
| 2"   | Dovetail Ring            | 40712-001-04000 | 1    |
|      | O-Ring for Orifice Plate | 40700-005-06000 | 2    |
|      | O-Ring for Chamber Lid   | 40552-051-06000 | 2    |
| 3"   | Dovetail Ring            | 40713-006-04000 | 1    |
|      | O-Ring for Orifice Plate | 40702-025-06000 | 2    |
|      | O-Ring for Chamber Lid   | 40553-051-06000 | 2    |
| 4"   | Dovetail Ring            | 40714-010-04000 | 1    |
|      | O-Ring for Orifice Plate | 40714-052-06000 | 2    |
|      | O-Ring for Chamber Lid   | 40714-059-06000 | 2    |
| 6"   | Dovetail Ring            | 40706-080-04000 | 1    |
|      | O-Ring for Orifice Plate | 40706-098-06000 | 2    |
|      | O-Ring for Chamber Lid   | 40556-038-06000 | 2    |



Use only spare parts identified in this manual. NuFlo bears no legal responsibility for the performance of a product that has been serviced or repaired with parts that are not authorized by NuFlo.

**REDRESS KITS  
MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**

| SIZE | DESCRIPTION                    |                         | PART NO.     |
|------|--------------------------------|-------------------------|--------------|
| 2"   | ORIFICE FITTING PART NO. 40552 | SWEET                   | 150# - 300#  |
|      |                                | (H <sub>2</sub> S) SOUR | 150# - 300#  |
|      |                                | SWEET                   | 600# - 1500# |
|      |                                | (H <sub>2</sub> S) SOUR | 600# - 1500# |
| 3"   | ORIFICE FITTING PART NO. 40553 | SWEET                   | 150# - 300#  |
|      |                                | (H <sub>2</sub> S) SOUR | 1500# - 300# |
|      |                                | SWEET                   | 600# - 1500# |
|      |                                | (H <sub>2</sub> S) SOUR | 600# - 1500# |
| 4"   | ORIFICE FITTING PART NO. 40554 | SWEET                   | 150# - 300#  |
|      |                                | (H <sub>2</sub> S) SOUR | 150# - 300#  |
|      |                                | SWEET                   | 600# - 1500# |
|      |                                | (H <sub>2</sub> S) SOUR | 600# - 1500# |
| 6"   | ORIFICE FITTING PART NO. 40556 | SWEET                   | 150# - 300#  |
|      |                                | (H <sub>2</sub> S) SOUR | 150# - 300#  |
|      |                                | SWEET                   | 600#         |
|      |                                | (H <sub>2</sub> S) SOUR | 600#         |

NOTE: Specify pressure rating when ordering redress kits.

## Model 4042 Single Chamber Orifice Fittings

The NuFlo Single Chamber Orifice Fitting is designed for use in installations in which the line can be depressurized to change or inspect the orifice plate. Economical and lightweight, the single chamber features a simplicity of design with a minimum number of parts. A quick and easy method for removing orifice plates minimizes shutdown time. The interchangeability of the orifice plates and retainers between the NuFlo Dual Chamber and Single Chamber orifice fittings also provides an economy in inventory requirements.

### Standard Specifications

Single chamber orifice fittings are available in flangeweld and weldneck types. All NuFlo single chamber orifice fittings meet AGA/API specifications. Two sets of 1/2" NPT flange taps are provided on all single chamber orifice fittings. They are available in 2", 3" and 4" sizes.

### When Ordering, Specify:

- Quantity
- Assembly part number
- Type of single chamber orifice fitting  
(flangeweld, weldneck)
- Service (sweet, (H<sub>2</sub>S) sour)
- Flange rating
- Flange type (raised face, ring type joint)
- Pipe schedule
- Orifice plate bore size(s)

### Installation and Maintenance

Install the NuFlo single chamber orifice fitting with the two 1/2" NPT flange taps and instruction plate facing upward. The flow arrow cast on the body chamber lid must correspond with flow direction of line. The orifice fitting is shipped with an orifice plate installed. Remove the orifice plate before flushing or purging the line. Maintenance is minimal; lubrication is not required.

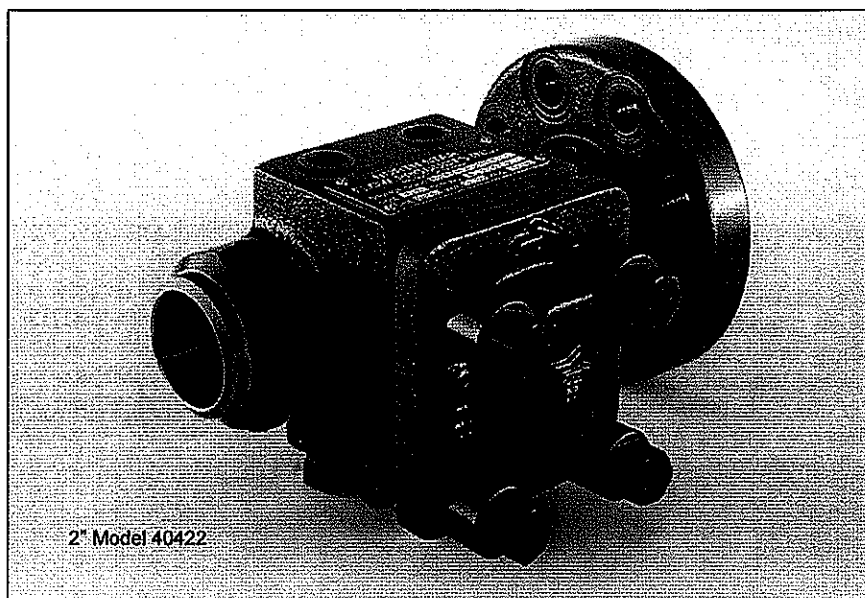
### Operating Instructions

#### Removing Orifice Plate

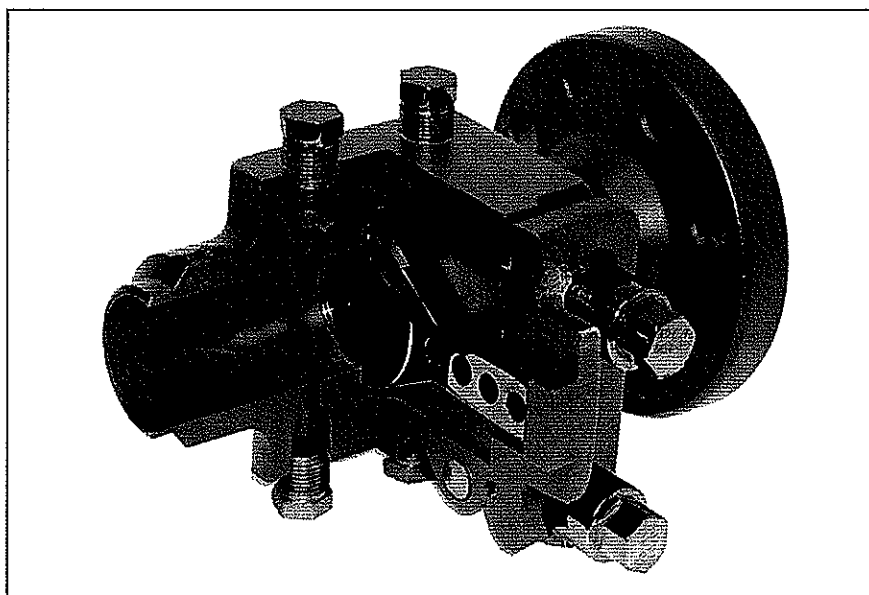
1. Depressurize line.
2. Open chamber lid by loosening the hinge bolt cap nuts and removing the two top cap nuts. This will allow the chamber lid to open freely.
3. Remove orifice plate and retainer.

#### Replacing Orifice Plate

1. Place orifice plate and retainer into the slot of the fitting with "OUTLET" facing same direction as flow arrow on chamber lid.
2. Close chamber lid and tighten the four cap nuts.
3. Pressurize line.



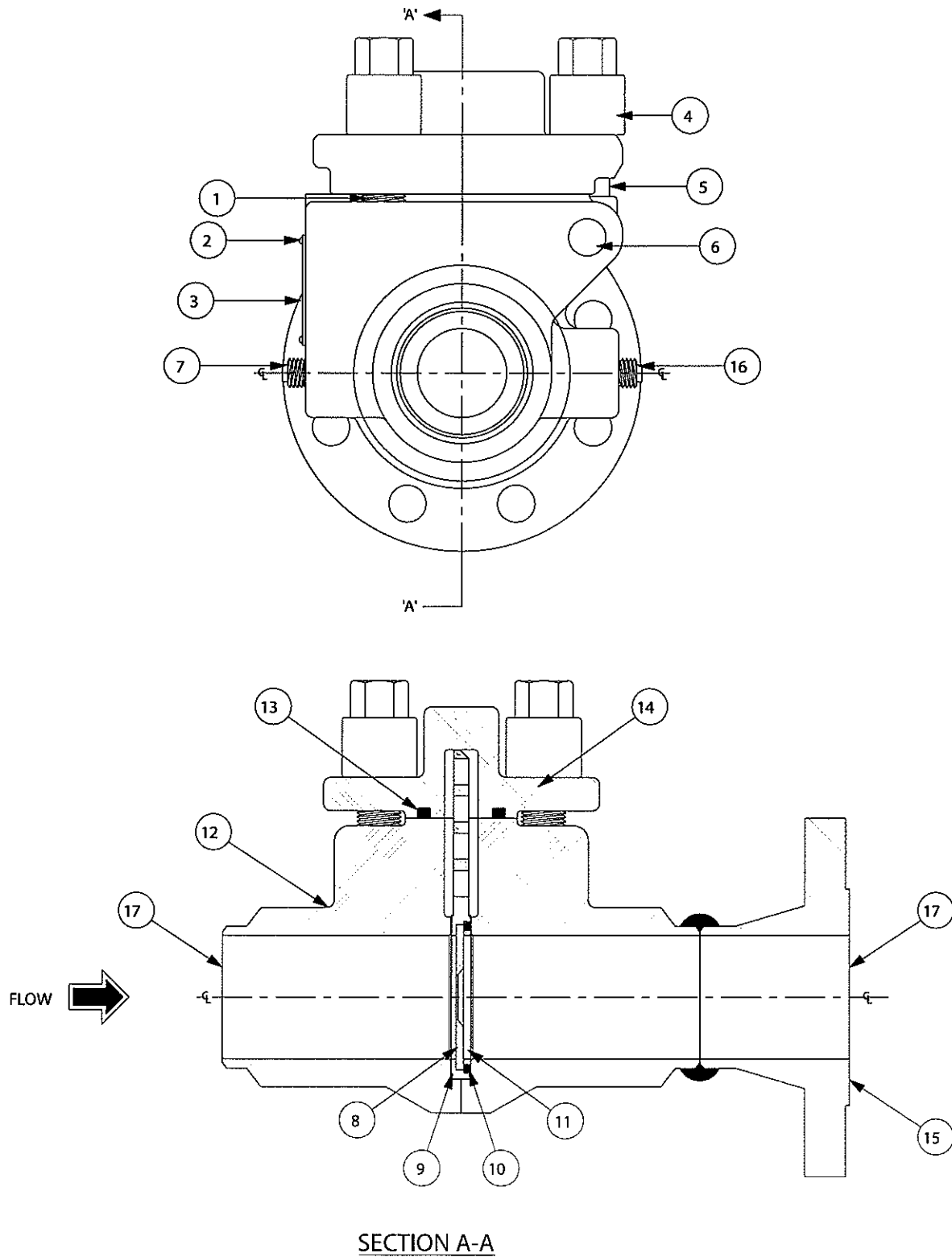
*Single chamber orifice fitting, flangeweld type*



*Cut-away, single chamber orifice fitting, flangeweld type*

| ORIFICE FITTING SIZES              | 2"                          | 3"                           | 4"                           |
|------------------------------------|-----------------------------|------------------------------|------------------------------|
| ASSEMBLY PART NUMBER               | 40422                       | 40423                        | 40424                        |
| ANSI FLANGE<br>PRESSURE<br>RATINGS | 150<br>THROUGH<br>1500      | 150<br>THROUGH<br>1500       | 150<br>THROUGH<br>1500       |
| INTERNAL DIAMETER                  | SCH 40<br>THROUGH<br>SCH XX | SCH 40<br>THROUGH<br>SCH 160 | SCH 40<br>THROUGH<br>SCH 160 |

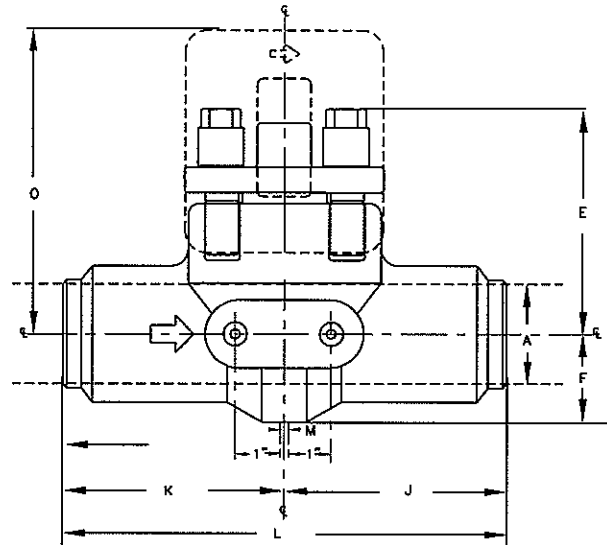
# **MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS**



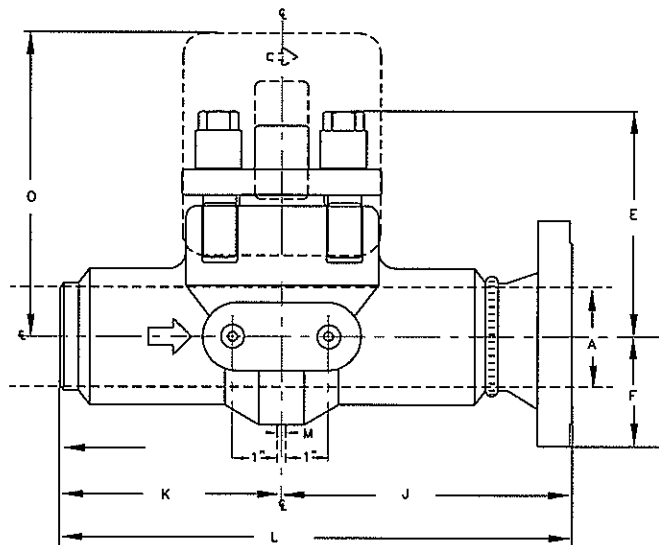
**PARTS LIST**  
**2", 3" AND 4" MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS**

| ITEM  | DESCRIPTION  | QTY. | ASSY.NO.40422 (2")                                    |        | ASSY.NO.40422 (3")                 |        | ASSY.NO.40422 (4")                 |        |
|---|--|------|---|--------|------------------------------------|--------|------------------------------------|--------|
|   |  |      | PART NO.  | NOTE   | PART NO.                           | NOTE   | PART NO.                           | NOTE   |
| 1   | STUD BOLT  | 2    | 40726-006-04000                                       | C      | 40703-026-04000                    | C      | 40704-019-04000<br>40724-002-04000 | A<br>B |
| 2   | DPI VE SCREW #4 - 1/4" TYPE U  | 4    | NCN   |        | NCN                                |        | NCN                                |        |
| 3   | IDENTIFICATION PLATE   | 1    | 40726-014-04000                                       |        | 40726-014-04000                    |        | 40726-014-04000                    |        |
| 4   | HEX NUT  | 4    | 40701-021-04000                                       | C      | 40703-025-04000                    | C      | 40704-021-04000                    | C      |
| 5   | HINGE BOLT   | 2    | 40726-005-04000                                       | C      | 40703-027-04000                    | C      | 40704-018-04000<br>40424-001-04000 | A<br>B |
| 6   | HINGE  | 1    | 40726-008-04000                                       | C      | 40728-011-04000                    | C      | 40729-008-04000<br>40424-008-04000 | A<br>B |
| 7   | PLASTIC PIPE PLUG  | 2    | NCN   |        | NCN                                |        | NCN                                |        |
| 8   | STANDARD ORIFICE PLATE 316 S.S.  | 1    | 40552-052-00000                                       |        | 40553-055-00000                    |        | 40554-049-00000                    |        |
| 9   | STANDARD ORIFICE PLATE RETAINER<br>ORIFICE PLATE RETAINER (TEFLON)                                     | 1    | 40552-062-04000<br>40552-069-04000                    | A<br>B | 40553-062-04000<br>40553-065-04000 | A<br>B | 40554-063-04000<br>40554-065-04000 | A<br>B |
| 10  | O-RING PLATE RETAINER<br>O-RING (TEFLON) PLATE RE-TAINER   | 1    | 40700-005-06000<br>40552-059-06000                    |        | 40702-025-06000<br>40553-060-06000 |        | 40714-052-06000<br>40554-059-06000 |        |
| 11  | DOVETAIL RING  | 1    | 40712-001-04000                                       |        | 40713-006-04000                    |        | 40714-010-04000                    |        |
| 12  | ORIFICE FITTING BODY<br>WELDNECK 150# - 600# RATING<br>SCH 40<br>WELDNECK 150# - 600# RATING<br>SCH 80 | 1    | 40726-010-04000<br>40726-020-04000                    |        | 40728-007-04000<br>40728-014-04000 |        | 40729-010-04000<br>40729-025-04000 |        |
|   | WELDNECK 900# - 1500# RATING<br>WELDNECK 900# - 1500# RATING   | 1    | 40726-020-04000<br>40726-042-04000                    | D<br>E | 40728-026-04000<br>40728-024-04000 | D<br>E | 40424-003-04000<br>40424-004-04000 | D<br>E |
| 13  | O-RING CHAMBER LID   | 1    | 40552-051-06000                                       | C      | 40553-051-06000                    | C      | 40714-059-06000                    |        |
| 14  | CHAMBER LID  | 1    | 40726-032-04000                                       | C      | 40728-021-04000                    | C      | 40729-021-04000<br>40424-006-04000 | A<br>B |
| 15  | FLANGE<br>150# RF SCH 40   | 1    | 40552-001-04000                                       |        | 40553-001-04000                    |        | 40554-001-04000                    |        |
|   | 300# RF SCH 40   | 1    | 40552-002-04000                                       |        | 40553-002-04000                    |        | 40554-002-04000                    |        |
|   | 600# RF SCH 40<br>600# RF SCH 80   | 1    | 40552-005-04000<br>40552-003-04000                    |        | 40553-004-04000<br>40553-006-04000 |        | 40554-003-04000<br>40554-005-04000 |        |
|   | 600# RTJ SCH 40<br>600# RTJ SCH 80<br>900# RF SCH 40   | 1    | 40552-016-04000<br>40552-017-04000<br>40552-014-04000 |        | 40553-040-04000<br>40553-041-04000 |        | 40554-032-04000<br>40551-033-04000 |        |
|   | 900# RF SCH 80<br>900# RF SCH 160<br>900# RTJ SCH 40   | 1    | 40552-009-04000<br>40552-007-04000<br>40552-020-04000 |        | 40553-010-04000                    |        | 40554-007-04000                    |        |
|   | 900# RTJ SCH 80<br>900# RTJ SCH 160<br>1500# RF SCH 80   | 1    | 40552-019-04000<br>40552-018-04000<br>40552-009-04000 |        | 40553-043-04000<br>40553-014-04000 |        | 40551-034-04000                    |        |
|   | 1500# RF SCH 160<br>1500# RTJ SCH 80   | 1    | 40552-007-04000<br>40552-019-04000                    |        | 40553-044-04000                    |        | 40554-036-04000                    |        |
|   | 1500# RTJ SCH 160  | 1    | 40552-018-04000                                       |        |                                    |        |                                    |        |
| 16  | 1/2" STEEL PIPE PLUG   | 2    | 35364-004-04000                                       |        | 35364-004-04000                    |        | 35364-004-04000                    |        |
| 17  | PLASTIC BORE PLUGS   | 2    | NCN   |        | NCN                                |        | NCN                                |        |
| NOTES: A) FOR 150# THROUGH 600# RATING<br>B) FOR 900# THROUGH 1500# RATING<br>C) FOR 150# THROUGH 1500# RATING<br>D) SCH 80<br>E) SCH 160 |  |      |   |        |                                    |        |                                    |        |

# **DIMENSIONAL DATA** **MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS**



**FLANGEWELD TYPE SINGLE CHAMBER**



**WELDNECK TYPE SINGLE CHAMBER**

**MODEL 4042 SINGLE CHAMBER  
DIMENSIONS—FLANGEWELD TYPE WITH RAISED FACE FLANGES**

| SIZE  | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO TOP | CENTERLINE TO<br>BOTTOM | CENTERLINE OF<br>ORIFICE PLATE TO<br>FACE AT END | CENTERLINE OF<br>ORIFICE PLATE TO<br>FACE AT END | OVERALL LENGTH<br>FACE TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | APPROXIMATE<br>WEIGHT, LB |
|---|------------------------------|-------------------|-------------------------|--|--|-------------------------------|----------------------------|--|---------------------------|
|   | A                            | E                 | F                       | J  | K  | L                             | M                          | O  |                           |
| <b>FLANGEWELD TYPE, 150 LB. A.N.S.I. - RAISED FACE FLANGE - 285 PSI. C.W.P.</b>   |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | 2.067*                       | 5-1/4             | 3                       | 6-5/8  | 4  | 10-5/8                        | 1/8                        | 7  | 33                        |
| 3   | 3.068*                       | 6-3/8             | 6-3/4                   | 7  | 4-1/8  | 11-1/8                        | 1/8                        | 9  | 57                        |
| 4   | 4.026*                       | 7-3/8             | 4-1/2                   | 7-11/16  | 4-9/16   | 12-1/4                        | 1/8                        | 10-3/4   | 79                        |
| <b>FLANGEWELD TYPE, 300 LB. A.N.S.I. - RAISED FACE FLANGE - 740 PSI. C.W.P.</b>   |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | 2.067*                       | 5-1/4             | 3-1/4                   | 6-7/8  | 4  | 10-7/8                        | 1/8                        | 7  | 36                        |
| 3   | 3.068*                       | 6-3/8             | 4-1/8                   | 7-3/8  | 4-1/8  | 11-1/2                        | 1/8                        | 9  | 63                        |
| 4   | 4.026*                       | 7-3/8             | 5                       | 8-1/16   | 4-9/16   | 12-5/8                        | 1/8                        | 10-3/4   | 89                        |
| <b>FLANGEWELD TYPE, 600 LB. A.N.S.I. - RAISED FACE FLANGE -1480 PSI. C.W.P.</b>   |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | 2.067*                       | 5-1/4             | 3-1/4                   | 7-1/4  | 4  | 11-1/4                        | 1/8                        | 7  | 38                        |
| 3   | 3.068*                       | 6-3/8             | 4-1/8                   | 7-3/4  | 4-1/8  | 11-7/8                        | 1/8                        | 9  | 63                        |
| 4   | 4.026*                       | 7-3/8             | 5-3/8                   | 8-15/16  | 4-9/16   | 13-1/2                        | 1/8                        | 10-3/4   | 99                        |
| <b>FLANGEWELD TYPE, 900 LB. A.N.S.I. - RAISED FACE FLANGE - 2220 PSI. C.W.P.</b>  |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | 1.939*                       | 5-1/4             | 4-1/4                   | 8-3/8  | 4  | 12-3/8                        | 1/8                        | 7  | 51                        |
| 3   | 2.900*                       | 6-3/8             | 4-3/4                   | 8-1/2  | 4-1/8  | 12-5/8                        | 1/8                        | 9  | 79                        |
| 4   | 3.826*                       | 7-3/8             | 5-3/4                   | 9-7/16   | 4-9/16   | 14                            | 1/8                        | 10-3/4   | 127                       |
| <b>FLANGEWELD TYPE, 1500 LB. A.N.S.I. - RAISED FACE FLANGE - 3705 PSI. C.W.P.</b> |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | **                           | 5-1/4             | 4-1/4                   | 8-3/8  | 4  | 12-3/8                        | 1/8                        | 7  | 51                        |
| 3   | **                           | 6-3/8             | 5-1/4                   | 9-1/8  | 4-1/8  | 13-1/4                        | 1/8                        | 9  | 98                        |
| 4   | **                           | 7-3/8             | 6-1/8                   | 9-13/16  | 4-9/16   | 14-3/8                        | 1/8                        | 10-3/4   | 145                       |
| *AVAILABLE IN OTHER BORES   |                              |                   |                         |  |  |                               |                            |  |                           |
| ** BORE TO BE SPECIFIED   |                              |                   |                         |  |  |                               |                            |  |                           |



**MODEL 4042 SINGLE CHAMBER  
DIMENSIONS—FLANGEWELD TYPE WITH RING TYPE JOINT FLANGES**

| SIZE  | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO TOP | CENTERLINE TO<br>BOTTOM | CENTERLINE OF<br>ORIFICE PLATE TO<br>FACE AT END | CENTERLINE OF<br>ORIFICE PLATE TO<br>FACE AT END | OVERALL LENGTH<br>FACE TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | APPROXIMATE<br>WEIGHT, LB |
|---|------------------------------|-------------------|-------------------------|--|--|-------------------------------|----------------------------|--|---------------------------|
|   | A                            | E                 | F                       | J  | K  | L                             | M                          | O  |                           |
| <b>FLANGEWELD TYPE, 600 LB. A.N.S.I. - RING TYPE JOINT FLANGE -1480 PSI. C.W.P.</b>   |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | 2.067*                       | 5-1/4             | 3 -1/4                  | 7-5/16   | 4  | 11-5/16                       | 1/8                        | 7  | 38                        |
| 3   | 3.068*                       | 6-3/8             | 4-1/8                   | 7-3/4  | 4-1/8  | 11-7/8                        | 1/8                        | 9  | 63                        |
| 4   | 4.026*                       | 7-3/8             | 5-3/8                   | 8-15/16  | 4-9/16   | 13-1/2                        | 1/8                        | 10-3/4   | 99                        |
| <b>FLANGEWELD TYPE, 900 LB. A.N.S.I. - RING TYPE JOINT FLANGE - 2220 PSI. C.W.P.</b>  |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | 1.939*                       | 5-1/4             | 4-1/4                   | 8-1/2  | 4  | 12-1/2                        | 1/8                        | 7  | 51                        |
| 3   | 2.900*                       | 6-3/8             | 4-3/4                   | 8-5/8  | 4-1/8  | 12-3/4                        | 1/8                        | 9  | 79                        |
| 4   | 3.826*                       | 7-3/8             | 5-3/4                   | 9-7/16   | 4-9/16   | 14                            | 1/8                        | 10-3/4   | 127                       |
| <b>FLANGEWELD TYPE, 1500 LB. A.N.S.I. - RING TYPE JOINT FLANGE - 3705 PSI. C.W.P.</b> |                              |                   |                         |  |  |                               |                            |  |                           |
| 2   | **                           | 5-1/4             | 4-1/4                   | 8-1/2  | 4  | 12-1/2                        | 1/8                        | 7  | 51                        |
| 3   | **                           | 6-3/8             | 5-1/4                   | 9-1/8  | 4-1/8  | 13-1/4                        | 1/8                        | 9  | 98                        |
| 4   | **                           | 7-3/8             | 6-1/8                   | 9-13/16  | 4-9/16   | 14-3/8                        | 1/8                        | 10-3/4   | 145                       |
| *AVAILABLE IN OTHER BORES   |                              |                   |                         |  |  |                               |                            |  |                           |
| ** BORE TO BE SPECIFIED   |                              |                   |                         |  |  |                               |                            |  |                           |

**MODEL 4042 SINGLE CHAMBER  
DIMENSIONS—WELDNECK TYPE**

| SIZE   | DIAMETER OF<br>INTERNAL BORE | CENTERLINE TO TOP | CENTERLINE TO<br>BOTTOM | CENTERLINE OF<br>ORIFICE PLATE TO<br>FACE AT END | CENTERLINE OF<br>ORIFICE PLATE TO<br>FACE AT END | OVERALL LENGTH<br>FACE TO END | ORIFICE PLATE<br>THICKNESS | OPERATING<br>CLEARANCE FROM<br>CENTER WITH<br>CHAMBER LID OPEN | APPROXIMATE<br>WEIGHT, LB |
|--|------------------------------|-------------------|-------------------------|--|--|-------------------------------|----------------------------|--|---------------------------|
|  | A                            | E                 | F                       | J  | K  | L                             | M                          | O  |                           |
| <b>WELDNECK TYPE, 600 LB. A.N.S.I. -1480 PSI. C.W.P.</b>   |                              |                   |                         |  |  |                               |                            |  |                           |
| 2  | 2.067*                       | 5-1/4             | 1-15/16                 | 4  | 4  | 8                             | 1/8                        | 7  | 27                        |
| 3  | 3.068*                       | 6-3/8             | 2-1/2                   | 4-1/8  | 4-1/8  | 8-1/4                         | 1/8                        | 9  | 45                        |
| 4  | 4.026*                       | 7-3/8             | 2-7/8                   | 4-9/16   | 4-9/16   | 9-1/8                         | 1/8                        | 10-3/4   | 62                        |
| <b>WELDNECK TYPE, 900 LB. A.N.S.I. - 2220 PSI. C.W.P.</b>  |                              |                   |                         |  |  |                               |                            |  |                           |
| 2  | 1.939*                       | 5-1/4             | 1-15/16                 | 4  | 4  | 8                             | 1/8                        | 7  | 27                        |
| 3  | 2.900*                       | 6-3/8             | 2-1/2                   | 4-1/8  | 4-1/8  | 8-1/4                         | 1/8                        | 9  | 50                        |
| 4  | 3.826*                       | 7-3/8             | 2-7/8                   | 4-9/16   | 4-9/16   | 9-1/8                         | 1/8                        | 10-3/4   | 76                        |
| <b>WELDNECK TYPE, 1500 LB. A.N.S.I. - 3705 PSI. C.W.P.</b> |                              |                   |                         |  |  |                               |                            |  |                           |
| 2  | **                           | 5-1/4             | 1-15/16                 | 4  | 4  | 8                             | 1/8                        | 7  | 27                        |
| 3  | **                           | 6-3/8             | 2-1/2                   | 4-1/8  | 4-1/8  | 8-1/4                         | 1/8                        | 9  | 50                        |
| 4  | **                           | 7-3/8             | 2-7/8                   | 4-9/16   | 4-9/16   | 9-1/8                         | 1/8                        | 10-3/4   | 76                        |
| *AVAILABLE IN OTHER BORES                                  |                              |                   |                         |  |  |                               |                            |  |                           |
| ** BORE TO BE SPECIFIED                                    |                              |                   |                         |  |  |                               |                            |  |                           |

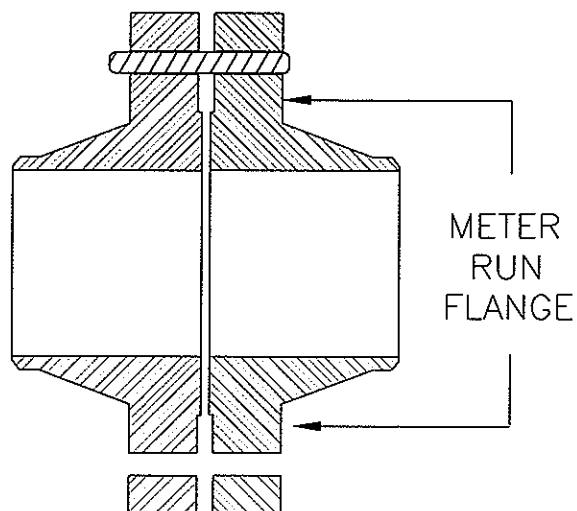
## Meter Runs

The meter runs are fabricated by trained manufacturing personnel with complete facilities for machining, welding, gauging and inspection. This produces a product with quality and metering accuracy not possible with field-fabricated units.

All meter runs are factory-aligned and welded with special equipment that guarantees a straight, smooth meter run without defects. Standard lengths meet AGA/API requirements.

## Meter Run Alignment

Orifice fitting to meter run alignment can be specified with dowel pins. This option assures proper bore alignment.

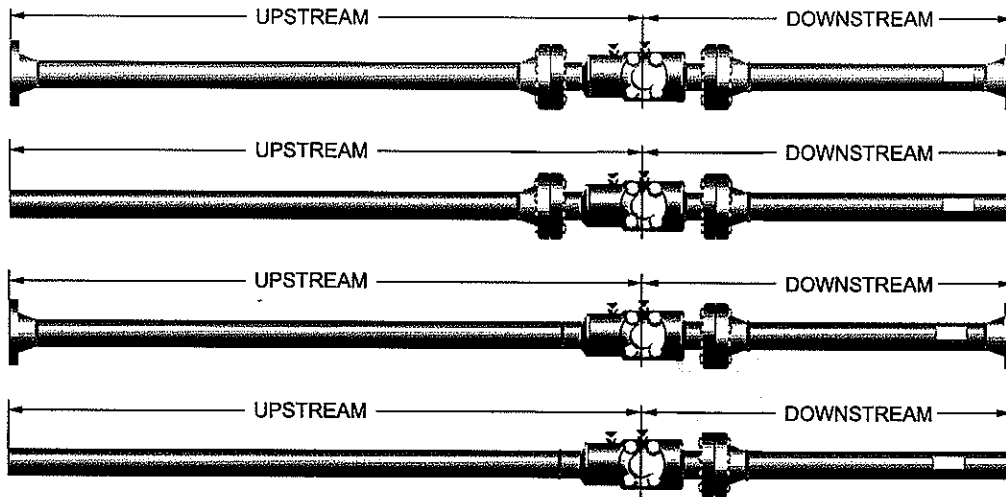


## Technical Data

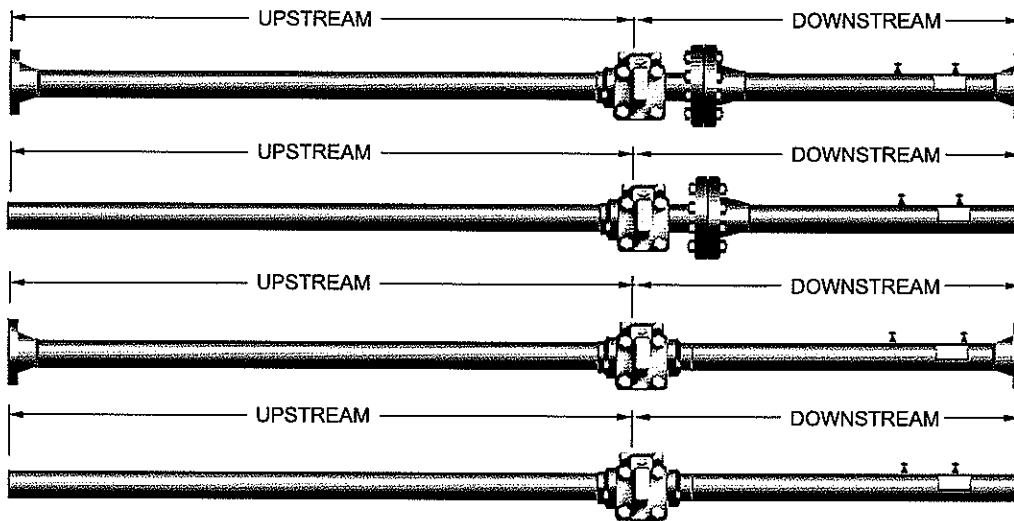
| METER RUN I.D. FOR NOMINAL DIMENSIONS |       |       |       |       |
|---------------------------------------|-------|-------|-------|-------|
| SCH                                   | 2"    | 3"    | 4"    | 6"    |
| 40                                    | 2.607 | 3.068 | 4.026 | 6.065 |
| 80                                    | 1.939 | 2.900 | 3.826 | 5.761 |
| 160                                   | 1.687 | 2.624 | 3.438 | 5.187 |

| ANSI Rating                 | Working Pressure (psi) | Test Pressure (psi) |
|-----------------------------|------------------------|---------------------|
| 150                         | 285                    | 450                 |
| 300                         | 740                    | 1125                |
| 600                         | 1480                   | 2225                |
| 900                         | 2220                   | 3350                |
| 1500                        | 3705                   | 5575                |
| TEMPERATURE: -20°F TO 100°F |                        |                     |

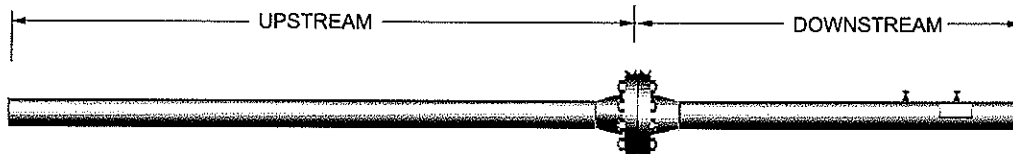
### MODEL 4055 DUAL CHAMBER METER RUNS



### MODEL 4042 SINGLE CHAMBER METER RUNS



### ORIFICE FLANGE UNION METER RUNS



NOTES: METER RUNS CAN BE MANUFACTURED TO SPECIFIC CUSTOMER REQUIREMENTS. METER RUNS CAN BE SUPPLIED WITH THREDOLETS FOR 1/2", 3/4" AND 1" NPT AND ANY COMBINATION OF BEVELED FOR WELDING OR FLANGED ENDS.

## Orifice Flange Unions

Orifice flange unions are available in 300 lb. ANSI through 2500 lb. ANSI. They are available in SA 105N, SA350 LF2, 304 ST/STL, 316 ST/STL or MONEL materials. All flanges conform to the ANSI B16.5 Flange Piping Code. All flanges are machined to close tolerances and are carefully inspected before shipment. Orifice flange assemblies are provided with studs, nuts, gaskets, jack screws and pipe plugs.

## Paddle Type Orifice Plates

Note: Paddle type orifice plates must be ordered separately.

NuFlo paddle type orifice plates are designed for use between orifice flange unions. The line size, flange rating, material and bore size are stamped on the handle. Paddle plates are available in type 304 or 316 stainless steel. Other materials are available on special order.

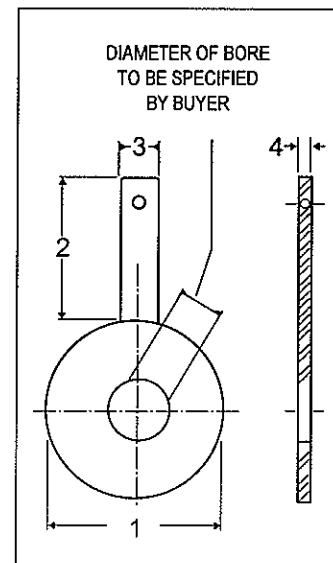
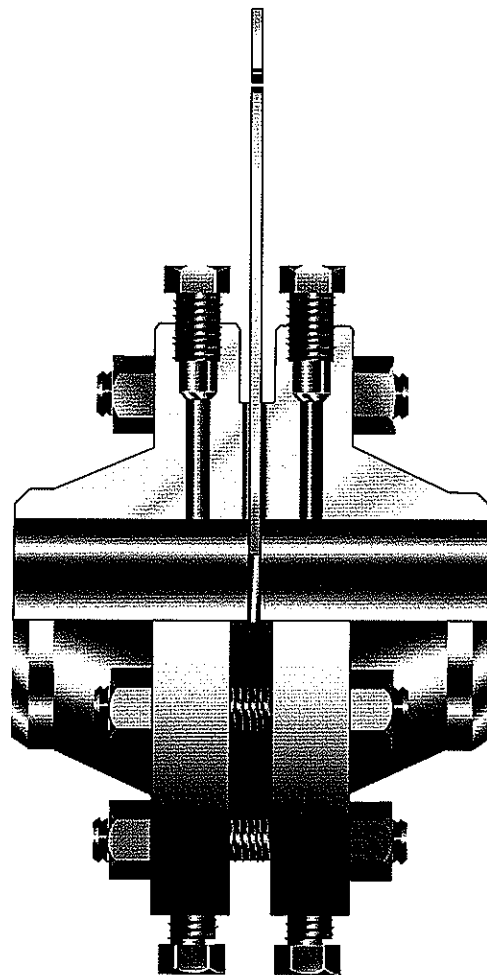
### When Ordering, Specify:

- Quantity
- Size, flange rating, pipe schedule
- Material (flange, studs, nuts and gaskets)
- Orifice bore size
- Orifice plate thickness
- Orifice plate material

### Paddle Plate Dimensions

|        | 300 lb<br>ANSI | 600 lb<br>ANSI | For All Pressure Ratings<br>300 - 1500 lb ANSI |        |      |
|--------|----------------|----------------|--|--------|------|
| SIZE * | 1              | 1              | 2  | 3      | 4    |
| 2"     | 4-3/8"         | 4-3/8"         | 4"   | 1"     | 1/8" |
| 3"     | 5-7/8"         | 5-7/8"         | 4"   | 1-1/4" | 1/8" |
| 4"     | 7-1/8"         | 7-5/8"         | 4"   | 1-1/4" | 1/8" |

\*Other sizes available on request



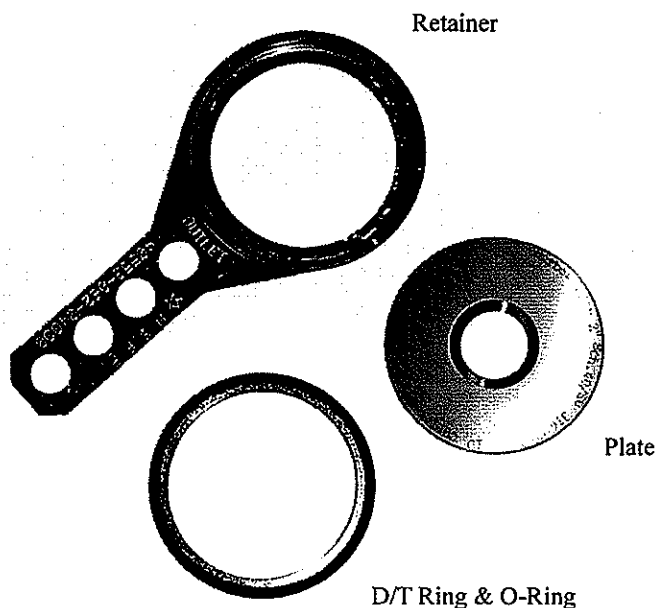
## Orifice Plate Assembly

The orifice plate retainer assembly is used in both the dual and single chamber orifice fittings. The orifice retainer and chamber lid are designed to assure the center alignment of orifice bore with the line bore. The chamber lid cannot be closed without centering the orifice in the correct position. If the plate is not correctly centered, closing the lid will align the plate automatically. The plate retainer and the dovetail ring are nickel plated for corrosion resistance.

The orifice retainer, dovetail ring and O-ring together hold the orifice plate in a rigid position and perpendicular to the bore at all times.

Universal orifice plates are stocked in 1/8-in. increments, beginning at 0.125 inch. The orifice bore size and outlet are clearly etched on each plate. All AGA/API requirements are specifically met.

The NuFlo orifice plate is interchangeable with other universal type plates. Standard orifice plates are constructed of 316 stainless steel; however, they are available in other material upon special request. Each orifice plate has a 15-30 micro-inch finish.



