FCC

Series 10C
Cryogenic Globe Control Valve

Contents

Foreword

Series 10C cryogenic valves use the Body

Numerous valves have been effectively utilized in challenging conditions across various global air separation units and LNG services for many years. These valves have extended plug travels with additional intermediate control points for improved control, and their trim parts are manufactured with meticulous tolerances and clearances based on operating temperatures. They also undergo thorough process control with meticulous inspection and traceability, as well as robust design review, verification, and validation in accordance with the latest specifications and ISO-9001 standards.

They are designed to meet the highest quality standards and undergo stringent quality control measures to ensure their reliability and performance. These valves have been extensively tested and refined to deliver exceptional performance and reliability in critical applications.

They are the result of advanced engineering and manufacturing processes that adhere to industry standards and best practices. They are built to last and deliver reliable performance in the most challenging conditions.

Their robust design, adherence to industry standards and thorough quality control measures make them a dependable choice for critical applications, and you can trust their durability, precision, and control in demanding environments such as Air separation, LNG production and Liquefication, LNG storage and LNG receiving facilities

Model Numbering

Series	Rating	Trim Type	Temperature
10	1 - 150	10 – Contour Unbalanced	4 - Cryogenic
	2 - 300	20 – Micro Spline	
	3 - 600	30 – Cage, Unbalanced*	
		40 – Cage, Balanced*	

*Ported Cage, MHC, Anti-cavitation and Low dB Trims

Engineering Data

Body Style	Globe Straight, Globe Angle
Design Standard	ASME B16.34
Sizes, Pressure rating	1" to 8", ASME Class 150-600
Trim Type	Micro Spline Contoured Ported Cage Multi Hole Cage (MHC) Anti-Cavitation Trim Low dB Trim
Trim Characteristics	Equal Percentage Linear
Flow Co-efficient	Refer Flow Coefficient Table, Consult factory for customized Cv / Trim Characteristics.
Guiding	Top Guided Cage Guided
Seat Leakage	As per ANSI / FCI 70.2 / IEC 60534-4 Standard : Class IV Optional : Class V & VI
Flow Direction	For Anticavitation and Low dB Trims Flow Under is recommended for Low dB Trims Flow Over is reccomended for Anti Cavitation Trims For standard Trims in General service Unbalanced Trims | Flow Under for Contoured, Micro spline, MHC Trims Balanced Trims | Flow Over is standard for MHC and Ported cage Trims
Bonnet Design	Cryogenic (-196°C to -46°C) Option - 1:12" Extension Option - 2: 24" Extension
NACE Conformance	NACE conformance shall be offered for Body, Bonnet & Bolting material when requested
Trim Balancing	Unbalanced 1" to 4", Balanced 1" to 8"
End Connection Styles	Standard Flanged RF as per ASME B16.5 Optional Flanged RTJ as per ASME B16.5, Socket Welding as per ASME B16.11 (0.5" to 2"), Butt welding ends as per ASME B 16.25
Face To Face	Globe Straight: ISA 75.08.01 (Up to 8") Globe Angle: ISA 75.08.08 (Up to 8")
Cleanliness Requirements	General cleanliness for ASU. Cleanliness for O_2 service
Cryogenic Testing	Cryogenic testing shall be performed at -196°C on request
Drip Plate / Cold Box Mounting Plate	Drip plate / cold box mounting plate on bonnet shall be provided on request

