Fast Electrically Actuated Valves

FAIL-SAFE CONTROL VALVE FOR MODULATING CONTROL OF INSTANTANEOUS WATER HEATER & HEAT EXCHANGER APPLICATIONS

SERIES

ARIA

ADVANCED, RELIABLE, INDUSTRIAL ACTUATOR

MODELS

- **ARA** -3-Way ,Flanged Steel Mix Valves; 1/2″ - 2″
- **ARB** -2-Way & 3-Way, NPT Threaded Bronze & SS Valve; 1/2″ - 2″
- **ARC** -2-Way & 3-Way, Flanged, Cast Iron Valves; 2-1/2″ - 6″
- **ARD** -2-Way, Flanged Steel Cage Valves; 1/2″ - 2″

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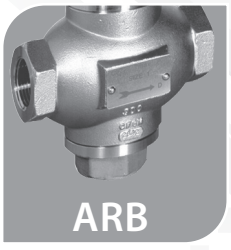


ARD PRODUCT SPEC

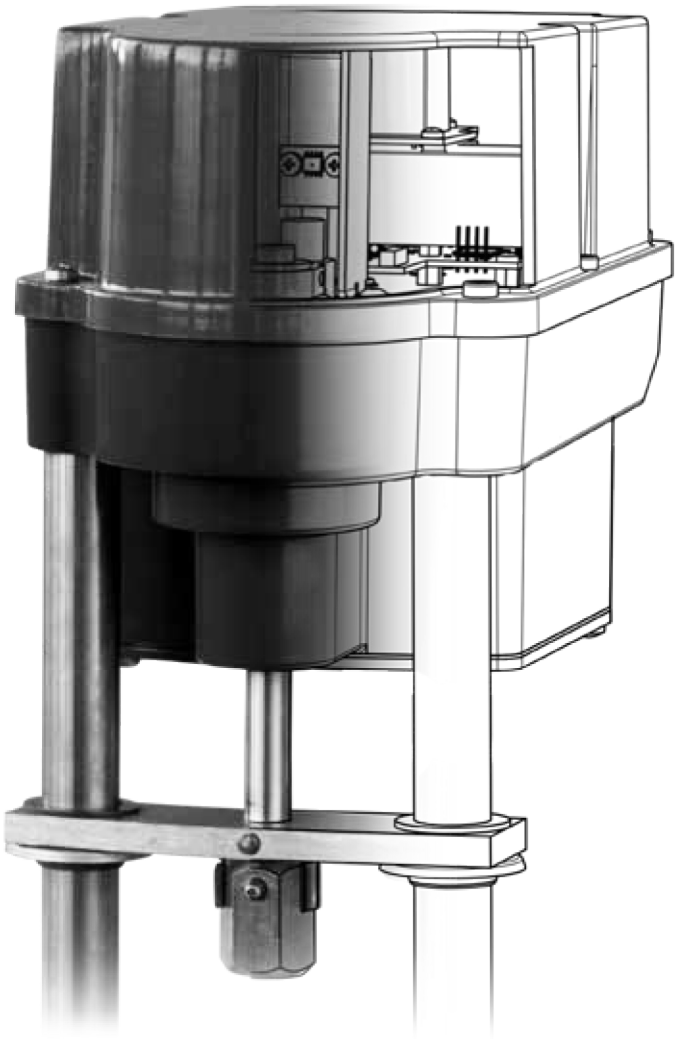
WARREN CONTROLS

2600 EMRICK BLVD • BETHLEHEM, PA 18020 • USA •800-922-0085 • WWW.WARRENCONTROLS.COM

DEPENDABLE, RUGGED, PRECISION CONTROL VALVES AND ACCESSORIES

ARIA SERIES: small frame actuators

HIGH QUALITY, MODULATING, LINEAR, INDUSTRIAL ELECTRIC VALVE ACTUATOR



At 2mm/sec travel speed (12 seconds/inch), the ARIA Series Actuators incorporate spring-fail open or closed (model dependent) on loss of power or signal. The actuator is mounted onto the control valve via pillars and mounting base and attached via a yoke locknut. The actuator stem and valve stem are connected as well.

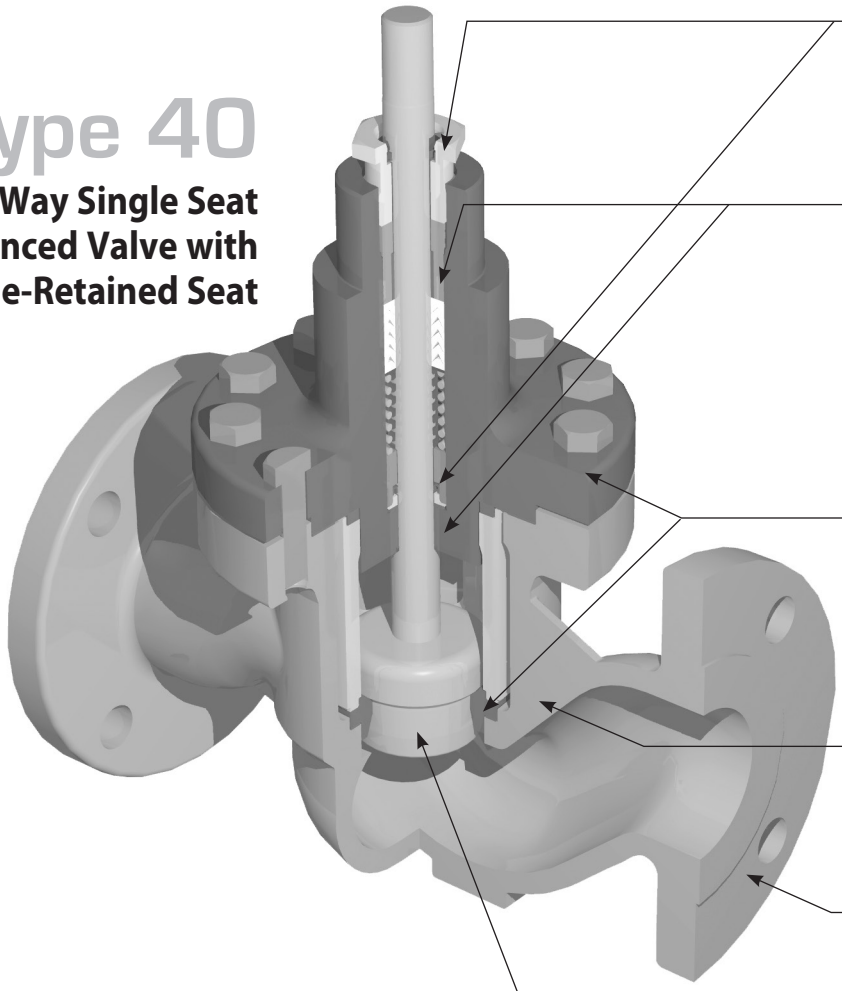
Based on a brushless DC motor (BLDC) the generated torque is transmitted via a multi-stage spur gear onto a spindle nut. The spindle nut transmits the input torque into an axial thrust force of 450 Lbf, via a spindle. The linear stroke is transmitted to the valve spindle by a coupling piece.

The stroke is measured and controlled by a linear 12 Bit Hall sensor. In case of mains power loss, the stroke movement is in OPEN or CLOSE direction by spring force. Electrical wiring is terminated at a terminal block under the actuator cover.

The ARIA Series actuated control valves are ideally suited for challenging, modulating, industrial processes that require electric actuation with the actuation speed and reliability of pneumatics.

Type 40

Two-Way Single Seat Unbalanced Valve with Cage-Retained Seat



Stem Wipers
provide outstanding packing protection and stem stability.

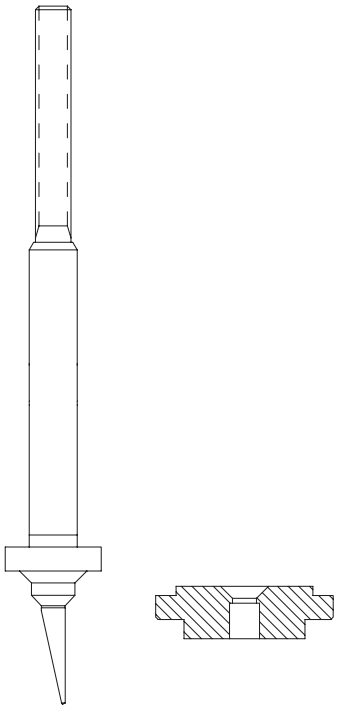
Dual Point PEEK Bearing Plug Guiding
provides both stability and low friction, resulting in lowest hysteresis and precision control. Graphalloy Bearings for higher temperature with Extension Bonnet.

Bolted Bonnet and Cage-Retained Seat
make the valve ideal for easy access, maintenance, and trim inspection.

Rugged Body
with a selection of port reductions.

Low Profile Design
offers footprint minimizing valuable space consumption, yet conforms to ANSI/ISA standards for NPT, Flanged and Socket Weld ends.

Trim Choices Available
includes 316SS, Alloy 6, PEEK and PTFE.



Type 48

Low Flow Trim Choices Available Include 316SS, PEEK and PTFE

Description
Warren Controls Compact Globe Control Valves feature rugged high efficiency bodies of steel or stainless steel, with cage-retained seats for ease of maintenance, and a variety of trim materials and port sizes. The equal percentage and linear plugs provide excellent modulating control of a wide variety of fluids. The Series AMD is ideally suited where value and long life are important objectives for applications including but not limited to the Chemical, Food & Beverage, General Service, Marine, Pulp & Paper, Refining, District Energy and Pharmaceutical Industries with temperatures from -20°F to 550°F, severe service, dirty fluids, high pressure drops, and corrosive fluids.

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RUGGEDNESS AND HIGH PERFORMANCE	
Features	**Advantages**
Compact rugged valve body	Reduces envelope size and weight without sacrificing pressure boundary integrity or high Cv's.
Precision manufactured valve components	Valve bodies machined in single operation in 4 axis computer numerical controlled horizontal machining centers. Bodies and trim components held to exacting geometric tolerances ensuring smooth reliable operation of finished valve.
Body materials specialized alloys	Standard body materials are WCB steel and CF8M stainless steel. Bodies available custom cast in other specialized alloys.
Trim components	Durable rugged plug and seat construction shuts off tightly.
Equal % or Linear plug	Provides exceptional modulating control with 50:1 rangeability.
Reduced ports	Match valve size to line size and capacity to flow requirements. Maximizes performance. Prevents oversized valves. Simplifies piping. Reduces need for reducers or expanders. 1, 2, & 3 sizes reduced trim available.
Trim materials	Alloy 6 wrapped stainless steel trim promotes long dependable service life in applications controlling hard to handle fluids. 316 & 400 stainless steel trim, PEEK & TFE soft seat trim available for ANSI Class VI shut-off in non-corrosive non-erosive service.
Oversized bearings and shafts	Ideal for high pressure drops.
Valve stem to plug connection	Rigid connection provides zero backlash. Assures minimum dead band and hysteresis.
Threaded valve stem connection and split stem connector	Solid actuator interface. Provides zero backlash. Assures minimum dead band and hysteresis.
Factory lubricated packing and valve stem	Minimizes hysteresis from packing friction.
Available Extension bonnet	Allows for wide range of temperature applications.

INCREASED SERVICEABILITY AND REDUCED MAINTENANCE	
Features	**Advantages**
Integral valve body flanges	Promote secure valve installations and piping integrity. Easy installation. Eliminate exposed line flange bolting. Shorten alignment and installation time. Many different classes of pipe flanges.
ANSI Standard valve body face to face dimensions and bolt patterns	Simplifies piping designs and layouts for new installations. Minimizes need to change piping in existing installations.
Easy actuator mounting & calibration	Facilitates removal and installation for service and maintenance.
Roller burnished valve stem	Ultra smooth finish minimizes packing wear and maximizes life. Smooth function and minimum stick/slip.
Bonnet and packing nut bearings and stem wiper	Prevent external particles from infiltrating and damaging packing.
Bolted bonnet and cage retained seat	Provides fast easy access to trim. Speeds inspection and maintenance.

