

TBV Cryogenic Ball Valves

Cameron's quarter-turn valve product portfolio for cold service and cryogenic solutions, around the world

TECHNOLOGY



TBV Cryogenic Ball Valves



Millbury, Mass., USA

Cameron is a leading provider of valves, valve automation, and measurement systems to the oil and gas industry. Its products are used primarily to control, direct, and measure the flow of oil and gas as it is moved from individual wellheads through flowlines, gathering lines, and transmission systems to refineries, petrochemical plants, and industrial centers for processing.

Cameron provides critical service valves for refinery, chemical, and petrochemical processing businesses, and for associated storage terminal applications, particularly through its ORBIT® and GENERAL VALVE® product lines. These brands are complimented by WKM® and TBV™ valve products, and considerably expand the scope of Cameron's product offerings.

TBV valve products are manufactured and assembled at Cameron's facility in Millbury, Mass. The TBV facility offers 100,000 sq ft of space, of which, 80,000 sq ft is dedicated to manufacturing, assembling, testing, shipping, and quality assurance. This manufacturing space allows Cameron the opportunity to expand its product offerings and size range. Cameron's TBV valves are competitive in the LNG, mining, and petrochemical markets with the ability to offer larger size ranges in its line of product.

Facility Features

- Clean room for oxygen, chlorine, and phosgene assembly and testing
- Painting room
- Dedicated cryogenic testing area
- State-of-the-art CNC machining



Table of Contents

TBV CRYOGENIC BALL VALVES

Technical Summary	2
TBV Cryogenic Ball Valves Chart.....	3
Features.....	4
Series 21/11	9
Series 21/51	10
Series 21/51A	11
Series 21/18.....	12
Series 21/20.....	13
Series 21/28.....	14
Series 21/80.....	15
CAMSERV Aftermarket Services for Valves and Actuation.....	16
Trademark Information	17

TECHNICAL SUMMARY

Size Range	1/2" through 18" (15 mm through 450 mm) DN15 through DN450	
Porting Configurations	Standard port and full port	
Applications	Air separation Liquefaction (export terminals) Liquefied petroleum gas (LPG) Pharmaceutical (blanketing, pH control, pipe freezing, process chilling, water treatment, and shrink fitting) Infrastructure (pipelines and refueling) Transport (trucking, marine, rail) FLNG (floating LNG) production High-purity gases for semi-conductor applications Food freezing Aerospace	
Cold Service Applications	Ammonia -28° F (-33° C) Argon -303° F (-186° C) Carbon dioxide -109° F (-78° C) Carbon monoxide -312° F (-191° C) Chlorine -30° F (-34° C) Deuterium -417° F (-249° C) Ethylene -155° F (-104° C) Fluorine -307° F (-188° C) Freon -18° F (-28° C)	Helium -452° F (-269° C) Hydrogen -423° F (-253° C) Krypton -244° F (-153° C) Methane -259° F (-162° C) Neon -410° F (-246° C) Nitric oxide -241° F (-152° C) Nitrogen -320° F (-196° C) Oxygen -297° F (-183° C) Propane -44° F (-42° C)
Pressure Range	Vacuum through ASME 900	
Temperature Range	-452° F to 250° F (-269° C to 121° C)	
Materials (All materials used are fully traceable)	316/316L stainless steel ASTM A351 CF3M – casting 316/316L stainless steel ASTM A182 F316L – forging 316/316L stainless steel ASTM A276 or A479 316L – bar Monel® ASTM B164 Brass ASTM B584	
End Connections	Flange Socket weld Butt weld	Extended welded ends Threaded
Specifications	ASME B1.20.1 NPT pipe thread ASME B16.10 Face-to-face dimensions ASME B16.11 Socket-weld ends (diameter and depth) ASME B16.25 Butt-weld ends ASME B16.34 Steel valves (performance and design) ASME B31.3 Process piping (application) ASME B16.5 Pipe flanges and fittings MSS SP25 Valve marking MSS SP61 Pressure testing BS 6364 British standard cryo leak test standard API 607 6th Ed. Fire safe Bechtel 3PC-PV00-F0001 Low-temp. and cryo-service testing Chevron Low-Temp. and Cryo-Service Testing Low-temp. and cryo-service testing	
Operation	OH – Oval handle LH – Lever handle LG – Locking gear operator	AP – Prepared for actuation AI – Actuator installed 90-degrees and 180-degrees rotations
Cryogenic Testing	BSI BS 6364 Bechtel 3PS-PV-F001 Chevron low-temp. and cryo testing	
FE Testing	ISO 15848	

TBV CRYOGENIC BALL VALVES CHART

Model	Size Range in. (mm)	Description	Port		ASME Rating				End Connections					Materials		
			Full Port	Standard Port	150	300	600	900	RF	RTJ	BW	SW	Thread	316LSS/316SS	Monel	Brass
Series 21/11	1/4 to 2 (6 to 50)	Three-piece cryogenic ball valve, floating	•	•			•	•			•	•	•	•	•	•
Series 21/18	1/2 to 12 (15 to 300)	Split-body, two-piece, flanged, standard or full-port cryogenic ball valve, floating	•	•	•	•	•	•	•	•				•	•	•
Series 21/20	1/2 to 8 (15 to 200)	Standard-port, end-entry (unibody), flanged cryogenic ball valve, floating		•	•	•	•		•					•	•	•
Series 21/28	1/2 to 8 (15 to 200)	Full-port, split body, flanged cryogenic ball valve	•		•	•	•		•					•	•	•
Series 21/51	1/2 to 2 (15 to 50)	Three-piece cryogenic diverter ball valve, floating		•			•	•			•	•	•	•	•	•
Series 21/51A	1 to 1-1/2 (25 to 40)	High-flow cryogenic safety-relief valve, floating	Consult Cameron		600 psi								•	•	•	•
Series 21/80	10 to 18 (250 to 450)	Large-bore, split body, cryogenic ball valve, trunnion ball support	•		•	•	•		•					•		