Cross Sectional View

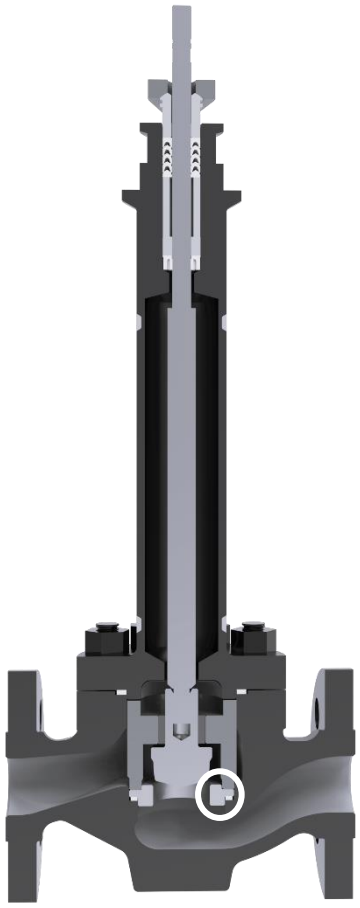


Fig 1: Cryogenic Globe Valve

Soft Seat & Balance Seal

Soft Seat

Soft Seat is recommended for applications where tight shut off is required with minimal actuator force for temperature less than 232°C.

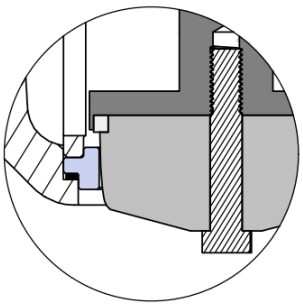


Fig 2a: Soft Seal for Contour Trim

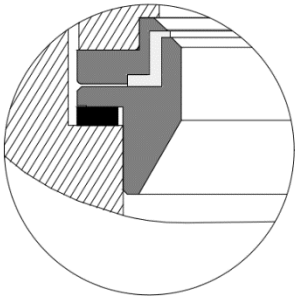


Fig 2b: Soft Seal for Cage guided Trim

Balance Seal

A balance seal is used to arrest the leakage through the clearance between plug and cage.

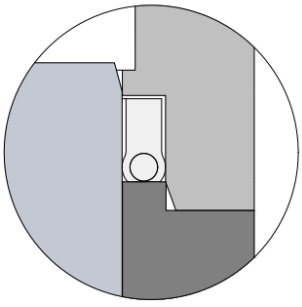


Fig 3: PTFE Balance Seal

Bonnet Designs

Fig 4a :
12” Cryogenic Bonnet

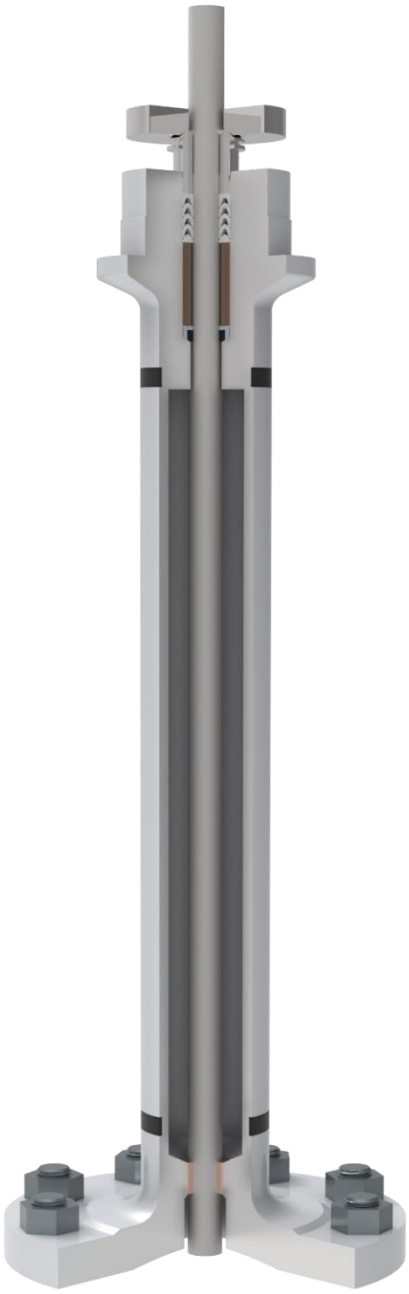


Fig 4b :
24” Cryogenic Bonnet

12” Extension Cryogenic Bonnet

12” Extension Cryogenic bonnets are designed to typically operate in service conditions with temperature ranging from -196°C to 232°C in yard valve application. The length of the extension is sufficient to maintain the stem packing far enough away from the cold area of the valve to prevent freeze- up of the packing.