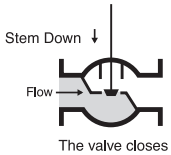
ESTABLISHED FEATURES & QUALITY	
Features	**Advantages**
Linear Control Valve	Combines reciprocating globe valve ruggedness with linear actuators to produce heavy duty automatic throttling control valve which dependably controls fluids in process industries.
Quality valve design & engineering	Components and materials designed and selected to meet or exceed demanding applications, specifications, functional and chemical and temperature compatibility requirements. Product quality built on tried and tested designs and engineering.
Fast electric actuators	Full valve travel in approximately 8 seconds, mimics performance of pneumatic actuators. Incorporates mechanical Spring-Fail for loss of power for open or closed. Available for 24 Vac/Vdc or 115/230 Vac power sources. Using all common process signals (0-10 Vdc, 2-10 Vdc, 0-20mA, 4-20 mA) the analog controls and feedback signals are galvanically isolated. Also offer flow curve correction and split-range inputs as options, all in an IP67 enclosure.
Factory testing and set-up	Each control valve undergoes careful set-up and thorough testing by our highly skilled and experienced factory assembly personnel to ensure it is pre-set for its specified service.

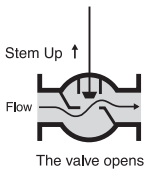
2-WAY VALVES
(Control of Liquids, Gases, and Steam)

Type 40 2-Way Single Seat Unbalanced Valve with Cage Retained Seat

The 5840 Valve is particularly effective for the control of liquids, gases, and steam. It is a suitable solution for applications with dirty fluids and high pressure drops. ANSI Class IV and VI leakage ratings standard. Available with Warren Class IV+ leakage rating for less leakage than ANSI Class IV. (See Allowable Seat Leakage Class table on page 6.)
See Table on page 28 for Fluid Temperature Limits

Sizes:	1/2, 3/4, 1, 1-1/2, 2, inch
Body:	WCB Steel or CF8M Stainless Steel 300 NPT or 300 Socketweld (1/2 thru 2), 150LB Flange or 300LB Flange (1/2 thru 4)
Trim:	EQ% or Linear: 316 Stainless Steel, Alloy 6 Wrapped 316 SS, 400 Stainless Steel, or Alloy 6 Wrapped 400 SS; TFE or PEEK
Leakage Ratings:	ANSI Class IV (Stainless Steel and Alloy 6 Trim), Warren Class IV+ (Stainless Steel and Alloy 6 Trim, SPECIAL ORDER - Consult Factory) ANSI Class VI (TFE and PEEK Trim)
Packing, Type & Bonnet Construction:	**LS** EPDM Lip w/ PEEK Bearings **L8** EPDM Lip w/ Z PEEK Bearings **TS** TFE V-Ring, Spring Loaded, w/ PEEK Bearings **T8** TFE V-Ring, Spring Loaded, w/ Z PEEK Bearings **GS** Adjustable Graphite w/ PEEK Bearings **G8** Adjustable Graphite w/ Z PEEK Bearings **GG** Adjustable Graphite w/ Graphite Gaskets, *Copper Based* Graphalloy Bearings & Extension Bonnet (*For NON-Oxidizing Media ONLY, Best Suited for Hot Water & Steam*) **GL** Adjustable Graphite w/ Graphite Gaskets, *Nickel Based* Graphalloy Bearings & Extension Bonnet (*For NON-Oxidizing Media ONLY, Best Suited for Heat Transfer Oils*) **G7** Adjustable Graphite w/ Graphite Gaskets, *Oxidation Resistant* Graphalloy Bearings & Extension Bonnet (*For Oxidizing Media ONLY*) ***Note: PEEK Bearings are best suited for water and chemical applications. Z-PEEK Bearings are best suited for steam applications.***
Rangeability:	50:1

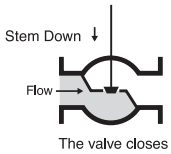


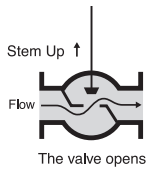


Type 48 2-Way Single Seat Low-Flow Unbalanced Valve with Cage Retained Seat

The 5848 Valve is particularly effective for the control of clean, very low flow liquids, gases, and steam. ANSI Class IV and VI leakage ratings standard.
See Table on page 28 for Fluid Temperature Limits

Sizes:	1/2, 3/4, 1 inch
Body:	WCB Steel or CF8M Stainless Steel 300 NPT, 300 Socketweld, 150LB Flange or 300LB Flange
Trim:	Modified Linear: 316 Stainless Steel; TFE or PEEK
Leakage Rating:	ANSI Class IV (Stainless Steel Trim), ANSI Class VI (TFE and PEEK Trim)
Packing, Type & Bonnet Construction:	**LS** EPDM Lip w/ PEEK Bearings **L8** EPDM Lip w/ Z PEEK Bearings **TS** TFE V-Ring, Spring Loaded, w/ PEEK Bearings **T8** TFE V-Ring, Spring Loaded, w/ Z PEEK Bearings **GS** Adjustable Graphite w/ PEEK Bearings **G8** Adjustable Graphite w/ Z PEEK Bearings **GG** Adjustable Graphite w/ Graphite Gaskets, *Copper Based* Graphalloy Bearings & Extension Bonnet (*For NON-Oxidizing Media ONLY, Best Suited for Hot Water and Steam*) **GL** Adjustable Graphite w/ Graphite Gaskets, *Nickel Based* Graphalloy Bearings & Extension Bonnet (*For NON-Oxidizing Media ONLY, Best Suited for Heat Transfer Oils*) **G7** Adjustable Graphite w/ Graphite Gaskets, *Oxidation Resistant* Graphalloy Bearings & Extension Bonnet (*For Oxidizing Media ONLY*) ***Note: PEEK Bearings are best suited for water and chemical applications. Z-PEEK Bearings are best suited for steam applications.***
Rangeability:	40:1 for Cv 0.75 30:1 for Cv 0. 50 20:1 for Cv 0.25





BODY PRESSURE-TEMPERATURE RATINGS:				
Temp. (F)	STEEL		STAINLESS STEEL	
	150 FLG	300 NPT, SWE, or FLG	150 FLG	300 NPT, SWE, or FLG
-20° To 100°F	285	740	275	720
150°	272	710	255	670
175°	266	695	245	645
200°	260	680	235	620
225°	252	673	230	605
250°	245	667	225	590
275°	237	661	220	575
300°	230	655	215	560
325°	222	650	210	548
350°	215	645	205	537
375°	207	640	200	526
400°	200	635	195	515
450°	185	620	182	497
500°	170	605	170	480
550°	155	587	155	465

Pressure ratings are PSIG

For applications below 32°F or above 550°F, consult factory

Body Pressure — Temperature Ratings conform to ANSI based on body/flange rating and body material. As the fluid temperature increases, the maximum allowable internal pressure decreases. Verify maximum pressures and temperatures prior to selecting body material and body/flange rating.

TRIM MATERIALS	FLOWING DIFFERENTIAL PRESSURE LIMIT
316 Stainless Steel	100 PSID
TFE	15 PSID
PEEK	100 PSID
400 Stainless Steel	200 PSID
Alloy 6	300 PSID

NOTE ON BEARINGS: PEEK or Z PEEK Bearings should not be used for temperatures above 450°F or flowing differential pressure above 300 PSIG.

NOTE: Approaching limits for continuous use will reduce trim life. For continuous use, stay within half of rated maximum.

ALLOWABLE SEAT LEAKAGE CLASSES				
Leakage Class	Maximum Seat Leakage	Test Fluid	Test Pressure	Relative Seat Tightness **
ANSI Class IV	0.01% of rated CV	Water	45 to 60 PSI	50
Warren Class IV+ (linear)	0.02 ml /min/inch of trim size/ ΔP(PSI)	Water	Max Operating ΔP	6,000
ANSI Class VI	Class VI about 0.9 ml/min *	Air	50 PSI	600,000

* Leakage rate varies by valve size, Refer to the ANSI/FCI Standard 70.2.
** Relative to ANSI Class II Leakage Class Maximum Seat Leakage of 0.5% at rated Cv.

Class IV + is not an ANSI/FCI Designation, but a proprietary classification invented and used by Warren Controls, achievable with Metal seats. It is available as a SPECIAL ORDER. Consult Factory with fluid, shut-off pressure, and temperature for special pricing.

ANSI Class VI is reserved for soft seated valves, available with PTFE or PEEK seat inserts.

TRIM STYLE

EQUAL % VS. LINEAR
Trim style describes how the plug's shape (style) changes a valve's capacity as the plug moves (travels) inside it. With the Equal % Trim Style, the shape of the plug produces an equal percentage change in capacity for each equal incremental change in travel. As a typical case this results in 3% of capacity at 10% of travel, 4.4% of capacity at 20% of travel, 6.7% of capacity at 30% of travel, on up to 100% of capacity at 100% of travel. With the Linear Trim Style, the shape of the plug produces a linear incremental change in capacity for each incremental change in travel. This results in 10% of capacity at 10% of travel, 20% of capacity at 20% of travel, 30% of capacity at 30% of travel, on up to 100% of capacity at 100% of travel. Compared to the Linear Trim Style, the Equal % Trim Style produces smaller capacities for equal travels. This makes the Equal % Trim Style better suited for flows that are a small percentage of its total capacity, which may occur if the valve is not operating near full capacity, or when flows vary widely over time. The Linear Trim Style is better suited for flows that are a larger percentage of its total capacity which may occur if the valve is operating near full capacity and flows are more steady over time.

MODIFIED LINEAR
Trim style describes how the plug's shape (style) changes a valve's capacity as the plug moves (travels) inside it. With the Modified Linear Trim Style, the shape of the plug produces an incremental change in capacity that falls between that of the EQ% and Linear Trim Styles. This results in 5% of capacity at 10% of travel, 11% of capacity at 20% of travel, 17% of capacity at 30% of travel, on up to 100% of capacity at 100% of travel. This makes the Modified Linear Trim Style suitable for flows ranging from a small to large a percentage of its total capacity.

TRIM MATERIAL

316 STAINLESS STEEL
316 stainless steel is our most common and lowest cost trim material choice. 316 stainless steel trim is suitable for flowing differential pressures up to 100 psig, is capable of tight Class IV and Class IV+ leakage ratings, is corrosion resistant to many fluids, but is less erosion resistant than Alloy 6 wrapped trims. It contains nickel and molybdenum, and a greater amount of chromium, making it more corrosion resistant than 400 series stainless steel

TFE SOFT SEAT
TFE is our most common choice for a resilient trim material. TFE soft seat trim is suitable for flowing differential pressures up to 15 PSIG and temperatures to 250ºF, is capable of our tightest Class VI leakage rating, is corrosion resistant to many fluids, but is much less erosion resistant than other trim materials. TFE soft seat trim is not recommended for use in valves with socket weld end connections. When the valve is being installed in the piping, the heat generated by the welding process may damage the soft seat. Consult the factory if the application requires a soft seat in a valve with a socket weld end connection.

PEEK SOFT SEAT
PEEK remains harder than TFE at higher temperatures making it our most durable choice for a resilient trim material. PEEK soft seat trim is suitable for flowing differential pressures up to 100 PSIG and temperatures to 450F, is capable of our tightest Class VI leakage rating, is corrosion resistant to many fluids, but is much less erosion resistant than other trim materials. PEEK soft seat trim is not recommended for use in valves with socket weld end connections. When the valve is being installed in the piping, the heat generated by the welding process may damage the soft seat. Consult the factory if the application requires a soft seat in a valve with a socket weld end connection.

ALLOY 6 WRAPPED 316 STAINLESS STEEL
Alloy 6 wrapped 316 stainless steel is an extremely durable choice for trim material. Alloy 6 wrapped trim is suitable for flowing differential pressures up to 300 psig, is capable of tight Class IV leakage rating. While somewhat corrosion resistant, Alloy 6 wrapped trim is particularly well suited to wear longer in a cavitation prone environment. Alloy 6 wrapped 316 stainless steel is more corrosion resistant, but less erosion resistant, than Alloy 6 wrapped 400 stainless steel trim.

400 STAINLESS STEEL
400 stainless steel is our most durable stainless steel trim material choice. 400 stainless steel trim is suitable for flowing differential pressures up to 200 PSIG, is capable of tight Class IV and Class IV+ leakage ratings, is corrosion resistant to many fluids, but is less erosion resistant than Alloy 6 wrapped trims. 400 stainless steel contains a greater amount of carbon, so it can be heat treated, making it harder and more erosion resistant than 316 stainless steel.

