

# WILLIS

Multiple Orifice Valve (MOV) chokes





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# WILLIS MOV Chokes

## Greater control through technology

Cameron Multiple Orifice Valves (MOV) together with four special trim designs are examples of the many ways the company has solved customer problems throughout the years. In addition, this broad product range exemplifies the many ways Cameron is committed to the application of state-of-the-art technology to control production costs.

Research on materials also has helped Cameron control the effects of cavitation, erosion, and freezing, three of the greatest threats to efficient flow control operations. This research provides an extensive database where we can select the proper materials and alloys for specific choke applications. Continuing investigations to determine the relative erosion, abrasion, and cavitation resistance characteristic of materials allows Cameron to develop improved choke technologies for enhanced durability and wear resistance.

The effects of abrasion, erosion, and cavitation can be reduced by applying hardfacing to the interior surfaces of the choke outlet or by using an extended wear sleeve in the outlet.

Our research has shown that specific grades of tungsten carbide are effective at reducing erosion wear, while Stellite<sup>5</sup> is most resistant to the destructive consequences of cavitation.

Combined with the proper disc design and valve/orifice sizing, we can help you greatly prolong the wear life of the valve.

## Sizing

At Cameron, our many years of experience tells us that paying close attention to the correct choke sizing is the first and foremost means of avoiding problems later on.

That is why we place a special emphasis on making sure your MOV choke is sized correctly for your particular application.

Getting it wrong has implications on controllability, maximum flow capacity, erosion, and the service life of your equipment.

Using the Cameron choke sizing program with our experience in a diverse range of applications, we're there to help when it comes to choke sizing and selection.



*In addition to testing chokes over a wide range of pressures, Cameron measures flow rates and noise in a flow loop per ISA specifications.*



*Cameron has an extensive erosion test facility with specially designed equipment yielding high differential pressure capabilities, as well as variable abrasive content flow.*



*MOV Chokes are available in various configurations and include a range of actuator options.*

# Styles

Our MOV chokes are classified into four basic styles depending upon the kind of service needed:

## 1. Style 0—standard service

Standard service valves are the lowest cost choke styles. They generally are intended for sweet crude oil, deaerated water, sweet natural gas, and other non-corrosive fluids.

## 2. Style 8—sour service

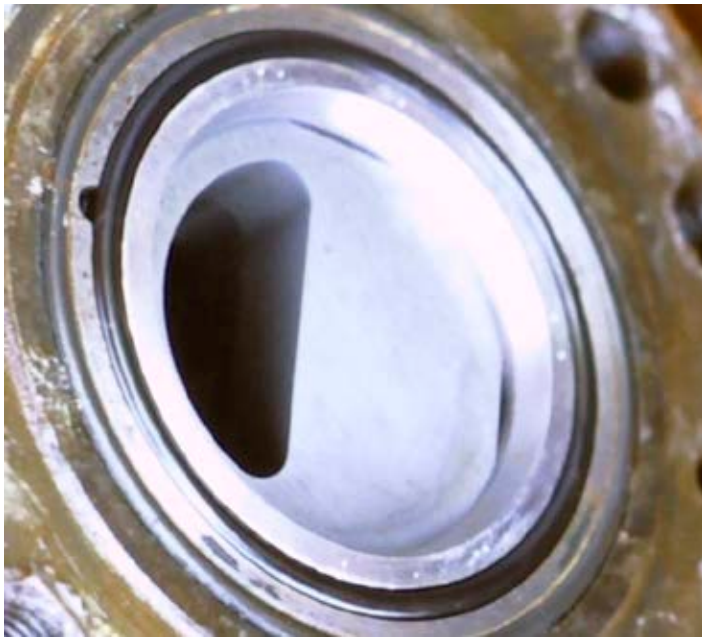
In addition to the requirements of the standard valve type, the materials of the pressure containing parts of this style meet the requirements of NACE MR-01-75. Sour service chokes are intended for applications with H<sub>2</sub>S present as defined by NACE MR-01-75 requirements.

## 3. Style 4—wet CO<sub>2</sub> service

This type of choke is intended for applications and service with wet CO<sub>2</sub> (sweet or sour) and other applications where 410 or 316 SS is accepted. All wetted pressure-containing parts are made of stainless steel.

## 4. Style C—low temperature/sour service

In addition to the requirements of standard and sour gas service chokes, the requirements of API 6A specifications are met. This adds Charpy impact testing of materials for pressure containing parts. These valves are intended for cold -50 degF [-46 degC] flow and/or ambient conditions, with or without sour service.



MOV drilling trim

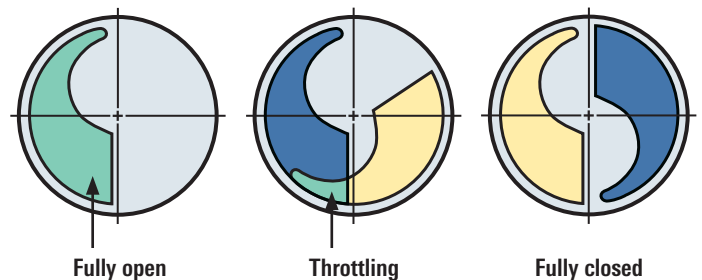


## Trim solutions for every job

The purpose of the MOV is to provide accurate, calibrated flow control, and increased choke service life in all applications, including erosive conditions. Toward that goal, new disc designs have been required to meet new and greater demands of better rangeability, higher capacity, and increasingly severe conditions. These new disc designs involve altering the normally round orifice shapes on the discs to adapt them for special conditions.

### Extended range trim

As an example, in a water injection application on the Alaska North Slope, an oil company required a large valve that could control flow in the same manner as a small valve. A special trim was designed with spiral-shaped holes. This unusually high-rangeability trim solved the problem and joined the Cameron MOV line as our extended range trim.



### Pie-shaped trim

To tackle the problem of increasing flow capacity without increasing choke body size, Cameron introduced the pie-shaped trim. By enlarging the holes to resemble a slice of pie, this trim increases flow volume ( $C_v$ ) while reducing nominal body size. This reduces costs normally incurred by using a larger nominal body.

### Drilling choke trim

Drilling conditions call for another special type of MOV trim. With practically every drilling job, large cuttings come up the casing with the mud. The cuttings can block the throttling restriction in many chokes. However, our drilling choke trim is specially designed for mud service. Utilizing a half-moon shaped hole, the drilling choke trim rotates through a control range from fully open to fully closed in 180 degrees. This design delivers control so reliable that the drilling choke outperforms other designs for well killing and pressure control, especially in severe service involving H<sub>2</sub>S, abrasive fluids, and high pressures.

# Multiple Orifice Valves—Multiple Solutions

## Operation and features

For more than six decades, the Cameron MOV choke has set the standard for precision flow control in a wide variety of applications all over the world. As one of the Cameron four main choke technologies, which includes needle and seat chokes, control chokes, and multistage chokes, the MOV choke is recognized for its proven durability and precise flow control.

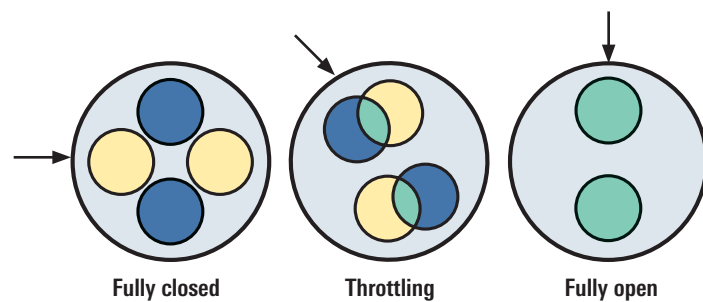
The term multiple orifice refers to the exclusive design of the MOV, which utilizes a set of adjacent discs, each containing a pair of circular openings or orifices. Other shapes can be used for custom applications. The two discs are diamond lapped on the mating surfaces to tolerances near two light bands of flatness. This allows for complete shutoff over a prolonged period and precise flow rate control throughout the service life of the equipment. In fact, most MOV chokes meet the requirements of ANSI B104 Class IV shutoff as standard.

As one disc is rotated with respect to the other, the flow area is enlarged from closed to fully open, affecting a change in the flowing volume of liquid and/or gas passing through the choke. Differential pressures across the discs hold them together. There are no loose or unsupported parts to cause vibration, noise, or fatigue failures. The exposed portion of the disc's surface is wiped clean of foreign deposits each time the valve is rotated. Rotational trim movement also reduces problems associated with asphaltenes. These types of fluids tend to solidify on linear motion trims, limiting throttling capabilities.