24” Extension Cryogenic Bonnet

24” Extension Cryogenic bonnets are designed to typically operate in service conditions with temperature ranging from -196°C to 232°C in cold box application. The length of the extension is sufficient to maintain the stem packing far enough away from the cold area of the valve to prevent freeze- up of the packing.

Packing Box Options

Single PTFE

Single PTFE arrangement use positioning springs, this packing arrangement offers very good seal performance with lowest packing friction. This packing set consists of box ring, positioning spring, anti-extrusion rings & set of V-rings.

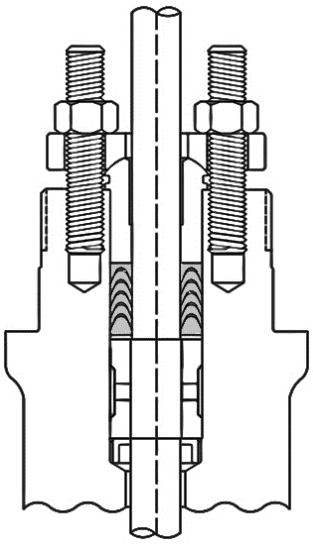


Fig 5a: Single PTFE

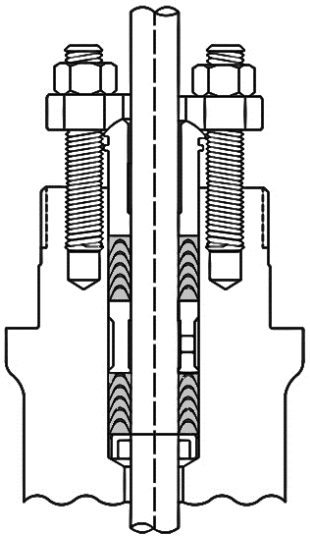


Fig 5b: Double PTFE

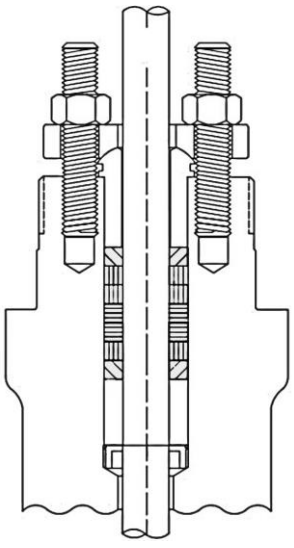


Fig 5c: Graphite

Double PTFE

Double PTFE arrangement is similar to single PTFE arrangement .This consists of two packing sets this gives better performance for controlling leakage.

Graphite

Graphite packing system operate at higher stress levels and have higher friction values for a given level of sealing. It will be withstand with high temperature and pressure.

Trim Designs

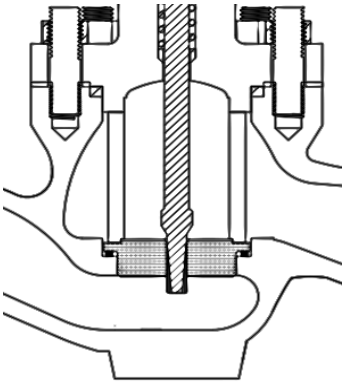


Fig 6a: Micro spline

Micro Spline

Micro splined trims are suitable for very low Cv applications that require precise control. The plug and seat are manufactured as a matched pair. Flow under is preferred.