**Universal Orifice Plates and Plate Dimensions**

| SIZE               | 2"              | 3"              | 4"              | 6"              | NOTES              |
|--------------------|-----------------|-----------------|-----------------|-----------------|--------------------|
| PLATE<br>RETAINERS | 40552-062-04000 | 40553-062-04000 | 40554-063-04000 | 40556-076-04000 | 150 - 600# RATING  |
|                    | 40552-069-04000 | 40553-065-04000 | 40554-065-04000 | 40556-083-04000 | 900 - 1500# RATING |
| DOVETAIL RING      | 40712-001       | 40713-006       | 40714-010       | 40706-080-04000 |                    |
| O-RING             | 40700-005-06000 | 40702-025-06000 | 40714-052-06000 | 40706-098-06000 | 150 - 600# RATING  |
|                    | 40552-059-04000 | 40553-060-06000 | 40554-059-06000 | 40556-074-06000 | 900 - 1500# RATING |

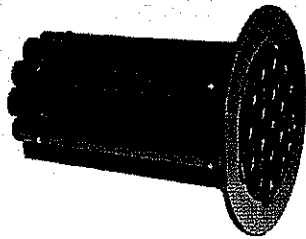
|      | Material: 304 S.S. | Material: 316 S.S. |
|------|--------------------|--------------------|
| Size | Part Number        | Part Number        |
| 2"   | 40700-022          | 40552-052          |
| 3"   | 40702-003          | 40553-055          |
| 4"   | 40704-091          | 40554-049          |
| 6"   | 40706-023          | 40556-046          |
| 8"   | 40558-061          | 40558-070          |
| 10"  | 40540-012          | 40540-024          |

| Size | Plate Thickness | Plate Diameter |
|------|-----------------|----------------|
| 2"   | 1/8             | 2.437          |
| 3"   | 1/8             | 3.437          |
| 4"   | 1/8             | 4.406          |
| 6"   | 1/8             | 6.437          |
| 8"   | 1/8             | 8.437          |
| 10"  | 1/8             | 10.687         |

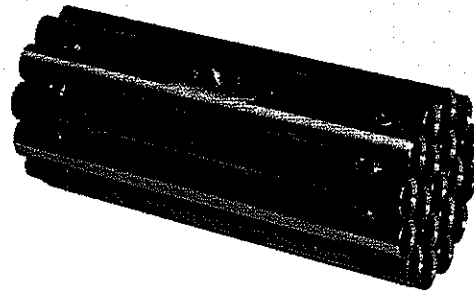
## Straightening Vanes

The use of straightening vanes in meter runs serves a twofold purpose: (1) the turbulence often created in a complex piping system is straightened and smoothed to a normal flow pattern and (2) the amount of straight pipe required preceding an orifice is reduced. NuFlo offers both flanged and pin type straightening vanes.

Vanes are available with carbon steel, 304 or 316 stainless steel tubing welded together and securely attached into the meter run. The tubes are reamed as thin as is practical at both ends and are constructed so as to minimize the possibility of vibration. All vanes are manufactured according to the latest AGA/API specifications.



**FLANGE TYPE**



**PIN TYPE**

| VANE<br>MODEL | 2"              |                    | 3"              |                    | 4"              |                    | 6"              |                    |
|---------------|-----------------|--------------------|-----------------|--------------------|-----------------|--------------------|-----------------|--------------------|
|               | Carbon<br>Steel | Stainless<br>Steel | Carbon<br>Steel | Stainless<br>Steel | Carbon<br>Steel | Stainless<br>Steel | Carbon<br>Steel | Stainless<br>Steel |
| Flange Type   | 40807           | 40807              | 40813           | 40813              | 40814           | 40814              | 40818           | 40818              |
| Pin Type      | 40806           | 40806              | 40812           | 40812              | 40815           | 40815              | 40819           | 40819              |
| Vane Length   | 6"              |                    | 8"              |                    | 10"             |                    | 12"             |                    |

Other sizes available on request.

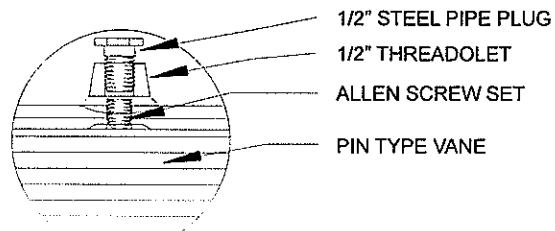
When ordering specify: part number, type of material and pipe bore size.

## Installation

The flange type straightening vane is held in place by a flange ring between two pipe flanges.

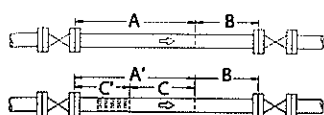
The pin type straightening vane is held in place by an allen set screw. The set screw seats into a countersunk hole in the center of a welded pad that is welded to the straightening vane itself. The tapped hole in the pipe is sealed off by welding a threadolet around the hole. A pipe plug is installed into the threadolet.

### PIN TYPE INSTALLATION

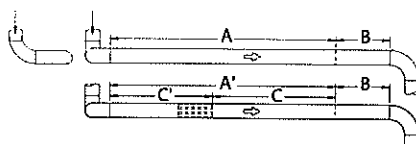


**AGA/API MINIMUM LENGTHS FOR METER RUN WITH FLANGE TAPS  
USING .70 BETA RATIO (AGA REP. NO. 3. -ANSI/API MPMS 14.3.2 1991)**

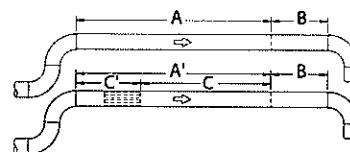
**FIGURE 3A**



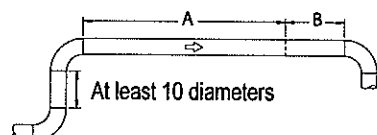
**FIGURE 3B**



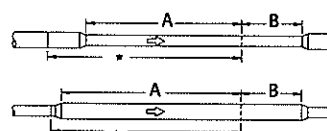
**FIGURE 3C**



**FIGURE 3D**



**FIGURE 3E**



\* AS REQUIRED BY PRECEDING FITTING.

| NORMAL<br>PIPE SIZE | 2"  | 3"   | 4"   | 6"   |
|---------------------|-----|--|------|------|
|                     |     | AGA FIGURE 3A-Fitting or Regulator         |      |      |
| A                   | 78" | 117"                                       | 155" | 233" |
| A'                  | 31" | 47"  | 62"  | 93"  |
| B                   | 21" | 25"  | 30"  | 38"  |
| C                   | 13" | 20"  | 26"  | 39"  |
| C'                  | 18" | 27"  | 36"  | 54"  |
|                     |     | AGA FIGURE 3B-Two Ells in Different Planes |      |      |
| A                   | 63" | 95"  | 126" | 189" |
| A'                  | 28" | 42"  | 55"  | 83"  |
| B                   | 21" | 25"  | 30"  | 38"  |
| C                   | 13" | 20"  | 26"  | 39"  |
| C'                  | 15" | 22"  | 29"  | 44"  |
|                     |     | AGA FIGURE 3C-Two Ells in Same Plane       |      |      |
| A                   | 38" | 57"  | 75"  | 113" |
| A'                  | 25" | 37"  | 49"  | 74"  |
| B                   | 21" | 25"  | 30"  | 38"  |
| C                   | 13" | 20"  | 26"  | 39"  |
| C'                  | 12" | 17"  | 23"  | 34"  |
|                     |     | AGA FIGURE 3D                              |      |      |
| A                   | 28" | 42"  | 56"  | 84"  |
| A'                  | —   | —  | —    | —    |
| B                   | 21" | 25"  | 30"  | 38"  |
| C                   | —   | —  | —    | —    |
| C'                  | —   | —  | —    | —    |
|                     |     | AGA FIGURE 3E Reducer                      |      |      |
| A                   | 25" | 37"  | 49"  | 74"  |
| A'                  | —   | —  | —    | —    |
| B                   | 21" | 25"  | 30"  | 38"  |
| C                   | —   | —  | —    | —    |
| C'                  | —   | —  | —    | —    |

Note 1: For Pipe Taps: A, A' and C' should be increased by 2 pipe diameters.

Note 2: In Figure 3B, when two ells are closely preceded by a third which is not in the same plane as the middle or second ell, the piping requirements shown by A should be doubled.

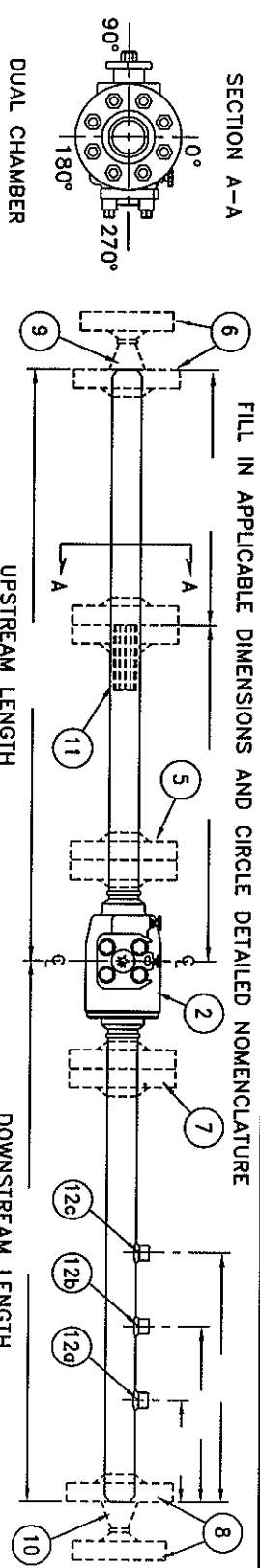


## DATA REQUIREMENTS FOR ORIFICE BORE CALCULATIONS

|   |  |  |  |  |  |
|---|--|--|--|--|--|
| <div style="display: flex; justify-content: space-between;"> <div style="width: 25%;"> Plate Type:<br/> Material:<br/> Bore:<br/> Tap Location: </div> <div style="width: 45%;"> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Paddle <input type="checkbox"/><br/> Concentric <input type="checkbox"/><br/> 316 <input type="checkbox"/><br/> Maximum Rate <input type="checkbox"/><br/> Flange <input type="checkbox"/><br/> Other _____ </div> <div style="width: 45%;"> Universal <input type="checkbox"/><br/> Other <input type="checkbox"/><br/> 304 <input type="checkbox"/><br/> Nearest 1/8" <input type="checkbox"/><br/> Corner <input type="checkbox"/><br/> Up _____ </div> </div> <div style="width: 25%;"> Other _____<br/> Other _____<br/> Down _____ </div> </div> </div> |  |  |  |  |  |
| GENERAL   | Flange Rating _____  |  |  |  |  |
|   | Tag No. _____  |  |  |  |  |
|   | Line No. _____   |  |  |  |  |
|   | Fluid _____  |  |  |  |  |
|   | Flow Temperature °F _____                                  |  |  |  |  |
|   | Flow Pressure psig _____                                   |  |  |  |  |
|   | Actual Orifice I.D. _____                                  |  |  |  |  |
|   | Line Flange I.D. _____                                     |  |  |  |  |
|   | Meter Type (Mercury or Dry) _____                          |  |  |  |  |
|   | S. G. of Seal @ Ambient T. _____                           |  |  |  |  |
|   | Diff. Range H <sub>2</sub> O _____                         |  |  |  |  |
|   | Static Range psig _____                                    |  |  |  |  |
|   | Chart or Scale Range _____                                 |  |  |  |  |
|   | Chart Multiplier _____                                     |  |  |  |  |
| LIQUIDS   | Flow Units _____   |  |  |  |  |
|   | Maximum Flow _____   |  |  |  |  |
|   | Normal Flow _____  |  |  |  |  |
|   | Specific Gravity @ 60°F _____                              |  |  |  |  |
|   | Specific Gravity @ Flowing Cond. _____                     |  |  |  |  |
|   | Viscosity cp @ Flowing Cond. _____                         |  |  |  |  |
| VAPOR/GAS   | Flow Units _____   |  |  |  |  |
|   | Maximum Flow _____   |  |  |  |  |
|   | Normal Flow _____  |  |  |  |  |
|   | Specific Gravity _____                                     |  |  |  |  |
|   | Molecular Weight _____                                     |  |  |  |  |
|   | Flowing Density lbs/ft³ _____                              |  |  |  |  |
|   | Barometric Pressure or Elev. of Plant Site (approx.) _____ |  |  |  |  |
|   | Pressure Base _____  |  |  |  |  |
|   | Temperature Base _____                                     |  |  |  |  |
|   | Supercom Factor _____                                      |  |  |  |  |
|   | @ Flowing T. & P. _____                                    |  |  |  |  |
|   | Viscosity cp @ Flowing T. & P. _____                       |  |  |  |  |
| STEAM   | Flow Units _____   |  |  |  |  |
|   | Maximum Flow _____   |  |  |  |  |
|   | Quality % or Superheat °F _____                            |  |  |  |  |

# NUFLO PRODUCTS MODEL 4055 DUAL CHAMBER METER RUN ORDERING FORM

DATE \_\_\_\_\_ CUSTOMER \_\_\_\_\_ TAG \_\_\_\_\_ ASSEMBLY NO \_\_\_\_\_  
 DISTRICT \_\_\_\_\_ QUANTITY ORDERED \_\_\_\_\_ L.S.D. \_\_\_\_\_ SHIPPING ADDRESS \_\_\_\_\_  
 DESIRED SHIPPING DATE \_\_\_\_\_ ORDERED BY \_\_\_\_\_ END USER \_\_\_\_\_



FILL IN APPLICABLE DIMENSIONS AND CIRCLE DETAILED NOMENCLATURE

- Nominal Size Meter Run (inches)  
2 - 3 - 4 - 6
- Type of orifice fitting: Dual Chamber
- Pressure Rating (ANSI)  
150 - 300 - 600 - 900 - 1500
- Wall Schedule of Meter Run  
40 - 80 - 160
- Upstream Connection to Orifice Fitting  
Welded - RF Flange - RTJ Flange  
Threaded - Socket Weld
- Upstream Outer End of Meter Run  
Beveled - RF Flange - RTJ Flange  
Reducer - Threaded - Elbow @ \_\_\_\_\_
- Downstream Connection to Orifice Fitting  
Welded - RF Flange - RTJ Flange  
Threaded - Socket Weld
- Downstream Outer End of Meter Run  
Beveled - RF Flange - RTJ Flange  
Reducer - Threaded - Elbow @ \_\_\_\_\_
- Size of Upstream Reducer/Elbow if used,  
Inches, \_\_\_\_\_  
None - Threaded - Beveled - Elbow @ \_\_\_\_\_
- Size of Downstream Reducer/Elbow if used  
Inches, \_\_\_\_\_  
None - Threaded - Beveled - Elbow @ \_\_\_\_\_
- Straightening Vanes/Flow Conditioner  
None - Pin Type - Flange Type  
Carbon Steel - Stainless Steel
- Size of Downstream Couplings if used.  
Numbered from outer end of downstream tube  
a. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
b. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
c. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
Orientation  
a. 45° or Vertical  
b. 45° or Vertical  
c. 45° or Vertical
- Size of installed Orifice Plate, \_\_\_\_\_ Inches.
- Install Thermowell: Yes No
- Description \_\_\_\_\_
- Special Coating: None/Primer/Paint \_\_\_\_\_
- Are MTRS/Calibration Sheets desired with Meter Run  
Yes No
- Purchase order No. \_\_\_\_\_

| METER TUBE I.D. FOR NOMINAL DIMENSIONS | 2"    | 3"    | 4"    | 6"    |
|--|-------|-------|-------|-------|
| SCH. 40                                | 2.067 | 3.068 | 4.026 | 6.065 |
| 80                                     | 1.939 | 2.900 | 3.826 | 5.761 |
| 160                                    | 1.687 | 2.624 | 3.438 | 5.187 |

| ANSI RATING | WORKING PRESSURE (PSI) | TEST PRESSURE (PSI) |
|-------------|------------------------|---------------------|
| 150         | 285                    | 450                 |
| 300         | 740                    | 1125                |
| 600         | 1480                   | 2225                |
| 900         | 2220                   | 3350                |
| 1500        | 3705                   | 5575                |

TEMPERATURE: -20° F TO 100° F

## SPECIAL INSTRUCTIONS:

TYPE OF SERVICE:

SERVICE TEMP.:

X RAY: YES ☐ NO ☐

M.P.I. YES ☐ NO ☐

P.W.H.T. YES ☐ NO ☐

HYDRO REPORTS YES ☐ NO ☐

API/AGA-3 (2000) YES ☐ NO ☐

AGA FIGURE#:

WELD PROCEDURES: TOL'S: BETA:

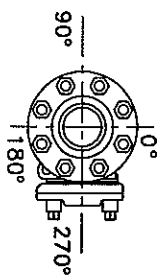
WELD PROCEDURES: PIPE BODY, FLANGE:

OTHER:

# NUFLO PRODUCTS MODEL 4042 SINGLE CHAMBER METER RUN ORDERING FORM

DATE \_\_\_\_\_ CUSTOMER \_\_\_\_\_ TAG \_\_\_\_\_ ASSEMBLY NO \_\_\_\_\_  
 DISTRICT \_\_\_\_\_ QUANTITY ORDERED \_\_\_\_\_ L.S.D. \_\_\_\_\_ SHIPPING ADDRESS \_\_\_\_\_  
 DESIRED SHIPPING DATE \_\_\_\_\_ ORDERED BY \_\_\_\_\_ END USER \_\_\_\_\_

SECTION A-A



FILL IN APPLICABLE DIMENSIONS AND CIRCLE DETAILED NOMENCLATURE

SINGLE CHAMBER

UPSTREAM LENGTH

DOWNSTREAM LENGTH

- Nominal Size Meter Run (inches)  
2 - 3 - 4
- Type of orifice fitting: Single Chamber
- Pressure Rating (ANSI)  
150 - 300 - 600 - 900 - 1500
- Wall Schedule of Meter Run  
40 - 80 - 160
- Upstream Connection to Orifice Fitting  
Welded - RF Flange - RTJ Flange  
Threaded - Socket Weld
- Upstream Outer End of Meter Run  
Beveled - RF Flange - RTJ Flange  
Reducer - Threaded - Elbow @ \_\_\_\_\_
- Downstream Connection to Orifice Fitting  
Welded - RF Flange - RTJ Flange  
Threaded - Socket Weld
- Downstream Outer End of Meter Run  
Beveled - RF Flange - RTJ Flange  
Reducer - Threaded - Elbow @ \_\_\_\_\_
- Size of Upstream Reducer/Elbow if used, \_\_\_\_\_ Inches,  
None - Threaded - Beveled - Elbow @ \_\_\_\_\_
- Size of Downstream Reducer/Elbow if used \_\_\_\_\_ Inches,  
None - Threaded - Beveled - Elbow @ \_\_\_\_\_
- Straightening Vanes/Flow Conditioner  
None - Pin Type - Flange Type  
Carbon Steel - Stainless Steel
- Size of Downstream Couplings if used.  
Numbered from outer end of downstream tube  
a. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
b. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
c. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
Orientation  
a. 45° or Vertical  
b. 45° or Vertical  
c. 45° or Vertical
- Size of installed Orifice Plate, \_\_\_\_\_ Inches.
- Install Thermowell: Yes No
- Special Coating: None/Prime/Paint
- Are MTRIS/Calibration Sheets desired with Meter Run  
Yes No
- Purchase order No. \_\_\_\_\_

| METER TUBE I.D. FOR NOMINAL DIMENSIONS |       |       |       |
|--|-------|-------|-------|
| SCH.                                   | 2"    | 3"    | 4"    |
| 40                                     | 2.067 | 3.068 | 4.026 |
| 80                                     | 1.939 | 2.900 | 3.826 |
| 160                                    | 1.687 | 2.624 | 3.438 |

| ANSI RATING | WORKING PRESSURE (PSI) | TEST PRESSURE (PSI) |
|-------------|------------------------|---------------------|
| 150         | 285                    | 450                 |
| 300         | 740                    | 1125                |
| 600         | 1480                   | 2225                |
| 900         | 2220                   | 3350                |
| 1500        | 3705                   | 5575                |

TEMPERATURE: -20 °F TO 100 °F

## SPECIAL INSTRUCTIONS:

TYPE OF SERVICE:

SERVICE TEMP.:

X RAY:

M.P.I.

P.W.H.T.

HYDRO REPORTS

API/AGA-3 (2000)

AGA FIGURE #:

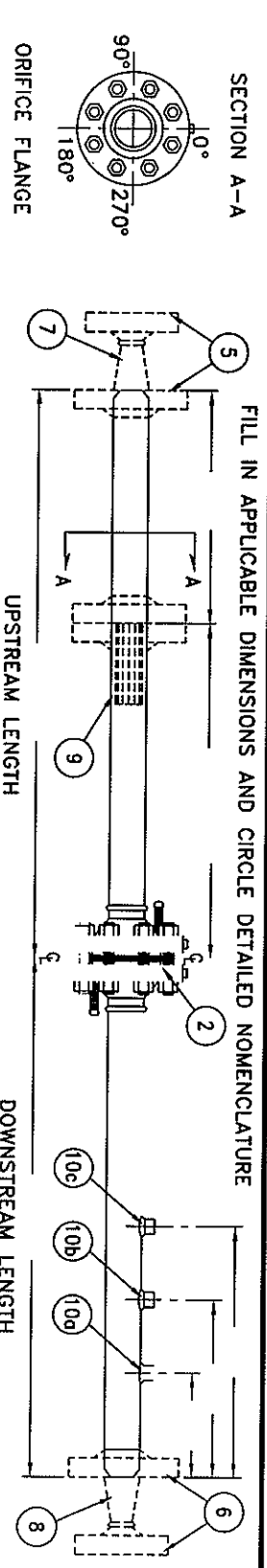
WELD PROCEDURES:

WELD PROCEDURES:

OTHER:

# NUFLO PRODUCTS ORIFICE FLANGE METER RUN ORDERING FORM

DATE \_\_\_\_\_ CUSTOMER \_\_\_\_\_ TAG \_\_\_\_\_ ASSEMBLY NO. \_\_\_\_\_  
 DISTRICT \_\_\_\_\_ QUANTITY ORDERED \_\_\_\_\_ VIA \_\_\_\_\_ SHIPPING ADDRESS \_\_\_\_\_  
 DESIRED SHIPPING DATE \_\_\_\_\_ ORDERED BY \_\_\_\_\_ END USER \_\_\_\_\_



| METER TUBE I.D. FOR NOMINAL DIMENSIONS |       |       |       |       |      |       |        |  |  |
|--|-------|-------|-------|-------|------|-------|--------|--|--|
| SCH.                                   | 2"    | 3"    | 4"    | 6"    | SCH. | 8"    | 10"    |  |  |
| 40                                     | 2.067 | 3.068 | 4.026 | 6.065 | 30   | 8.071 | 10.136 |  |  |
| 80                                     | 1.939 | 2.900 | 3.826 | 5.761 | 40   | 7.981 | 10.020 |  |  |
| 160                                    | 1.687 | 2.624 | 3.438 | 5.187 | 80   | 7.625 | 9.564  |  |  |

| ANSI RATING | WORKING PRESSURE (PSI) | TEST PRESSURE (PSI) |
|-------------|------------------------|---------------------|
| 150         | 285                    | 450                 |
| 300         | 740                    | 1125                |
| 600         | 1480                   | 2225                |
| 900         | 2220                   | 3350                |
| 1500        | 3705                   | 5575                |
| 2500        | 6170                   | 9275                |

TEMPERATURE: -20 °F TO 100 °F

- Nominal Size Meter Run (inches)  
1 - 2 - 3 - 4 - 6 - 8 - 10
- Type of orifice fitting: Orifice Flange
- Pressure Rating (ANSI)  
150 - 300 - 600 - 900 - 1500 - 2500
- Wall Schedule of Meter Run  
40 - 80 - 160
- Upstream Outer End of Meter Run  
Beveled - RF Flange - RTJ Flange  
Reducer - Threaded - Elbow @ \_\_\_\_\_
- Downstream Outer End of Meter Run  
Beveled - RF Flange - RTJ Flange  
Reducer - Threaded - Elbow @ \_\_\_\_\_
- Size of Upstream Reducer/ Elbow if used, \_\_\_\_\_ inches,  
None - Threaded - Beveled - Elbow @ \_\_\_\_\_
- Size of Downstream Reducer/ Elbow if used, \_\_\_\_\_ inches,  
None - Threaded - Beveled - Elbow @ \_\_\_\_\_
- Straightening Vanes/ Flow Conditioner  
None - Pin Type - Flange Type  
Carbon Steel - Stainless Steel
- Size of Downstream Couplings if used.  
Numbered from outer end of downstream tube  
a. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
b. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
c. 1/2" 3/4" - 1" - None - 3000 Lbs. - 6000 Lbs.  
Orientation  
a. 45° or Vertical  
b. 45° or Vertical  
c. 45° or Vertical
- Size of Installed Orifice Plate, \_\_\_\_\_ inches.
- Install Thermowell: Yes No  
Description \_\_\_\_\_
- Special Coating: None/ Prime/ Paint \_\_\_\_\_
- Are MTRS/ Calibration Sheets desired with Meter Run  
Yes No
- Purchase order No. \_\_\_\_\_

FORM NUMBER: NS-3C  
 REVISION NUMBER: 3  
 REVISION DATE: 10/26/04

**SPECIAL INSTRUCTIONS:**  
 TYPE OF SERVICE: \_\_\_\_\_  
 SERVICE TEMP.: \_\_\_\_\_  
 X RAY: YES ☐ NO ☐  
 M.P.I.: YES ☐ NO ☐  
 PWHT: YES ☐ NO ☐  
 HYDRO REPORTS: YES ☐ NO ☐  
 API/AGA-3 (2000) YES ☐ NO ☐  
 AGA FIGURE#: \_\_\_\_\_ BETA: \_\_\_\_\_  
 WELD PROCEDURES: TOL'S: \_\_\_\_\_  
 WELD PROCEDURES: PIPE, FLANGE: \_\_\_\_\_  
 OTHER: \_\_\_\_\_

# **STANDARD MATERIALS FOR PARTS USED ON MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS**

| ITEM | MIN -20°F (-29°C)   |                                 | MIN -50°F (-45°C)               |                                 | REMARKS  |
|------|---|---------------------------------|---------------------------------|---------------------------------|--|
|      | SWEET SERVICE   | (H <sub>2</sub> S) SOUR SERVICE | SWEET SERVICE                   | (H <sub>2</sub> S) SOUR SERVICE |  |
| 1    | 316 S.S.  | 316 S.S.                        | 316 S.S.                        | 316 S.S.                        |  |
| 2    | 316 S.S.  | 316 S.S.                        | 316 S.S.                        | 316 S.S.                        |  |
| 3    | AISI 4130   | AISI 4130                       | AISI 4130                       | AISI 4130                       | W/NYLON SEAT & VITON, HSN O-RING & HANDLES   |
| 4    | ALUMINUM  | 316 S.S.                        | ALUMINUM                        | 316 S.S.                        |  |
| 5    | SPLIT   | SPLIT STL                       | SPLIT STL                       | SPLIT STL                       |  |
| 6    | AISI 1020   | AISI 1020                       | AISI 1020                       | AISI 1020                       |  |
| 7    | N/A   | N/A                             | N/A                             | N/A                             |  |
| 8    | AISI 1020 CSTG.   | AISI 1020 CSTG.                 | AISI 1020 CSTG.                 | AISI 1020 CSTG.                 |  |
| 9    | AISI 4140   | AISI 4140                       | AISI 4140                       | AISI 4140                       | HRc 18-22  |
| 10   | AISI 4130   | AISI 4130                       | AISI 4130                       | AISI 4130                       | ON 4" AND 6" SIZE ONLY   |
| 11   | AISI 4130   | AISI 4130                       | AISI 4130                       | AISI 4130                       | ON 4" AND 6" SIZE ONLY   |
| 12   | VITON - B, HSN  | VITON - B, HSN                  | VITON - B, HSN                  | VITON - B, HSN                  | 70 DURO  |
| 13   | AISI 4140   | AISI 4140                       | AISI 4140                       | AISI 4140                       | HRc 18-22  |
| 14   | TEFLON®   | TEFLON®                         | TEFLON®                         | TEFLON®                         |  |
| 15   | VITON - B, HSN  | VITON - B, HSN                  | VITON - B, HSN                  | VITON - B, HSN                  | 70 DURO  |
| 16   | N/A   | N/A                             | N/A                             | N/A                             | ON 4" SIZE ONLY  |
| 17   | VITON-B, HSN  | VITON-B, HSN                    | VITON-B, HSN                    | VITON-B, HSN                    | 70 DURO  |
| 18   | ASTM SA-216 GR. WCB                                       | ASTM SA-216 GR. WCB             | ASTM SA-216 GR. WCB             | ASTM SA-216 GR. WCB             |  |
| 19   | SAE1075   | INCONEL X 750                   | SAE 1075                        | INCONEL X 750                   | INCONELX-TEMPERED  |
| 20   | AISI 4130   | AISI 4130                       | AISI 4130                       | AISI 4130                       | ELECTROLESS NI-PLATED 0.0027/SIDE  |
| 21   | 316 S.S.  | 316 S.S.                        | 316 S.S.                        | 316 S.S.                        |  |
| 22   | AISI 4130   | AISI 4130                       | AISI 4130                       | AISI 4130                       | ELECTROLESS NI-PLATED  |
| 23   | DISOGRIN, VITON, HSN OR TEFLON®                           | DISOGRIN, VITON, HSN OR TEFLON® | DISOGRIN, VITON, HSN OR TEFLON® | DISOGRIN, VITON, HSN OR TEFLON® | DISOGRIN, VITON, HSN OR TEFLON®  |
| 24   | ASTM SA-216 GR. WCB                                       | ASTM SA-216 GR. WCB             | ASTM SA-352 GR. LCC             | ASTM SA-352 GR. LCC             | NORMALIZED & TEMPERED TO 18-22 HRc RANGE. IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE |
| 25   | 1015-18 STEEL   | 1015-18 STEEL                   | 1015-18 STEEL                   | 1015-18 STEEL                   |  |
| 26   | ASTM SA-487 CLASS 4N                                      | ASTM SA-487 CLASS 4N            | ASTM SA-487 CLASS 4N            | ASTM SA-487 CLASS 4N            | NT TO HRc 18-22 RANGE ELECTRO-LESS NI-PLATED 0.0027/SIDE                                   |
| 27   | 1015-18 STEEL   | 1015-18 STEEL                   | 1015-18 STEEL                   | 1015-18 STEEL                   |  |
| 28   | ASTM SA-105 (N)   | ASTM SA-105 (N)                 | ASTM SA-350 LF2                 | ASTM SA-350 LF2                 | HARDNESS RANGE BETWEEN 18-22 HRc IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE          |
| 29   | ASTM SA-216 GR. WCB                                       | ASTM SA-216 GR. WCB             | ASTM SA-352 GR. LCC             | ASTM SA-352 GR. LCC             | NT TO 18-22 HRc RANGE. IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE                    |
| 30   | VITON - B, HSN  | VITON - B, HSN                  | VITON - B, HSN                  | VITON - B, HSN                  | 70 DURO  |
| 31   | ASTM SA-193 B7  | ASTM SA-193 B7                  | ASTM SA-320 L7M                 | ASTM SA-320 L7M                 |  |
| 32   | AISI 4130   | AISI 4130                       | SA-320 L7                       | SA-320 L7                       |  |
| 33   | AISI 4140   | AISI 4140                       | SA-320 L7                       | SA-320 L7M                      |  |
| 34   | ASTM SA-194 2H  | ASTM SA-194 2HM                 | ASTM SA-320 L7                  | ASTM SA-320 L7M                 |  |
| 35   | VITON - B, HSN  | VITON - B, HSN                  | VITON - B, HSN                  | VITON - B, HSN                  | 70 DURO  |
| 36   | 1015-18 RING W/MOLY-TEFLON® SEAL INSERT VITON, HSN O-RING |                                 |                                 |                                 |  |
| 38   | ASTM SA-105 (N)   | ASTM SA-105 (N)                 | ASTM SA-350 LF2                 | ASTM SA-350 LF2                 |  |
| 39   | ASTM SA-36  | ASTM SA-36                      | ASTM SA-36                      | ASTM SA-36                      | GA-12 PLATE  |

**STANDARD MATERIALS FOR PARTS USED ON  
MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS (cont'd)**

| ITEM   | MIN -20°F (-29°C) |                                 | MIN -50°F (-45°C) |                                 | REMARKS               |
|--|-------------------|---------------------------------|-------------------|---------------------------------|-----------------------|
|  | SWEET SERVICE     | (H <sub>2</sub> S) SOUR SERVICE | SWEET SERVICE     | (H <sub>2</sub> S) SOUR SERVICE |                       |
| 40   | PLASTIC           | PLASTIC                         | PLASTIC           | PLASTIC                         | PLASTIC               |
| 41   | ASTM SA-105 (N)   | ASTM SA-105 (N)                 | ASTM SA-350 LF2   | ASTM SA-350 LF2                 | AVAILABLE IN 316 S.S. |
| 45   | 316 S.S.          | 316 S.S.                        | 316 S.S.          | 316 S.S.                        |                       |
| 46   | 316 S.S.          | 316 S.S.                        | 316 S.S.          | 316 S.S.                        |                       |
| 47   | NYLON             | NYLON                           | NYLON             | NYLON                           |                       |
| 48   | ASTM SA-36        | ASTM SA-36                      | ASTM SA-36        | ASTM SA-36                      | GA-12 PLATE           |
| NOTES: 1. MTR'S. HEAT TREAT CHARTS, AND OTHERS NDT RECORDS AVAILABLE UPON REQUEST.<br>2. WELDING PROCEDURES IN ACCORDANCE WITH ASME BOILER AND PRESSURE VESSEL CODE SECTION IX LATEST EDITION AND ADDENDA FOR GMAW AND SMAW PROCESSES. ALL POSITION, APPROVED BY ALBERTA BOILERS BRANCH, ARE AVAILABLE AT NUFLO'S EDMONTON PLANT. WELDS ARE MADE ON FITTINGS WHEN FLANGEWELD, OR FLANGED ORIFICE FITINGS OR COMPLETE METER RUNS ARE ORDERED. |                   |                                 |                   |                                 |                       |

**STANDARD MATERIALS FOR PARTS USED ON  
MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS**

| ITEM | MIN -20°F (-29°C)              |                                 | MIN -50°F (-45°C)              |                                 | REMARKS  |
|------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--|
|      | SWEET SERVICE                  | (H <sub>2</sub> S) SOUR SERVICE | SWEET SERVICE                  | (H <sub>2</sub> S) SOUR SERVICE |  |
| 1    | ASTM SA-193 B7                 | ASTM SA-193 B7M                 | ASTM SA-320 L7                 | ASTM SA-320 L7M                 |  |
| 2    | SPLIT STL.                     | SPLIT STL.                      | SPLIT STL.                     | SPLIT STL.                      |  |
| 3    | ALUMINUM                       | 316 S.S.                        | ALUMINUM                       | 316 S.S.                        |  |
| 4    | ASTM SA-194 2H                 | ASTM SA-194 2HM                 | ASTM SA-320 L7                 | ASTM SA-320 L7M                 |  |
| 5    | AISI 4130                      | AISI 4130                       | SA-320 L7                      | SA-320 L7M                      |  |
| 6    | AISI 4140                      | AISI 4140                       | SA-320 L7                      | SA-320 L7M                      |  |
| 7    | PLASTIC                        | PLASTIC                         | PLASTIC                        | PLASTIC                         |  |
| 8    | 316 S.S.                       | 316 S.S.                        | 316 S.S.                       | 316 S.S.                        |  |
| 9    | AISI 4130                      | AISI 4130                       | AISI 4130                      | AISI 4130                       | ELECTROLESS NI-PLATED 0.002" SIDE  |
| 10   | DISOGRIN, VITON, HSN OR TEFLON | DISOGRIN, VITON, HSN OR TEFLON  | DISOGRIN, VITON, HSN OR TEFLON | DISOGRIN, VITON, HSN OR TEFLON  |  |
| 11   | AISI 4130                      | AISI 4130                       | AISI 4130                      | AISI 4130                       | ELECTROLESS NI-PLATED 0.002" SIDE  |
| 12   | ASTM SA-216 GR. WCB            | ASTM SA-216 GR. WCB             | ASTM SA-352 GR. LCC            | ASTM SA-352 GR. LCC             | NORMALIZED & TEMPERED TO 18-22 Hrc RANGE, IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE |
| 13   | VITON-B, HSN                   | VITON-B, HSN                    | VITON-B, HSN                   | VITON-B, HSN                    | 70 DURO  |
| 14   | ASTM SA-216 GR. WCB            | ASTM SA-216 GR. WCB             | ASTM SA-352 LCC                | ASTM SA-352 LCC                 | NORMALIZED & TEMPERED TO 18-22 Hrc RANGE, IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE |
| 15   | ASTM SA-105(N)                 | ASTM SA-105(N)                  | ASTM SA-350 LF2                | ASTM SA-350 LF2                 |  |
| 16   | ASTM SA-105(N)                 | ASTM SA-105(N)                  | ASTM SA-350 LF2                | ASTM SA-350 LF2                 |  |
| 17   | PLASTIC                        | PLASTIC                         | PLASTIC                        | PLASTIC                         |  |

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## **NuFlo Measurement Systems**

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▼ **Figure 1** *Dyna-flo 4000 Controllers Mounted on a Dyna-Flo Control Valve Assembly*



# Dyna-Flo 4000

## Operation, Parts and Instruction Manual

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# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals



### !Notice!

These instructions are meant to be used with the Dyna-Flo 4000 Series Technical Bulletin as they refer to Figures and Tables therein. If you not have the Technical Bulletin, contact Dyna-Flo immediately, or visit [www.dynaflo.com](http://www.dynaflo.com)

Each controller is factory checked. Check the calibration for the specific application, before a controller is put into service.

### Calibration Procedure | Initial Set-up

#### The 4020 Differential Gap Instructions are at the end of this section.

1)  
It is recommended to calibrate the controller in the position in which it will be operated

2)  
Determine supply pressure requirement by checking controller output signal range:

a) *An output signal range of 6-30 psi (40-200 KPa) would require 35 psi (240 KPa) supply pressure*

b) *An output signal range of 3-15 psi (20-100 KPa) would require 20 psi (140 KPa) supply pressure*

3)  
Connect a supply pressure line at the required setting, to the SUPPLY connection at the back of the case as shown in figure 5.

4)  
Install 1/4" NPT pipe plug at the OUTPUT connection at the back of the case as shown in figure 5. The controller output pressure change is measured by the output pressure gauge.

5)  
Locate a pressure supply (of compressed air or nitrogen) equivalent to the bourdon tube rating.

6)  
With the block valve closed, connect the pressure supply through a block valve and regulator to the CONTROL pressure block.

#### Note

There are 2 possible connections to the control pressure block:

- a) the CONTROL connection in the back of the case
- b) the connection at the left side of the case

Plug the unused connection.

7)  
Verify that the calibration adjuster screws (figure 10 key 44) are at mid-point in the calibration adjuster (figure 10 key 8)

8)  
Inspect the following for leaks (using leak detection solution or soapy water):

#### 4000 / 4020 Controller

Relay and relay base  
All tubing and connections (relay & compensator)  
Bellows, bellows frame and bellows screws  
Proportional band

#### 4010 Controller

Relay and relay base  
All tubing and connections (relay & compensator)  
Bellows, bellows frame and bellows screws  
Proportional band  
Reset restrictor valve  
Reset and compensator tubing

9)  
Set PRESSURE SETTING knob (figure 9) at 0 (zero) setting

10)  
Adjust the nozzle (figure 7 key 50), until the output pressure is between 8 and 10 psi.

#### 4000 Controller

Rotate proportional band knob and set at zero (closed position).

### Calibration Procedure Initial Set-up (cont'd)

#### 4000 Controller (cont'd)

**The output pressure gauge should indicate full supply pressure.**

**Check that for a direct acting unit the bellows movement is downward, and upward for a reverse acting controller.**

B)  
Rotate proportional band knob and set at 10 (open position).

**The output pressure gauge should indicate 0 – 5 psi pressure.**

**Check that for a direct acting unit the bellows movement is downward, and upward for a reverse acting controller.**

C)  
Rotate proportional band knob and set at 1.5 (15% proportional band).

The output pressure gauge should indicate 8-10 psi pressure.

#### 4010 Controller

Refer to Figure 6.

Rotate Reset Restrictor Valve and set at MAX .

#### Note

If the 4010 is to be left at the maximum Reset setting, the 4010 controller will perform as a 4000 (proportional band) controller. It is recommended that the reset bellows tubing be removed and retubed as shown in Figure 7 for a 4000 (proportional band) controller.

#### Range

#### 4000 Controller

Verify that the proportional band is set at 1.5.

#### 4010 Controller

Additionally, verify that the reset valve is set at 0.01 minutes per repeat.

A)  
Apply input pressure equal to the bourdon tube maximum rating.

B)  
Rotate pressure setting knob (figure 4) to the maximum value which is equal to the bourdon tube rating.

C)  
Output gauge reading should be between 8 and 10 psi. If not, adjust controller span by loosening one of the two calibration adjuster screws (figure 5 key 44) and move the calibration adjuster (figure 5 key 8) a small distance as explained below and illustrated in figure 5.

#### For direct-acting controller

- a) If output is below 8 to 10 psi, move calibration adjuster to the left
- b) If output is above 8 to 10 psi, move calibration adjuster to the right

#### For reverse-acting controller

- a) If output is below 8 to 10 psi, move calibration adjuster to the right
- b) If output is above 8 to 10 psi, move calibration adjuster to the left

D)  
Repeat calibration adjuster movements until output gauge reads between 8 and 10 psi on both zero and maximum value. (Maximum value is bourdon tube upper limit.)

E)  
Isolate the controller from process, control, and supply pressure.

F)  
Vent any trapped pressure from the controller.

#### 4020 Controller

A)  
Temporarily set-up the 4020 (differential gap) controller as a 4000 (proportional band) controller, by changing the proportional band tubing connection to the bellows frame. The reversing block IS NOT inverted at this time.

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals



### Calibration Procedure | Initial Set-up (cont'd)

#### 4020 Controller (cont'd)

B)

Calibrate as a 4000 (proportional band) controller

C)

After calibration, restore the proportional band tubing to it's original connection on the bellows frame.

D)

Due to physical differences in the bellows, there may be a slight shift in the output pressure. This will be adjusted out through nozzle adjustments described below.

E)

Set the proportional band knob for the required differential gap (See adjustment section for differential gap details)

F)

Set the process pressure:

#### Direct Acting Controller

1) Move the pressure setting to the upper switch point value at which the output pressure will go from zero, to full supply pressure, with rising process pressure

2) Apply input pressure to the bourdon tube, as you observe the output gauge. When the upper switch point value is reached, while increasing input pressure, the controller output should switch from zero pressure, to full supply pressure.

3) Adjust the nozzle to correct any upper switch point error, and retest until the switch point and input pressure values agree.

#### Reverse Acting Controller

The controller output described above will be reversed.

G)

Check controller operation by running the input pressure from zero to above the upper switch point, and observing the switching points. Set a new differential gap, vary the input pressure, and then repeat with the calibration settings

### Adjustments

#### Manual Set Point (4000 / 4010 / 4020)

Adjust the pressure setting by turning the pressure setting 410b (figure 9) to the desired pressure. This represents the upper switch point for a direct acting 4020.

