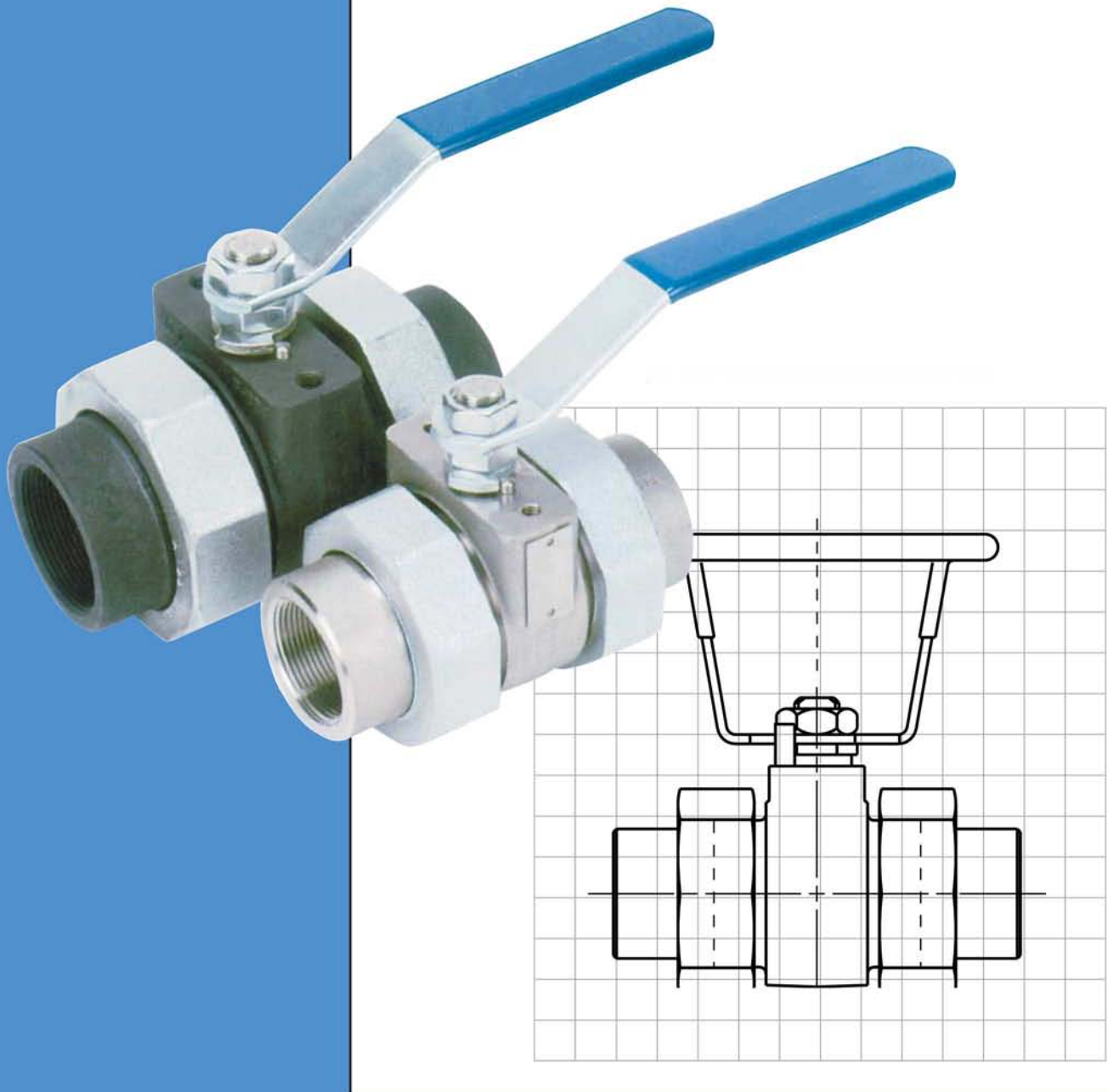




Worcester Controls



Series 790 Ball Valve

Double-Union End Pressures to 4500 psig

Series 790 Ball Valves

The Series 790 ball valves employ rugged double-union ends which eliminate the space, labor and material required to install a pipe union and nipples in the piping run.

In-line maintenance effectiveness is maximized by the seat retainer design. With this design, a rebuilt body center section can be field bench tested to verify seat integrity in both directions.

The dual stem seal is a basic but important innovation that delivers better seal life and requires fewer adjustments in service. Improved operation is achieved by overall design rather than simply changing or adding materials.

Size Range: ¼" - 2"

Temperature Range: -50 to 525°F

Pressure Ratings: vacuum to 4500 psig.

Body Style: Three piece—double-union end.

Materials: Forged carbon steel, stainless steel and others upon request.

Actuation: Integral mounting pad for ease of automation.