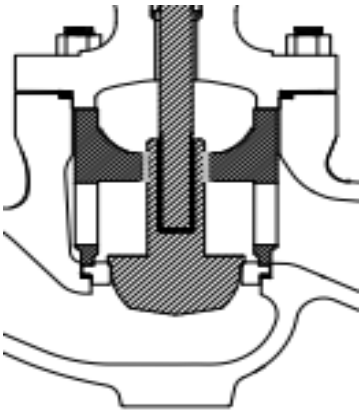


Fig 6b: Contoured

Contoured

Contoured plug with post guiding enables perfect alignment of the trim components. The trim offers wide range of Cv and characteristics. This design is suitable for viscous, dirty fluid and non-lubricating process.

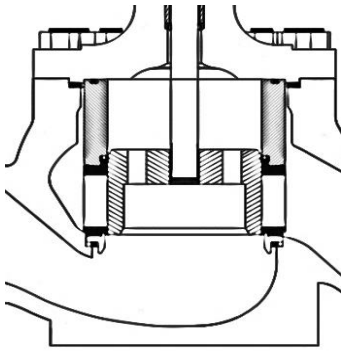


Fig 6c: Ported Cage

Ported Cage

Ported Cages offer massive guiding and high flow capacity even with shorter travels. These Trims are suitable for low pressure drop general service applications. Ported cages are often investment cast and are manufactured from standard stock parts.

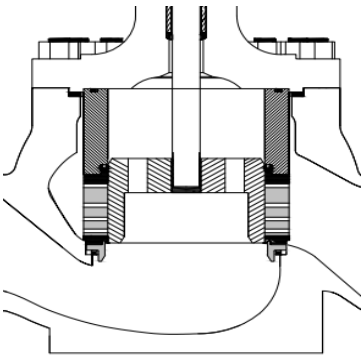


Fig 6d: Multi Hole Cage

Multi Hole Cage

Single and multiple heavy section 'drilled hole' cage design offers low pressure recovery that reduce the potential for excessive noise, cavitation, vibration and erosion. The MHC trim range has been designed to operate on all fluid combinations, both clean and dirty service.

The MHC range of trims are preferred choice for medium to relatively high pressure drop applications. Also, MHC trims are easily available in various special material combinations.

Cavitation Service

Anti-Cavitation Trim

To eliminate cavitation the static pressure of the fluid shall be maintained above the vapour pressure. In high pressure drop applications, it is necessary to drop the pressure in multiple stages to keep the static pressure of the fluid above the vapour pressure of the fluid.

This design uses either Single cage or Multiple-concentric cages with many small drilled holes to achieve staged pressure drop. Numerous small holes and colliding flow jets at the cage's core result in achieving a low recovery trim that will eliminate cavitation.

Follow the equation below & select suitable Trim
Ki > pressure drop / (P1-Pv)

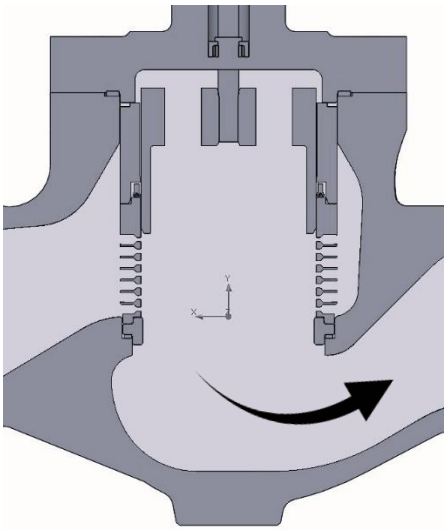


Fig 7: Anti-Cavitation Trim

Cavitation Index, Ki for Anti-Cavitation Trim

No of Pressure reduction stages	Valve Size (inch)	Pressure Drop (psid)	Cavitation Index
1-stage	1- 2	< 600	1
	1- 2	600 to 1440	FI^2
	3 - 6	< 500	1
	3 - 6	500 to 1440	FI^2
	8	< 400	1
	8	400 to 1440	FI^2
2-stage	1 - 2	< 2160	1
	3 - 6	< 1800	1
	3 - 6	1800 to 2160	FI^2
	8	< 1200	1
	8	1200 - 2160	FI^2
Microspline, Anti Cav-2	1 - 2	< 2160	1
Microspline, Anti Cav-2	1 - 2	< 3000	1

Noise Service

Low dB Trim

Low dB trim combines the fact that the noise generated in standard trim designs fall in audible range with the fact that flow through small holes shifts the frequency beyond audible frequencies. Selection of suitable hole configuration (hole size, hole profile and the distance between the holes) based on dp/P1 is vital for efficient performance.