#### Proportional Band (4000 and 4010)

To adjust the proportional band, rotate the proportional band 140b (figure 9) to the desired value (between 3 to 100%). This represents 3-100% of the sensing element range, and controls the percentage of sensed pressure change required to cause full output of the controller

#### Differential Gap (4020)

Adjust the proportional band 140b (figure 9) to set the width of the differential gap about the switch point. Use Table 4 as a guide. Calculate the Differential Gap as follows:

$$\frac{(\text{Upper Switch Point} - \text{Lower Switch Point}) \times 100}{\text{Bourdon Tube Range}}$$

| Proportional Band Setting | Differential Gap (% Of Element Range) |
|---------------------------|---------------------------------------|
| 1.2                       | 10                                    |
| 1.8                       | 20                                    |
| 2.5                       | 30                                    |
| 3.1                       | 40                                    |
| 3.8                       | 50                                    |
| 4.4                       | 60                                    |
| 5.1                       | 70                                    |
| 5.7                       | 80                                    |
| 6.4                       | 90                                    |
| 7                         | 100                                   |

Table 4 – Differential Gap Setting Guide

#### Reset (4010 only)

To adjust the reset action, rotate the reset 160b (figure 11) counter-clockwise to increase the speed. The minutes per repeat indicate the time required for the reset bellows pressure to equal the proportional bellows pressure.

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals

**! Warning !**

The following maintenance procedures require taking the controller out of service. To avoid personnel injury, only qualified technician should perform the following procedures. Always ensure the controller is fully released of pressure or process fluid before starting maintenance.

### Controller Maintenance

#### Regular Maintenance

A)

If the installation includes a supply regulator, periodically open the drain on the filter regulator to drain accumulated moisture.

B)

Push the cleaner wire on the relay orifice (key 83, figure 3) to release moisture or particulate.

C)

Inspect, and if necessary, clean the opening of the vent assembly (key 71, figure 4) or the opening of the remote vent pipe, if one is used.

#### Replacing Gauges

Refer to figure 4.

A)

Quantity 2 gauges (key 31) are used, one for output, and one for supply pressure.

B)

Always ensure to check the range of the controller before ordering replacement gauges (0-30 psi gauges WILL NOT work on a 6-30 psi controller).

C)

Always use approved thread sealant on the threaded connections.

#### Replacing Bourdon Tube

Refer to figures 4 & 5.

**! WARNING !**

Isolate the process sensing line prior to disconnecting the bourdon tube from the control tubing (key 14)  
Be aware of potential hazards from disconnecting process connections.

A)

Disconnect the control tubing (figure 4 key 14) at the bourdon tube end.

B)

Remove the screw (key 11) that connects the link (key 12) to the beam (key 1).

C)

Unscrew two screws (key 38) and washers (key 35), and remove the bourdon tube (key 7).

D)

Remove the screw (key 11) that retains the link (key 12) and link bearing (key 34) to the bourdon tube (key 7).

---

**! Note ! Be careful!** – Bearings are easy to loose.

---

E)

Attach the link and bearing to the replacement bourdon tube.

F)

Attach the bourdon tube (key 7) with two machine screws (keys 38) and washers (key 35).

G)

Connect the link and bearing to the beam (key 1).

H)

Check to be sure that the beam is reasonably parallel with the bottom of the case. The link (key 12) should be in tension. If the beam is not parallel with the case, loosen the machine screws (key 38), reposition the bourdon tube to get the beam parallel, and retighten the screws.

---

**! Note !**

If a bourdon tube with a different range was installed, install a new dial having an adjustment range corresponding to the range of the bourdon tube. Remove the machine screw and washer (keys 19 and 72) and dial (key 20).

---

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals



### ! Warning !

The following maintenance procedures require taking the controller out of service. To avoid personnel injury, only qualified technician should perform the following procedures. Always ensure the controller is fully released of pressure or process fluid before starting maintenance.

### Controller Maintenance (cont'd)

I)  
Check all tubing connections and the bourdon tube machine screws for leaks, tighten as necessary.

J)  
Perform the calibration procedure.

#### Changing Proportional Valve

A)  
Disconnect the tubing and remove the proportional band valve assembly (figure 4 key 55) from the case by turning it counter-clockwise

B)  
Install the desired replacement assembly – **Do not over torque**

C)  
Use a proper thread sealant when reinstalling the tubing

D)  
Check for leaks

#### Changing Reset Valve

A)  
Disconnect the tubing and remove the reset restriction valve assembly (figure 6 ) by removing a retaining screw (not shown) on the back of the controller

B)  
Install the desired replacement assembly.

C)  
Use a proper thread sealant when reinstalling the tubing

D)  
Connect the tubing

E)  
Check all connections for leaks

F)  
Perform the calibration procedure.

### Changing Controller Action

Isolate the controller from process, control, and supply pressure. Vent any trapped pressure from the controller before proceeding.

Refer to figure 2

#### Direct to Reverse Action

##### Direct action

*Increasing sensed pressure produces increasing output pressure)*

##### Reverse action

*Increasing sensed pressure produces decreasing output pressure*

A)  
Refer to figure 2, and locate the new tubing and reversing block positions for the action desired.

B)  
Changing the action is accomplished by reversing the positions of 2 components:

- 1) the reversing block
- 2) the bellows tubing

C)  
In the controller, locate the two bellows and the reversing block (key 63, figure 2)

#### For a 4000 (proportional-only) controller

Disconnect the proportional tubing (key 10) from the bellows frame and reconnect it in the opposite hole.

#### For a 4010 (proportional-plus-reset) controller

Disconnect the proportional tubing (key 10) and reset tubing from the bellows frame, and reconnect them in the opposite hole.

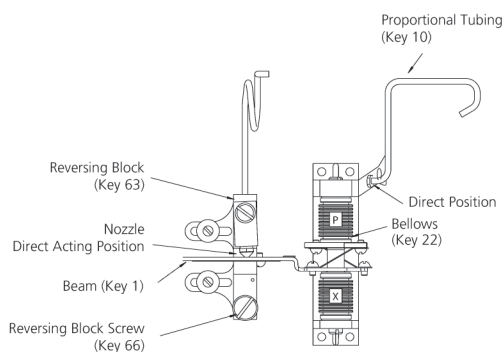
#### For both Models of Controllers

A)  
Remove the reversing block screw (key 66, figure 2) and reversing block assembly (key 63).



# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals



**Direct Acting**

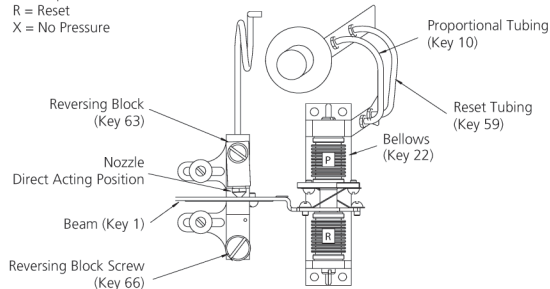
### MODEL 4000 Proportional-Only Controller

**Bellows Notes:**

P = Proportional

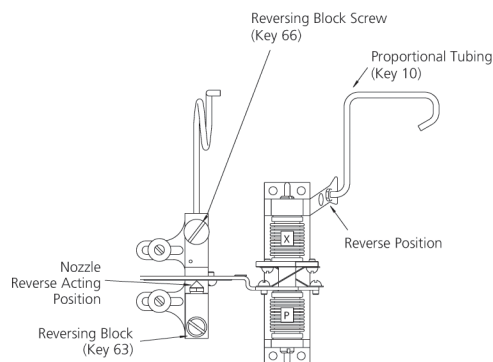
R = Reset

X = No Pressure

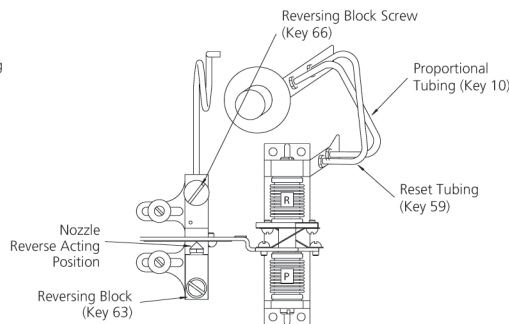


**Direct Acting**

### MODEL 4010 Proportional-Plus Reset Controller



**Reverse Acting**



**Reverse Acting**

▲ Figure 2 Tubing Connections

#### For both Models of Controllers (cont'd)

B)

Inspect the o-rings (key 53) located in the recessed area under the reversing block screw head and between the reversing block assembly and the calibration adjuster (key 8, figure 5). Replace these o-rings, if necessary.

C)

Position the reversing block assembly, with o-ring, on the calibration adjuster so that the nozzle is on the opposite side of the beam (key 1, figure 2) from which it was removed. Properly position the reversing block assembly so that the alignment pin engages the hole in the calibration adjuster. Install the reversing block screw (key 66) with o-ring (key 53).

D)

Install the sealing screw with o-ring in the hole previously covered by the reversing block assembly.

E)

Install the relay tubing (key 58) in the reversing block (key 62).

F)

Check all the connections for leaks with leak detector solution.

G)

Perform the calibration procedure.

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals



### Relay

#### Replacement

Refer to figure 4

A)  
Always shut down the supply, control and process pressure line to the controller.

B)  
Disconnect the relay tubing (key 58) from the relay (key 56).

C)  
Remove the relay (key 56) from the case by unscrewing the 2 retaining screws (key 39– not shown) on the back of the case.

D)  
Remove the relay gasket (key 57, not shown).

E)  
Replace the relay gasket, and hold it place by inserting the retaining crews from the back of the case.

F)  
Attach the replacement relay.

G)  
Connect the tubing, and check all connections for leaks.

H)  
Perform the calibration procedure.

#### Relay Reconditioning

Refer to figure 3.

#### Disassembly

A)  
Complete Steps 1 through 4 of relay replacement.

B)  
Unscrew the orifice assembly (key 83). Remove the O-rings (key 79) from the orifice assembly.

C)  
Place the relay on the work surface with the casing screws facing up. Remove the casing screws (key 78), in a criss-cross pattern.

D)  
Remove and separate the lower casing (key 76), bottom diaphragm (key 86), spacer ring (key 84), diaphragm assembly (key 75), and relay spring (key 82) from the relay body (key 81).

E)  
Remove the screws (key 77), spring plate (key 85), spring plate gasket (key 80), spring (key 88), and valve plug (key 87).

F)  
Inspect the valve seats (under a good light) for roughness due to corrosion. One seat is located in the diaphragm assembly (key 75), and the other seat is located in the relay body (key 81). Replace the diaphragm assembly or relay body if seats are damaged or worn.

G)  
Inspect the diaphragms and gaskets, and replace them if necessary.

H)  
Replace the spring and valve plug if they show signs of corrosion.

I)  
The lower diaphragm is part of the diaphragm assembly and must be replaced as an assembly.

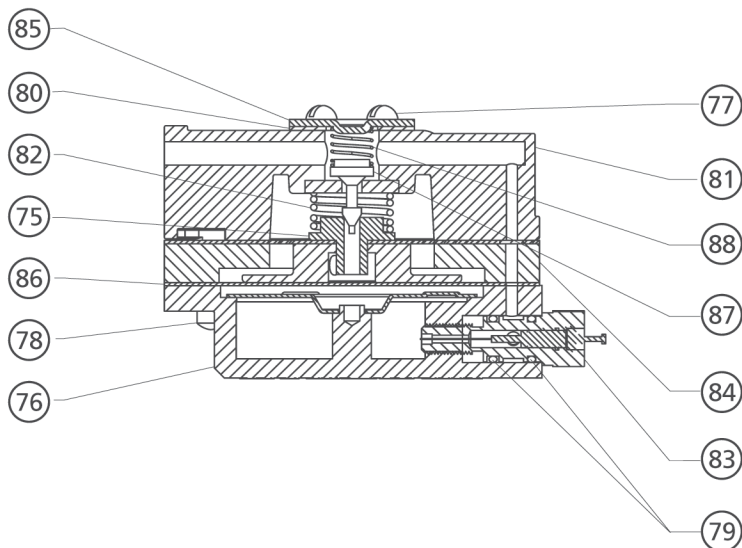
J)  
Clean all parts thoroughly before re-assembling.

#### Re-assembly

A)  
With the relay body opening facing up, place the relay spring in the relay body, and set aside.

B)  
Place, in order, the top diaphragm, spacer ring, and diaphragm assembly on the lower casing so that the flow passage holes are lined up.





▲ Figure 3 Relay Cross-section

### Relay (cont'd)

#### Re-assembly (cont'd)

C)

Put the assembly just built on the relay body and spring assembly, taking care to maintain the alignment of the flow passages. A second check is to align the grooves on the casing and spacer ring, with the tab on the relay body.

D)

Install the casing screws, but do not tighten them.

E)

Tighten the casing screws (key 78) evenly, in a criss-cross pattern.

F)

Install the valve plug, spring, gasket, and cover plate (keys 80, 86, 87, and 88). Secure with the machine screws (key 77).

G)

Install the o-ring (key 79) on the orifice assembly (key 83), and install the orifice assembly into the relay casing.

H)

Replace the relay gasket (key 57), and hold it place by inserting the retaining crews from the back of the case.

I)

Attach the reconditioned relay.

J)

Connect the tubing, and check all connections for leaks.

K)

Perform the calibration procedure.

### Changing Output Signal Range

From 3 to 15 psig (20 to 100 kpag) to a 6 to 30 psig (40 to 200 psig) output signal range or vice versa.

A)

Always shut down the supply, control and process pressure line to the controller.

B)

Refer to the parts list to make sure you have the bellows in appropriate range and material. Quantity 2 are required.

C)

Disconnect the tubing (key 58) from the relay (key 56) to the reversing block (figure 2, key 63), at the relay end.

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals



### Changing Output Signal Range (cont'd)

D)  
Disconnect the tubing from the bellows frame (figure 5, key 2) to the proportional band assembly, at the bellows frame end. (Bending of the tubing will be reduced if you loosen the fitting at the proportional valve end as well).

E)  
Disconnect the tubing (figure 4 key 14) from the CONTROL pressure block (figure 4 key 13) to the bourdon tube (key 7), at the CONTROL pressure block end.

F)  
Remove the 4 machine screws (key 40, figure 4), and lift the controller subassembly from the case.

G)  
Remove the screw (key 11, figure 5) that connects the link (key 12) to the beam (key 1).

H)  
Unscrew two screws (key 38) and washers (key 35), and remove the bourdon tube (key 7).

I)  
Remove the screw (key 11) that retains the link (key 12) and bearing (key 34) to the bourdon tube.

---

**! Note ! Be careful!** – Bearings are easy to loose.

---

J)  
Unscrew the bellows screws (key 4) from each end of the bellows frame (key 2).

K)  
Compress the feedback bellows so that the end of the bellows and beam can be removed from the end of the bellows frame (key 2).

L)  
While firmly holding the bottom feedback bellows (key 22) in your hand, turn the upper bellows counter clockwise with your other hand to separate the bellows from the beam assembly.

M)  
Remove the bellows connecting stud (not shown) for re-use with the new bellows.

N)  
With the stud that connects the two bellows in place in the spacer (key 69), screw the new bellows onto the stud. Install new gaskets (key 3) on each bellows.

O)  
Compress the feedback bellows, and install them into the bellows frame (key 2).

P)  
With the beam parallel with the mounting base, secure the feedback bellows with the bellows screws (key 4).

Q)  
When tightening the bellows screws, make sure that the nozzle (key 50) is centered on the flapper (key 23).

R)  
Install the bourdon tube if it was removed – Refer to the Replacing Bourdon Tube section.

S)  
Replace the subassembly in the case and secure with the machine screws (key 40, figure 4).

T)  
Reconnect all tubing. Take care to get the proportional tubing back in the right connection on the proportional valve (Refer to Figure 2).

U)  
Unscrew the supply and output gauges (key 31, figure 4) and install new gauges with correct ranges.

V)  
Check all tubing connections and the bellows screws (key 4) for leaks. Tighten as necessary.

W)  
Perform the calibration procedure.

---

**Note: Use Proper Thread Sealant on all tubing connections.**

---

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals

### Start-Up & Tuning Guidelines

#### 4000

- 1)  
Check that controller is calibrated.
- 2)  
Check that supply regulator set point matches the controller output range.
- 3)  
Set the pressure setting knob at the required pressure.
- 4)  
Based on your process (fast, or slow) set the proportional band:
  - a) for a fast (liquid) system, use a setting of 10 (100 percent)
  - b) for slow (gas) system uses a calculated proportional band setting, from the expression:
 
$$20 \times \frac{\text{Allowable Error}}{\text{Output Pressure Range}}$$
 (X 10 for percent value)

Example:

  - 3 psig Allowable Error
  - 30 psig output Range
  - $20 \times 3 / 30 = \text{setting of } 2 \text{ (20\% PB)}$
- 5)  
Check the proportional action by either making a small set point change, or bumping the flapper lightly, and watching for the output to cycle. Lower the proportional band setting if the system does not cycle, and check again. Repeat this process until the controller output does cycle, and then double proportional band setting for a reasonable starting point.
- 6)  
Minimize proportional band effect on set point by turning the nozzle (Key 50) until the process pressure matches the controller pressure setting.
- 7)  
Check the proportional band setting for stable operation by making a change in the process and watching for cycling.

#### 4010

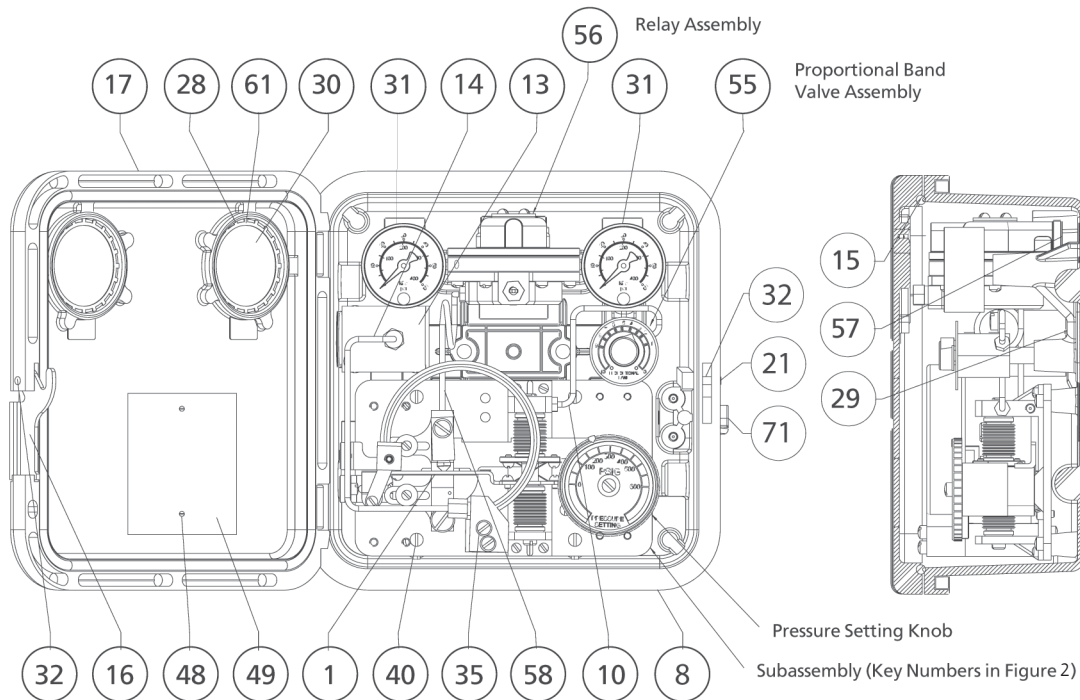
- 1)  
Check that controller is calibrated.
- 2)  
Check that supply regulator set point matches the controller output range.
- 3)  
Set the pressure setting knob at the required pressure.
- 4)  
Based on your process (fast, or slow) set the reset:
  - a) for a fast (liquid) system use 0.05 minutes per repeat
  - b) for a slow system (gas) use 0.5 minutes per repeat
- 5)  
Based on your process (fast, or slow) set the proportional band:
  - a) for a fast (liquid) system, use a setting of 10 (100 percent)
  - b) for slow (gas) system uses a calculated proportional band setting, from the expression:
 
$$20 \times \frac{\text{Allowable Error}}{\text{Output Pressure Range}}$$
 (X 10 for percent value)

Example:

  - 3 psig Allowable Error
  - 30 psig output Range
  - $20 \times 3 / 30 = \text{setting of } 2 \text{ (20\% PB)}$
- 6)  
Check the proportional action by either making a small set point change, or bumping the flapper lightly, and watching for the output to cycle. Lower the proportional band setting if the system does not cycle, and check again. Repeat this process until the controller output does cycle, and then double proportional band setting for a reasonable starting point.
- 7)  
Check the reset action by either making a small set point change, or bumping the flapper lightly, and watching for the output to cycle. Increase the reset setting if the system does not cycle, and check again. Repeat this process until the controller output does cycle, and then triple that reset setting for a reasonable starting point.
- 8)  
Check the reset setting for stable operation by making a change in the process and watching for cycling.

# Dyna-Flo 4000 Pressure Controllers Operation, Parts and Instruction Manuals

**DYNA-FLO**  
CONTROL VALVE SERVICES LTD.



▲ Figure 4 Dyna-Flo Model 4000 General Detail

## Parts Ordering

Whenever corresponding with Dyna-Flo about a 4000 series pressure controller, refer to the nameplate (key 48, figure 4) for the serial number of the unit. Please order by the complete part number (as given in the following parts list) of each part required.

### Parts Kits

#### Relay Replacement Kit

Kit contains key 58 and 3C and the replacement relay

**Part Number**  
RRELAYX0L2D

#### Controller Repair kit

Kit contains keys 3C, 12, 19, 26, 29, 34, 37, 50, 51, 52, 53, 55, 62, 63, 66, and 68

R4150X00L1D

#### Relay Repair Kit

Kit contains keys 58, 76, 77, 80, 81, 83, 84, 88, and 89

RRELAYX0L1D

### Assemblies

#### Assemblies Part

Proportional Band Valve Assembly  
Relay Assembly  
Reset Restriction Valve Assembly

**Number**  
10A9122X03D  
22B0463X01D  
19A4361X01D

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals

### Parts

| Key | Description                               | Part Number |  |             |
|-----|---|-------------|--|-------------|
| 1   | Beam, steel                               | 1H26682507D | 0-3000 psig  | 16A7662X09D |
| 2   | Bellows Frame, aluminum                   | 2H26530801D | 0-5000 psig  | 16A7662X10D |
| 3*  | Bellows Gasket, neoprene (2 req'd)        | 1D39700301D | 0-8000 psig  | 16A7662X11D |
| 4   | Bellows Screw (2 req'd)                   | 1D39761402D | 0-10000 psig   | 16A7662X12D |
| 5   | Bellows Stud, SST (not shown)             | 1H2658X001D | 21 Door Latch Pin, steel pl (2 req'd)                | PC00000003D |
| 6   | Bourdon Tube Bracket                      | PC00000025D | 22 Feedback Bellows                                  |             |
| 7*  | Bourdon Tube, sst                         |             | Brass  |             |
|     | 0-30 psig                                 | 10B2892X01D | 3-15 psig (20-100 kpag) (2 req'd)                    | 14A5726X01D |
|     | 0-60 psig                                 | 10B2892X02D | 6-30 psig (40-200 kpag) (2 req'd)                    | 14A5726X03D |
|     | 0-100 psig                                | 10B2892X03D | Stainless Steel                                      |             |
|     | 0-200 psig                                | 10B2892X04D | 3-15 psig (20-100 kpag) (2 req'd)                    | 14A5726X02D |
|     | 0-300 psig                                | 10B2892X05D | 6-30 psig (40-200 kpag) (2 req'd)                    | 14A5726X04D |
|     | 0-600 psig                                | 10B2892X06D | 23 Flapper, sst                                      | 1H26694113D |
|     | 0-1000 psig                               | 10B2892X07D | 24 Flexure Strip Base, steel                         | 1C89772508D |
|     | 0-1500 psig                               | 10B2892X08D | 25 Flexure Strip Washer, steel pl (2 req'd)          | 16A7671X01D |
|     | 0-3000 psig                               | 10B2892X09D | 26 Flexure Strip, sst                                | 1C89783601D |
|     | 0-5000 psig                               | 10B2892X10D | 27* Gasket, Bellows Frame (not shown), neoprene      | 1H26540301D |
|     | 0-8000 psig                               | 10B2892X11D | 28* Gasket, gauge Glass, neoprene (2 req'd)          | OT01910408D |
|     | 0-10000 psig                              | 10B2892X12D | 29* Gasket, Pressure Block, neoprene (not shown)     | C32860301D  |
| 8   | Calibration Adjuster, steel pl            | 2H26624401D | 30 Gauge Glass (2 req'd)                             | PC00000039D |
| 9   | Case, aluminum                            | PC00000010D | 31 Gauge, Supply and Output Pressure (2 req'd)       |             |
| 10  | Proportional Tubing Assembly, sst         |             | 0-30 psig  | PC00000037D |
|     | 4000                                      | 1H6864000AD | 0-60 psig  | PC00000038D |
|     | 4010                                      | 1H6870000AD | 32 Latch Roll Pin, steel pl                          | PC00000003D |
| 11  | Connecting Link Screw, steel pl (2 req'd) | 1B28562898D | 33 Knob Spring, steel pl (not shown)                 | 1C22152702D |
| 12  | Connecting Link, sst                      | 1L37964101D | 34 Link Bearing, sst (2 req'd)                       | 1L37954620D |
| 13  | Control Pressure Block, steel pl          | PC00000024D | 35 Lockwasher, Bourdon Tube, steel pl (2 req'd)      | 1H26722898D |
| 14  | Control Tubing Assembly                   | PC00000023D | 36 Lockwasher, steel pl (2 req'd)                    | 1H26712898D |
| 15  | Cover Gasket, nitrile                     | 1J40750643D | 37 Machine Screw, Flapper, steel pl                  | 1B27512899D |
| 16  | Cover Latch, steel pl                     | 1H28862898D | 38 Machine Screw, Bourdon Tube, steel pl (2 req'd)   | 1H26772898D |
| 17  | Cover, aluminum                           | PC00000011D | 39 Machine Screw, steel pl, Relay (2 req'd)          | 1H52712898D |
| 18  | Cross Spring, sst (2 req'd)               | 1H26603703D | (not shown)  |             |
| 19  | Dial Screw, steel pl                      | 1J84152898D | 40 Machine Screw, steel pl (4 req'd)                 | 1A33212898D |
| 20  | Dial, sst                                 |             | 41 Machine Screw, steel pl (4 req'd)                 | 14B4995X01D |
|     | 0-30 psig                                 | 16A7662X01D | 42 Machine Screw, steel pl (4 req'd)                 | 1V74352898D |
|     | 0-60 psig                                 | 16A7662X02D | 43 Machine Screw, steel pl, pressure block (4 req'd) | PC00000026D |
|     | 0-100 psig                                | 16A7662X03D | (not shown)  |             |
|     | 0-200 psig                                | 16A7662X04D | 44 Machine Screw, steel pl (9 req'd)                 | 1A5733X001D |
|     | 0-300 psig                                | 16A7662X05D | 45 Mounting Base, aluminum                           | 2H26512501D |
|     | 0-600 psig                                | 16A7662X06D | 46 Mounting Screw for reset valve (not shown)        | 1H52702898D |
|     | 0-1000 psig                               | 16A7662X07D | 47 Nameplate Screw, steel pl                         | 1C94192898D |
|     | 0-1500 psig                               | 16A7662X08D |  |             |

# Dyna-Flo 4000 Pressure Controllers

## Operation, Parts and Instruction Manuals

### Parts (cont'd)

| Key | Description  | Part Number |
|-----|--|-------------|
| 48  | Nameplate, sst   | PC00000013D |
| 49* | Nozzle O-ring, nitrile   | 1E22260699D |
| 50  | Nozzle, Reversing Block, sst   | 1U63913513D |
| 51* | O-ring, nitrile )<br>-under reversing block screw (key 62)<br>-under reversing block (key 63)<br>-under sealing screw (key 66) | 1D68750699D |
| 53  | Pipe Plug, steel (not shown)   | 1A76752466D |
| 54  | Pressure Set Arm, steel pl   | PC00000012D |
| 55  | Proportional Band Valve Assembly   | 10A9122X03D |
| 56  | Relay Assembly   | 22B0463X01D |
| 57* | Relay Gasket, neoprene   | 1C89740301D |
| 58  | Relay Tubing Assembly, sst   | 1H6861000AD |
| 59  | Reset Tubing Ass'y, sst<br>4010  | 1H6866000AD |
| 60  | Reset Valve Ass'y<br>4010  | 10A9129X0AD |
| 61  | Retaining Ring, Gauge Glass, sst (2 req'd)   | PC00000006D |
| 62  | Reversing Block Screw, sst   | 24A5720X01D |
| 63  | Reversing Block, steel pl  | 26A0975X01D |
| 64  | Roll Pin, Door Hinge, sst (2 req'd)  | 1H28882899D |
| 65  | Rotary Spring, sst   | 1J42343702D |
| 66  | Sealing Screw, sst   | 14A5721X01D |
| 67  | Set Point Adjustment Post, alum (not shown)  | PC00000001D |
| 68  | Sleeve, Delrin   | 16A0976X01D |
| 69  | Spacer, aluminum   | 1H26594401D |
| 70  | Spring Washer, steel pl  | PC00000004D |
| 71  | Vent Assembly  | Y602-12D    |
| 72  | Washer, Dial, steel pl   | 1R98202507D |
| 73  | Washer, Cal. Adjuuster, steel (2 req'd)  | 1E87302899D |

### Relay (See Figure 3)

| Key | Description                            | Part Number |
|-----|--|-------------|
| 75  | Diaphragm Assembly                     | 18A2451X01D |
| 76  | Diaphragm Casing Ass'y, aluminum/steel | 12B0460X04D |
| 77  | Machine Screw, steel pl (4 req'd)      | 1A8664X00AD |
| 78  | Machine Screw, steel pl (6 req'd)      | 1C89692898D |
| 79  | O-ring, nitrile (2 req'd)              | 1D68750699D |
| 80  | Plate Gasket, neoprene                 | 1H26960301D |
| 81  | Relay Body, aluminum/sst               | 48A3776X03D |
| 82  | Relay Spring, steel pl                 | 1C89612701D |

|    |                              |             |
|----|------------------------------|-------------|
| 83 | Reset Plug and Wire Assembly | 12B0468X01D |
| 84 | Spacer Ring, aluminum        | 38A3778X01D |
| 85 | Spring Plate, steel pl       | 1H26972507D |
| 86 | Top Diaphragm                | 1L55560204D |
| 87 | Valve Plug, sst              | 0Y0617X002D |
| 88 | Valve Spring, sst            | 0X08363702D |

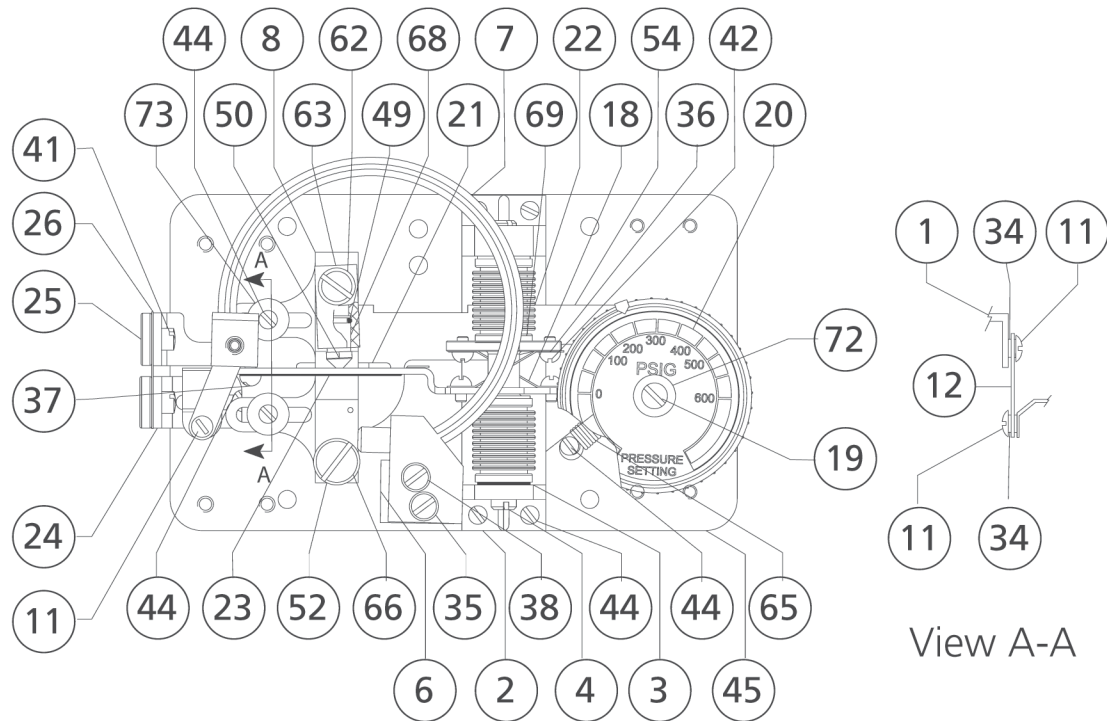
### Mounting (See Figure 7 & 8)

| Key | Description  | Part Number                |
|-----|--|----------------------------|
| 89  | Cap Screw, steel pl (4 req'd) for wall or<br>Panel Mounting                                      | 1B84802405D                |
| 90  | Cap Screw, steel pl (specify qty req'd)<br>-5/16 UNC x 1 inch<br>-5/16 UNC x 3/4 inch            | 1A35262405D<br>1A38162405D |
| 91  | Cap Screw, steel pl (4 req'd)  | 1C33332898D                |
| 92  | Hex Nut, steel pl (4 req'd)  | 1C33282898D                |
| 93  | Lockwasher, steel pl (2 req'd)   | 1C22572898D                |
| 94  | Machine Screw, steel pl (2 req'd)  | 1C63922898D                |
| 95  | Mounting Bracket, actuator casing, steel pl<br>(not shown)                                       | 1F40122507D                |
| 96  | Mounting Bracket, actuator yoke, steel pl<br>(not shown)<br>-Dyna-Flo Model DFC, DFR, and Others | 1C22182502D                |
| 97  | Mounting Bracket, Panel or Wall, steel pl<br>(2 req'd)   | 1H2892000AD                |
| 98  | Mounting Bracket, <b>pipestand</b>   | 3N97572509D                |
| 99  | Mounting Spacer, steel pl (specify qty req'd)  | 1F90672409D                |
| 100 | Pipe Mounting Clamp, steel (2 req'd)   | 1P42702898D                |

### • Commonly Replaced Part

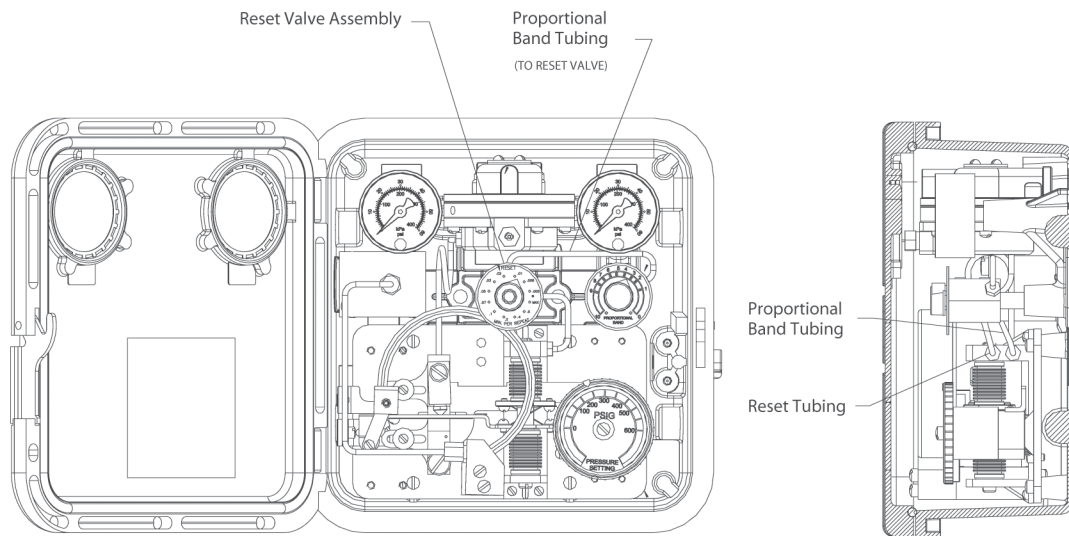


# Dyna-Flo 4000 Pressure Controllers Operation, Parts and Instruction Manuals



▲ Figure 5 Sub-Assembly Detail

▼ Figure 6 4010 Controller General Arrangement

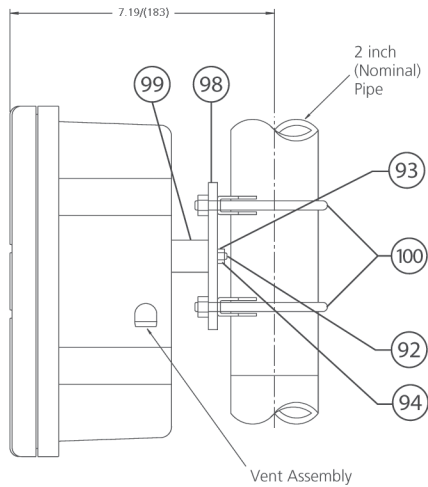


Not Shown: Reset Valve Mounting Screw

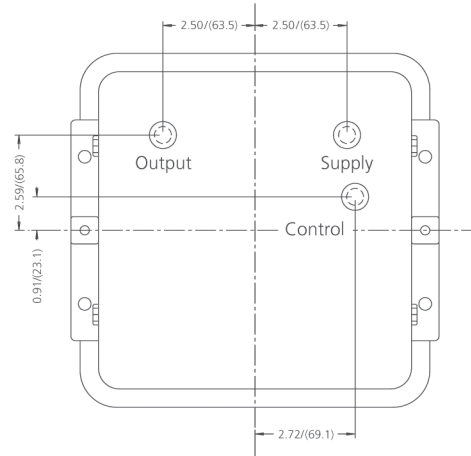
# Dyna-Flo 4000 Pressure Controllers Operation, Parts and Instruction Manuals

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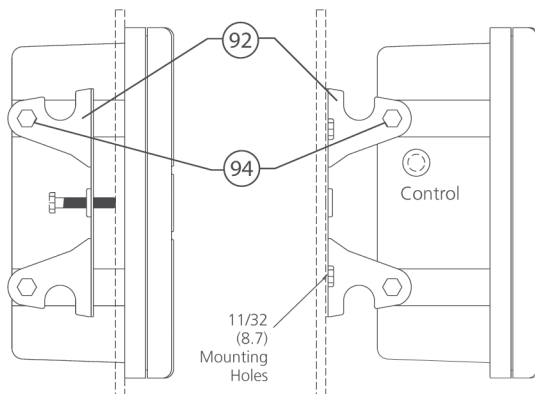
7 Figure 12 Model 4000 Mounting Details, Pipestand, Surface, Panel



Pipestand Mounting

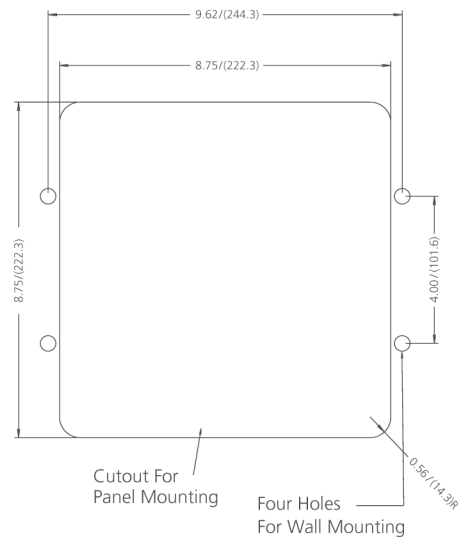


Back View



Panel Mounting

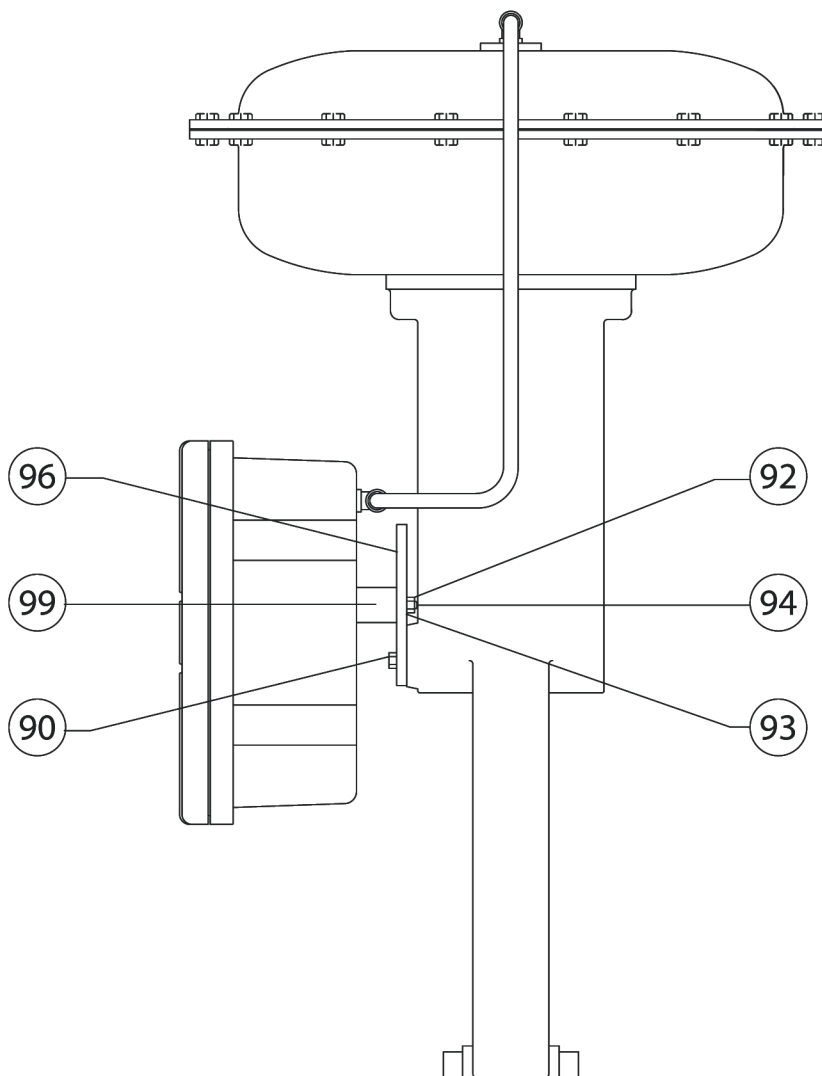
Wall Mounting



Inch (mm)



▼ Figure 8 Model 4000 Mounting Details, Actuator yoke



### ***Our Commitment of Quality***

*Dyna-Flo is committed to continuous improvement. All efforts have been taken to maximize the accuracy of this information. Without notification, product specifications and designs may be modified at any time. The issue of this document is for information only, and does not imply suitability, a warranty, or guarantee for a specific service.*



# Liquid Turbine Flowmeter

## Installation and Maintenance Instructions



**EXPLOSION PROOF FOR USE IN  
CLASS 1, GROUPS A,B,C and D  
HAZARDOUS ENVIRONMENTS.  
CSA FILE: LR21617**

Manual No. 100062201NX



# Liquid Turbine Flowmeter

## Installation and Maintenance Instructions



EXPLOSION PROOF FOR USE IN  
CLASS 1, GROUPS A,B,C and D  
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## PRINCIPLE OF OPERATION

The NuFlo Liquid Turbine Flowmeter is a rugged versatile sensor capable of handling a wide variety of liquids including many types of slurries and suspensions. The flowmeter contains a rotor secured to a tungsten carbide shaft. The shaft is supported at each end in tungsten carbide bearings. The rotor is made of a magnetic material, while the flowmeter body is non-magnetic. A magnetic pickup consisting of a magnet and coil is mounted externally in the body in the same plane as the rotor. Fluid moving through the flowmeter causes the rotor to rotate at a speed proportional to the fluid velocity. The rotor blades cutting the magnetic field in the vicinity of the magnetic pickup create a frequency signal proportional to the fluid velocity. This signal is used to represent flow rate and can be accumulated to totalize the volume of liquid passing through the flowmeter.

