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☐ **Public Document**

Xcel Energy	Information Request No.	62
Docket No.:	OAH 71-2500-37763; MPUC CI-21-610	
Response To:	Minnesota Department of Commerce	
Requestor:	Nancy Campbell	
Date Received:	January 27, 2022	

Question:
Topic: Wescott LNG Facility
Reference(s): n/a

Provide the following information on the Wescott LNG Facility for the LNG pumps installed at the time of the events on December 31, 2020 and January 4, 2021 that caused the natural gas release ("old LNG pumps"):

a. Provide copies of the design specifications of the old LNG pumps.
b. Provide copies of the purchase requisition for the old LNG pumps.
c. Provide copies of the operating and maintenance manuals of the old LNG pumps.
d. Provide copies of testing procedures for the old LNG pumps.
e. Provide a description of the LNG pumps control logic that identifies all interfacing instruments and the operating conditions of those instruments which will cause the LNG pumps to alter flow rates, trip, or not start.
f. Provide copies of the maximum, minimum, and normal operating conditions for the old LNG pumps.
g. Provide copies of the design specification for properly sized the LNG pumps to replace the old LNG
h. Provide the design specifications for the motors driving the old LNG pumps.
i. When did Xcel become aware the old LNG pumps were oversized?
j. Provide all analysis or reasoning that led to Xcel becoming aware of the oversized of the old LNG pumps.
k. Provide the LNG pump metric that defines the pump as oversized in flow rate, pressure, etc.
l. Identify the percentage the installed LNG pump is oversized.
m. Provide the specifications for a properly sized LNG pump for the Wescott LNG Facility.

n. If the properly sized LNG pumps were installed at Westcott LNG Facility at time of the events that led to the natural gas release on December 31, 2020 and January 4, 2021, would the release have been prevented?
   i) Provide any analysis that was performed leading to this conclusion.
   ii) Provide a detailed explanation that leads to this conclusion including a description of how the control system would have responded differently with the properly sized LNG pumps.

o. If Xcel replaced the oversized old LNG pumps, provide copies of all design specifications and operating and maintenance manuals.

Response:

a. Xcel does not have the design specifications for pumps **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** installed in 2000. Records indicate that the 2000 replacement pump project was designed by CHI Engineering Service, Inc, an engineering firm with experience with LNG facilities.

b. Xcel does not have the purchase requisition for pumps **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** installed in 2000.

c. Xcel does not have the operating and maintenance manuals for the **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** LNG pumps installed in 2000. "Wescott LNG Operating Manual Complete 2019" and "Wescott LNG Maintenance Manual Complete 2019" have procedures for the pumps that were installed in 2000. These documents were provided in response to DOC Information Request No. 61 as Attachments A and D, respectively.

d. The **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** LNG pumps installed in 2000 did not require routine maintenance testing themselves. The pumps were physically run and, in a sense, tested during each vaporization season startup. Those procedures are included in the Wescott Operations Manual provided as Attachment A in DOC IR No. 61. Additionally, instrumentation and controls testing was conducted. Procedures for testing are included in the Wescott Maintenance Manual provided as Attachment D in DOC IR No. 61. See Attachment A to this response, "LNG Product Pump Oct 2020," for an example of annual testing and calibration of the equipment related to the pumps. The Company is providing calibration records for **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** in response to DOC IR. No. 64. The

Company has calibration records for other components at the plant and will provide them to the Department or any other party upon request.

e. This data cannot be provided because a description of the LNG Pump control logic at the time of the unplanned releases at Wescott "that identifies all interfacing instruments and the operating conditions of those instruments which will cause the LNG pumps to alter flow rates, trip, or not start" does not exist. The below FBD (Function Block Diagram) is the control logic for the LNG pumps – taken from the PLC database with a modification date of January 13, 2021. It can be reasonably concluded based on documented changes to the system as described in DOC IR No. 61, subpart (n) that this is the logic that would have been in place at the time of the December 31, 2020 and January 4, 2021 events.

[PROTECTED DATA BEGINS

PROTECTED DATA ENDS]

f. The available requested information can be found in the "Wescott LNG Operating Manual Complete 2019" Section 4.4, which was provided as Attachment A to DOC IR No. 61.

g. The **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** pumps that were installed in 2000 have not been replaced. As noted in the Rebuttal testimony of Steven Martz at p. 29, l. 24- p.30, l.1, the Company installed two variable frequency drives (VFDs). These were installed on **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS].** The VFDs add dynamic speed control to the pumps to prevent the pumps from quickly ramping up to the point of over-pressuring the vapor system and the discharge pipe; it also sets a maximum speed for the pumps. Pump **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** is currently out of service and a VFD would need to be added before it is placed back in service.

h. The motors are encased within the **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** pumps and are not separate components.

i. Xcel became aware that the pumps could exceed the PSV set points during the December 31, 2020 and January 4, 2021 events and during the HAZOP vaporization system review conducted from March 29 to April 1, 2021.

j. The HAZOP report has previously been provided as Attachment 45 to DOC IR No. 18a. The "Root Cause Investigation Report" for the unplanned releases at Wescott were previously provided as Attachment A to DOC IR No. 18b.

k. Prior to the installation of the Variable frequency drives (VFDs) in 2021, the **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** pumps could establish 1200 psig of discharge pressure. The previous pumps original to the facility were capable of approximately 650 psig discharge pressure. Thus the original pumps could not produce sufficient pressure to exceed the pressure safety valve set points, or produce a release from the system. The rating provided for the **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** pumps are based on max discharge pressure rating without VFD controls.

l. The setpoints of the PSVs were set to the service limits of the vaporizers, or 1000 psig, as this was the controlling equipment on the vaporization circuit between the LNG pumps and the vaporizer discharge. Prior to installation of the VFDs, the pumps could exceed the 1000 psig setpoints by twenty percent.

m. A design has not been initiated for replacing LNG pumps **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]**. Variable frequency drives (VFDs) were installed in 2021, to add dynamic

control to the operating and discharge pressures of the LNG pumps **[PROTECTED DATA BEGINS [redacted] PROTECTED DATA ENDS]**.

n. If LNG pumps were not able to exceed the PSV setpoints, the natural gas releases on December 31, 2020 and January 4, 2021 would not have occurred. This could have been accomplished with different LNG pumps, VFDs, pump modifications, or system controls.

   i) This conclusion was made by subject matter experts with knowledge of natural gas systems and LNG facilities.

   ii) These conclusions are based on common industry knowledge by subject matter experts. A control system would have interlocked or shutdown the pumps prior to LNG pump discharge exceeding 1000 psig.

o. If Xcel replaced the oversized old LNG pumps, provide copies of all design specifications and operating and maintenance manuals.

   Xcel has not replaced the pumps installed in 2000. As discussed in subpart (g), VFDs have been added to the pumps **[PROTECTED DATA BEGINS [redacted] PROTECTED DATA ENDS]**.

Portions of this response are considered Not Public Security Information. The redacted information is Security Information pursuant to Minn. Stat. 13.37 because it provides specific and technical information about the peaking plants and the disclosure of this information could substantially jeopardize the facilities. Accordingly, the redacted information has been marked as Not Public data.

Preparer:	Kevin Joyce	Clarence Wong
Title:	Director	Manager
Department:	Gas Programs	Gas Process & Control Engineering
Telephone:	651-229-5519	823-341-1645
Date:	February 4, 2022	

LNG PRODUCT PUMPS

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE
					PASS	10-28-2020
					PASS	10-30-2020
					PASS	10-30-2020
					PASS	10-28-2020
					PASS	
					PASS	
					PASS	
					PASS	
					PASS	10-28-2020
					PASS	10-30-2020
					PASS	10-30-2020
					PASS	10-28-2020
					PASS	
					PASS	
					PASS	
					PASS	
					PASS	10-28-2020
					PASS	10-30-2020
					PASS	10-30-2020
					PASS	10-28-2020
					PASS	
					PASS	
					PASS	
					PASS	

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE
					PASS	10-30-2020
					PASS	10-28-2020
					CIRCUIT BRK	10-28-2020
					PASS	10/28/2020

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Xcel Energy	Information Request No.	63
Docket No.:	OAH 71-2500-37763; MPUC CI-21-610	
Response To:	Minnesota Department of Commerce	
Requestor:	Nancy Campbell	
Date Received:	January 27, 2022	

Question:
Topic: Wescott LNG Facility
Reference(s): n/a

Provide the following information regarding the modifications to the Wescott LNG Facility after the January 4, 2021 natural gas release event:

a. Identify all equipment modified, reconditioned and/or replaced in response to the January 4, 2021 natural gas release event at the Wescott LNG Facility.
b. For any equipment modifications, reconditioning, or replacements responsive to subpart (a), provide a detailed explanation for that action that includes the identification of all relevant persons, documents, analyses, and communications.
c. Provide copies of documents, analyses, and communications identified in subpart (b).
d. For equipment identified in subpart (a), provide equipment specifications for the original and any replacement equipment.
e. For equipment identified in subpart (a), provide any analysis performed that caused Xcel to determine equipment needed replacement, reconditioning, or modification.
f. For equipment identified in subpart (a), identify all testing performed subsequent to equipment modifications and provide copies of those test reports.
g. Identify all control systems modified, reconditioned, or replaced in response to the January 4, 2021 natural gas release event at the Wescott LNG Facility.
h. For any control system modifications, reconditioning, or replacements responsive to subpart (g), provide a detailed explanation for that action that includes the identification of all relevant persons, documents, analyses, and communications

i. Provide copies of documents, analyses, and communications identified in subpart (h).
j. For any control system modifications, reconditioning, or replacements responsive to subpart (g), identify all testing performed subsequent to control modifications and provide copies of those test reports.

Response:
More details on the projects the Company undertook at Wescott in 2021 after the unplanned releases can be found in the Direct Testimony of Joni H. Zich and Mary P. Palkovich in the pending Gas Rate Case, Docket No. G002/GR-21-678.

a. The control system replacement (DeltaV) and installation of the variable frequency drives for the LNG pumps was approved and being designed prior to the January 4, 2021 natural gas release event at the Wescott LNG Facility. These two changes, along with the other facility modifications are outlined below:

- Delta V
  - Refer to Wescott Control System Equipment Replacement, Attachment A to this response.
- Valve Replacement
  [PROTECTED DATA BEGINS
  - [redacted]

  PROTECTED DATA ENDS]
- Thermal Relief
  - Thermal Relief Header Modifications
  - Thermal Relief valves were bench tested and re-utilized
- Process Relief
  - Installation of 2 new process relief valves on **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]** discharge and manifold piping
- VFD
  - Installation of new control logic, electrical equipment and VFD's

b.

- Delta V
  - Refer to Wescott Control System Equipment Replacement, Attachment A to this response.
- Valve Replacement

    - Leak survey documentation
    - Control valve sizing – HYSYS Model Calcs
    - Destructive Valve Testing on **[PROTECTED DATA BEGINS** [redacted] **PROTECTED DATA ENDS]**
- Thermal Relief
    - Review of relief discharges and fluid at point of discharge
    - Review of facility containment
- Process Relief
    - Jan 2 event review
    - Pump documentation
    - Sizing Calculations

c. See Attachments B – G.

d.

- Original
    - Pump Spec
    - CHI Drawings/Design
- Proposed
    - CEPC New Drawings
    - CEPC Pipe and valve spec

e. See responses in subparts (b) and (c) above.

f. Referenced in transmittal, see Attachment H.

g.

- Delta V
    - Refer to Wescott Control System Equipment Replacement, Attachment A to this response.

h.

- Delta V
    - Refer to Wescott Control System Equipment Replacement, Attachment A to this response.

i.

- Delta V
    - Refer to Wescott Control System Equipment Replacement, Attachment A to this response.

j.

- Delta V
  - Refer to Wescott Control System Equipment Replacement, Attachment A to this response.

In the interest of providing these to the Department as quickly as possible, we've marked Attachments A-H to this response as Not Public information in their entirety because the documents contain security information. If the Department or any other party to the proceeding wishes to disclose excerpts of these reports throughout the course of the proceeding, the Company will work with those parties to refine this confidentiality determination and determine whether some information can be disclosed publicly.

Attachments A-H to this response are designated as Not Public in their entirety. Pursuant to Minn. R. 7829.0500, subp. 3, the Company provides the following description of the excised material:

1. **Nature of the Material:** Attachment A is a Wescott Control System Equipment Replacement Overview, Attachment B is the Wescott Design Basis Memorandum; Attachment C is Valve Specification; Attachments D-F are AsBuilts, Attachment G is the Pressure Relief Valve Design Workbook and Attachment H is a Document Transmittal.
2. **Authors:** Gas Operations or third party engineers
3. **Importance:** These attachments contain information that could be used to jeopardize the plant's security.
4. **Date the Information was Prepared:** 2021-2022

Preparer:	Clarence Wong
Title:	Manager
Department:	Gas Process & Control Engineering
Telephone:	823-341-1645
Date:	February 4, 2022

Attachments A-H
to this response are provided on iShare.

#759

NSP

PURCHASING DEPARTMENT COPY

TYPE MS

DATE	PURCHASE ORDER NO.
04/25/97	PL5101MS

NORTHERN STATES POWER COMPANY

SHIP 10326 SOUTH ROBERT TRAIL
INVER GR HGTS MN55075
ATTN-JAMES L. SCHUELKE
\RK-FOR E-MTCE1 VAPORIZER PROJECT -
ACTUATED WEG

339

PVF MIDWEST INC
2350 COUNTY ROAD C SUITE 150
ROSEVILLE, MN 55113

MAIL INVOICE TO:
Northern States Power Co.
Accounts Payable Dept.
P.O. Box 9366
Minneapolis, MN 55440-9366

Unless Otherwise Indicated Below
Mail All Acknowledgments,
And Correspondence
Promptly To
Northern States Power Company
PROCUREMENT SERVICES
414 NICOLLET MALL
MINNEAPOLIS MN 55401
612 330-5674

PAGE 1 PMIWESD

O.B. DESTINATION
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Scheduled Delivery Date	Terms:
07/17/97	NET 30 DAYS

Account Or W.O. Number	Requisition No.	Requisitioner	Buyer
1250 75.28.40.12-00	G870391	SCHUELKE JAMES L	JIM HUBER

Line No.	Quantity	Material Or Services To Be Furnished	Price
		AS A CONDITION OF PAYMENT THE FOLLOWING SHALL BE ADHERED TO: ********** PURCHASE ORDER NUMBER AND RELEASE NO. SHALL BE REFERENCED ON ALL INVOICES, PACKING SLIPS, CORRESPONDENCES, ASSOCIATED DOCUMENTS, ETC. ********** PRICES SHALL BE INCLUDED ON ALL PACKING SLIPS, AND THE PACKING SLIP NUMBER SHALL BE RECORDED ON EACH INVOICE.	
1	2 EA	8" VICTAULIC SERIES 300 WAFERSTYLE BUTTERFLY VALVE, GROOVED ENDS, WITH EDPM LINED CARBON STEEL BODY, EDPM COATED CARBON STEEL DISC, O-RING PACKING WITH ELOMATIC ESA350 ACTUATOR, SPRING TO OPEN 60 PSIG MINIMUM AIR TO CLOSE, WESTLOCK ICOT MODEL 4060HKA0A00 POSITIONER RATE INTRINSICALLY SAFE FOR CLASS 1, DIV 1, GROUP D, WITH FISHER 67AFR INSTRUMENT AIR FILTER REGULATOR SET AT 65 PSIG, STAINLESS STEEL INSTRUMENT AIR TUBING AND FITTINGS, ALL AS PER YOUR DATA SHEETS SUBMITTED WITH BID TO NSP INQUIRY JLH-97-003 "ALTERNATE RATED AT 200 PSIG AT 230 DEGREES F.	2,483.00

See Reverse Side For Additional Terms And Conditions Applying To This Order

TAXES

MATERIAL SUBJECT TO TAX OF STATE TO WHERE MATERIAL IS SHIPPED. ACTUAL FREIGHT CHARGES ARE GENERALLY TAX EXEMPT AND MUST BE SHOWN SEPARATELY ON INVOICE.

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DATE	PURCHASE ORDER NO.
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PVF MIDWEST INC
2350 COUNTY ROAD C SUITE 150
ROSEVILLE, MN 55113

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Northern States Power Co.
Accounts Payable Dept.
P.O. Box 9366
Minneapolis, MN 55440-9366

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And Correspondence
Promptly To
Northern States Power Company
PROCUREMENT SERVICES
414 NICOLLET MALL
MINNEAPOLIS MN 55401
612 330-5674

PAGE 2 PMIWESD

B. DESTINATION
FREIGHT ALLOWED

THIS PURCHASE ORDER NO. AND LINE NO. MUST APPEAR ON ALL PAPERS AND PACKAGES.

cheduled ivery Date	Terms:		Buyer
07/17/97	NET 30 DAYS		
count Or W.O. Number	Requisition No.	Requisitioner	
1250 75.28.40.12-00	G870391	SCHUELKE JAMES L	JIM HUBER

ine No.	Quantity	Material Or Services To Be Furnished	Price
		VALVE TAG NUMBERS TCV-209, TCV-309	
2	1 EA	10" VICTAULIC SERIES 300 WAFER STYLE BUTTERFLY VALVE, GROOVED ENDS, WITH EDPM LINED CARBON STEEL BODY, EDPM COATED CARBON STEEL DISC, O-RING PACKING WITH ELOMATIC PSA500 ACTUATOR, SPRING TO OPEN, 60 PSIG MINIMUM AIR TO CLOSE, WESTLOCK ICOT MODEL 4060HKAOA00 POSITIONER RATED INTRINSICALLY SAFE FOR CLASS 1, DIV 1, GROUP D, WITH FISHER 67AFR INSTRUMENT AIR FILTER REGULATOR SET AT 65 PSIG, STAINLESS STEEL INSTRUMENT AIR TUBING AND FITTINGS, ALL AS PER YOUR DATA SHEET SUBMITTED WITH BID TO NSP, INQUIRY JLH-97-003 "ALTERNATE RATED AT 200 PSIG AT 230 DEGREES F.	3,635.00
		VALVE TAG NUMBER DPCV-109	
3	3 EA	12" VICTAULIC SERIES 300 WAFER STYLE BUTTERFLY VALVE, GROOVED ENDS, WITH EDPM LINED CARBON STEEL BODY, EDPM COATED CARBON STEEL DISC, O-RING PACKING WITH ELOMATIC PSA750 ACTUATOR, SPRING TO OPEN, 60 PSIG MINIMUM AIR TO CLOSE, WESTLOCK ICOT MODEL 4060HKAOA00 POSITIONER RATED INTRINSICALLY SAFE FOR	4,253.00

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ATTN-JAMES L. SCHUELKE
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ROSEVILLE, MN 55113

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P.O. Box 9366
Minneapolis, MN 55440-9366

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And Correspondence
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PAGE 3 PMIWESD

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heduled very Date	Terms:	
07/17/97	NET 30 DAYS	

count Or W.O. Number	Requisition No.	Requisitioner	Buyer
250 75.28.40.12-00	G870391	SCHUELKE JAMES L	JIM HUBER

ine No.	Quantity	Material Or Services To Be Furnished	Price
		CLASSS 1, DIV 1, GROUP D, WITH FISHER 67AFR INSTRUMENT AIR FILTER REGULATOR SET AT 65 PSIG, STAINLESS STEEL INSTRUMENT AIR TUBING AND FITTINGS, ALL AS PER YOUR DATA SHEET SUBMITTED WITH BID TO NSP, INQUIRY JLH-97-003, "ALTERNATE RATED AT 200 PSIG AT 230 DEGREES F. VALVE TAG NUMBERS FCV-833, FCV-933, AND FCV-1033.	

See Reverse Side For Additional Terms And Conditions Applying To This Order

TAXES

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NORTHERN STATES POWER COMPANY

BY

AUTHORIZED SIGNATURE

339

CONTROL VALVE DATA SHEET

Prepared By:
CHI ENGINEERING SERVICES, INC.
235 [illegible]osd, Unit 11
Portsi[illegible]d, NH 03801
1-800-437-1995
Purchase Specification for Actuated WEG Valves
Specification Number NSP9604-M-7,
Rev. 0

PROJECT	NORTHERN STATES POWER	DATA SHEET	1 of 6
UNIT	LNG VAPORIZER REPLACEMENT	SPEC	
P.O.		TAG	TCV-209
ITEM	BOM Item #1	DWG	NSP9604-PID1, Sheet 1
CONTRACT	NSP 9604	SERVICE	WEG inlet temp. ctrl vlv
*MFR SERIAL			

Fluid: 40% Ethylene Glycol 60% Water by volume — Crit Press PC

SERVICE COND

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	2800		0	—
Inlet Pressure	Psia	70		70	75
Outlet Pressure	Psia	65			
Inlet Temperature	Degrees F	180		180	
Spec Wt/Spec Grav/Mol Wt	Specific Gr.	1.03		1.03	—
Viscosity/Spec Heats Ratio	Centipoise	0.79		0.79	—
Vapor Pressure Pv					—
*Required Cv					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	85@3'/	85@3'/	85@ 3'/	—

LINE
- Pipe Line Size & Schedule: In 10" Schedule 40; Out 10" Schedule 40
- Pipe Line Insulation: 1"

VALVE / BODY / BONNET
- *Type: Butterfly - Water Style or Grooved Ends
- *Size: 8" ANSI Class 150#
- Max Press/Temp: 275 psig / 240 degrees F SEE NOTE
- *MFR & Model: VICTAULIC #300
- *Bod/Bonnet Matl: CARBON STEEL
- *Liner Material/ID: EPDM
- End Connection: In Raised Face or Grooved Ends; Out Raised Face or Grooved Ends
- Flg Face Finish: 125-250 AARH for flexatallic gasket
- End Ext/Matl
- *Flow Direction: BI DIRECTIONAL
- *Type of Bonnet: N/A
- Lub & Iso Valve: N/A Lube: N/A
- * Packing Material: EPDM
- * Packing Type: O-RINGS

TRIM
- * Type: BUTTERFLY VALVE
- * Size: 8" Rated Travel: 250 TURN
- * Characteristic: SEE DATA SHEETS
- *Balanced/Unbalanced: N/A
- * Rated CV: 3400 FL XT
- * Plug/Ball/Disk Material: EPDM COATED CS
- * Seat Material
- * Cage/Guide Material: N/A
- * Stem Material: 316 SS

SPECIAL ACCESSORIES

NEC Class 1 Group D Div 1

Notes:
All valve tubing and gauges are to be stainless steel. "Smart" transmitter to transmit actual valve position, and have the ability to store historical signals as received relative to valve postion. Material Test Reports required for all pressure containment components which are welded.