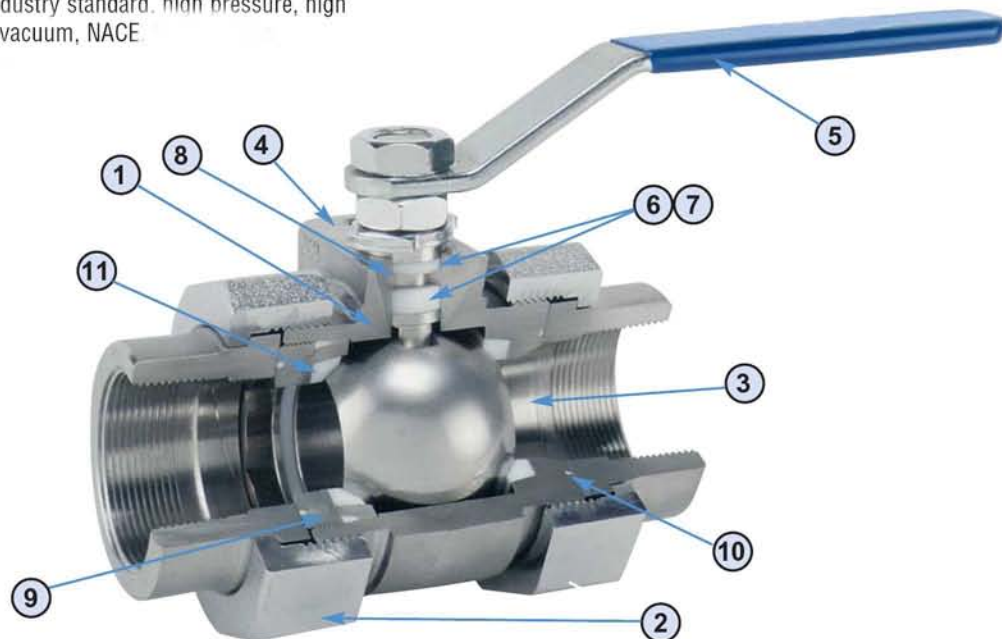
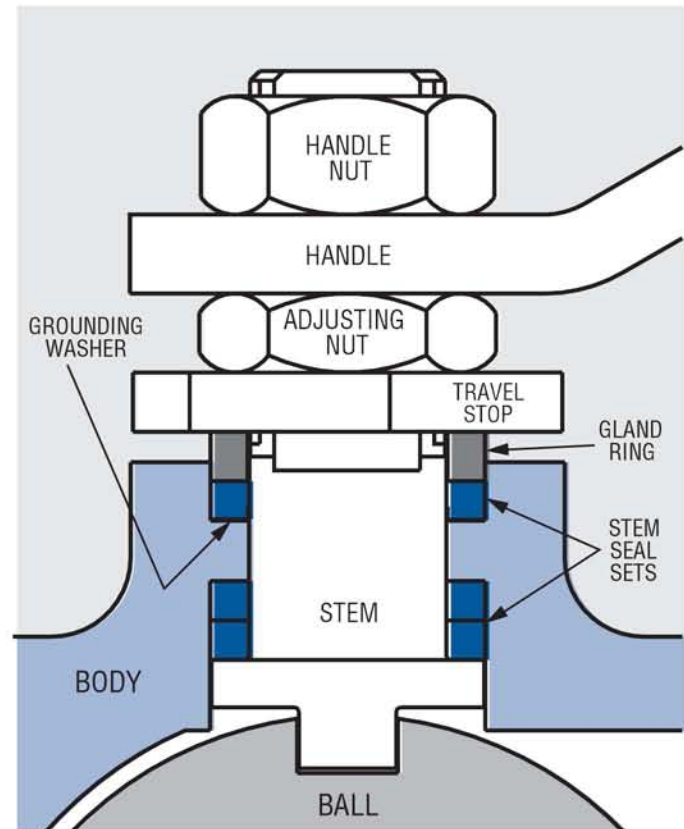
Porting: Full port through 1½", nearly full port 2".

End Configurations: Include threaded, socket-weld, butt-weld

Traceability: Carbon steel and stainless steel body, ends and nuts are heat coded to provide traceability to Mil. 1. certification.

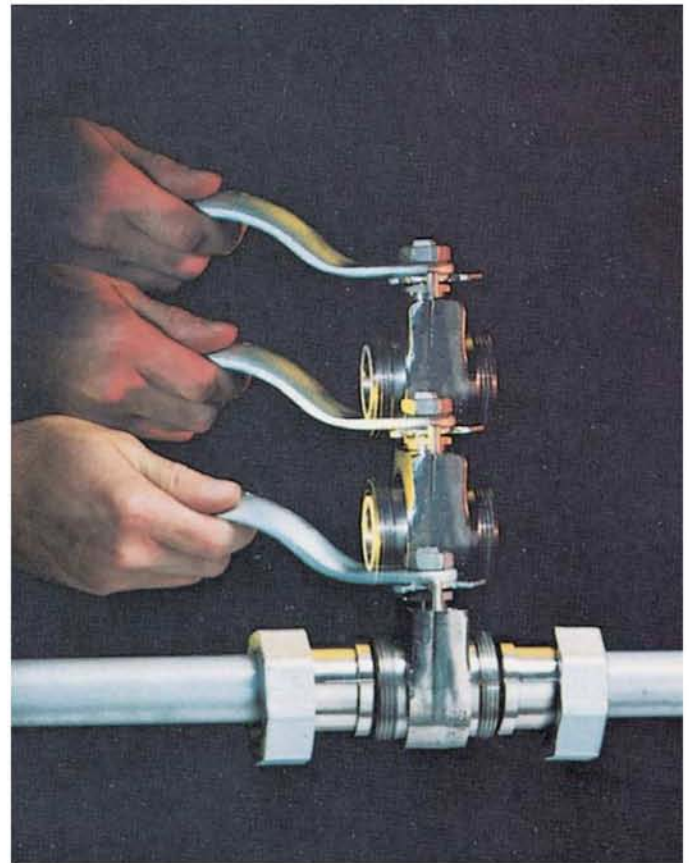
Options: Includes fire-safe to industry standard. high pressure, high temperature, oxygen, chlorine, vacuum, NACE