FEATURES

Blowout-Proof One-Piece Stem*

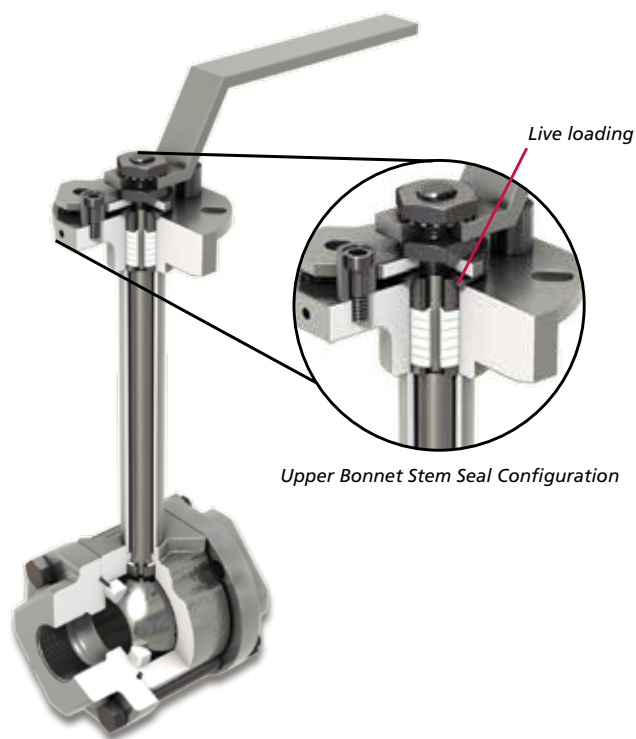
Cameron's TBV line of cryogenic valves utilize a one-piece stem that engages the ball and is secured in the valve cavity with a large, threaded stem collar that is set-screwed for safety.



A retaining ring threads to the bottom of the stem, which resists from blowing out.



Once the retaining ring is threaded to the bottom of the stem, it is set-screwed in place to prevent rotation.



Stem Seal Design

The valve's stem sealing capability is further enhanced by a welded bonnet design and V-ring packing that can be adjusted by a simple turn of the stem nut. The rings of the PTFE V-ring or graphoil packing, which sit on a shoulder machined on the stem. This allows the packing and stem to move as a unit during thermal cycles. In addition, the packing is live-loaded, retained by self-compensating Belleville spring washers, and a packing adjustment nut. These features, coupled with close-tolerance machining and finish of the packing bore, provide long stem seal life with reduced maintenance.

Fire Tested and Certified to API 607

The design includes a fire lip in the innermost diameter of the endplate.



* "Blowout-proof" refers to the stem being retained in the body. This term applies as long as the valve is used within its design parameters.

Cavity Pressure Relief

Cameron offers a variety of options in handling cavity pressure relief. The options listed depend on whether unidirectional or bi-directional flow is required, as well as the type of valve configuration used.

Option 1: Unidirectional Relief, Available on Three-Piece Valves (Center Section with Two End Plates)



This photo shows a slot in the upstream end plate, which provides the cavity pressure relief. The seat sits on the raised-face surface. When the ball is in the closed position, internal cavity pressure is reduced around the OD of the seat, through the slot, and to the upstream pipe.

Option 2: Unidirectional Relief, Available on Flanged Valves (Upstream Relief Hole in Ball)



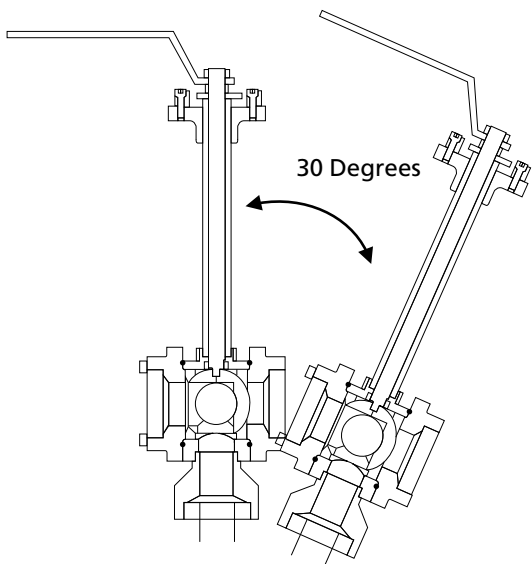
Option 3: Bi-Directional Flow (Cavity Pressure-Relieving Seats)

FEATURES (CONT.)

Flow Direction

When there is flow in a unidirectional valve, flow arrows are positioned on the valve in three areas to illustrate the direction the flow needs to go through the valve. When there is flow, the flow arrow points downstream. Most importantly, when the valve is in the closed position, the ball needs to vent to the high-pressure side. In other words, in the closed position, the cavity needs to relieve to the high-pressure side. It must be determined what the high-pressure side is when closed. For valves that have a vented slot in the upstream endplate (in lieu of a vented ball), that also has to vent to the high-pressure side. The areas that indicate the flow direction include:

- Bottom base of center section
- Top plate of the cryo extension
- Stainless steel tag on body