Each flowmeter is furnished with a calibration factor representing the number of pulses per gallon produced during the calibration process. Precalibrated rotor and vane kits are available for field replacement. Meters and kits are available in industrial grade with a linearity of  $\pm 0.5\%$  or standard grade with a linearity of  $\pm 1\%$ . *Note: 3/8" meters and kits are furnished as  $\pm 1\%$  linearity for industrial grade and  $\pm 2\%$  linearity for standard grade.*

## INSTALLATION

The NuFlo Liquid Turbine Flowmeter may be installed in any orientation (vertical, horizontal, etc). The direction of flow should correspond to the arrow that appears on the outside of the meter body. A 10-diameter length of straight pipe is required upstream and a five-diameter length of diameter straight pipe is required downstream of the flowmeter. Both pipe sections should be the same nominal pipe size as the flowmeter end connections.

The following precautions should be observed during the installation and operation of the flowmeter:

1. Clean all upstream lines before installing the flowmeter.
2. Do not blow out lines with compressed air or gas.
3. Do not slug the flowmeter with fluid. Initial filling of line with fluid should be done with care.
4. Do not exceed maximum recommended flow rate through the flowmeter.
5. Avoid hammer blows or other sharp impacts on the flowmeter; it may break the shaft.
6. The magnetic pickup should be installed per Figure 2. If vibration is present, the locknut should be tightened. A 3/4" 12-point deep thin wall socket wrench is required. (Part No. 100013146)

### CAUTION:

**ALWAYS REASSEMBLE THE VANE WITH THE FLOW DIRECTION REFERENCE ARROW ORIENTED OPPOSITE THE CONDUIT ADAPTER (OR TOWARD THE BOTTOM OF THE METER).**

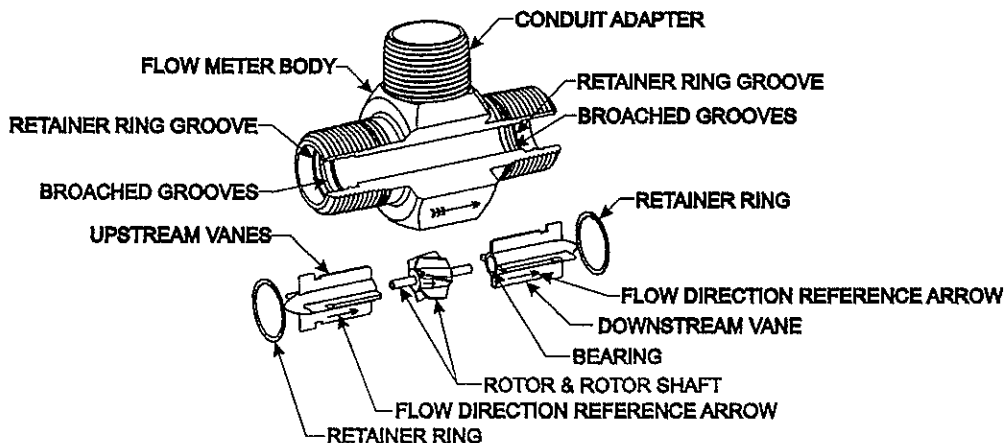
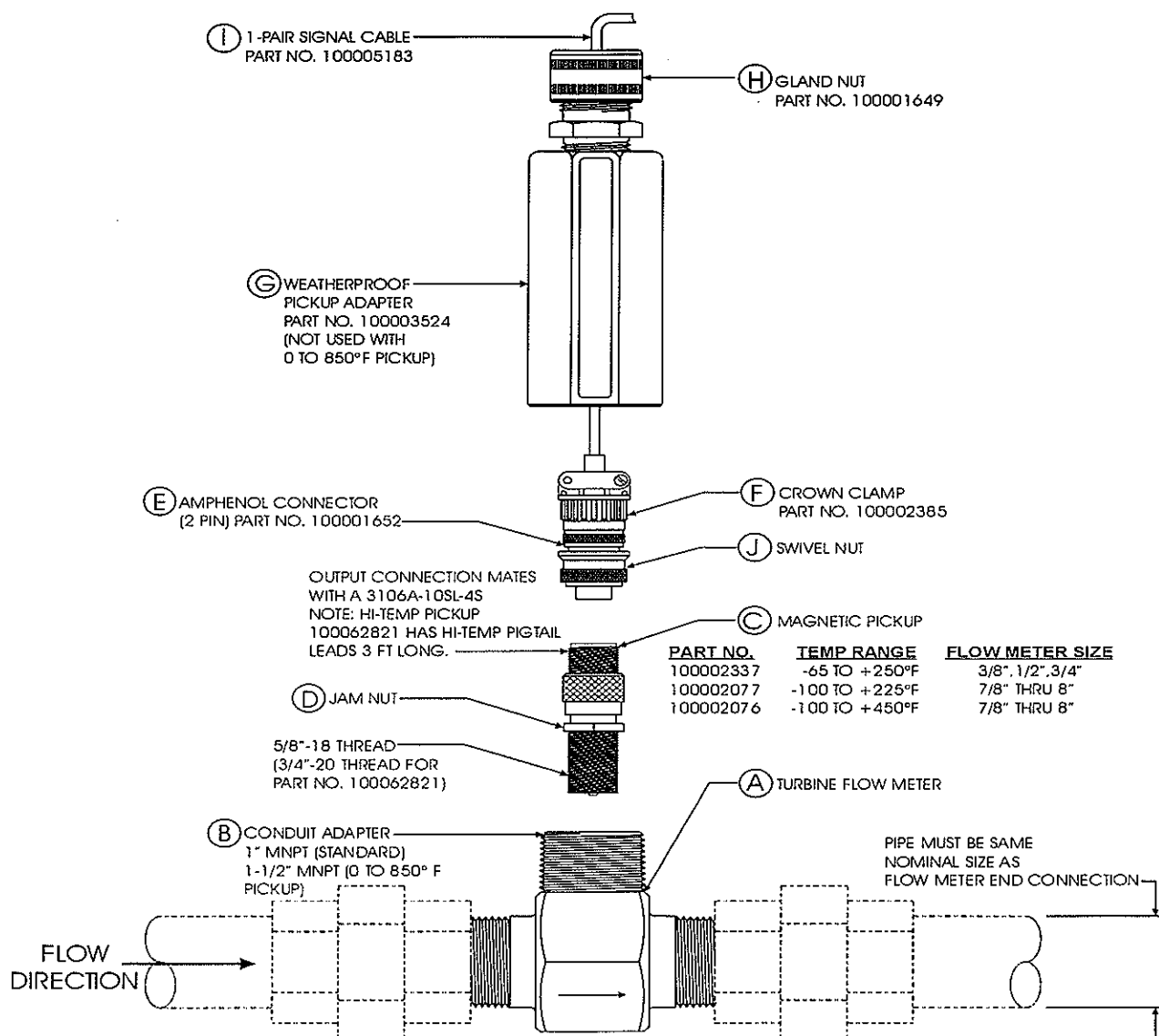


Figure 1

## INSTALLATION PROCEDURE

- STEP 1. INSTALL FLOW METER (A) IN ACCORDANCE WITH NOTE BELOW.
- STEP 2. LOOSEN GLAND NUT (H) SO THAT WEATHERPROOF PICKUP ADAPTER (G) IS FREE TO ROTATE WITHOUT TWISTING SIGNAL CABLE (I).
- STEP 3. SCREW MAGNETIC PICKUP (C) CLOCKWISE INTO CONDUIT ADAPTER (B) UNTIL "FINGER TIGHT", THEN ROTATE PICKUP COUNTER-CLOCKWISE ONE QUARTER TURN. DO NOT TIGHTEN WITH PLIERS.
- STEP 4. SCREW JAM NUT (D) CLOCKWISE UNTIL MAGNETIC PICKUP (C) IS SECURE.
- STEP 5. PLUG AMPHENOL CONNECTOR (E) INTO PICKUP (C) AND TURN SWIVEL NUT (J) UNTIL SECURE. DO NOT TIGHTEN WITH EXCESSIVE FORCE. SNUG IS SUFFICIENT.
- STEP 6. SLIP WEATHERPROOF PICKUP ADAPTER (G) OVER PICKUP (C) AND TIGHTEN ONTO CONDUIT ADAPTER (B).
- STEP 7. TIGHTEN GLAND NUT (H) UNTIL RUBBER GROMMET SEALS AROUND SIGNAL CABLE.



### NOTE:

THERE MUST BE A MINIMUM OF TEN PIPE DIAMETERS OF UNRESTRICTED FLOW IMMEDIATELY UPSTREAM AND FIVE PIPE DIAMETERS OF UNRESTRICTED FLOW DOWNSTREAM FROM THE FLOW METER.

THROTTLING VALVES **MUST NOT** BE INSTALLED UPSTREAM FROM THE FLOW METER.

Figure 2

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Manual No. 100062201NX

November 2003

## MAINTENANCE

Figure 1 illustrates a typical flow meter. The following instructions are applicable to all meter sizes except as noted.

The flow meter may be disassembled for inspection, cleaning or repair in the following manner:

1. Screw the magnetic pickup out of the meter body to avoid damage during handling of the meter.
2. Remove the retainer ring from one end of the meter body.
3. Slide the vane from the meter body. Note: Some slotted meters may require a slight twist of the vane to align the vane with the slot in the meter body. (If the vane should be stuck, insert a brass rod through the opposite vane and through the rotor and drive the vane out by **tapping** on alternate blades of the vane.)
4. In 3" and smaller size meters, the rotor may now be removed. In 4", 6" and 8" meters, it is necessary to remove the inner retainer ring before the rotor can be taken out. The rotor should be handled with care to prevent damage to the rotor shaft.
5. Remove the retainer ring from the other end of the meter body.
6. Remove the other vane.
7. **Do not attempt to remove the bearings and thrust balls from the vanes.**
8. Clean all parts with a suitable solvent for the material that has been pumped through the meter. A cotton swab is very useful for cleaning the inside diameter of the bearings.

If the meter internals are damaged, **always** replace the entire kit. Never exchange only the damaged piece. The kits are provided as a calibrated set of components. Accuracy will be sacrificed by replacing just individual parts.

The meter is assembled in the following manner:

1. Before assembling, note that an arrow is cast or engraved on each part. These arrows indicate the direction of flow. The meter must be assembled so that all arrowheads point the same way and the direction of flow must coincide with the direction of flow indicated on the meter body.
2. In all sizes, observe that one of the blades on each vane has an arrow on it. Also note that retainer

pins, welds or notches are provided at each end of the meter body. The marked blade must be inserted between these retainer pins, weld spots or notches that are opposite the conduit adapter (or on the bottom of the meter body). The meters are calibrated in this position, and should be reassembled in this position for the greatest accuracy. (See Figure 1)

3. Insert one of the vane assemblies in the meter body bore, being careful that the direction arrow is correctly oriented. The vane should fit snugly but should not require excessive force to install. Install the retainer ring.
4. Install the rotor and rotor shaft assembly, being careful to properly orient the direction arrow on the rotor. Care should be taken to avoid chipping the rotor shaft. Tungsten carbide is very brittle. Install the retainer ring in 4", 6", and 8" meters.
5. Insert the other vane assembly. If this vane does not fall into position when placed in the meter body, rotate the rotor, if possible, to align the bearing and rotor shaft. Do not attempt to drive the vane in, as this will result in a broken rotor shaft. Install the retainer ring.
6. Spin the rotor by hand, making sure that the rotor moves freely. If the rotor will not turn or stops abruptly, the meter should be disassembled and checked.
7. Screw the magnetic pickup into the meter body according to the procedures indicated in Figure 2. Tighten finger tight and set lock nut. Do not tighten with pliers or wrench.

## REPLACEMENT PARTS

| Meter Kit Size | Standard Grade | Industrial Grade |
|----------------|----------------|------------------|
| 3/8"           | 100003521      | 100003378        |
| 1/2"           | 100003531      | 100003379        |
| 3/4"           | 100003449      | 100003380        |
| 7/8"           | 100005124      | 100061059        |
| 1"             | 100003527      | 100003381        |
| 1-1/2"         | 100003469      | 100003382        |
| 2"             | 100003474      | 100003383        |
| 3"             | 100003470      | 100061056        |
| 4"             | 100003473      | 100003384        |
| 6"             | 100003471      | 100061057        |
| 8"             | 100003472      | 100061058        |

**NOTE:** Installation of a Standard Grade kit in an Industrial Grade flow meter will void the Industrial Grade linearity of the flow meter.



NuFlo Measurement Systems  
16538 Air Center Blvd.  
Houston, TX 77032  
Phone: 800-654-3760



**ACTION:**

Direct action; Pilot Output Pressure (Yellow) increases with temperature rise. As long as the temperature is above the set point, the output will remain at supply pressure. If the pilot flame goes out, the pressure decreases and drops to zero.

**APPLICATION:**

Used as a Pilot safety shutdown or as a high stack temperature shutdown.

**TEMPERATURE RANGE:**

- 30°F minimum to 2100°F maximum.
- 34°C minimum to 1149°C maximum.

**OPERATION:**

This Thermostat consists of a STAINLESS TUBE for monitoring the pilot flame, which is connected by a Low Expansion Alloy Rod to a BELLOWS ASSEMBLY. The changes in the length of the STAINLESS TUBE operate a PILOT PLUG seat. The PILOT PLUG consists of two stainless balls rigidly connected together. The seat at BALL 1 is the Output Pressure vent (Yellow to Atmosphere). The seat at BALL 2 is the Supply Pressure inlet (Violet to Yellow).

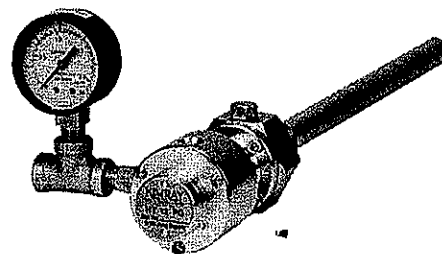
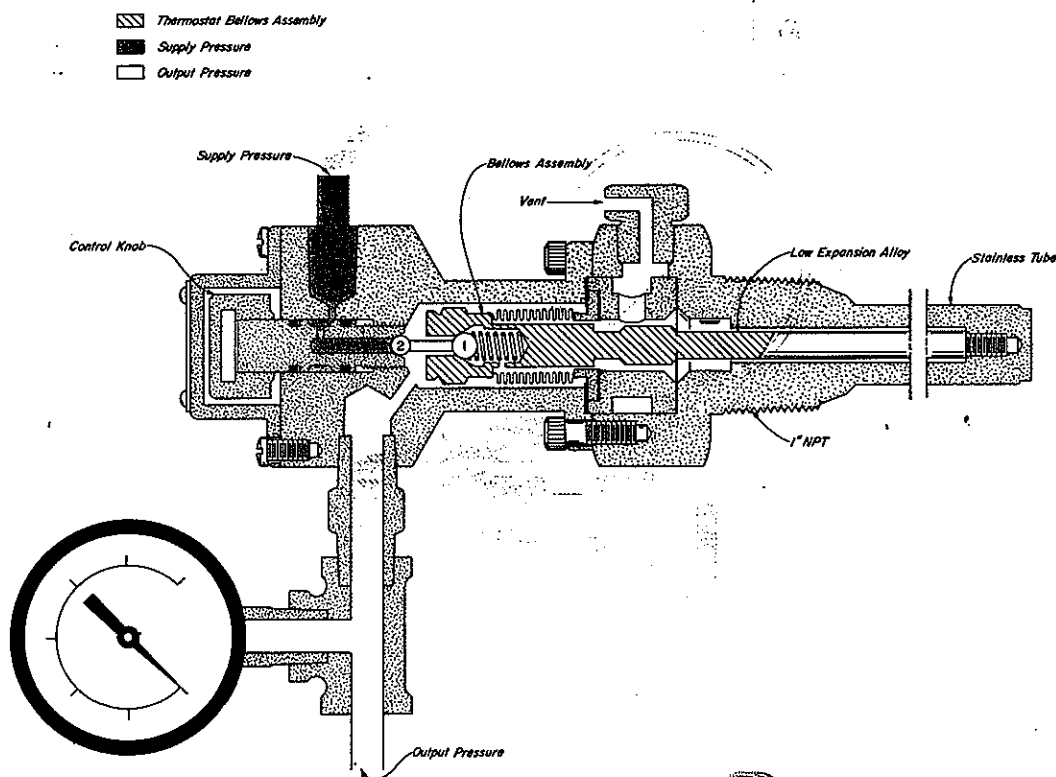
Assume the set point on the HT 12PG is above the temperature of the system. The vent at BALL 1 is open and the inlet at BALL 2 is closed. Output Pressure (Yellow) is at 0 psig or vented.

As the temperature rises in the system, the STAINLESS TUBE or outer tube increases in length to move the Thermostat Bellows Assembly in a direction to first close the seat at BALL 1 (Yellow to Atmosphere) and open the seat at BALL 2 (Violet to Yellow). This causes the Output Pressure (Yellow) to increase and hold a safety valve open.

If the temperature decreases (pilot flame goes out), the action reverses and Output Pressure (Yellow) goes to zero. This allows a safety valve to close, removing the gas supply for the burner and pilot light system.

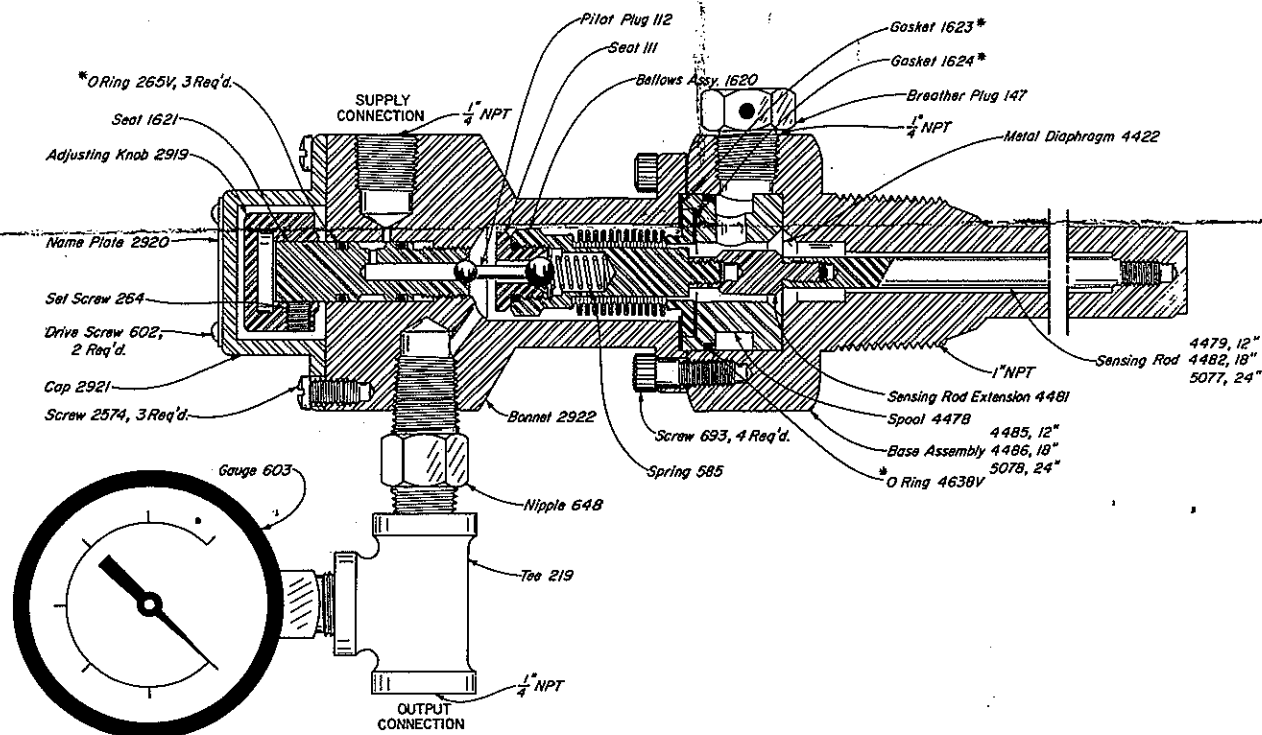
**SUPPLY PRESSURE:**

5 psig minimum to 30 psig maximum.

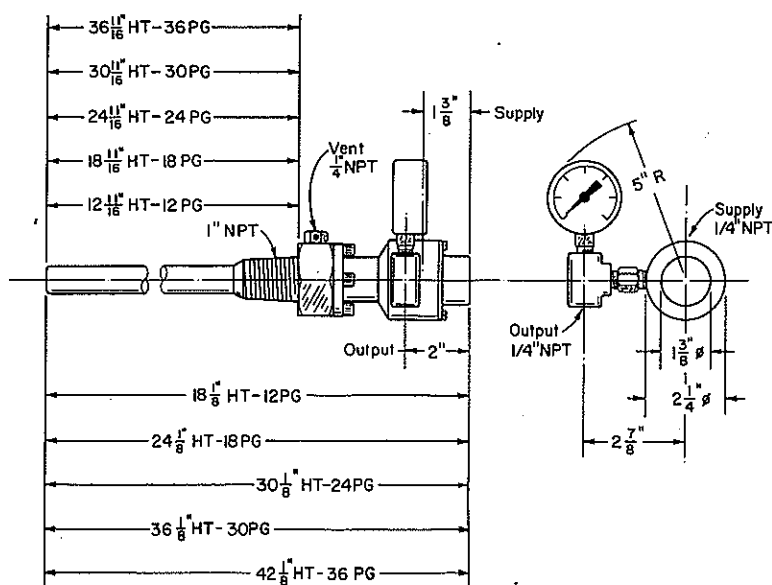


HT 12PG

HT 12/18/24 PG  
STEEL  
-30°F to 2100°F, -34°C to 1149°C



## PILOT GUARD DIMENSIONS



### HIGH TEMPERATURE PILOT GUARDS AVAILABLE: STEEL

| CAT. NO. | THERMOSTAT MODEL | MAX. TEMP. °F | MAX. TEMP. °C |
|----------|------------------|---------------|---------------|
| HBT      | HT 12 PG         | 2100          | 1149          |
| HBU      | HT 18 PG         | 2100          | 1149          |
| HBV      | HT 24 PG         | 2100          | 1149          |
| HBW      | HT 30 PG         | 2100          | 1149          |
| HBX      | HT 36 PG         | 2100          | 1149          |

\*These are recommended spare parts and are stocked as repair kits. To order repair kit, specify; "HT Repair Kit, RLQ."

A 1" NPT mounted collet for adjusting the HT 12 PG pilot guard for optimum sensing of the pilot flame is available. To order specify Cat. No. "YDE".

## Type 4660 High-Low Pressure Pilot

The Type 4660 pneumatic high-low pressure pilot (figure 1) activates safety shutdown systems for flowlines, production vessels, and compressors. This pilot is available with either single or dual set point capability, using patented switch points, to maintain full output pressure when the process pressure is within the set point range. If the process pressure is outside this range, the pilot switches from full output pressure to zero output pressure.

The primary switching mechanism in this pilot is a block-and-bleed relay assembly. This construction can be used in both block-and-bleed and bleed-only systems.

### Features

- **Superior Performance**—Repeatability meets the U.S. Minerals Management Service test tolerances referenced in Outer Continental Shelf (OCS) Order No. 5 and defined in the American Petroleum Institute (API) RP14C standard.
- **Easy Maintenance**—Simple modular construction plus a line of prepackaged parts kits makes pilot maintenance fast and easy.
- **Reliable Operation**—The pilot uses a field-proven Bourdon tube process pressure sensing element that reduces maintenance by eliminating the need for wetted dynamic O-rings.
- **Environmental Packaging**—Construction materials have been selected to protect the pilot from corrosive environments such as the salt spray atmosphere of offshore platforms.
- **Vibration Resistance**—The rugged Bourdon tube sensing element and shock-absorbing switch points dampen the effects of vibration while maintaining performance.



FRONT VIEW



LEFT SIDE WITH  
CASE COVER OFF

Figure 1. Type 4660 High-Low Pressure Pilot with Block and Bleed Relay

- **Set Point Accuracy**—Standard high-resolution set point adjustments are easy to set, non-interactive, and can be locked in place to maintain the desired set point. The optional set point indication assemblies on the front panel are easy to read and let you simply dial in the desired set point.



# 4660 Pressure Pilot

## Product Bulletin

34.5:4660

April 2003

Table 1. Additional Specifications, Bar

| BOURDON TUBE RATING <sup>(1)</sup> | SET RANGE <sup>(1)</sup> | SET POINT $\Delta P_{MIN}$ (MINIMUM ALLOWABLE DIFFERENCE BETWEEN HIGH AND LOW SETTINGS) |                             | TRIP-TO-RESET ZONE |
|------------------------------------|--------------------------|---|-----------------------------|--------------------|
|                                    |                          | Single High-Low Unit  | High-Only/<br>Low-Only Pair |                    |
| 7                                  | 0.3 to 6.6               | 0.7   | 0.2                         | ≤0.1               |
| 17                                 | 0.6 to 16.6              | 1.7   | 0.5                         | 0.3                |
| 35                                 | 1.1 to 33.4              | 3.5   | 1.0                         | 0.5                |
| 70                                 | 2.1 to 67.9              | 6.9   | 2.1                         | 1.0                |
| 100                                | 3.2 to 100.2             | 10.3  | 3.1                         | 1.6                |
| 170                                | 5.2 to 167.2             | 17.2  | 5.2                         | 2.6                |
| 350                                | 10.4 to 334.4            | 51.7  | 10.3                        | 5.2                |
| 500                                | 15.6 to 501.5            | 70.7  | 15.5                        | 7.8                |
| 700 <sup>(2)</sup>                 | 20.7 to 668.8            | 103.4   | 20.7                        | 10.3               |

1. Rating indicated on Bourdon tube and set range on front panel are in kPa (1 bar = 100 kPa).

2. Available in N05500 (K-Monel) only, for NACE.

Table 2. Additional Specifications, Psig

| BOURDON TUBE RATING   | SET RANGE   | SET POINT $\Delta P_{MIN}$ (MINIMUM ALLOWABLE DIFFERENCE BETWEEN HIGH AND LOW SETTINGS) |                             | TRIP-TO-RESET ZONE |
|-----------------------|-------------|---|-----------------------------|--------------------|
|                       |             | Single High-Low Unit  | High-Only/<br>Low-Only Pair |                    |
| 100                   | 3 to 97     | 10  | 3.0                         | ≤1.5               |
| 250                   | 8 to 242    | 25  | 7.5                         | 3.8                |
| 500                   | 5 to 485    | 50  | 15                          | 7.5                |
| 1000                  | 30 to 970   | 100   | 30                          | 15                 |
| 1500                  | 45 to 1455  | 150   | 45                          | 23                 |
| 2500                  | 75 to 2425  | 250   | 75                          | 38                 |
| 5000                  | 150 to 4850 | 750   | 150                         | 75                 |
| 7500                  | 225 to 7275 | 1025  | 225                         | 113                |
| 10,000 <sup>(1)</sup> | 300 to 9700 | 1500  | 300                         | 150                |

1. Available in N05500 (K-Monel) only, for NACE

- **Cost-Effective Design**—One pilot provides either a high-low function or a single switch point, whichever the application requires.

- **Installation Versatility**—Panel, rack, pipestand, or actuator mounting is available to meet field requirements.

- **Operational Indications**—A supply pressure test function is provided. The optional output indicator lets you check at a glance whether the pilot output pressure is at full output or zero output pressure.

- **NACE Conformance**—A K-Monel Bourdon tube is available for those applications where the pilot must meet the requirements of NACE Standard MR0175.

## Specifications

### Available Configurations

■ High-low, ■ low-only, or ■ high-only set point capability

### Input Signal<sup>(1)</sup>

**Type:** Process pressure sensed with a Bourdon tube

**Bourdon Tube Ratings:** See table 1 or 2

**Overpressure Protection:** Maximum allowable emergency process pressures and maximum allowable process pressures to ensure set point readjustability are shown in table 3

### Output Signal<sup>(1)</sup>

■ Zero pressure or ■ full supply pressure (automatically resets)

### Supply Pressure<sup>(1),(3)</sup>

**Normal Operating Pressure:** 1.4 to 4.4 bar (20 to 65 psig)

**Medium:** Air or natural gas

**Quality:** Should be dry with solid particles removed

### Steady-State Air Consumption<sup>(2)</sup>

**Output Signal at 0 psig:**  $\leq 0.134$  normal  $\text{m}^3/\text{hr}$  ( $\leq 5$  Scfh)

**Output Signal at Full Supply Pressure:**  $\leq 0.00134$  normal  $\text{m}^3/\text{hr}$  ( $\leq 0.05$  Scfh)

### Set Point Adjustments

Continuously adjustable between 3 and 97% of Bourdon tube rating; see table 1 or 2 for ranges

### Performance in Percentage of Bourdon Tube Rating

**Repeatability<sup>(1)</sup>:**  $\leq 0.25\%$

**Set Point  $\Delta P_{\min}$ .**  
(See table 1 or 2)

**Single High-Low Unit:** 10% for up to 170 bar (2500 psig) Bourdon tubes; 15% for 350, 500, and 700 (NACE) bar (5000, 7500, and 10,000 (NACE) psig) Bourdon tubes

*Low-Only and High-Only Pair:* 3%

**Trip-to-Reset Zone:**  $\leq 1.5\%$  (see table 1 or 2)

### Exhaust Capacity

$C_g \geq 15$

### Construction Materials

**Case and Cover:** Polyester

**Front Cover:** Tinted Lexan with scratch-resistant coating

**Base:** Hard-anodized nickel-sealed aluminum alloy

**Bourdon Tube:** ■ 316 stainless steel, or ■ N05500 (K-Monel)

**Relay Body, Relay Flange, Nozzle/Flapper Assembly Orifice Block, and Switch Point.**

**Housings:** Glass-filled Ryton

**Relay Diaphragm:** ■ Nitrile/Polyester or ■ Fluorosilicone/Polyester (low temperature version), or ■ Fluoroelastomer/Polyester

**Relay Disks:** ■ Nitrile, ■ Fluorosilicone (low temperature version), or ■ Fluoroelastomer/Polyester

**Process Pressure Block, Tubing, Front Plate, Flapper, Linkages, and Other Major Metal**

**Parts:** Stainless steel

**Gaskets:** Neoprene and nitrile

**O-Rings.**

**Relay:** ■ Nitrile or ■ Fluoroelastomer

**Switchpoint Assembly:** Nitrile impregnated with molybdenum disulphide

**Base/Case:** Nitrile

### Operating Conditions<sup>(1),(3)</sup>

| Condition           | Normal Operating Limits   | Nominal Reference |
|---------------------|---|-------------------|
| Ambient temperature | Nitrile Elastomers:<br>-40 to 60°C<br>(-40 to 140°F)                      | 21°C (70°F)       |
|                     | Fluoroelastomer Elastomers:<br>-7 to 71°C<br>(-20 to 160°F)               |                   |
|                     | Fluorosilicone Elastomers:<br>(Low Temperature Version)<br>-75 °F (-59°C) |                   |
| Process temperature | -29 to 93°C<br>(-20 to 200°F)   | 21°C (70°F)       |

(continued)

## Specifications (continued)

Operating Influences<sup>(1)</sup> on Switch Point Sensitivity

**Supply Pressure:** ≤0.05% of Bourdon tube rating for a 10% change in supply pressure

**Ambient Temperature:** ■ ≤1.5% (standard construction) or ■ ≤2.5% (low temperature version) of Bourdon tube rating throughout normal operating limits with nominal reference

**Time:** ≤1% of Bourdon tube rating over 30 days at ambient temperature nominal reference

**Process Pressure:** Range shift or set point drift can occur if process pressure exceeds the Bourdon tube rating

## Pressure Connections

1/4 inch NPT female

## Mounting

■ Panel, ■ rack, ■ pipestand, or ■ actuator

## Approximate Weight

2.3 kg (5 pounds)

## Options

■ Visual output indication, ■ fluoroelastomers in relay, ■ low-temperature version to -59°C- (75°F) ■ 316 stainless steel panel mounting flange, ■ set point indication, ■ tamper-resistant front cover, or ■ 1/2 inch NPT male pressure connections

1. This term is defined in ISA Standard S51.1.

2. Normal m<sup>3</sup>/h--Normal cubic meters per hour at 0°C and 1.01325 bar, absolute. Scfh--Standard cubic feet per hour at 60°F and 14.7 psia.

3. The pressure/temperature limits in this bulletin and any applicable standard or code limitation for valve should not be exceeded.

Table 3. Maximum Allowable Process Pressure<sup>(1)</sup>

| BOURDON TUBE RATING   |        | MAXIMUM ALLOWABLE EMERGENCY PROCESS PRESSURE |      |                                       |        |
|---|--------|--|------|---------------------------------------|--------|
| Bar <sup>(2)</sup>  | Psig   | Stainless Steel Bourdon Tubes                |      | N05500 (K-Monel) Bourdon Tubes (NACE) |        |
|   |        | Bar <sup>(2)</sup>                           | Psig | Bar <sup>(2)</sup>                    | Psig   |
| 6.9   | 100    | 13.8   | 200  | 13.8                                  | 200    |
| 17.2  | 250    | 34.2   | 500  | 34.2                                  | 500    |
| 34.5  | 500    | 69.0   | 1000 | 69.0                                  | 1000   |
| 69.0  | 1000   | 138.0  | 2000 | 138.0                                 | 2000   |
| 103.4   | 1500   | 206.8  | 3000 | 206.8                                 | 3000   |
| 172.4   | 2500   | 344.8  | 5000 | 258.6                                 | 3750   |
| 344.8   | 5000   | 517.2  | 7500 | 430.9                                 | 6250   |
| 517.2   | 7500   | 646.3  | 9375 | 568.8                                 | 8250   |
| 689.5   | 10,000 | N/A  | N/A  | 758.5                                 | 11,000 |
| Maximum Allowable Process Pressure to Ensure Set Point Readjustability <sup>(3)</sup> |        |  |      |                                       |        |
| 6.9   | 100    | 13.8   | 200  | 13.8                                  | 200    |
| 17.2  | 250    | 34.8   | 500  | 22.3                                  | 325    |
| 34.5  | 500    | 51.7   | 750  | 53.4                                  | 775    |
| 69.0  | 1000   | 103.5  | 1500 | 89.7                                  | 1300   |
| 103.4   | 1500   | 155.1  | 2250 | 124.0                                 | 1800   |
| 172.4   | 2500   | 172.4  | 2500 | 227.5                                 | 3300   |
| 344.8   | 5000   | 517.2  | 7500 | 344.8                                 | 5000   |
| 517.2   | 7500   | 646.3  | 9375 | 517.2                                 | 7500   |
| 689.5   | 10,000 | N/A  | N/A  | 689.5                                 | 10,000 |

1. Normal operating process pressures should not exceed the Bourdon tube rating.

2. Ratings indicated on Bourdon tube are in psig and kPa (1 bar = 100 kPa).

3. Values listed for the N05500 Bourdon tubes are for a 2% deviation from set point due to overpressure.

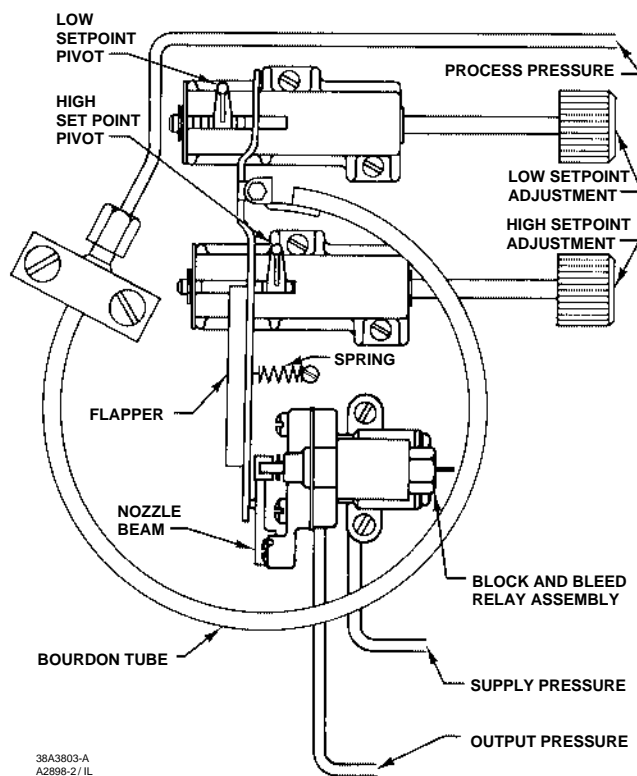


Figure 2. Principle of Operation Schematic

## Principle of Operation

Refer to figure 2.

Process pressure is connected to the Bourdon tube sensing element. While the process pressure remains in the adjusted set ranges (between the low set point and the high set point), the flapper does not contact either set point pivot. This keeps the nozzle capped and maintains full output pressure.

As the process pressure decreases below the low set point value, the radius of arc of the Bourdon tube contracts. This causes the flapper to contact the low set point pivot and uncap the nozzle, which blocks supply pressure and vents (bleeds) output pressure. As the process pressure increases above the high set point value, the radius of arc of the Bourdon tube extends. This causes the flapper to contact the high set point pivot, also uncapping the nozzle and providing block-and-bleed action. When the process pressure returns to the set range, the nozzle is again capped, switching the relay back to maintain full output pressure.

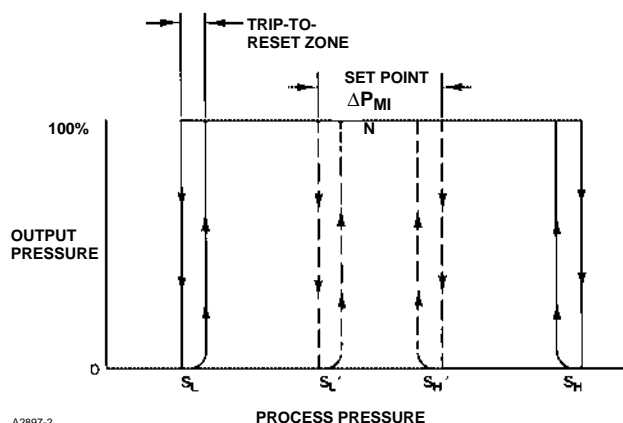
## Performance

The performance characteristics shown in figure 3 and table 4 illustrate several important functional parameters.

$S_L$  represents the low set point and  $S_H$  represents the high set point. The set range capability is 3 to 97 percent of the Bourdon tube rating. However, with a single high-low unit or a high-only/low-only pair, there is a limit on how close to each other the set points can be adjusted. This limit is defined as set point  $\Delta P_{MIN}$  and is shown as  $S_L'$  and  $S_H'$ .

Trip-to-reset is the combined effect of pilot deadband and hysteresis. After the pilot has tripped, it automatically resets when the process pressure returns to the set range. However, full output pressure is not instantaneous. The difference between the set point and reset to full output pressure is the trip-to-reset zone. This parameter is also a function of the Bourdon tube rating as shown in figure 3 and table 4.

Repeatability is the switch point deviation around the set point as a percentage of the Bourdon tube rating.



A2897-2

Figure 3. Performance Characteristics (also see table 4).

Table 4. Performance Characteristics

| CONSTRUCTION            | PERCENT OF BOURDON TUBE RATING |                    |               |
|-------------------------|--------------------------------|--------------------|---------------|
|                         | SET POINT $\Delta P_{MIN}$     | TRIP-TO-RESET ZONE | REPEATABILITY |
| Single High-Low Unit    | 10 <sup>(1)</sup>              | 1.5                | 0.25          |
| High-Only/Low-Only Pair | 3                              |                    |               |

1. 5000 and 7500 Psig Bourdon tubes are 15 percent of Bourdon tube rating.

## Applications

Figure 4 shows some of the many ways in which the Type 4660 high-low pressure pilot may be connected to accommodate requirements for single and dual outputs as well as single and dual process pressure lines. Examples A and D in figure 4 show how a pair of high-only and low-only pilots are connected to obtain closer set points as specified by the set point  $\Delta P_{MIN}$  values in tables 1 and 2. Example B or C shows connections for a two-segment flow line configuration that adheres to API Specification RP14C. Example E shows a typical connection to an electrical pressure switch.

## Installation

Normal installation is with the pilot mounted vertically and the connections for process pressure, supply pressure, and output pressure facing down. The supply medium should be regulated dry air or natural gas with solid particles removed.

Figures 5 and 6 illustrate the mounting dimensions and the location of the pressure connections.