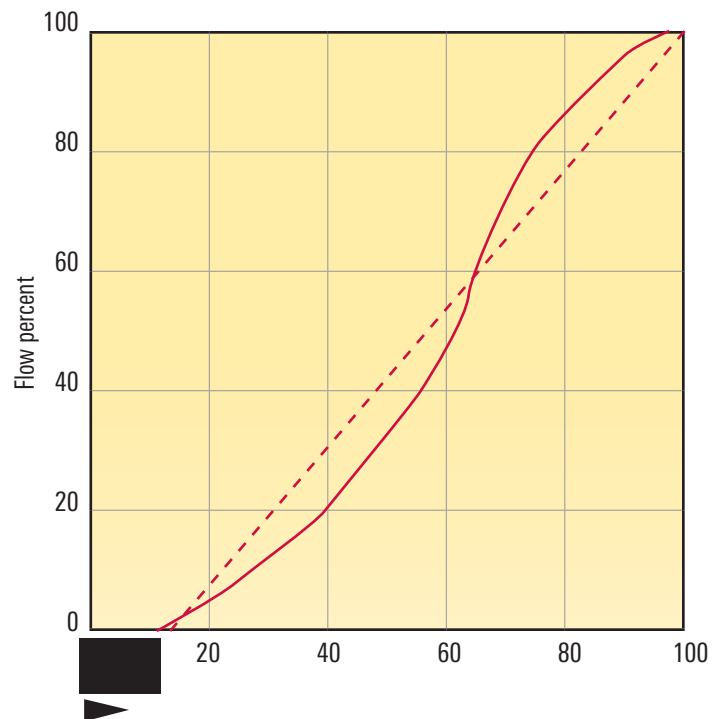
The circular shape of the MOV's standard flow disc offers a smaller wearing surface. Also, there is no interfacing shape in the center of the flow area. The net result is less wear on the throttling and shut-off area and a more accurate, calibrated flow rate which means an extended service life with little downtime for maintenance.

The MOV's design has another benefit, this time adding to its service life: a second set of orifice wearing edges are available by simply rotating the discs in the opposite direction. Standard MOV discs are made from tungsten carbide, which is proven to give enhanced durability and erosion resistance, even in high pressure drop and severe service conditions.

Due to the simplicity in design, there are minimal wear components to be replaced when the choke must be serviced, resulting in ease of field maintenance, less downtime, and reduced operational costs.



The arrows below indicate the relative position of the front discs.



Dead band shut-off area provided by the front disc overlapping the back disc holes.



## Applications

The Cameron MOV line covers 1- to 6-in [25- to 152-mm] sizes that can handle pressures up to 10,000 psi while operating at temperatures ranging from -50 to 650 degF [-46 to 343 degC]. They are manufactured to meet API, ANSI, and NACE standards.

MOVs are available in both adjustable and positive configurations, as well as angled and in-line body configurations, with a variety of end connections to meet most requirements.

The near-linear flow characteristics of the MOV make it well-suited for production choke applications including:

### Wellhead

Attached to the wing valve on the Christmas tree, and provides great control for oil and gas production.

### Manifold

Used to maintain pressures and control flow rates in oil or gas production systems, and for pressure control in choke and kill manifolds.

### Separator letdown

Used as a quick open/quick close quarter-turn valve to maintain levels in separators.

### Heater bypass

Used on a secondary bypass loop to reduce and control gas pressure.

### Water flood

Used to control injection rates for pressure maintenance and enhanced oil recovery (EOR).

### CO<sub>2</sub>

Provides accurate injection control for EOR with great resistance to freeze up.

### Gas lift

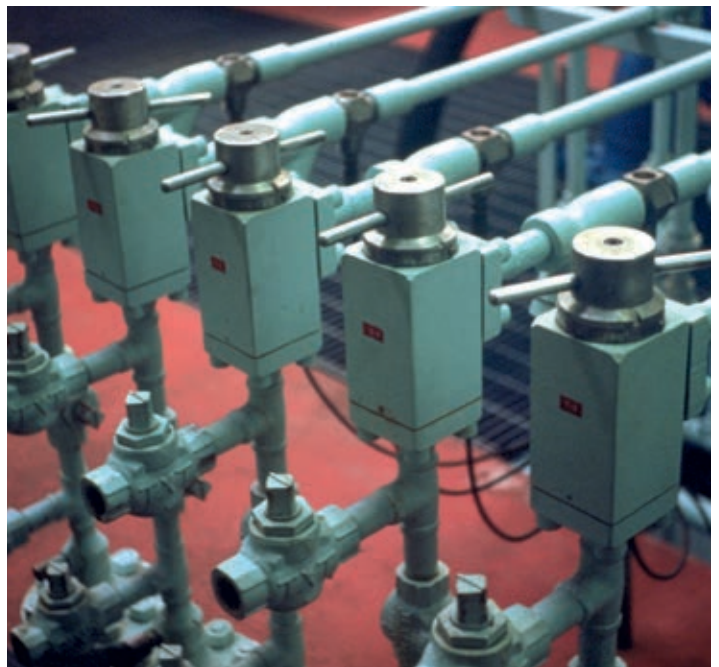
Used to maintain pressures and control gas injection rates in a well to aid in oil production.



*The first Cameron subsea choke supplied in 1975, installed in the Gulf of Mexico.*



*MOV chokes within a offshore platform installation.*



*MOV angled chokes manually operated.*



*MOV inline/axial choke electrically actuated.*

# Actuation

The actuation of MOVs can take many forms, including:

- Manual bar handles
- Handwheel gear operator
- Linear pneumatic actuator
- Linear hydraulic actuator
- Electric actuation
- Stepping actuator

Any MOV can be actuated, and field conversion from manual to actuated is possible on most models.

## Pneumatic actuators

Pneumatic actuators are applicable to all of Cameron MOV choke models. They are especially effective for economical, automated control of the M2 and larger choke valves. Accessories such as positioners, limit switches, filter regulators, local pressure controllers, solenoid valves, and more are available with pneumatic actuators.

Selecting the most economical size of actuator is determined primarily by the turning torque required to effectively operate the choke. Diaphragm actuators are preferred on many applications as they are more economical than piston types, and they require only 35-psi line pressure to operate. Piston actuators are required if the torque is in excess of, or near, the maximum capabilities of the diaphragm actuators.

A Cameron representative can assist you in the selection of the proper pneumatic actuator for the specified MOV application. Cameron MOV chokes are easily adapted to pneumatic actuation using ruggedly-constructed actuator adapters.

## Electric actuators

Electric actuators are most popular for applications on smaller MOV chokes such as the MC10, M1A, and M2. These chokes are designed with actuation in mind and provide for an extremely compact and simple installation.

Electrically-actuated MOV chokes are especially applicable to field automated production installations using closed-loop computer control systems. Specific advantages include:

- Control capability over a wide range of flow rates
- The capability of electronically controlled positioning
- Near-linear increasing flow rates with increasing valve opening
- Dynamic stability at all pressure drop and flow-rate conditions.  
Availability of valve trim to allow for different ranges of flow rates, while using the same actuator, valve body, and control software system
- Low energy and torque requirements

Selection of electric actuators is primarily determined by the choke turning torque required and the specific control feedback and environmental considerations of the installation. Cameron electrically-actuated MOV choke valves can be provided with adjustable travel stops, a potentiometer for remote valve position readout, electronic speed control, weather-proof and explosion-proof housings, and a manual override.



*Pneumatic diaphragm actuated MOV choke.*



*Electrically-actuated inline MOV choke.*



## Stepping actuators

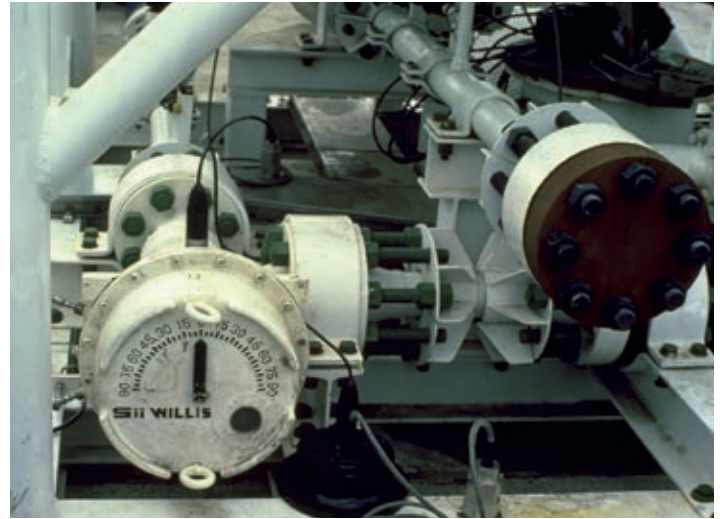
The S-15,000 stepping actuator is designed to open and/or close MOV chokes in precise one-degree increments. The capabilities of this heavy-duty actuator make it particularly applicable to M3, M3G, M4, and M6 MOVs choke.

The S-15,000 draws its name from the amount of torque it delivers, 15,000 in-lb, and is designed to work with either 100 psi pneumatic or 1,000 to 3,000 psi hydraulic fluid supply. The proven design features of the S-15,000 make it one of the top actuators for remote and automated control for locations on land, offshore, or subsea. The S-15,000 operates at temperatures from  $-30$  to  $180$  degF [ $-34$  to  $82$  degC] in a watertight, marine corrosion-resistant enclosure. In subsea applications, the unit has been tested and rated to operate at depths of 4,000 ft.