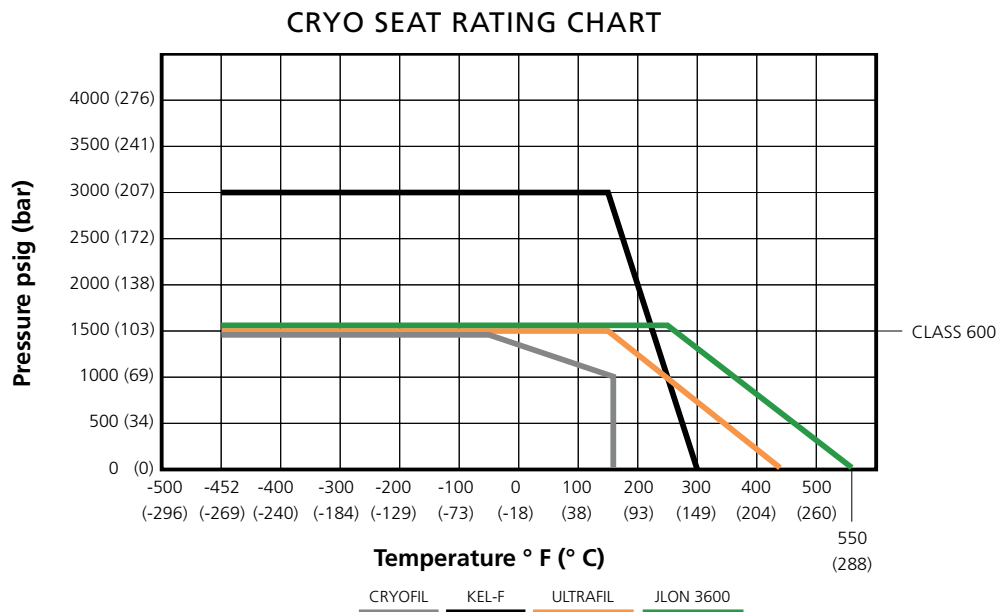


Inclination Limitations

It is recommended that TBV valves be installed with an extended bonnet within 30 degrees of true vertical. Valves with graphite packing can be oriented in any direction.

Seats

TBV valves can use Cryofil, Kel-F®, Ultrafil™, or JLON™ seats, specifically designed to provide industry-accepted leak rates down to -452° F (-269° C).



The valve rating is the lesser of the body rating and the seat rating. Cameron manufactures an extensive line of high-pressure TBV valves capable of the full seat ratings shown. Consult Cameron for details.

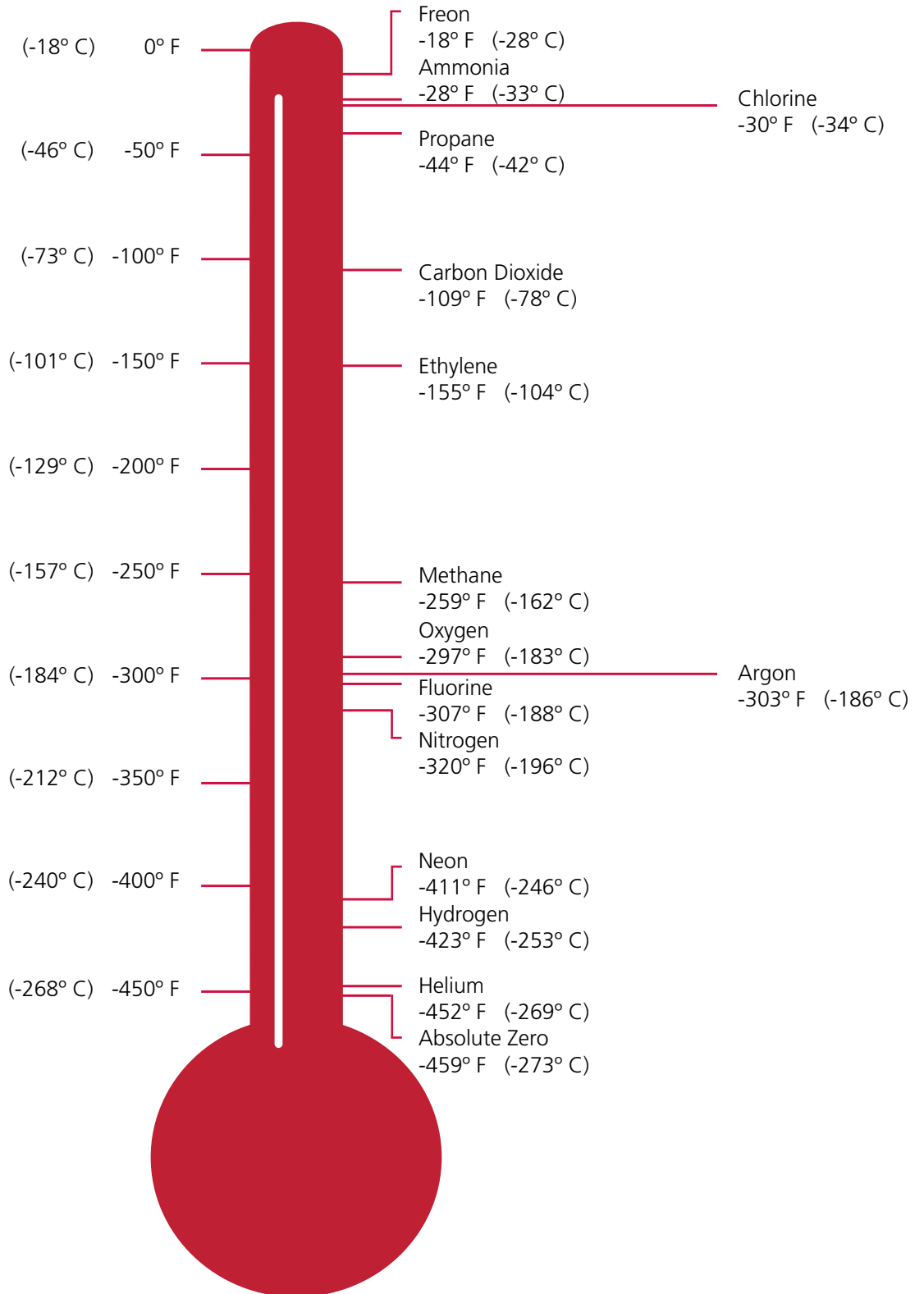
Cleaning Procedures

- In accordance with Praxair® GS 38 specifications
- Clean room environment only
- All components detergent washed and rinsed
- White- and ultraviolet-light visual inspection to detect lint, oils, and greases
- Inaccessible surfaces to be cleaned using wipe method
- All oxygen and cryogenic valves are assembled dry
- Valves are double bagged and sealed in two-ply polyethylene bags



FEATURES (CONT.)