ACTUATOR
- * Type: Pneumatic, air to close actuator
- * MFR & Model: ELOMATIC ESA350
- * Size: ESA350 Eff Area: N/A
- On/Off: Modulating: Yes
- Spring Action Open/Close: Spring to open
- * Max Allowable Pressure: 120 PSIG
- * Min Required Pressure: 60 PSIG
- Available Air Supply Pressure: 60 psig
- Max 80 psig Min
- * Bench Range: N/A /
- Actuator Orientation: N/A
- Handwheel Type: No Set at
- Air Failure Valve

POSITR
- Input Signal
- * Type: "Smart" type, Hart or Modbus protocol
- * MFR & Model: (See Notes) WESTLOCK ICOT 4060 H
- * On Incr Signal Output Incr/Decr: PROGRAMMABLE
- Gauges: Yes By-pass: No
- * Cam Characteristic: Beacon is std w/ actuator

SWITCH
- Type Quantity
- * MFR & Model
- Contacts/Rating
- Actuation Points

AIR SET
- * MFR & Model: Fisher Model 67AFR
- * Set Pressure: as required by the positioner
- Filter: Yes Gauge: Yes

TEST
- * Hydro Pressure
- ANSI/FCI Leakage Class: V

Rev	Date	Revision	Orig	App
Orig.	7/24/97	Issued for Review		

339

CONTROL VALVE DATA SHEET

Prepared By:
CHI ENGINEERING SERVICES, INC.
135 W[illegible]ad, Unit 11
Portsmouth, NH 03801
1-800-437-1995
Purchase Specification for Actuated WEG Valves
Specification Number NSP9604-M-7, Rev. 0

PROJECT	NORTHERN STATES POWER	DATA SHEET	2 of 6
UNIT	LNG VAPORIZER REPLACEMENT	SPEC	
P.O.		TAG	TCV-309
ITEM	BOM Item #2	DWG	NSP9604-PID3, Sheet 1
CONTRACT	NSP 9604	SERVICE	WEG inlet temp. cont vlv
*MFR SERIAL			

Fluid 40% Ethylene Glycol 60% Water by volume — Cvs Press PC

SERVICE COND

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	2800		0	—
Inlet Pressure	Psia	70		70	75
Outlet Pressure	Psia	65			
Inlet Temperature	Degrees F	180		180	
Spec Wt/Spec Grav/Mol Wt	Specific Gr.	1.03		1.03	—
Viscosity/Spec Heat Ratio	Centipoise	0.79		0.79	—
Vapor Pressure Pv					—
*Required Cv					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	85@3' /	85@3' /	85@ 3' /	—

LINE
Pipe Line Size & Schedule — In 10" Schedule 40 / Out 10" Schedule 40
Pipe Line Insulation 1"

VALV ODY/BONNET
*Type Butterfly - Wafer Style or Grooved Ends
*Size 8" ANSI Class 150#
Max Press/Temp 275 psig / 240 degrees F
*MFR & Model VICTAULIC #300
*Bod/Bonnet Mat CARBON STEEL
*Liner Material/ID EPDM
End Connection — In Raised Face or Grooved Ends / Out Raised Face or Grooved Ends
Flg Face Finish 125-250 AARH for flexatallic gasket
End Ext/Mat
*Flow Direction BI DIRECTIONAL
*Type of Bonnet N/A
Lub & Iso Valve N/A Lube N/A
* Packing Material EPDM
* Packing Type O-RINGS

TRIM
* Type BUTTERFLY VALVE
* Size 8" Rated Travel .250 TURN
* Characteristic SEE DATA SHEETS
*Balanced/Unbalanced N/A
* Rated CV 3400 FL XT
* Plug/Ball/Disk Material EPDM COATED CS
* Seat Material
* Cage/Guide Material N/A
* Stem Material 316SS

ACTUATOR
* Type Pneumatic, air to close scanner
* MFR & Model ELOMATIC ESA350
* Size ESA350 Eff Area N/A
On/Off Modulating Yes
Spring Action Open/Close Spring to open
* Max Allowable Pressure 120 PSIG
* Min Required Pressure 60 PSIG
Available Air Supply Pressure: 60 psig
Max 80 psig Min
* Bench Range N/A /
Actuator Orientation N/A
Handwheel Type No Set at
Air Failure Valve

POSITR
Input Signal
* Type "Smart" type, Hart or Modbus protocol
* MFR & Model (See Notes) WESTLOCK ICOT 4000A
* On Incr Signal Output Incr/Decr PROGRAMMABLE
Gauges Yes By-pass No
* Cam Characteristic

SWITCH
Type Quantity
* MFR & Model
Contacts/Rating
Actuation Points

AIR SET
* MFR & Model Fisher Model 67AFR
* Set Pressure as required by the positioner
Yes
Filter Gauge Yes

TEST
* Hydro Pressure
ANSI/FCI Leakage Class V

SPECIAL ACCESSORIES
NEC Class 1 Group D Div 1

Notes:
All valve tubing and gauges are to be stainless steel. "Smart" transmitter to transmit actual valve position, and have the ability to store historical signals as received relative to valve position. Material Test Reports required for all pressure containment components which are welded.

Rev	Date	Revision	Orig	App
Orig.	7/21/97	Issued for Review		

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CONTROL VALVE DATA SHEET

Prepared By:
CHI ENGINEERING SERVICES, INC.
235 [illegible]oad, Unit 11
Ports[illegible]n, NH 03801
1-800-437-1995
Purchase Specification for Actuated WEG Valves
Specification Number NSP9604-M-7,
Rev. 0

PROJECT	NORTHERN STATES POWER	DATA SHEET	3 of 6
UNIT	LNG VAPORIZER REPLACEMENT	SPEC	
P.O.		TAG	DPCV-109
ITEM	BOM Item #3	DWG	NSP9604-PID1, Sheet 3
CONTRACT	NSP 9604	SERVICE	WEG Recirculation Valve
*MFR SERIAL			

Fluid: 40% Ethylene Glycol 60% Water by volume — Cnt Press PC

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	7200	900		—
Inlet Pressure	Psia	70	70		75
Outlet Pressure	Psia	63	67		
Inlet Temperature	Degrees F	180	180		
Spec Wt/Spec Grav/Mol Wt	Specific Gr.	1.03	1.03		—
Viscosity/Spec Heat Ratio	Centipoise	0.79	0.79		—
Vapor Pressure Pv					—
*Required Cv					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	85@3' /	85@3' /	85@3' /	—

LINE
Pipe Line Size & Schedule: In 10" Schedule 40; Out 10" Schedule 40
Pipe Line Insulation: 1"

VALVE BODY/BONNET
*Type: Butterfly - Water Style or Grooved Ends
*Size: 10" ANSI Class: 150#
Max Press/Temp: 275 psig / 240 degrees F
*MFR & Model: VICTAULIC #300
*Bod/Bonnet Matl: CARBON STEEL
*Liner Material/ID: EPDM
End Connection: In Raised Face or Grooved Ends; Out Raised Face or Grooved Ends
Flg Face Finish: 125-250 AARH for flexatallic gasket
End Ext/Matl:
*Flow Direction: BI DIRECTIONAL
*Type of Bonnet: N/A
Lub & Iso Valve: N/A Lube: N/A
* Packing Material: EPDM
* Packing Type: O-RINGS

TRIM
* Type: BUTTERFLY VALVE
* Size: 10" Rated Travel: .250 TURN
* Characteristic: SEE DATA SHEETS
*Balanced/Unbalanced: N/A
* Rated CV: 5750 FL: XT:
* Plug/Ball/Disk Material: EPDM COATED CS.
* Seat Material:
* Cage/Guide Material: N/A
* Stem Material: 316SS

SPECIAL ACCESSORIES
NEC Class: 1 Group: D Div: 1
Notes:
All valve tubing and gauges are to be stainless steel. "Smart" transmitter to transmit actual valve position, and have the ability to store historical signals as received relative to valve postion. Material Test Reports required for all pressure containment components which are welded.

ACTUATOR
* Type: Pneumatic, air to close actuator
* MFR & Model: ELOMATIC PSA500
* Size: PSA500 Eff Area:
On/Off: Modulating: Yes
Spring Action Open/Close: Spring to open
* Max Allowable Pressure: 120 PSIG
* Min Required Pressure: 60 PSIG
Available Air Supply Pressure: 80 psig
Max: 80 psig Min:
* Bench Range: N/A /
Actuator Orientation: N/A
Handwheel Type: Yes - Mfg's Std Set at:
Air Failure Valve:

POSITR
Input Signal
* Type: "Smart" type, Hart or Modbus protocol
* MFR & Model: (See Notes) WESTLOCK ICOT 4000M
* On Incr Signal Output Incr/Decr: PROGRAMMABLE
Gauges: Yes By-pass: No
* Cam Characteristic:

SWITCH
Type: Quantity:
* MFR & Model:
Contacts/Rating:
Actuation Points:

AIR SET
* MFR & Model: Fisher Model 67AFR
* Set Pressure: as required by the positioner
Filter: Yes Gauge: Yes

TEST
* Hydro Pressure:
ANSI/FCI Leakage Class: V

Rev	Date	Revision	Orig	App
Orig.	2/21/97	Issued for Review		

339

CONTROL VALVE DATA SHEET

Prepared By:
CHI[illegible] ENGINEERING SERVICES, INC.
23[illegible] Road, Unit 11
Port[illegible]arth, NH 03801
1-800-437-1995
Purchase Specification for Actuated WEG Valves
Specification Number NSP9604-M-7,
Rev. 0

PROJECT	NORTHERN STATES POWER	DATA SHEET	4 of 6
UNIT	LNG VAPORIZER REPLACEMENT	SPEC	
P.O.		TAG	FCV-833
ITEM	BOM Item #4	DWG	NSP9604-PID8, Sheet 2
CONTRACT	NSP 9604	SERVICE	WEG Hir Inlet FCV
*MFR SERIAL			

Fluid: 40% Ethylene Glycol 60% Water by volume — Cvr Press PC

SERVICE COND

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	1800		0	—
Inlet Pressure	Psia	45		45	75
Outlet Pressure	Psia	43			
Inlet Temperature	Degrees F	130		130	
Spec Wt/Spec Grav/Mol Wt	Specific Gr.	1.03		1.03	—
Viscosity/Spec Heats Ratio	Centipoise	0.79		0.79	—
Vapor Pressure Pv					—
*Required Cv					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	85@3' /	85@3' /	85@3' /	—

LINE
Pipe Line Size & Schedule: In 12" STD (may be 14" STD); Out 12" STD (may be 14" STD)
Pipe Line Insulation: 1"

VALV ODY BONNET
*Type: Butterfly - Wafer Style or Grooved Ends
*Size: 12" ANSI Class: 150#
Max Press/Temp: 275 psig / 240 degrees F
*MFR & Model: VICTAULIC 300
*Bod/Bonnet Matl: CARBON STEEL
*Liner Material/ID: EPDM
End: In Raised Face or Grooved Ends; Out Raised Face or Grooved Ends
Connection
Flg Face Finish: 125-250 AARH for flexatallic gasket
End Ext/Matl
*Flow Direction: BI DIRECTIONAL
*Type of Bonnet: N/A
Lub & Iso Valve: N/A Lube: N/A
* Packing Material: EPDM
* Packing Type: ORINGS

TRIM
* Type: BUTTERFLY VALVE
* Size: 12" Rated Travel: .250 TURN
* Characteristic: SEE DATA SHEETS
*Balanced/Unbalanced: N/A
* Rated CV: 8300 FL XT
* Plug/Ball/Disk Material: EPDM COATED DISC
* Seat Material
* Cage/Guide Material: N/A
* Stem Material: 316SS

SPECIAL ACCESSORIES
NEMA 1

ACCESSORIES
Notes:
All valve tubing and gauges are to be stainless steel. "Smart" transmitter to transmit actual valve position, and have the ability to store historical signals as received relative to valve position. Material Test Reports required for all pressure containment components which are welded.

ACTUATOR
* Type: Pneumatic, air to close actuator
* MFR & Model: ELOMATIC PSA750
* Size: PSA750 Eff Area: N/A
On/Off: On/Off Service Modulating: No
Spring Action Open/Close: Spring to open
* Max Allowable Pressure: 120 PSIG
* Min Required Pressure: 60 PSIG
Available Air Supply Pressure: 60 psig
Max: 80 psig Min
* Bench Range: N/A /
Actuator Orientation: N/A
Handwheel Type: No Set at
Air Failure Valve

POSITR
Input Signal
* Type: "Smart" type, Hart or Modbus protocol
* MFR & Model (See Notes): WESTLOCK ICOT 4060H
* On Incr Signal Output Incr/Decr: PROGRAMMABLE
Gauges: Yes By-pass: No
* Cam Characteristic

SWITCH
Type Quantity
* MFR & Model
Contacts/Rating
Actuation Points

AIR SET
* MFR & Model: Fisher Model 67AFR
* Set Pressure: as required by the positioner
Filter: Yes Gauge: Yes

TEST
* Hydro Pressure
ANSI/FCI Leakage Class: V

Rev	Date	Revision	Orig	App
Orig.	2/24/21	Issued for Review		

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CONTROL VALVE DATA SHEET

Prepared By:
CHI ENGINEERING SERVICES, INC.
235 W[illegible] Road, Unit 11
Port[illegible], NH 03801
1-800-[illegible]37-1995
Purchase Specification for Actuated WEG Valves
Specification Number NSP9604-M-7, Rev. 0

PROJECT	NORTHERN STATES POWER	DATA SHEET	5 of 6
UNIT	LNG VAPORIZER REPLACEMENT	SPEC	
P.O.		TAG	FCV-933
ITEM	BOM Item #5	DWG	NSP9604-PID9, Sheet 2
CONTRACT	NSP 9604	SERVICE	WEG Htr Inlet FCV
*MFR SERIAL			

Fluid: 40% Ethylene Glycol 60% Water by volume — Crit Press PC

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	1800		0	—
Inlet Pressure	Psia	45		45	75
Outlet Pressure	Psia	43			
Inlet Temperature	Degrees F	120		120	
Spec Wt/Spec Grav/Mol Wt	Specific Gr.	1.03		1.03	—
Viscosity/Spec Heats Ratio	Centipoise	0.79		0.79	—
Vapor Pressure Pv					—
*Required Cv					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	85@3'/	85@3'/	85@3'/	—

LINE
- Pipe Line Size & Schedule: In 12" STD (may be 14" STD); Out 12" STD (may be 14" STD)
- Pipe Line Insulation: 1"

VALVE
- *Type: Butterfly - Water Style or Grooved Ends
- *Size: 12" ANSI Class: 150#
- Max Press/Temp: 275 psig / 240 degrees F
- *MFR & Model: VICTAULIC #300
- *Bod/Bonnet Mat'l: CARBON STEEL
- *Liner Material/ID: EPDM
- End: In Raised Face or Grooved Ends; Out Raised Face or Grooved Ends
- Connection
- Flg Face Finish: 125-250 AARH for flexatallic gasket
- End Ext/Mat'l
- *Flow Direction: BI DIRECTIONAL
- *Type of Bonnet: N/A
- Lub & Iso Valve: N/A Lube: N/A
- * Packing Material: EPDM
- * Packing Type: O RINGS

TRIM
- * Type: BUTTERFLY VALVE
- * Size: 12" Rated Travel: .250 TURN
- * Characteristic: SEE DATA SHEETS
- *Balanced/Unbalanced: N/A
- * Rated Cv: 8300 FL XT
- * Plug/Ball/Disk Material: EPDM COATED DISC
- * Seat Material
- * Cage/Guide Material: N/A
- * Stem Material: 316SS

SPECIAL ACCESSORIES

NEMA 4

Notes:

All valve tubing and fittings are to be stainless steel. "Smart" transmitter to transmit actual valve position, and have the ability to store historical signals as received relative to valve position. Material Test Reports required for all pressure containment components which are welded.

ACTUATOR
- * Type: Pneumatic, air to close actuator
- * MFR & Model: ELOMATIC PSA750
- * Size: PSA750 Eff Area: N/A
- On/Off: On/Off Service Modulating: No
- Spring Action Open/Close: Spring to open
- * Max Allowable Pressure: 120 PSIG
- * Min Required Pressure: 60 PSIG
- Available Air Supply Pressure: 60 psig
- Max: 80 psig Min
- * Bench Range: N/A /
- Actuator Orientation: N/A
- Handwheel Type: No Set at
- Air Failure Valve

POSITIONER
- Input Signal
- * Type: "Smart" type, Hart or Modbus protocol
- * MFR & Model (See Notes): WESTLOCK ICOT 4060
- * On Incr Signal Output Incr/Decr: PROGRAMMABLE
- Gauges: Yes By-pass: No
- * Cam Characteristic

SWITCH
- Type Quantity
- * MFR & Model
- Contacts/Rating
- Actuation Points

AIR SET
- * MFR & Model: Fisher Model 67AFR
- * Set Pressure: as required by the positioner
- Filter: Yes Gauge: Yes

TEST
- * Hydro Pressure
- ANSI/FCI Leakage Class: V

Rev	Date	Revision	Orig	App
Orig.	4/24/97	Issued for Review		

* Information supplied by manufacturer unless already specified.

ISA Form S20-S1 Rev. 1

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CONTROL VALVE DATA SHEET

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il ENGINEERING SERVICES, INC.
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00-437-1995
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ecification Number NSP9604-M-7,
v. 0

PROJECT	NORTHERN STATES POWER	DATA SHEET	6 of 6
UNIT	LNG VAPORIZER REPLACEMENT	SPEC	
P.O.		TAG	FCV-1033
ITEM	BOM Item #6	DWG	NSP9604-PID10, Sheet 2
CONTRACT	NSP 9604	SERVICE	WEG Htr inlet FCV
*MFR SERIAL			

Fluid: 40% Ethylene Glycol 60% Water by volume — Cnt Press PC

SERVICE COND

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	1800		0	—
Inlet Pressure	Psia	45		45	75
Outlet Pressure	Psia	43			
Inlet Temperature	Degrees F	130		130	
Spec Wt/Spec Grav/Mol Wt	Specific Gr.	1.03		1.03	—
Viscosity/Spec Heat Ratio	Centipoise	0.79		0.79	—
Vapor Pressure Pv					—
*Required Cv					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	85@3' /	85@3' /	85@ 3' /	—

LINE
Pipe Line Size & Schedule: In 12" STD (may be 14" STD); Out 12" STD (may be 14" STD)
Pipe Line Insulation: 1"

VALVE BODY/BONNET
*Type: Butterfly - Water Style or Grooved Ends
*Size: 12" ANSI Class: 150#
Max Press/Temp: 275 psig / 240 degrees F
*MFR & Model: VICTAULIC #300
Body/Bonnet Mat'l: CARBON STEEL
Liner Material/ID: EPDM
End Connection: In Raised Face or Grooved Ends; Out Raised Face or Grooved Ends
Flg Face Finish: 125-250 AARH for flexatallic gasket
End Ext/Mat'l:
*Flow Direction: BI DIRECTIONAL
*Type of Bonnet: N/A
Lub & Iso Valve: N/A Lube: N/A
* Packing Material: EPDM
* Packing Type: O RINGS

TRIM
* Type: BUTTERFLY VALVE
* Size: 12" Rated Travel: .250 TURN
* Characteristic: SEE DATA SHEETS
*Balanced/Unbalanced: N/A
* Rated CV: 8300 FL: XT:
* Plug/Ball/Disk Material: EPDM COATED DISC
* Seat Material:
* Cage/Guide Material: N/A
* Stem Material: 316SS

SPECIAL ACCESSORIES
NEMA 4

Notes:
All valve tubing and gauges are to be stainless steel. "Smart" transmitter to transmit actual valve position, and have the ability to store historical signals as received relative to valve postion. Material Test Reports required for all pressure containment components which are welded.

ACTUATOR
* Type: Pneumatic, air to close actuator
* MFR & Model: ELOMATIC PSA750
* Size: PSA 750 Eff Area: N/A
On/Off: On/Off Service Modulating: No
Spring Action Open/Close: Spring to open
* Max Allowable Pressure: 120 PSIG
* Min Required Pressure: 60 PSIG
Available Air Supply Pressure: 60 psig
Max: 80 psig Min:
* Bench Range: N/A /
Actuator Orientation: N/A
Handwheel Type: No Set at
Air Failure Valve:

POSITIONER
Input Signal
* Type: "Smart" type, Hart or Modbus protocol
* MFR & Model (See Notes): WESTLOCK ICOT 4060 H
* On Iner Signal Output Iner/Deer: PROGRAMMABLE
Gauges: Yes By-pass: No
* Cam Characteristic:

SWITCH
Type Quantity
* MFR & Model
Contacts/Rating
Actuation Points

AIR SET
* MFR & Model: Fisher Model 67AFR
* Set Pressure: as required by the positioner
Filter: Yes Gauge: Yes

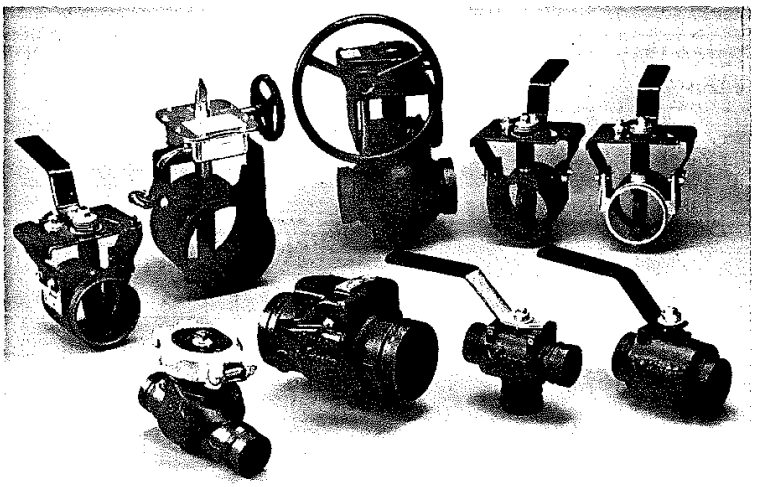
TEST
* Hydro Pressure:
ANSI/FCI Leakage Class: V

Rev	Date	Revision	Orig	App
Orig.	2/24/97	Issued for Review		

Grooved End Valves

Victaulic, the originator and leading manufacturer of grooved end products, has a full line of butterfly, ball, check and plug valves for nearly every market and almost any application. Designed, tested, and manufactured under one roof, Victaulic valves are known for their reliability and ease of installation. As an ISO 9001 certified company, Victaulic manufactures its products to meet or exceed your piping requirements.

Victaulic valves are available for carbon steel, stainless steel and copper piping systems. Vic-Plug™ valves are specifically designed to meet AWWA standards.