Dual Stem Seal Arrangement



Design Features and Advantages

1. **In-line Maintenance** — easily achieved through quick change-out of the self-contained body section.
2. **Double Union Ends**
 - Eliminate piping unions and nipples for quicker, less expensive installation and easy maintenance.
 - Valve mounts in any position and permits minimized spacing for nested runs.
3. **Full-Port Design** — minimizes pressure loss and allows smoother media flow.
4. **Integral Mounting Pad** — for easy automation, while still allowing in-line maintainability.
5. **Rugged Vinyl-Coated Steel Handle** — strong and durable construction.
6. **Conical-Shaped TFE and RTFE Packing Rings** — completely fill the packing cavity to ensure tight sealing at low compressive force.
7. **Dual Packing Sets** — maximize seal integrity and eliminate problems commonly associated with multiple top-loaded packing designs. Greater distance between stem support points and tighter tolerances reduce destructive stem wobble.
8. **Standard Internal Grounding Device** — all styles except FIRE-GARD — where the flexible graphite stem packing provides the grounding.
9. **Threaded Spacer** — within the body assembly locks in body components as a set and permits dead end service in either direction.
10. **Totally Encapsulated End Seals** — full retention and control of end seals prevent “cold flow” even under severe stress, and assure a reliable assembly under the most severe service conditions. A variety of end seals (TFE, Buna-N, Viton, Flexible Graphite, etc.) are available to suit your applications.
11. **Seat Configurations** — standard Series 790 Seats include TFE, RTFE, Thermopac (carbon and glass fiber filled TFE), UHMWP and Kel-F. Standard Kel-F seated versions have an upstream RTFE seat and a downstream Kel-F seat. The valve is marked for unidirectional installation.



Seal Code	Max. Temp.
T – TFE, R – RTFE	450°F
V – Viton	350°F
C – oxidizing nonoxidizing	700°F 1000°F

Options, Applications and Special Services

FIRE-GARD®



FIRE-GARD valves tested to API 607, 4th Edition. For use in refineries, petrochemical plants and processing industries handling flammable media - for which the .790 FIRE-GARD ball valve is well suited.

Tested to the requirements of API 607 REV 4, the Series .790 FIRE-GARD ball valve includes:

Secondary Metal Back-Up Seating — onto which the free-floating ball may move to reduce internal leakage should the soft seats burn out in fire. (This feature is standard on all 790 Ball Valves.)

Flexible Graphite Body and End Seals — replaces the standard gasket materials.

Flexible Graphite Spacer Seal — replaces the standard spacer seal to prevent external leakage.

High-Temperature Stem Packing — (flexible graphite) replaces the standard TFE or RTFE packing.

High-Temperature and Steam Service

Standard Series .790 Ball Valves are easily applied to steam service. RTFE seats, Viton end seals and 316 stainless steel trim are suggested for all steam service applications up to 150 psig/400°F. Body material recommendations are as follows:

Carbon Steel — for superheated steam service.

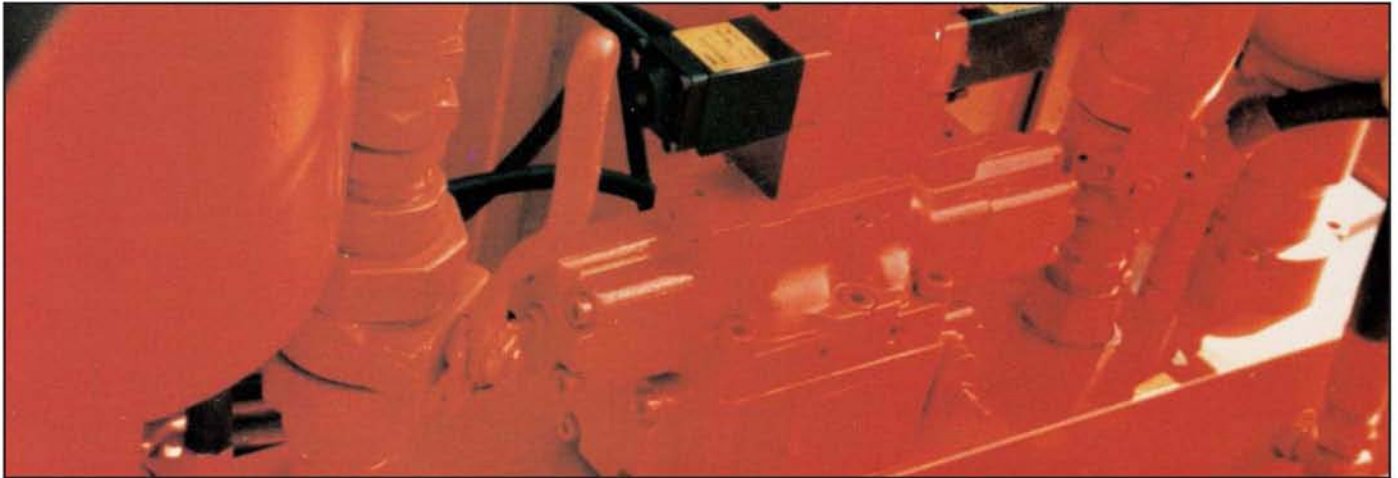
Stainless Steel — up to 300 psig in saturated or superheated steam service within pressure-temperature curve.