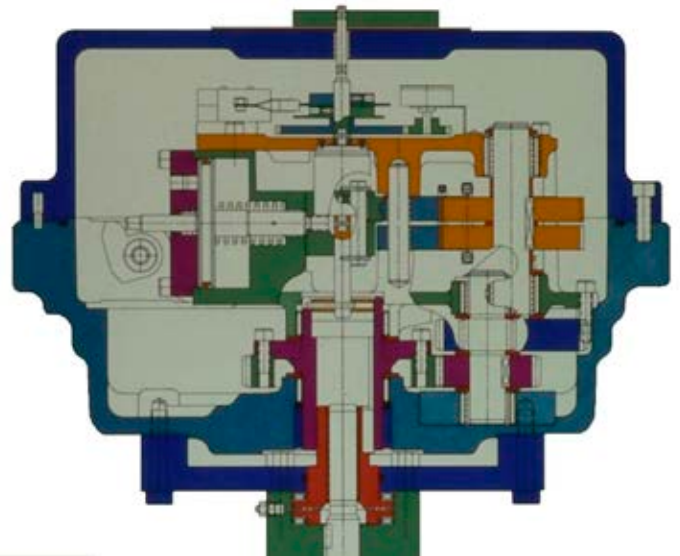
For remote readings of the choke's position, there is a standard 5,000-ohm potentiometer which can be used with a transmitter to provide a feedback signal in milliamps.

External position indicators on surface models of the S-15,000 can read percent open, degrees rotated, or bean size for a quick visual reference of MOV position at any given time. The S-15,000 has been tested through 1,000,000 cycles without any malfunction. In the event of a pneumatic or hydraulic supply failure, the actuator will remain locked in its last set position. There is a manual override drive achieved by rotating one of the two hex shafts external to the actuator housing with a wrench.

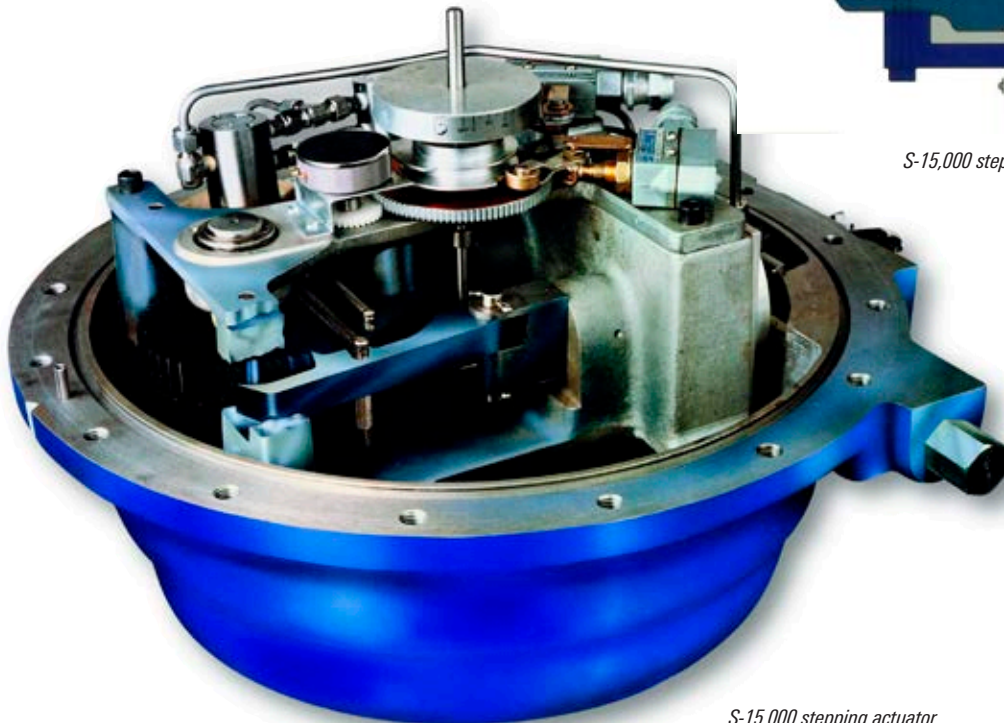
Because of these features, and the high operational reliability of the S-15,000, it can be specified for any production operation onshore or offshore that requires precise, trouble-free flow control.



*MOV choke with S-15,000 stepping actuator.*



*S-15,000 stepping actuator-cross section view.*



*S-15,000 stepping actuator*

# MC10

The MC10 choke is a 1-in [25-mm] nominal in-line MOV choke, and is suitable for a wide variety of applications. It is commonly used in water and gas injection operations as part of enhanced recovery processes. The MC10 choke's precise control also has gained acceptance in gas injection and gas lift operations, and production systems.

The trim design resists freezing in CO<sub>2</sub> service. It also has positive shutoff and adapts easily to field applications utilizing electric, hydraulic, and pneumatic actuators.

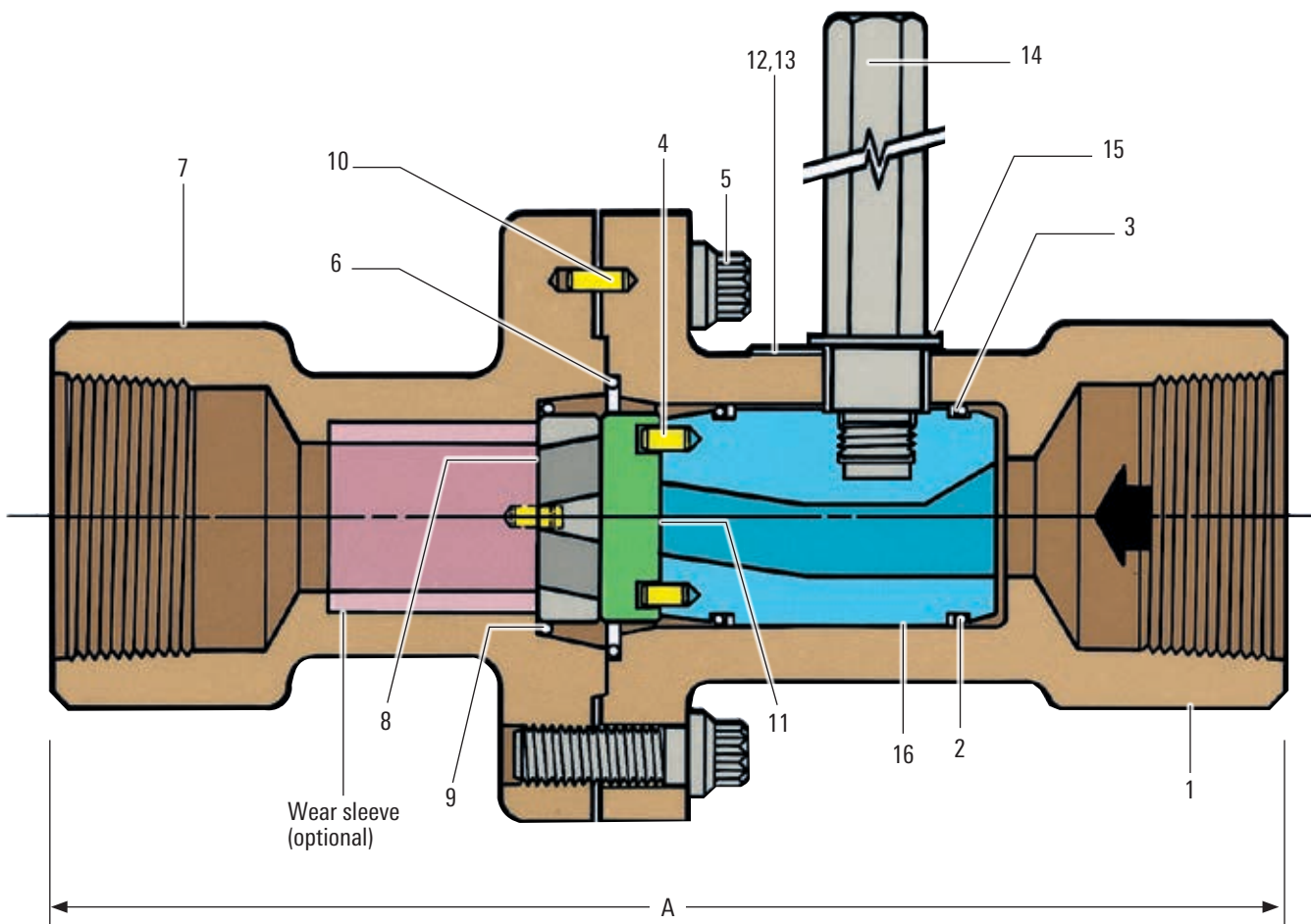
The standard MC10 choke end connections are 1-in [25-mm] and 2-in [51-mm] female threaded interfaces or 2-in [51-mm] flanges. Other options are available subject to inquiry. Optional Stellite or tungsten carbide outlet wear sleeves are available to protect against cavitation and erosion.

A backpressure bean can be added to the choke to provide a second pressure drop to reduce choked flow conditions.