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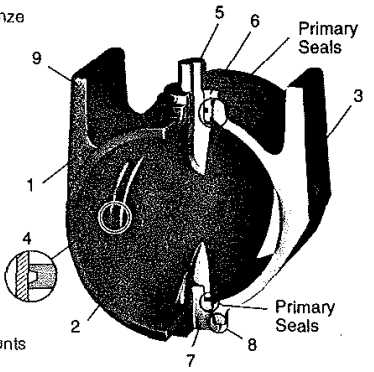
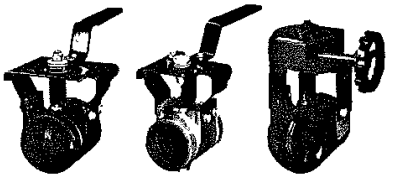
Butterfly Valves

1. **BODY** - Vic®-300 cast of durable ductile iron; Series 608 bronze sand casting; Vic-300S Type 316 stainless steel
2. **DISC COATING** - Synthetic elastomers for most services; coating functions as upper and lower primary seal
3. **BODY COATING** - (Vic-300 only) - Polyphenylene sulfide blend; epoxy coating also available
4. **DUAL SEAL DISC** - Two molded-in rings assure inner body wiping action; bubble-tight shut-off to 300 PSI including dead-end service in either direction
5. **DRIVE HUB** - Integrally cast with disc to provide accurate disc positioning
6. **HUB BEARING** - Bronze (316 SS available); provides positive hub alignment
7. **TRUNNION** - Bronze (316 SS available); acts as lower disc pivot to maintain disc alignment
8. **HUB AND TRUNNION SEALS** - O-ring seals provide a secondary shaft seal
9. **BRACKET CONNECTIONS** - Integral side wing bracket mounts permit connection of varied manual or powered actuators



Vic-300®, Vic-300S and Series 608

- Rated to 300 PSI (2065 kPa) WOG service
- Vic-300 size range 2 - 12" (50 - 300 mm); Vic-300S size range 2 -12" (50 - 300 mm)
- Series 608 from 2½ - 6" (65 - 150 mm)
- Available disc coatings - EPDM for water services; nitrile for petroleum services; fluoroelastomers for corrosives and aromatics



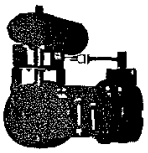
For more detailed information on the Vic-300 see Section 08.02; For Vic-300S see Section 17.05.
For more detailed information on the Series 608 see Section 22.05.

Series 700

- 1½ - 6" (40 - 150 mm) sizes
- Rated to 200 PSI (1400 kPa)
- Rubber-lined body
- Dead-end service to fully rated working pressure

For more detailed information on the Series 700 see Section 08.05.

Three Way Valves



- Available for 2 - 24" (50 - 600 mm) sizes
- For blending, diverting, and mixing
- Factory assembled and adjusted for intended service

For more detailed information on Three Way Valves see Section 08.06.

BUTTERFLY VALVE NUMBERING SYSTEM

V - 040 3 3 5 2 - 11

Type	Size	Pressure Rating	Body Material	Disc/Trim	Bracket	Operator
V	020 025 030 040 050 060 080 100 120 140 160 180 200 240	1 - 175 PSI 3 - 300 PSI	1 - Iron w/Internal PPS coatings # 3 - Epoxy Coated Iron 5 - PPS Coated Iron 7 - 316 Stainless Steel 9 - Special*	1 - Buna/Bronze 2 - EPDM/Bronze 3 - Fluoroelastomer/SS 4 - Buna/SS 5 - EPDM/SS 7 - Iron painted w/Nitrile Seat/ SS stems# 8 - Iron painted w/EPDM seat - SS stem # 9 - Special*	0 - No Bracket** 2 - Standard 3 - Std. with Insulation 9 - Special*	00 - Bare 11 - Standard handle w/memory stop 15 - 2 Position detent handle (sizes 2", 2½" & 3" only) 20 - Gear Operator 21 - Gear Operator w/memory stop 22 - Gear Operator w/chain wheel 23 - Gear Operator w/AWWA square operating nut 24 - Gear Operator w/memory stop and chain wheel 29 - Non-standard gear operator* VV - Pneumatic* WW - Electric* YY - Hydraulic*

*Details of operator and accessories must be supplied with order. **Code only used with two position detent handle. #Series 709 only.
‡ Sizes 2 - 12" (50 - 300 mm) Vic-300; 14 - 24" (350 - 600 mm) Series 709.

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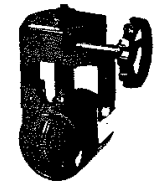
IPS CARBON STEEL GROOVED VALVES **08.02**

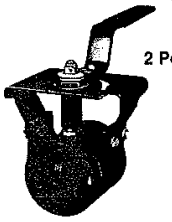
Vic®-300 Butterfly Valves

PRODUCT DESCRIPTION



4" with Gear Operator

3" with 2 Position Handle



6" with Lever Lock Handle

Vic-300 butterfly valves are designed for pressures ranging from vacuum to 300 PSI (2065 kPa). Vic-300 butterfly valves feature a narrow profile disc design with a smooth, coated inner body which combine for superior flow characteristics. This combination results in low break-away torque, reducing gear operator and actuator sizing and costs. Standard polyphenylene sulfide blend (PPS) coating accommodates a wide variety of severe services (epoxy coating or full stainless body are available for severe services). The dual-seal disc provides bubble-tight sealing up to 300 PSI (2065 kPa) in both directions without added valve modifications or cost.

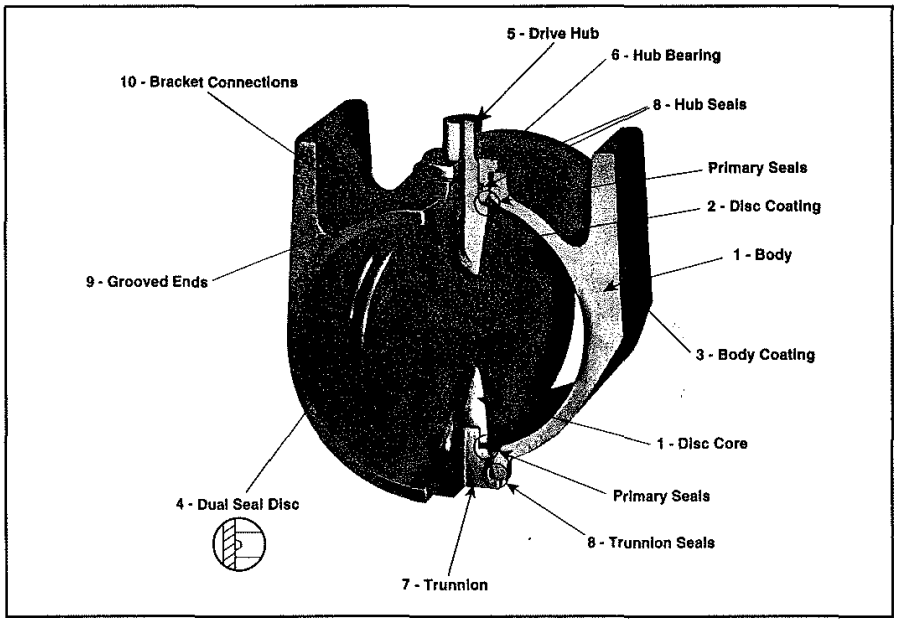
When using Victaulic butterfly valves with flange adapters consult Victaulic.

Available disc coatings include EPDM for water service to +230°F (+110°C) and nitrile for oil services with the option of fluoroelastomer for corrosives and aromatics. The Vic-300 butterfly valve is available with manual handles, gear operators or automated in two-way and three way configurations.

For fire protection services see Series 708-W butterfly valve, refer to page 10.06.

FEATURES

1. **Body and Disc Core** – Cast of rugged ductile iron for durability and strength.
2. **Disc Coating** – Disc is encapsulated with various synthetic elastomers to accommodate varied service requirements.
3. **Body Coating** – Polyphenylene sulfide blend is heat fused to the entire body. Epoxy coating is available.
4. **Dual Seal Disc** – Two molded-in rings assure inner body wiping action and a back-up seal for flow in both directions providing bubble-tight shut-off to 300 PSI (2065 kPa).
5. **Drive Hub** – Cast integrally with the disc to provide direct disc drive and allow positive location of the disc.



6. **Hub Bearing** – Bronze (316 stainless available) bearing provides positive hub alignment.
7. **Trunnion** – Bronze (316 stainless available) trunnion.
8. **Hub and Trunnion Seals** – O-ring seals (of the same material as the disc coating) provide a secondary shaft seal.
9. **Grooved Ends** – Permits installation with two Victaulic grooved couplings.
10. **Bracket Connections (Vic-300/Series 608)** – Side-wing connection permits bracket design to accept varied manual or power actuators.

Victaulic Company of America • P.O. Box 31, Easton, PA 18044-0031 • 4901 Kesslersville Rd., Easton, PA 18040 • 610/559-3300 • FAX: 610/250-8817

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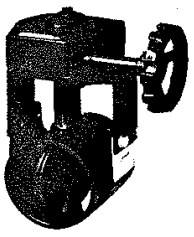
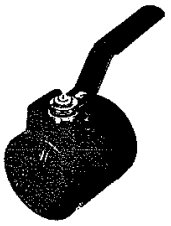
DIMENSIONS

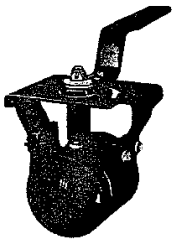
Vic-300 Butterfly Valves



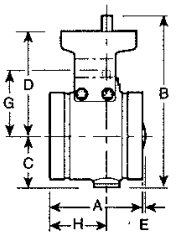
4" with Gear Operator



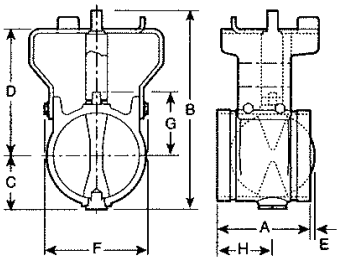
3" with 2 Position Handle



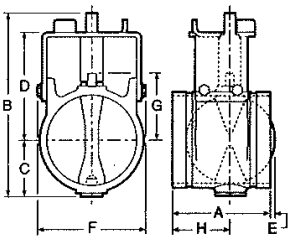
6" with Lever Lock Handle



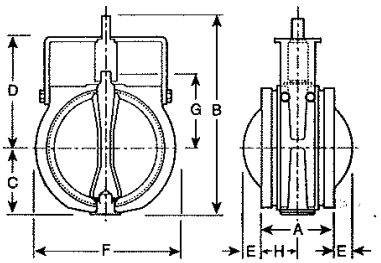
2 - 3" (typical)



4 - 5" (typical)



6" (typical)



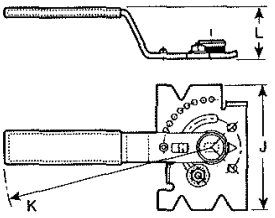
8 - 12" (typical)

Pipe Inches/mm		Dimensions – Inches/millimeters										Approx. Weight Each Lbs. kg
			Overall Height B			D						
Nom. Size	Actual Size	E - E A	Lever Lock/ Inf. Var. Handle	Gear Operator	C	Lever Lock/ Inf. Var. Handle	Gear Operator	E	F	G	H	
2†	2.375	3.21	4.21	6.40	1.52	3.53	3.53	–	2.38	1.69	1.78	3.7
50	60.3	82	107	163	39	90	90	–	60	43	45	1.7
2½	2.875	3.77	4.77	7.06	1.80	3.92	3.92	–	2.88	2.25	2.31	4.4
65	73.0	96	121	179	46	100	100	–	73	57	59	2.0
3 O.D.	3.000	3.77	5.39	7.66	2.09	4.22	4.22	0.08	3.50	2.54	2.31	5.1
	76.1	96	137	195	53	107	107	2	89	65	59	2.3
3†	3.500	3.77	5.39	7.66	2.09	4.22	4.22	0.08	3.50	2.54	2.31	5.1
80	88.9	96	137	195	53	107	107	2	89	65	59	2.3
4†	4.500	4.63	8.93	9.04	2.50	5.15	5.28	0.07	5.88	3.19	2.79	10.5
100	114.3	118	227	230	64	131	134	2	149	81	71	4.8
5	5.563	5.88	9.94	10.05	3.00	5.67	5.80	0.43	5.88	3.70	3.92	14.0
125	141.3	149	253	255	76	144	147	11	149	94	100	6.4
6†	6.625	5.88	10.97	12.01	3.57	6.15	6.94	1.00	7.50	4.16	4.00	19.0
150	168.3	149	279	305	91	156	176	25	191	106	102	8.6
6½ O.D.	6.500	5.88	10.97	12.01	3.57	6.15	6.94	1.00	7.50	4.16	4.00	19.0
	165.1	149	279	305	91	156	176	25	191	106	102	8.6
8†	8.625	5.38	14.41	14.32	4.88	7.93	7.93	1.28	10.25	5.50	2.69	41.0
200	219.1	137	366	364	124	201	201	33	260	140	68	18.6
10†	10.750	6.38	17.13	16.60	5.87	8.68	8.68	1.75	12.25	6.69	3.19	59.0
250	273.0	163	435	422	149	221	221	45	311	170	81	26.8
12†	12.750	6.50	19.64	19.11	7.07	10.00	10.00	2.63	14.25	8.00	3.25	85.0
300	323.9	165	499	485	180	254	254	67	362	203	83	38.6

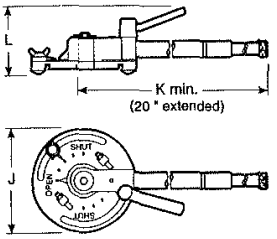
† Stainless steel body also available. See Section 17.05 for details.
For 14 - 24" (350 - 600 mm) butterfly valves, refer to 08.03.
Large diameter 14 - 24" (350 - 600 mm) butterfly valves are available rated to 300 PSI (2065 kPa). Contact Victaulic for details.

DIMENSIONS

Lever Lock/ Infinitely Variable Handle



2 - 8" Sizes

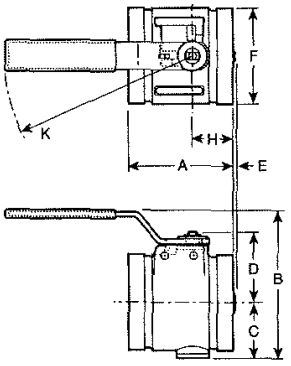


10 - 12" Sizes

Nominal Size Inches/mm	Dimensions – Inches/millimeters				Approx. Wgt. Ea Lbs./kg
	J	K	L	M	
2 50	4.20 107	7.08 180	1.70 43	– –	1.5 0.7
2½ 65	4.20 107	7.08 180	1.70 43	– –	1.5 0.7
3 80	4.20 107	7.08 180	1.70 43	– –	1.5 0.7
4 100	7.00 178	12.00 305	2.50 64	– –	1.5 0.7
5 125	7.00 178	12.00 305	2.50 64	– –	1.5 0.7
6 150	7.00 178	12.00 305	2.50 64	– –	1.5 0.7
8 200	5.25 133	16.00 406.4	1.75 45	0.50 13	4.5 2.0
10 250	7.13 181	20.00 508	4.57 116	0.15 4	12.0 5.4
12 300	7.13 181	20.00 508	4.57 116	0.15 4	12.0 5.4

NOTES: Handles for 2 - 8" (50 - 200 mm) valves come complete with hardware for both variations.
10 and 12" (250 and 300 mm) equipped with infinitely variable handle only.

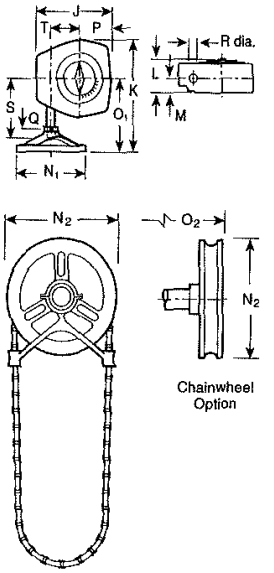
Two Position Handle



Pipe Inches/mm		Dimensions – Inches/millimeters								Approx. Wgt. Ea. Lbs. kg
Nom. Size	Actual Size	End to End A	Overall Hgt. B	C	D	E	F	H	K	
2 50	2.375 60.3	3.21 82	4.21 107	1.50 38	2.06 52	– –	2.38 60	1.14 36	6.58 167	2.2 1.0
2½ 65	2.875 73.0	3.77 96	4.77 121	1.75 44	2.40 61	– –	2.88 73	1.46 37	6.83 173	2.9 1.3
3 80	3.500 88.9	3.77 96	5.39 137	2.06 52	2.80 71	0.08 2	3.50 89	1.46 37	6.83 173	3.6 1.6

DIMENSIONS

Gear Operator



Nom. Size In. mm	Dimensions – Inches/millimeters													No. Turns to Close	Aprx. Wgt. Ea. Lbs. kg
					Handwheel		Chainwheel								
	J	K	L	M	N	O_1	N_2	O_2	P	Q	R	S	T		
2 50	4.23 107	5.99 152	2.15 55	2.12 55	3.12 79	3.87 98	4.00 102	8.25 210	1.90 48	– –	– –	– –	1.66 42	10	2.6 1.2
2½ 65	4.23 107	5.99 152	2.15 55	2.12 55	3.12 79	3.87 98	4.00 102	8.25 210	1.90 48	– –	– –	– –	1.66 42	10	2.6 1.2
3 80	4.23 107	5.99 152	2.15 55	2.12 55	3.12 79	3.87 98	4.00 102	8.25 210	1.90 48	– –	– –	– –	1.66 42	10	2.6 1.2
4 100	5.19 132	8.13 207	2.36 60	1.13 29	4.00 102	5.75 146	4.00 102	8.25 210	2.19 56	0.38 10	0.63 16	5.00 127	1.84 47	7	4.5 2.0
5 125	5.19 132	8.13 207	2.36 60	1.13 29	4.00 102	5.75 146	4.00 102	8.25 210	2.19 56	0.38 10	0.63 16	5.00 127	1.84 47	7	4.5 2.0
6 150	5.19 132	9.25 235	2.36 60	1.13 29	8.00 203	6.87 175	9.00 229	9.38 238	2.19 56	0.38 10	0.63 16	5.00 127	1.84 47	7	4.5 2.0
8 200	5.19 132	9.25 235	2.36 60	1.13 29	8.00 203	6.87 175	9.00 229	9.38 238	2.19 56	0.38 10	0.63 16	5.00 127	1.84 47	7	4.5 2.0
10 250	5.94 151	10.50 267	2.38 61	1.13 29	8.00 203	7.88 200	9.00 229	10.38 264	2.44 62	0.38 10	0.63 16	6.00 152	2.36 60	10	7.0 3.2
12 300	5.94 151	10.50 267	2.38 61	1.13 29	8.00 203	7.88 200	9.00 229	10.38 264	2.44 62	0.38 10	0.63 16	6.00 152	2.36 60	10	7.0 3.2

*Contact Victaulic for details.

Accessories

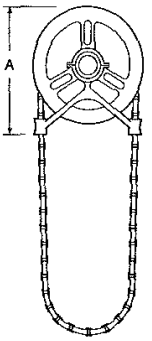
Chain wheel and Guide

Chain wheels are mounted to the gear operator hand wheels. Sprocket rim and guide arms are made of cast aluminum. Chain is galvanized steel.

HOW TO ORDER:
Specify type valve and operator by valve numbering system shown on back page.

Always specify length of chain required.

Valve Size Inches mm	Dimensions – Inches/millimeters			Approx. Wgt. Ea. Lbs. kg
	Sprocket Size	Hand wheel Size (Dia.)	A	
2 - 5 50 - 125	0	4.00 102	4.63 118	3.5 1.6
6, 8, 10, 12 150 - 300	2	9.00 229	10.5 267	5.0 2.6



PERFORMANCE

C_V Values

C_V values are charted to the right for approximate disc opening and full performance data charted below.
For additional details contact Victaulic.

Formulas for C_V Values:

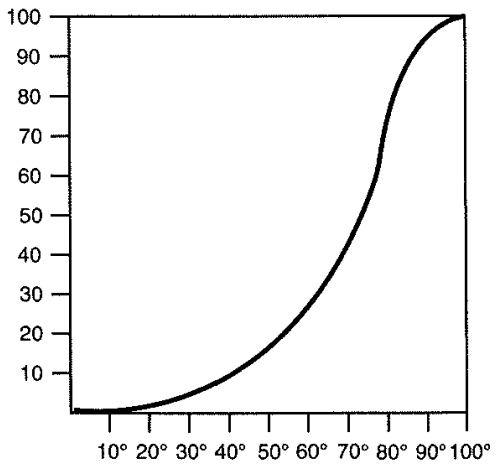
$$\Delta P(PSI) = \frac{Q^2}{C^2} \quad (GPM^2/C_V \text{ Value Squared})$$

$$Q(GPM) = C_V \times \sqrt{\Delta P(PSI)}$$

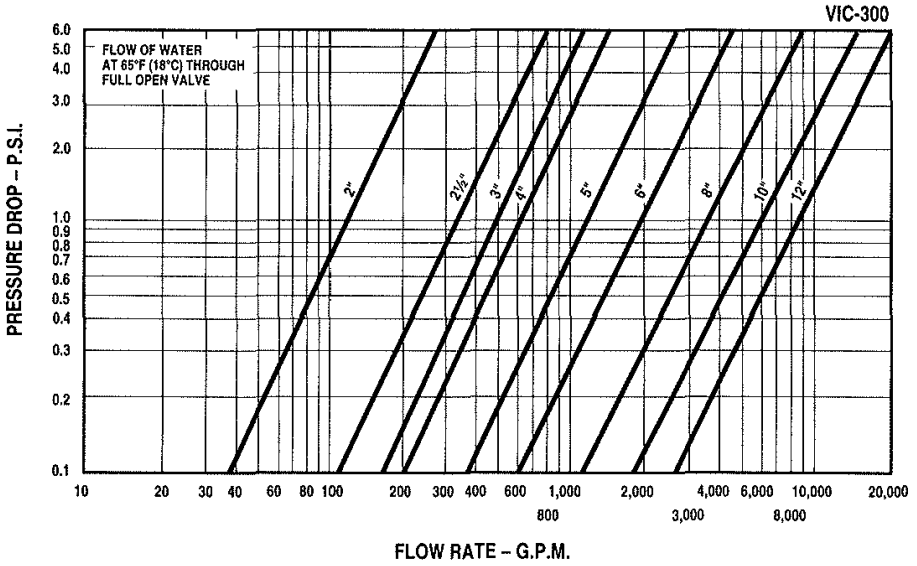
Valve Size Inches mm	C_V (Full Open)	Valve Size Inches mm	C_V (Full Open)	Valve Size Inches mm	C_V (Full Open)
2 50	115	4 100	600	8 200	3400
2½ 65	325	5 125	1150	10 250	5750
3 80	482	6 150	1850	12 300	8300

Nominal Size Inches mm	Valve Disc Angle/ GPM (m^3/h)						
	90°	70°	60°	50°	40°	30°	20°
2 50	115 26.1	80 18.2	40 9.1	17 3.9	10 2.3	5 1.1	1 0.3
2½ 65	325 73.8	160 36.2	84 19.1	48 10.9	27 6.1	10 2.3	2 0.5
3 80	482 109.4	196 44.5	114 25.9	73 16.6	44 10.0	18 4.1	3 0.7
4 100	600 136.2	450 102.2	230 52.2	148 33.6	85 19.3	42 9.5	3 0.7
5 125	1150 261.1	560 127.1	330 74.9	210 47.7	120 27.2	60 13.6	15 3.4
6 150	1850 420.0	960 217.9	600 136.2	380 86.3	240 54.4	130 29.5	45 10.2
8 200	3400 771.8	1910 433.6	1170 265.6	780 177.1	470 106.7	260 59.0	104 23.6
10 250	5750 1305.3	3220 433.6	1980 449.5	1320 299.6	800 181.6	440 99.9	180 40.9
12 300	8300 1884.1	4650 1055.6	2850 647.0	1900 431.3	1150 261.1	640 145.3	250 56.8

Typical Flow Characteristics



PERFORMANCE



VALVE TORQUE REQUIREMENTS

Victaulic Vic-300 valves have low torque requirements for operating the valve. This results in less manual effort, smaller gear operators or smaller, less expensive actuators to open and close the valve.