Paint Service



For industrial paint applications, .790 Ball Valves are specially cleaned and assembled to be silicone free to prevent paint contamination.

Options, Applications and Special Services



Sour Gas Service

The **Series 790** ball valve is available for general sour gas service, in accordance with NACE Standard (**contact factory for requirements**) both carbon and stainless steel configurations. Carbon steel valves require stainless steel trim for sour gas service, in addition to the service preparation.

Vacuum Service

Series 790 ball valves with TFE seats and seals can be prepared for vacuum service. Operating pressure and leakage requirements should be submitted with every valve order to determine which, if any, modifications will be required. **Contact Factory for this application**

Oxygen Service

Stainless steel **Series 790** ball valves can be prepared for oxygen service with special degreasing, cleaning, testing and packaging procedures performed by Flowserve staff, to oxygen service cleaning specification in Flowserve's on-site clean room facility. Body and trim materials are limited to stainless steel. Certain seat and seal materials are incompatible with oxygen; therefore, Flowserve recommends contacting Customer Service with your requirements.

Dead-End Service

The **.790** dead-end capability utilizes a threaded insert allowing easy maintenance of other piping components such as filters or meters located on either side of an **.790** and takes advantage of both unions in processes where multiple piping devices are separated by **.790** ball valves.



Hydraulic Fluid Service

Series 790 Ball Valves with ultra high molecular weight polyethylene (J) seats rated to 3000 psi are primarily intended for hydraulic service where clean line fluid and good lubricity can be expected. Viton seals are appropriate for phosphate esters, while TFE is compatible with most media with mineral oil and water glycol. Contact factory to assist in determining appropriate body and end seals for your application.

Specifications Series 790 Double-Union End Ball Valves

SIZE RANGE: ¼" thru 2"

PORTING: Full port through 1½", oversize regular port 2"

END CONNECTIONS: Threaded, socket-weld and others –
See back cover.

PRESSURE RATINGS:

790 – Up to 2500 psig with TFE, RTFE or

Thermopac seats

.790J High Pressure – Up to 3000 psig using

UHMWP seats

.790K High Pressure – Up to 4500 psig using Kel-F downstream,

RTFE upstream (a unidirectional valve)

TEMPERATURES:

790 – -50°F to 525°F

790J & 790K High Pressure – -50°F to 250°F

INDUSTRY STANDARDS: ANSI/ASME B1.20.1 (NPT); B16.11, (socket ends); B16.24, (butt-weld ends)

STANDARD BODY MATERIALS:

790 – Carbon Steel, Stainless Steel, (other materials, contact factory)

.790J & 790K High Pressure – Carbon Steel, Stainless Steel

STANDARD TRIM MATERIALS:

790 – Carbon Steel, Stainless Steel, Monel

.790J & 790K High Pressure – Carbon Steel, Stainless Steel, Monel

SEAT MATERIALS:

790 – TFE, RTFE, Thermopac, others

.790J High Pressure – UHMWP seats

.790K High Pressure – Kel-F downstream. RTFE upstream (a unidirectional valve)

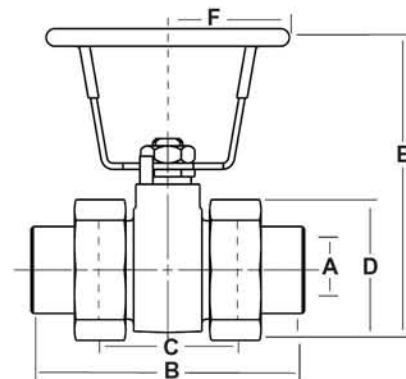
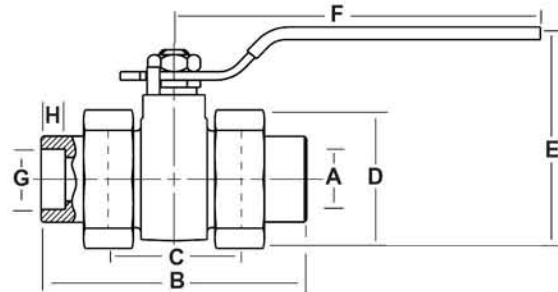
SEAL MATERIALS:

790 – TFE, Viton, Buna N, Flexible Graphite

790J & 790K High Pressure – TFE, 90 Durometer

Viton A O-ring

OPTIONS: See page 9.