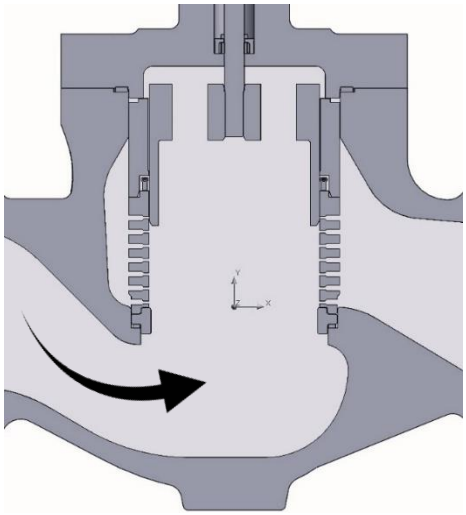


Fig 8: Low dB Trim

Pressure drop ratio ((P1-P2) / P1)	Cage Hole Configuration
0.6	A1, A3
0.75	B1, B3
0.85	C1, C3
0.99	D1, D3

The pipeline velocity and valve outlet velocity shall be limited to 0.3 Mach maximum. Use of baffles and diffusers shall be considered to decrease the valve outlet velocity to the desired level.

Material Specifications & Temperature Limits for Body-Bonnets

Body, Bonnet Materials	NACE MR0175 / 0103	Stud, Nut Material	Balance seal (Note 1)
CF3M & CF8M	NA	B8M / 8M st.hardened	PTFE Seal
	Yes	B8M / 8MA Annealed	PTFE Seal

Note:
1. Temperature limits -196°C to 232°C
2. Cryo Bonnets shall be fabricated from cast, forge and pipe of stainless steel grade materials based on manufacturing feasibility and availability of materials

Material Specifications & Temperature Limits for Trim Parts

Trim Type	Trim No	Plug	Clamp / Cage	Seat Ring (Metal Seat)	Guide bush	Stem	Temperature °C	
							min	max
Micro spline (1-2")	104(1)	316 + CoCr-A Tip	316	316 + CoCr-A (S&G)	-	316	-	232
Contoured (1-4")	206	316	316	316	316 +CoCr-A	316	-	232
	207	316 + CoCr-A	316	316 + CoCr-A	316 +CoCr-A	316	-	232
Cage Guided (1-8")	310	316	316 Cr Plated	316	-	316	-	232
	311	316 + CoCr-A	316 Cr Plated	316 + CoCr-A	-	316	-	232
	312	316 + CoCr-A S&G	316	316 + CoCr-A	-	316	-	232

Note:
1. Plug is guided by the seat bore.
2. Optional PTFE soft seat is available in various Trim combinations, consult factory more details.
3. For other materials consult factory

Soft Parts List

Item	Standard
Gasket	316L spiral wound gaskets w/ graphite filler
Packing Spacer	316
Packing Rings	PTFE, Carbon filled PTFE, High density PTFE
Gland Follower	CF8M
Gland Flange	SS316 hard faced CoCr- A

Note:
1.All soft parts are available with BAM certification on request
2..Temperature limits -196°C to 232°C.