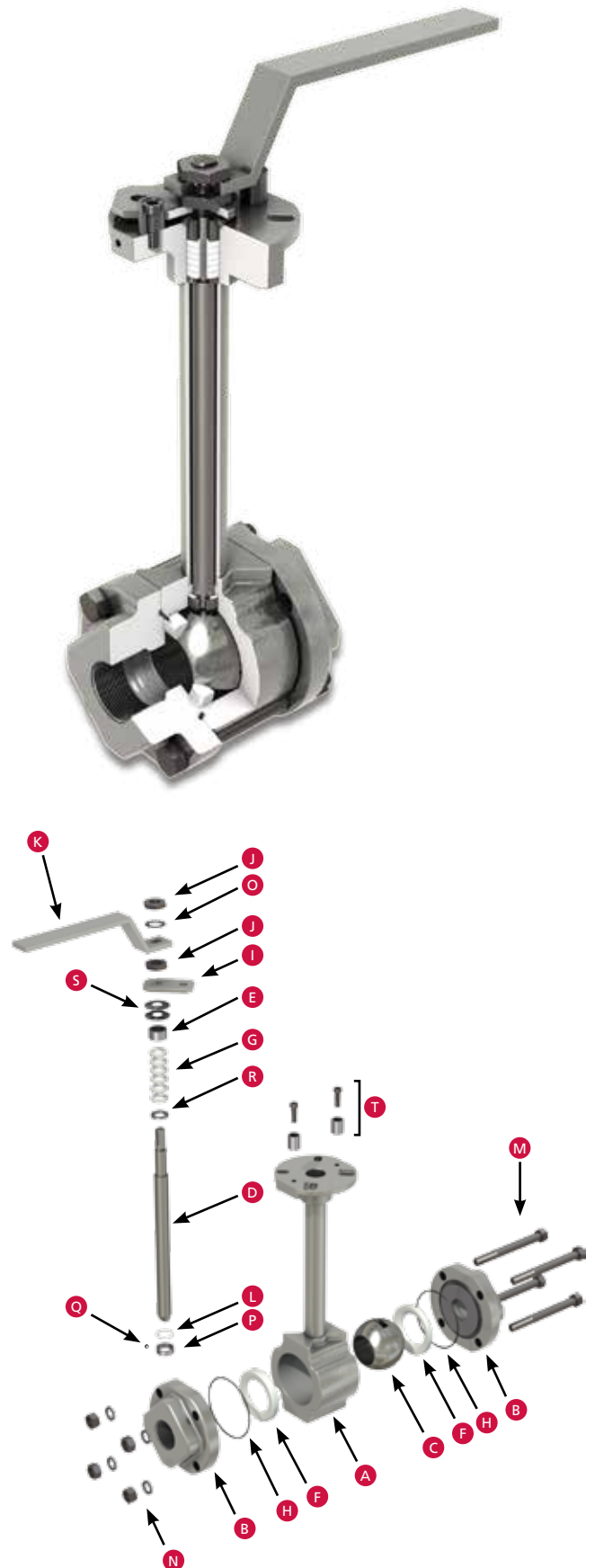
Cryogenic Boiling Points at 1 atm



Series 21/11

THREE-PIECE, CAST AND BARSTOCK CRYOGENIC BALL VALVE

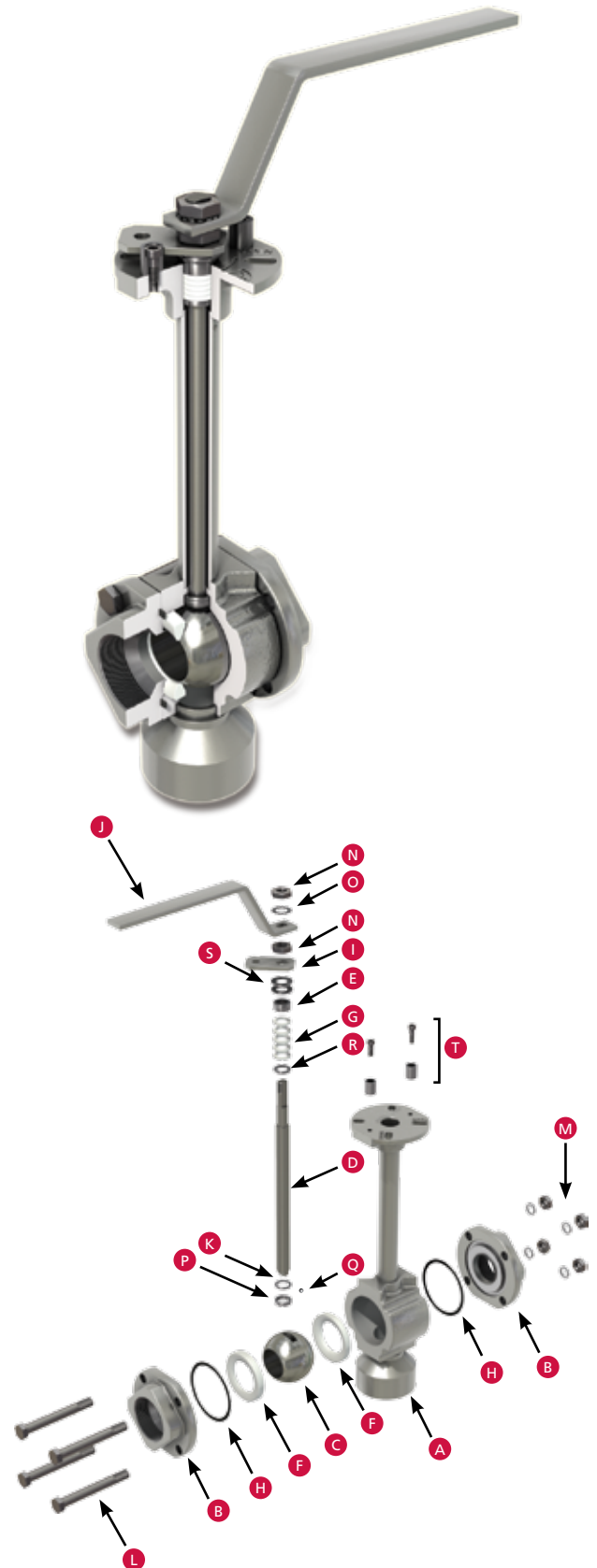
Size Range	1/4" to 2" (6 mm to 50 mm)	
Pressure Range	ASME Classes 150 to 900	
End Connections	Raised-face end plates for positive component alignment and reduction of radial pipe stresses; socket, butt-weld or threaded connections are available	
Standard Cavity Pressure Relief Method	Upstream end plate slot or cavity pressure-relieving seats (for bi-directionality)	
Ball/Seat Configuration	Floating ball	
Body Seal Design	Totally encapsulated body seals to resist cold flow of PTFE; high performance over wide temperature and pressure range; spiral-wound body seals above ASME Class 600	
Casting Type	Investment cast or sand cast; size and pressure class dependent	
Unique Features	Versatile design with numerous end connections available	
Bill of Materials	Part	Item
	Body	A
	End Plates	B
	Ball	C
	Stem	D
	Follower	E
	Seats	F
	Stem Seals	G
	Body Seals	H
	Stop	I
	Stem Nuts	J
	Handle	K
	Thrust Bearing	L
	Body Bolts	M
	Body Nuts with Lock Washers	N
	Lock Washer	O
	Stem Collar	P
	Set Screw for Collar	Q
	Stem Seal Washer	R
	Stem Belleville Springs	S
	Stop Pins/Bolts	T