Dimensions and Weights

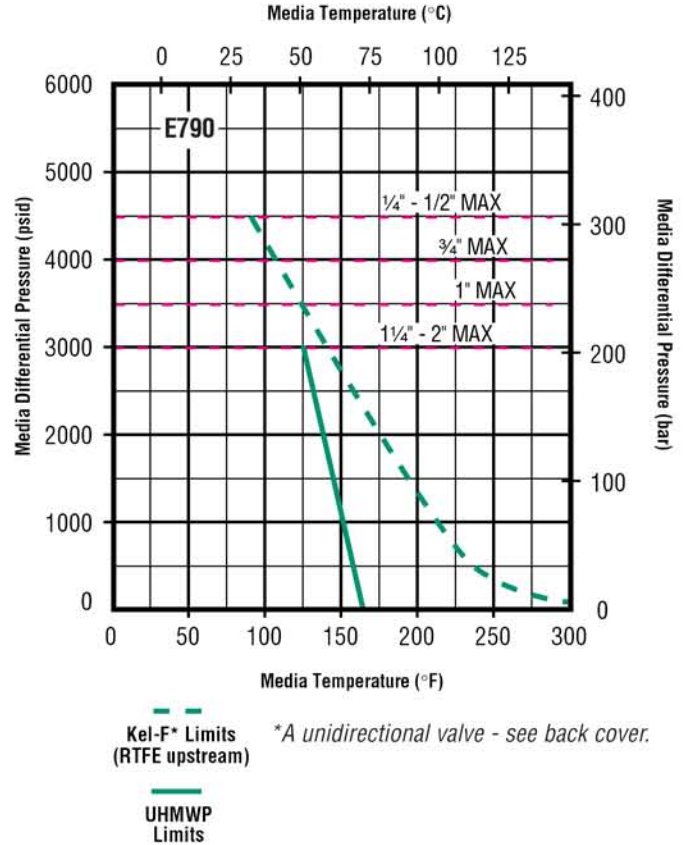
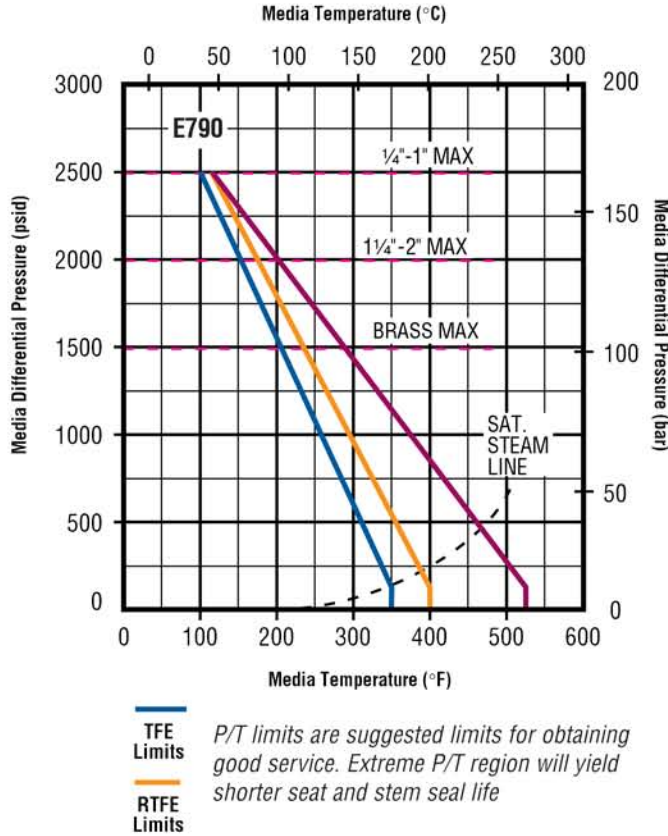
Size in/mm	A	B	C	D	E		F		Socket Weld		Weight lb/kg
					Lever	Safety	Lever	Safety	G*	H*	
¼ 6	.44 11.2	3.938 100.0	1.938 49.2	1.875 47.6	3.29 83.5	4.53 115.1	5.50 139.7	2.50 63.5	.56 14.2	.57 14.5	2.5 1.1
⅜ 9	.58 14.7	3.938 100.0	1.938 49.2	1.875 47.6	3.29 83.5	4.53 115.1	5.50 139.7	2.50 63.5	.69 17.5	.62 15.7	2.4 1.1
½ 12	.66 16.8	3.939 100.0	1.938 49.2	1.875 47.6	3.29 83.5	4.53 115.1	5.50 139.7	2.50 63.5	.86 21.8	.77 19.6	2.4 1.1
¾ 20	.81 20.6	4.500 114.3	2.188 55.6	2.188 55.6	3.60 91.4	4.84 122.9	5.50 139.7	3.25 82.6	1.0 25.4	.82 20.8	3.3 1.5
1 25	1.0 25.4	4.938 125.4	2.375 60.3	2.563 65.1	4.53 115.1	5.22 132.6	6.50 165.1	3.25 82.6	1.3 33.0	.95 24.1	5.2 2.4
1¼ 32	1.23 31.2	5.375 136.5	2.500 63.5	3.063 77.8	5.32 135.1	5.82 147.8	8.50 215.9	3.25 82.6	1.6 40.6	.97 24.6	7.2 3.3
1½ 40	1.44 36.6	5.875 149.2	2.750 69.9	3.438 87.3	5.74 145.8	6.24 158.5	8.50 215.9	3.25 82.6	1.9 48.3	1.0 25.4	9.6 4.4
2 50	1.72 43.7	6.875 174.6	3.375 85.7	4.125 104.8	6.45 163.8	6.95 176.5	8.50 215.9	5.00 127.0	2.4 61.0	1.0 25.4	15.4 7.0