ALLOY 6 WRAPPED 400 STAINLESS STEEL
Alloy 6 wrapped 400 stainless steel is an extremely durable choice for trim material. Alloy 6 wrapped trim is suitable for flowing differential pressures up to 300 PSIG, is capable of tight Class IV and Class IV+ leakage ratings. While somewhat corrosion resistant, Alloy 6 wrapped trim is particularly well suited to wear longer in a cavitation prone environment. Alloy 6 wrapped 400 stainless steel is more erosion resistant, but less corrosion resistant, than alloy 6 wrapped 316 stainless steel trim.

PACKING TYPE

TEFLON V-RING
Teflon v-ring packing is the most common choice for steam and most chemical applications. Teflon v-ring packing is good from 60°F to 450°F. TFE v-ring packing is not suitable for service below 60°F.

EPDM LIP
EPDM lip packing is commonly used for water packing. EPDM lip packing is good from -20°F to 450°F. EPDM lip packing is not suitable for fluids containing or contaminated with oil. For applications from 32°F to -20°F when condensation on the stem can turn to ice (consult factory) an optional stem heater is also recommended.

GRAPHITE
Graphite packing is our most durable packing material choice. Graphite packing is good from -20°F to 800°F and is required for temperatures above 450°F to the valve's limit of 800°F. For applications from 32°F to -20°F when condensation on the stem can turn to ice (consult factory) an optional stem heater is also recommended.

VACUUM SERVICE
Vacuum service packing is teflon v-ring packing that is designed for use when the pressure inside the valve is lower than the atmospheric pressure outside the valve. Like teflon v-ring packing, vacuum service packing is good from 60°F to 450°F. Vacuum service packing is not suitable for service below 60°F.

BONNET CONSTRUCTION

PEEK BEARINGS
Bonnet constructions using PEEK Bearings are our most common and lowest cost choices for water and chemical applications. PEEK bearings are good to 450°F. PEEK Bearings are used with EPDM lip, teflon v-ring, graphite, or vacuum service packing.

Z PEEK BEARINGS
Bonnet constructions using Z PEEK Bearings are our most common and lowest cost choices for steam applications. Z PEEK bearings are good for temperatures up to 450°F. Z PEEK bearings are used with EPDM lip, teflon v-ring, graphite, or vacuum service packing.

GRAPHALLOY BEARINGS WITH EXTENSION BONNET
Bonnet constructions using Graphalloy bearings with an extension bonnet are the preferred choice for applications greater than 450°F. Three kinds of Graphalloy bearings are available. Copper based Graphalloy bearings are good from -20°F to 750°F for non-oxidizing media ONLY and are best suited for hot water and steam. Nickel based Graphalloy bearings are good from -20°F to 750°F for non-oxidizing media ONLY and are best suited for heat transfer oils. Oxidation resistant Graphalloy bearings are good from -20°F to 800°F for oxidizing media. Bonnet constructions using Graphalloy bearings with an extension bonnet are used with graphite packing and graphite gaskets. This construction is commonly selected for higher temperature applications where it is necessary to have space between the actuator and valve.

TYPE 40 CONSTRUCTION DETAILS

BODY MATERIALS

CODE W *WCB BODY*

Item	Part Nomenclature	Materials
4	YOKE LOCKNUT	PLATED STEEL
10	HEX HEAD CAPSCREW	ALLOY STEEL GR B7
12	BONNET	STEEL A216 WCB
22	VALVE BODY	STEEL A216 WCB

CODE F *CF8M BODY*

Item	Part Nomenclature	Materials
4	YOKE LOCKNUT	300 SERIES SST
10	HEX HEAD CAPSCREW	SST GR B8M CLASS 2
12	BONNET	SST A351 CF8M
22	VALVE BODY	SST A351 CF8M

TRIM MATERIALS

CODE S *316 STAINLESS STEEL TRIM*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	316 SST
20	SEAT RING	316 SST

CODE T *TFE SOFT SEATS*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
20	SEAT RING	316 SST
29	DISC HOLDER	316 SST
30	DISC	REINFORCED PTFE
31	DISC RETAINER	316 SST
32	SELF-LOCKING NUT	18-8 SST
33	INSERT	REINFORCED PTFE
34	RETAINER	316 SST

CODE P *PEEK SOFT SEATS*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
20	SEAT RING	316 SST
29	DISC HOLDER	316 SST
30	DISC	REINFORCED PEEK
31	DISC RETAINER	316 SST
32	SELF-LOCKING NUT	18-8 SST
33	INSERT	REINFORCED PEEK
34	RETAINER	316 SST

CODE 6 *ALLOY 6 WRAPPED 316 STAINLESS STEEL TRIM*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	316 SST/ ALLOY 6 INLAY
20	SEAT RING	316 SST/ ALLOY 6 INLAY

CODE 7 *400 STAINLESS STEEL TRIM*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	400 SST
20	SEAT RING	400 SST

CODE 8 *ALLOY 6 WRAPPED 400 STAINLESS STEEL TRIM*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	400 SST/ ALLOY 6 INLAY
20	SEAT RING	316 SST/ ALLOY 6 INLAY

PACKING TYPE

CODE T / V *TEFLON V-RING PACKING & TEFLON V-RING PACKING VACUUM SERVICE*

Item	Part Nomenclature	Materials
7	V-RING PACKING SET	PTFE
8	LOAD WASHER	316 SST
9	PACKING SPRING	316 SST

CODE L *EPDM LIP PACKING*

Item	Part Nomenclature	Materials
37	LIP PACKING SET	EPDM

CODE G *GRAPHITE PACKING*

Item	Part Nomenclature	Materials
24	PACKING CARTRIDGE	DIE-FORMED GRAPHITE
25	SPACER	316 SST
26	PACKING RING	BRAIDED GRAPHITE
27	PACKING RING	DIE-FORMED GRAPHITE

BONNET CONSTRUCTION

CODE S *PEEK BEARINGS*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
3	STEM WIPER	GRAPHITE FILLED TFE/ SST
5	PACKING RETAINER	316 SST
6	SLEEVE BEARING	REINFORCED PEEK
11	BOX RING	316 SST
13	WIPER RETAINER	316 SST
14	BONNET GASKET	NONASBESTOS
15	CAGE SPRING	316 SST/ PTFE
16	FLANGED BEARING	REINFORCED PEEK
21	SEAT GASKET	NONASBESTOS

CODE 8 *Z PEEK BEARINGS*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
3	STEM WIPER	GRAPHITE FILLED TFE/ SST
5	PACKING RETAINER	316 SST
6	SLEEVE BEARING	REINFORCED PEEK
11	BOX RING	316 SST
13	WIPER RETAINER	316 SST
14	BONNET GASKET	NONASBESTOS
15	CAGE SPRING	316 SST/ PTFE
16	FLANGED BEARING	Z PLASTIC (PEEK BASE)
21	SEAT GASKET	NONASBESTOS

CODE G *COPPER BASED GRAPHALLOY BEARINGS W/ EXTENSION BONNET*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
11	BOX RING	316 SST
12	EXTENSION BONNET	AS SPECIFIED
14	BONNET GASKET	GRAPHITE
15	CAGE SPRING	INCONEL/ GRAPHITE
21	SEAT GASKET	GRAPHITE
23	BEARING	GRAPHALLOY GRADE GM 320.3
26	PACKING RING	BRAIDED GRAPHITE
28	RETAINING RING	316 SST
35	RETAINER WASHER	316 SST
36	UPPER BEARING AND RETAINER SUBASSY	316 SST/ GRAPHALLOY GRADE GM 320.3

CODE L *NICKEL BASED GRAPHALLOY BEARINGS W/ EXTENSION BONNET*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
11	BOX RING	316 SST
12	EXTENSION BONNET	AS SPECIFIED
14	BONNET GASKET	GRAPHITE
15	CAGE SPRING	INCONEL/ GRAPHITE
21	SEAT GASKET	GRAPHITE
23	BEARING	GRAPHALLOY GRADE GM 111.3
26	PACKING RING	BRAIDED GRAPHITE
28	RETAINING RING	316 SST
35	RETAINER WASHER	316 SST
36	UPPER BEARING AND RETAINER SUBASSY	316 SST/ GRAPHALLOY GRADE GM 111.3

CODE 7 *OXIDATION RESISTANT GRAPHALLOY BEARINGS W/ EXTENSION BONNET*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
11	BOX RING	316 SST
12	EXTENSION BONNET	AS SPECIFIED
14	BONNET GASKET	GRAPHITE
15	CAGE SPRING	INCONEL/ GRAPHITE
21	SEAT GASKET	GRAPHITE
23	BEARING	GRAPHALLOY GRADE GM GDG-2
26	PACKING RING	BRAIDED GRAPHITE
28	RETAINING RING	316 SST
35	RETAINER WASHER	316 SST
36	UPPER BEARING AND RETAINER SUBASSY	316 SST/ GRAPHALLOY GRADE GM GDG-2

TYPE 48 CONSTRUCTION DETAILS

BODY MATERIALS

CODE W *WCB BODY*

Item	Part Nomenclature	Materials
4	YOKE LOCKNUT	PLATED STEEL
10	HEX HEAD CAPSCREW	ALLOY STEEL GR B7
12	BONNET	STEEL A216 WCB
22	VALVE BODY	STEEL A216 WCB

CODE F *CF8M BODY*

Item	Part Nomenclature	Materials
4	YOKE LOCKNUT	300 SERIES SST
10	HEX HEAD CAPSCREW	SST GR B8M CLASS 2
12	BONNET	SST A351 CF8M
22	VALVE BODY	SST A351 CF8M

TRIM MATERIALS

CODE S *316 STAINLESS STEEL TRIM*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	316 SST
20	SEAT RING	UNS S21800

CODE T *TFE SOFT SEATS*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	316 SST
20	SEAT RING	316 SST
33	INSERT	REINFORCED PTFE
34	RETAINER	UNS S21800

CODE P *PEEK SOFT SEATS*

Item	Part Nomenclature	Materials
1	VALVE STEM	316 SST
18	CAGE	316 SST
19	PLUG	316 SST
20	SEAT RING	316 SST
33	INSERT	REINFORCED PEEK
34	RETAINER	UNS S21800

PACKING TYPE

CODE T *TEFLON V-RING PACKING &* V *TEFLON V-RING PACKING VACUUM SERVICE*

Item	Part Nomenclature	Materials
7	V-RING PACKING SET	PTFE
8	LOAD WASHER	316 SST
9	PACKING SPRING	316 SST

CODE L *EPDM LIP PACKING*

Item	Part Nomenclature	Materials
37	LIP PACKING SET	EPDM

CODE G *GRAPHITE PACKING*

Item	Part Nomenclature	Materials
24	PACKING CARTRIDGE	DIE-FORMED GRAPHITE
25	SPACER	316 SST
26	PACKING RING	BRAIDED GRAPHITE
27	PACKING RING	DIE-FORMED GRAPHITE

BONNET CONSTRUCTION

CODE S *PEEK BEARINGS*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
3	STEM WIPER	GRAPHITE FILLED TFE/ SST
5	PACKING RETAINER	316 SST
6	SLEEVE BEARING	REINFORCED PEEK
11	BOX RING	316 SST
13	WIPER RETAINER	316 SST
14	BONNET GASKET	NONASBESTOS
15	CAGE SPRING	316 SST/ PTFE
16	FLANGED BEARING	REINFORCED PEEK
21	SEAT GASKET	NONASBESTOS

CODE 8 *Z PEEK BEARINGS*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
3	STEM WIPER	GRAPHITE FILLED TFE/ SST
5	PACKING RETAINER	316 SST
6	SLEEVE BEARING	REINFORCED PEEK
11	BOX RING	316 SST
13	WIPER RETAINER	316 SST
14	BONNET GASKET	NONASBESTOS
15	CAGE SPRING	316 SST/ PTFE
16	FLANGED BEARING	Z PLASTIC (PEEK BASE)
21	SEAT GASKET	NONASBESTOS

CODE G *COPPER BASED GRAPHALLOY BEARINGS W/ EXTENSION BONNET*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
11	BOX RING	316 SST
12	EXTENSION BONNET	AS SPECIFIED
14	BONNET GASKET	GRAPHITE
15	CAGE SPRING	INCONEL/ GRAPHITE
21	SEAT GASKET	GRAPHITE
23	BEARING	GRAPHALLOY GRADE GM 320.3
26	PACKING RING	BRAIDED GRAPHITE
28	RETAINING RING	316 SST
35	RETAINER WASHER	316 SST
36	UPPER BEARING AND RETAINER SUBASSY	316 SST/ GRAPHALLOY GRADE GM 320.3