The torque data listed below is the highest required to operate the valve at the given pressures in wet service. These torque values are based on extensive testing by Victaulic. These values are for normal wet service only and may vary for dry services or for lubricating fluids. Contact Victaulic for other services.

Nominal Valve Size Inches/mm	Torque Inch Pounds/Newton Meters *Differential Pressure – PSI/kPa				
	50/345	100/690	150/1035	200/1375	300/2065
2 50	30 3.4	30 3.4	50 5.7	60 6.8	70 7.9
2½ 65	50 5.7	60 6.8	80 9.0	95 10.7	120 13.6
3 O.D.	36 4.1	36 4.1	50 5.7	60 6.8	84 9.5
3 80	70 7.9	90 10.2	110 12.4	130 14.7	170 19.2
4 100	150 17.0	250 28.3	250 28.3	350 39.5	500 56.5
5 125	300 33.9	350 39.5	350 39.5	450 50.8	550 62.1
6 150	500 56.5	600 67.8	700 79.1	800 90.4	950 107.3
6½ O.D.	500 56.5	600 67.8	700 79.1	800 90.4	950 107.3
8 200	1320 149.2	1450 163.9	1650 186.5	1900 214.7	2250 254.2
10 250	1450 163.9	1700 192.1	2100 237.3	2600 293.8	3000 338.9
12 300	1650 186.4	2300 259.9	2750 310.7	3500 395.4	4800 542.3

MATERIAL SPECIFICATIONS

Body: Ductile iron to ASTM A-536

Body Coating: PPS–Polyphenylene sulfide blend

❑ **Optional:** Epoxy

Disc: Ductile iron to ASTM A-536

Disc Coating: (specify choice)

❑ **Grade "E" EPDM**
EPDM (Green color code). Temperature range –30°F to +230°F (–34°C to +110°C). Recommended for cold and hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. NOT RECOMMENDED FOR PETROLEUM SERVICES.

❑ **Grade "T" nitrile**
Nitrile (Orange color code). Temperature range –20°F to +180°F (–29°C to +82°C). Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range. Not recommended for hot water services over +150°F (+66°C) or for hot dry air over +140°F (+60°C).

❑ **Optional:**
Grade "O" fluoroelastomer
Fluoroelastomer (Blue color code). Temperature range for continuous service up to +300°F (+149°C). Recommended for many oxidizing acids, petroleum oils, halogenated hydrocarbons, lubricants, hydraulic fluids, organic liquids and air with hydrocarbons to +300°F (+149°C).

*Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

NOTE: When connecting Vic-300 butterfly valves to Style 741 or Style 743 Vic-Flange® adapters, please contact Victaulic.

Drive Hub Adapter: Hot rolled steel–black enamel coated

Upper Bearing/Lower Trunnion Seals: Same as Disc Coating

Upper Bearing/Lower Trunnion: Bronze alloy

❑ **Optional:** Type 316 stainless steel

Operator Bracket: Hot rolled steel–black enamel coated

Bracket Bolts/Washers: Cold rolled steel–zinc plated

Operator: (specify choice)

❑ **2 - 3" (50 - 80 mm) Two-position detent manual handle:** Hot rolled steel–black enamel coated

❑ **Manual lever lock/infinitely variable handle:** Ductile iron to ASTM A-536 (other parts cold rolled steel, zinc electroplated)

❑ **Optional:** Memory stop

❑ **Manual gear operator with hand wheel**

❑ **Optional:** Memory stop

❑ **Optional:** Chain wheel

Electric actuator #

Pneumatic actuator #

Contact Victaulic for dimensions and other details.

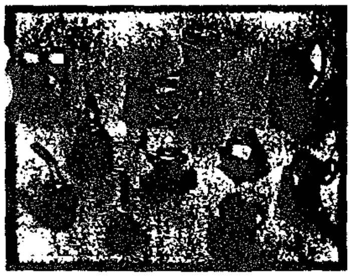
Butterfly Valve Numbering System for Vic-300, Series 709 and Series 708 UL/FM

V - 040 3 5 2 2 - 11

Type	Size	Pressure Rating	Body Material	Disc Coating/Trim	Bracket	Operator
V	020 024 030 040 050 060 080 100 120 140 160 180 200 240	1 - 175 PSI (3) 3 - 300 PSI	1 - Iron w/Internal PPS coating (1) 3 - Epoxy coated iron 5 - PPS coated iron 6 - Bronze (w/copper connection grooves) 7 - 316 stainless steel 9 - Special*	1 - Buna/Bronze 2 - EPDM/ Bronze 3 - Fluoroelastomer/SS 4 - Buna/SS 5 - EPDM/SS 7 - Iron painted disc, Nitrile seat/SS stems 8 - Iron Painted Disc, EPDM seal/SS stems (1) 9 - Special*	0 - No Bracket** 2- Standard 3 - Std. with Insulation 9 - UL/FM	00 - Bare 11 - Standard handle w/memory stop 15 - 2 Position detent handle (sizes 2", 2½" & 3" only) 20 - Gear Operator 21 - Gear Operator w/memory stop 22 - Gear Operator w/chain wheel 23 - Gear Operator w/AWWA square operating nut 24 - Gear Operator w/memory stop and chain wheel 29 - Non-standard gear operator* F0 - UL/FM Gear Operator w/no switches (3) F2 - UL/FM G.O., w/2 SPDT switches (3) W1 - UL/FM Weatherproof gear operator w/unwired switches W2 - UL/FM Weatherproof gear operator w/2 SPDT switches VV - Pneumatic* WW - Electric* YY - Hydraulic*

*Details of operator and accessories must be supplied with order. **Code only used with two position detent handle.
(1) Series 709 only (2) Used with 2 position detent handle only. (3) Used with Series 708 UL/FM only.

GROOVED IPS VALVES



Victaulic offers a complete line of grooved end valves from 2 - 24" (50 - 600 mm) available with manual handles, gear operators, a variety of remote actuators and in three-way configurations.

Other quarter-turn valves Vic-Ball®, Vic-Plug™, and the Series 723 diverter valve are also available with varied actuators and automation.

Victaulic valves complement the complete grooved system consisting of rigid and flexible couplings, fittings, flange adapters, accessories and grooving tools. Refer to the table (right) to locate information on the appropriate Victaulic valves in this catalog.

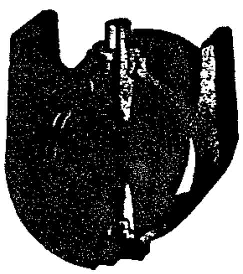
Pipe Inches/mm		Butterfly				Combo	Check		Ball †	Plug	Fire Protection		
Nom. Size	Actual Size	Vic-300®	Series 709	Series 700	3-Way	Tri-Service	Vic-Check® Series 716	Swinger® Series 712/713	Vic-Ball® Series 721/723#	‡ Vic-Plug™ Series 365/377	FireBall® Series 727	Butterfly Series 705-W	FireLock™ Check Series 717, 717R
PRESSURE RATING – kPa													
1½ 40	1.900 48.3	- -	- -	200 1420	200 1420	- -	- -	- -	600 4130	- -	- -	- -	- -
2 50	2.375 60.3	300 2065	- -	200 1420	300 2065	- -	- -	300 2065	600* 4130	- -	300 2065	175 1200	- -
2½ 65	2.875 73.0	300 2065	- -	200 1420	300 2065	300 2065	300 2065	300 2065	600 4130	- -	300 2065	175 1200	- -
3 80	3.500 88.9	300 2065	- -	200 1420	300 2065	300 2065	300 2065	300 2065	600 4130	175 1200	300 2065	175 1200	- -
4 100	4.500 114.3	300 2065	- -	200 1420	300 2065	300 2065	300 2065	300 2065	600 4130	175 1200	- -	175 1200	250 1725
5 125	5.563 141.3	300 2065	- -	200 1420	300 2065	300 2065	300 2065	- -	- -	- -	- -	175 1200	250 1725
6 150	6.625 168.3	300 2065	- -	200 1420	300 2065	300 2065	300 2065	- -	600 4130	175 1200	- -	175 1200	250 1725
8 200	8.625 219.1	300 2065	- -	- -	300 2065	300 2065	300 2065	- -	- -	175 1200	- -	175 1200	250 1725
10 250	10.750 273.0	300 2065	- -	- -	300 2065	300 2065	300 2065	- -	- -	175 1200	- -	- -	- -
12 300	12.750 323.9	300 2065	- -	- -	300 2065	300 2065	300 2065	- -	- -	175 1200	- -	- -	- -
14 350	14.000 355.6	- -	175 1200	- -	175 1200	- -	- -	- -	- -	- -	- -	- -	- -
16 400	16.000 406.4	- -	175 1200	- -	175 1200	- -	- -	- -	- -	- -	- -	- -	- -
18 450	18.000 457.0	- -	175 1200	- -	175 1200	- -	- -	- -	- -	- -	- -	- -	- -
20 500	20.000 508.0	- -	175 1200	- -	175 1200	- -	- -	- -	- -	- -	- -	- -	- -
24 600	24.000 610.0	- -	175 1200	- -	175 1200	- -	- -	- -	- -	- -	- -	- -	- -

* Available as Three Port Diverter, page 19.
‡ Vic-Plug made to AWWA sizes, adapts to IPS with Transition coupling Style 307, page 46.
Vic-Plug Valve for balancing/throttling service shown on page 19. For semi-solids piping services, see page 46.
† Series 722 brass body ball valve available in ¼" through 2" size; details on page 19.
#Series 713 rated at 1000 PSI (6900 kPa).

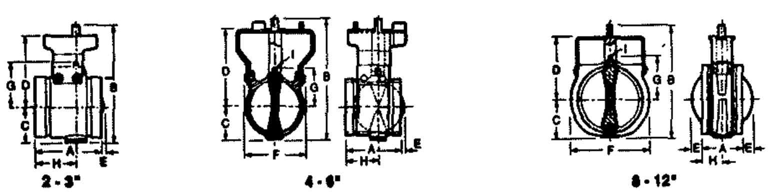
Vic-300®

Butterfly Valves

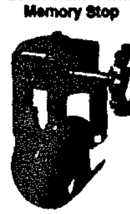
- Excellent flow characteristics
- Low torque for easy manual operation and reduced actuation cost
- Dual-seal, rubber coated ductile disc for bi-directional bubble-tight shut-off to 300 PSI (2065 kPa)
- Sizes 2 - 12" (50 - 300 mm)
  Request VS-708 for submittal.
- Stainless steel butterfly valves available for 2 - 12" (50 - 300 mm) piping systems
  Request VS-SSV for submittal.



V-711



Lever Handle with Memory Stop

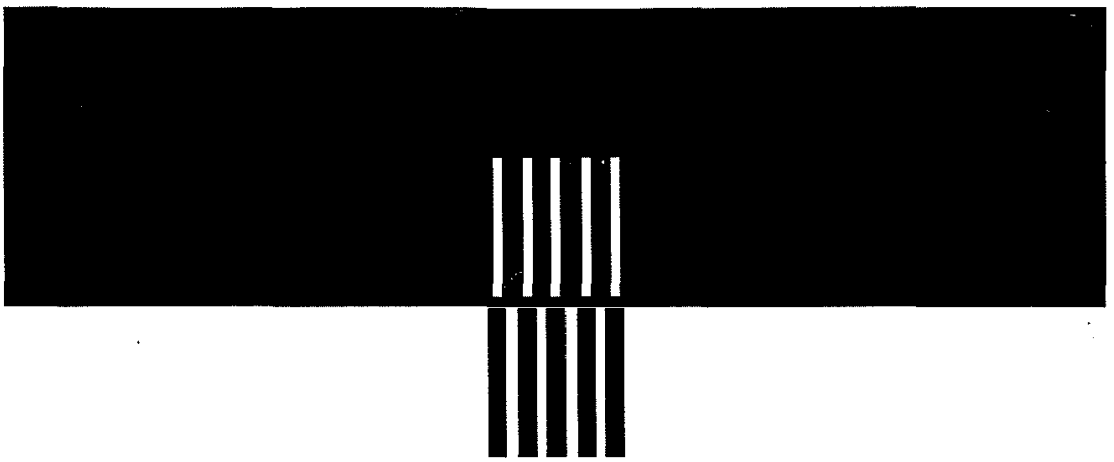


Gear Operator

Two Position

Pipe Inches/mm		Dimensions – Inches/millimeters										Approx. Wgt. Ea. Lbs. kg
		End to End	Overall Height B			D						
Nom. Size	Actual Size	A	Lever Lock/ Inf. Var. Handle	Gear Operator	C	Lever Lock/ Inf. Var. Handle	Gear Operator	E	F	G	H	
[redacted]												
2½ 65	2.875 73.0	3.77 96	4.77 121	7.08 179	1.80 46	3.92 100	3.92 100	- -	2.88 73	2.25 57	2.31 59	4.4 2.0
3 O.D. 86	3.000 76.1	3.77 96	5.39 137	7.86 195	2.09 53	4.22 107	4.22 107	0.08 2	3.50 89	2.54 65	2.31 59	5.1 2.3
3† 80	3.500 88.9	3.77 96	5.39 137	7.66 195	2.09 53	4.22 107	4.22 107	0.08 2	3.50 89	2.54 65	2.31 59	5.1 2.3
4† 100	4.500 114.3	4.63 118	8.93 227	9.04 230	2.50 64	5.15 131	5.28 134	0.07 2	5.88 149	3.19 81	2.79 71	10.5 4.8
5 125	5.563 141.3	5.88 149	9.94 253	10.05 255	3.00 76	5.67 144	5.80 147	0.43 11	5.88 149	3.70 94	3.92 100	14.0 6.4
6† 150	6.625 168.3	5.88 149	10.97 279	12.01 305	3.57 91	6.15 156	6.94 176	1.00 25	7.50 191	4.16 106	4.00 102	19.0 8.6
6½ O.D. 166	6.500 165.1	5.88 149	10.97 279	12.01 305	3.57 91	6.15 156	6.94 176	1.00 25	7.50 191	4.16 106	4.00 102	19.0 8.6
8† 200	8.625 219.1	5.38 137	14.41 366	14.32 364	4.88 124	7.93 201	7.93 201	1.28 33	10.25 260	5.50 140	2.69 68	41.0 18.6
10 250	10.750 273.0	6.38 163	17.13 435	16.60 422	5.87 149	8.68 221	8.68 221	1.75 45	12.25 311	6.69 170	3.19 81	59.0 26.8
12 300	12.750 323.9	6.50 165	19.64 499	19.11 485	7.07 180	10.00 254	10.00 254	2.63 67	14.25 362	8.00 203	3.25 83	85.0 38.6

† Stainless steel body also available. Contact Victaulic for details.



ICoT Smart Positioner Operating Manual

Table of Contents

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Tunbridge Wells, Kent TN2 3EF England
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Westlock Equipamentos De Controle Ltda.
Calcada das Betulas, 65 Centro Comercial de Alphaville
Barueri - SP - Brasil - 06487-080
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8/14/96

Westlock ICoT Smart Positioner
Principle of Operation

Unlike conventional positioners, the ICoT Smart Positioner (patent pending) feeds back valve position without the need for linkages, levers, and rotary or linear seals. Position sensing is performed totally by non-contacting means, permitting use of advanced control strategies where knowledge of valve position is used in predictive and other algorithms. By the integration of multiple components into a singular, cost-efficient unit, microprocessor-based intelligence can now be used to implement advanced functions such as early-warning diagnostics and fugitive emissions monitoring.

The ICoT positioner provides intelligence for the control valve through a microprocessor-based diagnostic system utilizing the HART protocol. Accurate measurement of valve stem position, input signal, actuator pressure and travel time can be recorded during normal operation, thereby providing information for control valve signature generation.

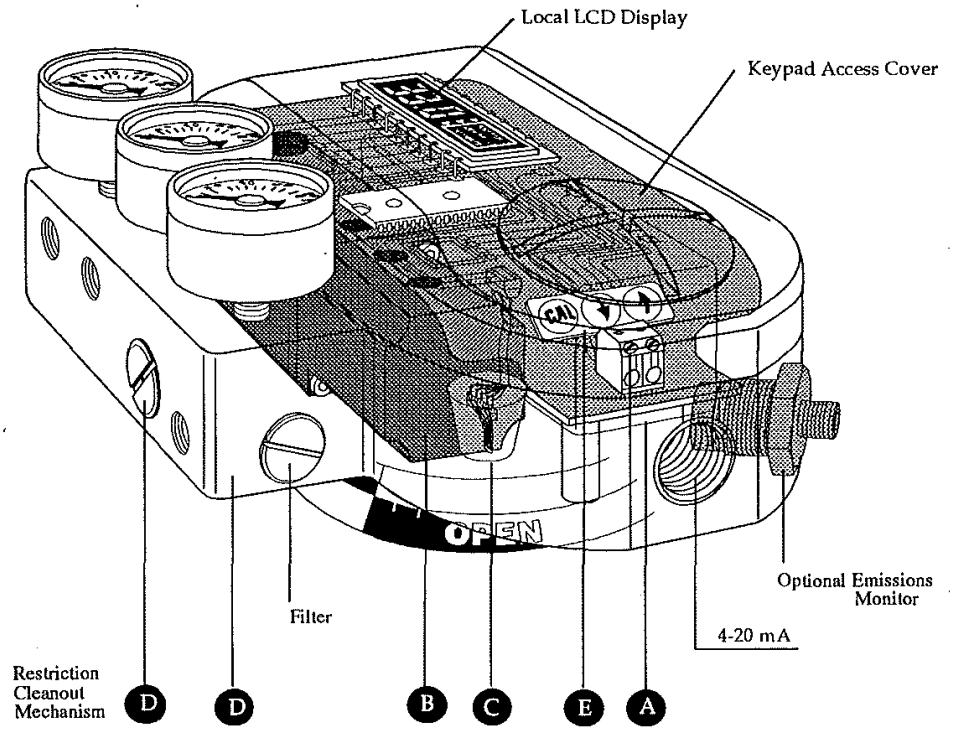
A A microprocessor, housed within an environmentally sealed canister, performs position sensor linearization, characterization for valve type, HART information processing, and display management.

B An electropneumatic transducer, with internal diagnostic elements, converts the servo output signal into a pneumatic signal for directly driving valve actuators.

C Position feedback is accomplished by a non-contact Hall effect magnetic sensor. All rotary positioners are standardly equipped with a Beacon position monitor.

D Air lines are connected to an aluminum, nylon encapsulated manifold with gauges, filters, and a self-contained mechanism for cleaning the transducer.

E For positioners not equipped with a HART interface, a 3-button "membrane keypad" is provided for performing on-site electronic calibration.

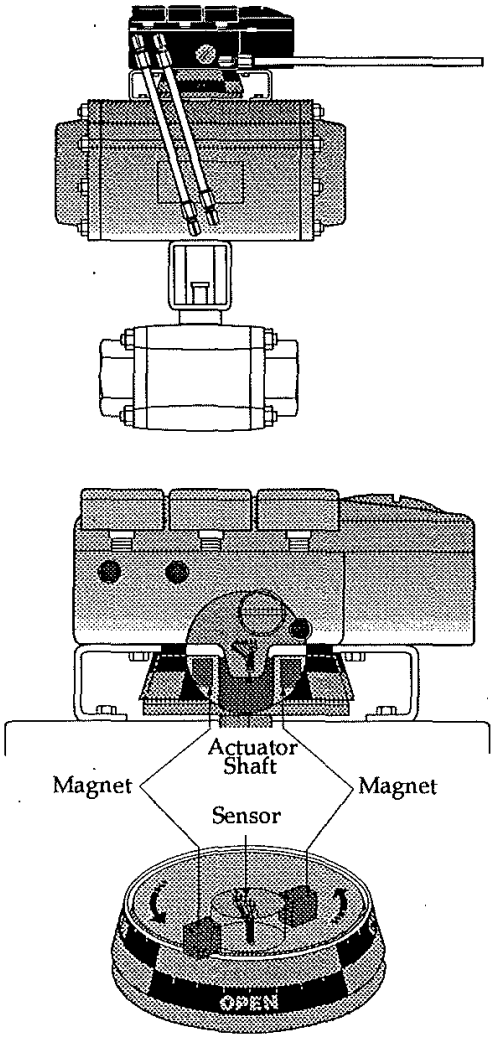


NON-CONTACT POSITION FEEDBACK

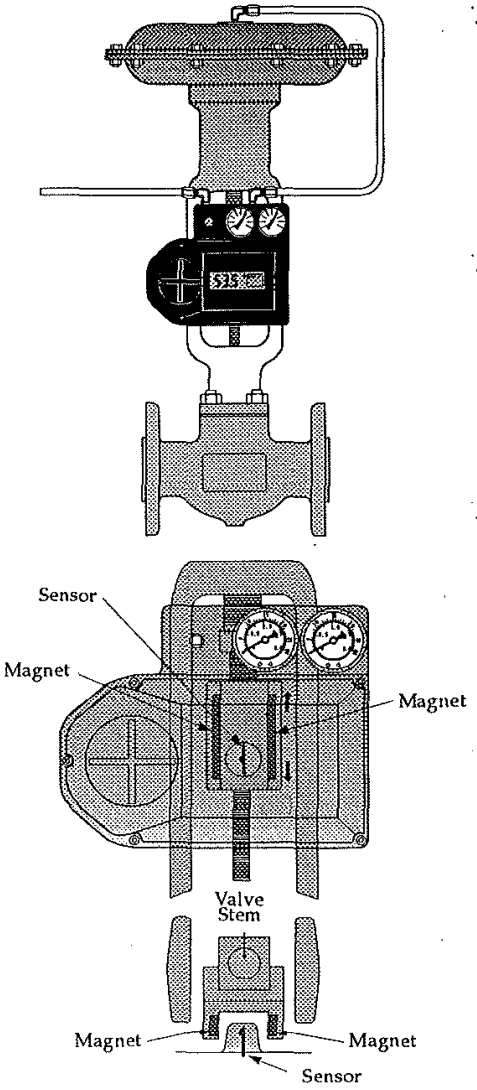
To provide consistently accurate performance information, all linkages, levers and connecting rods, from the positioner to the control valve, have been eliminated from the design.

Valve position sensing is performed totally by non-contacting means based upon characterization of flux strength as a function of position.