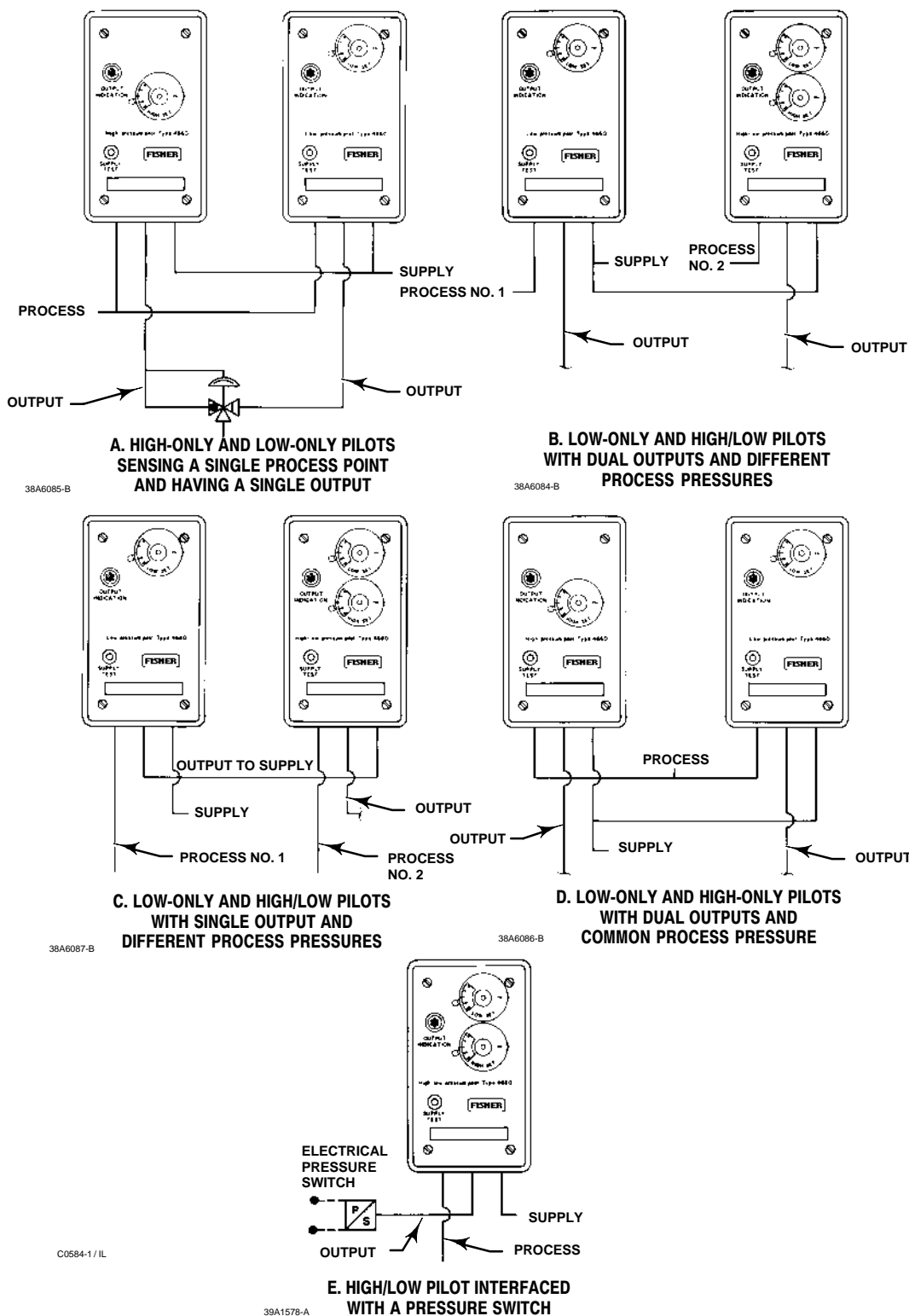


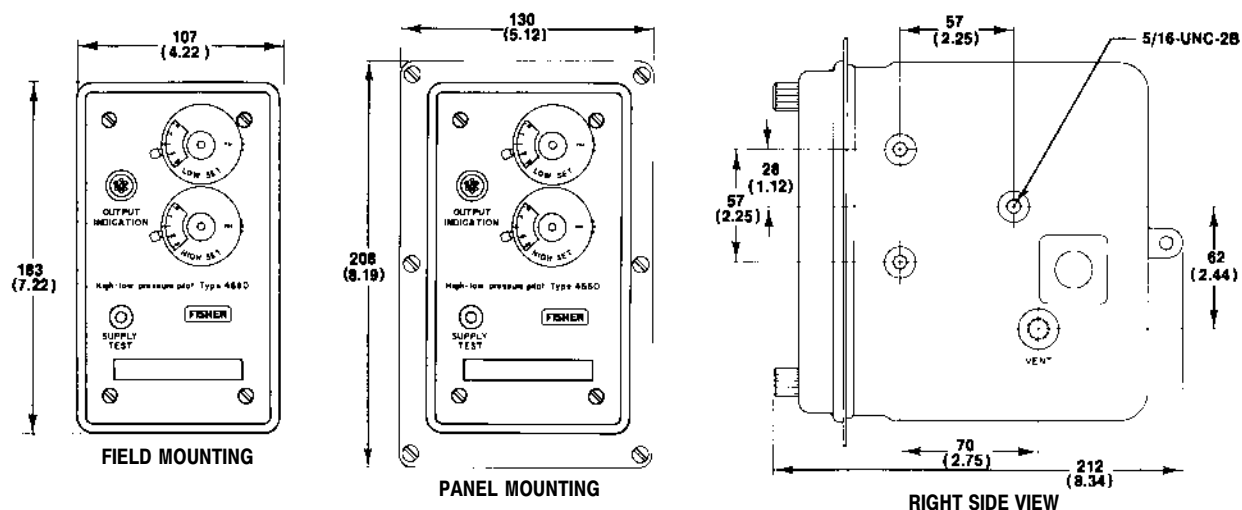
Figure 4. Typical Connection Schematics

# 4660 Pressure Pilot

## Product Bulletin

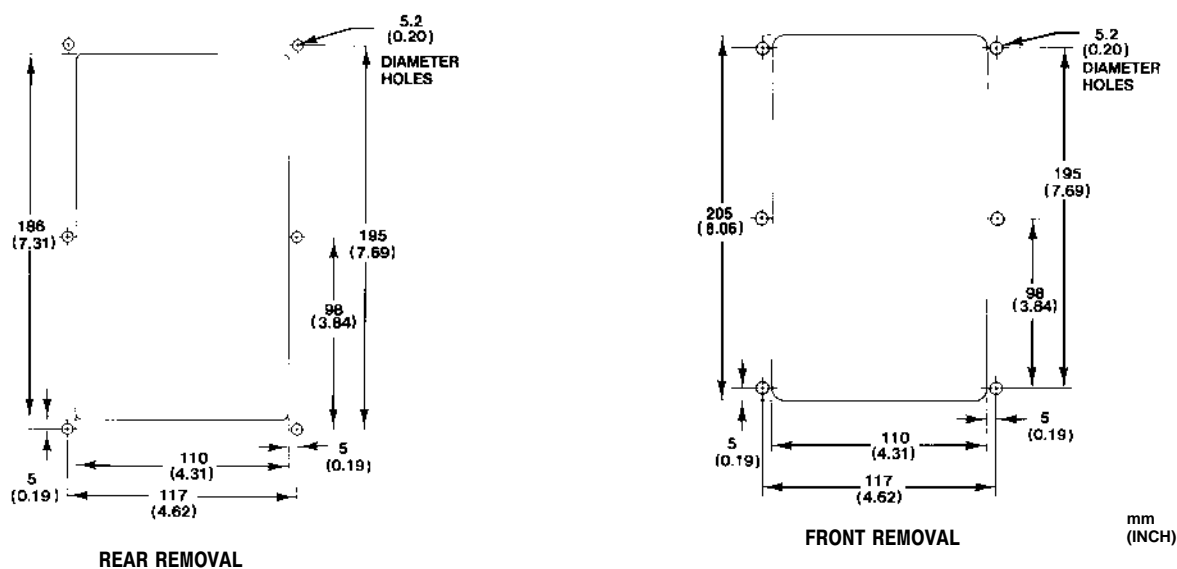
34.5:4660

April 2003



**NOTE:**  
 ALL CONNECTIONS ARE 1/4 NPT

39A1578-A  
 18A3804-G  
 B1589-3/IL



18A3804-F  
 A3299-1/IL

Figure 5. Panel Mounting Dimensions

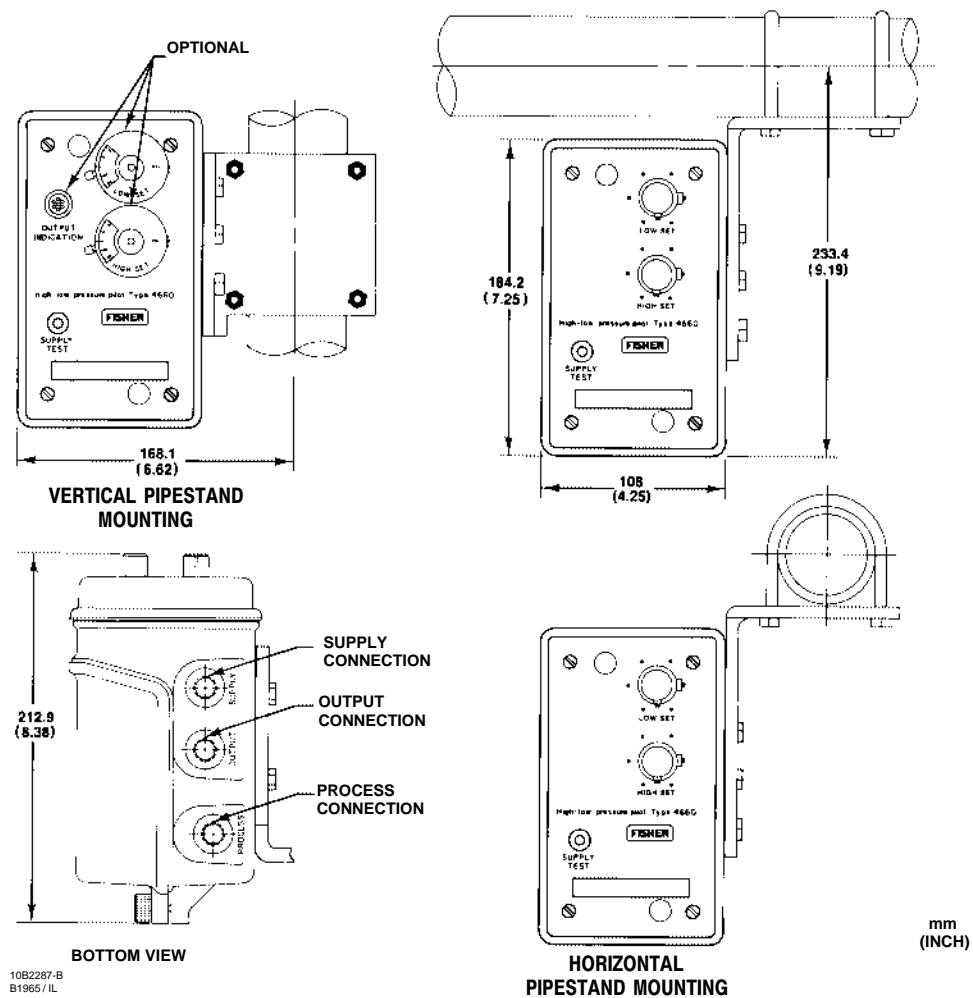


Figure 6. Pipestand Mounting Dimensions

## Ordering Information

**Note: Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for the proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.**

When ordering, specify:

## Application

- Bourdon tube rating and material

- Composition, pressure, and temperature of the process fluid

- Ambient temperature range

- Description of application

## Construction

Refer to the Specifications table. Review the information under each specification and in the referenced tables; specify the desired selection whenever there is a choice to be made.

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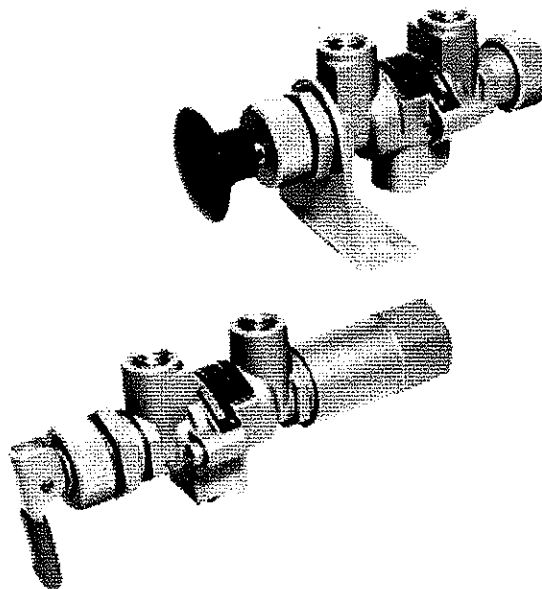
[www.Fisher.com](http://www.Fisher.com)



# AMOT CONTROLS

## Model 4057/4457

### 3-Way Valves



### FEATURES

- **BALANCED FORCE DESIGN-  
PRESSURE CAN BE APPLIED  
TO ANY PORT**
- **CENTER DEAD SPOT-STD.**
- **PORT OVERLAP-OPTIONAL**
- **ARRANGED FOR PANEL OR  
BRACKET MOUNTING**
- **AVAILABLE IN ALUMINUM OR  
316 STAINLESS STEEL**

### APPLICATIONS

- **HYDRAULIC FLUID CONTROL**
- **ACTUATOR CONTROL**
- **PNEUMATIC PANEL SYSTEMS**
- **SAFETY CONTROL SYSTEMS**

AMOT Model 4057 or 4457 Valves were developed for use in manual and automatic hydraulic or pneumatic control systems. They offer versatility in operating requirements and allowable pressure limits. For a 1/4" size control valve, they offer exceptional flow capacity.

These valves are suitable for use on clean air, natural gas, L.P. gases, petroleum-base lubricants and hydraulic oils as well as many other fluids.

Each valve is carefully assembled, tested, and inspected to ensure that high quality standards are met. Valves are made from precision cast and machined aluminum or stainless steel parts. The unique porting arrangement eliminates seal ring cutting, and permits pressure inlet at any port without danger of seal "blow out". Standard construction permits valve pressures to 125 psi.

Certain of these valves are completely unique in the industry. For example, the 4057 or 4457 Type CP has a manual reset latch which automatically will drop out on introduction of pilot pressure, and permits return stroke on loss of pilot pressure.

These valves make use of AMOT's patented "Tad-Pole" seal which provides for lower friction and longer cycle life than conventional O-rings. (U.S. Pat. No. 3,926, 444).

## INSTALLATION

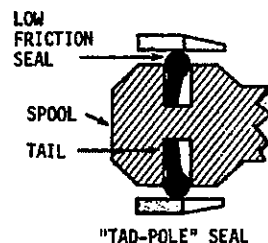
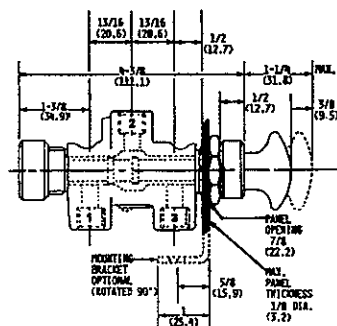
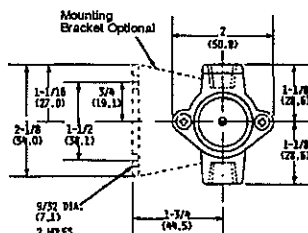
All connections on 4057 and 4457 Valves are made with 1/4" pipe thread fittings. Apply a quality thread sealant such as Loctite Pipe Sealant to pipe thread connections but do not permit it to enter the valve passages. Teflon thread sealing tape may be used but must be applied so that shreds of the tape do not enter the valve.

**Avoid overtightening fittings on the valve port bosses as they may be cracked, especially when Teflon thread sealing tape is used.**

All valves may be bracket mounted; most are also suitable for panel mounting. A Satin Chrome Nut, Part No. 3496L001, is available as an option for most types. It substitutes for standard Nut (8) to improve the appearance for front of panel mountings. A red Knob, Part No. 681L001, is available for Types CA, CB, CD or CE if desired as a substitute for standard black Knob (11).

## DIMENSIONS

Dimensions in Inches  
Millimeters in ( )



## OPERATION

AMOT Model 4057 and 4457 3-Way Valves feature modular construction and incorporate a sliding spool. The standard spool has a small center dead spot position and no valve port overlap. With the spool fully to the left (rest position) as shown in the diagrams, Port 2 is open to Port 3 and Port 1 is closed. With the spool moved to the right (actuated

position), Port 2 is open to Port 1 and Port 3 is closed. The valves are available with a variety of manual and pressure operators and with manual, pressure or spring returns. See the Valve Type Description Table for the standard variations which are available.

## MODEL CODE SYSTEM

|              |            |          |          |          |            |
|--------------|------------|----------|----------|----------|------------|
| <b>4057D</b> | <b>019</b> | <b>F</b> | <b>1</b> | <b>-</b> | <b>( )</b> |
| <b>4457A</b> | <b>001</b> | <b>F</b> | <b>1</b> | <b>-</b> | <b>( )</b> |

Basic  
Model  
No.

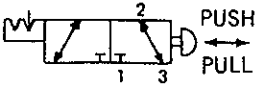
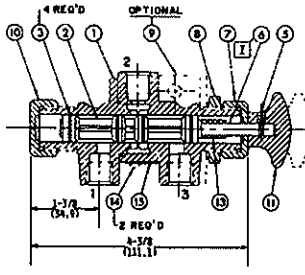
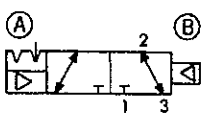
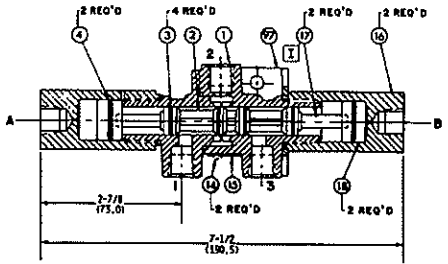
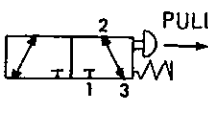
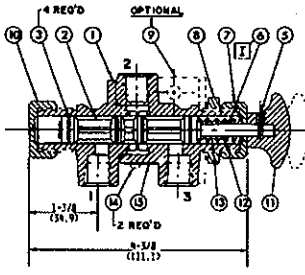
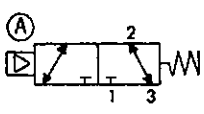
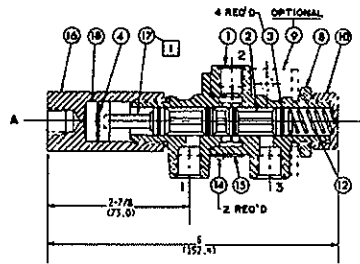
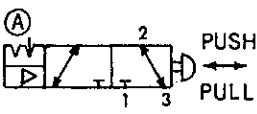
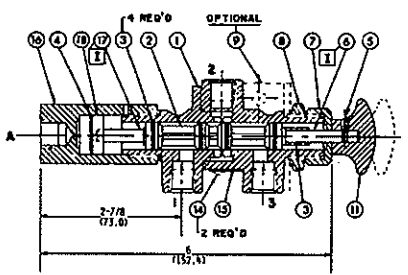
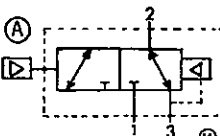
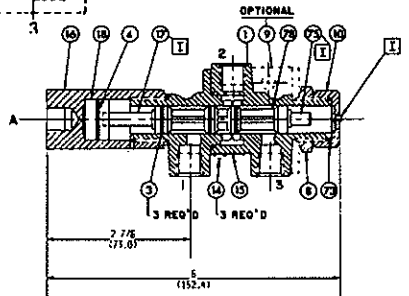
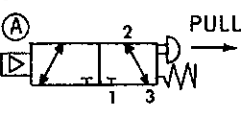
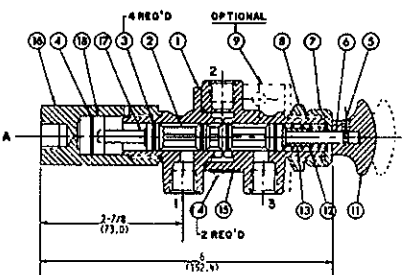
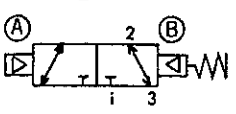
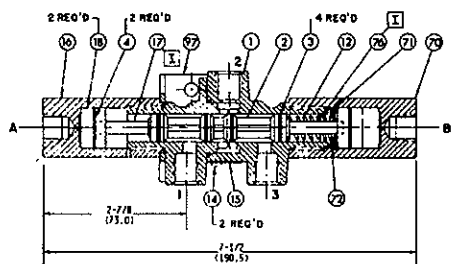
**Note:** Letters or numbers in the MTO space, other than nothing, A1 or AA, indicate the unit is built to special requirements and some of the other code numbers may not be valid. Check with the factory for full specification of such models.


| Table A                            |                     |                  |                           |                        | Table B                | Table C        |                    |
|------------------------------------|---------------------|------------------|---------------------------|------------------------|------------------------|----------------|--------------------|
| Operator, Finish & thread Code No. |                     |                  |                           |                        | Seal Material Code No. | Spool Code No. |                    |
| Valve Type                         | Stainless Steel NPT | Gulf-Proofed NPT | Stainless Steel *BSP (PL) | Gulf-Proofed *BSP (PL) | Viton                  | Standard       | Valve Port Overlap |
| CA                                 | 001                 | 019              | 073                       | 091                    | F                      | 1              | 2                  |
| CB                                 | 002                 | 020              | 074                       | 092                    | F                      | 1              | 2                  |
| CD                                 | 004                 | 022              | 076                       | 094                    | H                      | 1              | 2                  |
| CE                                 | 005                 | 023              | 077                       | 095                    | H                      | 1              | 2                  |
| CP                                 | 007                 | 025              | 079                       | 097                    | H                      | 1              | 2                  |
| SB                                 | --                  | 027              | --                        | 099                    | K                      | 5              | 6                  |
| CT                                 | --                  | 029              | --                        | 101                    | K                      | 1              | 2                  |
| CG                                 | 013                 | 031              | 085                       | 103                    | H                      | 1              | 2                  |
| CF                                 | 014                 | 032              | 086                       | 104                    | J                      | 1              | 2                  |
| CZ                                 | --                  | 035              | --                        | --                     | J                      | 1              | 2                  |

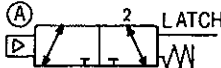
\* Available from U.K.  
Factory Only

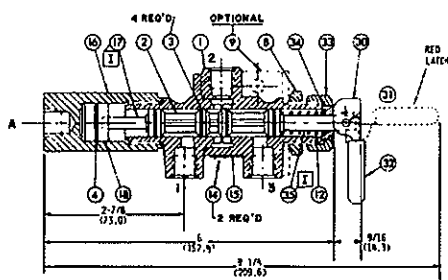
- - Not Available

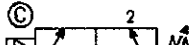
# VALVE TYPE DESCRIPTION TABLE

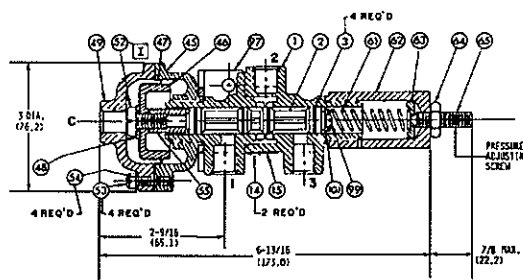
|   |   |
|---|---|
| <p><b>TYPE CA</b></p>  <p>PUSH<br/>PULL</p> <p>Manual Operated<br/>5 lbs Force Required</p>   | <p><b>TYPE CF</b></p>  <p>Double Pilot Operated<br/>10 psi Pressure Required</p>    |
| <p><b>TYPE CB</b></p>  <p>PULL</p> <p>Manual Pull<br/>Spring Return<br/>15 lbs Force Required</p>   | <p><b>TYPE CG</b></p>  <p>Pressure Operated,<br/>Spring Return<br/>26 psi Pressure Required</p>                                 |
| <p><b>TYPE CD</b></p>  <p>PUSH<br/>PULL</p> <p>Manual or<br/>Pressure Operated<br/>Manual Return<br/>10 psi Pressure or<br/>6 lbs Force Required</p>  | <p><b>TYPE C1</b></p>  <p>Normally Open<br/>Pressure Operated<br/>Internal Pressure Return</p>                              |
| <p><b>TYPE CE</b></p>  <p>PULL</p> <p>Manual or<br/>Pressure Operated<br/>Spring Return<br/>26 psi Pressure or<br/>16 lbs Force Required</p>          | <p><b>TYPE C2</b></p>  <p>Double Pilot Operated<br/>Spring Return In One<br/>Direction, 10 psi<br/>and 26 psi required</p>  |

Note: The symbol  does not designate a detent, but indicates that the valve has a memory and that the piston will remain in position until moved.

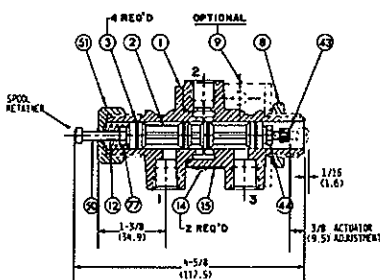
**TYPE CP**  
 (A)  **LATCH**  
 Manual Latch or Pressure  
 Operated, Spring Return  
 when Released  
 26 psi Pressure Required

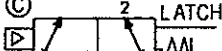


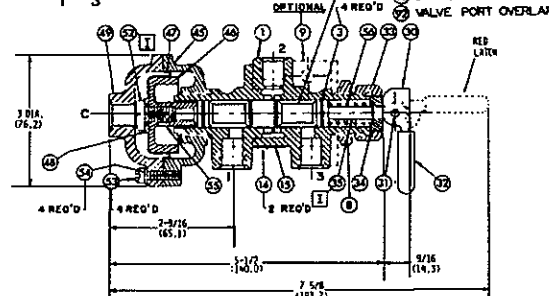
**TYPE CT**  
 (C)   
 Adjustable Pressure Operated  
 Spring Return  
 Adjustable from 5-15 psi



**TYPE CS**  
 (A)   
 Mechanical Limit Valve  
 Machine Actuated  
 Spring Return  
 15 lbs Force Required



**TYPE SB**  
 (C)  **LATCH**  
 Manual Latch or Pressure  
 Operated, Spring Return  
 when Released  
 13 psi Pressure Required



## MAINTENANCE

AMOT 4057 and 4457 Valves make use of AMOT's "Tad Pole" rubber seals to provide low operating forces and high cycle life. Wear can be observed by checking for leakage which will increase as there is more wear.

To check the seal rings, the valve spool can be removed. This is done on most versions by simply removing the end cap and pulling out the spool. Spools on panel mounted valves can be removed from in front of the panel without disconnecting any piping.

To replace seal rings, remove the spool, take off the old rings, thoroughly clean the grooves, and coat the grooves with Dow Corning No. 33 grease (AMOT Part No. 911L001). Lightly coat the new rings with grease and install them, first inserting the thin tail section of the ring into one side of the groove. Work around the ring until it is uniformly positioned. Remove excess grease and reinstall the piston.

When these valves are used in safety control systems, it is recommended that the system be checked monthly for proper functioning.

When communicating with AMOT regarding operation of a control, always give the Model No. and Serial No. If ordering service parts, also include the Description, Part No., and quantity desired. If any parts are ordered by Reference No. only, please include the Form No., Revision No., and date of the brochure.

## SERVICE KITS

| Ref No.   | Part No. | Qty | Description      |
|---|----------|-----|------------------|
| For all Types except CT & SB (Viton) Kit 9113X001 |          |     |                  |
| 3   | 7896L002 | 4   | Seal Ring, Viton |
| 4   | 7898L002 | 2   | Seal Ring, Viton |

Service Kit 9113X002 may contain extra parts when used with some valve types.

| For Types CT & SB (Viton) |          | Kit 9128X001 |                  |
|---------------------------|----------|--------------|------------------|
| 3                         | 7896L002 | 4            | Seal Ring, Viton |
| 47                        | 2254L002 | 1            | Diaphragm, Viton |
| 48                        | 7898L002 | 1            | Thread Seal      |

## SERVICE PARTS

| Ref No. | Part No. | Qty | Description                            |
|---------|----------|-----|--|
| 3       | 7986L002 |     | Seal Ring, Viton                       |
| 4       | 7898L002 |     | Seal Ring, Viton                       |
| 47      | 2254L002 |     | Diaphragm, Viton,<br>for Types CT & SB |
| 48      | 714L004  |     | Seal Ring, Viton                       |

These Parts Lists effective with Valve Serial No. C761.

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# Instruction Manual

## CVS 7970 High-Low Pressure Sensor

### Introduction

This instruction manual includes the following information for CVS 7970 High-Low Pressure Pilot:

1. Description
2. Piston Arrangement Changeover Instructions
3. Parts Information

Only persons qualified through training or experience should install, operate and service this equipment. If you have any questions regarding this product or this manual, please contact your CVS Controls Sales Representative before proceeding.

### Description

The CVS 7970 is a versatile sensor that can be programmed to detect and react to either increasing pressure or decreasing pressure with an adjustable range of 10 to 10,000 PSI (.689 to 689.5 Bar).

When used within standard safety systems, a pressure sensor monitors a specific media or process pressure source for changes to the normal operating range. Loss of pressure within the control circuit will begin a shutdown sequence or trigger an alarm, and pressure sensors can also indirectly operate on/off flow

control valves or pneumatic driven pumps. The CVS 7970 is a two position, three-way pilot with universal port (H, O, L), automatic reset (spring return) and pressure balance spool.

Each CVS 7970 is a self-contained unit containing necessary components for four different piston arrangements. Changeover instructions and drawings are included in this manual. Parts which are not installed in your current piston arrangement are kept in an enclosed storage tube. Machined within the piston housing of the CVS 7970 is a convenient 1/8"-27 NPT Female process connection and 1/2" NPT Male process connection.



Figure 1: CVS 7970 High/Low Pressure Sensor

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**CVS**  
Controls Ltd.

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205, 2323 - 32 Avenue NE  
Calgary, Alberta, Canada  
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Office: (403) 250-1416  
Fax: (403) 291-9487

Table 1: CVS 7970 Specifications

| Specifications                |                        | Dimensions                      |
|-------------------------------|------------------------|---------------------------------|
| <b>Dimensions</b>             |                        | 1.750" diameter x 8.0" length   |
| <b>Working Pressure</b>       | Process Pressure Inlet | 10,000 PSI Maximum (689.5 Bar)  |
|                               | Control Parts          | 125 PSI Maximum (8.62 Bar)      |
| <b>Connections</b>            | Process Pressure Inlet | 1/2"-14 NPT M and 1/8"-27 NPT F |
|                               | Control Ports          | 1/4"-18 NPT F                   |
| <b>Weight</b>                 |                        | 3.5 lbs / 1.6 kg                |
| <b>Panel Hole Cutout Size</b> |                        | 1 5/8" (39.81 mm)               |

One particular advantage of the CVS 7970 is its adjustment range capability. Because of the complete supplied components, there is no need to purchase and store additional sets of matching piston and spring components. The installation or reorientation of the existing piston components allows for an adjustment range capability of 10 to 10,000 PSI. This is especially convenient for remote facilities which require changes to pressure settings to match changes in process conditions.

## Piston Arrangement Changeover Instructions

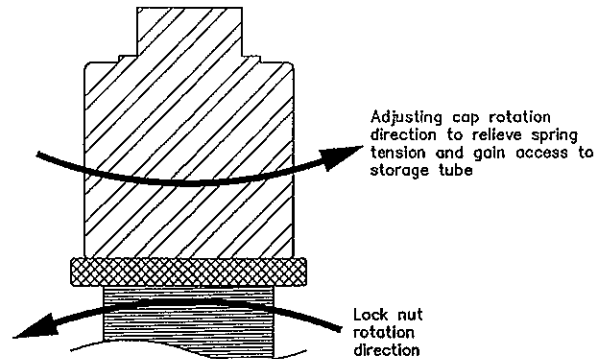
When your CVS 7970 High/Low Pressure Sensor is shipped, it is set with your specified piston arrangement and pressure setting. When it becomes necessary to adjust pressure setting to that which is out of range of the current piston arrangement, make use of the additional components stored in a tube within the piston housing.

The information in this manual, including the parts listings and piston detail drawings, will assist you in completing the Piston Arrangement Changeover.

**Caution:** Consult and follow the established safety procedures of your facility prior to beginning disassembly of any CVS Controls product. Ensure that all pressure is exhausted from the system prior to performing any service work. Failure to remove the pressure from the system can result in serious personal injury.

1. Isolate and depressurize the control system.
2. Disconnect the control circuit instrumentation tubing from control valve, as well as the monitored process connection from the piston housing.
3. Where possible, remove the CVS 7970 from the service location to perform the changeover in a clean work environment.
4. Loosen the lock nut and remove from the adjusting cap. (See figure 2)
5. Gently relieve all spring tension by fully unscrewing the adjusting cap. This allows access to the storage tube.
6. Unscrew the piston housing from the valve body.
7. Turn the piston housing upside down and tap it gently on a flat, clean surface to remove the piston arrangement. The pistons should slide out easily.
8. Thoroughly clean the piston components, including the piston housing and internal bores, using warm water and a liquid detergent. Do not use abrasive tools or acidic cleansers. Dry all components with a cloth or paper towel.
9. Lightly lubricate all components and seals, and assemble the piston arrangement as desired according to the enclosed detail drawing.
10. When inserting the new piston arrangement into the piston housing, apply even pressure. Press evenly using both thumbs on the piston's outer edges for the insertion of the 1-1/8", 1/2" and 3/16" piston arrangements.
11. For the 1/4" piston insertion, install the 1/4" piston first, using a needle-nosed pliers. Then press the other piston components into place.

12. Lightly lubricate the threads of the piston housing, body and spring housing. Be sure to use a grease or medium appropriate for stainless steel.
13. Reassemble the pressure sensor.
14. Adjust the pressure setting to the required amount, and function test the pressure sensor. When the desired setting is achieved, tighten the lock nut securely against the adjusting cap.
15. Connect the instrumentation tubing and the pressure connection to the monitored process.
16. Introduce pressure to the pressure sensor's control circuit and monitored process inlet. Resume normal operation.



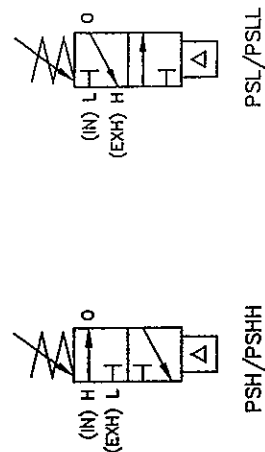
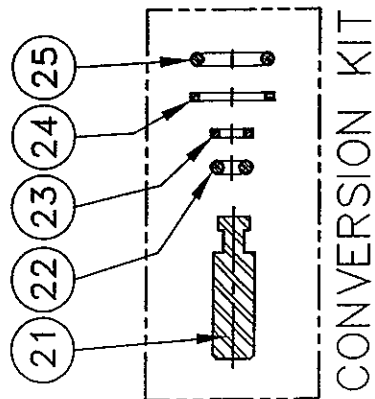
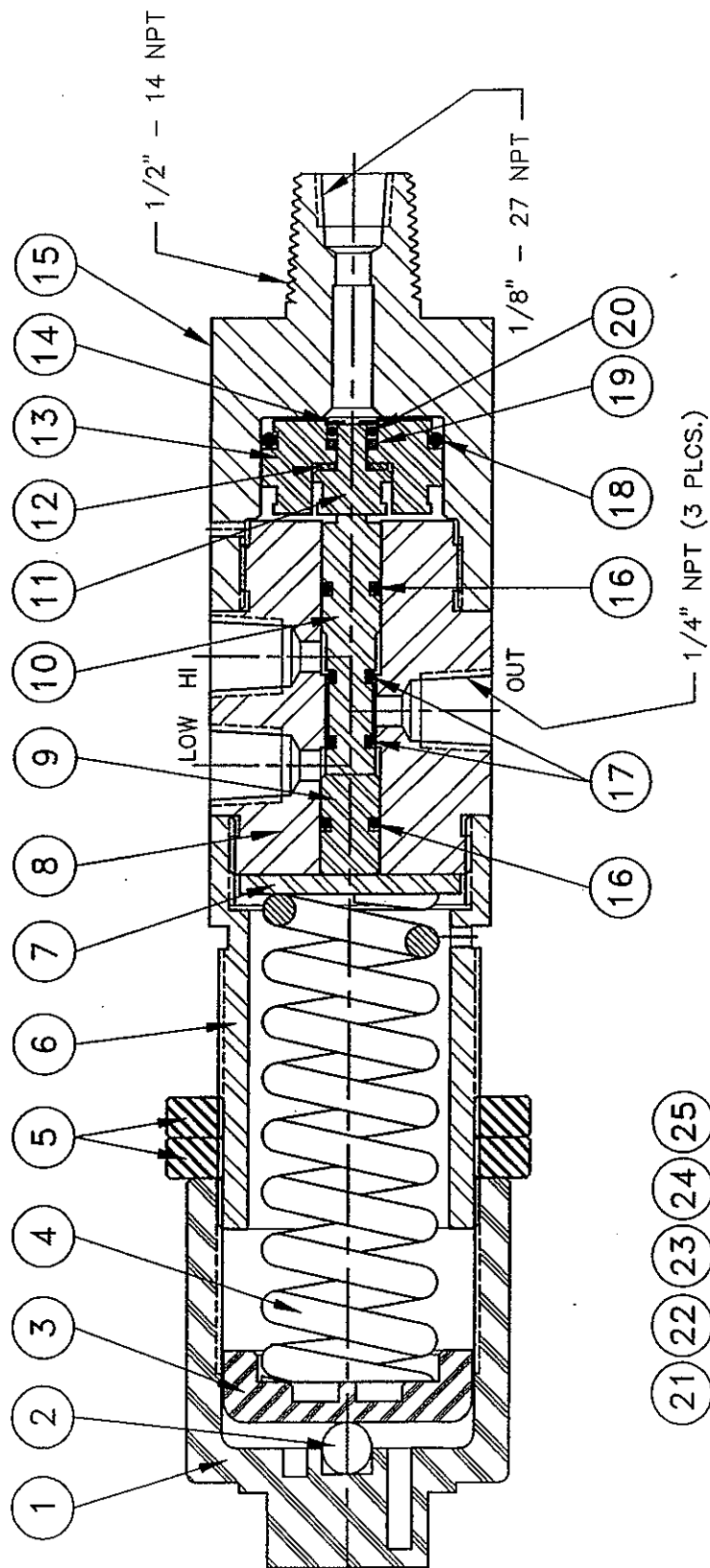
## CVS 7970 High-Low Pressure Sensor

Table 2: Parts List

|    |           |   |                    |                     |
|----|-----------|---|--------------------|---------------------|
| 1  | CVS79710A | 1 | Adjusting Cap      | Black Delrin        |
| 2  | CVS79702A | 1 | 5/16" Ball Bearing | Stainless Steel     |
| 3  | CVS7911A  | 1 | Spring Guide       | Black Delrin        |
| 4  | CVS7970A  | 1 | Spring             | 302 Stainless Steel |
| 5  | CVS79712A | 2 | Lock Nut           | Black Delrin        |
| 6  | CVS79709A | 1 | Spring Housing     | 316 Stainless Steel |
| 7  | CVS79708  | 1 | Stop Plate         | 316 Stainless Steel |
| 8  | CVS79704A | 1 | Body Housing       | 316 Stainless Steel |
| 9  | CVS79707A | 1 | Upper Stem         | 316 Stainless Steel |
| 10 | CVS79706A | 1 | Lower Stem         | 316 Stainless Steel |
| 11 | CVS79703A | 1 | Small Piston       | 316 Stainless Steel |
| 12 | CVS79705  | 1 | Stop Washer        | 316 Stainless Steel |
| 13 | CS79702   | 1 | Large Piston       | 316 Stainless Steel |
| 14 | CVS797014 | 1 | Snap Ring          | 304 Stainless Steel |
| 15 | CVS79701A | 1 | Piston Housing     | 316 Stainless Steel |
| 16 | V-75-010  | 2 | O-Ring             | Viton               |
| 17 | V-75-008  | 2 | O-Ring             | Viton               |
| 18 | V-75-119  | 1 | O-Ring             | Viton               |
| 19 | TFE-008   | 1 | Back-Up Ring       | Teflon              |
| 20 | V-75-008  | 1 | O-Ring             | Viton               |
| 21 | CVS79713A | 1 | 1/4" Piston        | 316 Stainless Steel |
| 22 | V-75-006  | 1 | O-Ring             | Viton               |
| 23 | TFE-006   | 1 | Back-Up Ring       | Teflon              |
| 24 | TFE-012   | 1 | Back-Up Ring       | Teflon              |
| 25 | V-75-012  | 1 | O-Ring             | Viton               |

### O-Ring Kits

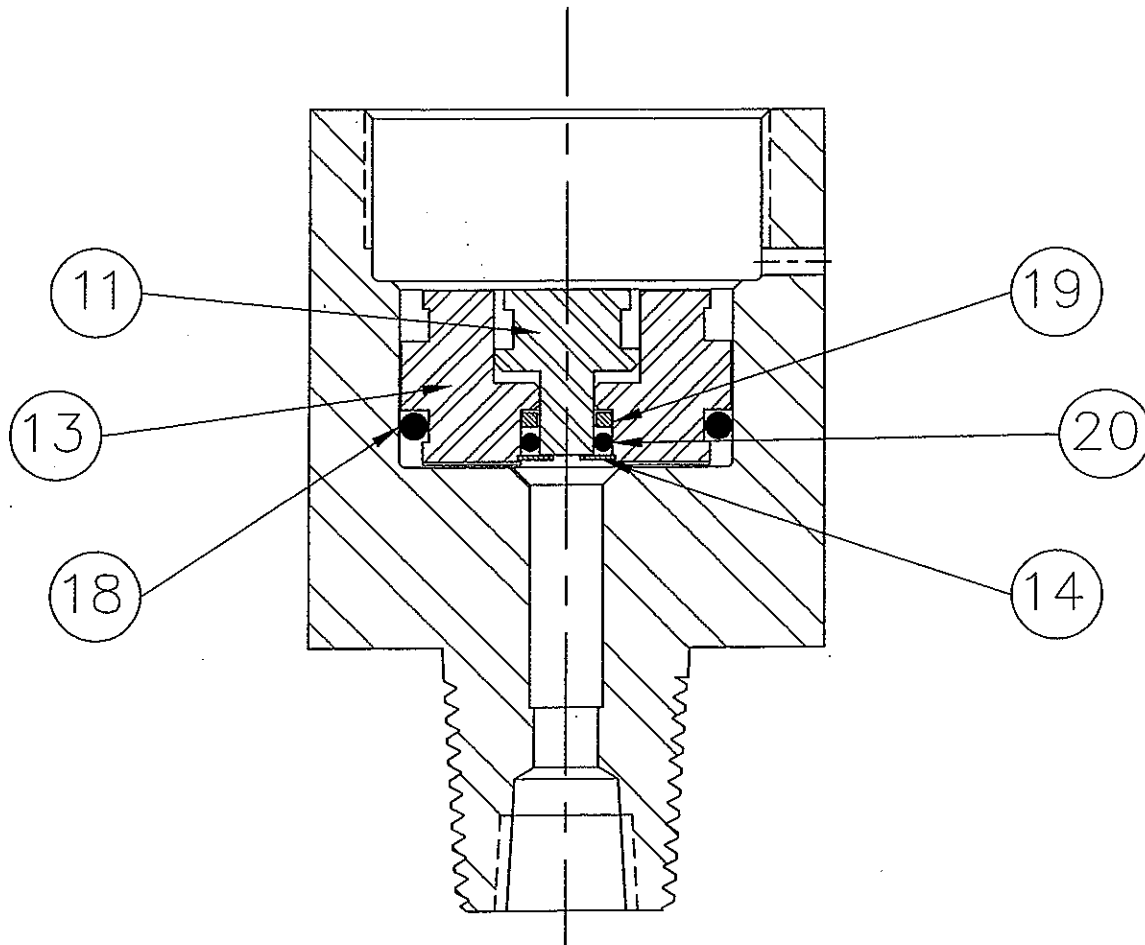
|             |   |                                  |        |
|-------------|---|----------------------------------|--------|
| CS7970-BKK  | 1 | Piston O-Ring Kit (Body Housing) |        |
| V-75-008    | 1 | O-Ring                           | Viton  |
| V-75-010    | 1 | O-Ring                           | Viton  |
| CVS7970-Pkk | 1 | Piston O-Ring Kit (Body Housing) |        |
| V-75-006    | 1 | O-Ring                           | Viton  |
| V-75-008    | 1 | O-Ring                           | Viton  |
| V-75-012    | 1 | O-Ring                           | Viton  |
| V-75-119    | 1 | O-Ring                           | Viton  |
| TFE-006     | 1 | Back-Up Ring                     | Teflon |
| TFE-008     | 1 | Back-Up Ring                     | Teflon |
| TFE-012     | 1 | Back-Up Ring                     | Teflon |



## 3/16 Piston Arrangement

### Enlarged Detail Drawing

For pressures from 5900 to 10,000 PSI  
(406.8 to 689.5 Bar)