CODE L *NICKEL BASED GRAPHALLOY BEARINGS W/ EXTENSION BONNET*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
11	BOX RING	316 SST
12	EXTENSION BONNET	AS SPECIFIED
14	BONNET GASKET	GRAPHITE
15	CAGE SPRING	INCONEL/ GRAPHITE
21	SEAT GASKET	GRAPHITE
23	BEARING	GRAPHALLOY GRADE GM 111.3
26	PACKING RING	BRAIDED GRAPHITE
28	RETAINING RING	316 SST
35	RETAINER WASHER	316 SST
36	UPPER BEARING AND RETAINER SUBASSY	316 SST/ GRAPHALLOY GRADE GM 111.3

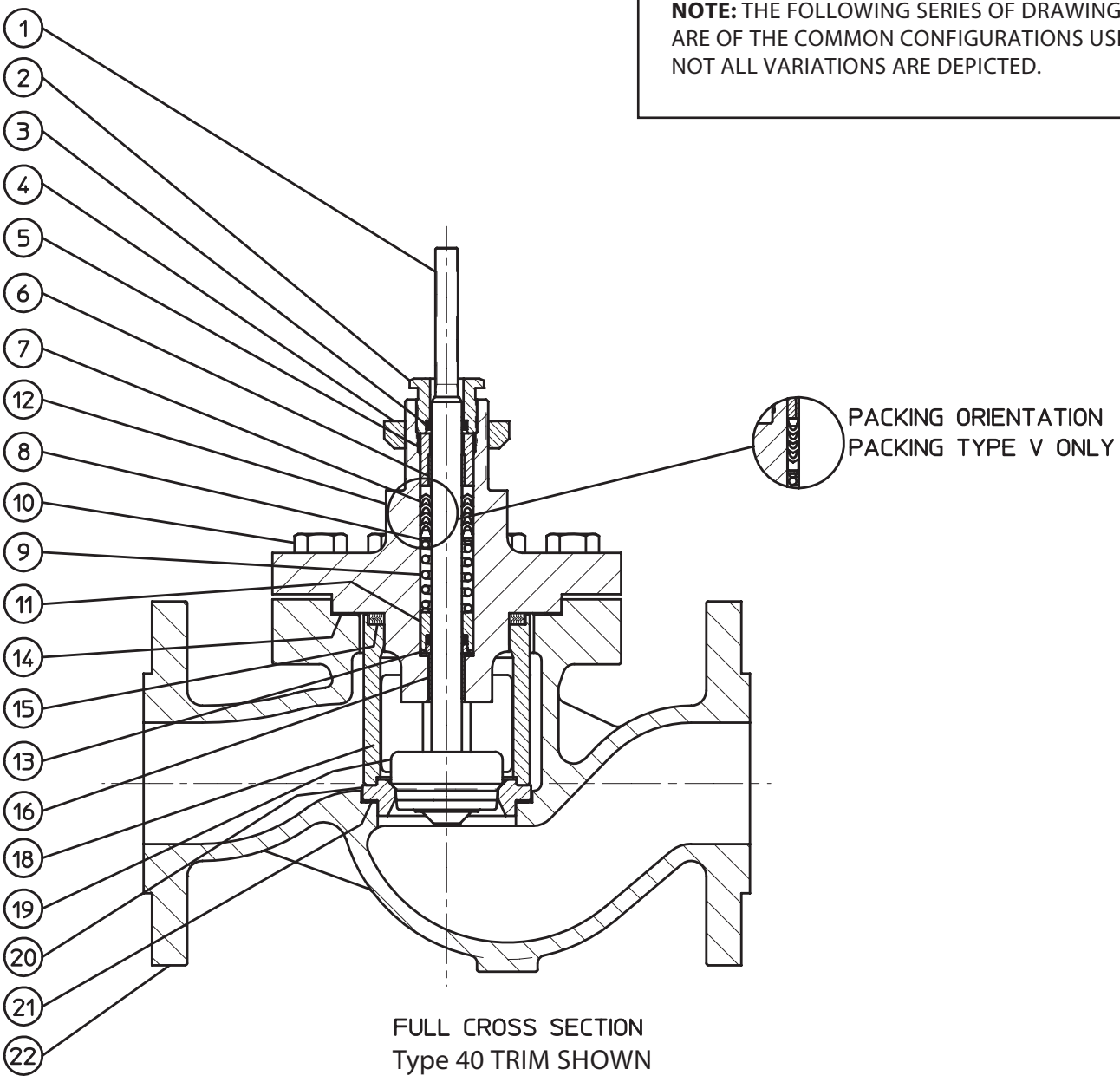
CODE 7 *OXIDATION RESISTANT GRAPHALLOY BEARINGS W/ EXTENSION BONNET*

Item	Part Nomenclature	Materials
2	PACKING NUT	316 SST
11	BOX RING	316 SST
12	EXTENSION BONNET	AS SPECIFIED
14	BONNET GASKET	GRAPHITE
15	CAGE SPRING	INCONEL/ GRAPHITE
21	SEAT GASKET	GRAPHITE
23	BEARING	GRAPHALLOY GRADE GM GDG-2
26	PACKING RING	BRAIDED GRAPHITE
28	RETAINING RING	316 SST
35	RETAINER WASHER	316 SST
36	UPPER BEARING AND RETAINER SUBASSY	316 SST/ GRAPHALLOY GRADE GM GDG-2

SERIES: ARD
Type 40 & 48
Construction Details

CONSTRUCTION DETAILS

NOTE: THE FOLLOWING SERIES OF DRAWINGS ARE OF THE COMMON CONFIGURATIONS USED. NOT ALL VARIATIONS ARE DEPICTED.

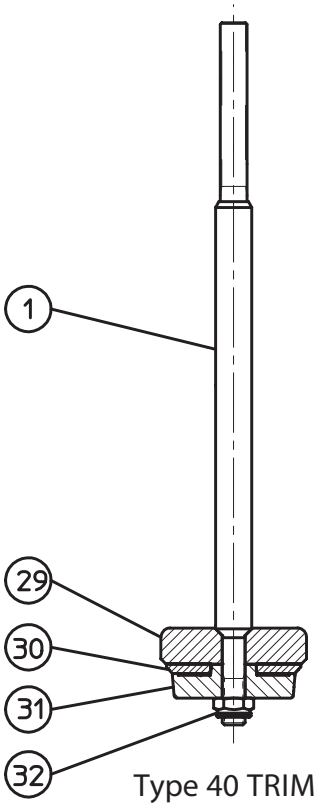


FULL CROSS SECTION
Type 40 TRIM SHOWN

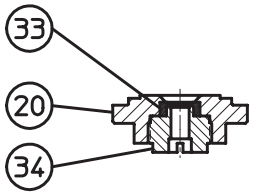
BODY MATERIAL CODE W & F
TRIM MATERIALS CODE S, 6 (Type 40) & S (Type 48)
PACKING TYPE & BONNET CONSTRUCTION CODES TS, VS, T8 & V8

SEE PAGES 9 & 10 FOR TYPE 40 AND PAGE 11 & 12 FOR TYPE 48 PART NOMENCLATURE AND MATERIALS

CONSTRUCTION DETAILS

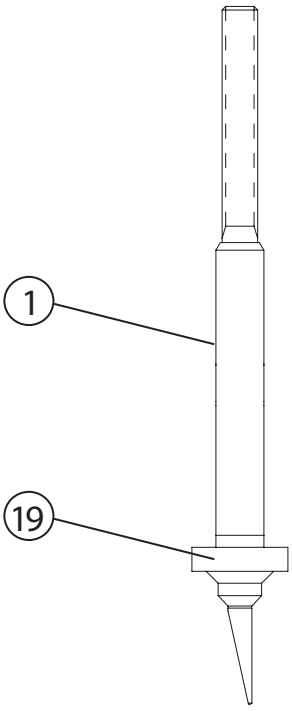


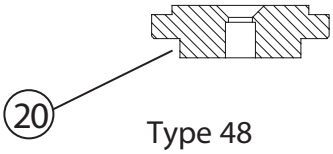
Type 40 TRIM SIZE
0.876 - 3.376



Type 40 TRIM SIZE
0.251 - 0.501
& Type 48

TRIM MATERIALS
CODES T & P





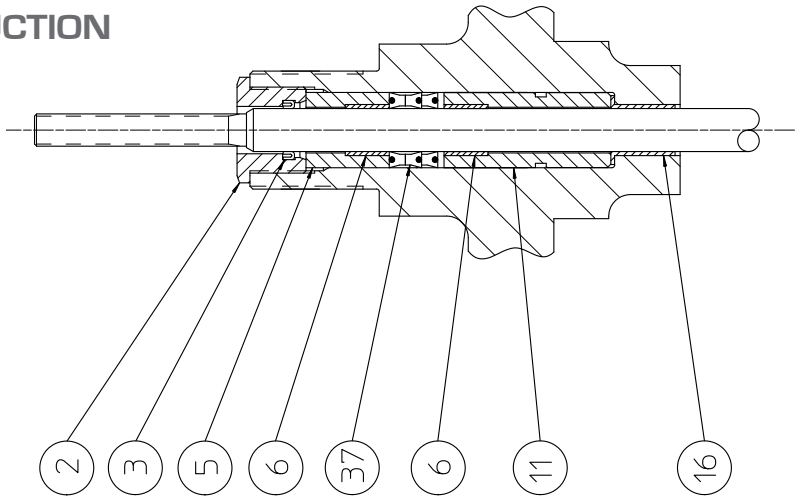
Type 48

TRIM MATERIALS
CODE S

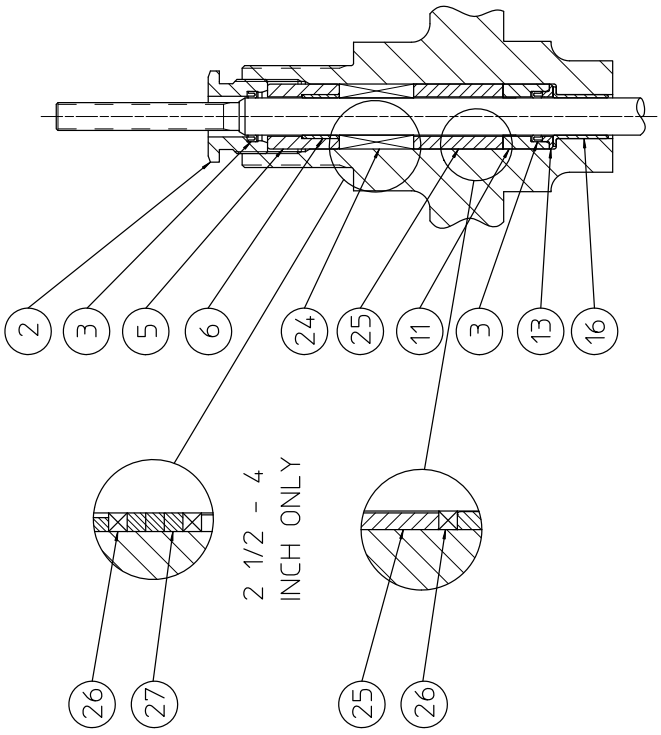
SEE PAGE 9 & 10 FOR TYPE 40 AND PAGE 11 & 12 FOR TYPE 48 PART NOMENCLATURE AND MATERIALS