ROTARY VALVES



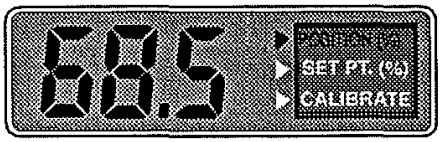
LINEAR VALVES



ON-BOARD DIAGNOSTICS

Local LCD Display

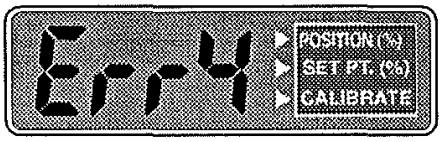
The ICoT positioner is supplied with a HART interface or a 3-button keypad interface. Both versions are furnished with a 4-digit, .5" tall LCD, and allow for automated calibration of the positioner.



The local LCD display provides a multitude of onsite diagnostic information. While the valve is being controlled by the positioner, and the error signal is NOT zero, the displayed information will alternate between setpoint and position as percentage. Each value is displayed for a period of two seconds. Once the setpoint and valve position agree to within less than 0.5%, the display will only show position.

The range of values displayed are from 0.0% (fully closed) to 100% (fully open). Displayed resolution is in 0.1% increments, however, internal calculations are maintained at higher precision.

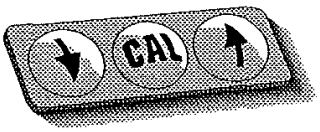
On-Board Sensors



The ICoT positioner has the capability to constantly monitor its own operation. If an error or failure condition occurs, it will be displayed on the local LCD or if the positioner is supplied with a HART interface, the error codes will be displayed on a handheld terminal or a PC maintenance station. NOTE: Error codes are denoted on a label affixed to the inside of the LCD flip-up protective cover.

Local Keypad

For positioners not ordered with a HART interface, a 3-button "membrane keypad" is provided for zero and span adjustments, as well as valve characterization and gain adjustments.



Intelligent Calibration HART Protocol

The ICoT positioner responds to HART commands for seeking the "valve closed" position and assigns an instrument signal of 4 mA to this position. The counterpart of the operation for a full open state is implemented next by setting the span value. Action reversal is also configurable.

Additionally, provisions are made for altering interanl servo loop tuning via the HART link. In this manner, positioner performance may be optimized with a wide combination of valves and actuators.

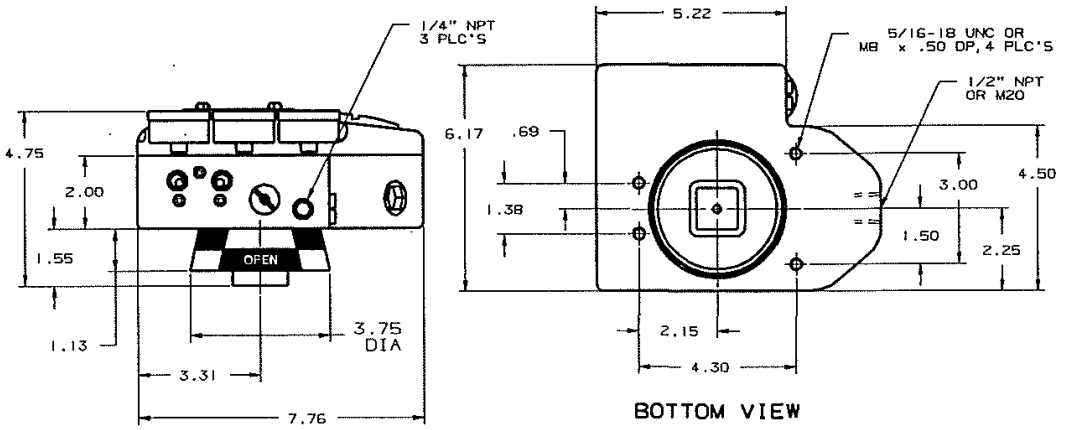
SPECIFICATIONS

TECHNICAL SPECIFICATIONS

SERIES 4000 - Engineered Resin Enclosure
(Dimensions are in inches)

Enclosure: Zytel Nema 4, 4X
Terminal Strip: 8 Point Standard

Conduit Entrance: One 1/2" NPT Standard



POSITIONER SPECIFICATIONS

MODEL	4020,4020H LINEAR	4060,4060H ROTARY
Input Current	4 to 20 mA (Analog) 4 mA (Digital HART)	
Voltage Drop	12.3 Volts	
Supply Air Pressure	(low) 15 to 45 PSI (high) 40 to 120 PSI	
Standard Stroke	.25 to 18 Inches	0 to 95 Degrees
Resolution	.2% Full Travel	
Linearity	1% Full Scale	5 % Full Scale
Hysteresis	.2% Full Scale	
Repeatability	.2% Over One Hour	
Thermal Coefficient	2% / 100° C	
Output Flow Rates	(low) 8.0 scfm @ 25 PSI (high) 16.2 scfm @ 90 PSI	
Air Consumption	(low) .30 scfm @ 25 PSI (high) .71 scfm @ 90 PSI	
Operating Temp. Range	-40°C to 85° C (-40°F to 185° F)	
Gain	Electronically Adjustable w/ Autotuning	
Speed Response	Electronically Adjustable	
Feedback	Magnetic (Non-contact)	
Diagnostics	HART Protocol	
Air Connection Ports	1/4" NPT	

MOUNTING INSTRUCTIONS

For Rotary Actuators

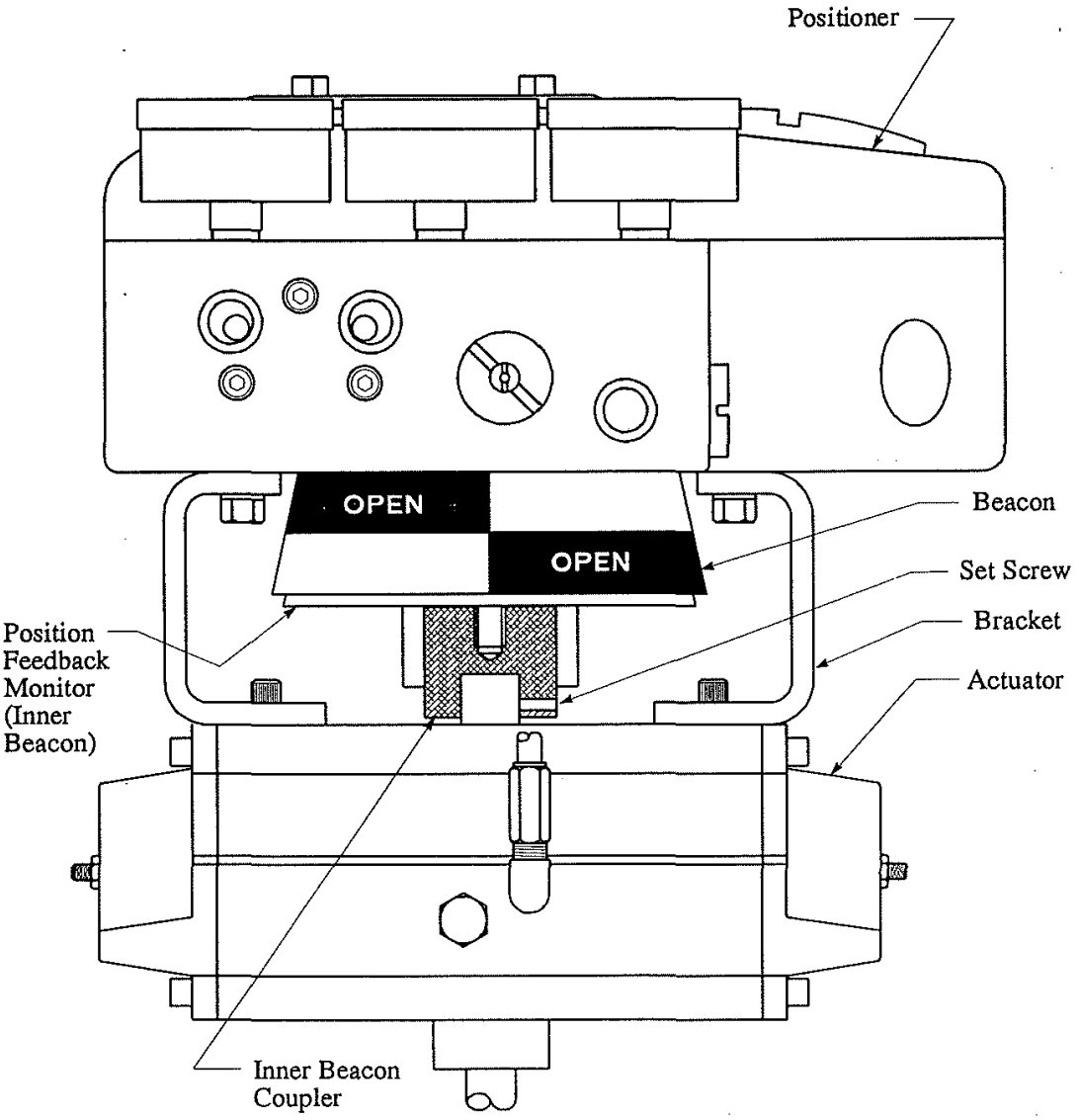


Figure 1

MOUNTING INSTRUCTIONS

For Rotary Actuators

Step 1: Mount bracket to actuator (Refer to Figure 1 on previous page).

Step 2: Fasten inner beacon coupler to actuator shaft stem and tighten with set screw (if applicable).

Step 3: Determine Position Feedback Monitor orientation as shown in Conditions 1 & 2.

Note: *The orientation of the position feedback monitor is dependent on the fail-safe mode and the clockwise or counterclockwise rotation of the actuator.*

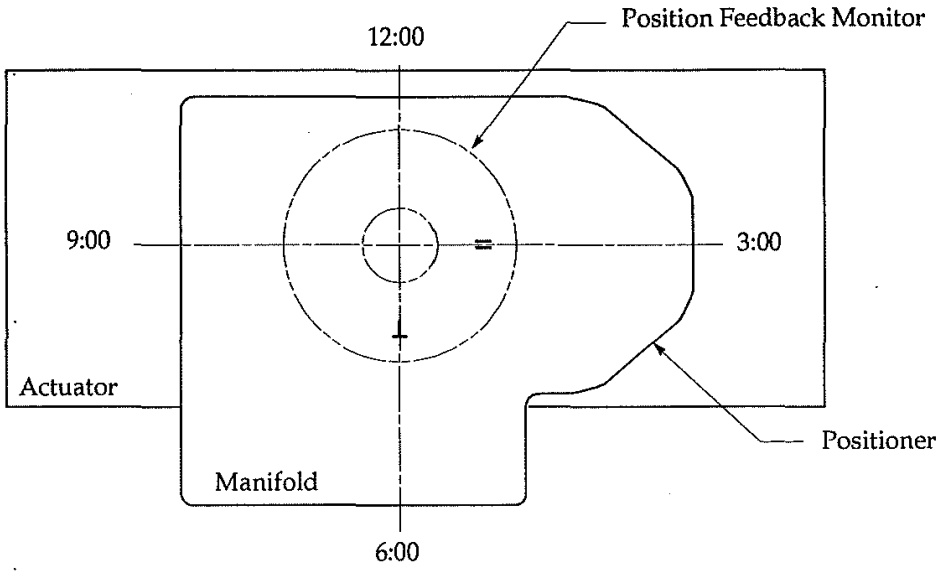
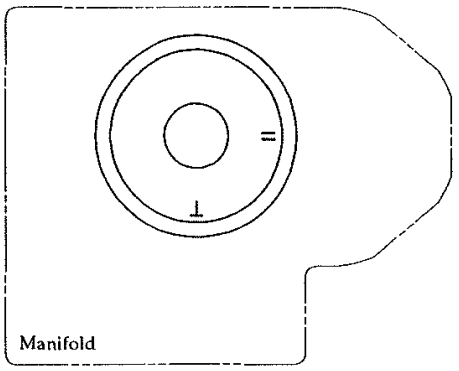


Figure 2: Top View of Positioner & Actuator

<u>Condition 1:</u> **A**: Fail-safe Closed - Clockwise Rotation or
B: Fail-safe Open - Clockwise Rotation



⊥ Placed at 6:00 (See Figure 2)

|| Placed at 3:00 (See Figure 2)

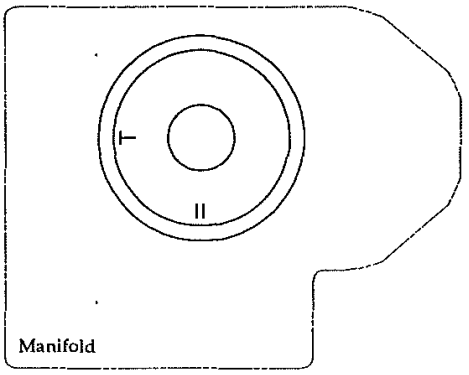
A: A fail-safe closed in a clockwise rotation actuator opens in a counterclockwise motion. Therefore, the inner beacon should be oriented as shown to the left.

B: A fail-safe open in a clockwise rotation actuator closes in a counterclockwise motion. Therefore, the inner beacon should be oriented as shown to the left.

MOUNTING INSTRUCTIONS

For Rotary Actuators

Condition 2: **A:** Fail-safe Open - Counterclockwise Rotation or
B: Fail-safe Closed - Counterclockwise Rotation



⊥ Placed at 9:00 (See Figure 2)

|| Placed at 6:00 (See Figure 2)

A: A fail-safe open in a counterclockwise rotation actuator closes in a clockwise motion. Therefore, the inner beacon should be oriented as shown to the left.

B: A fail-safe closed in a counterclockwise rotation actuator opens in a counterclockwise motion. Therefore, the inner beacon should be oriented as shown to the left.

Step 4: Fasten Position Feedback Monitor to Inner Beacon Coupler.

Step 5: Mount Positioner to bracket

Step 6: Pipe up the positioner to the actuator (Refer to Operating Instructions).

Step 7: Supply proper air supply to the positioner (Refer to Operating Instructions).

Step 8: Supply proper power to the positioner (Refer to Wiring Instructions).

SWITCH SETTING

For Rotary Actuators

Note: Prior to setting the switches, the ICot Valve Positioner should be wired properly (See Wiring Instructions) and calibrated (See Calibration Insturctions).

Step 1: Operate the actuator to a desired extreme.

Step 2: Loosen Magnetic Trigger Bolt #1. (See Figure 3)

Step 3: Slide Trigger Bolt #1 beneath the 1st switch and tighten.

Step 4: Operate the actuator to the opposite extreme.

Step 5: Loosen Magnetic Trigger Bolt#2.

Step 6: Slide Trigger Bolt #2 beneath the 2nd switch and tighten.

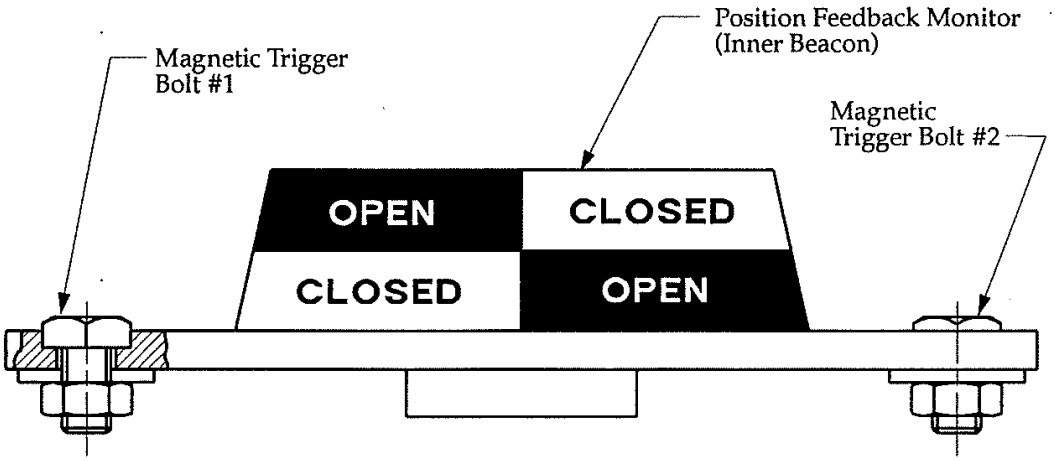


Figure 3

OUTER BEACON INDICATOR SETTING

For Rotary Actuators

Step 1: Stroke the positioner to the closed position.

Step 2: Notice the Beacon indication:

A. If the indicator reads "CLOSED", outer Beacon is already aligned.

B. If the indicator does not read "CLOSED", proceed to Step 3.

Step 3: Loosen the outer Beacon set screw (See Figure 4) and rotate the outer Beacon until it displays "CLOSED". Tighten the set screw.

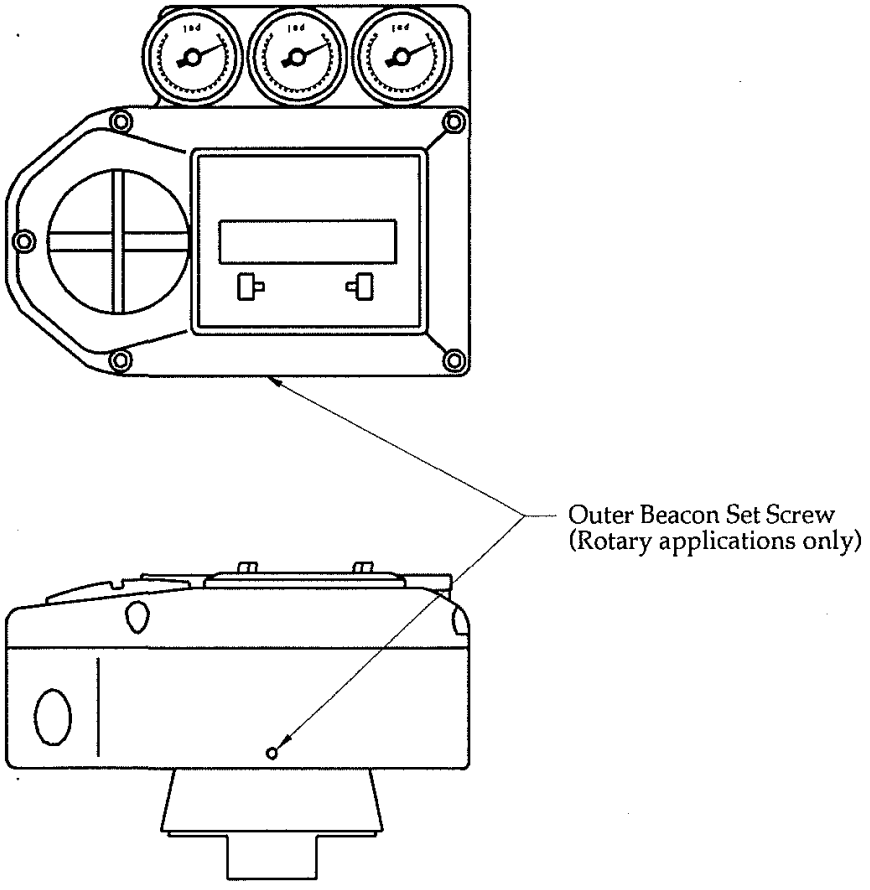


Figure 4

MOUNTING INSTRUCTIONS

For Linear Actuators

Step 1: Mount bracket to actuator (Refer to figure 5 below).

Step 2: Fasten position feedback monitor to the stem of the actuator.

Step 3: Mount positioner to bracket

Step 4: Pipe up the positioner to the actuator. (Refer to Operating Instructions)

Step 5: Supply proper air supply to the positioner. (Refer to Operating Instructions)

Step 6: Supply proper power to the positioner. (Refer to Wiring Instructions)

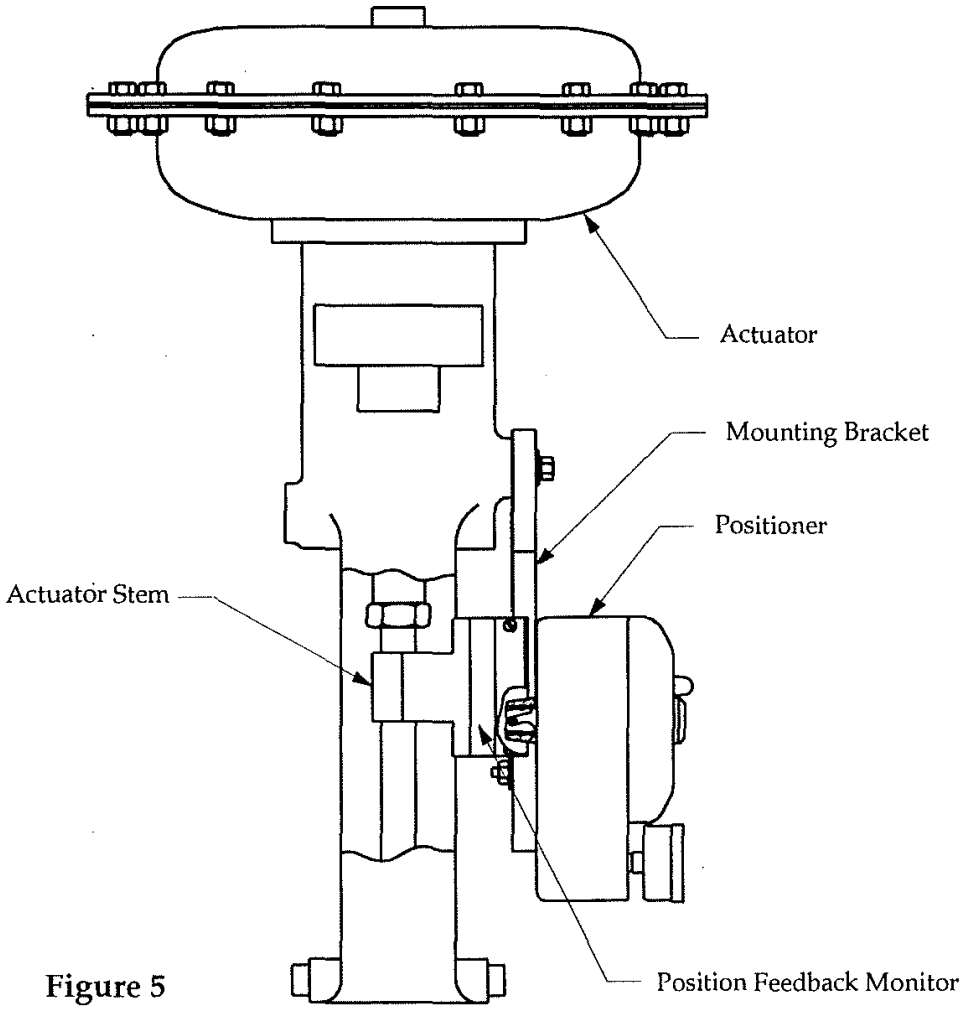
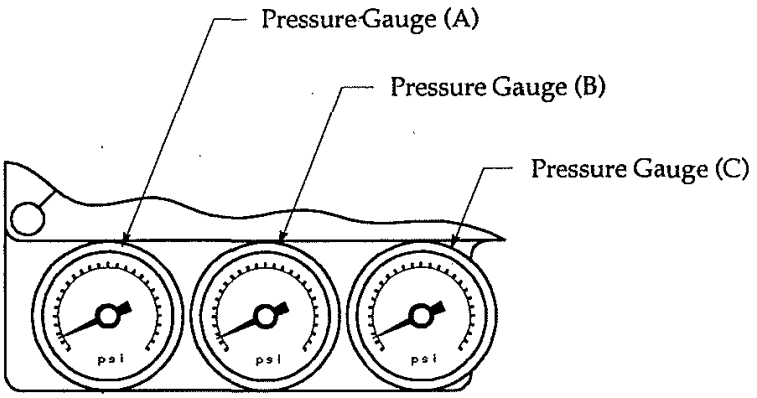
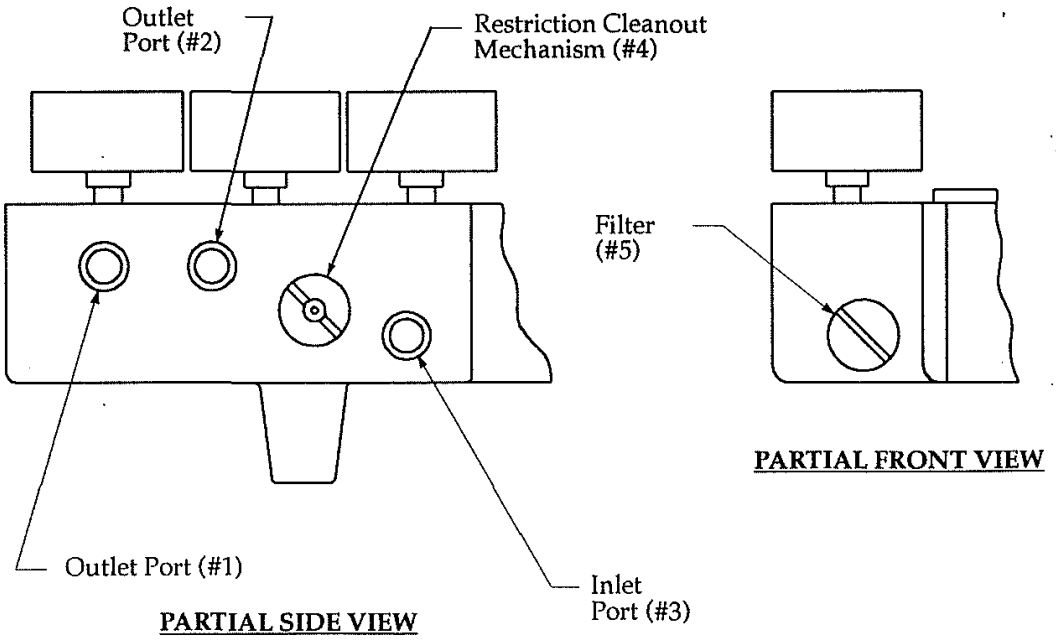


Figure 5

OPERATING INSTRUCTIONS



PARTIAL TOP VIEW



PARTIAL FRONT VIEW

PARTIAL SIDE VIEW

Note: All pneumatic connections are 1/4" NPT

Figure 6:
ICot Valve Positioner (Pneumatics Manifold)

OPERATING INSTRUCTIONS

The operating instructions are separated into two sections; single acting actuators and double acting actuators. Refer to Figure 6 (Pneumatic Manifold) on previous page.