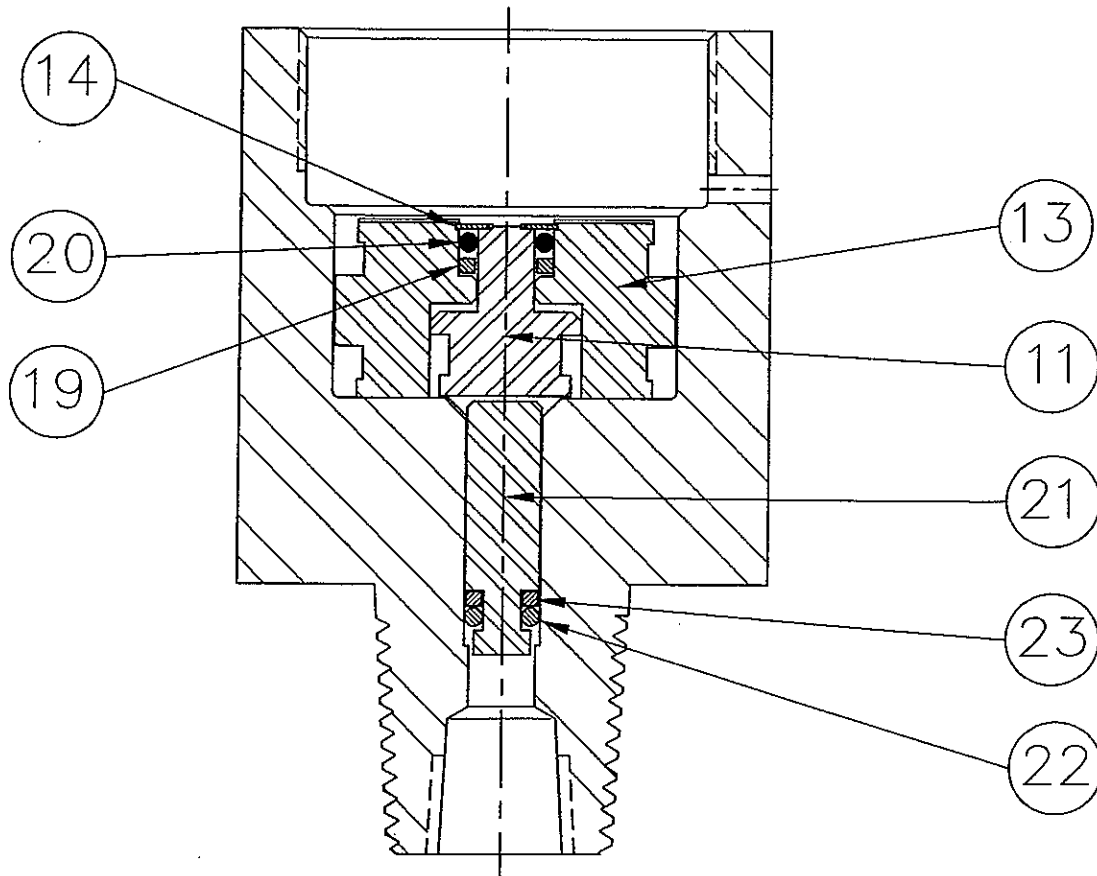


|    |           |   |              |                     |
|----|-----------|---|--------------|---------------------|
| 11 | CVS79703A | 1 | Small Piston | 316 Stainless Steel |
| 13 | CS79702   | 1 | Large Piston | 316 Stainless Steel |
| 14 | CVS797014 | 1 | Snap Ring    | 304 Stainless Steel |
| 18 | V-75-119  | 1 | O-Ring       | Viton               |
| 19 | TFE-008   | 1 | Back-Up Ring | Teflon              |
| 20 | V-75-008  | 1 | O-Ring       | Viton               |

## 1/4" Piston Arrangement

### Enlarged Detail Drawing

For pressures from 1440 to 5900 PSI  
(99.28 to 406.8 Bar)

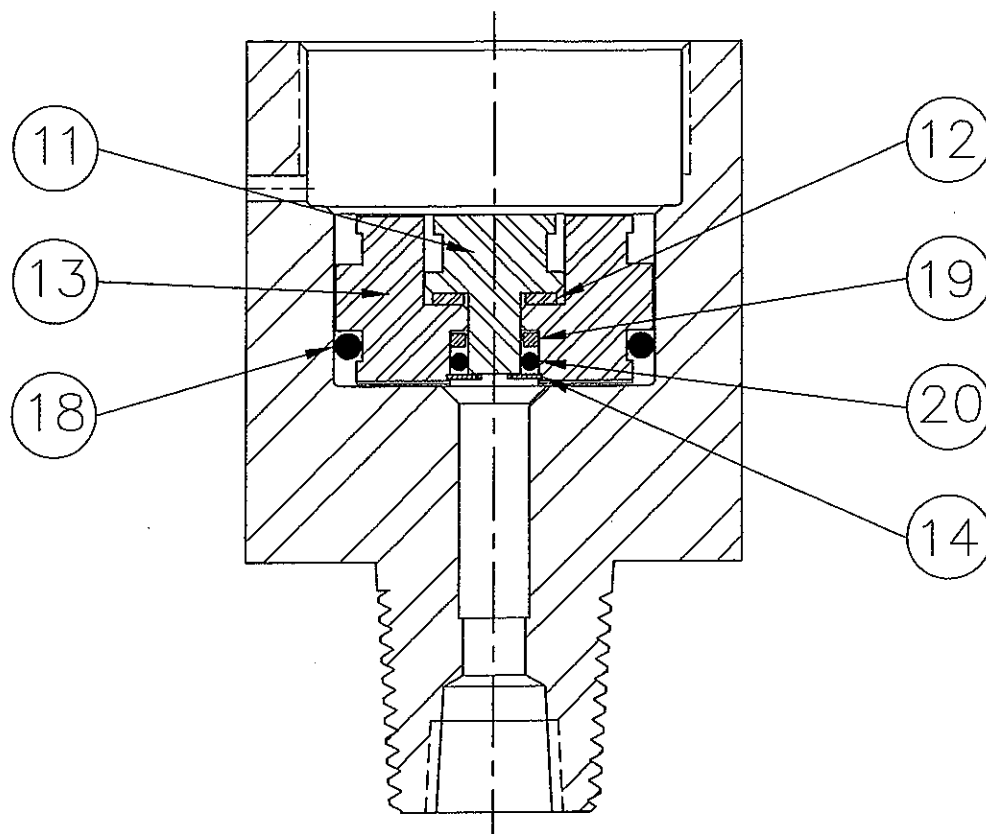


|    |           |   |              |                     |
|----|-----------|---|--------------|---------------------|
| 11 | CVS79703A | 1 | Small Piston | 316 Stainless Steel |
| 13 | CS79702   | 1 | Large Piston | 316 Stainless Steel |
| 14 | CVS797014 | 1 | Snap Ring    | 304 Stainless Steel |
| 19 | TFE-008   | 1 | Back-Up Ring | Teflon              |
| 20 | V-75-008  | 1 | O-Ring       | Viton               |
| 21 | CVS79713A | 1 | 1/4" Piston  | 316 Stainless Steel |
| 22 | V-75-006  | 1 | O-Ring       | Viton               |
| 23 | TFE-006   | 1 | Back-Up Ring | Teflon              |

# 1-1/8" Piston Arrangement

## Enlarged Detail Drawing

For pressures from 10 to 290 PSI  
(.689 to 20 Bar)

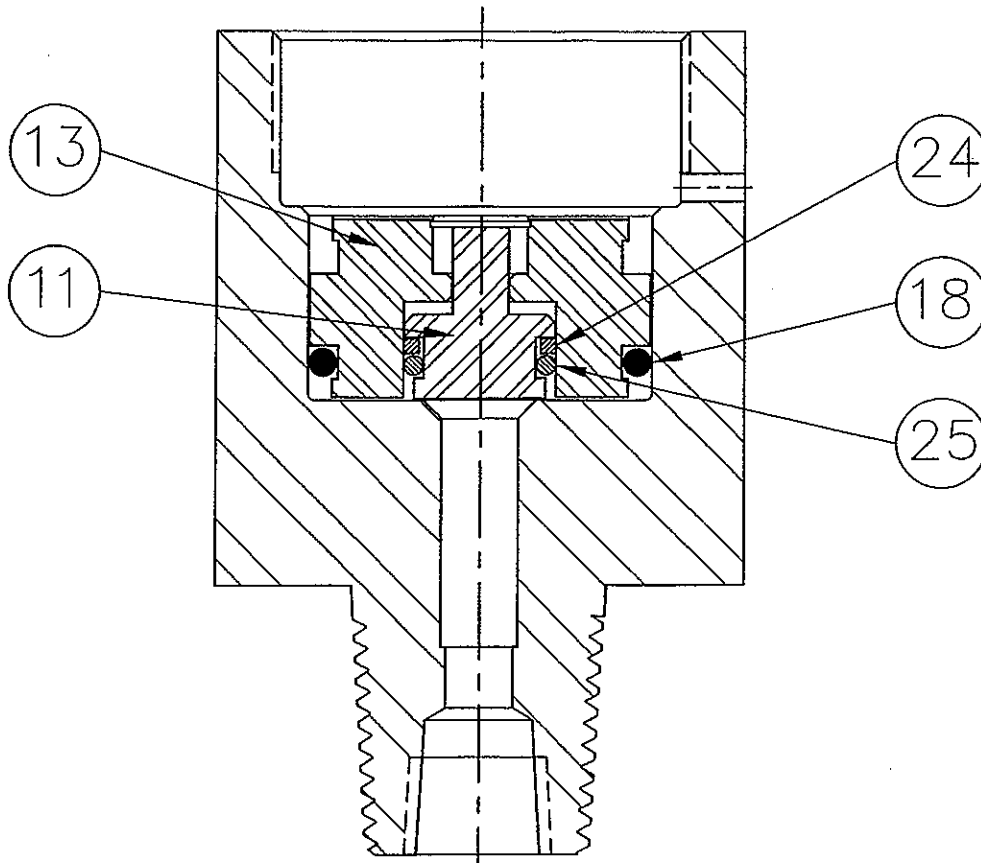


|    |           |   |              |                     |
|----|-----------|---|--------------|---------------------|
| 11 | CVS79703A | 1 | Small Piston | 316 Stainless Steel |
| 12 | CVS79705  | 1 | Stop Washer  | 316 Stainless Steel |
| 13 | CS79702   | 1 | Large Piston | 316 Stainless Steel |
| 14 | CVS797014 | 1 | Snap Ring    | 304 Stainless Steel |
| 18 | V-75-119  | 1 | O-Ring       | Viton               |
| 19 | TFE-008   | 1 | Back-Up Ring | Teflon              |
| 20 | V-75-008  | 1 | O-Ring       | Viton               |

# 1/2" Piston Arrangement

## Enlarged Detail Drawing

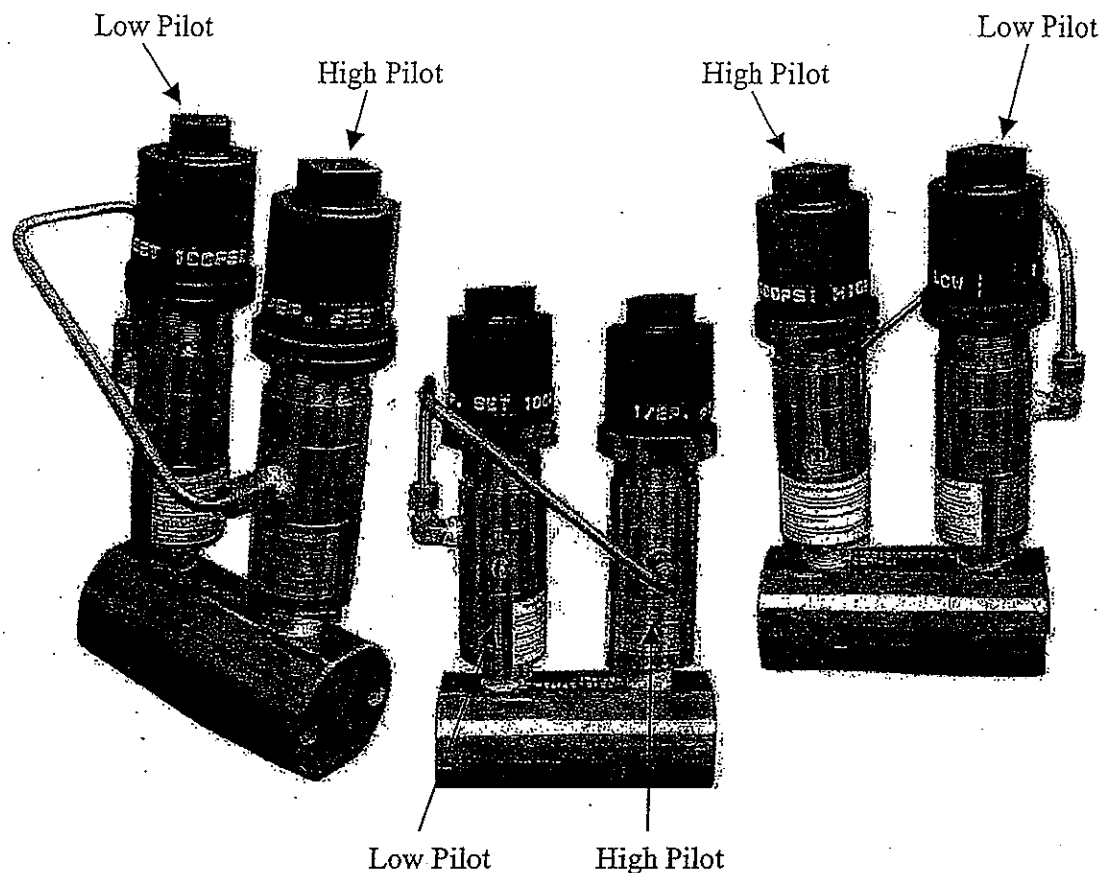
For pressures from 290 to 1440 PSI  
(20 to 99.28 Bar)



|    |           |   |              |                     |
|----|-----------|---|--------------|---------------------|
| 11 | CVS79703A | 1 | Small Piston | 316 Stainless Steel |
| 13 | CS79702   | 1 | Large Piston | 316 Stainless Steel |
| 18 | V-75-119  | 1 | O-Ring       | Viton               |
| 24 | TFE-012   | 1 | Back-Up Ring | Teflon              |
| 25 | V-75-012  | 1 | O-Ring       | Viton               |

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## 7970 Hi and Lo Pilot Pressure Switch

### Low Pressure Valve:

\*Out Port → To Valve  
 \*Hi Port → To Vent

### High Pressure Valve:

\*Hi Port → To (air/gas) Supply (Max Supply Pressure 125 psi)  
 \*Lo Port → To Vent

### Manifold:

\*Either port for process

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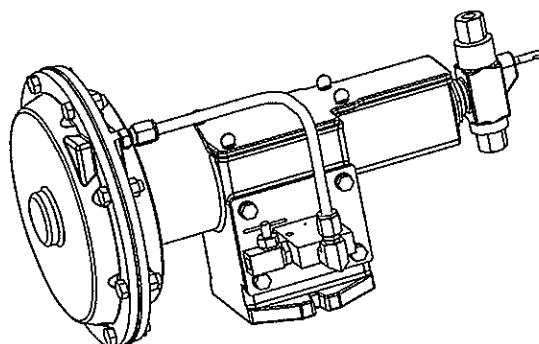
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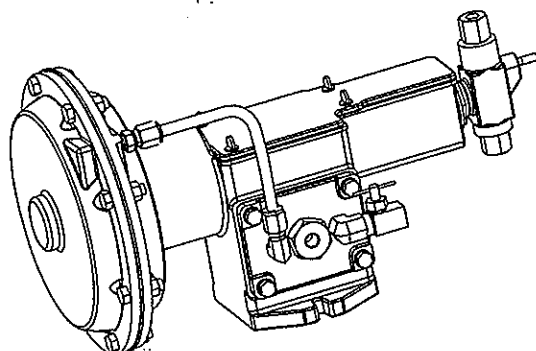


# BR5100

## Chemical Injection Pump



Chemical Pump with Micro Switch



Chemical Pump with Pilot Valve

### DESCRIPTION:

The Bruin BR5100 Chemical Injector Pump is a single acting, positive displacement plunger type pump. Pump operation is powered with gas pressure as low as 8 psig (35 psig-max.) acting onto a diaphragm resulting in plunger displacement. When full stroke (1 inch) is reached the internal switching system (standard supply – Micro Switch, Pilot Valve – optional) shuts off the supply gas and vents the diaphragm chamber. The diaphragm is equipped with a spring return allowing plunger retraction. The pump is capable of handling volume output to 30 gallons per day and discharge pressures up to 6000 psig. It is designed for ease of operation and maintenance under varied pumping applications at the field level. Conversion for handling of various chemicals is easily accomplished by the change out of the packing set and fluid end seals.

### TECHNICAL SPECIFICATIONS:

|                                 |      |  |  |
|---------------------------------|------|--|--|
| ◆ Air or Gas Driven             |      |  |  |
| ◆ Volume (maximum)              |      |  | 30 Imp. Gallons per Day  |
| ◆ Pressure                      | Std. |  | 3000 psig (std. packing)   |
|                                 | Max. |  | 6000 psig (hard packing)   |
| ◆ Operating Air or Gas Pressure | Max. |  | 35 psig  |
| ◆ Available Plunger Sizes       | Std. |  | 1/4", 3/8", 1/2"   |
| ◆ Stroke Length                 | Min. |  | 1/3"   |
|                                 | Max. |  | 1"   |
| ◆ Gas Switching System          | Std. |  | Micro Switch   |
|                                 | Opt. |  | Pilot Valve - Rotary   |
| ◆ Materials                     |      |  |  |
| ➤ Pressure Head Body            | Std. |  | Ductile Iron   |
|                                 | Opt. |  | Consult factory for SS head option   |
| ➤ Internal Wetted Components    | Std. |  | Stainless Steel  |
| ➤ Packing – V style             | Std. |  | Buna   |
|                                 | Opt. |  | Buna-Hard, Viton, Teflon, Fluorosilicone                                       |
| ➤ Seals – O-rings               | Std. |  | Fluorosilicone   |
|                                 | Opt. |  | Buna, Viton, Teflon, Metal-to-Metal  |
| ➤ Diaphragm                     | Std. |  | Thick molded Buna w/Nylon reinforcement<br>(utilizing skirted diaphragm plate) |

## INSTALLATION:

|                             |                    |           |
|-----------------------------|--------------------|-----------|
| Fluid Suction Connection    | _____              | 1/4" FNPT |
| Fluid Discharge Connection  | _____              | 1/4" FNPT |
| Supply Connection           | Micro Switch _____ | 3/8" FNPT |
|                             | Pilot Valve _____  | 1/4" FNPT |
| Operating Air or Gas Press. | Max. _____         | 35 psig   |
| Exhaust Valve Connection    | _____              | 1/4" FNPT |

| Plunger<br>Size | Base Model Number           |   |                                   |   | Discharge<br>Pressure<br>Range -<br>psig | Maximum<br>Recommended<br>Speed – strokes<br>per minute | Maximum<br>Volume –<br>Imp. Gallons<br>per day |
|-----------------|-----------------------------|---|-----------------------------------|---|--|---|--|
|                 | Standard Model <sup>*</sup> |   | High Pressure Model <sup>**</sup> |   |  |   |  |
|                 | Model<br>No.                | Maximum<br>Discharge<br>Pressure <sup>1</sup> | Model<br>No.                      | Maximum<br>Discharge<br>Pressure <sup>2</sup> |  |   |  |
| 1/4"            | BR5101                      | 3000 psig                                     | BR5111                            | 6000 psig                                     | 0 – 1500                                 | 30  | 7.5  |
|                 |                             |   |                                   |   | 1500 – 6000                              | 26  | 6.5  |
| 3/8"            | BR5103                      | 3000 psig                                     | BR5113                            | 6000 psig                                     | 0 – 1500                                 | 30  | 16.8   |
|                 |                             |   |                                   |   | 1500 – 6000                              | 14  | 7.9  |
| 1/2"            | BR5105                      | 3000 psig                                     | BR5115                            | 3500 psig                                     | 0 – 1500                                 | 30  | 30   |
|                 |                             |   |                                   |   | 1500 – 3500                              | 14  | 14   |

\* Volumes shown for standard model with standard packing are at zero psig discharge pressure

\*\* Volumes shown for high pressure model with hard packing are at 1500 psig discharge pressure

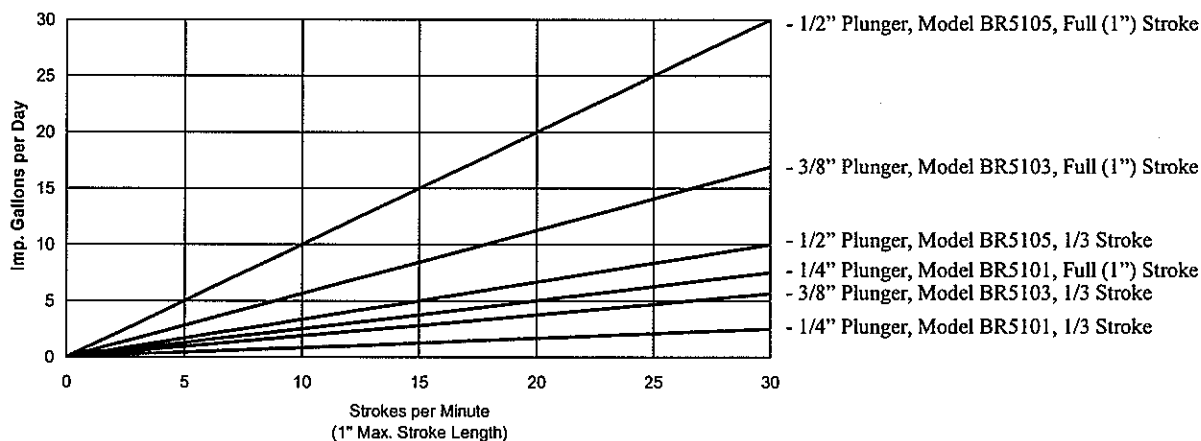
<sup>1</sup> Maximum discharge pressure for standard model is shown with Buna packing, other packing types are available and may contain different maximum discharge pressures, refer to "Plunger Packing - Maximum Discharge Pressures Chart"

<sup>2</sup> Maximum discharge pressure for high pressure model is shown with Buna Hard packing

## PLUNGER PACKING - MAXIMUM DISCHARGE PRESSURES

| Material       | Pressure, PSIG |      |      |
|----------------|----------------|------|------|
|                | 1/4"           | 3/8" | 1/2" |
| Buna           | 3000           | 3000 | 3000 |
| Buna Hard      | 6000           | 6000 | 3500 |
| Viton          | 3500           | 3500 | 3500 |
| Teflon         | 3000           | 3000 | 3000 |
| Fluorosilicone | 3000           | 3000 | 3000 |

## VOLUME



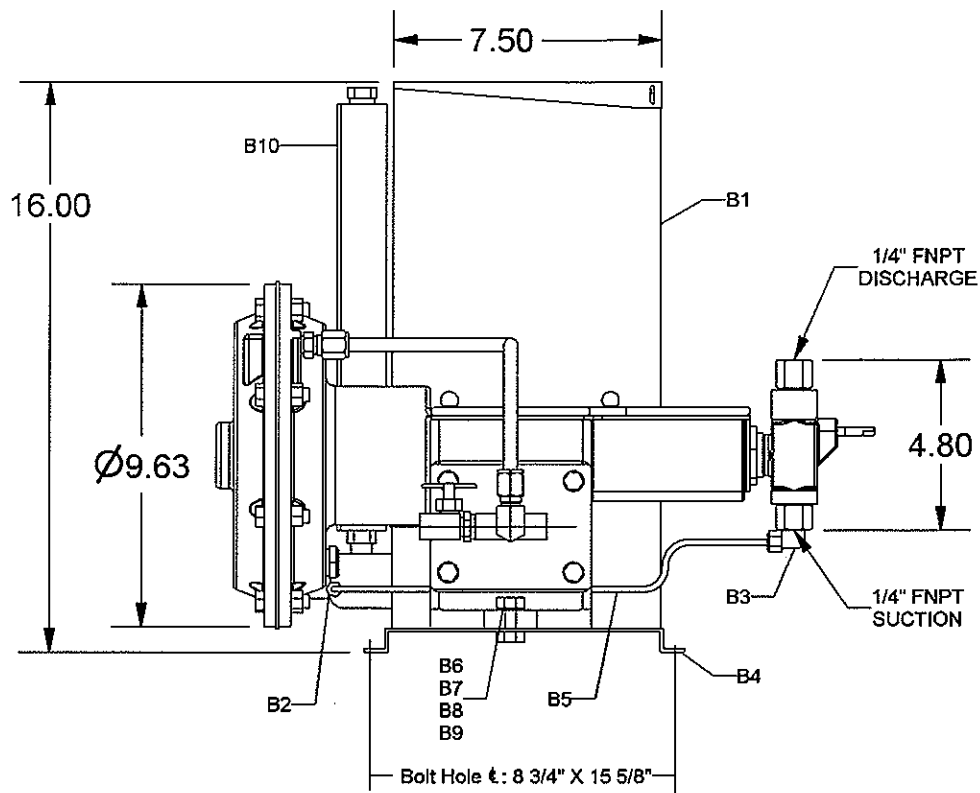
## VOLUMETRIC CONVERSION FACTORS

|                 |   |                           |   |           |                      |   |        |   |          |
|-----------------|---|---------------------------|---|-----------|----------------------|---|--------|---|----------|
| barrels         | X | 34.972                    | = | Imp. Gal. | bbl/day              | X | 1.457  | = | Imp. gph |
| cm <sup>3</sup> | X | 2.1997 x 10 <sup>-4</sup> | = | Imp. Gal. | cm <sup>3</sup> /s   | X | 0.7919 | = | Imp. gph |
| ft <sup>3</sup> | X | 6.229                     | = | Imp. Gal. | cft/h                | X | 6.229  | = | Imp. gph |
| in <sup>3</sup> | X | 3.605 x 10 <sup>-3</sup>  | = | Imp. Gal. | in <sup>3</sup> /min | X | 0.2163 | = | Imp. gph |
| m <sup>3</sup>  | X | 219.97                    | = | Imp. Gal. | m <sup>3</sup> /hr   | X | 219.97 | = | Imp. gph |
| gal. u.s.       | X | 0.8327                    | = | Imp. Gal. | gal-u.s./min         | X | 49.962 | = | Imp. gph |
| litres          | X | 0.2200                    | = | Imp. Gal. | litres/min.          | X | 13.2   | = | Imp. gph |
| ml              | X | 2.1997 x 10 <sup>-1</sup> | = | Imp. Gal. | ml/s                 | X | 0.7919 | = | Imp. gph |
| ounces - us     | X | 6.5053 x 10 <sup>-3</sup> | = | Imp. Gal. | ounces/min           | X | 0.3903 | = | Imp. gph |
| quarts          | X | 0.2082                    | = | Imp. Gal. | qts/hr               | X | 0.2082 | = | Imp. gph |

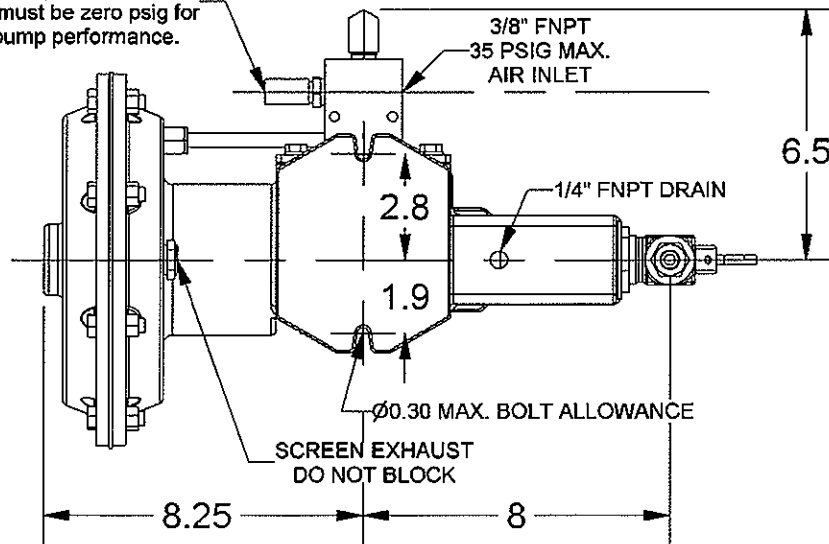
## INSTALLATION – Cont.

### Refer to Assembly Drawing and Parts List for Item Numbers

1. Install the priming valve (item 6) into fluid end body, leave valve in opened position.
2. Remove cover (item 17) by removing four thumbscrews (item 21). Select desired stroke length, either full (1") or short (1/3") with adjusting pin (item 19) position.
3. Lubricate thrust rod (item 23) with a molydisulfide grease and plunger (item 14) with a teflon packing grease. (Note – if equipped with a pilot valve assembly, fill main cavity to bottom of thrust rod with SAE 10W non-detergent oil, DO NOT fill cavity on micro switch assemblies).
4. Check plunger packing gland (item 13) with supplied gland wrench to make sure packing is snug but not too tight. For optimum operation and packing life, the packing should not be too tight. Over tightening the packing could result in the pump stalling and/or premature packing wear.
5. Re-install cover (item 17) with thumbscrews (item 21) ensuring gasket (item 16) is in place.
6. Connect suction and discharge lines to fluid end body (Note – arrow on fluid end body indicates direction of fluid flow). Ensure suction line contains a sufficient strainer to prevent foreign matter from entering the pump and that supplied line check is installed on the discharge line at the point of injection in correct orientation. The discharge line should be 5/16" tubing minimum.
7. Ensure gas exhaust valve (item 39) is in the closed position.
8. Connect gas supply line. Ensure supply pressure of 35 psig max. (Note – if the gas supply pressure exceeds 35 psig a pressure regulator to reduce the gas pressure to below 35 psig is required. Models BR5100HP or BR5100H are equipped with a pressure regulator that can be used up to 220 psig. An optional regulator (BB-0040) with a maximum inlet pressure of 1500 psig can be supplied for supply gas in excess of 220 psig. Supply gas should be clean and free of moisture and debris, filters should be incorporated to ensure supply cleanliness.
9. Open supply gas valve slowly ensuring regulator (if equipped) is set to ensure supply gas pressure is less than 35 psig to diaphragm. **Note – as supply gas is supplied to diaphragm, the pump will begin to stroke, ensure cover is on pump and keep fingers and other obstacles out of pump internals.**
10. Slowly open exhaust valve (item 39). Pump will begin to operate.
11. Once the pump discharges fluid without bubbles from the priming valve opening, close the priming valve for operation.
12. Check the plunger packing for leaks and tighten the gland as required until leakage stops. Packing should only be adjusted after pressure has been removed from the pump head, **never adjust packing against pressure.** During the break in period, a slight leak is beneficial to allow the packing to 'set in'. Packing should be checked periodically after start up. Keep the gland wrench handy for future packing adjustments.
13. Once the pump reaches full pressure, alter the stroke rate by adjusting the exhaust valve and the supply pressure (35 psig max.) until desired flow rate is achieved. Note – for correct operation the exhaust port from the exhaust valve (item 39) must have zero back pressure and the screen on the air vent (item 37) must not be blocked.



1/4" FNPT GAS EXHAUST  
NOTE - The backpressure on this exhaust port must be zero psig for maximum pump performance.



#### OPTIONAL TANK, BASE AND GAUGE PARTS LIST

| Item | Desc.        | Material      | Qty | Part No. | Item | Desc.             | Material | Qty | Part No. |
|------|--------------|---------------|-----|----------|------|-------------------|----------|-----|----------|
| B1   | 5 Gal. Tank  | S.S           | 1   | BA-0664  | B6   | Cut Washer        | Steel    | 4   | BA-0300  |
| B2   | Connector    | Polypropylene | 1   | BA-3118  | B7   | Lockwasher        | Steel    | 2   | BA-0425  |
| B3   | Elbow Con.   | Polypropylene | 1   | BA-3116  | B8   | Hex Nut           | Steel    | 2   | BA-0144  |
| B4   | Base         | Steel         | 1   | BA-0950  | B9   | Hex Head Capscrew | Steel    | 2   | BA-0142  |
| B5   | Suction Line | Polypropylene | 1   | BA-3123  | B10  | Tank Gauge*       |          | 1   | BB-0871  |

\*contact factory for parts breakdown

## MAINTENANCE:

Refer to Assembly Drawing and Parts List for Item Numbers

**Disconnect operating air supply and ensure pressure is removed from fluid end prior to performing any maintenance.**

### FLUID END DISASSEMBLY INSTRUCTIONS

1. Ensure all pressure is removed from pump head and isolate fluid discharge and suction lines. Open and remove priming valve (item 6). Disconnect fluid discharge and suction lines.
2. Loosen & remove top bushing (item 1), ball check spring (item 2), ball (item 3) and top seat (item 5). Remove o-ring (item 4) from top seat. Remove ¼" ball (item 7).
3. Loosen & remove bottom seat (item 9) and ball (item 3). Remove o-ring (item 4) from bottom seat.
4. Remove cover (item 17) and gasket (item 16) by loosening and removing wing screws (item 21).
5. Remove plunger pin (item 15) and unthread plunger packing gland nut (item 13).
6. Loosen lock nut (item 10) and remove body (item 8) from housing (item 22).
7. Remove plunger (item 14), plunger packing gland (item 12) and plunger packing (item 11).

### FLUID END REASSEMBLY INSTRUCTIONS

Lubricate all o-rings with a petroleum based lubricant, lubricate packing and plunger with a teflon based packing lubricant. Ensure all parts are clean and free from damage (see Inspection section).

1. Install o-ring (item 4) into bottom seat (item 9). Install ball (item 3) into bottom seat and thread bottom seat into suction end of body (item 8) utilizing a thread sealant on the threads. Tighten bottom seat.
2. Install ¼" ball (item 7) into body (item 8).
3. Install o-ring (item 4) into top seat (item 5). Install top seat into body (item 8).
4. Install ball check spring (item 2) into top bushing (item 1) and thread top bushing into body (item 8) utilizing a thread sealant on the threads. Tighten top bushing.
5. Install packing (item 11) into body (item 8). Ensure packing is installed in correct order and orientation.
6. Install plunger packing gland (item 12) into body (item 8) and install plunger (item 14) into packing. Thread lock nut (item 10) onto body.
7. Thread body into housing (item 22) ensuring plunger fits through the plunger packing

gland nut (item 13) and fits into rod adapter (item 18), note – adjusting pin (item 19) can be removed allowing rod adapter to extend and rotate to align pin holes. Install plunger pin (item 15). Thread plunger packing gland nut (item 13) onto body (item 8). **DO NOT OVER TIGHTEN** plunger packing gland nut.

8. Tighten lock nut (item 10). Install gasket (item 16) and cover (item 17) with wing screws (item 21).
9. Install and tighten priming valve (item 6) into body (item 8).

### MICRO SWITCH REMOVAL INSTRUCTIONS

Refer to exploded and assembly drawing.

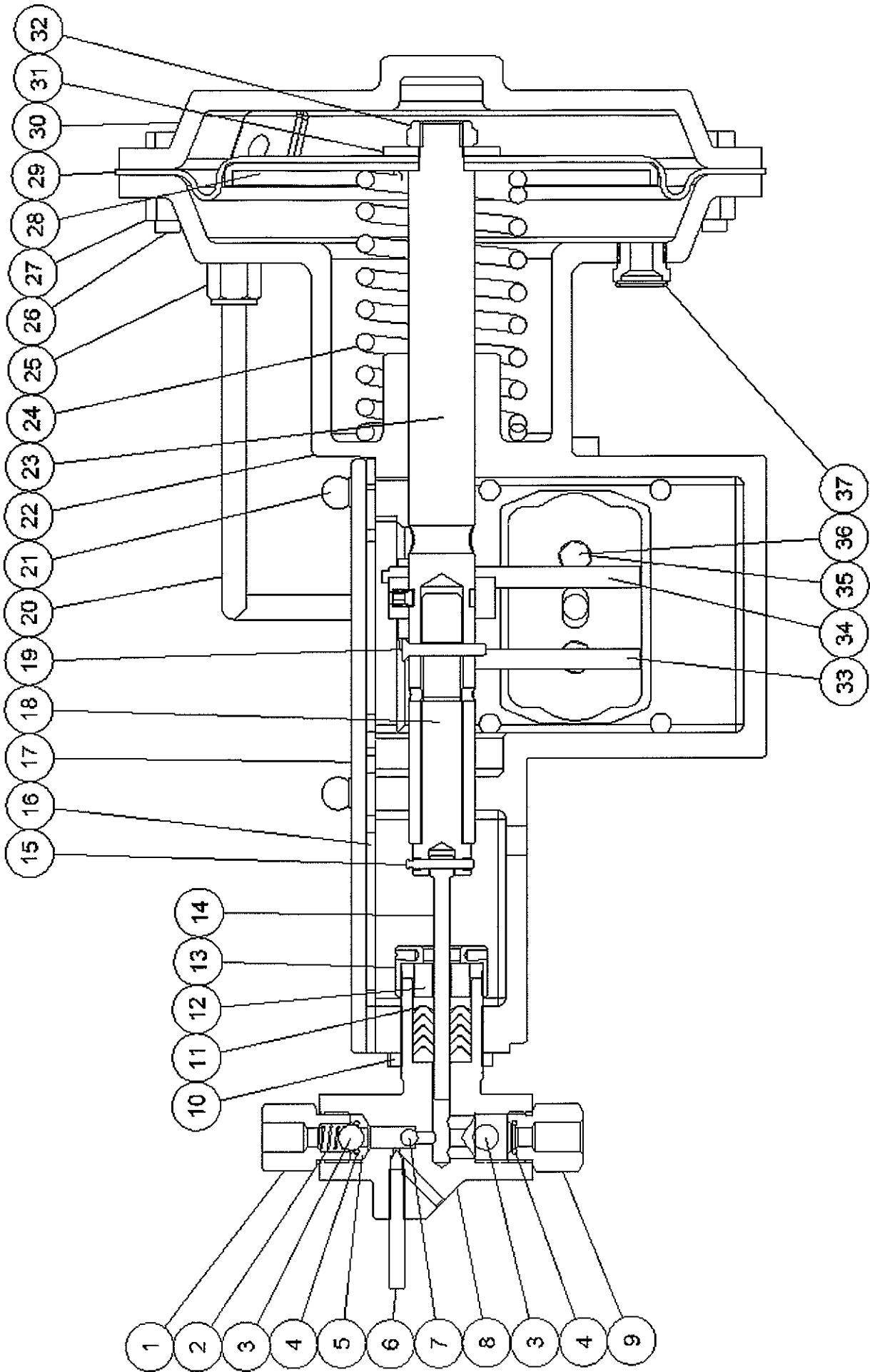
1. Disconnect operating air supply from micro switch (item 42).
2. Loosen and disconnect micro switch line assembly (item 20).
3. Remove cap screws (item 43) and lockwashers (item 44). Remove micro switch assembly and gasket (item 46).
4. Remove cap screws (item 36) and lockwashers (item 35). Remove micro switch (item 42) from mount plate (item 45).
5. Remove elbow connector (item 41), gas exhaust valve (item 39) and bushing (item 38) from micro switch (item 42).
6. See Housing Disassembly Instructions for switch arm (items 33 & 34) removal.

### MICRO SWITCH INSTALLATION INSTRUCTIONS

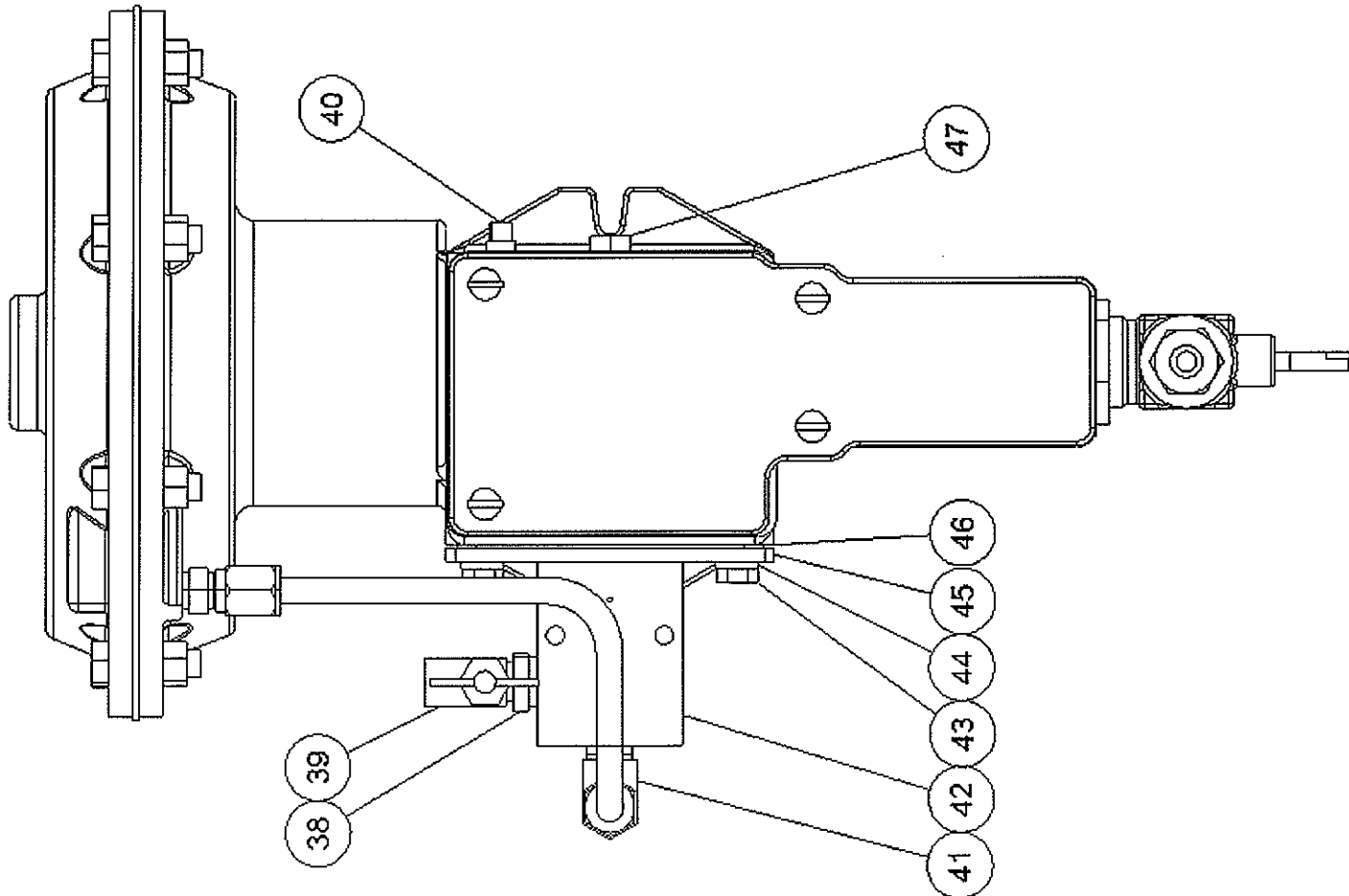
Ensure all parts are clean and free from damage (see Inspection section).

1. See Housing Assembly Instructions for switch arm (item 33 & 34) installation.
2. Thread elbow connector (item 41), bushing (item 38) and gas exhaust valve (item 39) into micro switch valve (item 42) utilizing a thread sealant on all threads.
3. Mount micro switch valve (item 42) onto mount plate (item 45) with cap screws (item 36) and lockwashers (item 35).
4. Mount mount plate (item 45) and gasket (item 46) to housing (item 22) utilizing cap screws (item 43) and lockwashers (item 44).
5. Connect line assembly (item 20) between micro switch connector (item 41) and housing connector (item 25).