**MC10 Choke Parts List**

Key no.	Description	Qty	Standard material
1	Body	1	Ni-Al-Bz or stainless steel
2	O-ring <sup>†</sup>	2	Aflas
3	Backup ring <sup>†</sup>	2	Teflon <sup>§</sup>
4	Dowel pin	4	Stainless steel
5	Capscrew	6	Alloy
6	O-ring <sup>†</sup>	1	Teflon
7	Outlet hub	1	Ni-Al-Bz or stainless steel
8	Back disc <sup>†</sup>	1	Ceramic or tungsten carbide
9	O-ring <sup>†</sup>	1	Teflon
10	Dowel pin	1	Stainless steel
11	Front disc <sup>†</sup>	1	Ceramic or tungsten carbide
12	Calibration band	1	Stainless steel
13	Drive screw	2	Stainless steel
14	Handle	1	Alloy steel
15	Indicator ring	1	Stainless steel
16	Rotator	1	Ni-Al-Bz or stainless steel
-	Wear sleeve <sup>†</sup>	1	Stellite or tungsten carbide

<sup>§</sup>Recommended spare parts for one year of operation.  
<sup>†</sup>Optional



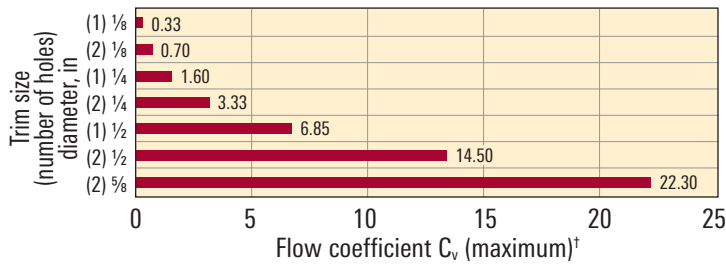


### MC10 Physical Dimensions

Inlet and outlet connections	A, in [mm]	Weight, lb [kg]
1 in [25 mm] Female NPT, Ni-Al-Bz	8.87 [225]	16 [7]
1 in [25 mm] Female NPT, C.S., S.S.	10.30 [262]	20 [9]
2 in [51 mm] Female NPT	10.30 [262]	20 [9]
2 in [51 mm] ANSI Class 900 RF	10.30 [262]	64 [29]
2 in [51 mm] ANSI Class 900 RTJ	10.30 [262]	64 [29]
2 in [51 mm] ANSI Class 1500 RF	10.30 [262]	64 [29]
2 in [51 mm] ANSI Class 1500 RTJ	10.30 [262]	64 [29]
2½ in [52.4 mm] 3000 API	10.30 [262]	64 [29]

### MC10 trim

Maximum body pressure rating, psi—ANSI Class 1500<sup>†</sup>

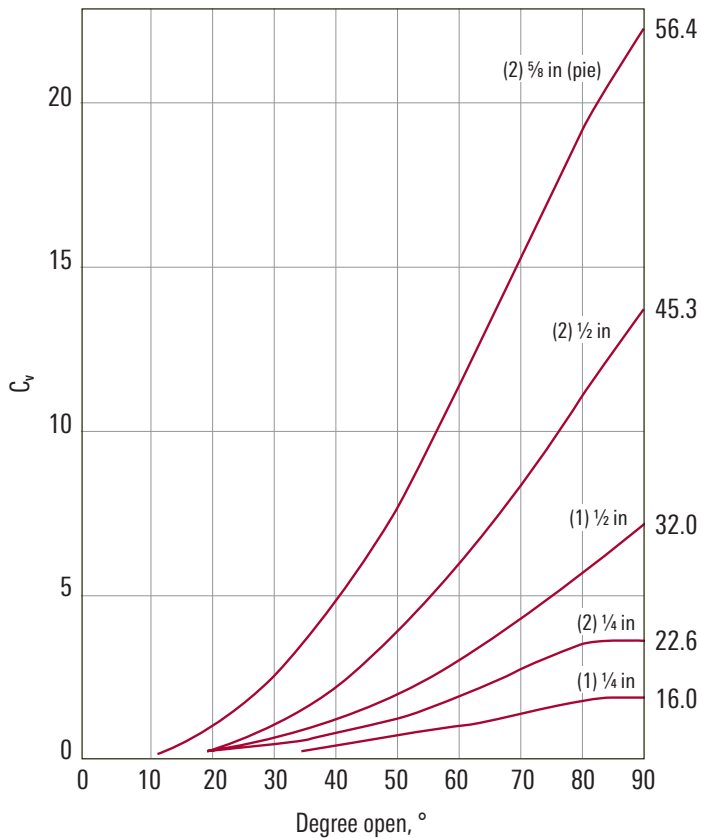


<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>†</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.

### MC10 flow curves

Bean size, 1/64 in equivalent area



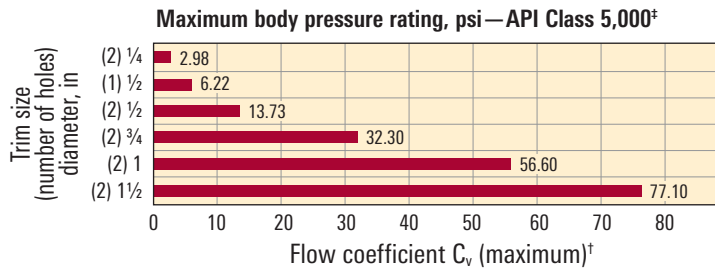
# MC20

The MC20 choke is a 2-in [51-mm] nominal in-line MOV choke, with suitability for multiple applications, particularly water, and gas injection operations to achieve EOR. The MC20 choke's precise control also has gained acceptance in gas injection and gas lift operations, and production systems.

The trim design resists freezing in CO<sub>2</sub> service. It also has positive shutoff and easily adapts to field applications utilizing electric, hydraulic, and pneumatic actuators.

The MC20 choke is available with 2-in [51-mm] female threaded interfaces or 2- to 4-in [51- to 102-mm] flanges. Other interface options are available subject to inquiry. Optional Stellite or tungsten-carbide outlet wear sleeves are available to protect against cavitation and erosion.

A backpressure bean can be added to the choke to provide a second pressure drop to reduce choked flow conditions.



<sup>†</sup> C<sub>v</sub> values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

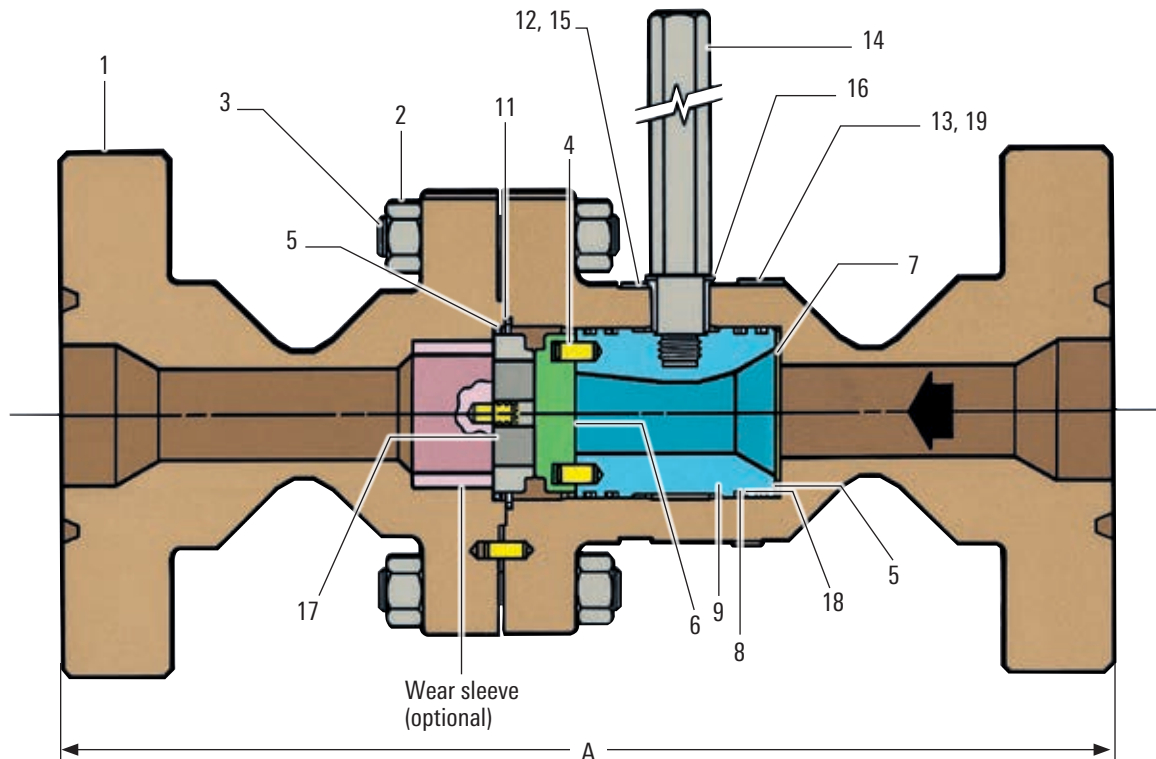
<sup>‡</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.