Flow Coefficients

Micro Spline Trim

Valve Size (inch)	Seat Bore (inch)	Travel (inch)	Flow Direction	Cv, Eq %
1/2 to 2	1/4	3/4	Under	1.08
1/2 to 2	1/4	3/4	Under	0.351
1/2 to 2	3/16	3/4	Under	0.177
1/2 to 2	3/16	3/4	Under	0.073

Contoured Trim

Valve Size (inch)	Seat Bore (inch)	Travel (inch)	Flow Direction	Cv, Eq %	Cv, Lin
1	1	3/4	Under	13.1	13.2
1	3/4	3/4	Under	8.79	-
1	1/2	3/4	Under	4.96	-
1	3/8	3/4	Under	3.05	-
1 1/2	1 1/2	3/4	Under	27.8	30.8
1 1/2	1	3/4	Under	16.9	16.4
1 1/2	3/4	3/4	Under	9.98	-
1 1/2	1/2	3/4	Under	5.21	-
1 1/2	3/8	3/4	Under	3.15	-
2	2	1 1/8	Under	53.6	51.8
2	1	3/4	Under	16.2	14.8
2	3/4	3/4	Under	9.98	-
2	1/2	3/4	Under	5.21	-
2	3/8	3/4	Under	3.15	-
3	3	1 1/2	Under	109	110
3	2	1 1/8	Under	71.8	81.2
4	4	2	Under	192	210
4	2	1 1/8	Under	71.9	85.2

Flow Coefficients

Ported cage, MHC (1CC)

Valve Size (inch)	Seat Bore (inch)	Travel (inch)	Flow Direction	Ported Cage		MHC -1	
				Cv, Eq %	Cv, Lin	Cv, Eq %	Cv, Lin
1	1 13/64	3/4	Over	15.8	17.2	12.0	13.8
1 1/2	1 7/8	3/4	Over	36.2	39.5	29.0	31.6
1 1/2	1 5/16	3/4	Over	22.7	28.7	18.2	23.0
2	2 5/32	1 1/8	Over	55.1	65.5	44.0	52.4
2	1 5/16	3/4	Over	23.8	32.2	19.0	25.8
3	3 7/32	1 1/2	Over	137	149	110	119
3	2 5/16	1 1/8	Over	70.4	103	56.3	82.4
4	4 5/32	2	Over	219	229	175	183
4	2 7/8	1 1/2	Over	110	109	88.0	87.2
6	7	2	Over	395	428	316	342
6	4 5/32	2	Over	257	303	205	242
8	8	3 3/8	Over	850	875	738	751
8	8	2 1/2	Over	692	767	589	651

Anti-Cavitation Trim for Liquids

Valve Size (inch)	Flow Direction	1-Stage			2-Stage		
		Seat Bore (inch)	Travel (inch)	Cv	Seat Bore (inch)	Travel (inch)	Cv
1	Over	1 13/64	1	13.6	1	1	5.8
1 1/2	Over	1 7/8	7/8	22.5	1 5/16	7/8	6.3
2	Over	2 5/32	1 1/4	33.8	1 7/8	1 1/4	14.4
3	Over	3 7/32	1 5/8	79.5	2 7/8	1 5/8	26.5
4	Over	4 3/8	2 1/8	141	2 7/8	2 1/8	43.2
6	Over	7	2 1/4	259	5 3/8	2 1/4	90
8	Over	8	3 3/8	457	7	3 3/8	149