Series 21/51

THREE-PIECE, DIVERTING CAST AND BARSTOCK CRYOGENIC DIVERTER BALL VALVE

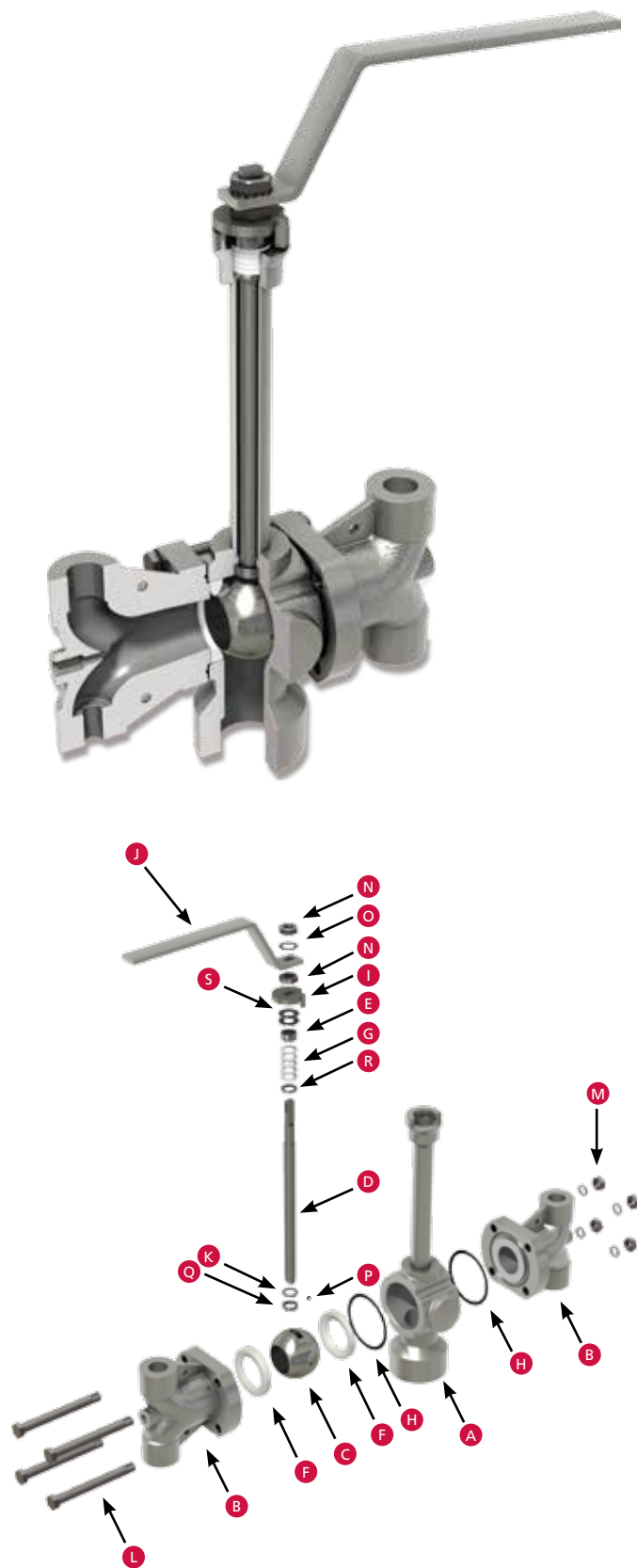
Size Range	1/2" to 2" (15 mm to 50 mm)	
Pressure Range	ASME Classes 150 to 900	
End Connections	Raised-face end plates for positive component alignment and reduction of radial pipe stresses; socket, butt-weld or threaded connections are available	
Standard Cavity Pressure Relief Method	Does not apply because flow is diverted at all times	
Ball/Seat Configuration	Floating ball	
Body Seal Design	Totally encapsulated body seals to resist cold flow of PTFE; high performance over wide temperature and pressure range; spiral-wound body seals ASME Class 600 and above	
Casting Type	Investment cast or sand cast; size and pressure class dependent	
Unique Features	Available in two porting arrangements: 90-degree and 180-degree operation; the 90-degree operation allows flow from a bottom port to be diverted to either of two outlet ports over a 90-degree turn of the handle, but never shutting off; the 180-degree operation also diverts from the bottom port to the outlet ports, but uses a 180-degree turn of the handle, allowing flow to be completely shut off at the 90-degree position	
Bill of Materials	Part	Item
	Body	A
	End Plates	B
	Ball	C
	Stem	D
	Follower	E
	Seats	F
	Stem Seals	G
	Body Seals	H
	Stop	I
	Handle	J
	Thrust Bearing	K
	Body Bolts	L
	Body Nuts with Lock Washers	M
	Stem Nuts	N
	Lock Washer	O
	Stem Collar	P
	Set Screw for Collar	Q
	Stem Seal Washer	R
	Stem Belleville Springs	S
	Stop Pins/Bolts	T