*G – Socket Weld Diameter (same for Safety Handle Configuration)

*H – Socket Weld Depth (same for Safety Handle Configuration)

Technical Data

Pressure/Temperature



Valve Flow Capacity

Valve Size	CV†	Valve Size	CV†
1/4"	5.5	1"	53
3/8"	12	1 1/4"	90
1/2"	23	1 1/2"	127
3/4"	35	2"	180

† GPM with 1 psig pressure drop

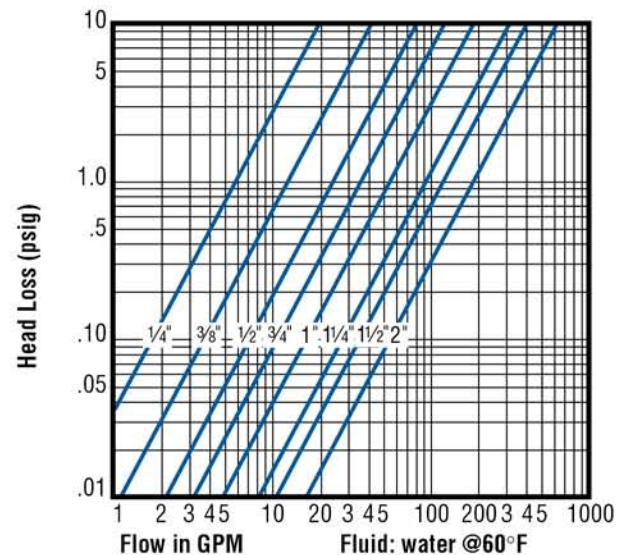
Minimum Temperatures:

Carbon Steel — -20°F (-29°C)
 Stainless Steel w/ stainless steel nuts — -50°F (-46°C)
 Stainless Steel w/ all other nuts — -20°F (-29°C)

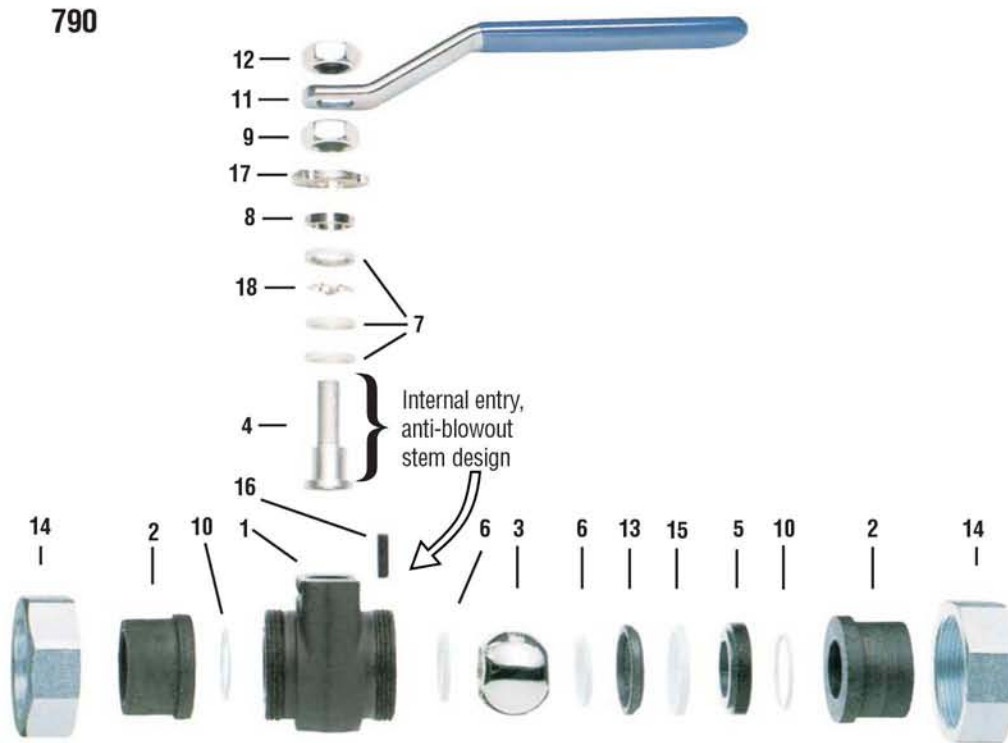
Steam Rating:

RTFE Seats, Viton Seals — 150 psig @ 365°F Saturated, (13.8 bar @ 190°C) or within P/T Curve for Superheated
 Thermopac — Saturated Steam 350 psig @ 432°F (29.5 bar @ 134°C) or within P/T Curve for Superheated