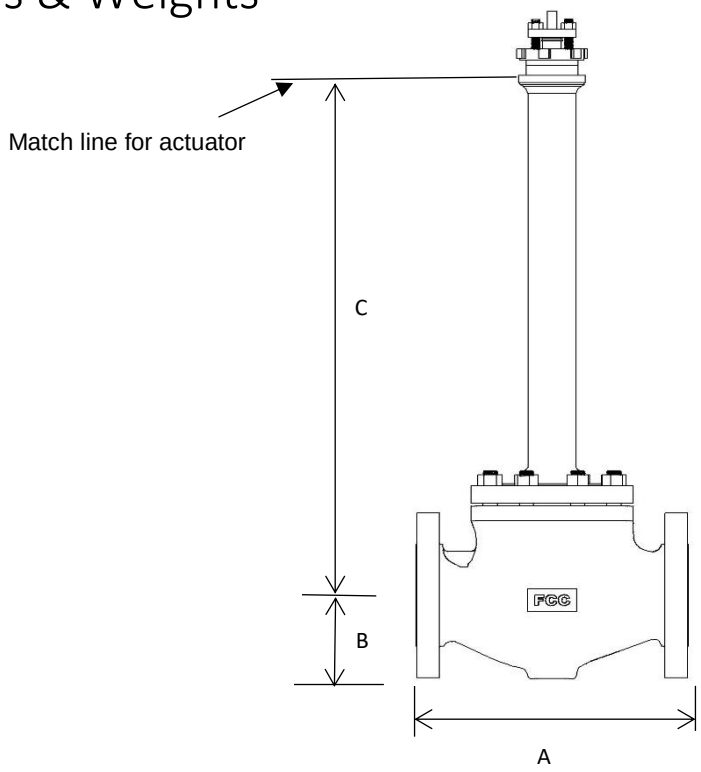
Flow Coefficients

Low dB Trim for Gases

Valve size (inch)	Seat bore (inch)	Travel (inch)	Flow direction	A1	A3	B1	B3	C1	C3
1	1 13/64	1	Under	18.6	-	-	-	-	-
1 1/2	1 7/8	7/8	Under	30.1	-	-	-	-	-
1 1/2	1 5/16	7/8	Under	-	25.2	20.1	14.6	-	-
1 1/2	3/4	7/8	Under	-	-	-	-	5.92	6.64
2	2 5/32	1 1/4	Under	43	-	-	-	-	-
2	1 5/16	1 1/4	Under	-	29.3	24.4	19.5	14.2	14
3	3 7/32	1 1/2	Under	93.1	-	-	-	-	-
3	2 5/16	1 1/2	Under	-	88.9	67.1	74.4	45.1	44.7
4	4 3/8	2	Under	156	-	-	-	-	-
4	3 7/16	2	Under	-	138	110	99.4	75.9	73.3
6	7	2	Under	285	-	-	-	-	-
6	5 3/8	2 1/4	Under	222	225	182	174	96	107
8	8	2 1/2	Under	357	-	-	-	-	-
8	8	3 3/8	Under	567	570	367	364	248	229