## MC20 Choke Parts List

Key no.	Description	Qty	Standard material
1	Outlet hub	1	Ni-Al-Bz or stainless steel
2	Nut	16	Alloy
3	Stud	8	Alloy
4	Dowel pin	5	Stainless steel
5	O-ring <sup>†</sup>	3	Teflon
6	Front disc <sup>†</sup>	1	Ceramic or tungsten carbide
7	Belleville washer <sup>†</sup>	1	Inconel <sup>§</sup> 718
8	Backup ring	1	Teflon
9	Rotor	1	Alloy steel or stainless steel
10	Body	1	Alloy steel or stainless steel
11	O-ring <sup>†</sup>	1	Teflon
12	Screw	1	Stainless steel
13	Nameplate	2	Stainless steel
14	Handle	1	Alloy steel
15	Calibration band	1	Stainless steel
16	Indicator ring <sup>†</sup>	1	Stainless steel
17	Back disc <sup>†</sup>	1	Ceramic or tungsten carbide
18	O-ring <sup>†</sup>	2	Buna-N
19	Drive screw	4	Stainless steel
-	Wear sleeve <sup>‡</sup>	1	Stellite or tungsten carbide

<sup>†</sup> Recommended spare parts for one year of operation.

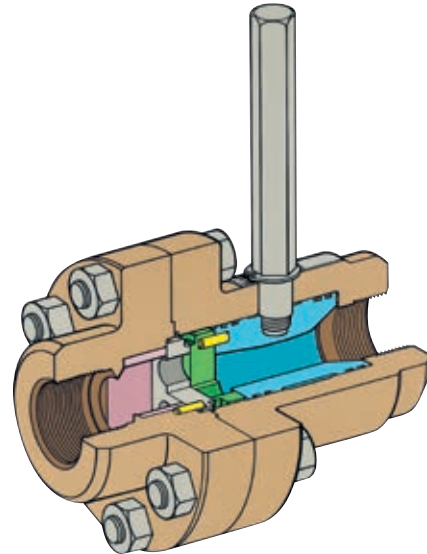
<sup>‡</sup> Optional



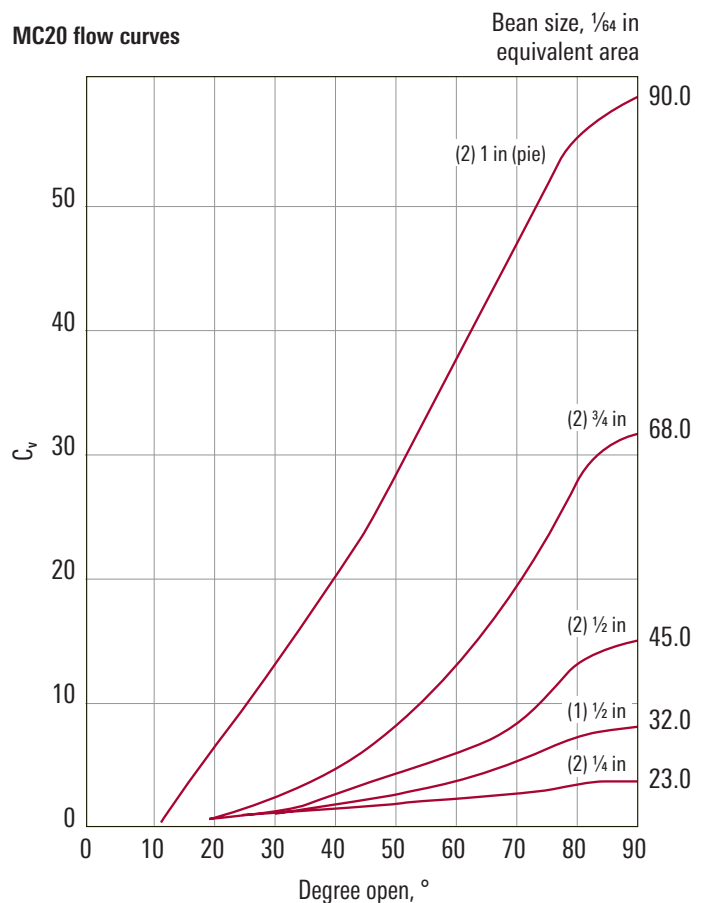


### MC20 Physical Dimensions

Inlet and outlet connections	A		Weight	
	in	mm	lb	kg
2 in [51 mm] Female NPT	10.39	264	64	29
2 in [51 mm] ANSI Class 600 RF	16.59	421	84	38
2 in [51 mm] ANSI Class 600 RTJ	16.71	424	84	38
2 in [51 mm] ANSI Class 900 RF	18.81	478	112	51
2 in [51 mm] ANSI Class 900 RTJ	18.93	481	112	51
2 in [51 mm] ANSI Class 1,500 RF	18.81	478	112	51
2 in [51 mm] ANSI Class 1,500 RTJ	18.93	481	112	51
3 in [76 mm] ANSI Class 600 RF	17.31	440	100	46
3 in [76 mm] ANSI Class 600 RTJ	17.43	443	100	46
3 in [76 mm] ANSI Class 900 RF	18.81	478	122	56
3 in [76 mm] ANSI Class 900 RTJ	18.93	481	122	56
3 in [76 mm] ANSI Class 1,500 RF	20.00	483	160	73
3 in [76 mm] ANSI Class 1,500 RTJ	20.12	486	160	73
4 in [102 mm] ANSI Class 600 RF	18.81	478	138	63
4 in [102 mm] ANSI Class 600 RTJ	18.93	487	138	63
4 in [102 mm] ANSI Class 900 RF	19.80	503	166	76
4 in [102 mm] ANSI Class 900 RTJ	19.92	506	166	76
4 in [102 mm] ANSI Class 1,500 RF	20.50	521	202	92
4 in [102 mm] ANSI Class 1,500 RTJ	20.62	524	202	92
2½ in [52.4 mm] API 3,000	18.93	481	112	51
2½ in [52.4 mm] API 5,000	18.93	481	112	51
2¾ in [65.09 mm] API 3,000	19.20	488	136	62
2¾ in [65.09 mm] API 5,000	19.20	488	136	62
3⅝ in [79.4 mm] API 3,000	18.93	481	122	56
3⅝ in [79.4 mm] API 5,000	20.12	486	160	73
4⅞ in [103.2 mm] API 3,000	19.92	506	166	76
4⅞ in [103.2 mm] API 5,000	20.62	524	202	92



MC20 flow curves

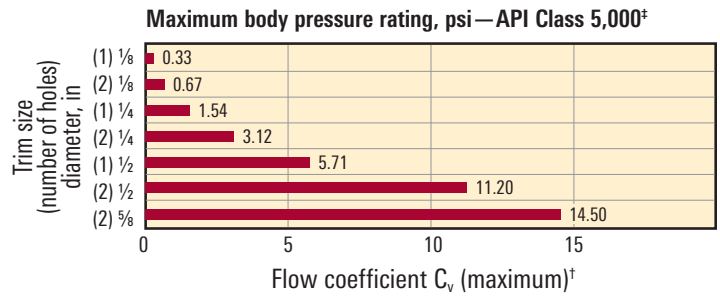


# M1A

Like the MC10 choke, the M1A has the same economical, easy to replace trim. The M1A choke is available with 1-in [25-mm] and 2-in [51-mm] male threaded, 2-in [51-mm] male threaded, 2-in [51-mm] flanged or butt-weld configurations. Other end connections are available as required. Optional tungsten-carbide or Stellite outlet wear sleeves are available on the M1A choke for erosive or cavitation conditions.

The M1A choke is designed for easy automation. You can change from manual to actuated right in the field. No additional brackets or adjustments are required for most models.

## M1A trim



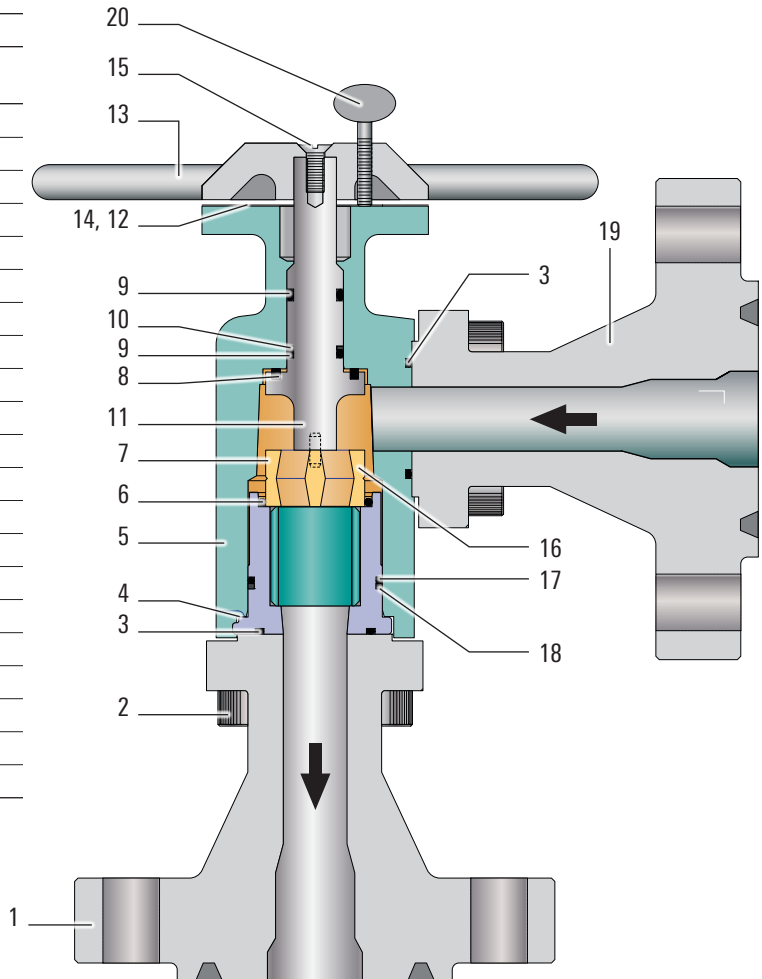
<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>‡</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.