SERIES: ARD
Type 40 & 48
Construction Details

CONSTRUCTION DETAILS



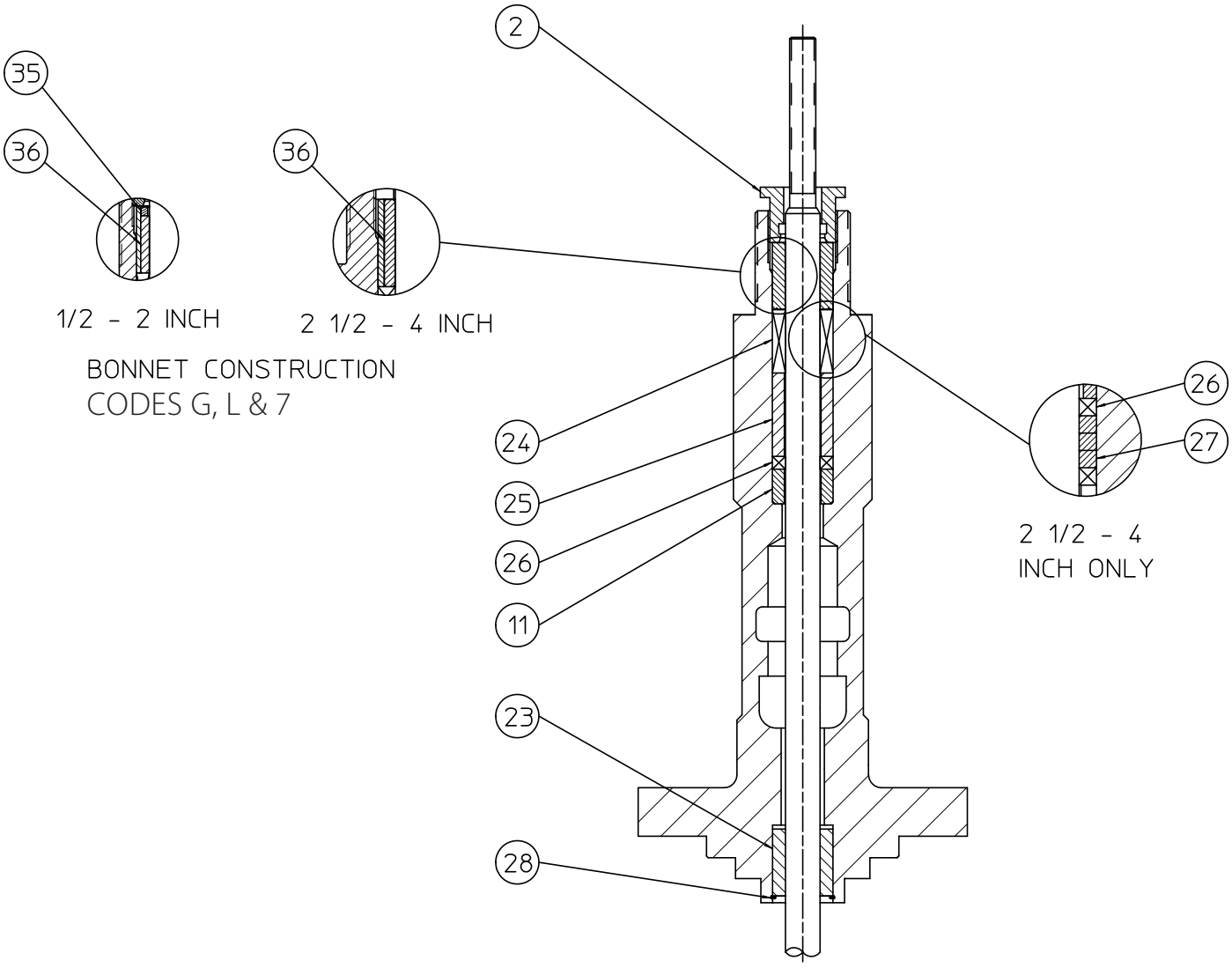
PACKING TYPE AND BONNET CONSTRUCTION
CODES LS & L8



PACKING TYPE AND BONNET CONSTRUCTION
CODES GS & G8

SEE PAGE 9 & 10 FOR TYPE 40 AND 11 & 12 FOR TYPE 48 PART NOMENCLATURE AND MATERIALS

CONSTRUCTION DETAILS



SEE PAGE 9 & 10 FOR 5840 AND 11 & 12 FOR TYPE 48 PART NOMENCLATURE AND MATERIALS

ARIA SERIES: small frame actuators

FAST-ACTING, MODULATING, LINEAR, INDUSTRIAL ELECTRIC VALVE ACTUATOR

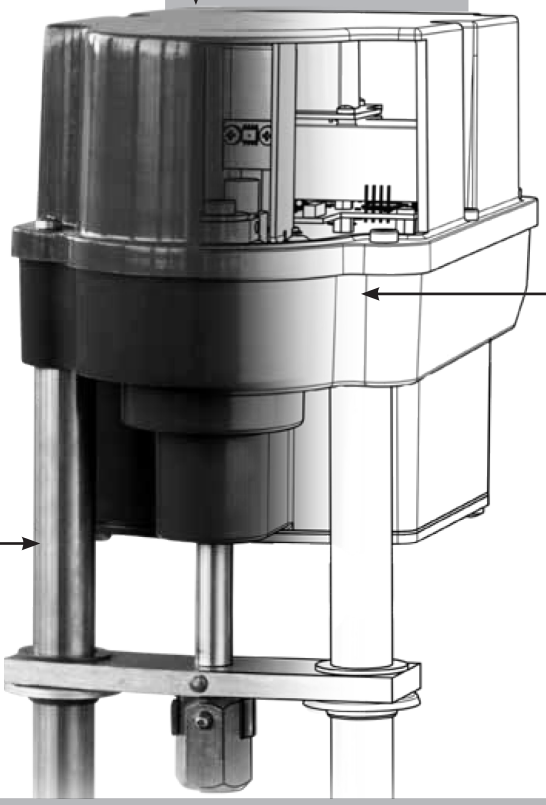
For smaller sized control valves, this compact design packs a nice set of features at an economical price point. The Brushless DC motor ensures long life.

Robust industrial design with polycarbonate cover, enclosure IP67 / NEMA4X

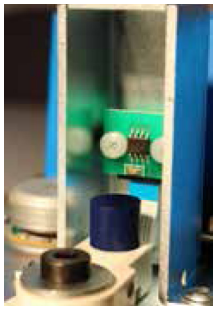
Compact design with low installation height, durable aluminium gearbox

Integrated power spring for fail safe function in case of loss of power supply, either extending or retracting actuator stem

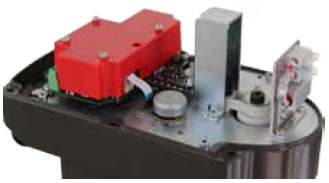
SPRING FAIL



DESIGN FEATURES

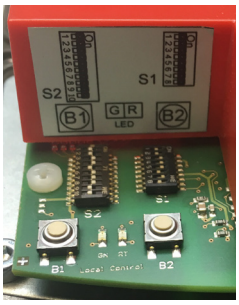


Contactless, non-wearing travel detection with Hall sensor for exact positioning



Brushless DC motor (BLDC). Controller with integrated positioner function. Status display and automatic commissioning

Manual operation with push buttons or handwheel. Parameter setting via DIP switches



ADDITIONAL ARIA SPECIFICATIONS

Power Supply	24 VAC/DC, optionally wide range power supply (100-240 VAC)
Motor Protection	Electronic motor current monitoring with safety cut-off
Duty cycle as per IEC 60034-1,8	S2 30 min / S4 1200c/h - 50% ED
Isolation	Galvanically isolated inputs and outputs
Permitted ambient temperature	-4°F to 140°F (-20 to +60°C)
Signal to Stroke Resolution	~2000 Parts to full scale stroke
Accuracy	±0.1 mA or ±50 mV
Linearity	±1.0%
Repeatability	±0.2%
Internal fault monitoring	Thrust, set value, temperature, power supply
Binary control	24 - 230 VAC for ON/OFF service
Control Signal and Feedback	0-20 mA, 4-20 mA, 0-10 V, 2-10 V, selectable (or split - ranges)
Mounting position	Any position, except below horizontal
Conduit entries	Up to 3 each 1/2 NPT
Enclosure Rating	NEMA 4X/IP67
Cover material	Polycarbonate
Gear case material	High quality aluminium die casting, powder-coated (60 µm thickness)
Pillar material	Steel 1.4104

	UNITS	SPECIFICATIONS
Thrust / Force	(Lbf)	450
MAX Stroke	(Inches)	1.31
Pillar distance, C to C	(Inches)	4
Weight, approx. kg 5.6	(Lbs.)	12.3
Stroke Speed	(Secs / Inch)	12
Approximate Height	(Inches)	11
Approx. clearance above to remove cover	(Inches)	3.25
Manual Override		Electrically via 2 push buttons
What happens under the condition of:		
Overvoltage/Undervoltage on the power supply or loss of power		Actuator engages Spring Fail, to Open or Closed, depending on model
Loss of Analog Control Signal		Actuator engages Spring Fail, to Open or Closed, depending on model
Loss of Binary Input Control Signal		Actuator stops in position when event occurs
Loss of Binary Override		Actuator responds to Analog Control Signmal

ENERGY CONSUMPTION

ELECTRIC PARAMETER	UNITS	POWER SUPPLY VOLTAGE			
		115 VAC	230 VAC	24 VAC	24 VDC
Nominal Current	(Amps)	0.2	0.4	2.0	1.2
Max Current	(Amps)	0.2	0.4	2.0	1.2
Power Consumption	(Watts)	28	28	28	27

FACTORY DEFAULT SOFTWARE SETTINGS & ALTERNATE SOFTWARE SETTINGS

Control Signal:
- 4-20 mA (2-10 Vdc, wiring dependent) <FACTORY DEFAULT>
- 0-20 mA (0-10 Vdc, wiring dependent)

Control Action:
- Decreasing Signal Closes valve (2-way) closes Lower Port (3-Way) <FACTORY DEFAULT>
- Increasing Signal Opens valve (2-way) opens Lower Port (3-Way)

Feedback Signal:
- 4-20 mA (2-10 Vdc, wiring dependent) <FACTORY DEFAULT>
- 0-20 mA (0-10 Vdc, wiring dependent)

Feedback Action:
- Closing Valve (2-way), Lower Port Closing (3-Way); Decreases Signal <FACTORY DEFAULT>
- Closing Valve (2-way), Lower Port Closing (3-Way); Increases Signal

Control Signal Ranges:
- 4-20 mA (2-10 VDC) <FACTORY DEFAULT>
- 0-20 mA (0-10 VDC)
- 12-20 mA (6-10 VDC) Split Range HIGH
- 10-20 mA (5-10 VDC) Split Range HIGH
- 4-12 mA (2-6 VDC) Split Range LOW
- 0-10 mA (0-5 VDC) Split Range LOW

} Split-Range capability for parallel high/low valve configurations

Flow Curve Correction:
- Travel is Linear w/Signal <FACTORY DEFAULT>
- Travel is Quick Opening w/Signal

BLANKETS & ACTUATOR ORIENTATION

Fluid Temperature Limit Thresholds

The engineering data within our product specification will share information about MAX fluid temperature limits as if it is an absolute for any configurable valve assembly. It is not. The MAX fluid temperatures listed, sometimes as high as 800°F depending on the valve is only an absolute one for the valve body itself. It does not take into consideration the actuation or accessories. Actuators and accessories each have their own MAX ambient temperature limits that may be anywhere from 122°F to 250°F depending on the items for the electronics or soft goods these items contain. ***It is nearly impossible to correlate JUST fluid temperature to determine when any of these actuators or accessories will have their ambient exceeded.***

Predicting Safe Fluid Temperatures for Actuators & Accessories

THERE ARE SEVERAL FACTORS THAT DETERMINE FLUID TEMPERATURE LIMIT THRESHOLDS WHICH INCLUDE BUT ARE NOT LIMITED TO:

- valve size
- actuator orientation
- room ambient temperature
- distance from the valve body to the components of interest
- bonnet style/size
- conducted heat versus radiated heat
- ventilation

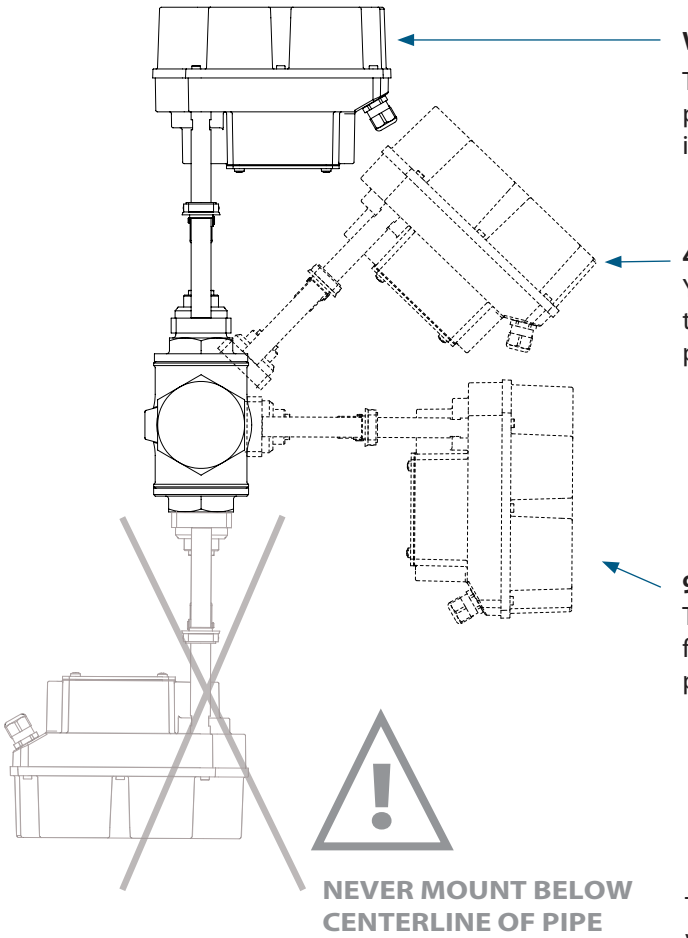
With all of these variables it is a challenge to come up with reliable guidelines.