Series 21/51A

THREE-PIECE, HIGH-FLOW DUAL SAFETY RELIEF, CAST CRYOGENIC BALL VALVE

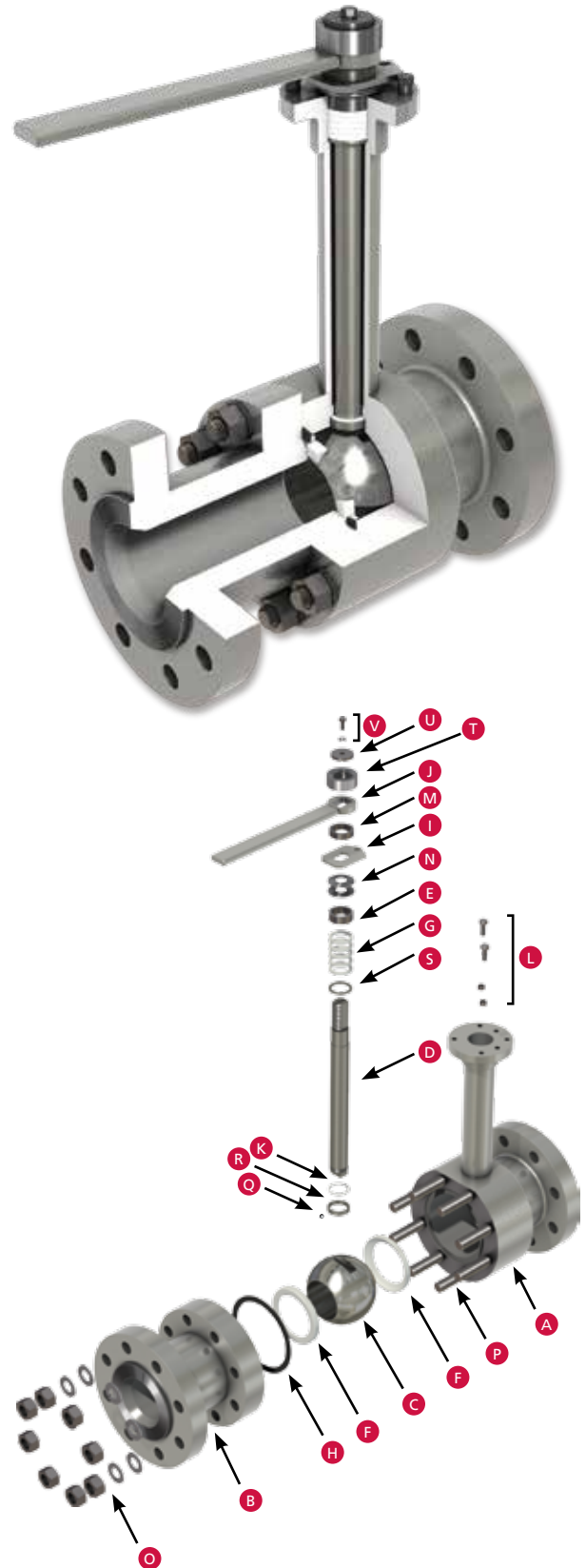
Size Range	1" (25 mm) standard port 1" full port 1-1/2" (40 mm) full port	
Pressure Range	600 psi	
End Connections	Smooth transition, high-flow end plates; male and female threaded connections are available	
Standard Cavity Pressure Relief Method	Symmetrical valve for dual relief; each side has redundant safety relief with both a rupture disc and safety relief valve available	
Ball/Seat Configuration	Floating ball	
Body Seal Design	Totally encapsulated body seals to resist cold flow of PTFE; high performance over wide temperature and pressure range	
Casting Type	Investment body, sand cast ends	
Unique Features	High flow capacity protects vessels from overpressurization; consistent high flow ensures safe operation; tanks are protected even during operation of the valve	
Bill of Materials	Part	Item
	Body	A
	End Plates	B
	Ball	C
	Stem	D
	Follower	E
	Seats	F
	Stem Seals	G
	Body Seals	H
	Stop	I
	Handle	J
	Thrust Bearing	K
	Body Bolts	L
	Body Nuts with Lock Washers	M
	Stem Nuts	N
	Lock Washer	O
	Set Screw for Collar	P
	Stem Collar	Q
	Stem Seal Washer	R
Stem Belleville Springs	S	



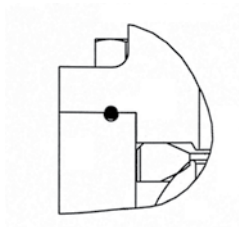
Series 21/18

TWO-PIECE, FULL- AND STANDARD-PORT, SPLIT-BODY,
FORGED OR BARSTOCK CRYOGENIC BALL VALVE

Size Range	1/2" to 12" (15 mm to 300 mm)	
Pressure Range	ASME Classes 150 to 900	
End Connections	Flanged – raised face	
Standard Cavity Pressure Relief Method	Upstream hole in ball or cavity pressure-relieving seats	
Ball/Seat Configuration	Floating ball or trunnion ball support	
Body Seal Design	Totally encapsulated body seals to resist cold flow of PTFE; high performance over wide temperature and pressure range; spiral-wound body seals ASME Classes 600 and above	
Casting Type	Does not apply	
Unique Features	The 21/18 offers unsurpassed reliability with a body machined from solid wrought materials, providing increased strength and virtually eliminating porosity	
Bill of Materials	Part	Item
	Body	A
	End Plates	B
	Ball	C
	Stem	D
	Follower	E
	Seats	F
	Stem Seals	G
	Body Seal	H
	Stop Plate	I
	Handle	J
	Thrust Bearing	K
	Stop Pins/Bolts	L
	Stem Nuts	M
	Stem Belleville Springs	N
	Body Nuts with Lock Washers	O
	Body Studs	P
	Set Screw for Collar	Q
	Stem Collar	R
	Stem Seal Washer	S
	Handle Spacer	T
	Retaining Washer	U
	Handle Retaining Bolt	V