## M1A Choke Parts List

Key no.	Description	Qty	Standard material
1	Outlet hub	1	Ni-Al-Bz, alloy steel, or stainless steel
2	Capscrew	8	Alloy
3	O-ring <sup>†</sup>	2	Buna-N, Viton <sup>§</sup> or aflas <sup>§</sup>
4	Carrier	1	Ni-Al-Bz, alloy steel, or stainless steel
5	Body	1	Ni-Al-Bz, alloy steel, or stainless steel
6	O-ring <sup>†</sup>	1	Buna-N, viton, or aflas
7	Front disc <sup>†</sup>	1	Ceramic or tungsten carbide
8	Thrust bearing <sup>†</sup>	1	Delrin
9	O-ring	2	Buna-N, Viton, or aflas
10	Backup ring <sup>†</sup>	1	Teflon
11	Turning fork	1	Ni-Al-Bz or stainless steel
12	Indicator plate	1	Stainless steel
13	Bar handle	1	Ni-Al-Bz
14	Plate screw	2	Stainless steel
15	Stem screw	1	Stainless steel
16	Back disc <sup>†</sup>	1	Ceramic or tungsten carbide
17	O-ring <sup>†</sup>	1	Buna-N, viton, or aflas
18	Backup ring <sup>†</sup>	1	Teflon
19	Inlet hub	1	Ni-Al-Bz, alloy steel, or stainless steel
20	Thumbscrew	1	Alloy steel
—	Wear sleeve (optional)	1	Tungsten carbide or stellite

<sup>†</sup> Recommended spare parts for one year of operation.

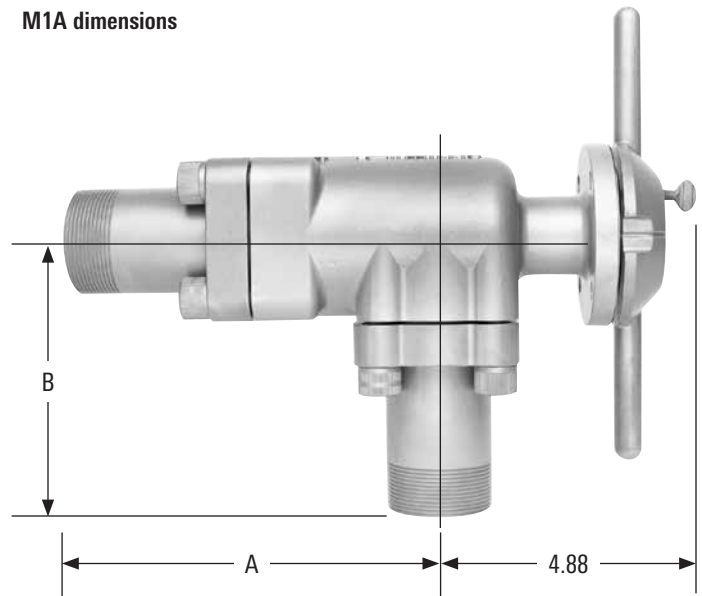




### M1A Physical Dimensions

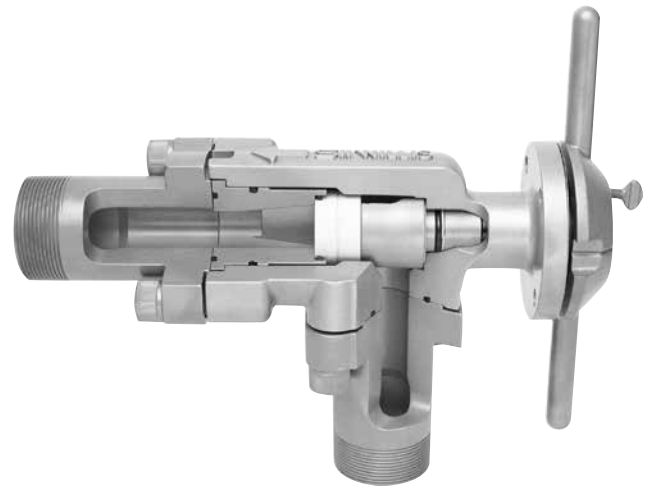
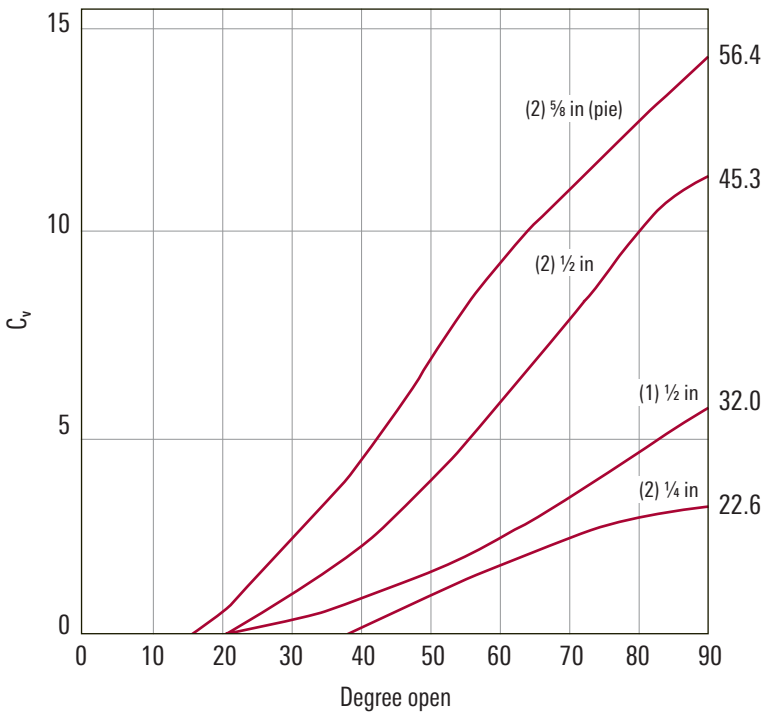
Inlet and outlet connections	A		B		Weight	
	in	mm	in	mm	lb	kg
1 in [25 mm] Female NPT	8.11	206	6.00	152	28	13
2 in [51 mm] Female NPT	9.06	230	6.95	177	29	13
2 in [51 mm] Male NPT	8.11	206	6.00	152	28	13
2 in [51 mm] Butt Weld	8.00	203	5.89	150	28	13
2 in [51 mm] ANSI Class 600 RF	9.88	251	7.77	197	48	22
2 in [51 mm] ANSI Class 600 RTJ	9.94	252	7.83	199	48	22
2 in [51 mm] ANSI Class 900 RF	9.88	251	7.77	197	76	35
2 in [51 mm] ANSI Class 900 RTJ	9.94	252	7.83	199	76	35
2 in [51 mm] ANSI Class 1,500 RF	9.88	251	7.77	197	76	35
2 in [51 mm] ANSI Class 1,500 RTJ	9.94	252	7.83	199	76	35
2 1/16 in [52.4 mm] 2,000 API	9.94	252	7.83	199	48	22
2 1/16 in [52.4 mm] 3,000 API	9.94	252	7.83	199	76	35
2 1/16 in [52.4 mm] 5,000 API	9.94	252	7.83	199	76	35