ASSEMBLY DRAWING BR5100 w/ STANDARD MICRO SWITCH







| Pump Model   |   |                    |     |            |             |         |
|--------------|---|--------------------|-----|------------|-------------|---------|
| Plunger Size |   |                    |     |            |             |         |
| Item         | Description   | Material           | Qty | 1/4"       | 3/8"        | 1/2"    |
|              | Head Assembly   | Ductile w/ SS trim |     | BB-0166    | Part Number | BB-0496 |
| 1*           | Top Bushing   | 304 SS             | 1   | BA-1496    | BA-1496     |         |
| 2*           | Ball Check Spring   | 316 SS             | 1   | BA-0077    | BA-0077     |         |
| 3*           | Ball - 3/8"   | 316 SS             | 2   | BA-0054    | BA-0054     |         |
| 4*           | Ball - 1/2" (use with BA-0771 Metal to Metal Bottom Seal Only)      | 316 SS             | 1   | BA-0053    | BA-0053     |         |
|              | O-Ring  | Fluorosilicone     |     | BA-0479F   | BA-0479F    |         |
|              |   | Buna - N           | 2   | BA-0479    | BA-0479     |         |
| 5*           | Top Seal (requires item 4)  | Viton              |     | BA-2380    | BA-2380     |         |
|              |   | Teflon             |     | BA-0479T   | BA-0479T    |         |
|              |   | 316 SS             | 1   | BB-0737    | BB-0737     |         |
| 6            | Top Seal, Metal to Metal  | 316 SS             | 1   | BA-0806    | BA-0806     |         |
| 7*           | Priming Valve   | 304 SS             | 1   | BA-1497A   | BA-1497A    |         |
| 8            | Ball - 1/4"   | 316 SS             | 1   | BA-0126    | BA-0126     |         |
| 9*           | Body  | Ductile            | 1   | BC-0275    | BC-0276     | BC-0272 |
|              | Bottom Seal (requires item 4)                                       | 304 SS             |     | BB-0736    | BB-0736     |         |
|              | Bottom Seal Bushing Metal to Metal (use w/ BA-0053, 1/2" ball only) | 304 SS             | 1   | BA-0771    | BA-0771     |         |
| 10           | Lock Nut  | Brass              | 1   | BA-0225    | BA-0225     |         |
| 11*          | Plunger Packing   | Buna-N             |     | BA-1461    | BA-1456     | BA-0959 |
|              |   | Buna Hard          |     | BA-2295    | BA-1875     | BA-1874 |
|              |   | Viton              | 1   | BA-4102    | BA-4101     | BA-4103 |
|              |   | Teflon             |     | BA-1642    | BA-1234     | BA-1012 |
| 12           | Plunger Packing Gland   | Fluorosilicone     |     | BA-6257    | BA-6258     | BA-6259 |
| 13           | Plunger Packing Gland Nut   | 316 SS             | 1   | BA-1463    | BA-0957     | BA-1219 |
| 14*          | Plunger   | 304 SS             | 1   | BA-1104    | BA-1104     |         |
| 15           | Plunger Pin   | 17-4PH SS          | 1   | BA-1312    | BA-1745     | BA-1876 |
|              | Gasket  | Steel - Zinc Pl    |     | BA-0290    | BA-0290     |         |
|              | Cork  | Cork               | 1   | BA-1949A   | BA-1949A    |         |
| 17           | Cover   | Clear Acrylic      | 1   | BB-0548A   | BB-0548A    |         |
| 18           | Rod Adapter   | Steel - Zinc Pl    | 1   | BB-0447    | BB-0447     |         |
| 19           | Adjusting Pin   | Steel              | 1   | BA-1828    | BA-1828     |         |
| 20           | Micro Switch Line Assembly  | 316 SS Tubing      | 1   | BA-5100-7  | BA-5100-7   |         |
| 21           | Wing Screw  | Steel - Zinc Pl    | 4   | BA-0136    | BA-0136     |         |
| 22           | Housing   | Cast Iron          | 1   | BD-0251    | BD-0251     |         |
| 23           | Thrust Rod  | 17-4PH SS          | 1   | BB-0444    | BB-0444     |         |
| 24           | Return Spring   | Steel - Zinc Pl    | 1   | BA-1821    | BA-1821     |         |
| 25           | Male Connector  | Steel              | 1   | BA-5100-11 | BA-5100-11  |         |
| 26           | Hex Head Capscrew   | Steel              | 8   | BA-0139    | BA-0139     |         |
| 27           | Hex Nut   | Steel              | 8   | BA-2207    | BA-2207     |         |
| 28           | Diaphragm Plate   | Steel              | 1   | BB-0438A   | BB-0438A    |         |
| 29*          | Molded Diaphragm  | Buna - N, Nylon    | 1   | BC-0290    | BC-0290     |         |
| 30           | Diaphragm Cover   | Cast Iron          | 1   | BC-0252    | BC-0252     |         |
| 31           | Washer  | Steel              | 1   | BA-3321    | BA-3321     |         |
| 32           | Hex Lockout   | Steel              | 1   | BA-3320    | BA-3320     |         |
| 33           | Adjustable Switch Arm   | Steel - Zinc Pl    | 1   | BA-5100-6  | BA-5100-6   |         |
| 34           | Main Switch Arm   | Steel - Zinc Pl    | 1   | BA-5100-3  | BA-5100-3   |         |
| 35           | Lockwasher  | Steel - Zinc Pl    | 2   | BA-5100-10 | BA-5100-10  |         |
| 36           | Hex Head Capscrew   | Steel - Zinc Pl    | 2   | BA-5100-9  | BA-5100-9   |         |
| 37           | Air Vent  | Brass              | 1   | BA-1835    | BA-1835     |         |
| 38           | Bushing   | Brass              | 1   | BA-5000-7  | BA-5000-7   |         |
| 39           | Gas Exhaust Valve   | Brass              | 1   | BA-2489    | BA-2489     |         |
| 40           | Pipe Plug - 1/8" NPT  | Steel              | 1   | BA-0516    | BA-0516     |         |
| 41           | Male Elbow Connector  | Steel              | 1   | BA-5100-12 | BA-5100-12  |         |
| 42*          | Micro Switch Valve  | Aluminum / SS      | 1   | BA-5100-2  | BA-5100-2   |         |
| 43           | Hex Head Capscrew   | Steel - Zinc Pl    | 4   | BA-0141    | BA-0141     |         |
| 44           | Lockwasher  | Steel - Zinc Pl    | 4   | BA-0425    | BA-0425     |         |
| 45           | Micro Switch Mount Plate  | Steel              | 1   | BA-5100-1  | BA-5100-1   |         |
| 46*          | Gasket  | Fiber              | 1   | BA-0038    | BA-0038     |         |
| 47           | Hex Head Capscrew   | Steel              | 1   | BA-5100-13 | BA-5100-13  |         |
|              | Gland Wrench  | Steel              | 1   | BA-0315    | BA-0315     |         |
|              | Line Check  | Brass              | 1   | BA-0676    | BA-0676     |         |
|              |   | SS                 |     | BA-0675    | BA-0675     |         |

\*Recommended Spare Parts

## HOUSING DISASSEMBLY INSTRUCTIONS

1. Disconnect operating air supply and ensure pressure is removed from fluid end.
2. Remove wing screws (item 21), cover (item 17) and gasket (item 16).
3. Remove plunger pin (item 15) and adjusting pin (item 19). Loosen both set screws on main switch arm (item 34).
4. Place a pin (punch or drift pin) into large hole next to main switch arm (item 34) on thrust rod (item 23) to prevent rod from turning or moving under spring load.
5. Loosen diaphragm cover capscrews and hex nuts (items 26 & 27). Leave one capscrew / hexnut combination loosely installed while removing remaining capscrews. Ensure diaphragm cover (item 30) is loose and free prior to removing all capscrews. Remove diaphragm cover (item 30).
6. Loosen but do not remove hex locknut (item 32). Remove pin installed in thrust rod (item 23) being careful to retain the small spring load while removing pin, and remove thrust rod / diaphragm assembly from housing (item 22), sliding main switch arm (item 34) along thrust rod.
7. Remove adjusting rod (item 18), switching arms (item 33 & 34) and return spring (item 24). Remove adjustable switch arm (item 33) from main switch arm (item 34).
8. Remove hex locknut (item 32), washer (item 31), diaphragm (item 29), and diaphragm plate (item 28) from thrust rod (item 23).
9. Remove air vent (item 37) and connector (item 25) from housing (item 22).

## HOUSING ASSEMBLY INSTRUCTIONS

Lubricate thrust rod with a molydisulfide lubricant grease. Ensure all parts are clean and free from damage (see Inspection section).

1. Place rod adapter (item 18) into thrust rod (item 23). Install thrust rod into housing (item 22) ensuring main switch arm (item 34) is installed onto thrust rod in correct orientation.
2. Install rod adapter (item 18) onto plunger (item 14) and install plunger pin (item 15).
3. Install return spring (item 24) over thrust rod (item 23). Install diaphragm plate (item 28), and diaphragm (item 29) onto thrust rod.

Place a small amount of silicon on diaphragm around thrust rod to seal diaphragm to thrust rod. Install washer (item 31) and hex locknut (item 32), DO NOT TIGHTEN locknut.

4. Push thrust rod (item 23) into housing (item 22) against return spring (item 24) until large hole in thrust rod is visible and install a pin (punch or drift pin) into hole to retain spring preload and prevent rod from turning. Note – ensure thrust rod fits through second hole in housing while pushing thrust rod.
5. Align air hole and bolt holes in diaphragm (item 29) with mating holes in housing (item 22). Tighten hex locknut (item 32) ensuring holes in diaphragm remain aligned, Note – do not overtighten hex nut resulting in the diaphragm being over compressed.
6. Install diaphragm cover (item 30) with capscrews (item 26) and hexnuts (item 27). Evenly tighten capscrews, Note – do not overtighten capscrews resulting in the diaphragm being over compressed.
7. Remove pin installed in thrust rod hole.
8. Position main switch arm (item 34) on correct side of micro switch (item 42) arm and ensure that the main switch arm is positioned on the groove of the thrust rod (item 23) and locked, with the rod in a vertical position, with the setscrew.
9. To adjust switch arms, switch micro switch (item 42) manually so that the arm is furthest away from the main switch arm (item 34) rod. Install adjustable switch arm (item 33) into main switch arm (item 34) until rod on micro switch (item 42) switches over. Continue to install adjustable switch arm (item 34) a further 1/16" to 1/8" after micro switch rod switches. Tighten setscrew to hold adjustable switch arm vertical and in place. Further adjustments should be made as required to ensure pump operates correctly and continuously.
10. Install air vent (item 37), connector (item 25) (utilize thread sealant on threads) and micro switch line assembly (item 20).
11. Install adjusting pin (item 19) into correct location for desired stroke.
12. Install gasket (item 16), and cover (item 17) with wing screws (item 21).

## OPTIONAL PILOT VALVE ASSEMBLY MAINTENANCE

Refer to Assembly and Exploded Drawing and Parts Lists for Item Numbers

**Disconnect operating air supply and ensure pressure is removed from fluid end prior to performing any maintenance.**

### PILOT VALVE ASSEMBLY REMOVAL INSTRUCTIONS

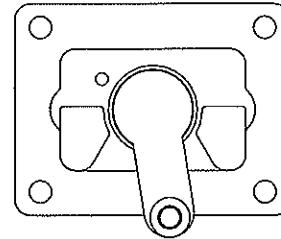
1. Remove line assembly (item A17).
2. Remove connector (item A16), gas exhaust valve (item 39), and elbow (item A11).
3. Remove disc retainer (item A14), valve spring (item 2), washer (item A15), valve disc (item A13) and pin (item A12).
4. Drain body cavity of oil by removing drain plug (item 40). Remove cover (item 17) and gasket (item 16) by removing wing screws (item 21).
5. Remove hexhead capscrews (item 43) and lockwashers (item 44). Remove pilot valve assembly from body by rotating pilot valve housing (item A10) and sliding flipper arm (item A9) from bottom spring adapter (item A21). Remove gasket (item 46).
6. Remove socket head capscrew (item A7) and retaining washer (item A8). Remove flipper arm and bearing assembly (item A9) from pilot valve housing (item A10) utilizing a punch and tapping the assembly out.
7. If the stirrup assembly (item A6) needs to be removed, follow the instructions under 'Housing Disassembly Instructions' replacing the switch arm assembly (items 33 & 34) with the trip stirrup assembly (item A6).
8. Remove hex nut (item A4) and lockwasher (item A3). Unthread bumper plate screw (item A18) and remove washers (item A20) and bumper plate (item A19).

### PILOT VALVE ASSEMBLY INSTALLATION INSTRUCTIONS

1. Insert bumper plate screw (item A18) through bumper plate (item A19) and through all three washers (item A20). Thread bumper plate screw into housing (item 22) from inside. Ensure bumper plate can be rotated with ease and install lockwasher (item A3) and hexnut (item A4) onto bumper plate screw to lock it to the housing.
2. Follow the instructions under 'Housing Assembly Instructions' replacing the switch arm assembly (items 33 & 34) with the stirrup assembly (item A6) to install the trip stirrup assembly. Ensure that the trip stirrup assembly is positioned on the groove of the

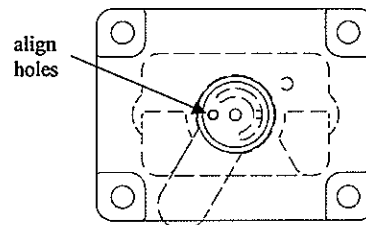
thrust rod (item 23) and locked in position with the hex head screw (item A1).

3. Install the flipper arm and bearing assembly (item A9) into the pilot valve housing (item A10). Ensure that the flipper arm is in the correct orientation per the following figure.



Inside View

4. Lock flipper arm in position with socket head capscrew (item A7) and washer (item A8).
5. Install drive pin (item A12) into flipper arm (item A9).
6. Install valve disc (item A13) onto drive pin (item A12). Lubricate face of valve disc with a light petroleum grease. Ensure valve disc is installed in correct orientation in regards to the flipper arm position per following figure.



Outside View

7. Install washer (item A15), spring (item 2) and disc retainer (item A14).
8. Place gasket (item 46) onto pilot valve housing (item A10) and place pilot valve housing into pump housing (item 22) ensuring the flipper arm (item A9) is inserted into the bottom spring adapter (item A21) and is retained within the bumper plate (item A19). Retain housing with capscrews (item 43) (utilize thread sealant on threads) and lockwashers (item 44).
9. Install elbow connector (item A16), elbow (item A11) and gas exhaust valve (item 39) utilizing thread sealant on threads. Install line assembly (item A17).
10. Install drain plug (item 40) utilizing thread sealant on threads and fill main cavity to bottom of thrust rod with SAE 10W non-detergent oil. Install gasket (item 16) and cover (item 17) with wing screws (item 21).

## **INSPECTION**

---

1. Replace or repair components as necessary.
2. Inspect all threads for damage.
3. Inspect all seals, packing and diaphragm for damage.
4. Inspect body (item 8) seal areas for corrosion, pitting, or damage. Seal areas on the body include the packing area and the tapered area below the top seat (item 5).
5. Inspect balls (items 3 & 7), top seat (item 5) and bottom seat (item 9) and ball check spring (item 2) for corrosion or damage.
6. Inspect plunger (item 14) and thrust rod (item 23) for wear, scarring, or damage.
7. Inspect housing (item 22) for wear, scarring or damage within thru bore.
8. Inspect all other components for damage

## **OPTIONAL PILOT VALVE ASSEMBLY INSPECTION**

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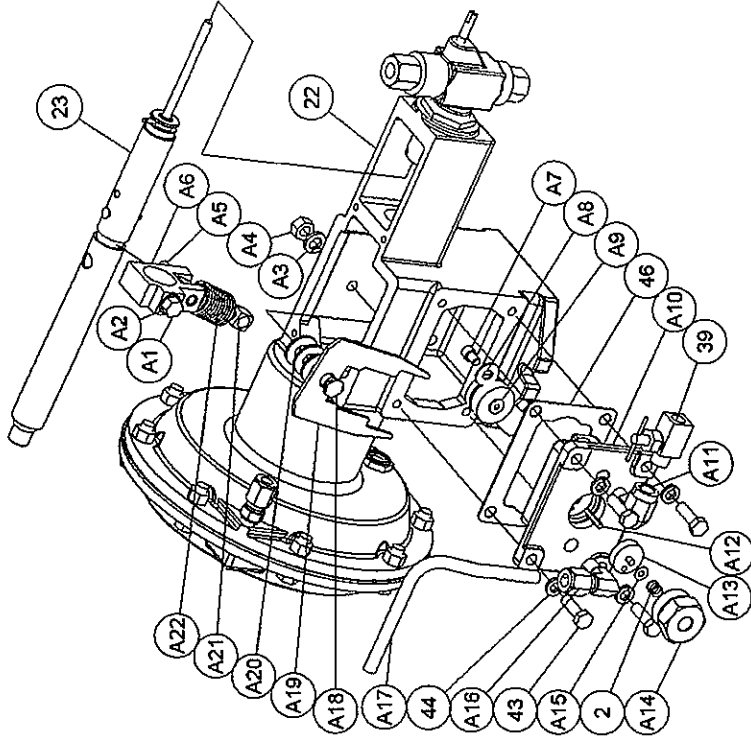
Replace or repair components as necessary.

1. Inspect all threads for damage.
2. Inspect valve disc (item A13) sealing face for pitting, scratches or damage. Inspect mating face on pilot valve body (item A10).
3. Inspect valve disc pin (item A12).
4. Inspect flipper arm & bearing assembly (item A9) for ease of operation.
5. Inspect flipper spring (item A22) for damage

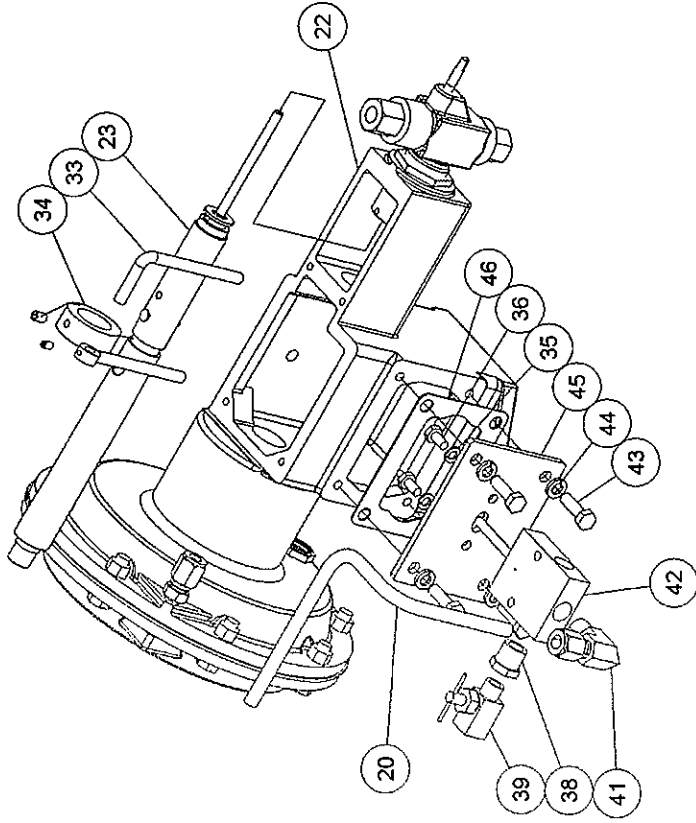
## **TROUBLESHOOTING**

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1. Pump operates but fails to pump fluid or reach required discharge pressure:
  - ◆ Ensure pilot valve (item 6) is completely shut and not leaking.
  - ◆ Ensure plunger pin (item 15) and adjusting pin (item 19) are in place and not broken.
  - ◆ Check for leaks around bottom seat (item 9), top bushing (item 1) and packing (item 11).
  - ◆ Inspect and clean bottom seat (item 9), top seat (item 5), balls (item 3) and valve spring (item 2). Inspect for damage and replace components if necessary.
2. Pump fails to operate:
  - ◆ Ensure gas exhaust valve (item 39) is open and not blocked.
  - ◆ Ensure air vent (item 37) is not blocked.
  - ◆ Check micro switch (item 42) for correct operation and correct adjustment. (For optional pilot valve assembly, check for correct operation and leakage.)
  - ◆ Inspect diaphragm (item 29) for ruptures.
  - ◆ Inspect return spring (item 24) for damage
  - ◆ Inspect thrust rod (item 23) for excessive scarring and galling.



**PILOT VALVE ASSEMBLY**  
(Optional)



**MICRO SWITCH ASSEMBLY**  
(Standard)

**Pilot Valve Assembly Parts List**

| ITEM | DESCRIPTION                 | MATERIAL       | QTY | PART NUMBER | ITEM | DESCRIPTION                  | MATERIAL       | QTY | PART NUMBER |
|------|-----------------------------|----------------|-----|-------------|------|------------------------------|----------------|-----|-------------|
| A1   | Hex Head Capscrew           | Steel          | 1   | BA-1829     | A12  | Pin (included in BA-4147)    | Hardened Steel | 1   | BA-4062     |
| A2   | Int. Tooth Lockwasher       | Steel Cad. Pl. | 1   | BA-3406     | A13  | Valve Disc & Drive Pin Assy. | 17-4 SS        | 1   | BA-4147     |
| A3   | Lockwasher                  | Cad. Pl.       | 1   | BA-0459     | A14  | Disc Retainer                | CS Cad. Pl.    | 1   | BA-0906     |
| A4   | Hex Nut                     | Steel Cad. Pl. | 1   | BA-3323     | A15  | Washer                       | SS             | 1   | BA-0579     |
| A5   | Rollpin                     | Steel          | 1   | BA-2355     | A16  | Elbow Connector              | CS Cad. Pl.    | 1   | BA-4016     |
| A6   | Trip Stirrup                | Steel          | 1   | BB-0471     | A17  | Pilot Valve Line Assy.       | SS Tubing      | 1   | BB-1193     |
| A7   | Socket Head Capscrew        | Steel          | 1   | BA-3387     | A18  | Bumper Plate Screw           | Steel          | 1   | BA-1827     |
| A8   | Washer                      | Steel          | 1   | BA-0167     | A19  | Bumper Plate                 | Steel          | 1   | BA-1823     |
| A9   | Flipper Arm & Bearing Assy. | 17-4 SS / CS   | 1   | BB-0440     | A20  | Washer                       | Steel          | 3   | BA-0746     |
| A10  | Pilot Valve Body            | Cast Iron      | 1   | BB-0441     | A21  | Spring Adapter               | Steel          | 2   | BA-1838     |
| A11  | Elbow                       | CS Cad. Pl.    | 1   | BA-0075     | A22  | Flipper Spring               | Steel          | 1   | BA-1820     |

## MODEL NUMBERING SYSTEM:

| BR51 <span style="margin-left: 20px;">1 2 3</span> - <span style="margin-left: 20px;">4 5 6 7</span> |                          |  |
|--|--------------------------|--|
| 1  | Pressure Group           | 0 – Low Pressure, 0 – 3500 psig, dependant on packing (standard)<br>1 – High Pressure, 0 – 6000 psig for 1/4" & 3/8" sizes, 0 – 3500 psig for 1/2" plunger size, (Buna-Hard packing only)  |
| 2  | Plunger Size             | 1 – 1/4" Plunger<br>3 – 3/8" Plunger (standard)<br>5 – 1/2" Plunger  |
| 3  | Options                  | LP – Pump, no Tank, Base, Regulator or Gauge – est. wt. 45 lbs (standard)<br>L – Pump /w 5 gal. S.S. Tank, Base, Level Gauge & Suction Line – est. wt. 60 lbs<br>HP – Pump w/Regulator (220 psig max.) & Gauge, No Base or Tank – est. wt. 47 lbs<br>H – Pump w/ 5 gal. S.S. Tank, Base, Regulator (220 psig max.) and Gauge – est. wt. 62 lbs |
| 4  | Packing Material         | 1 – Buna (standard)<br>2 – Buna Hard<br>3 – Viton<br>4 – Teflon<br>5 – Fluorosilicone  |
| 5  | Seal Material            | 1 – Buna<br>2 – Metal-to-Metal<br>3 – Viton<br>4 – Teflon<br>5 – Fluorosilicone (standard)   |
| 6  | Operating Valve Assembly | 1 – Micro Switch Assembly (standard)<br>2 – Pilot Valve Assembly   |
| 7  | Head Material            | 1 – Ductile Iron (standard)<br>2 – Stainless Steel (consult factory)   |

Example: BR51 0 3 LP - 1 5 1 1

Description: BR5100 Chemical Injection Pump, low pressure, 3/8" plunger, pump only, (no tank, base, regulator or gauge), Buna packing, Fluorosilicone seals, Micro Switch Operating Valve, Ductile Iron head.

Manufactured, Sold and Serviced by:



9709 – 60 Avenue  
Edmonton, Alberta, Canada  
T6E 0C4  
Ph: (780) 430-1777  
Fax: (780) 430-1412

Sales Office  
Calgary, Alberta, Canada

Ph: (403) 271-9111  
Fax: (403) 271-9161

Email: [info@bruinstruments.ab.ca](mailto:info@bruinstruments.ab.ca)  
[www.bruinpumps.com](http://www.bruinpumps.com)

All information, specifications and illustrations contained in this document reflect the latest available information at publication time. Bruin Instruments reserves the right to make changes at any time without notice.

51-0120

# CATA-DYNE™ HEATER

## STANDARD HEATER APPLICATIONS

## INSTALLATION & OPERATION INSTRUCTIONS

**⚠ WARNING:** Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.



The Cata-Dyne™ heater can be used in all industrial indoor locations where a source of infrared radiant heat is required, providing adequate ventilation is available.

## CERTIFICATION

Model WX (Series X) Cata-Dyne™ Explosion-proof, flameless infrared catalytic gas heaters are certified by the Canadian Standards Association (CSA) for use in Class I, Divisions 1 and 2, Group D hazardous (classified) locations and Factory Mutual Global (FM), for use in Class I, Division 1, Group D hazardous (classified) locations, temperature code T2C at an ambient temperature of 40°C (104°F).

The Model BX (Series G) Cata-Dyne™ heater is certified by CSA and FM for use in general industrial non-hazardous locations. The MKII model (Series X) Explosion-proof, flameless infrared catalytic gas heater is certified by CSA for use in Class I, Divisions 1 and 2, Group D hazardous (classified) locations. Models listed are certified for industrial use only, for either natural gas or propane gas. CSA approved models are equipped for high altitudes: 0 - 4,500 ft. (0-1,370 m) above sea level.

## INSTALLATION

To ensure maximum efficiency of your Cata-Dyne™ heater, it should be installed with the heating surface positioned plus or minus 45° from the vertical plane at a height of no more than 8 ft. (2.44 m). All heaters must be installed in accordance with the latest revisions of the *Canadian Electrical Code*, CAN/CGA-B149.1, the *Natural Gas Installation Code* and/or CAN/CGA-B149.2, the

### Cata-Dyne™ Heater - Models Available

| WX Model (Series X)  |  |          |              |  |           |
|--|--|----------|--------------|--|-----------|
| Approved for use in Class I, Division 1 and 2, Group D hazardous (classified) locations by both FM and CSA |  |          |              |  |           |
| Model Number   | Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas |          | Model Number | Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas |           |
|  | Max. Btu/hr  | Max. kW  |              | Max. Btu/hr  | Max. kW   |
| WX 6 x 6   | 1,000 Btu/hr   | 0.293 kW | WX 18 x 24   | 12,000 Btu/hr  | 3.514 kW  |
| WX 6 x 12  | 2,000 Btu/hr   | 0.586 kW | WX 18 x 30   | 15,000 Btu/hr  | 4.393 kW  |
| WX 6 x 24  | 4,000 Btu/hr   | 1.171 kW | WX 18 x 36   | 18,000 Btu/hr  | 5.272 kW  |
| WX 6 x 60  | 10,000 Btu/hr  | 2.929 kW | WX 18 x 48   | 24,000 Btu/hr  | 7.029 kW  |
| WX 8 x 8   | 1,778 Btu/hr   | 0.521 kW | WX 18 x 60   | 30,000 Btu/hr  | 8.786 kW  |
| WX 10 x 12   | 3,333 Btu/hr   | 0.976 kW | WX 18 x 72   | 36,000 Btu/hr  | 10.543 kW |
| WX 12 x 12   | 4,000 Btu/hr   | 1.171 kW | WX 24 x 24   | 16,000 Btu/hr  | 4.686 kW  |
| WX 12 x 24   | 8,000 Btu/hr   | 2.343 kW | WX 24 x 30   | 20,000 Btu/hr  | 5.857 kW  |
| WX 12 x 36   | 12,000 Btu/hr  | 3.514 kW | WX 24 x 36   | 24,000 Btu/hr  | 7.029 kW  |
| WX 12 x 48   | 16,000 Btu/hr  | 4.686 kW | WX 24 x 48   | 32,000 Btu/hr  | 9.372 kW  |
| WX 12 x 60   | 20,000 Btu/hr  | 5.857 kW | WX 24 x 60   | 40,000 Btu/hr  | 11.715 kW |
| WX 12 x 72   | 24,000 Btu/hr  | 7.029 kW | WX 24 x 72   | 48,000 Btu/hr  | 14.058 kW |
| BX Model (Series G)  |  |          |              |  |           |
| Approved for use in general industrial non-hazardous locations by both FM and CSA                          |  |          |              |  |           |
| Model Number   | Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas |          | Model Number | Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas |           |
|  | Max. Btu/hr  | Max. kW  |              | Max. Btu/hr  | Max. kW   |
| BX 6 x 6   | 1,500 Btu/hr   | 0.4 kW   | BX 18 x 24   | 18,000 Btu/hr  | 5.3 kW    |
| BX 6 x 12  | 3,000 Btu/hr   | 0.9 kW   | BX 18 x 30   | 22,500 Btu/hr  | 6.6 kW    |
| BX 6 x 24  | 6,000 Btu/hr   | 1.8 kW   | BX 18 x 36   | 27,000 Btu/hr  | 7.9 kW    |
| BX 8 x 8   | 3,500 Btu/hr   | 1.0 kW   | BX 18 x 48   | 36,000 Btu/hr  | 10.5 kW   |
| BX 10 x 12   | 5,000 Btu/hr   | 1.5 kW   | BX 18 x 60   | 45,000 Btu/hr  | 13.2 kW   |
| BX 12 x 12   | 6,000 Btu/hr   | 1.8 kW   | BX 18 x 72   | 54,000 Btu/hr  | 15.8 kW   |
| BX 12 x 24   | 12,000 Btu/hr  | 3.5 kW   | BX 24 x 24   | 24,000 Btu/hr  | 7.0 kW    |
| BX 12 x 36   | 18,000 Btu/hr  | 5.3 kW   | BX 24 x 30   | 30,000 Btu/hr  | 8.8 kW    |
| BX 12 x 48   | 24,000 Btu/hr  | 7.0 kW   | BX 24 x 36   | 36,000 Btu/hr  | 10.5 kW   |
| BX 12 x 60   | 30,000 Btu/hr  | 8.8 kW   | BX 24 x 48   | 48,000 Btu/hr  | 14.1 kW   |
| BX 12 x 72   | 36,000 Btu/hr  | 10.5 kW  | BX 24 x 60   | 60,000 Btu/hr  | 17.5 kW   |
|  |  |          | BX 24 x 72   | 72,000 Btu/hr  | 21.0 kW   |
| MKII Model (Series X)  |  |          |              |  |           |
| Approved for use in Class I, Division 1 and 2, Group D hazardous (classified) locations by CSA             |  |          |              |  |           |
| Model Number   | Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas |          | Model Number | Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas |           |
|  | Max. Btu/hr  | Max. kW  |              | Max. Btu/hr  | Max. kW   |
| MKII 12 x 12   | 4,000 Btu/hr   | 1.171 kW |              |  |           |
| MKII 12 x 24   | 8,000 Btu/hr   | 2.343 kW |              |  |           |
| MKII 24 x 24   | 16,000 Btu/hr  | 4.686 kW |              |  |           |

Model WX Series Heaters are certified for use in Class I, Division 1 and 2, Group D hazardous locations by both FM and CSA/CGA

The WX Series Cata-Dyne™ features an improved efficiency catalyst pad that requires 1/3 less fuel to generate the same heat value as our BX Series Cata-Dyne™ heater.



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[www.ccithermal.com](http://www.ccithermal.com)

Date of issue: February 2003

*Propane Installation Code* and/or any local codes and regulations. Before installing the heater, all information on the heater nameplate must be carefully reviewed. The nameplate lists all the fuel and electrical requirements for the heater.

**Natural Gas** – these heaters are designed to use natural gas (1000 Btu/ft<sup>3</sup>, 37 MJ/m<sup>3</sup>) at 7 in. w.c. (1.73 kPa), 4.5 in. w.c. (1.12 kPa), or 3.5 in. w.c. (0.86 kPa).

**Propane** – these heaters are designed to use propane gas (2500 Btu/ft<sup>3</sup>, 88 MJ/m<sup>3</sup>) at 11 in. w.c. (2.72 kPa).

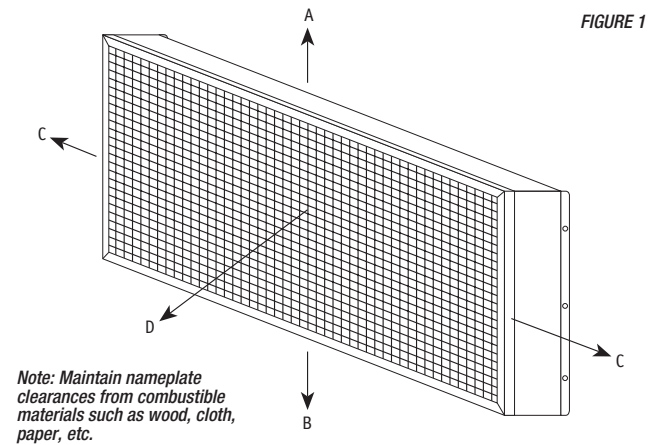
## SPECIFICATIONS

### Clearances

Appropriate clearances from the heating surface must be observed during the installation of the Cata-Dyne™ heaters (See Figure 1). Maintain nameplate clearances from combustible materials such as wood, cloth, paper, etc.

### Fuels

The Cata-Dyne™ flameless gas heater is designed to operate on clean, dry natural or propane gas as specified on the heater nameplate.



| HEATER CLEARANCE         |                             |                                 |                                 |                                 |                             |                                 |                                 |                             |                                 |                                 |
|--------------------------|-----------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------|---------------------------------|---------------------------------|-----------------------------|---------------------------------|---------------------------------|
|                          | Radiant Surface             |                                 |                                 | Sides                           | Top                         |                                 |                                 | Bottom                      |                                 |                                 |
| Radiant Surface Position | Heaters Up To 12,000 Btu/hr | Over 12,000 Up To 48,000 Btu/hr | Over 48,000 Up To 72,000 Btu/hr | All Heaters Up To 72,000 Btu/hr | Heaters Up To 12,000 Btu/hr | Over 12,000 Up To 48,000 Btu/hr | Over 48,000 Up To 72,000 Btu/hr | Heaters Up To 12,000 Btu/hr | Over 12,000 Up To 48,000 Btu/hr | Over 48,000 Up To 72,000 Btu/hr |
| Vertical (0°)            | 28 in.                      | 42 in.                          | 60 in.                          | 12 in.                          | 18 in.                      | 18 in.                          | 42 in.                          | 7 in.                       | 12 in.                          | 18 in.                          |
| 0-45° up                 | 28 in.                      | 42 in.                          | 60 in.                          | 12 in.                          | 18 in.                      | 32 in.                          | 54 in.                          | 0 in.                       | 12 in.                          | 18 in.                          |
| 0-45° down               | 28 in.                      | 42 in.                          | 60 in.                          | 12 in.                          | 18 in.                      | 18 in.                          | 18 in.                          | 22 in.                      | 24 in.                          | 42 in.                          |

### Piping

1. A main shut-off valve must be installed upstream of all auxiliary heater controls.
2. The 100% safety shut-off valve and appliance regulator (natural gas heaters only) must be installed in the upright position.
3. The thermostatic temperature controller should be installed with the dial shaft in the horizontal position.
4. The maximum inlet pressure to the 100% safety shut-off valve, thermostatic temperature controller and appliance regulator is 1/2 psi (3.4 kPa). If the inlet pressure is higher than this, a low-pressure service regulator must be installed upstream of these components.
5. The maximum inlet pressure to the low-pressure service regulator is 250 psi (1.7 MPa). If the inlet pressure is higher than this, a high-pressure regulator must be installed upstream.
6. All components should be installed as indicated in Figure 2 (WX and BX models only) or Figure 3 (MKII model only).

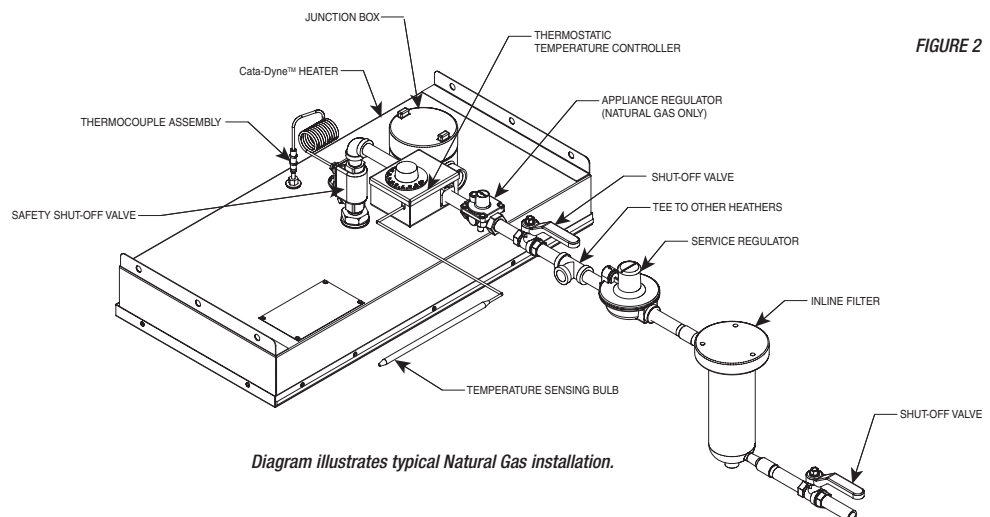


Diagram illustrates typical Natural Gas installation.



## Electrical

1. All wiring is to be installed in accordance with the latest revisions of the Canadian Electrical Code (CEC) and/or any applicable local codes.
2. It is desirable to install an indicating light on all starting systems. This will reduce the possibility of the power being left on once the heater is started, which can severely reduce the lifespan of the heater.
3. Ground connections for 120 V and above heaters are required as indicated in Figures 4 and 5.
4. The number of terminals in the junction box can be two or four depending on the number of elements used in the fabrication of the heater. All MKII models incorporate a single element and therefore have only two terminals. The connection procedure for the different combinations is as described in Figures 4 and 5:

## Ventilation

The catalytic reaction in Cata-Dyne™ heaters occurs when natural gas or propane reacts with oxygen to produce water vapor, carbon dioxide and infrared energy. Ventilation must be provided to allow an adequate supply of oxygen for the reaction.

For every 1.0 ft<sup>2</sup> (0.093 m<sup>2</sup>) of heater surface, 40 ft<sup>3</sup>/hr (1.13 m<sup>3</sup>/hr) of air supply is required. For example, a WX 24 x 24 heater (16,000 Btu/hr / 4.686 kW ) would require 160 ft<sup>3</sup>/hr (4.53 m<sup>3</sup>) of air to ensure proper operation of the Cata-Dyne™ heater.

To reduce the carbon dioxide and water vapor concentrations in the building, a vent hood assembly can be installed to provide positive ventilation from the heater (See Figure 6).

FIGURE 4

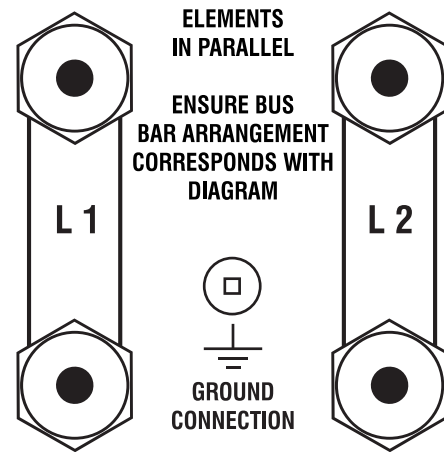


FIGURE 5

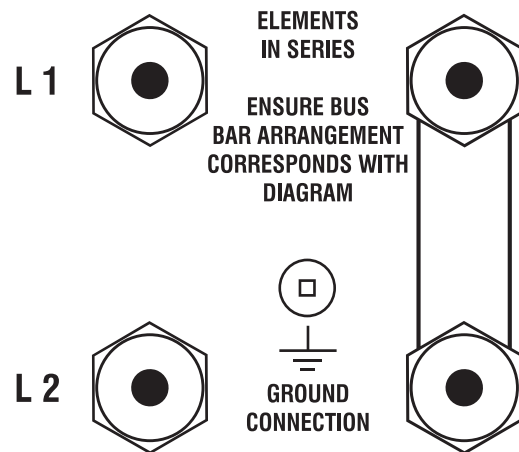


FIGURE 3

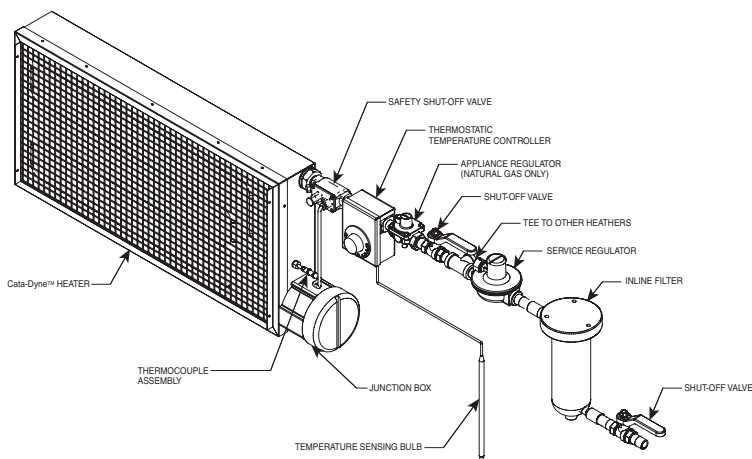
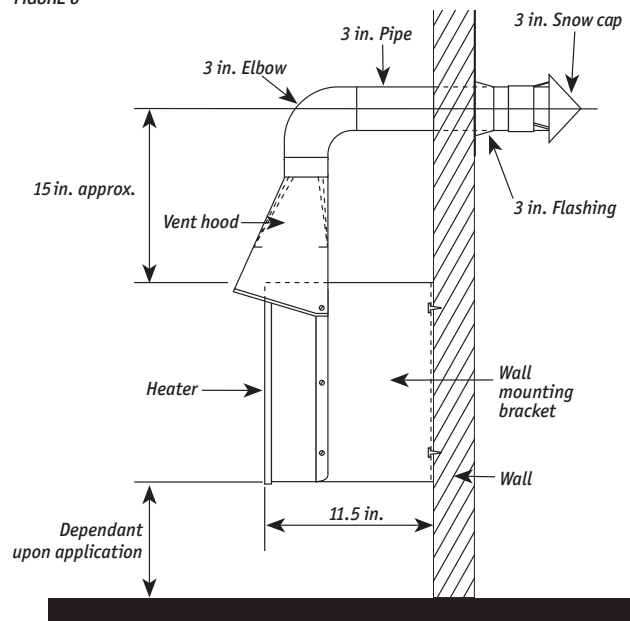


Diagram illustrates typical Natural Gas installation.