However, we have attempted to do that in the table that follows on page 22. Realize these are only guidelines.

Actuator Mounting VS *Insulating Blankets*

When working with higher fluid temperatures, thermal insulating blankets can ***dramatically reduce surface temperatures on pipes, valves and other fixtures*** in a fluid control system such that the ambient room temperatures in these environments are dramatically reduced as well. This is often required for valve actuators and accessories to reliably survive when fluid temperatures rise well above the safe ambient temperatures of the devices. Radiant heat and convected heat are the major sources for damage to these actuators and accessories. When a valve actuator is mounted to the side of a valve there is still radiant heat but convected heat is mostly eliminated. ***For globe control valves, having the actuator mounted vertically above the valve is best for optimum valve packing life but will then suffer the most with both radiant and convected heat to deal with.*** Alternatives to blankets and the mounting orientation listed include longer yoke actuators and extension bonnets on valves. These put distance between the heat sources and the components you are trying to protect from heat.

Actuator Mounting Orientations



VERTICAL ABOVE PIPING

This is the recommended position for mounting as it is the best position to ensure the service life of the equipment; however this is where it will encounter the most heat.

45° FROM VERTICAL ABOVE PIPING ON EITHER SIDE

You may mount in this position to try to reduce the heat in high temperature applications; however this will reduce the life of the packing.

90° TO PIPING HORIZONTAL ON EITHER SIDE

This orientation provides the best temperature relief w/higher fluid temperatures but places the greatest strain on the valve packing, reducing packing life.

NEVER MOUNT BELOW CENTERLINE OF PIPE

The table that follows on page 22 will identify temperature ranges, valve size ranges, actuator orientation and use of thermal blankets to determine what is required to get longevity out of your actuators.

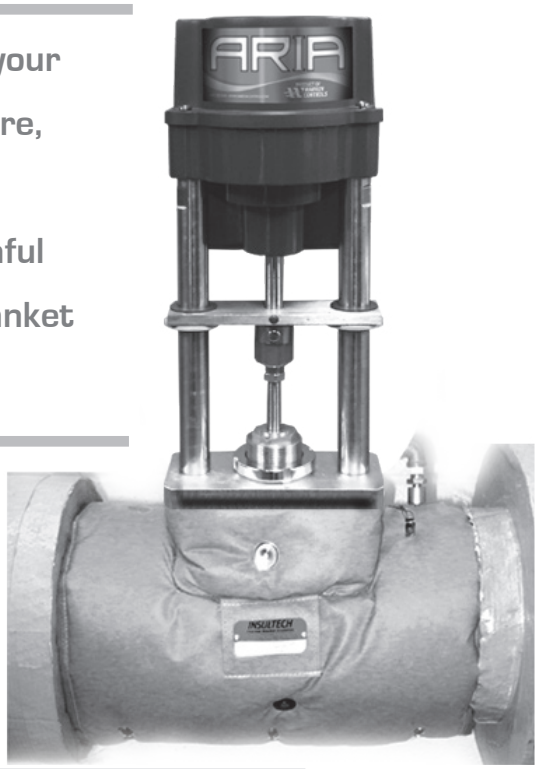
Choose the right blanket

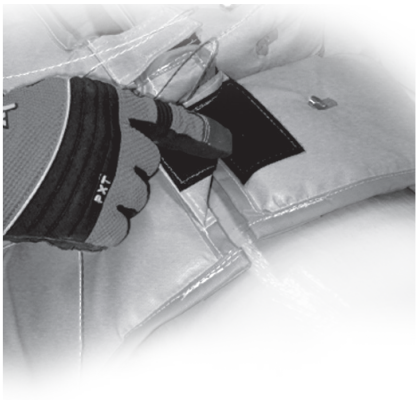
ACOUSTIGUARD™ VS THERMIGUARD™

At Warren Controls our ***AcoustiGuard™ & ThermiGuard™*** blankets are nearly identical. In fact they have identical thermal properties. The ***AcoustiGuard™*** has an additional layer of high density barium sulfate vinyl reflector for sound reflection. Each blanket is specifically designed in a one or two piece design that is made to be easily removable for valve servicing. When used in conjunction with high temperature fluids, significant energy savings, lower surface and ambient temperatures, and a ***safer environment for employees*** are just some of the benefits.

BLANKETS & ACTUATOR ORIENTATION

Whether you need to lower your mechanical room temperature, protect your actuator, avoid getting burned, reduce harmful noise or save energy, our blanket wraps are your solution!





AcoustiGuard™ & ThermiGuard™ are custom fit high quality insulation blanket systems pre-engineered to either reduce harmful noise, or save energy by retaining radiant heat. Both are designed to improve the surrounding work environment. While ***AcoustiGuard™*** is designed to act as a "sound attenuation" and thermal barrier, ***ThermiGuard™*** is capable of withstanding weather conditions and chemical environments. Both are capable of withstanding maximum service temperatures of 450°F (***AcoustiGuard™ & ThermiGuard™***) or up to 800°F with the High Temperature option. Any piece will not exceed 40 pounds. ***AcoustiGuard™*** comes with two fastening options: Lacing Pins & Metal "D" Ring Strap with Velcro Tab. In addition to these fastening options, ***ThermiGuard™*** comes with two additional fastening options: Velcro Flaps & Side Release Buckles. The ***AcoustiGuard™ & ThermiGuard™*** products are designed to be flexible and easier to install, easy to remove and reinstall, allowing quick access and easy equipment serviceability.

- ***EASY TO INSTALL & REINSTALL***
- ***CAN WITHSTAND UP TO 450°F OR 800°F***
- ***MULTIPLE FASTENING OPTIONS***

AcoustiGuard Insertion Loss Sound Pressure Levels

107 dBA Source	A-Weighted Measurements	Linear Weighted Measurements
Test Frequency (In Hz)	Noise Reduction (In dBA)	Insertion Loss (In dBA)
100	13	13
125	14	13
160	13	13
200	13	13
250	13	12
315	15	15
400	19	19
500	25	25
630	26	33
800	39	39
1000	38	39
1250	42	42
1600	43	43
2000	43	43
2500	44	44
3150	45	44
4000	44	45
5000	46	45

Fluid Temperature Limit Guidelines

ARIA SERIES • MODEL: ARD

Ensures reliable, long-term performance of electric actuator.

STANDARD BONNET		
ACTUATOR ORIENTATION	***Valves: 1/2" - 2"***	***Valves: 2.5" - 4"***
	FLUID TEMPERATURE LIMIT	
Above the Valve	300°F	N/A
45° To the Side of the Valve	325°F	N/A
Either way w/ ThermiGuard*	450°F	N/A
EXTENSION BONNET		
ACTUATOR ORIENTATION	***Valves: 1/2" - 2"***	***Valves: 2.5" - 4"***
	FLUID TEMPERATURE LIMIT	
Above the Valve	325°F	N/A
45° To the Side of the Valve	425°F	N/A
Either way w/ ThermiGuard*	800°F	N/A

**Custom Fit Insulating Blankets, assumes pipes are insulated as well.*
These are simply rough guidelines and not absolute thresholds.

As a matter of reliability, for all steam applications ABOVE 52 PSI (300°F), Warren Controls will require the use of a Thermiguard Insulating Blanket when actuator orientation is directly above the valve. Alternatively, the customer can opt in writing that they will take the responsibility for insulating the valve, and/or alternate actuator orientations.

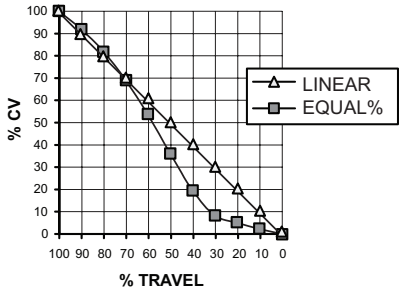
THE MAXIMUM PERMITTED RUNNING AMBIENT TEMPERATURE FOR THE ARIA ACTUATOR IS 140°F (60°C). IF AN OVER-TEMPERATURE EVENT OCCURS, THE ACTUATOR WILL STILL FAIL TO ITS PRESCRIBED FAILURE MODE.

FLOW COEFFICIENTS (CV) VERSUS TRAVEL

VALVE				Type 40 FLOW COEFFICIENTS (CV) 2-WAY SINGLE SEAT UNBALANCED VALVE WITH CAGE-RETAINED SEAT									
Valve Size (IN)	Trim Size(N)	Trim Style	Port Size	%Travel									
				100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
1/2	0.501	EQ%	FULL	4.34	3.89	3.21	2.24	1.15	0.69	0.47	0.34	0.23	0.13
		LINEAR	FULL	4.34	3.91	3.47	3.04	2.60	2.17	1.74	1.30	0.87	0.43
	0.376	EQ%	1SR	2.50	2.24	1.85	1.29	0.66	0.40	0.27	0.20	0.14	0.07
		LINEAR	1SR	2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25
	0.251	EQ%	2SR	1.25	1.12	0.93	0.65	0.33	0.20	0.14	0.10	0.07	0.04
		LINEAR	2SR	1.25	1.13	1.00	0.88	0.75	0.63	0.50	0.38	0.25	0.13
3/4	0.876	EQ%	FULL	11.4	10.2	8.44	5.89	3.02	1.81	1.24	0.89	0.62	0.33
		LINEAR	FULL	11.4	10.3	9.12	7.98	6.84	5.70	4.56	3.42	2.28	1.14
	0.501	EQ%	1SR	5.00	4.48	3.70	2.59	1.33	0.80	0.55	0.39	0.27	0.15
		LINEAR	1SR	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.50
	0.376	EQ%	2SR	2.50	2.24	1.85	1.29	0.66	0.40	0.27	0.20	0.14	0.07
		LINEAR	2SR	2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25
	0.251	EQ%	3SR	1.25	1.12	0.93	0.65	0.33	0.20	0.14	0.10	0.07	0.04
		LINEAR	3SR	1.25	1.13	1.00	0.88	0.75	0.63	0.50	0.38	0.25	0.13
1	0.876	EQ%	FULL	12.0	10.8	8.88	6.20	3.18	1.91	1.31	0.94	0.65	0.35
		LINEAR	FULL	12.0	10.8	9.60	8.40	7.20	6.00	4.80	3.60	2.40	1.20
	0.501	EQ%	1SR	5.00	4.48	3.70	2.59	1.33	0.80	0.55	0.39	0.27	0.15
		LINEAR	1SR	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.50
	0.376	EQ%	2SR	2.50	2.24	1.85	1.29	0.66	0.40	0.27	0.20	0.14	0.07
		LINEAR	2SR	2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25
	0.251	EQ%	3SR	1.25	1.12	0.93	0.65	0.33	0.20	0.14	0.10	0.07	0.04
		LINEAR	3SR	1.25	1.13	1.00	0.88	0.75	0.63	0.50	0.38	0.25	0.13
1.5	1.251	EQ%	FULL	24.0	21.5	17.8	12.4	6.36	3.82	2.62	1.87	1.30	0.70
		LINEAR	FULL	24.0	21.6	19.2	16.8	14.4	12.0	9.60	7.20	4.80	2.40
	0.876	EQ%	1SR	12.0	10.8	8.88	6.20	3.18	1.91	1.31	0.94	0.65	0.35
		LINEAR	1SR	12.0	10.8	9.60	8.40	7.20	6.00	4.80	3.60	2.40	1.20
	0.501	EQ%	2SR	5.00	4.48	3.70	2.59	1.33	0.80	0.55	0.39	0.27	0.15
		LINEAR	2SR	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.50
2	1.688	EQ%	FULL	43.0	38.5	31.8	22.2	11.4	6.84	4.69	3.35	2.32	1.25
		LINEAR	FULL	43.0	38.7	34.4	30.1	25.8	21.5	17.2	12.9	8.60	4.30
	1.251	EQ%	1SR	24.0	21.5	17.8	12.4	6.36	3.82	2.62	1.87	1.30	0.70
		LINEAR	1SR	24.0	21.6	19.2	16.8	14.4	12.0	9.60	7.20	4.80	2.40
	0.876	EQ%	2SR	12.0	10.8	8.88	6.20	3.18	1.91	1.31	0.94	0.65	0.35
		LINEAR	2SR	12.0	10.8	9.60	8.40	7.20	6.00	4.80	3.60	2.40	1.20