### M1A dimensions



### M1A flow curves

Bean size, 1/64 in  
equivalent area



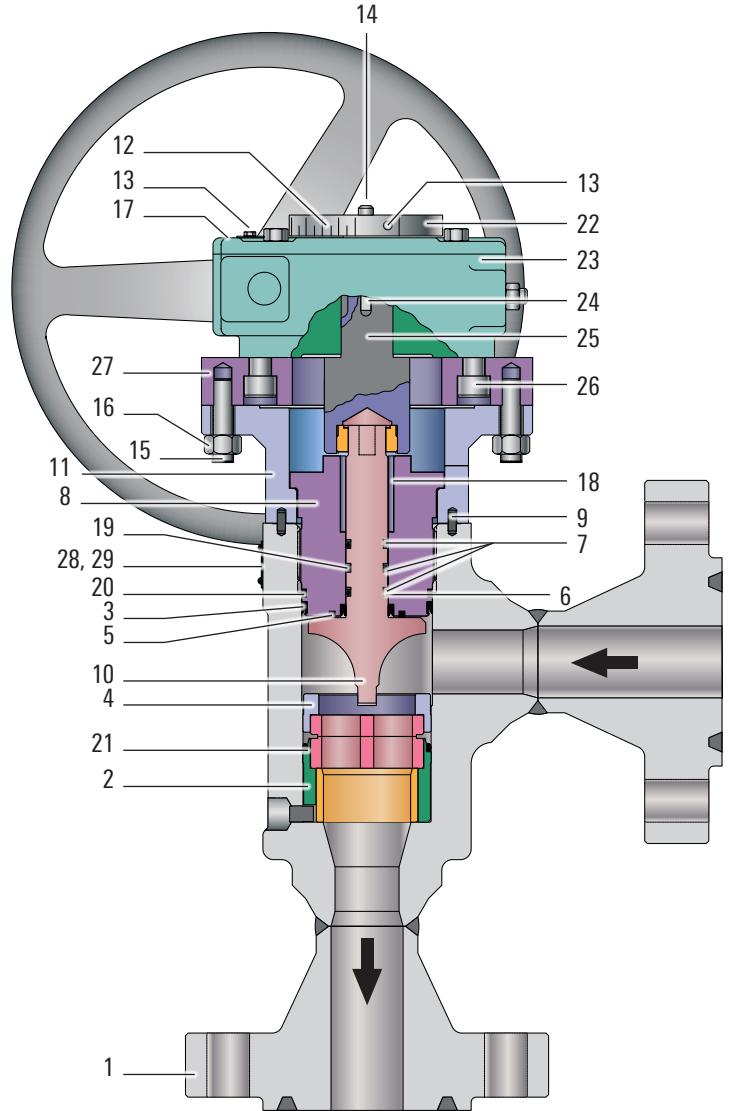
# M2

The M2 choke is a compact, 2-in [51-mm] nominal MOV choke used widely throughout the world primarily for wellhead and production applications. This closed die-forged body valve has a threaded bonnet for easy maintenance and is available in several versions. The standard M2 choke is bar-handle operated. Handwheel operators, electric, and pneumatic actuators also are available.

## M2 Choke Parts List

Key no.	Description	Qty	Standard material
1	Body	1	Alloy steel
2	Disc assembly, back <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
3	O-ring, bonnet <sup>†</sup>	1	Viton
4	Disc assembly, front <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
5	Thrust bearing	1	Delrin <sup>†</sup>
6	O-ring, turning fork <sup>†</sup>	1	Viton
7	Backup ring <sup>†</sup>	3	Teflon
8	Bonnet	1	Alloy steel
9	Dowel pin <sup>†</sup>	4	High-strength alloy
10	Turning fork	1	Alloy steel
11	Mounting flange	1	Alloy steel
12	Calibration band <sup>†</sup>	1	Stainless steel
13	Sheet metal screw <sup>†</sup>	4	Alloy steel
14	Capscrew	1	Stainless steel
15	Stud	8	High-strength alloy
16	Nut	8	High-strength alloy
17	Pointer	1	Stainless steel
18	Shaft bushing	1	Turcite-A
19	O-ring, turning fork <sup>†</sup>	2	Viton
20	O-ring, bonnet <sup>†</sup>	1	Buna-N
21	O-ring, back disc assembly <sup>†</sup>	1	Viton
22	Indicat or head	1	Alloy steel
23	Gear operator, handwheel	1	Alloy steel
24	Key	1	High-strength alloy
25	Drive shaft assembly	1	Alloy steel
26	Capscrew	4	High-strength alloy
27	Mounting plate	1	Alloy steel
28	Drive screw	4	Stainless steel
29	Valve ID tag	1	Stainless steel

<sup>†</sup> Recommended spare parts for one year of operation.

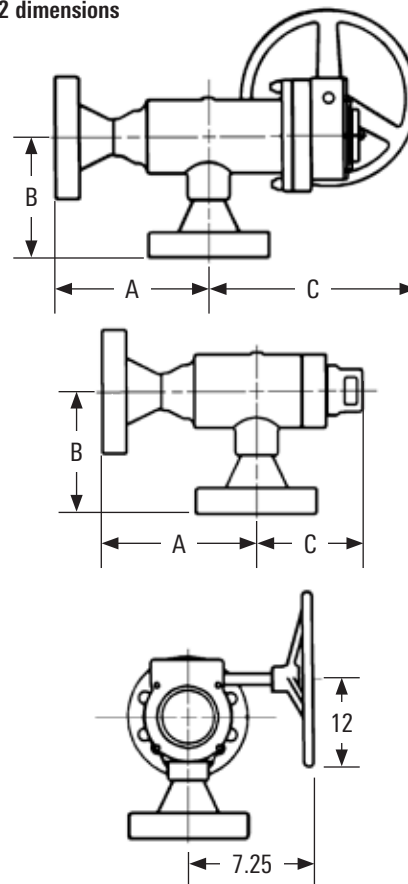


M2 chokes, manually operated.

### M2 Choke Physical Dimensions

Inlet and outlet connections	A		B		Weight		
	in	mm	in	mm	lb	kg	
2 in [51 mm] ANSI Class 600 RF	9.29	236	7.10	180	84	38	
2 in [51 mm] ANSI Class 600 RTJ	9.35	237	7.16	182	84	38	
2 in [51 mm] ANSI Class 900 RF	10.41	264	8.22	209	110	50	
2 in [51 mm] ANSI Class 900 RTJ	10.47	266	8.28	210	110	50	
2 in [51 mm] ANSI Class 1500 RF	10.41	264	8.22	208	110	50	
2 in [51 mm] ANSI Class 1500 RTJ	10.47	265	8.28	210	110	50	
2 in [51 mm] ANSI Class 2500 RF	11.38	289	9.19	233	144	65	
2 in [51 mm] ANSI Class 2500 RTJ	11.44	291	9.25	235	144	65	
2 1/16 in [52.4 mm] 2,000 API	9.35	237	7.16	182	84	38	
2 1/16 in [52.4 mm] 3,000 API	10.47	266	8.28	210	110	50	
2 1/16 in [52.4 mm] 5,000 API	10.47	265	8.28	210	110	50	
2 9/16 in [65.09 mm] 2,000 API	9.60	244	7.41	188	90	41	
2 9/16 in [65.09 mm] 3,000 API	10.60	269	8.41	213	116	53	
2 9/16 in [65.09 mm] 5,000 API	10.57	269	8.38	213	116	53	
3 in [76 mm] ANSI Class 600 RF	9.66	245	7.72	196	102	46	
3 in [76 mm] ANSI Class 600 RTJ	9.72	247	7.78	197	102	46	
3 in [76 mm] ANSI Class 900 RF	10.41	264	8.47	215	126	57	
3 in [76 mm] ANSI Class 900 RTJ	10.47	266	8.53	216	126	57	
3 in [76 mm] ANSI Class 1500 RF	11.00	280	9.06	230	156	71	
3 in [76 mm] ANSI Class 1500 RTJ	11.06	281	9.12	232	156	71	
3 in [76 mm] ANSI Class 2500 RF	13.00	330	11.06	281	204	93	
3 in [76 mm] ANSI Class 2500 RTJ	13.12	333	11.18	284	204	93	
3 1/8 in [79.4 mm] 2,000 API	9.72	247	7.78	197	102	46	
3 1/8 in [79.4 mm] 3,000 API	10.47	266	8.53	216	126	57	
3 1/8 in [79.4 mm] 5,000 API	11.07	281	9.13	232	156	71	
1 13/16 in [42.9 mm] BX-150, 10,000	10.39	264	8.20	208	121	55	
1 13/16 in [46 mm] BX-151, 10,000	10.39	264	8.20	208	121	55	
2 1/16 in [52.4 mm] BX-152, 10,000	10.75	273	8.82	224	126	57	
2 9/16 in [65.09 mm] BX-153, 10,000	10.99	279	9.05	230	133	60	