FIGURE 6



## OPERATION

All Cata-Dyne™ heaters are supplied with a Safety Shut-Off Valve (SSOV)/Thermocouple assembly to ensure the safe operation of the heater. Under no circumstances should the reset button be held or locked into the depressed position by use of a mechanical restraint. A tamper resistant model SSO V is available if desired.

### Start-up

1. Ensure the heater has been installed according to all instructions and relevant codes.
2. Turn on the main gas supply to the system.
3. If the heater is equipped with a thermostatic temperature controller, rotate the dial completely clockwise to the fully open position.
4. Turn on the power to the electrical elements.
5. After 15 minutes, depress the reset button on the top of the 100% safety shut-off valve. The button should return to the original position and internally open the valve and allow gas to flow to the heater. If the valve does not stay open when the reset button is released, it may be necessary to wait an additional few minutes and then depress the reset button again. This will allow the electrical elements additional time to warm up.
6. When the catalytic reaction is well established, turn off the electrical power to the elements.
7. If the heater is equipped with a thermostatic temperature controller, it can be set to the desired setting after the catalytic reaction has been established for at least one hour.

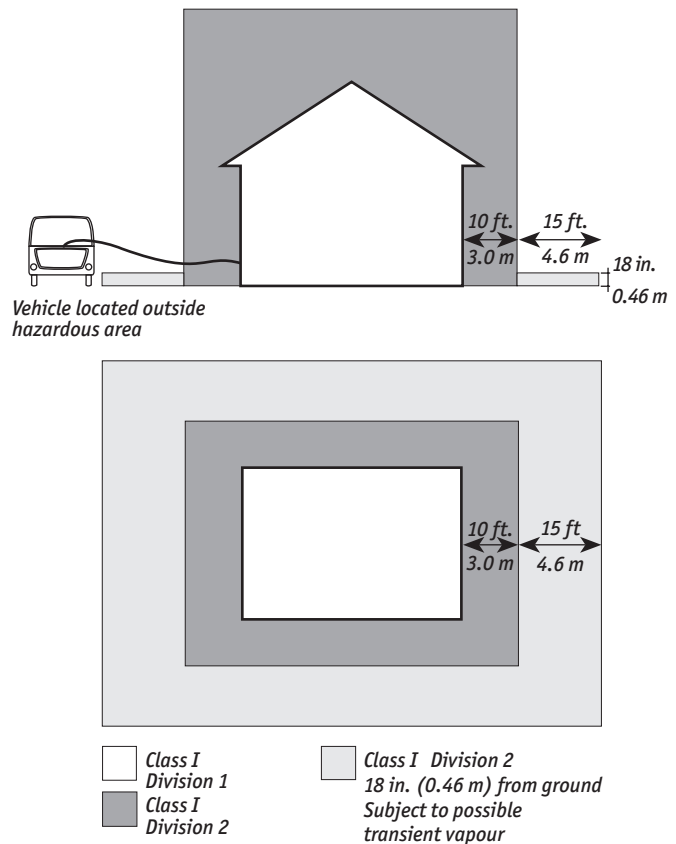
### Shut down

Turn off the gas supply to the heater.

### Multi-heater start-up

Cata-Dyne™ heaters can also be purchased/installed in multi-heater assemblies. If these assemblies are 12 V, each heater must be started individually. This ensures the correct voltage and current will be reaching the heater from the power supply.

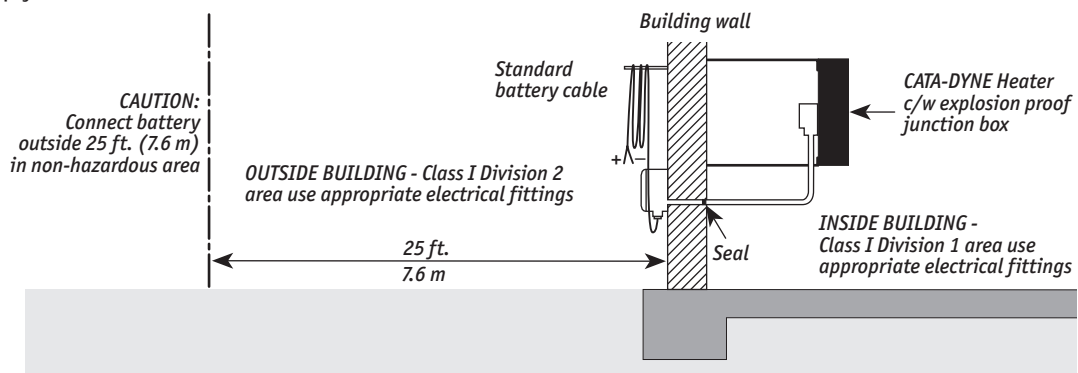
## 12 V HAZARDOUS ELECTRICAL INSTALLATIONS



Most oil and gas production buildings have an area classification as follows:

1. Class I, Division 1, within the building.
2. Class I, Division 2, outside the building for a distance of 10 ft.(3.0 m) from the building at all elevations.
3. Class I, Division 2, outside the building for a distance of 25 ft.(4.5 m) from the building at an elevation of 18 in. (0.45 m) from the ground.

All electrical apparatus and wiring within this area must conform to the appropriate codes. Connection to the power supply must be outside of the Class I, Division 2 location.



## SPOT HEATING

There are several factors to consider when Cata-Dyne™ heaters are utilized for spot heating.

Infrared energy travels in straight lines from the face of the Cata-Dyne™ heater covering approximately 160° of arc and is inversely proportional to the square of the distance. The heater should therefore be mounted as close as practical (min. of 8 in. (20 cm)) to the object requiring heat for maximum temperature rise.

Match the shape of the object requiring heat with the appropriate Cata-Dyne™ heater, e.g. WX/BX 6 x 24 for long narrow objects or WX/BX 12 x 12 for a square object.

Objects requiring heat should be painted dull, dark colors for maximum infrared absorption and objects not requiring heat should be painted light or reflective colors.

Insulate and protect plastic, rubber and similar materials from direct intense infrared heat.

## SPACE HEATING

A separate heat load calculation should be done for each building in which a Cata-Dyne™ heater will be installed for space heating purposes.

The heat load calculation determines the building heat losses through the structure and allows for air infiltration (refer to the sample Heat Load Calculation in the Cata-Dyne™ catalogue).

Cata-Dyne™ heaters produce low intensity infrared heat that is absorbed by objects within the range of the heat source. The closer the object is to the source of heat, the more heat the object will absorb. Cata-Dyne™ heaters should be placed close to the floor level within the building to heat objects close to the floor.

Ideally, Cata-Dyne™ heaters should be mounted 1-3 ft.(0.3-1 m) from the floor and equally spaced around the building perimeter for space heating applications.

If low mounting is not practical, then overhead mounting may be utilized. Overhead mounted heaters should be sloped face down to a maximum 45° angle to direct the infrared energy towards the floor. Overhead mounting should be restricted to heaters of 30,000 Btu/hr (8.8 kW) capacity and larger.

If the building requires only one heater, place the Cata-Dyne™ heater as close as possible to the center of the longest wall.

For multiple heater installations, space the Cata-Dyne™ heaters as evenly as possible around the perimeter of the building.

Make sure the piping is large enough to handle the gas load (refer to the sample Piping Calculation in the Cata-Dyne™ catalogue for sizing information).

Make sure the electrical starting system has sufficient current carrying capacity and conforms to all applicable electrical codes.

It is advisable to install an indicator light in the electrical circuit to reduce the possibility of the power being left on once the heater is started.

## PERSONAL SAFETY

The Cata-Dyne™ flameless infrared catalytic gas heater does not produce harmful carbon monoxide gas when used with natural gas or propane. Adequate ventilation must be incorporated in any building design to ensure oxygen replenishment and removal of any carbon dioxide. Protective grills should be used on any installation where personnel may come in contact with the face of the heater.

## ORDERING INFORMATION

You can order any of CCI Thermal's products by telephone, fax, mail or e-mail. To assist us in processing your order as quickly and efficiently as possible, please provide us with the following information:

- ◆ Cata-Dyne™ product name
- ◆ Cata-Dyne™ model number
- ◆ Fuel gas - natural gas or propane
- ◆ Starting voltage - 12, 24, 120, 208, 240, 480, or 600 V
- ◆ Accessories required:
  - Protection Grill
  - Wall Mount Brackets
  - Thermostat
  - Regulator
  - Start Up Leads (12 V system only)
  - Vent Hood
  - Other
- ◆ Company name and contact
- ◆ Billing address, phone number, fax or e-mail
- ◆ Shipping address and phone number
- ◆ Shipping instructions
- ◆ Special tagging instructions
- ◆ Date required
- ◆ Method of payment:
  - on account - P.O. number required
  - credit card - Visa or Mastercard number
  - cash or cheque

## GUARANTEE

CCI Thermal warrants all Cata-Dyne™ flameless infrared heaters sold to be free from defects in material or workmanship under normal use and service. The company agrees to repair or replace any Cata-Dyne™ heater which, upon its examination, reveals it to have been defective due to faulty workmanship or material, if returned to our factory, transportation PREPAID, within one (1) year from date of purchase. The company does not assume responsibility for misuse or misapplication of its heaters.

Warranty is void if Cata-Dyne™ heaters are used with sour, dirty or wet gas, or where sulphur content is greater than allowable for utility gas specifications. Warranty is void if, upon our inspection, the heater has been tampered with. Neither CCI Thermal nor the selling dealer shall be held responsible for loss of time, inconvenience, commercial loss or consequential damages relating to the use of Cata-Dyne™ heaters.

## RETURN GOODS POLICY

Prior written approval must be obtained from CCI Thermal for the return of any Cata-Dyne™ product(s). A restocking charge of 15% will apply. All returns must be shipped to our factory in Edmonton, freight prepaid. Final acceptance will be contingent on inspection at our factory.

## REPAIRS

Cata-Dyne™ heaters may require periodic maintenance or repair. Our factory is staffed with technicians who are qualified to perform any required repairs. The procedure to follow to have a heater repaired is as follows.

Send the heater to our factory in Edmonton. Include the following information with the heater:

- ◆ Company name and address
- ◆ Contact name
- ◆ Telephone number/fax number/e-mail
- ◆ P.O. number
- ◆ Advise if an estimate is required prior to starting the repair
- ◆ Details on the repair or conversion required
- ◆ Return shipping instructions

**NOTE:** Under the terms of our certification, all repairs must be performed at our factory in Edmonton.

## TROUBLE SHOOTING

1. Ensure that the fuel matches that listed on the nameplate.
2. Ensure that the voltage matches that listed on the nameplate.
3. Check for any physical damage. All signs of physical damage to the catalyst pad such as holes, tears or a general deterioration of the catalyst bed signal that it is time to have the heater repaired.
4. Check the gas supply pressure at the heater – 7 in. w.c. (1.73 kPa), 4.5 in. w.c. (1.12 kPa), or 3.5 in. w.c. (0.86 kPa) for natural gas and 11 in. w.c. (2.72 kPa) for propane.
5. Check the gas orifice for obstructions or dirt and ensure the size matches that listed on the nameplate. It may be necessary to install a filter upstream of the heater or regulator if the gas supply is dirty. If the fuel supply is constantly dirty and/or wet it would be advisable to use bottled propane fuel.
6. Check the mounting position of the heater. The face of the heater should be preferably in the vertical position and should not vary more than 45° from the vertical position for maximum efficiency.
7. Check for saturation of the catalyst face caused by condensation or rain running down the face of the heater. If the heater has been exposed to water, it is advisable to place the unit in a warm area for a period of a few hours or longer if required. Once the moisture is removed, the heater can be re-installed and re-started.
8. Check the jumper cable size to ensure that the resistance of the cable is not reducing the current to the heater. This would not allow sufficient power to the electrical element to preheat the catalyst to the activity temperature. It is recommended to run the service vehicle at fast idle while starting the heater.
9. Cata-Dyne™ heaters are designed to use clean fuel and to be used in non-contaminated atmospheres. Sulphur compounds in the fuel or atmosphere will poison the catalyst bed over a period of time and render the heater inoperative. If the heater has been exposed to sulphur compounds, it should be sent to the factory for service.
10. Avoid spraying the face of the heater with high-pressure air, steam or water because this can damage the catalyst bed. If physical damage is visible, return the heater to the factory for servicing.
11. Ensure that the temperature controller is correct for the model size, fuel, and pressure specifications for the heater it is fitted to. If the temperature controller is too low, the heater will not have sufficient fuel rating to operate and will stop.

*Separate Installation and Operation Instructions are available for oven and industrial heating applications.*

## 7400 Snaftrol / LLC, Liquid Level Control, Low Pressure No-Bleed

### Application

For use in low-pressure vessels or tanks, this versatile and multi-optional device can be used as a level control or as a component of Hi-Lo level alarm systems. The 1" NPTM unit may be mounted into a 1" coupling when the float is accessible from inside the vessel. If float is not accessible, a 2" or larger connection must be provided to allow passage of the float through the connection. The pneumatic 3-way 2-port no-bleed pilot valve makes this unit an excellent choice for the control of liquid level in oil and gas production equipment such as separators, dehydrators, treaters, as well as in manufacturing plants, hazardous waste disposal, food processing, petro-chemical facilities, or wherever fluid levels need to be monitored or controlled.

### Features

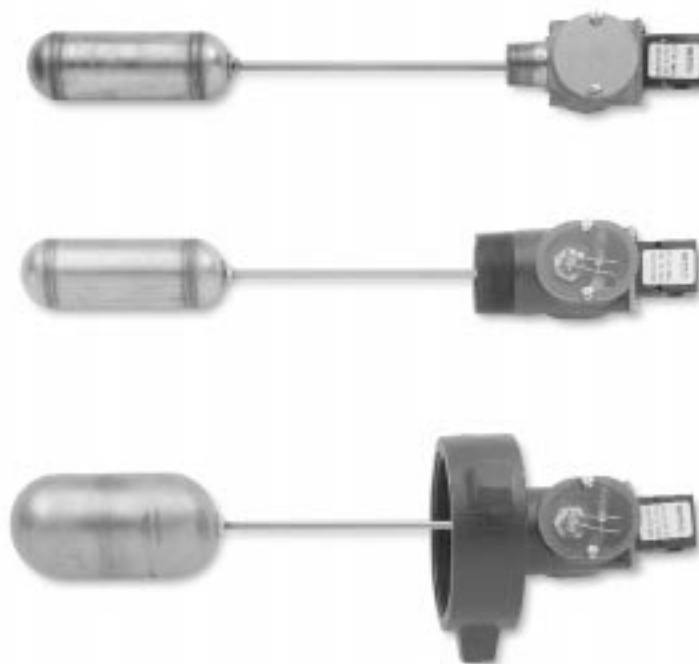
- No-Bleed
- Cost Effective
- Pneumatic or Electric
- 1" and 2" Threaded or 4" Union
- Other Connections Available on Request
- Choices of Float Size and Float Arm Extension Length

### Specifications

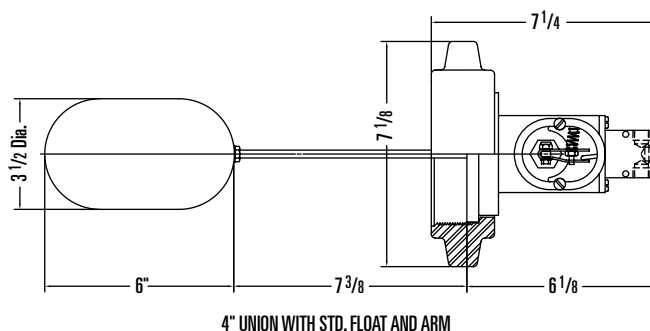
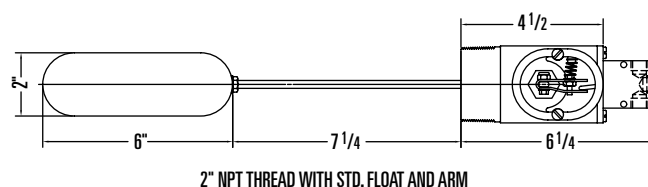
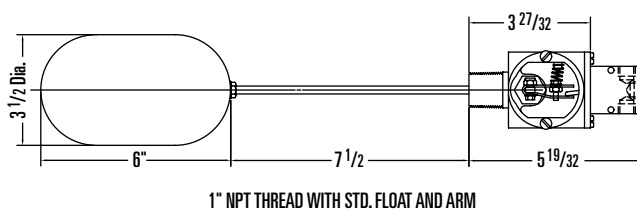
|   |  |                 |               |
|---|--|-----------------|---------------|
| Size  | 1" Threaded                              | 2" Threaded     | 4" Union      |
| Body Working Pressure   |  | 500 psi         |               |
| Float   |  |                 |               |
| Size  | *2" x 6"                                 | 3" x 6"         | **3 1/2" x 6" |
| Working Pressure  | 500 psi                                  | 500 psi         | 500 psi       |
| Collapse Pressure   | 720 psi                                  | 850 psi         | 800 psi       |
| Operating Temperature   | ... -50°F to +212°F (available to 400°F) |                 |               |
| Supply Pressure   | ..... .75 psi (100 psi available)        |                 |               |
| 3-Way Pilot Connections   | ..... 1/4" FNPT                          |                 |               |
| Material  | 1" Threaded                              | 2" Threaded     | 4" Union      |
| Body  | 836 Bronze                               | A216 WCB        | A216 WCB      |
| Float   |  | Stainless Steel |               |
| Float Arm   |  | Stainless Steel |               |
| Seals   | Buna-N Standard (others available)       |                 |               |
| Bushing (Retainer)  | 360 Brass (S.S. available)               |                 |               |
| Electric Switch   | ..... Explosion Proof                    |                 |               |
| Electric Switch, Single Pole / Double Throw, UL and CSA listed: |  |                 |               |
| "L96" 15 amps, 125, 250, or 480 VAC; 1/2 HP-125 VAC,            |  |                 |               |
| 1/4 HP-250 VAC, 1/2 amp-125 VDC, 1/4 amp-250 VDC                |  |                 |               |

\*Standard on 2"

\*\*Standard on 1" Threaded & 4" Union

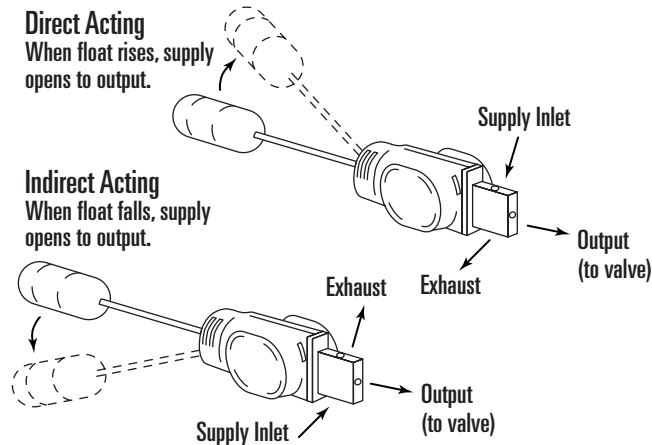


### Dimensional Data



## 7400 Snaptrol / LLC, Liquid Level Control, Low Pressure No-Bleed

### Plumbing Schematic



### Determining the Model Number

Example given: Standard Model ST2TP - Series 7400, 2" Threaded Process Connection, Pneumatic Type Control.

#### MODEL ST2TP

ST • 7400 Series

Process Connection

1T • 1" Threaded\*

2T • 2" Threaded

4U • 4" Union

4G • 4" Grooved

Type

P • Pneumatic

E • Electric

For deviation, or exception to standard, please specify.

\*ST1TP Model No. was the 1S-LLC

### Parts List

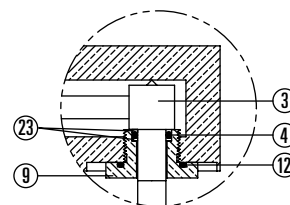
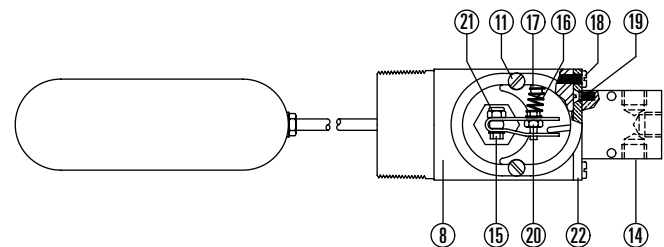
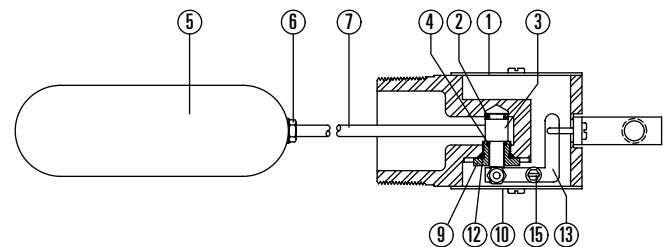
| Item  | Description                          | Qty. | Part No.   |
|-------|--------------------------------------|------|------------|
| 1*    | NAME PLATE, ALUMINUM                 | 1    | 10068      |
| 2*    | BEARING SLEEVE, DELRIN               | 1    | 20031      |
| 3*    | TRUNNION, STAINLESS STEEL            | 1    | 20030      |
| 3**   | PIVOT SHAFT, STAINLESS STEEL         | 1    | 05010-1773 |
| 4     | O-RING, BUNA-N •                     | 1    | 05000-0041 |
| 5     | FLOAT 2"x6", STAINLESS STEEL         | 1    | 10051      |
|       | FLOAT 3"x6", STAINLESS STEEL         | 1    | 10266      |
|       | FLOAT 3 1/2"x6", STAINLESS STEEL     | 1    | 10128      |
| 6     | JAM NUT, STAINLESS STEEL             | 1    | 10007      |
| 7     | FLOAT ARM, STAINLESS STEEL, 10" STD. | 1    | 20028      |
| 8     | BODY, 1" NPT PNEUMATIC, 836 BRONZE   | 1    | 05010-1625 |
|       | BODY, 2" NPT PNEUMATIC, STEEL WCB    | 1    | 40016      |
|       | BODY, 2" NPT ELECTRIC, STEEL WCB     | 1    | 40067      |
|       | BODY, 4" UNION, PNEUMATIC, STEEL WCB | 1    | 40041      |
|       | BODY, 4" UNION, ELECTRIC, STEEL WCB  | 1    | 40043      |
| 9*    | BUSHING, 360 BRASS                   | 1    | 20029      |
| 9**   | RETAINER, 360 BRASS                  | 1    | 05010-1757 |
| 10*   | COVER PLATE, LEXAN                   | 1    | 10050      |
| 10**  | COVER PLATE, ALUMINUM                | 2    | 05010-2128 |
| 11    | COVER SCREW, STL. PLATED             | 4    | 10046      |
| 12*   | O-RING, BUNA-N •                     | 1    | 10133      |
| 12**  | O-RING, BUNA-N •                     | 1    | 05000-0058 |
| 13    | ACTUATOR, STAINLESS STEEL            | 1    | 10049      |
| 14    | 3-WAY VALVE, PNEUMATIC ONLY •        | 1    | 06000-0577 |
|       | ELECTRIC SWITCH, ELECTRIC ONLY       | 1    | 10219      |
| 15    | SCREW, STL. PLATED                   | 2    | 10041      |
| 16    | SPRING, STAINLESS STEEL              | 1    | 10045      |
| 17    | SPRING KEEPER, BRASS                 | 1    | 20033      |
| 18    | SCREW, STL. PLATED                   | 2    | 10043      |
| 19    | SCREW, STL. PLATED                   | 2    | 10047      |
| 20    | JAM NUT, STAINLESS STEEL             | 1    | 10060      |
| 21    | LOCK NUT, STL. PLATED                | 1    | 10044      |
| 22    | MOUNTING PLATE, ALUM. PNEUMATIC      | 1    | 20032      |
|       | MOUNTING PLATE 1, ELECTRIC           | 1    | 20185      |
|       | MOUNTING PLATE 2, ELECTRIC           | 1    | 20186      |
| 23**  | BACK UP RING, TEFLON® •              | 2    | 05011-3612 |
| 24*** | HAMMER UNION, STD. V THREAD, WCB     | 1    | 05012-6705 |
|       | HAMMER UNION, ACME THREAD, WCB       | 1    | 05012-3702 |
| 25*** | O-RING, BUNA-N FOR SCH.80 WN •       | 1    | 05000-5446 |
|       | O-RING, BUNA-N FOR SCH.160 WN •      | 1    | 05000-0561 |

\*For 2" NPT and 4" Union only.

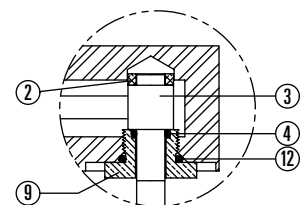
\*\*For 1" NPT only.

\*\*\*For 4" Union only.

• Recommended Spare Part



PIVOT SHAFT DETAIL  
FOR 1" NPT ONLY



TRUNNION DETAIL  
FOR 2" NPT AND 4" UNION

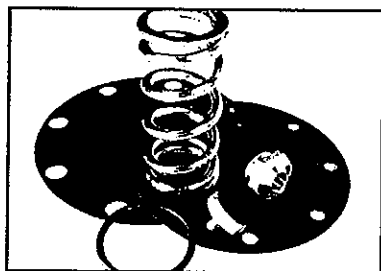


The P627 is a spring loaded, direct-operated regulator for both low and high pressure applications in the oil and gas industries. These regulators provide durability, from the powder-coated epoxy exterior finish, as well as installation versatility, from the multi-position body and spring case configurations. These regulators are also available in an external pressure registration model (P627M), and NACE construction.

- Farm Tap Regulation
- Monitoring Regulators
- Gate Regulators

**Body, Bonnet, Diaphragm Case . . . . . Steel Body, Bonnet & Diaphragm Case**  
**OR . . . . . Cast Ductile Iron Body/Aluminum Bonnet & Diaphragm Case**  
**OR . . . . . Steel Body/Aluminum Bonnet & Diaphragm Case (NACE only)**  
**Diaphragm . . . . . Nitrile (low pressure) or Neoprene (high pressure)**  
**Seat . . . . . Nitrile or Nylon**  
**Orifice . . . . . Aluminum**

|                                     |  |
|-------------------------------------|--|
| <b>Maximum Inlet:</b>               |  |
| Nylon Seat . . . . .                | .2000 psig (steel); 1000 psig (ductile iron) |
| Nitrile Seat . . . . .              | .1000 psig (steel); 1000 psig (ductile iron) |
| <b>Outlet . . . . .</b>             | <b>.5–500 psig</b>                           |
| <b>Port Sizes . . . . .</b>         | <b>3/4", 1", 2" NPT</b>                      |
| <b>Orifice Sizes . . . . .</b>      | <b>1/4", 3/16", 1/2", 3/8", 1/2"</b>         |
| <b>Outlet Range . . . . .</b>       | <b>Flow Range *</b>                          |
| 5–20 psig . . . . .                 | 300–43,000                                   |
| 15–40 psig . . . . .                | 1,000–71,000                                 |
| 35–80 psig . . . . .                | 1,200–142,000                                |
| 70–150 psig . . . . .               | 2,500–172,000                                |
| 140–250 psig . . . . .              | 3,200–95,000                                 |
| 240–500 psig . . . . .              | 4,500–140,000                                |
| (SCFH of 0.6 S.G. Natural Gas)      |  |
| <b>Temperature Range . . . . .</b>  | <b>–20° to 180°F (–18° to 82°C)</b>          |
| <b>Approximate Weight . . . . .</b> | <b>1" 5.3 lbs, 2.39 kg</b>                   |
| <b>. . . . .</b>                    | <b>2" 8.8 lbs, 3.96 kg</b>                   |



|               | KIT INCLUDES   | PART NUMBER |
|---------------|--|-------------|
| Low Pressure  | 627 Nitrile diaphragms (2), Nitrile valve disk, O'rings, back-up rings, and retaining pin. | 971-627-000 |
| Low Pressure  | 627 Nitrile diaphragms (2), Nylon valve disk, O'rings, back-up rings, and retaining pin.   | 971-627-001 |
| High Pressure | 627 Neoprene diaphragm, Nitrile valve disk, O'rings, back-up rings, and retaining pin.     | 971-627-002 |
| High Pressure | 627 Neoprene diaphragm, Nylon valve disk, O'rings, back-up rings, and retaining pin.       | 971-627-003 |



|   |   |   |   |  |  |  |  |  |  |  |   |
|---|---|---|---|--|--|--|--|--|--|--|---|
| P | 6 | 2 | 7 |  |  |  |  |  |  |  | 1 |
|---|---|---|---|--|--|--|--|--|--|--|---|

|           |     |
|-----------|-----|
| PORT SIZE |     |
| 1/4"      | 040 |
| 3/8"      | 040 |
| 1/2"      | 080 |

| SPRING RANGE |           |     |
|--------------|-----------|-----|
| psi          | BAR       |     |
| 5-20         | 0.34-1.4  | 020 |
| 15-40        | 1-2.8     | 040 |
| 35-80        | 2.4-5.5   | 080 |
| 70-150       | 4.8-10.3  | 150 |
| 140-250 *    | 9.7-17.2  | 250 |
| 240-500 *    | 16.5-34.5 | 500 |

\* Steel Casing/Steel Body Only

|                   |  |
|-------------------|--|
| SEAT CONSTRUCTION |  |
| NITRILE           |  |
| NYLON             |  |
| STEEL             |  |

|          |   |
|----------|---|
| VERSIONS |   |
| Standard | 0 |
| NACE *   | N |

\* Available as Steel/Steel or Aluminum/Steel only

|         |  |
|---------|--|
| ORIFICE |  |
| 1/4"    |  |
| 3/8"    |  |
| 1/2"    |  |

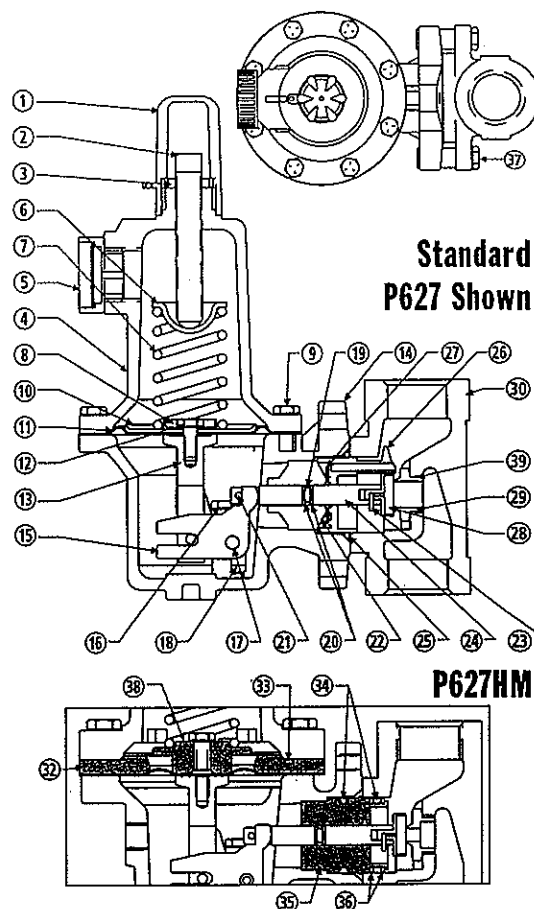
|                  |   |
|------------------|---|
| SEAT MATERIAL    |   |
| Nitrile (Buna-N) | 0 |
| Nylon            | 1 |

|                            |   |
|----------------------------|---|
| CASING MATERIAL            |   |
| Aluminum Casing/Steel Body | 0 |
| Steel Casing/Steel Body    | 1 |
| Aluminum Casing/Steel Body | 2 |

# 6227 HIGH FLOW GAS REGULATOR

| ITEM | DESCRIPTION  | PART NUMBER                |
|------|--|----------------------------|
| 1    | Cover Adj. Screw   | 610-053-000                |
| 2    | Adjustment Screw   | 648-465-000                |
| 3    | Locknut  | 634-154-000                |
| 4    | Bonnet, P627 - aluminum<br>Bonnet, P627M, P627H & P627HM - Steel | 604-210-000<br>604-211-000 |
| 5    | Vent Assembly  | 836-005-000                |
| 6    | Spring Guide, Upper  | 626-079-000                |
| 7    | Range Spring   |                            |
|      | 5-20 psig Yellow   | 655-661-000                |
|      | 15-40 psig Green   | 655-661-001                |
|      | 35-80 psig Blue  | 655-661-002                |
|      | 70-150 psig Red  | 655-661-003                |
|      | 140-250 psig Blue  | 655-661-002                |
|      | 240-500 psig Red   | 655-661-003                |
| 8    | Spring Guide, Lower (P627 or P627M only)                         | 637-306-000                |
| 9    | Build Screw, Spring Case (8 required)                            |                            |
|      | P627 - Aluminum  | 648-466-000                |
|      | P627 or P627M - Steel  | 648-467-003                |
|      | P627H or P627HM  | 648-467-002                |
| 10   | Diaphragm Piston (P627 or P627M only)                            | 643-191-000                |
| 11   | Diaphragm P627 & P627M   |                            |
|      | Aluminum/Iron Case   | 618-069-000                |
|      | Steel Case   | 618-070-000                |
|      | Diaphragm P627H & P627HM   |                            |
|      | Steel Case   | 618-070-001                |
| 12   | Screw, Diaphragm P627 & P627M                                    | 648-466-002                |
|      | Screw, Diaphragm P627H & P627HM                                  | 648-467-000                |
| 13   | Post, Pusher P627 & P627M Assy                                   | 827-005-000                |
|      | Post, Pusher P627H & P627HM Assy                                 | 827-005-001                |
|      | Post, Pusher P627 & P627M, NACE                                  | 827-008-000                |
|      | Post, Pusher P627H & P627HM, NACE                                | 827-008-001                |
| 14   | Diaphragm Case P627 - aluminum w/o gauge tap                     | 629-202-000                |
|      | Diaphragm Case P627 & P627H - steel                              | 629-203-000                |
|      | Diaphragm Case P627M & P627HM - steel                            | 629-204-000                |
|      | Diaphragm Case, aluminum/steel                                   | 629-215-000                |
| 15   | Lever  | 703-004-000                |
|      | Lever, NACE  | 703-005-000                |
| 16   | Lever Screw (2 required)   | 648-466-002                |
|      | Lever Screw, NACE (2 required)                                   | 648-474-000                |
| 17   | Pin, Lever   | 635-053-000                |
|      | Pin, Lever, NACE   | 635-057-000                |
| 18   | Lever Retainer   | 643-192-000                |
|      | Lever Retainer, NACE   | 643-194-000                |
| 19   | Stem O'Ring, nitrile   | 649-000-003                |
| 20   | Stem Backup Ring, TFE (2 required)                               | 644-047-000                |
| 21   | Pin, Groove  | 635-054-000                |
|      | Pin, Groove NACE   | 635-058-000                |
| 22   | Stem Guide   | 626-083-000                |
| 23   | Pin Clip<br>Pin Clip NACE  | 635-055-000<br>635-056-000 |
| 24   | Stem, 316SS  | 689-005-000                |
| 25   | Diaphragm Case O'Ring, nitrile (P627 & P627H)                    | 649-280-000                |
| 26   | Boost Body P627 or P627H   | 686-003-000                |
| 27   | Stabilizer, nitrile P627 or P627H                                | 649-278-000                |
| 28   | Seat assembly - aluminum holder/nitrile disk                     | 822-019-000                |
|      | Seat assembly - aluminum/nylon                                   | 822-019-001                |
|      | Seat assembly - 316SS holder/nitrile (NACE only)                 | 822-020-000                |
|      | Seat assembly - 316SS/nylon (NACE only)                          | 822-020-001                |
| 29   | Orifice - Aluminum   |                            |
|      | 1/4"   | 688-013-004                |
|      | 1/2"   | 688-013-003                |
|      | 3/4"   | 688-013-002                |



\* For 648-466-003 only, order 662-000-023 lock washer.

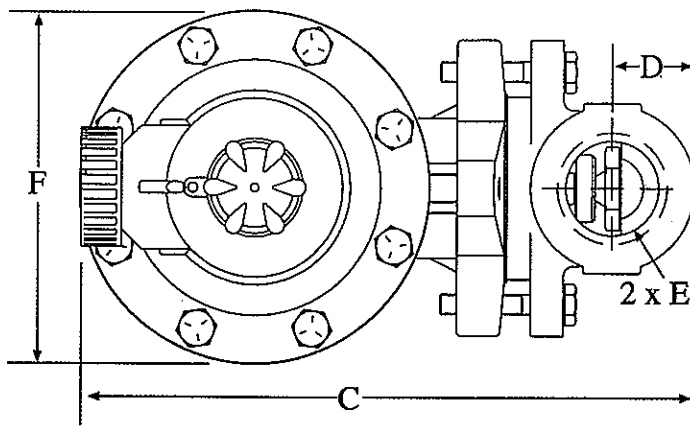
| ITEM | DESCRIPTION                                     | PART NUMBER    |
|------|---|----------------|
| 29   | 1/4"  | 688-013-001    |
|      | 1/2"  | 688-013-000    |
|      | Orifice - 316SS (NACE units)                    |                |
|      | 1/4"  | 688-014-004    |
|      | 1/2"  | 688-014-003    |
|      | 3/4"  | 688-014-002    |
| 30   | Body - Ductile Iron                             |                |
|      | 1/2" NPT  | 664-280-000    |
|      | 1" NPT  | 664-280-001    |
|      | 2" NPT  | 664-282-000    |
|      | Body - Steel                                    |                |
|      | 1/2" NPT  | 664-281-000    |
| 31   | 1" NPT  | 664-281-001    |
|      | 2" NPT  | 664-283-000    |
| 31   | Nameplate (not shown)                           | 632-474-000    |
| 32   | Diaphragm Spacer (P627H or P627HM only)         | 654-167-000    |
| 33   | O'Ring, Spacer (P627H or P627HM only)           | 649-279-000    |
| 34   | O'Ring, Throat Block (2 required)               | 649-281-000    |
| 35   | Throat Block (P627M or P627HM only)             | 626-081-000    |
| 36   | Backup Ring, Throat Block (2 required)          | 644-048-000    |
| 37   | Build Screw, 1/4" & 1" aluminum unit            | 648-466-001    |
| 38   | Build Screw, all steel bodies                   | 648-467-001    |
|      | Build Screw 2" aluminum unit (2 required) *     | 648-466-003    |
| 39   | Spring Guide, Lower (P627H & P627HM only)       | 637-307-000    |
| 40   | Thread Locker                                   | consult factor |
| 40   | Name Plate Drive Screw (2 required) (not shown) | 648-464-000    |



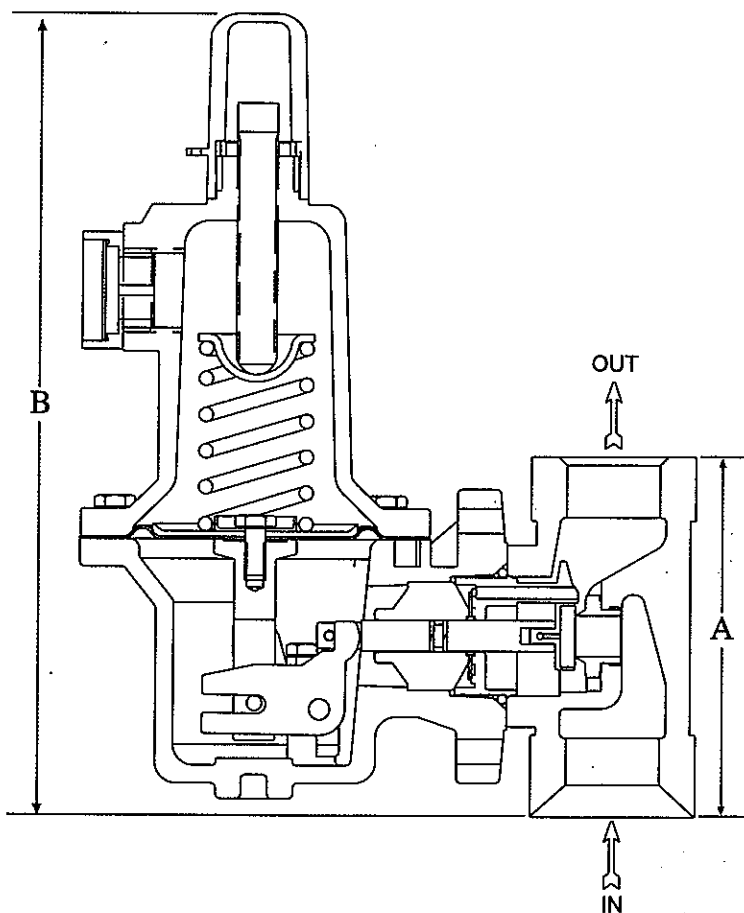
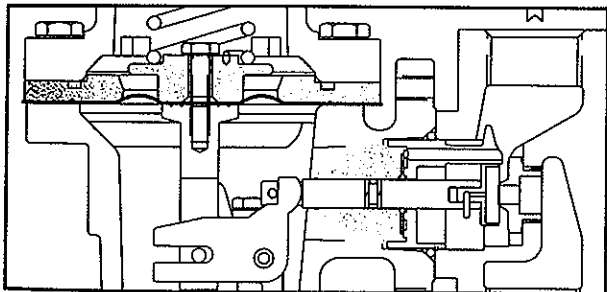
# **DIMENSIONS: Aluminum/Cast Ductile Iron Units**

| TYPE         | BODY SIZE |        | A    | B     | C    | D    | E      | F    |
|--------------|-----------|--------|------|-------|------|------|--------|------|
| 627 & 627M   | 3/4"      | mm     | 104  | 243   | 190  | 26   | 3/4"   | 108  |
|              |           | inches | 4.08 | 9.54  | 7.46 | 1.0  | NPT    | 4.25 |
|              | 1"        | mm     | 104  | 243   | 190  | 26   | 1" NPT | 108  |
|              |           | inches | 4.08 | 9.54  | 7.46 | 1.0  |        | 4.25 |
|              | 2"        | mm     | 127  | 256   | 218  | 43   | 2" NPT | 108  |
|              |           | inches | 5.0  | 10.06 | 8.56 | 1.69 |        | 4.25 |
| 627H & 627HM | 3/4"      | mm     | 104  | 250   | 194  | 26   | 3/4"   | 120  |
|              |           | inches | 4.08 | 9.82  | 7.62 | 1.0  | NPT    | 4.70 |
|              | 1"        | mm     | 104  | 250   | 194  | 26   | 1" NPT | 120  |
|              |           | inches | 4.08 | 9.82  | 7.62 | 1.0  |        | 4.70 |
|              | 2"        | mm     | 127  | 265   | 224  | 43   | 2" NPT | 120  |
|              |           | inches | 5.0  | 10.44 | 8.80 | 1.69 |        | 4.70 |

\*F Dimensions for steel P627 and P627M - 120mm/4.7 inches



**P627H**



**P627 HIGH FLOW GAS REGULATOR**