Head Loss



Parts Identification and Materials of Construction



Materials of Construction

No.	Part Description	Carbon Steel	Stainless Steel
1	Body	ASTM-A105 Carbon Steel (Manganese Phosphate Coated)	ASTM-A182 316 Stainless Steel
2	Union End†	ASTM-A105 F316L Carbon Steel (Manganese Phosphate Coated)	ASTM-A182 F316L 316 Stainless Steel
3	Ball†	316 Stainless Steel	316 Stainless Steel
4	Stem	316 Stainless Steel	316 Stainless Steel
5	Threaded Spacer	316 Stainless Steel	316 Stainless Steel
6	Seats†	TFE, RTFE, Thermopac, UHMWP, and Kel-F	
7	Stem Seal Set	TFE, RTFE (Flexible Graphite used on FIRE-GARD and Thermopac)	
8	Gland Ring	Carbon Steel (Zinc Plated)	304 Stainless Steel
9	Adjusting Nut	Carbon Steel (Zinc Plated)	
10	Body Seal† End Seal	TFE, Buna, Viton, and EPR (Flexible Graphite used on FIRE-GARD and Thermopac)	
11	Handle	¼" – 2" Carbon Steel Plastic Coated	
12	Stem Nut	Carbon Steel (Zinc Plated)	
13	Seat Socket	Carbon Steel (Manganese Phosphate Coated)	316 Stainless Steel
14	Union Nut†	A105 Carbon Steel (Zinc Plated)	
15	Spacer Seal	TFE (Flexible Graphite used on FIRE-GARD and Thermopac)	
16	Stop Pin	Carbon Steel (Zinc Plated)	
17	Travel Stop*	Carbon Steel (Zinc Plated)	
18	Grounding Washer	302 Stainless Steel (non FIRE-GARD only)*	

*Sizes 1 inch (25mm) and larger only. ¼" – ¾" (6-20 mm) have stop integral with handle.

† Other materials available. Contact factory with specific requirements.

Unless otherwise noted, FIRE-GARD materials are the same as standard.

FIRE-GARD and Thermopac configurations available on carbon and stainless steel valves only.

Options and Accessories

End Connections

Series 790 ball valve ends are available with NPT taper threads to ANSI B2.1. Optional end preparations include:

Socket-Weld Ends — meet ANSI B16.11 for socket dimensions.

316 Stainless Steel Union Nuts — for severely corrosive environments.

Insulated Screwed End — a Kynar® coating is applied to one end of a threaded-end carbon steel 790 Ball Valve; the union nut is also provided with a fiber shim to protect the coating.

Butt-Weld and Socket-Weld Nipples — available by special order; specify length, pipe schedule, material and end preparation when ordering.

Handles

For details regarding standard 790 handles see Materials of Construction listed on page 8. Optional handles available include:

Safety Handles — for those applications where accidental operation of the valve could be dangerous. The torque capabilities of a safety handle is lower than that of a lever handle. Handle proportions for the following working pressures:

Valve Size (in/mm)	Safety Handle	Rating (psig/bar)
¼" – ¾"/6-20	Oval	1500/102
1" – 1¼"/25-32	Oval	2000/136
1½"/40	Oval	1500/102
2"/50	Oval	500/34

Padlock Devices — offering padlocking capabilities in the open or closed positions.

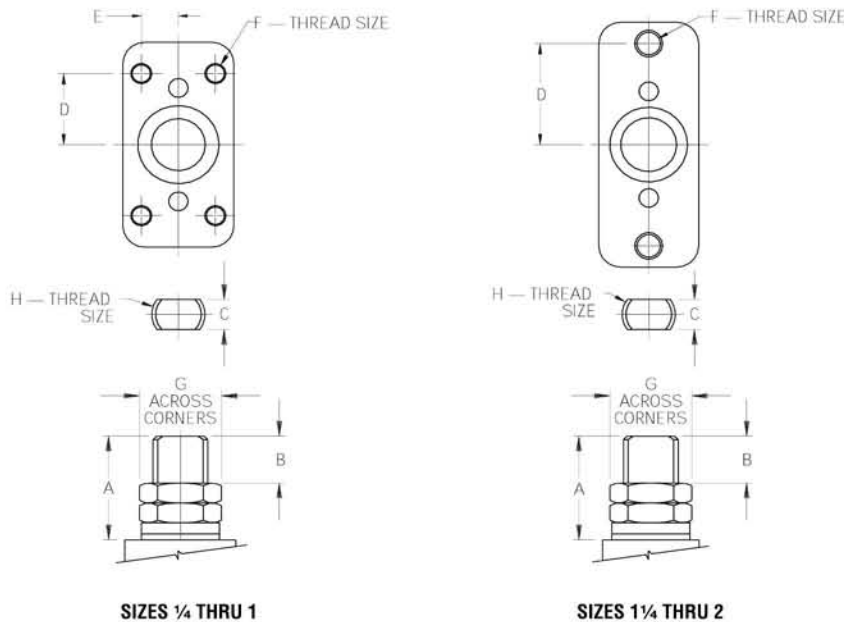
Spring-Return Handle — provides unassisted opening or closing of manually operated valves. The handle is driven by a powerful, completely enclosed torsion spring that automatically returns the valve to the desired fully open or fully closed position when released.



Mounting Dimensions for Actuator Selection

General Dimensions (in.)