Note: Air supply to the positioner must be pressure regulated and filtered. All pneumatic connections are 1/4" NPT.

Spring Return Actuator (Single Acting)

Step 1: Connect inlet (main) pressure to inlet port #3. (See Figure 6) (Max. supply pressure: 120 PSI)

Step 2: Connect positioner outlet port #1 to inlet port of actuator.

Pressure Gauges

Gauge A represents the outlet pressure of port (#1).

Gauge C represents the inlet pressure of port (#3).

Pre-Operating Suggestions

Step 3: Check the filter.

- **A.** Remove plug (#5) by turning the plug counterclockwise.
- **B.** Remove the filter from the plug.
- **C.** Inspect the filter while noting the following:
  - **1)** The filter should be chalk white in color.
  - **2)** After a period of usage: If the filter is yellow in color, the air supply contains oil and/or water.
  - **3)** After a period of usage: If the filter is black in color, the air supply contains dust and/or dirt.
- **D.** Replace the filter if the color is not chalk white. (Additional filters are available from Porex Technology, Fairburn, Georgia at 1-800-241-1095. Order Part Number: X6789)

Step 4: Transducer Cleanout

- **A.** Insert a flat screw driver or coin into the slot of the Restriction Cleanout Mechanism (#4).
- **B.** Press the circular plunger to exhaust any dust.

OPERATING INSTRUCTIONS

Double Return Actuator (Double Acting)

Step 1: Connect the inlet (main) pressure to inlet port (#3). (See Figure 6) (Max. supply pressure: 120 PSI)

Step 2: Connect positioner outlet ports (#1 & #2) to actuator inlet ports.

Note: In the event of power loss, the actuator will fail to a predetermined position. If the opposite failure mode is desired, reverse the positioner outlet connections to the actuator.

Pressure Gauges

Gauge A represents the outlet pressure of port (#1).

Gauge B represents the outlet pressure of port (#2).

Gauge C represents the inlet pressure of port (#3).

Pre-Operating Suggestions

Step 3: Check the filter.

A. Remove plug (#5) by turning the plug counterclockwise.

B. Remove the filter from the plug.

C. Inspect the filter while noting the following:

1) The filter should be chalk white in color.

2) After a period of usage: If the filter is yellow in color, the air supply contains oil and/or water.

3) After a period of usage: If the filter is black in color, the air supply contains dust and/or dirt.

D. Replace the filter if the color is not chalk white.

Step 5: Transducer Cleanout

A. Insert a flat screw driver or coin into the slot of the Restriction Cleanout Mechanism (#4).

B. Press the circular plunger to exhaust any dust.

WIRING INSTRUCTIONS

With Solenoid Option

Procedure for connecting 4-20 mA power source to positioner (Refer to Figure 7 below)

Step 1: Remove positioner cover.

Step 2: Locate terminal strip on keypad assembly and carefully disconnect (slide off).

Step 3: Connect 4-20 mA signal to terminal points marked (+) and (-).

Step 4: The power for the solenoid should be connected to points 3 and 4.

Step 5: The connection from the solenoid to the positioner is pre-wired internally through terminal points 1 and 2.

Step 6: After all connections have been properly made, carefully slide the terminal strip back on to the keypad assembly.

Step 7: Replace positioner cover.

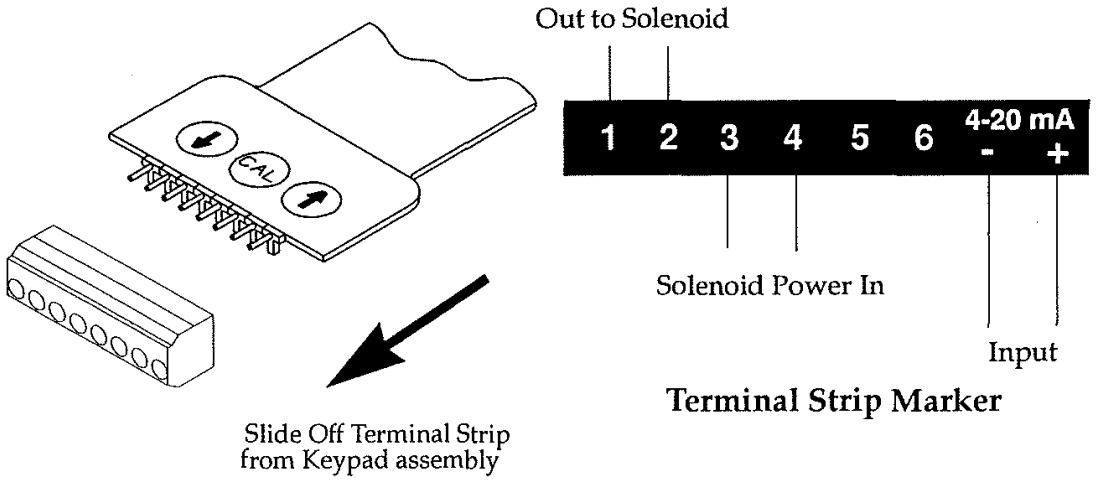


Figure 7

WIRING INSTRUCTIONS

With Switches

Procedure for connecting 4-20 mA power source to positioner (Refer to Figure 8 below)

Step 1: Remove positioner cover.

Step 2: Locate terminal strip on keypad assembly and carefully disconnect (slide off).

Step 3: Connect 4-20 mA signal to terminal points marked (+) and (-).

Step 4: Connect output wiring.

Step 5: After all connections have been properly made, carefully slide the terminal strip back on to the keypad assembly.

Step 6: Replace positioner cover.

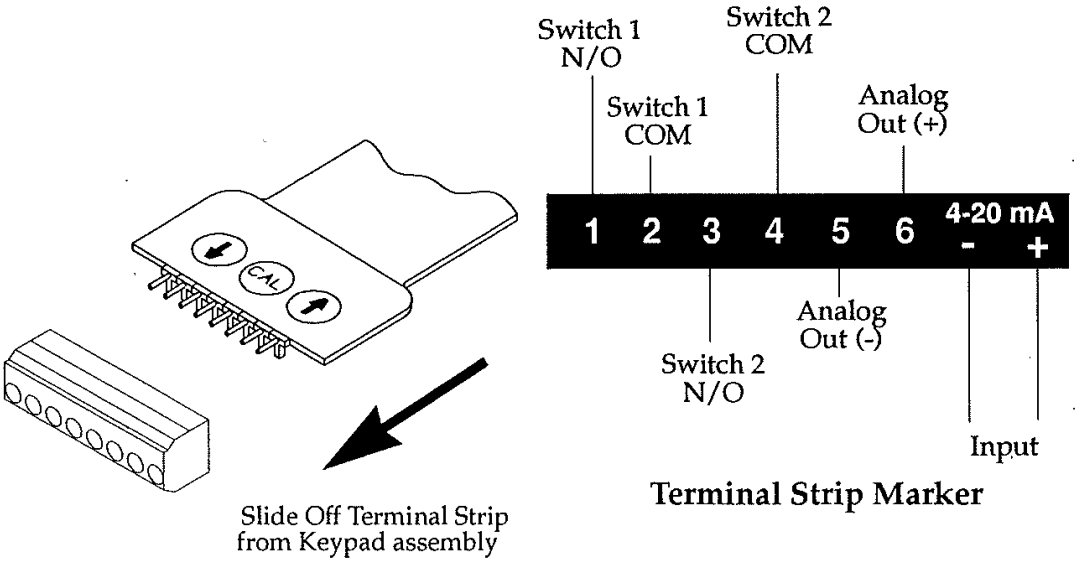


Figure 8

CALIBRATION INSTRUCTIONS

Step 1: Remove positioner cover

Step 2: Apply 4 to 20 mA current loop power source to the positioner terminal strip.

Step 3: Enter calibration mode and bring gain settings to their lowest values.

A. Press and hold the CAL key until **LO** appears on the LCD display.

B. Press the down arrow key several times until **PID** appears on the display.

C. Press the CAL key once to display **PCAL** and value. Decrease this value to **1.**

D. Press the Cal key once to display **ICAL** and value. Decrease this value to **1.**

E. Press the CAL key once to display **DCAL** and value. Decrease this value to **1.**

F. Press the CAL key to loop back to **PID.**

Step 4: Procedure for New Transducer Calibration (Use only when transducer or electronic canister is replaced)

A. Press the down arrow key several times until **trnd** appears on the display.

B. Apply 12 mA of current to the positioner.

C. Press the CAL Key once to initiate calibration.

D. Wait approximately 1 to 2 minutes for the positioner to calibrate itself. When calibrating, only **trnd** will appear on the display. When calibration is complete, position will display periodically with **trnd.**

Step 5: Procedure to set Proportional, Integral, and Derivative Gain

A. Press the down arrow key several times until **AUTO** appears on the display.

B. Apply 12 mA of current to the positioner.

C. Press the CAL Key once to initiate calibration.

D. The Auto Tuning can take several minutes to complete. While auto-tuning, only **AUTO** will appear on the display. When Auto-tuning is complete, position will display periodically with **AUTO.**

E. The Proportional, Integral, and the Derivative Gain settings can be fine tuned by pressing the down arrow key once until **PID** appears on the display.

1) Enter **PCAL** by pressing CAL key and adjust using up & down arrow keys.
2) Enter **ICAL** by pressing CAL key and adjust using up & down arrow keys.
3) Enter **DCAL** by pressing CAL key and adjust using up & down arrow keys.
4) Press the CAL key to loop back to **PID**.

Step 6: Procedure to set valve zero position (Low Calibration)

A. Press the down arrow key several times until **LO** appears on the display.

B. Apply 4 mA of current to the positioner. **

C. Press the CAL key once to initiate the Low calibration. The actuator will stroke to the fully closed position.

D. After approximately one minute, the display will alternately show position **0.0%** with set point **0.0%** and **LO**.

E. Next, the low position must be determined. If a 0.0% open (fully closed) is desired, press the CAL key to accept this position. If a different position is desired , press the up arrow key to drive the set point to the desired position. Once the position matches the set point, press the CAL key.

Step 7: Procedure to set valve span position (High Calibration)

A. Press the down arrow key several times until **HI** appears on the display.

B. Apply 20 mA of current to the positioner. **

C. Press the CAL key once to initiate the High calibration. The actuator will stroke to the fully open position.

D. After approximately one minute, the display will alternately show position **100%** with set point **100%** and **HI**.

E. Next the high position must be determined. If a 100% open (fully open) is desired, press the CAL key to accept this position. If a different position is desired , press the down arrow key to drive the set point to the desired position. Once the position matches the set point, press the CAL key.

Step 8: Procedure to set the flow characteristics (Flo)

A. Press the down arrow key several times until Flo appears on the display.

B. Press the CAL key once.

C. Using the down arrow, select linear (Lin), Quick Opening (OPn), or Equal Percentage (EP).

D. Press the Cal key once to accept flow type.

Step 9: Procedure to set the valve type (**tyPE**).

A. Press the down arrow key once until **tyPE** appears on the display.

B. Press the CAL key once.

C. Using the down arrow key, select Linear valve (**Lin**), or Rotary valve (**Rot**).

D. Press the CAL key once to accept the valve type

Step 10: Procedure to set Fail Mode of display

A. Press the down arrow key once until **FLOP** appears on the display.

B. Press the CAL key once.

C. Using the down arrow key select **"OFF"** or **"ON"**.
(**"OFF"** for fail closed application. **"ON"** for fail open application.)

Step 11: Procedure to set Valve Opening Speed

A. Press the down arrow key once until **OPSP** appears on the display.

B. Press the CAL key once.

C. Using the up & down arrow keys, select speed (**5**=fastest, **1**=slowest)

D. Press the CAL key once to accept opening speed.

Step 12: Procedure to set Valve Closing Speed

A. Press the down arrow key once until **CLSP** appears on the display.

B. Press the CAL key once.

C. Using the up & down arrow keys, select speed (**5**=fastest, **1**=slowest)

D. Press the CAL key once to accept closing speed.

Step 13: To terminate calibration, press the up arrow key once. This will write all new calibration data to memory.

Step 14: Replace the positioner cover. The ICoT Valve Positioner is now ready for operation.

** *Note : If 20 to 4mA is desired, apply 20mA input in step 6B and 4mA in step 7B. For split range, enter desired inputs in 6B and 7B.*

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tech-078

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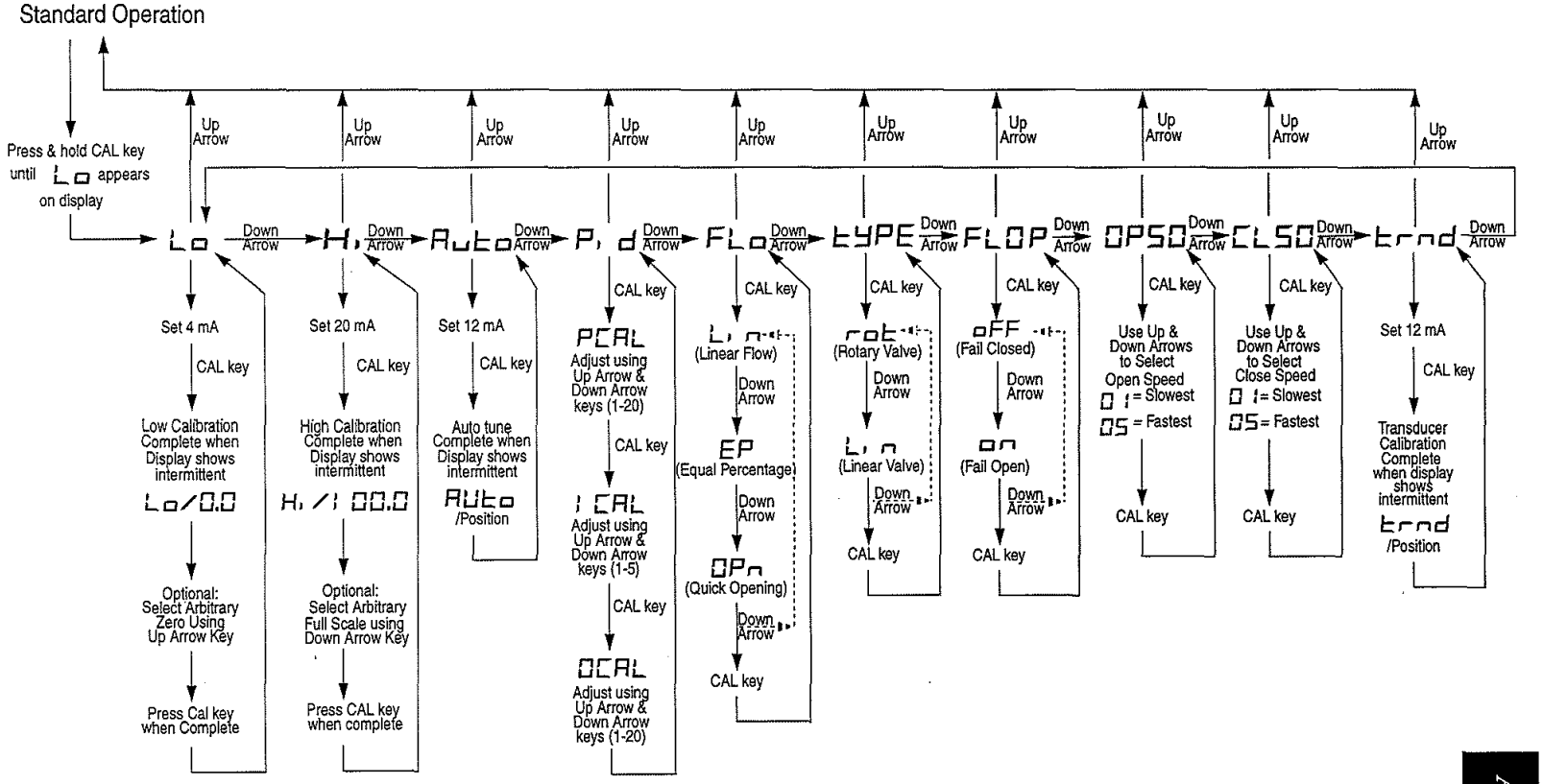
Calibration Loop Accessible Through Keypad



Appendix A

Appendix B

Procdure to Set PID Setting

Positioners Without Autotune

This procedure is to be used for easy PID Gain Settings:

Step 1: Set Pcal Value = 1

Set Ical Value = 1

Set dcal Value = 1

Step 2: Adjust Pcal Value until a 20% step change in input produces an uncontrollable oscillation. For example, Pcal = 1 no oscillaction, Pcal = 2 small oscillation, Pcal = 3 constant uncontrollable oscillation.

Step 3: The Pcal Value from Step 2 is termed "Ultimate Pcal" ie. Pcal = 3. Set Pcal, Ical and dcal values using table.

Step 4: Perform Lo and Hi calibration.

Ultimate	Auto Settings		
Pcal	Pcal	Ical	dcal
1			
2	1	5/4	2
3	1	5/4	2
4	2	5/4	3
5	2	5/4	3
6	3	5/4	4
7	4	5/4	4
8	4	4/3	4
9	5	4/3	5
10	6	4/3	6
11	7	4/3	6
12	7	4/3	7
13	8	4/3	7
14	9	4/3	8
15	10	4/3	9
16	11	4/3	9
17	12	4/3	10
18	13	4/3	17
19	13	4/3	17
20	14	4/3	17
20	15	3/2	18

Appendix C

ERROR MESSAGES

ERR 1	Clogged Nozzle or Clogged Filter
ERR 3	Low Input Pressure or Clogged Filter
ERR 5	Integrator Overflow - Position of actuator does not match setpoint of positioner
ERR 6	Calibration Error - Positioner could not successfully perform calibration

For further assistance in diagnosing problems which result in positioner error messages, please consult Westlock Controls at (201) 794-7650.

NSP

VWG #761

PURCHASE ORDER

TYPE MS

DATE	PURCHASE ORDER NO.
05/28/97	PL6202MS

NORTHERN STATES POWER COMPANY

10326 SOUTH ROBERT TRAIL
INVER GR HGTS MN55075
ATTN- JAMES L. SCHUELKE
MARK-FOR E-MTCE1 VAPORIZER WEG VALVES

633

MAIL INVOICE TO:
Northern States Power Co.
Accounts Payable Dept.
P.O. Box 9366
Minneapolis, MN 55440-9366

Unless Otherwise Indicated Below
Mail All Acknowledgments,
And Correspondence
Promptly To
Northern States Power Company
PROCUREMENT SERVICES
414 NICOLLET MALL
MINNEAPOLIS MN 55401
612 330-5674

PVF MIDWEST INC
2350 COUNTY ROAD C SUITE 150
ROSEVILLE, MN 55113

PAGE 1 PMIWESD

F.O.B. ORIGIN ROSEVILLE, MN
FREIGHT COLLECT

THIS PURCHASE ORDER NO. AND LINE NO. MUST APPEAR ON ALL PAPERS AND PACKAGES.

Scheduled Delivery Date	Terms		
08/01/97	NET 30 DAYS		
Account Or W.O. Number	**Requisition No.**	**Requisitioner**	**Buyer**
21250 75.28.40.12-00	G870393	SCHUELKE JAMES L	JIM HUBER ~~DUANE L FERKEY~~

Line No.	Quantity	Material Or Services To Be Furnished	Price
		AS A CONDITION OF PAYMENT THE FOLLOWING SHALL BE ADHERED TO: PURCHASE ORDER NUMBER AND RELEASE NO. SHALL BE REFERENCED ON ALL INVOICES, PACKING SLIPS, CORRESPONDENCES, ASSOCIATED DOCUMENTS, ETC. PRICES SHALL BE INCLUDED ON ALL PACKING SLIPS, AND THE PACKING SLIP NUMBER SHALL BE RECORDED ON EACH INVOICE. ********** ALL SHIPPING SHALL BE IN ACCORDANCE WITH THE ATTACHED SHIPPING INSTRUCTIONS. ALL FREIGHT CHARGES IN EXCESS SHALL BE CHARGED TO SUPPLIER ACCOUNT. NO C.O.D. ACCEPTED FOR MATERIAL OR LABOR.	
1		SUPPLY THE FOLLOWING VALVES PER THE ATTACHED TABLE WHICH INCLUDES VALVE TAG #, VALVE SIZE, MANUFACTURER AND MODEL #. THE APPROXIMATE SHIP DATE IS AUGUST 1, 1997. THE VALVES ARE TO BE HELD AND SHIPPED TO THE NSP JOBSITE WHEN REQUESTED BY NSP.	16,593.00

See Reverse Side For Additional Terms And Conditions Applying To This Order

TAXES

MATERIAL SUBJECT TO TAX OF STATE TO WHERE MATERIAL IS SHIPPED. ACTUAL FREIGHT CHARGES ARE GENERALLY TAX EXEMPT AND MUST BE SHOWN SEPARATELY ON INVOICE.