Single Body Seal Design

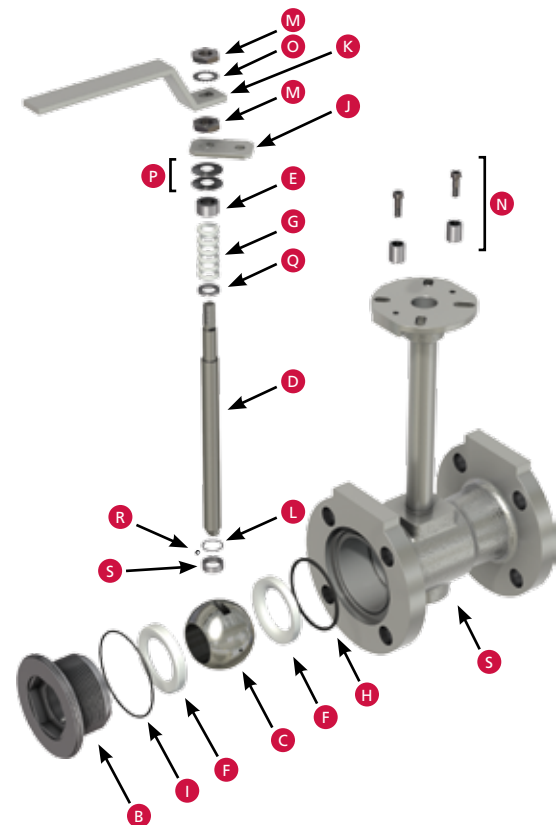
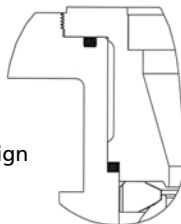


Series 21/20

END-ENTRY, STANDARD-PORT, CAST, FLANGED CRYOGENIC BALL VALVE

Size Range	1/2" to 8" (15 mm to 200 mm)	
Pressure Range	ASME Classes 150 to 600	
End Connections	Flanged – raised face	
Standard Cavity Pressure Relief Method	Upstream hole in ball or cavity pressure-relieving seats	
Ball/Seat Configuration	Floating ball	
Body Seal Design	Totally encapsulated body seals to resist cold flow of PTFE; high performance over wide temperature and pressure range	
Casting Type	Investment cast 1/2" to 3" (15 mm to 75 mm); sand cast 4" (100 mm) and above	
Unique Features	Unibody construction; no external leak paths through valve body; dual body seal design	
Bill of Materials	Part	Item
	Body	A
	End Plug	B
	Ball	C
	Stem	D
	Follower	E
	Seats	F
	Stem Seals	G
	Body Seal – Inner	H
	Body Seal – Outer	I
	Stop Plate	J
	Handle	K
	Thrust Bearing	L
	Stem Nuts	M
	Stop Pins/Bolts	N
	Lock Washer	O
	Stem Belleville Springs	P
	Stem Seal Washer	Q
	Stem Screw for Collar	R
	Stem Collar	S