Size	A	B	C	D	E	F	G	H
¼	.78	.31	.285	.63	.31	10-24	.85	½-20
1	1.18	.71	.285	.63	.31	10-24	.85	½-20
1¼	1.24	.49	.410	1.19	N/A	½-18	1.07	¾-18
1½	1.36	.61	.410	1.19	N/A	½-18	1.07	¾-18
2	1.51	.65	.473	1.48	N/A	¾-16	1.27	¾-16



Valves Shown in Open Position

NOTES

1. Stop pins must be removed from valve body.
2. For actuator dimensions for valves with bonnets consult factory.

Automation

The Series 790 ball valves greatly simplify design of automated piping systems. The double-union ends eliminate piping unions and nipples for quicker, less expensive installation and easy maintenance. Valves mount in any position permitting minimized spacing for nested runs. Actuator installation/removal is simply performed, without disassembling the valve or disrupting normal flow. Valve maintenance is easily accomplished without removing the actuator. All Series 790 Ball Valves feature actuator mounting holes drilled and tapped as standard.

For more information regarding automation of your Series 790 790 Ball Valves, refer to **attached** Torque Information for Actuator Sizing.



Worcester Automated Valve Packages

Worcester Automated Control Packages are made to suit your requirements. Whether your application calls for simple on-off flow control or more sophisticated process automation — Flowserve offers a wide range of valve actuator packages to match individual requirements and provide excellent flexibility for automated flow control.

Series 790, Basic Sizing Torques

Series 790 Valve Basic Sizing Torques (in-lb)

Valve Size	Seat/Seal Code	Line Pressure (psig)					Maximum Rated Pressure		
		to 100	100 to 500	500 to 1000	1000 to 1500	1500 to 2500	Size	JT JL	KT KL
¼", ½", ¾"	TT TE TF TL	40	45	55	65	85	¼", ½", ¾"	180	180
	RT RE RF RL PC	110	110	110	125	125			
¾"	TT TE TF TL	125	125	125	150	150	¾"	250	370
	RT RE RF RL PC	175	175	175	200	200			
1"	TT TE TF TL	190	190	190	210	250	1"	450	450
	RT RE RF RL PC	250	250	250	252	345			
1¼"	TT TE TF TL	220	240	340	400	450	1¼"	650	930
	RT RE RF RL PC	410	410	410	410	520			
1½"	TT TE TF TL	240	270	340	399	520	1½"	700	950
	RT RE RF RL PC	375	375	415	495	585			
2"	TT TE TF TL	375	375	410	470	575	2"	850	-
	TR RE RF RL PC	440	440	535	580	705			



Pneumatic Automation

The Series 39 pneumatic actuator is an accurate, compact, powerful, double-piston, rack-and-pinion actuator with an impressive track record for reliability.



Electric Automation

The Series 75 electric AC or DC actuator is designed for on/off and modulating applications. It provides precise, reliable, and automatic rotary valve operation in a rugged compact package. The series 75 is available in a variety of NEMA enclosures, and is easily adaptable for PLC/computer applications. Many options such as feedback systems and positioner/controller, are available with torques up to 3000 in-lbs.

How to Specify and Order

Worcester Controls Series 790 Ball Valve



Codes

Body Material

- 4 — Carbon Steel
- 6 — Stainless Steel

Trim

- 6 - 316 Stainless Steel
- 7 - Monel

Seat Material

- T — TFE
- R — Reinforced TFE
- F — Thermopac (Carbon/fiberglass-filled TFE)
- U — UHMWP
- K — Kel-F downstream/RTFE upstream (a unidirectional valve)
FEP and PEEK available upon application – consult factory

Seal Material

- T — TFE
- R — RTFE
- V — Viton A 90 durometer
- F — FIRE-GARD
- Z — Flexible graphite

Special Feature Codes

Service Preparation

- V38 - No Lubricant
- V46 - Silicone Free

- Contact Factory — NACE service
- Contact Factory — Chlorine

Note: Some special features are limited to specific body, trim, seat or seal codes. Contact factory for specific requirements.

End Connections

- SW — Socket-weld ends
- ESW — Extended socket-weld Ends (specify) - POA
- BW — Butt-weld ends
- SE/SW — One end threaded/one end socket-weld
All others (specify)
- SE - Screwed end

Operation

- V32 — Safety handle (oval thru 3/4", oval 1"-2")
- K — Padlock Device
- Other Features**
- V17 — Double grounding Device, ball-to-stem-to-body (stem-to-body grounding standard on non-FIRE-GARD valves)

- N — 316 stainless steel union nuts

NOTICE: Worcester Controls by Flowserve are designed and manufactured using good workmanship and materials, and they meet all applicable industry standards. Flowserve is anxious to avoid injuries and property damage which could result from misapplication of the product. Proper valve selection is imperative. Examples of the misapplications or misuse of a valve include but are not limited to use in a service in which the pressure/temperature rating is exceeded or in a chemical service incompatible with the valve materials; use of undersized valve actuators; use of extremely fast valve actuation and/or continuous valve cycling on standard valves; making modifications of the product of any kind; failure to use caution in operating valves in high temperature, high pressure, or highly hazardous services; and the failure to maintain valves as recommended. The right is reserved to change or modify product design or construction without prior notice and without incurring any obligation to make such changes and modification on products previously or subsequently sold.

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation, and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

While the information and specifications contained in this literature are believed to be accurate, they are supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because Flowserve is continually improving and upgrading its product design, the specifications, dimensions and information contained herein are subject to change without notice. Should any question arise concerning these provisions, the purchaser/user should contact Flowserve Corporation at any one of its worldwide operations or offices.

For more information about Flowserve Corporation, contact www.flowserve.com or call USA 1-800-225-6989.

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