BY NORTHERN STATES POWER COMPANY

AUTHORIZED SIGNATURE

NORTHERN STATES POWER

Valve Number	Valve Size NPS	Model Number Code	PVF Quote	Manufacturer + Model Numbers	Reference Quotation
V-505	2	B	$ 92.65	Victaulic V-620-3312-11	PVF Fax Quote to CHI 4/25/97
V-510	2	B	$ 92.65	Ditto	
V-604	2	B	$ 92.65	Ditto	
V-617	2	B	$ 92.65	Ditto	
V-619	2	B	$ 92.65	Ditto	
V-622	2	B	$ 92.65	Ditto	
V-628	2	B	$ 92.65	Ditto	
V-632	2	B	$ 92.65	Ditto	
V-711	2	B	$ 92.65	Ditto	
V-717	2	B	$ 92.65	Ditto	
V-848	2	A	$ 49.50	Milwaukee 2"-208 SOR 6008	PVF Quote Dated 4/1/97 Ball Valve Alternate
V-849	2	A	$ 49.50	Ditto	
V-862	2	A	$ 49.50	Ditto	
V-948	2	A	$ 49.50	Ditto	
V-949	2	A	$ 49.50	Ditto	
V-962	2	A	$ 49.50	Ditto	
V-501	3	B	$ 119.05	Victaulic V-630-3312-11	PVF Fax Quote to CHI 4/25/97
V-506	3	B	$ 119.05	Ditto	
CV-1045	8	F	$ 335.93	Victaulic Series 779	PVF Fax Quote to CHI 4/14/97
CV-845	8	F	$ 335.93	Ditto	
CV-945	8	F	$ 335.93	Ditto	
V-1046	8	D	$ 416.03	Victaulic V-680-3312-20	PVF Fax Quote to CHI 4/25/97
V-846	8	D	$ 416.03	Ditto	
V-946	8	D	$ 416.03	Ditto	
CV-222	10	F	$ 871.30	Victaulic Series 779	PVF Fax Quote to CHI 4/14/97
CV-322	10	F	$ 871.30	Ditto	
V-106	10	D	$ 606.80	Victaulic V-100-3312-20	PVF Fax Quote to CHI 4/25/97
V-111	10	D	$ 606.80	Ditto	
V-112	10	D	$ 606.80	Ditto	
V-210	10	D	$ 606.80	Ditto	

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MANUAL WEG VALVES BID TAB
4/26/97 Rev 3
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Doc No 633

WESCOTT LNG PLANT
OAH Docket No. 71-2500-37763
Schedule 3, Polich Surrebuttal
DOC Ex. ___, RAP-S-3 at 1

NORTHERN STATES POWER

Valve Number	Valve Size NPS	Model Number Code	PVF Quote	Manufacturer + Model Numbers	Reference Quotation
V-221	10	D	$ 606.80	Ditto	
V-310	10	D	$ 606.80	Ditto	
V-321	10	D	$ 606.80	Ditto	
V-940	12	D	$ 813.55	Victaulic V-120-3312-20	PVF Fax Quote to CHI 4/25/97
V-840	12	D	$ 813.55	Victaulic V-120-3312-20	
V-1040	12	D	$ 813.55	Victaulic V-120-3312-20	
V-931	12	E	$ 903.95	Victaulic V-120-3312-20 w/CW + Chain	PVF Fax Quote to CHI 4/25/97
V-831	12	E	$ 903.95	Victaulic V-120-3312-20 w/CW + Chain	
V-1031	12	E	$ 903.95	Victaulic V-120-3312-20 w/CW + Chain	
			$ 16,593.38		

Model Number Codes

All Valves to be supplied with Brass Valve Tag

A	Milwaukee #20B SOR 600# threaded Bronze body, Stainless Steel Ball & Trim, Teflon Seals, Stainless Steel Latch-Lock Handle
B	Victaulic Style 300, ductile iron body with grooved ends, EDPM coated disc, bronze bearing stainless steel lever handle with memory stop.
C	Silent or No-Slam check valves, Bronze or iron body, threaded or grooved ends, for mounting in either vertical or horizontal pipe.
D	Victaulic Style 300, ductile iron body with grooved ends, EDPM coated disc, Gear box actuator with memory stop.
E	Victaulic Style 300, ductile iron body with grooved ends, EDPM coated disc, Gear box actuator with chain wheel actuator, C/L of pipe 12 feet above grade.
F	Victaulic Style 779 Venturi check valve, ductile iron body with grooved ends, EDPM coated disc. with spring loading for "No-Slam" operation.

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MANUAL WEG VALVES BID TAB
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WESCOTT LNG PLANT

NORTHERN STATES POWER

Valve Number	Valve Size NPS	Model Number Code	PVF Quote	Manufacturer + Model Numbers	Reference Quotation
V-1001	0.5	A	$ 11.75	Milwaukee 1/2"-20B SOR 600#	PVF Quote Dated 4/1/97 Ball Valve/Alternate
V-225	0.5	A	$ 11.75	Ditto	
V-325	0.5	A	$ 11.75	Ditto	
V-502	0.5	A	$ 11.75	Ditto	
V-507	0.5	A	$ 11.75	Ditto	
V-605	0.5	A	$ 11.75	Ditto	
V-608	0.5	A	$ 11.75	Ditto	
V-618A	0.5	A	$ 11.75	Ditto	
V-618B	0.5	A	$ 11.75	Ditto	
V-801	0.5	A	$ 11.75	Ditto	
V-901	0.5	A	$ 11.75	Ditto	
V-1017	1	A	$ 21.90	Milwaukee 1"-20B SOR 600#	PVF Quote Dated 4/1/97 Ball Valve Alternate
V-1018	1	A	$ 21.90	Ditto	
V-1019	1	A	$ 21.90	Ditto	
V-1032	1	A	$ 21.90	Ditto	
V-1041	1	A	$ 21.90	Ditto	
V-1043	1	A	$ 21.90	Ditto	
V-1048	1	A	$ 21.90	Ditto	
V-1052	1	A	$ 21.90	Ditto	
V-1063	1	A	$ 21.90	Ditto	
V-110	1	A	$ 21.90	Ditto	
V-209	1	A	$ 21.90	Ditto	
V-211	1	A	$ 21.90	Ditto	
V-213	1	A	$ 21.90	Ditto	
V-215	1	A	$ 21.90	Ditto	
V-219	1	A	$ 21.90	Ditto	
V-309	1	A	$ 21.90	Ditto	
V-313	1	A	$ 21.90	Ditto	
V-316	1	A	$ 21.90	Ditto	
V-319	1	A	$ 21.90	Ditto	
V-603	1	A	$ 21.90	Ditto	
V-631	1	A	$ 21.90	Ditto	
V-718	1	A	$ 21.90	Ditto	
V-817	1	A	$ 21.90	Ditto	

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MANUAL WEG VALVES BID TABLE
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WESCOTT LNG PLANT

NORTHERN STATES POWER

Valve Number	Valve Size NPS	Model Number Code	PVF Quote	Manufacturer + Model Numbers	Reference Quotation
V-818	1	A	$ 21.90	Ditto	
V-819	1	A	$ 21.90	Ditto	
V-832	1	A	$ 21.90	Ditto	
V-841	1	A	$ 21.90	Ditto	
V-843	1	A	$ 21.90	Ditto	
V-848	1	A	$ 21.90	Ditto	
V-852	1	A	$ 21.90	Ditto	
V-863	1	A	$ 21.90	Ditto	
V-917	1	A	$ 21.90	Ditto	
V-918	1	A	$ 21.90	Ditto	
V-919	1	A	$ 21.90	Ditto	
V-932	1	A	$ 21.90	Ditto	
V-941	1	A	$ 21.90	Milwaukee 1"-20B SOR 600#	PVF Quote Dated 4/1/97 Ball Valve Alternate
V-943	1	A	$ 21.90	Ditto	
V-948	1	A	$ 21.90	Ditto	
V-952	1	A	$ 21.90	Ditto	
V-963	1	A	$ 21.90	Ditto	
CV-227	1.5	C	$ 44.95	Conbraco 61-107-01	PVF Fax Quote to CHI 4/25/97
CV-327	1.5	C	$ 44.95	Ditto	
V-223	1.5	A	$ 39.20	Milwaukee 1 1/2"-20B SOR 600#	PVF Fax Quote to CHI 4/14/97
V-227	1.5	A	$ 39.20	Ditto	
V-323	1.5	A	$ 39.20	Ditto	
V-327	1.5	A	$ 39.20	Ditto	
CV-504	2	C	$ 69.50	Conbraco 61-108-01	PVF Fax Quote to CHI 4/25/97
CV-509	2	C	$ 69.50	Ditto	
CV-602	2	C	$ 69.50	Ditto	
CV-621	2	C	$ 69.50	Ditto	
CV-630	2	C	$ 69.50	Ditto	
V-1048	2	A	$ 49.50	Milwaukee 2"-20B SOR 600#	PVF Quote Dated 4/1/97 Ball Valve Alternate
V-1049	2	A	$ 49.50	Ditto	
V-1062	2	A	$ 49.50	Ditto	

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MANUAL WEG VALVES BID TAB
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OAH Docket No. 71-2500-37763
Schedule 3, Polich Surrebuttal
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Victaulic®
An ISO 9001 certified company

IPS CARBON STEEL PIPE GROOVED VALVES **08.10**

Series 779 Venturi Check Valve

PRODUCT DESCRIPTION

The Victaulic Series 779 Venturi check valve provides a variety of functions unlike any other flow measuring device. The CAD-designed hydrodynamic inlet profile provides a natural venturi as part of the valve. The inlet is drilled, tapped and plugged, ready to receive the flow kit (incl.).

The venturi-like taps provide much greater measurement accuracy than taps placed across the valve seat. Valve turbulence and interference across the valve seat need not be a consideration. Twin taps on both sides of the valve provide positioning of measurement outlets for convenient meter connection and accurate flow measurement independent of the style of throttling valve or the position of the throttling element (ball, plug, disc, etc.).

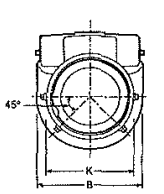
Grooved end design allows direct connection to either Vic®-300 butterfly valves or Series 377 Vic-Plug™ valves for triple service throttling and shutoff with non-slam check service and flow measurement capability. Vic-300 butterfly valves field connect with a single Style 07 Zero-Flex® coupling to form a single triple service unit. Series 377 Vic-Plug valve, an AWWA size component, connects directly with a Style 307 Transition coupling.

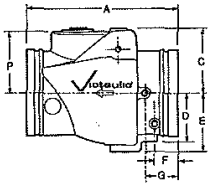
Series 779 Venturi check valves are available in sizes from 4 - 12" (100 - 300 mm). (Note: For 2½ and 3" triple service combinations, the Series 716 Vic-Check® valve, without measurement ports, can be combined with a Vic-300 butterfly valve.) The valve features a single spring-loaded, non-slamming disc, totally encapsulated in EPDM or nitrile (specify coating) for superior corrosion resistance. The valves have a welded-in nickel seat and optionally available drain taps up and downstream.

Sizes 4 - 12"
Patent Pending

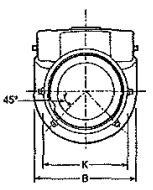
Every valve is factory tested and rated to 300 PSI (2065 kPa) working pressure. All sizes can be installed in horizontal or vertical position and provide leak-free sealing under conditions as low as five feet (1.5 m) of head pressure.

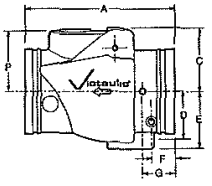
DIMENSIONS



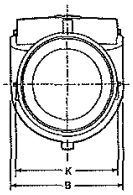


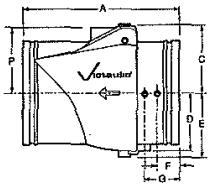
Typical 4"





Typical 5 - 8"





Typical 10 - 12"

08.10-1A

Nom. Size Inches mm	Dimensions- Inches/millimeters										Approx. Wgt. Ea. Lbs. kg
	Actual Size Inches mm	E - E A	B	C	D	E	F	G	K	P	
4† 100	4.500 114.3	9.63 245	5.88 149	3.88 99	2.75 70	3.50 89	1.50 38	2.38 60	4.50 114	3.50 89	20.0 9.1
5† 125	5.563 141.3	10.50 267	6.75 171	4.50 114	– –	4.25 108	1.65 42	2.38 60	5.88 149	4.08 104	27.0 12.3
5½ O.D.†	5.500 139.7	10.50 267	6.75 171	4.50 114	– –	4.25 108	1.65 42	2.38 60	5.88 149	4.08 104	27.0 12.3
6† 150	6.625 168.3	11.50 292	8.00 203	5.00 127	– –	4.50 114	1.56 40	2.68 68	6.68 170	4.75 121	38.0 17.2
6½ O.D.†	6.500 165.1	11.50 292	8.00 203	5.00 127	– –	4.50 114	1.56 40	2.68 68	6.68 170	4.75 121	38.0 17.2
8* 200	8.625 219.1	14.00 356	9.88 251	6.06 154	5.06 129	5.68 144	1.75 44	3.25 83	8.88 226	5.75 146	64.0 29.0
10* 250	10.750 273.0	17.00 432	12.00 305	7.12 181	6.00 152	6.68 170	1.82 46	3.94 100	10.94 278	6.75 171	100.0 45.4
12* 300	12.750 323.9	19.50 495	14.00 356	8.06 205	6.88 175	7.68 195	1.82 46	3.32 84	12.82 326	7.75 197	140.0 63.5

† "F" port located 45° off centerline of valve body. * Both ports on centerline of valve body.

Victaulic Company of America • P.O. Box 31, Easton, PA 18044-0031 • 4901 Kesslersville Rd., Easton, PA 18040 • 610/559-3300 • FAX: 610/250-8817

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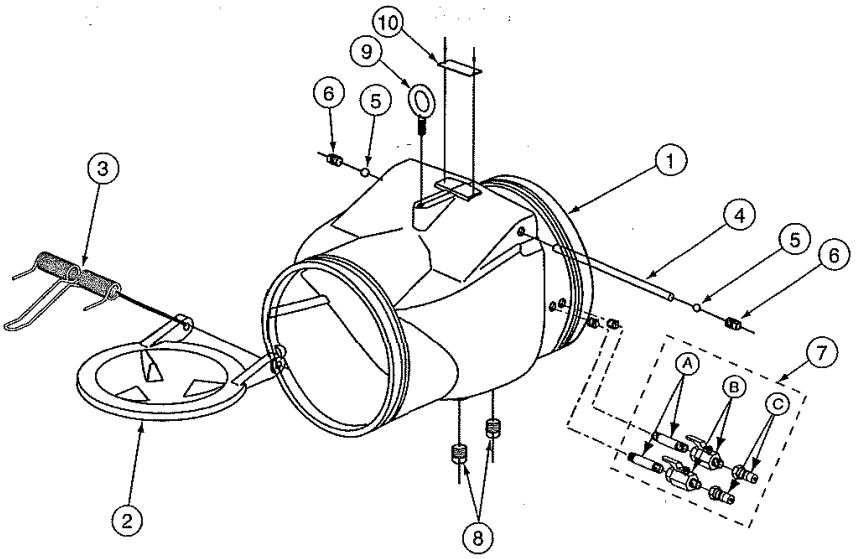
Venturi Check Valve

Series 779

1. Ductile iron body
2. Rubber encapsulated disc
3. Type 302/304 stainless spring
4. Type 316 stainless steel disc shaft
5. Elastomer shaft lock
6. Zinc plated shaft plug
7. Flow measuring kit*:
   - A. Extension nipples
   - B. Bronze access valves
   - C. Quick disconnect for meter connection (Per ISO 7241-1 Series B)
   - D. Easy-read flow chart and instructions (not shown)
8. Zinc plated, carbon steel drain plugs (optional)
9. Lifting ring (8 - 12" valves)
10. Name plate

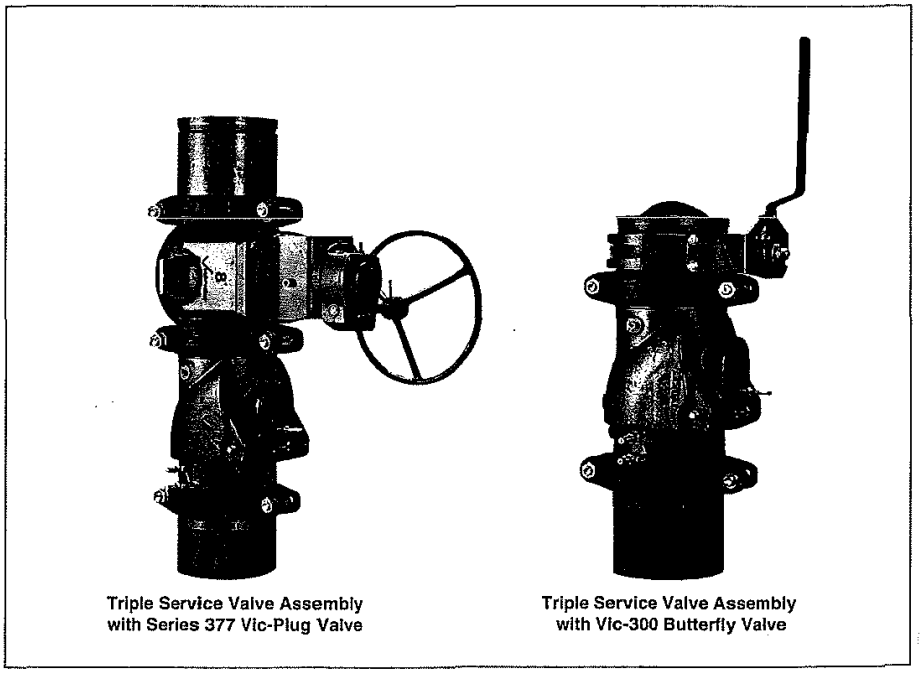
*Kit hardware is same for all sizes; charts for 4 and 5", 6 and 8", 10 and 12".



Triple Service Valve Combinations

Grooved end design allows direct connection to either Vic®-300 butterfly valves or Series 377 Vic-Plug™ valves for triple service throttling and shutoff with non-slam check service and flow measurement capability. Vic-300 butterfly valves field connect with a single Style 07 Zero-Flex® coupling to form a single triple service unit. Series 377 Vic-Plug valve (an AWWA size component), connects directly with a Style 307 transition coupling.

See Section 08.09.



Triple Service Valve Assembly with Series 377 Vic-Plug Valve

Triple Service Valve Assembly with Vic-300 Butterfly Valve

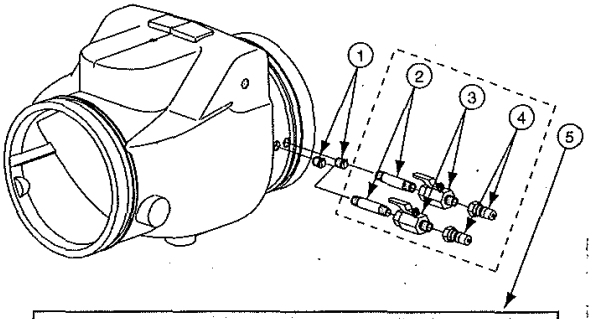
Victaulic®
An ISO 9001 certified company

PARTS KIT

SP-779

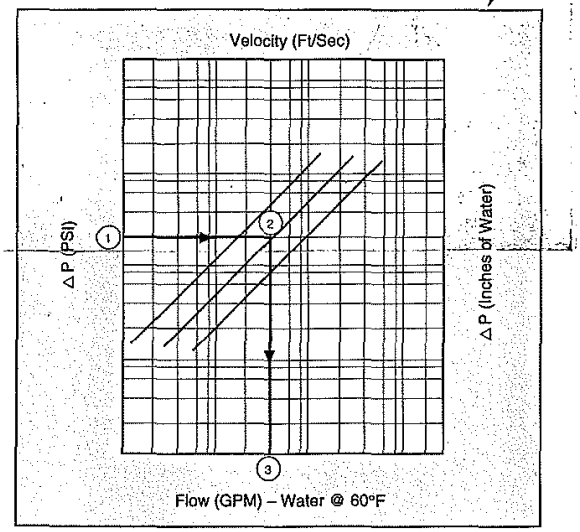
Instructions for Installation of Parts Kits on 4" - 12" Series 779 Check Valve

Parts Kit Components



Item Number	Description	Quantity
1	Pipe Plug (Not included in kit)	–
2	Nipple	2
3	Valve*	2
4	Quick Disconnect	2
5	Flow Chart	1

*Valves shown open for easy assembly.



⚠ WARNING

Failure to follow instructions and warnings can result in serious injury.

- Do not service any valve that is pressurized or contains harmful fluids or gasses.
- Before installing operating, or servicing, read and understand the Operating Instructions and all warning labels.
- Always wear safety glasses and foot protection.

If you have any questions about the safe operation of this valve, contact Victaulic Company, P.O. Box 31, Easton, PA 18044-0031, 610-559-3300.

Parts Kit Assembly

Step 1 - See warning above.

Step 2 - Check the parts kit provided to be sure that all of the required parts are included (Items 2 - 5).

Step 3 - Remove pipe plugs (Item 1).

Step 4 - Install Items 2 - 4 as shown above; NOTE: For 4" - 6" valves, one set of parts will be offset 45° from the other set. Apply a suitable thread sealer or Teflon tape to the threads prior to assembling. Torque all items to approximately 10 FT - LBS. Position the handles of the valves (Item 3) to prevent interference with each other.

Step 5 - Close valves (Item 3) prior to pressurizing. NOTE: Open valves (Item 3) only after meter (not shown) is connected to the quick disconnect (Item 4).

Step 6- To determine the flow rate at the valve, measure the pressure drop between the two ports. NOTE: The measuring device should be capable of reading 0 to 6 PSI or 0 to 150 inches of water.

① Enter the chart at the measured pressure drop (PSI or inches of water). ② Horizontally connect the pressure drop to the curve for the specific valve size. ③ Read flow at valve along X-axis.