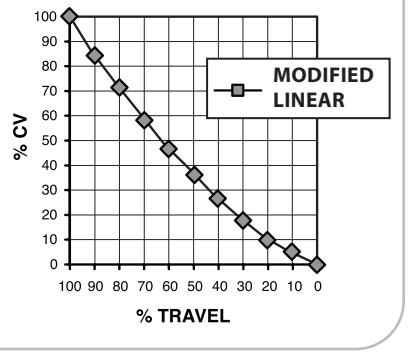
TYPE 40

2-WAY VALVE
TYPICAL FLOW CURVES



VALVE		Type 48		FLOW COEFFICIENTS (CV) Two-Way Single Seat, Low Flow Unbalanced Valve with Cage-Retained Seat									
Valve Size (IN)	Trim Size(N)	Trim Style	Port Size	% Travel									
				100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
1/2	0.250	MODIFIED LINEAR	FULL	0.75	0.64	0.54	0.44	0.35	0.27	0.20	0.13	0.08	0.04
			1SR	0.50	0.43	0.36	0.29	0.23	0.18	0.13	0.09	0.05	0.03
			2SR	0.25	0.21	0.18	0.15	0.12	0.09	0.07	0.04	0.03	0.01
3/4	0.250	MODIFIED LINEAR	FULL	0.75	0.64	0.54	0.44	0.35	0.27	0.20	0.13	0.08	0.04
			1SR	0.50	0.43	0.36	0.29	0.23	0.18	0.13	0.09	0.05	0.03
			2SR	0.25	0.21	0.18	0.15	0.12	0.09	0.07	0.04	0.03	0.01
1	0.250	MODIFIED LINEAR	FULL	0.75	0.64	0.54	0.44	0.35	0.27	0.20	0.13	0.08	0.04
			1SR	0.50	0.43	0.36	0.29	0.23	0.18	0.13	0.09	0.05	0.03
			2SR	0.25	0.21	0.18	0.15	0.12	0.09	0.07	0.04	0.03	0.01

TYPE 48 FLOW CURVE



CLOSE-OFF ΔP RATINGS

ARD Close-Off ΔP Ratings

NOTES:

1) Type 40 leakage ratings are ANSI Class IV (Stainless Steel or Alloy 6 Trim), ANSI Class VI (TFE or PEEK Trim.) Warren Class IV+ leakage rating is available for Stainless Steel or Alloy 6 Trim for less leakage than ANSI Class IV. (See Allowable Seat Leakage Classes table on page 6).

2) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

VALVE				Type 40 CLOSE-OFF ΔP 2-WAY (PSIG) UNBALANCED WITH CAGE-RETAINED SEAT	
Trim Size (IN)	Valve Size (IN)	Cv Rating	Plug Travel (IN)	Fail Open or Closed	
				With TFE or EPDM Packing	With Graphite Packing
0.251	1/2" thru 1"	See Tables	3/4	720	720
0.376	1/2" thru 1"	See Tables	3/4	720	720
0.501	1" thru 1-1/2"	See Tables	3/4	720	720
0.876	3/4" thru 2"	See Tables	3/4	527	194
1.251	1-1/2" and 2"	See Tables	3/4	230	66
1.688	2"	See Tables	3/4	108	18

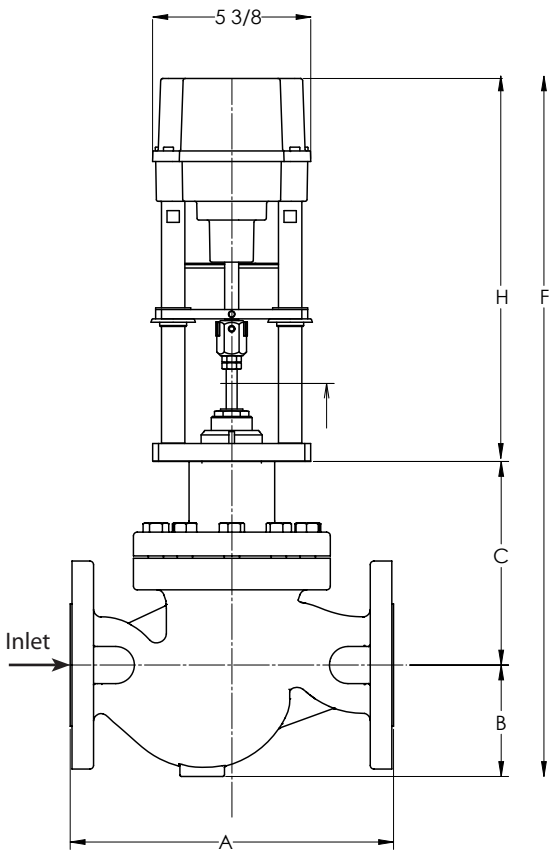
NOTES:

1) Type 48 leakage ratings are ANSI Class IV (Stainless Steel Trim), ANSI Class VI (TFE or PEEK Trim.)

2) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

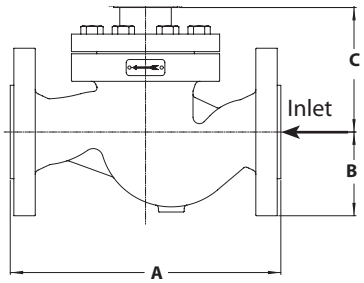
VALVE				Type 48 CLOSE-OFF ΔP (PSIG) 2-WAY, LOW FLOW,UNBALANCED WITH CAGE-RETAINED SEAT
Trim Size (IN)	Valve Size (IN)	Cv Rating	Plug Travel (IN)	Fail Open or Closed With TFE, EPDM, or Graphite Packing
0.250	1/2" thru 1"	See Tables	3/4	720

MEASUREMENT IN INCHES



2-WAY

Actuator Removal Clearance
Allow 6-1/8 inch above actuator for actuator removal
Allow 3-1/4 inch above actuator for cover removal



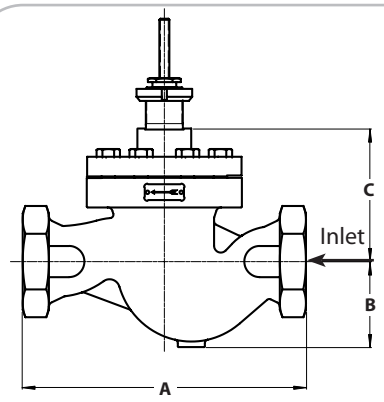
ARD Flanged
Valve Body

DIMENSION (IN) Type 40		VALVE SIZE (IN)				
Variable		**1/2**	**3/4**	**1**	**1-1/2**	**2**
A	300THD	7-1/2	7-5/8	7-3/4	9-1/4	10-1/2
	300SWE	7-1/2	7-5/8	7-3/4	9-1/4	10-1/2
	150FLG	7-1/4	7-1/4	7-1/4	8-3/4	10
	300FLG	7-1/2	7-5/8	7-3/4	9-1/4	10-1/2
B		2	2-3/8	2-1/2	3-1/4	3-3/8
C	Standard	5	5	5	4-7/8	4-7/8
	Extension Bonnet	10	10	10	9-7/8	9-7/8
H		13				
F	Standard	20	20-3/8	20-1/2	21-1/8	21-1/4
	Extension Bonnet	25	25-3/8	25-1/2	26-1/8	26-1/4

Face to face dimensions for 150 and 300 FLG conform to ANSI ISA S75.03

Consult factory for drawings, weights, and dimensions of configurations not shown. Actual shipping weights may vary.

VALVE SIZED (IN)	WEIGHT (LB) BODY ONLY							
	Standard				**With Extension Bonnet**			
	300THD	**300SWE**	**150FLG**	**300FLG**	**300THD**	**300SWE**	**150FLG**	**300FLG**
1/2	23	23	25	27	27	27	29	31
3/4	23	23	26	30	27	27	30	34
1	24	24	25	29	29	29	29	33
1-1/2	31	31	33	39	35	35	37	43
2	36	36	40	44	40	40	44	48
Weight (LB) Actuator Only	12.5							



ARD Threaded and
Socket Weld End Valve Body

DIMENSION (IN) Type 48		VALVE SIZE (IN)		
Variable		**1/2**	**3/4**	**1**
A	300THD	7-1/2	7-5/8	7-3/4
	300SWE	7-1/2	7-5/8	7-3/4
	150FLG	7-1/4	7-1/4	7-1/4
	300FLG	7-1/2	7-5/8	7-3/4
B		2	2-3/8	2-1/2
C	Standard	5	5	5
	Extension Bonnet	10	10	10
H		13		
F	Standard	20	20-3/8	20-1/2
	Extension Bonnet	25	25-3/8	25-1/2

Face to face dimensions for NPT and SWE conform to ANSI/ISA S75.03 300# (sizes 1/2 & 3/4 inch) and S75.12 short 300# (sizes 1 through 2 inch)

VALVE SIZED (IN)	WEIGHT (LB) BODY ONLY							
	Standard				**With Extension Bonnet**			
	300THD	**300SWE**	**150FLG**	**300FLG**	**300THD**	**300SWE**	**150FLG**	**300FLG**
1/2	23	23	25	27	27	27	29	31
3/4	23	23	26	30	27	27	30	34
1	24	24	25	29	29	29	29	33
Weight (LB) Actuator Only	12.5							

SIZING REFERENCE

STEAM TABLE					
Steam Pressure	Temp. °F	Temp. °C	Sensible Heat BTU/Lb.	Latent Heat BTU/Lb.	Total Heat BTU/Lb.
0	212	100	180	971	1151
10	239	115	207	952	1159
25	266	130	236	934	1170
50	297	147	267	912	1179
75	320	160	290	896	1186
100	338	170	309	881	1190
125	353	178	325	868	1193
150	365	185	339	858	1197
200	387	197	362	838	1200
250	406	208	381	821	1202
300	422	217	399	805	1204
400	448	231	438	778	1216
500	470	243	453	752	1205
600	489	254	475	729	1204

Rectangular Tank Capacity in Gallons

$$\text{Gallons} = \frac{\text{Height x Width x Length (inches)}}{230}$$

or

Gallons = H x W x L (Ft.) x 7.5

Circular Tank Storage Capacity in Gallons

Storage = $6D^2$ x L (Gallons)

Where:
D = Tank Diameter in Feet
L = Length in Feet

LOAD SIZING CALCULATIONS

Glossary of Terms
t = Time in Hours
Cp = Specific Heat of Liquid
S = Specific Gravity of Fluid
W = Weight in Lbs.
ΔT = Temperature Rise or Fall in °F
h_{fg} = Latent Heat of Steam

Conversion Factors
1 Lb. Steam / Hr. = 1000 BTU / Hr.
1 Cubic Meter = 264 U.S. Gallons
1 Cubic Foot Water = 62.4 Lbs.
1 PSI = 2.04 Inches of Mercury
1 PSI = 2.3 Feet of Water
1 PSI = 27.7 Inches of Water
1 U.S. Gallon Water = 231 Cubic Inches
1 U.S. Gallon Water = 8.33 Lbs.