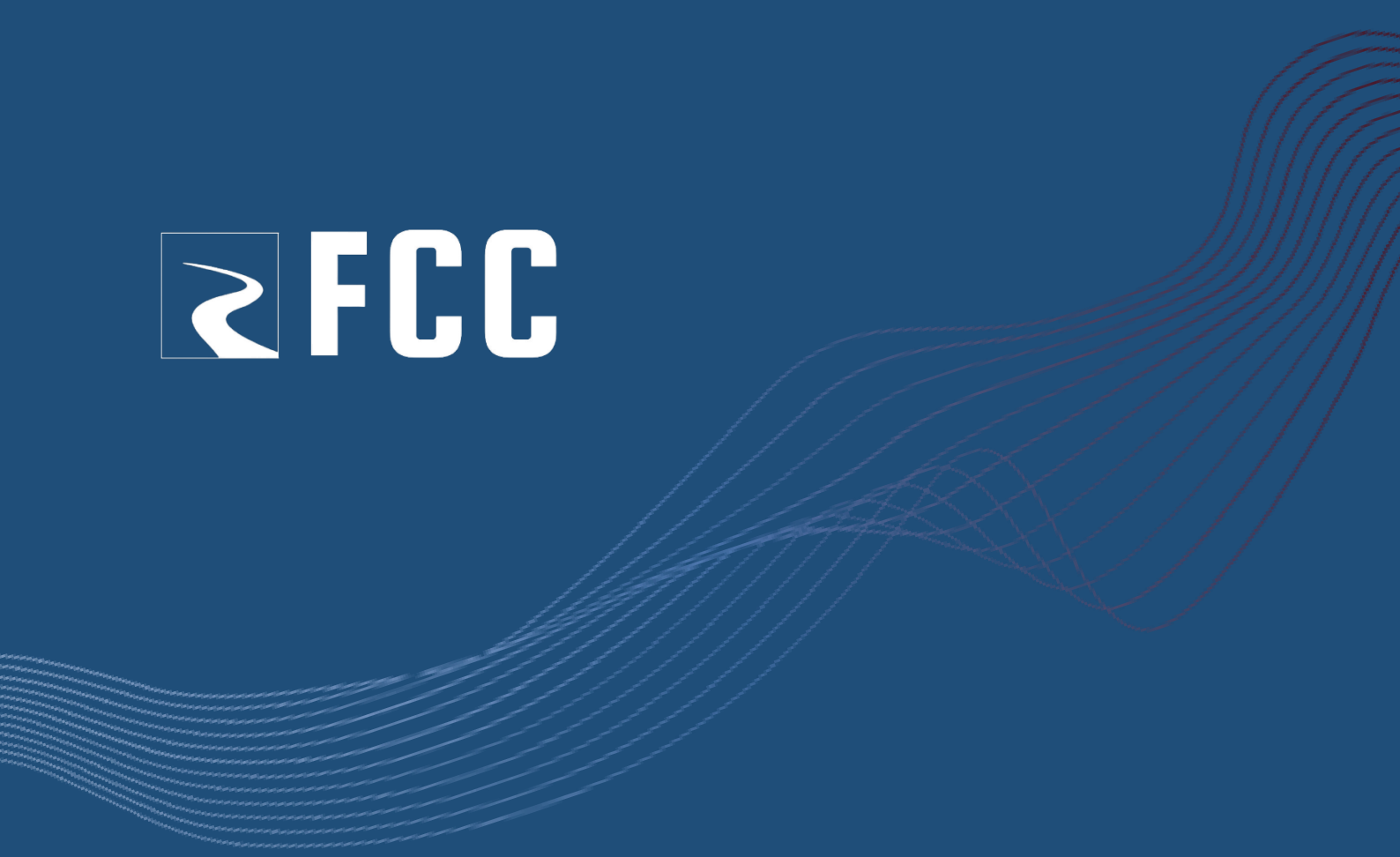
Note: Here 1st Digit A indicate the distance between the holes. And 2nd Digit here indicate the hole size (or) diameter.

Dimensions & Weights



Valve Size (inch)	Stem Dia	A (mm)			B (mm)		C[1] (mm)	Weight (kg)	
		150#	300#	600#	150-300#	600#		150-300#	600#
1	3/8	184	197	210	60		739	20	22
1	1/2	184	197	210	60		762		
1 1/2	3/8	222	235	251	71		735	27	29
1 1/2	1/2	222	235	251	71		754		
2	1/2	254	267	286	78		778	43	45
2	3/4	254	267	286	78		772		
3	1/2	298	317	337	97		805	72	75
3	3/4	298	317	337	97		802		
4	1/2	353	368	394	129		836	88	90
4	3/4	353	368	394	129		829		
6	3/4	451	473	508	162		865	186	192
6	1	451	473	508	162		878		
6[2]	3/4	451	473	508	162		920		
6[2]	1	451	473	508	162		985		
8	3/4	543	568	610	191		989	496	500
8	1	543	568	610	191		1040		

For non-standard sizes consult factory
Note 1: Applicable only for 12" Ext bonnet
Note 2: Only for Low noise trim
Note 3: Dimension C of 24" Ext bonnet = 12" + Dimension C of 12" Ext bonnet
Note 4: The Dim 'A' is for RF & FF, for RTJ the 'X' factor from ASME B16.10 shall be added.



Factory Address

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