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NSP

REQUISITIONERS COPY

TYPE MS

DATE	PURCHASE ORDER NO.
07/09/97	PL6473MS

NORTHERN STATES POWER COMPANY

TO: 10326 SOUTH ROBERT TRAIL
INVER GR HGTS MN55075
ATTN- JAMES L. SCHUELKE
MARK-FOR E-MTCE1 STRAINERS/VAP PROJ

MAIL INVOICE TO: Northern States Power Co.
Accounts Payable Dept.
P.O. Box 9366
Minneapolis, MN 55440-9366

Unless Otherwise Indicated Below
Mail All Acknowledgments,
And Correspondence
Promptly To
Northern States Power Company
PROCUREMENT SERVICES
414 NICOLLET MALL
MINNEAPOLIS MN 55401
612 330-5674

PVF MIDWEST INC
2350 COUNTY ROAD C SUITE 150
ROSEVILLE, MN 55113

PAGE 1 PMIWESD

F.O.B. ORIGIN SHIP PT
FREIGHT COLLECT

THIS PURCHASE ORDER NO. AND LINE NO. MUST APPEAR ON ALL PAPERS AND PACKAGES.

Scheduled Delivery Date	Terms:
08/01/97	NET 30 DAYS

Account Or W.O. Number	Requisition No.	Requisitioner	Buyer
21250 75.28.40.12-00	D099210	SCHUELKE JAMES L	MARY J LYRENMANN

Line No.	Quantity	Material Or Services To Be Furnished	Price
		CONFIRMING PURCHASE ORDER 06/30/97	
		AS A CONDITION OF PAYMENT THE FOLLOWING SHALL BE ADHERED TO: PURCHASE ORDER NUMBER AND RELEASE NO. SHALL BE REFERENCED ON ALL INVOICES, PACKING SLIPS, CORRESPONDENCES, ASSOCIATED DOCUMENTS, ETC. PRICES SHALL BE INCLUDED ON ALL PACKING SLIPS, AND THE PACKING SLIP NUMBER SHALL BE RECORDED ON EACH INVOICE. ********** ALL SHIPPING SHALL BE IN ACCORDANCE WITH THE ATTACHED SHIPPING INSTRUCTIONS. ALL FREIGHT CHARGES IN EXCESS SHALL BE CHARGED TO SUPPLIER ACCOUNT. NO C.O.D. ACCEPTED FOR MATERIAL OR LABOR.	
1		1 EACH PROVIDE THE FOLLOWING LOT OF STRAINERS PER THE ATTACHED BILL OF MATERIALS FOR PURCHASE DATED 6/26/97 REV 2 74/ $8197.74 COORDINATE SHIPPING/DELIVERY SCHEDULE WITH JIM SCHUELKE, WESCOTT PLANT AND/OR RON OLSON NSP SPECIAL CONSTRUCITON 612-520-6843.	8,200.00

See Reverse Side For Additional Terms And Conditions Applying To This Order

TAXES

MATERIAL SUBJECT TO TAX OF STATE TO WHERE MATERIAL IS SHIPPED. ACTUAL FREIGHT CHARGES ARE GENERALLY TAX EXEMPT AND MUST BE SHOWN

NSP9604

NORTHERN STATES POWER

Tag Number	Size (inches)	Manufacturer	Model or Style Number	Strainer Type	Strainer Basket hole opening size (inches)	ANSI Class Rating	Inlet Conn.	Outlet Conn.	Price	Note or Comment
STR-107	10	Victaulic	730	T type	0.125	N/A	Grooved End	Grooved End	$905.97	
STR-212	10	Victaulic	730	T type	0.125	N/A	Grooved End	Grooved End	$905.97	
STR-224	1 1/2	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$18.35	Cast Iron
STR-312	10	Victaulic	730	T type	0.125	N/A	Grooved End	Grooved End	$905.97	
STR-324	1 1/2	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$18.35	Cast Iron
STR-411	12	Hendrix	PB-WIP	Inline Basket	100 mesh	600	Flanged	Flanged	$420.00	Notes 1, 3 & 5 200% Open area. 100 Mesh over 0.125" backing Quoted as CS x SS
STR-502	2	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$28.50	Cast Iron
STR-507	2	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$28.50	Cast Iron
STR-609 & 610	2	Mueller	#791 SAH	Inline right angle basket type	0.0313	125	FNPT	FNPT	$971.55	Cast Iron Body, Screwed Duplex Strainer
STR-701	3"	Hendrix	PCL	Inline conical	100 mesh	600	RF Flange	RF Flange	$87.50	Notes 1, 3 & 5 100 Mesh over 0.125" backing
STR-821	1"	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$10.55	Cast Iron
STR-842	10 X 8	Victaulic	VS-731	Suction-Diffuser	Mfg's Std	N/A	Grooved End	Flanged	$1,291.81	
STR-921	1"	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$10.55	Cast Iron
STR-942	10 X 8	Victaulic	VS-731	Suction-Diffuser	Mfg's Std	N/A	Grooved End	Flanged	$1,291.81	
STR-1021	1"	Mueller	11M	Y type	0.0625	250	FNPT	FNPT	$10.55	Cast Iron
STR-1042	10 X 8	Victaulic	VS-731	Suction-Diffuser	Mfg's Std	N/A	Grooved End	Flanged	$1,291.81	
								Total Order Price:	$8,197.74	

Notes:
1 Raised face finish is 125 - 250 AARH for Flexitallic type gasket
2 - Deleted-
3 Material Test Reports required for all pressure containment components which are welded.
4 - Deleted-
5 To be installed between a pair of ANSI 16.5 raised face flanges

CHI ENGINEERING SERVICES, INC.

STRAINERS
Bill of Materials for Purchase
6/26/97; Rev. 2
Page 1 of 1

WESCOTT LNG VAPORIZER REPLACEMENT

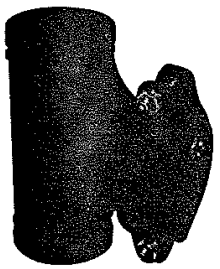
7:37PM FRC CHI ENGINEERING 603 431 1721 P.4

Victaulic®
An ISO 9001 certified company

IPS CARBON STEEL GROOVED ACCESSORIES 09.02

Style 730 Vic-Strainer®

PRODUCT DESCRIPTION



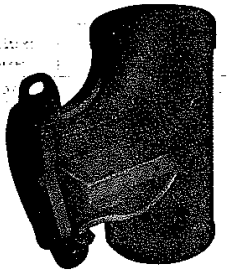
Style 730 Vic-Strainer is lighter than flanged "Y" type strainers and provides straight-through flow for lower pressure drop. It installs with two Victaulic couplings, and is rated up to 300 PSI (2065 kPa) depending upon the installed coupling's pressure rating.

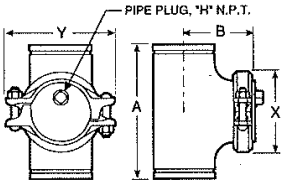
A durable 304 stainless screen is provided, 12 mesh sizes 2 - 3" (50 - 80 mm); 6 mesh sizes 4 - 16" (100 - 400 mm) standard; other smaller sizes available. Integral rails permit easy access for cleaning. Contact Victaulic for details.

⚠ WARNING

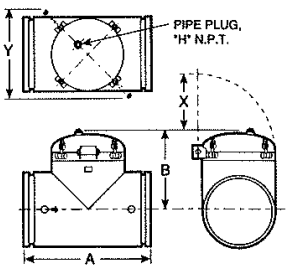
Always depressurize system before draining. Failure to do so could result in serious personal injury, property damage, joint leakage or joint separation.

DIMENSIONS





Typical 2 - 12" sizes



Typical 14 - 30" sizes

Pipe Inches/millimeters		Dimensions Inches/millimeters						Approx. Weight Each Lbs. kg
Nominal Size	Actual Size	Maximum Working Pressure PSI † kPa	A	B	X *	Y *	H	
2 50	2.375 60.3	300 2065	6.50 165	4.25 108	3.19 81	5.44 138	0.50 13	5.8 2.6
2½ 65	2.875 73.0	300 2065	7.50 191	4.75 121	3.88 98	6.13 156	0.50 13	8.9 4.0
3 80	3.500 88.9	300 2065	8.50 216	5.25 133	4.56 116	6.81 173	0.75 19	21.0 9.5
4 100	4.500 114.3	300 2065	10.00 254	6.13 156	5.81 148	8.25 210	1.00 25	19.6 8.9
5 125	5.563 141.3	300 2065	11.00 279	6.63 168	7.06 179	9.75 248	1.25 32	31.3 14.2
6 150	6.625 168.3	300 2065	13.00 330	7.63 194	8.00 203	10.75 273	1.25 32	43.3 19.6
8 200	8.625 219.1	300 2065	15.50 394	9.13 232	10.25 260	13.50 343	2.00 51	75.0 34.0
10 250	10.750 273.0	300 2065	18.00 457	10.38 264	12.88 327	16.75 426	2.00 51	136.0 61.7
12 300	12.000 323.9	300 2065	20.00 508	11.38 289	14.88 378	18.50 470	2.00 51	197.2 89.4
14 350	14.000 355.6	300 2065	22.00 559	12.75 324	16.19 411	19.75 502	2.00 51	300.0 136.1
16 400	16.000 406.4	300 2065	24.00 610	13.75 349	18.38 467	21.75 553	2.00 51	350.0 158.8
18 450	18.000 457.0	+ +	31.00 787	23.25 591	19.50 495	29.75 756	2.00 51	460.0 208.7
20 500	20.000 508.0	+ +	34.50 876	25.88 657	21.69 551	31.75 807	2.00 51	565.0 256.3
24 600	24.000 610.0	+ +	40.00 1016	30.13 765	25.69 653	37.63 956	2.00 51	830.0 376.5
30 750	30.000 762.0	+ +	50.00 1270	35.63 905	32 813	44.50 1130	2.00 51	1273.0 577.4

† Working pressure is maximum based on Style 07 access coupling and will be governed by couplings used for installation and related system components.
* Dimension will vary depending upon coupling orientation.
+Working Pressure is dependent upon the style of coupling used to join Style 730 to the piping system.

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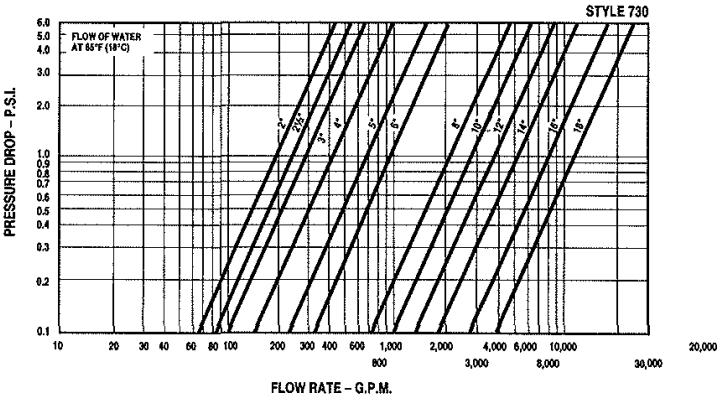
PERFORMANCE DATA

Flow Characteristics

Flow characteristics are charted to the right and are based on standard 12-mesh basket in the 2, 2½ and 3" (50, 65 and 80 mm) sizes; 6-mesh in 4 - 16" (100 - 400 mm) sizes.

Flow may vary from these figures.

For 20 - 30" (500 - 750 mm) performance contact Victaulic.



† For 20 - 30" sizes contact Victaulic for details.

C_V Values

Tabulated pressure drop or head loss is Static Pressure loss. The change in Velocity Pressure due to the reduction in pipe size is not included.

Total ΔP = Static ΔP_s + Velocity

Pressure Change:
(P_v inlet – P_v outlet)

$P_v = .001123\ GPM^2/d^4$ PSI.
*"d" is the inlet or outlet diameter (inches).

*At standard conditions of +60°F (+16°C)

Valve Size	C_V	Valve Size	C_V
2 50	190	8 200	2108
2½ 65	230	10 250	2683
3 80	290	12 300	3872
4 100	425	14 350	5050
5 125	685	16 400	8000
6 150	950	18 450	10540

For 20 - 30" (500 - 750 mm) contact Victaulic.

MATERIAL SPECIFICATIONS

Body, Coupling, End Cap: Ductile iron conforming to ASTM A-536, with enamel coating.
❑ **Optional:** Zinc electroplated

Basket: Stainless Steel, Type 304, frame and mesh.
2 - 3" (50 - 80 mm): 12 × 12 mesh (0.020" wire) with 0.063" opening.
4 - 16" (100 - 400 mm): 6 × 6 mesh (0.041" wire) with 0.126" opening.
18 - 30" (450 - 750 mm): 0.125 mesh
❑ **Optional:** Other mesh sizes and materials available, contact Victaulic for details.

Coupling Gasket: (specify choice*)
❑ **Grade "E" EPDM**
EPDM (Green color code). Temperature range –30°F to +230°F (–34°C to +110°C). Recommended for cold and hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. NOT RECOMMENDED FOR PETROLEUM SERVICES.
❑ **Grade "T" nitrile**
Nitrile (Orange color code). Temperature range –20°F to +180°F (–29°C to +82°C). Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range. Not recommended for hot water services over +150°F (+66°C) or for hot dry air over +140°F (+60°C).

*Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

Bolts/Nuts: Heat treated carbon steel zinc electroplated to ASTM B-633, track-head conforming to physical properties of ASTM A-183 minimum tensile 110,000 PSI (758340 kPa).

Magnets: Magnets, particularly for lubricating oil service applications and others can be added at the factory. Contact Victaulic for details.

Couplings: Vic-Strainer Style 730 is normally supplied with a Style 07 Zero-Flex coupling for cleaning access. All appropriately sized Victaulic standard grooved pipe couplings will fit (such as Style 78 Snap-Joint quick disconnect coupling) for cleaning access. Pressure ratings will vary according to access coupling (and installing couplings) used. Contact Victaulic for sizes, pressures and pricing for other access couplings.

Other: Special requirements can often be met. Contact Victaulic with specific requirements for recommendations, availability and delivery.

STR 841, 842, 1041

I-31
Installation and Assembly Suction Diffuser Style 731

Victaulic®

Installation Instructions

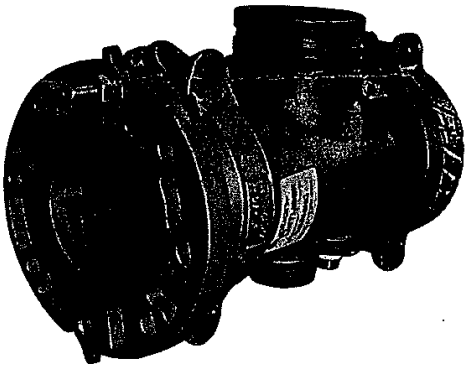
The following step-by-step procedures are designed as a guide for proper installation of Victaulic® Style 731 Suction Diffuser. Victaulic Style 731 is shipped fully assembled with a single shipping bolt in the flange and the gasket taped in place.

Always check gasket supplied to be certain it is suited for the service intended.

Grade	Temp. Range	Compound	Color Code	General Service Recommendations
E	−30°F (−34°C) to +230°F (+110°C)	EPDM	Green Stripe	Recommended for hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. NOT RECOMMENDED FOR PETROLEUM SERVICES.
T	−20°F (−29°C) to +180°F (+82°C)	Nitrile	Orange Stripe	Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range. NOT RECOMMENDED FOR HOT WATER SERVICES OVER +150°F (+66°C) OR HOT DRY AIR OVER 140°F (+60°C).

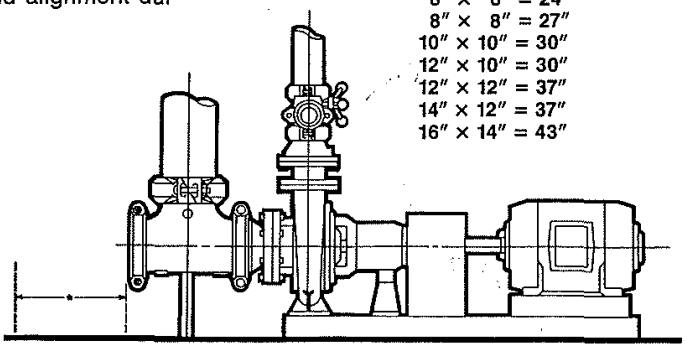
Refer to the latest Victaulic Gasket Selection Guide for specific recommendations and other available gaskets.

NOTE: The Victaulic Style 731 Suction Diffuser contains various Victaulic products. Always consult the Victaulic Pocket Handbook, I-100, for the appropriate instructions.



***NOTE:**
MINIMUM CLEARANCE REQUIRED FOR REMOVAL OF DIFFUSER

4″ × 3″	= 16″
6″ × 4″	= 20″
6″ × 6″	= 24″
8″ × 6″	= 24″
8″ × 8″	= 27″
10″ × 10″	= 30″
12″ × 10″	= 30″
12″ × 12″	= 37″
14″ × 12″	= 37″
16″ × 14″	= 43″



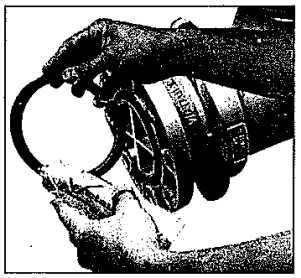
Always use lubrication for proper coupling assembly

Thorough lubrication of the gasket exterior including the lips and/or pipe ends and housing interiors, is essential to prevent pinching the gasket. Lubrication assists proper gasket seating and alignment during installation.

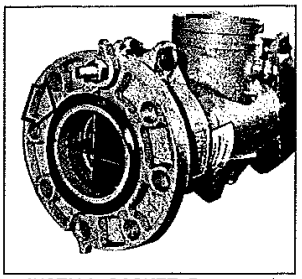
Use VICTAULIC LUBRICANT for installation. Other compatible materials such as silicone and others may be used, however, **petroleum based lubricants must not be used on Grade "E" gasket.**

Always specify the proper grade to assure maximum gasket life for the service intended.

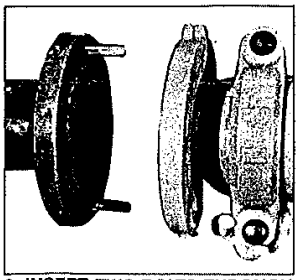
Installation and Assembly



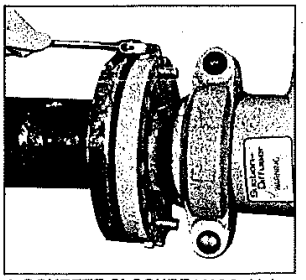
1. REMOVE FLANGE GASKET: Remove flange gasket and check to be certain it is suited for intended service. Apply a thin coat of Victaulic Lubricant or silicone lubricant to gasket lips and outside of gasket.



2. INSTALL GASKET: Press gasket into the cavity between the pipe O.D. and flange recess. Be sure the gasket is properly positioned as shown. After gasket is in place, apply additional lubricant liberally to outer gasket lip, which will seal on the mating flange. Remove shipping bolt.



3. INSERT TWO BOLTS THROUGH MATING FLANGE: Closure lugs are provided for ease of assembly. To use these closure lugs place an adjustable wrench or similar tool over the closure lugs. Bring the wrench forward until the flange holes are aligned and insert the bolt.



4. SQUEEZE CLOSURE LUGS: Using a wrench, squeeze the closure lugs to enable full insertion of the bolt. Mate the Suction Diffuser flat against the mating flange.
NOTE: Pliers or other suitable device may also be used to close the flange.

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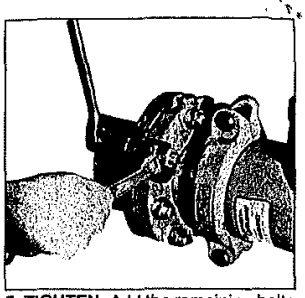


5. TIGHTEN: Add the remaining bolts and tighten all nuts evenly until flange faces are in firm contact.

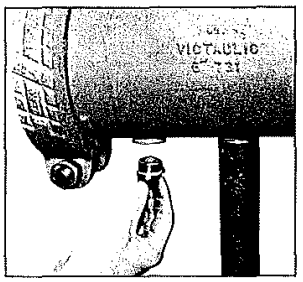
NOTE: A support boss is provided on the underside of the Suction Diffuser. Use 1¼" dia. Schedule 40 pipe, cut to provide proper alignment.

SYSTEM START-UP: Each Victaulic Suction Diffuser is provided with a removable, fine mesh sleeve, which is attached to the permanent perforated screen. Simply cut the sleeve off after start-up period and discard. Refer to clean out instructions for removal of screen.

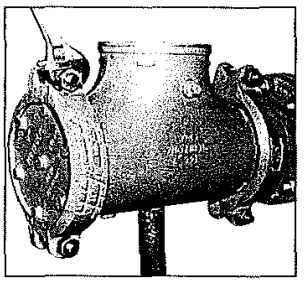
Clean Out/Service

IMPORTANT: System must always be depressurized and drained before removing end cap. For other component assembly/disassembly information refer to Victaulic's Pocket Handbook publication I-100, available at no charge from Victaulic.

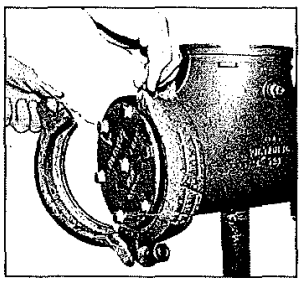
1. DEPRESSURIZE SYSTEM BEFORE BEGINNING DISASSEMBLY PROCEDURE.



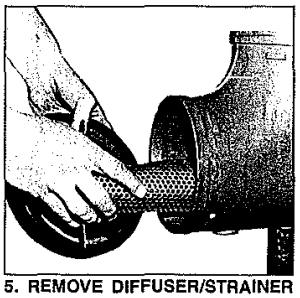
2. REMOVE DRAIN TAP: Remove drain tap located at underside of Suction Diffuser.



3. REMOVE ONE BOLT: Loosen and remove one bolt from the Style 07 ZeroFlex® access coupling.



4. REMOVE COUPLING: ZeroFlex couplings' unique angle pad design eases disassembly, allowing coupling to swing away with only one bolt removed. Remove gasket and End Cap.



5. REMOVE DIFFUSER/STRAINER

6. CLEAN: Remove dirt and debris and rinse. Reverse disassembly procedure for reassembly, being sure to Lubricate (using Victaulic Lubricant) the coupling gasket before proceeding. (Refer to Pocket Handbook I-100 for details.)

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PUBLIC DOCUMENT –
NOT PUBLIC DATA HAS BEEN EXCISED

[redacted] VAPORIZER

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE
[redacted]						10-5-16 SKG

[redacted] VAPORIZER

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE	
[redacted]						10-26-17	kw
						10-26-17	kw
						10-26-17	kw
						10-25-17	kw
						10-25-17	kw
						10-25-17	JEB
						10-12-17	kw

[redacted] VAPORIZER

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE
[redacted]						11/23/18

[redacted] VAPORIZER

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE
[redacted]						10-9-19
						10-9-19
						10-9-19
						10-9-19
						10-9-19
						10-9-19
						10-4-19
						10-4-19
						10-4-19
						10-4-19

[redacted] VAPORIZER

EQUIPMENT #	DESCRIPTION	INPUT	OUTPUT	FOUND	LEFT	DATE
[redacted]						10-24-2020
						10-22-2020

Polich Surrebuttal Schedule No. 5
This document is not public in its entirety.