Heating Water with Steam

Quick Method

$$\text{Lbs. /Hr.} = \frac{\text{GPM}}{2} \times \Delta T$$

Accurate Method

$$\text{Lbs. /Hr.} = \frac{\text{GPM} \times 500 \times \Delta T}{h_{fg}}$$

Heating or Cooling Water with Water

$$GPM_1 = GPM_2 \times \frac{°F\ water_2\ temp.\ rise\ or\ drop}{°F\ water_1\ temp.\ rise\ or\ drop}$$

Heating or Cooling Water

$$\text{GPM} = \frac{\text{BTU / Hr.}}{\text{°F water temp. rise or drop) x 500}}$$

Heating Oil with Steam

$$\text{Lbs./Hr.} = \frac{\text{GPM}}{4} \times (°F\ \text{oil temp. rise})$$

Heating Air with Water

$$\text{GPM} = 2.16 \times \frac{\text{CFM x (°F air temp. rise)}}{\text{1000 x (°F water temp. drop)}}$$

Heating Liquids with Steam

$$\text{Lbs. /Hr.} = \frac{\text{GPM} \times 60 \times Cp \times W}{h_{fg}} \times \Delta T$$

Heating Liquids in Steam Jacketed Kettles

$$\text{Lbs. /Hr.} = \frac{\text{Gallons} \times Cp \times S \times 8.33}{h_{fg} \times t} \times \Delta T$$

General Liquid Heating

$$\text{Lbs. /Hr.} = \frac{W \times Cp}{h_{fg} \times t} \times \Delta T$$

Heating Air with Steam

$$\text{Lbs. /Hr.} = \frac{\text{CFM}}{900} \times \Delta T$$

VALVE TYPE/TRIM MATERIAL COMBINATIONS:

	TRIM MATERIAL					
SIZE	**S** 316 SS	**T** TFE Soft Seats	**P** PEEK Soft Seats	**6** Alloy 6/316 SS	**7** 400 SS	**8** Alloy 6/400 SS
050 1/2 inch	40, 48	40, 48	40, 48	40	40	40
075 3/4 inch	40, 48	40, 48	40, 48	40	40	40
100 1 inch	40, 48	40, 48	40, 48	40	40	40
150 1-1/2 in.	40	40	40	40	40	40
200 2 inch	40	40	40	40	40	40

FLUID TEMPERATURE LIMITS

Valve Type	Body Material & Code	End Connection & Code	Trim Material & Code	Packing Type & Code	Bonnet Construction & Code	T MAX	T MIN
40 2-Way Single Seat	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G,** NPT **S,** Socket Weld **W**	316 **S**, Alloy 6 Wrapped 316 SS **6**, 400 SS **7**, Alloy 6 Wrapped 400 SS **8**	EPDM **L**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**, Alloy 6 Wrapped 316 SS **6**, 400 SS **7**, Alloy 6 Wrapped 400 SS **8**	Teflon **T**, Vacuum Service **V**	PEEK **S**, Z PEEK **8**	450ºF	60ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**, Alloy 6 Wrapped 316 SS **6**, 400 SS **7**, Alloy 6 Wrapped 400 SS **8**	Graphite **G**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G,** NPT **S**	Teflon **T**	EPDM **L**	PEEK **S**, Z PEEK **8**	250ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	Teflon **T**	Teflon **T**, Vacuum Service **V**	PEEK **S**, Z PEEK **8**	250ºF	60ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	Teflon **T**	Graphite **G**	PEEK **S**, Z PEEK **8**	250ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	PEEK **P**	EPDM **L**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	PEEK **P**	Teflon **T**, Vacuum Service **V**	PEEK **S**, Z PEEK **8**	450ºF	60ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	PEEK **P**	Graphite **G**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**, Alloy 6 Wrapped 316 SS **6**, 400 SS **7**, Alloy 6 Wrapped 400 SS **8**	Graphite **G**	Copper Based Graphalloy Bearings w/ Ext Bonnet **G**	750ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G,** NPT **S**, Socket Weld **W**	316 **S**, Alloy 6 Wrapped 316 SS **6**, 400 SS **7**, Alloy 6 Wrapped 400 SS **8**	Graphite **G**	Nickel Based Graphalloy Bearings w/ Ext Bonnet **L**	750ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G,** NPT **S**, Socket Weld **W**	316 S, Alloy 6 Wrapped 316 SS 6, 400 SS **7**, Alloy 6 Wrapped 400 SS 8	Graphite **G**	Oxidation Resistant Graphalloy Bearings w/ Ext Bonnet **7**	800ºF	-20ºF
48 2-Way Single Seat Low-Flow	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**	EPDM **L**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**	Teflon **T**, Vacuum Service **V**	PEEK **S**, Z PEEK **8**	450ºF	60ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**	Graphite **G**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	Teflon **T**	EPDM **L**	PEEK **S**, Z PEEK **8**	250ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	Teflon **T**	Teflon **T**, Vacuum Service **V**	PEEK **S**, Z PEEK **8**	250ºF	60ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT S	Teflon **T**	Graphite **G**	PEEK **S**, Z PEEK **8**	250ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	PEEK **P**	EPDM **L**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	PEEK **P**	Teflon **T**, Vacuum Service **V**	PEEK **S**, Z PEEK **8**	450ºF	60ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**	PEEK **P**	Graphite **G**	PEEK **S**, Z PEEK **8**	450ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**	Graphite **G**	Copper Based Graphalloy Bearings w/ Ext Bonnet **G**	750ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**	Graphite **G**	Nickel Based Graphalloy Bearings w/ Ext Bonnet **L**	750ºF	-20ºF
	WCB **W**, CF8M **F**	150 lb **F**, 300 lb **G**, NPT **S**, Socket Weld **W**	316 **S**	Graphite **G**	Oxidation Resistant Graphalloy Bearings w/ Ext Bonnet **7**	800ºF	-20ºF

NOTE: -20°F T MIN temperature limit is for indoor applications with low humidity where ice will not form on the valve stem.
ALL GRAPHALLOY BEARINGS ARE SPECIAL ORDER AT TIME OF ORDER AND MAY IMPACT DELIVERY TIMES.

CONFIGURATIONS

1. SELECTIONS
2. OPTIONS

Please make a selection from each table of OPTIONS below to make a complete model number string.

ARD – ☐☐ ☐☐☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

VALVE BODY

Model	Valve Type	Size	Body Mat'l.	End Connection	Trim Style	Trim Material	Trim Cv	Packing Type	Bonnet Construction
	40 Single Seat 2-Way, Unbalanced w/ Cage Retained Seat	**050** 1/2 inch	**W** WCB	**F** 150 lb. Flanged	**E** Equal %	**S** 316 Stainless Steel*	**F** Full Port	**T** Teflon	**S** PEEK Bearings
	48 Single Seat 2-Way, Low Flow Unbalanced w/Cage Retained Seat (1/2" - 1" sizes only)	**075** 3/4 inch	**F** CF8M	**G** 300 lb. Flanged	**L** Linear	**T** TFE Soft Seats	**1** 1st Port Reduction	**G** Graphite	**8** Z PEEK Bearings
		100 1 inch		**S** NPT Screwed	**M** Mod Lin	**P** PEEK Soft Seats	**2** 2nd Port Reduction	**V** Vacuum Service	**G** Cooper Based Graphalloy Bearings w/ Ext Bonnet
		150 1-1/2 inch		**W** Socket Weld	*NOTE: Type 48 Mod Lin Only*	**6** Alloy 6 Wrapped 316 SS	**3** 3rd Port Reduction	**L** EPDM	**L** Nickel Based Graphalloy Bearings w/ Ext Bonnet
		200 2 inch				**7** 400 Stainless Steel	**4** 4th Port Reduction		**7** Oxidation Resistant Graphalloy Bearings w/ Ext Bonnet
						8 Alloy 6 Wrapped 400SS	*NOTE: Check Factory for availability of Reduced Trims.*		
						**Type 48, 316 SS trim uses a harder Nitronic 60 seat.*			

TS	Teflon Packing, PEEK Bearings
GS	Graphite Packing, PEEK Bearings
VS	Teflon Packing, PEEK Bearings, Vacuum Service
LS	EPDM Packing, PEEK Bearings
T8	Teflon Packing, Z PEEK Bearings
G8	Graphite Packing, Z PEEK Bearings
V8	Teflon Packing, Z PEEK Bearings, Vacuum Service
L8	EPDM Packing, 7 PEEK Bearings
GG	Graphite Packing & Gaskets, Copper Based Graphalloy Bearings, Extension Bonnet
GL	Graphite Packing & Gaskets, Nickel Based Graphalloy Bearings, Extension Bonnet
G7	Graphite Packing & Gaskets, Oxidation Resistant Graphalloy Bearings, Extended Bonnet

APPLICATION SELECTION TIPS

PACKING

- Use Teflon for most fluids below 450°F except water.
- Use EPDM Packing for water service only. Do not use on oils, hydrocarbons or acids.
- Use Graphite Packing for fluids above 450°F.

BONNET CONSTRUCTION

- Use PEEK Bearings for most applications below 450°F that are not steam.
- Use Z PEEK for steam applications below 450°F.
- Use Graphalloy Bearings w/ext. bonnet above 450°F. See page 8 for further selection criteria on Graphalloy Type.

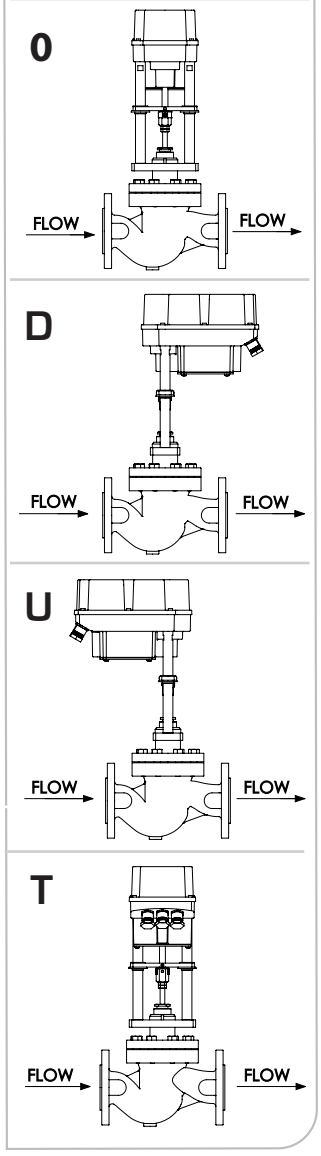
ACID SERVICE

For Acid Service, special rulon bearings are required.
Consult Factory.

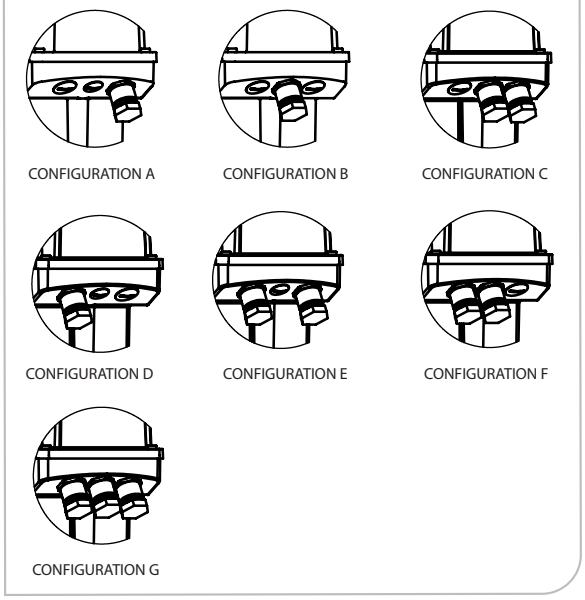
ARIA ACTUATOR ATTRIBUTES

Failure Mode	Voltage Supply	Electrical Connectors	Heater	Limit Switches	Actuator Orientation
D Spring Fail Down	**1** 115/230 Vac	**A** (Left) Capped (Middle) Capped (Right) 1/2 NPT	**0** None (Default)	**0** None (Default)	**0** None (Default)
U Spring Fail Up	**4** 24 Vac/ Vdc	**B** (Left) Capped (Middle) 1/2 NPT (Right) Capped	**H** Heater	**S** Silver Contact Limit Switches	**D** Pointing Down Stream
		C (Left) Capped (Middle) 1/2 NPT (Right) 1/2 NPT			**U** Pointing Up Stream
		D (Left) 1/2 NPT (Middle) Capped (Right) Capped			**T** Pointing Towards
		E (Left) 1/2 NPT (Middle) Capped (Right) 1-2 NPT			
		F (Left) 1/2 NPT (Middle) 1/2 NPT (Right) Capped			
		G (Left) 1/2 NPT (Middle) 1/2 NPT (Right) 1/2 NPT			

Actuator Orientations



Electrical Connectors Orientation



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ARD PRODUCT SPEC

ARD - is the breed defined for high temperature flow and pressure control. This 2-way steel valve with ANSI 150 or 300 Lb. ratings includes a bolted bonnet and cage retained seat for maximum durability and ease of long term maintenance. End connection options are flanged, NPT, or socket weld. An optional extension bonnet will accommodate the highest temperature applications possible for electric actuation. A rugged performer, available in multiple port sizes for finely tuned flows in sizes from 1/2" through 2".

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