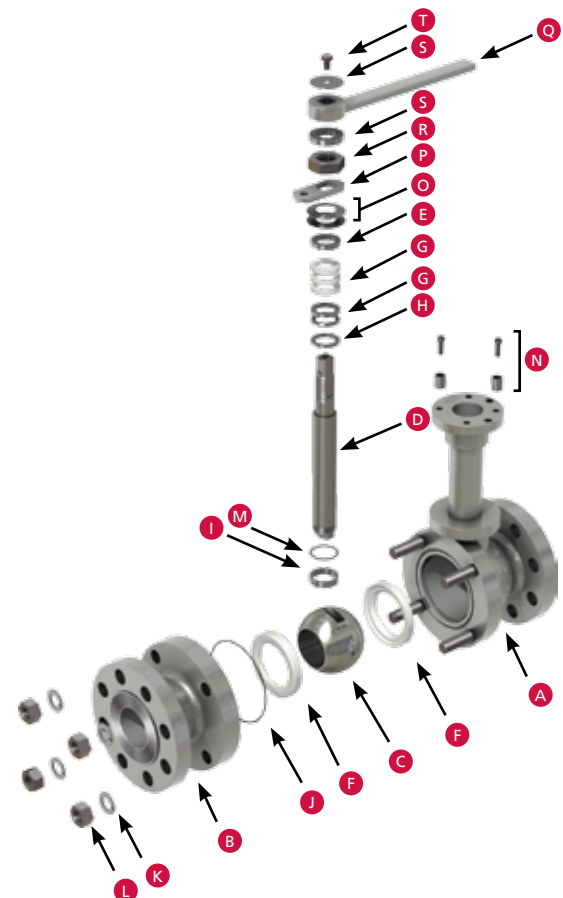
Dual Body Seal Design



Series 21/28

TWO-PIECE, FULL-PORT, SPLIT-BODY, CAST, FLANGED CRYOGENIC BALL VALVE

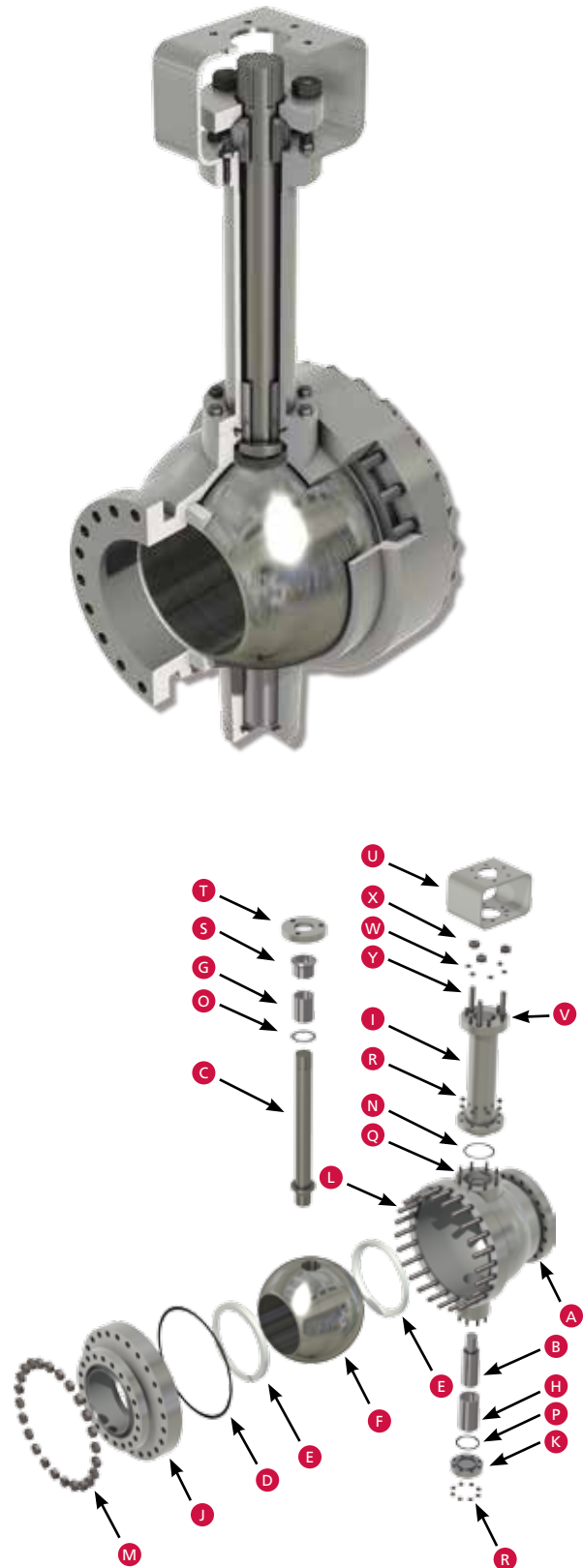
Size Range	1/2" to 8" (15 mm to 200 mm)	
Pressure Range	ASME Classes 150 to 600	
End Connections	Flanged – raised face	
Standard Cavity Pressure Relief Method	Upstream hole in ball or cavity pressure-relieving seats	
Ball/Seat Configuration	Floating ball	
Body Seal Design	Totally encapsulated body seals to resist cold flow of PTFE; high performance over wide temperature and pressure range	
Casting Type	Investment cast 1" to 3" (15 mm to 75 mm); sand cast 4" to 8" (100 mm to 200 mm)	
Unique Features	Now available in ASME Class 600: 3" to 8" (75 mm to 200 mm)	
Bill of Materials	Part	Item
	Body	A
	End Plate	B
	Ball	C
	Stem	D
	Follower	E
	Seats	F
	Stem Seals	G
	Stem Seal Washer	H
	Stem Collar	I
	Body Seal	J
	Body Studs	K
	Body Nuts	L
	Thrust Bearing	M
	Stop Pins/Bolts	N
	Stem Belleville Springs	O
	Stop Plate	P
	Handle	Q
	Handle Spacer	R
	Retaining Washers	S
	Handle Retaining Bolt	T



Series 21/80

TWO-PIECE, FULL-PORT, SPLIT-BODY, CAST, FLANGED CRYOGENIC BALL VALVE

Size Range	10" to 18" (250 mm to 450 mm)	
Pressure Range	ASME Classes 150 to 600	
End Connections	Flanged – raised face	
Standard Cavity Pressure Relief Method	Unidirectional flow with pressure relief upstream	
Ball/Seat Configuration	Trunnion mounted	
Body Seal Design	Spiral-wound gaskets	
Casting Type	Sand cast	
Unique Features	Trunnion mounted design with pressure-activated seats with cavity pressure relief in the ball	
Bill of Materials	Part	Item
	Body	A
	Trunnion	B
	Stem	C
	Body Gasket	D
	Seats	E
	Ball	F
	Upper Bushing	G
	Lower Bushing	H
	Bonnet Assembly	I
	End Flange	J
	Trunnion Flange	K
	Body Studs	L
	Body Nuts	M
	Bonnet Gasket	N
	Thrust Bearing	O
	Trunnion Gasket	P
	Bonnet Studs	Q
	Bonnet Nuts	R
	Follower	S
	Packing Flange	T
	Bracket	U
	Bracket Studs	V
	Bracket Nuts	W
	Packing Flange Nuts	X
	Packing Flange Bolts	Y



CAMSERV™ Aftermarket Services for Valves and Actuation

WE BUILD IT. WE BACK IT.



Global Network and Local Support

Cameron is well-positioned to deliver total aftermarket support, quickly and efficiently, with unmatched OEM expertise. Our highly skilled engineers and technicians are available around the clock, seven days a week, to respond to customer queries, troubleshoot problems, and offer reliable solutions.

Easily Accessible Parts and Spare Valves

- OEM spare valves, actuators, and parts (including non-Cameron brands)
- Handling, storage, packaging, and delivery
- Dedicated stocking program



Comprehensive Aftermarket Services Portfolio

- Parts and spare valves
- Repair
- Field services
- Preventative maintenance
- Equipment testing and diagnostics
- Remanufacturing
- Asset preservation
- Customer property management
- Training and recertification services
- Warranty



Customized Total Valve CareSM (TVC) Programs

Customized asset management plans that optimize uptime, availability, and dedicated services.

- Engineering consultancy
- Site management
- Flange management
- Startup and commissioning
- Spare parts and asset management
- Operational support



Trademark Information

TBV, Ultrafil, and CAMSERV are trademarks are of Cameron.

This document contains references to registered trademarks or product designations that are not owned by Cameron.

Trademark	Owner
Monel	INCO Alloys International, Inc.
Kel-F	3M Company
JLON	Jade Engineered Plastics, Inc.

3250 Briarpark Drive, Suite 300

Houston, TX 77042

USA

Tel 1 281 499 8511

For more information about TBV cryogenic ball valves:

www.c-a-m.com/TBV

TBV@c-a-m.com



HSE Policy Statement

At Cameron, we are committed ethically, financially and personally to a working environment where no one gets hurt and nothing gets harmed.