### M2 dimensions

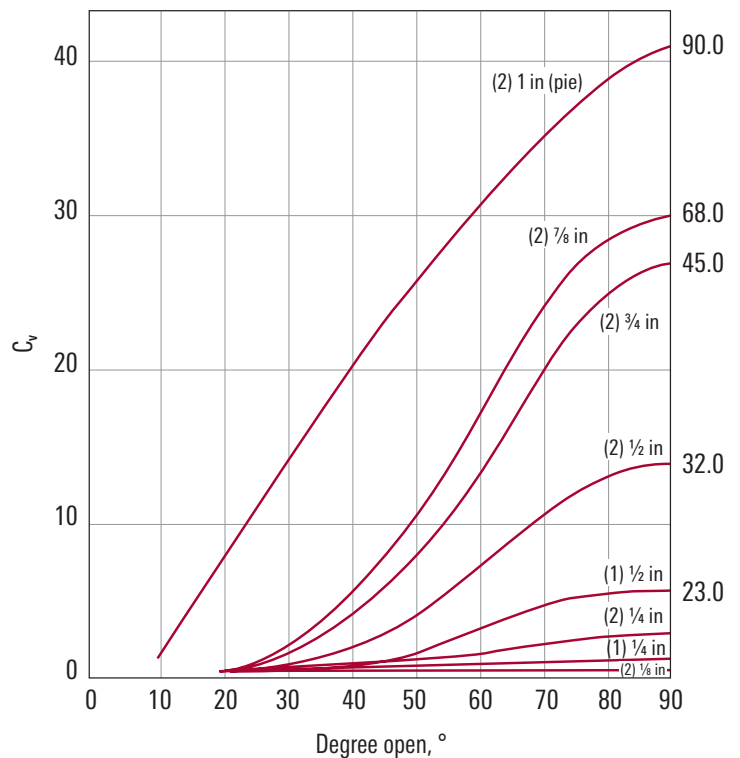


#### Dimensions

C Adj: HW Gear = 14.50 in  
 C Adj: Bar Handle = 7.48 in  
 C Positive = 5.00 in

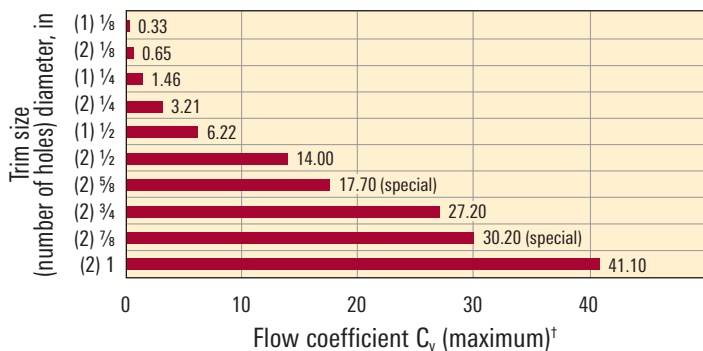
### M2 flow curves

Bean size, 1/64 in  
 equivalent area



### M2 trim

Body maximum pressure rating—API 10,000<sup>†</sup>



<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>†</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.



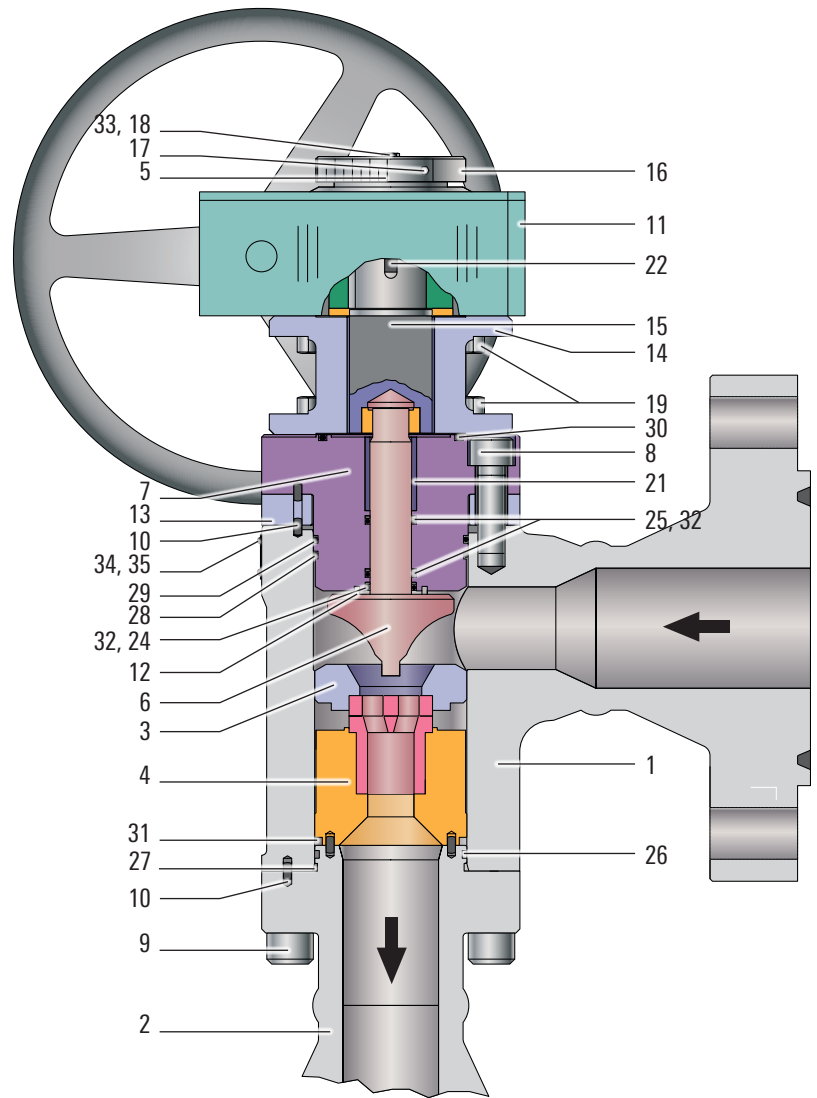
# M3

The M3 choke is a 3-in [76-mm] nominal MOV that is used worldwide in applications where high flow capacity is required. It is primarily used in surface wellhead and production applications. As with all MOV models, the M3 choke is available with multiple actuation options, including the S-15,000 stepping actuator. It also is available with various end connection options to suit specific requirements.

## M3 Choke Parts List

Key no.	Description	Qty	Standard material
1	Body	1	Alloy steel
2	Outlet flange assembly	1	Alloy steel
3	Front disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
4	Back disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
5	Calibration band <sup>†</sup>	1	Stainless steel
6	Turning fork	1	Alloy steel
7	Bonnet	1	Alloy steel
8	Capscrew	8	Alloy
9	Capscrew	8	Alloy
10	Dowel pin <sup>†</sup>	7	Stainless steel
11	Gear operator, handwheel	1	Alloy steel
12	Thrust bearing	1	Delrin
13	Spacer ring	1	Alloy steel
14	Gear operator adapter	1	Alloy steel
15	Drive shaft assembly	1	Alloy steel
16	Indicator head	1	Alloy steel
17	Sheet metal screw <sup>†</sup>	2	Alloy steel
18	Capscrew	2	High-strength alloy
19	Capscrew	8	High-strength alloy
21	Shaft bushing	1	Turcite-a
22	Key	1	High strength alloy
24	O-ring, turning fork <sup>†</sup>	1	Viton
25	O-ring, turning fork <sup>†</sup>	2	Viton
26	O-ring, outlet spool <sup>†</sup>	1	Viton
27	O-ring, outlet spool <sup>†</sup>	2	Viton
28	O-ring, bonnet <sup>†</sup>	1	Viton
29	O-ring, bonnet <sup>†</sup>	1	Viton
30	O-ring, bonnet <sup>†</sup>	1	Buna-N
31	O-ring, back disc assembly <sup>†</sup>	1	Viton
32	Backup ring <sup>†</sup>	3	Teflon
33	Flat washer	2	Alloy steel
34	Drive screw	4	Stainless steel
35	Valve ID tag	1	Stainless steel

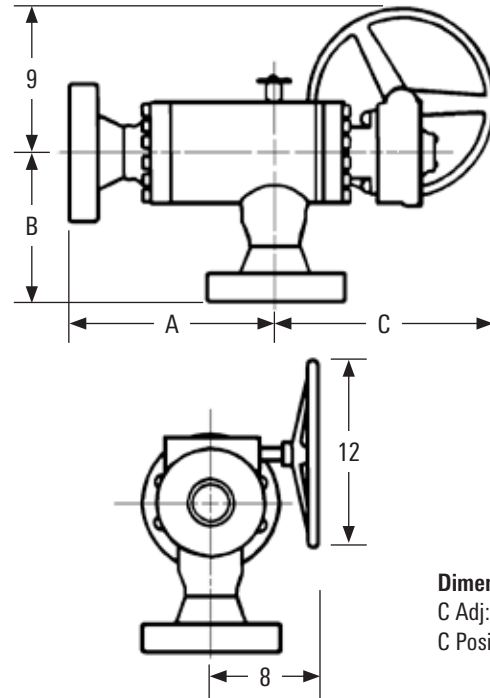
<sup>†</sup>Recommended spare parts for one year of operation.



### M3 Choke Physical Dimensions

Inlet and outlet connections	A		B		Weight	
	in	mm	in	mm	lb	kg
3 1/8 in [79.4 mm] 2,000 API	12.66	321	8.47	215	137	62
3 1/8 in [79.4 mm] 3,000 API	13.41	340	9.22	234	161	73
3 1/8 in [79.4 mm] 5,000 API	14.01	354	9.82	249	193	88
3 in [76 mm] ANSI Class 600 RF	12.60	320	8.41	213	137	62
3 in [76 mm] ANSI Class 600 RTJ	12.66	322	8.48	215	137	62
3 in [76 mm] ANSI Class 900 RF	13.35	339	9.16	232	161	73
3 in [76 mm] ANSI Class 900 RTJ	13.41	341	9.22	234	161	73
3 in [76 mm] ANSI Class 1500 RF	13.94	354	9.75	248	193	88
3 in [76 mm] ANSI Class 1500 RTJ	14.00	355	9.81	249	193	88
3 in [76 mm] ANSI Class 2500 RF	15.94	404	11.75	298	286	130
3 in [76 mm] ANSI Class 2500 RTJ	16.05	407	11.87	301	286	130
4 1/8 in [103 mm] 2,000 API	17.38	440	9.22	234	185	84
4 1/8 in [103 mm] 3,000 API	17.88	453	9.72	246	205	93
4 1/8 in [103 mm] 5,000 API	18.24	462	10.07	255	251	114
4 in [102 mm] ANSI Class 600 RF	17.32	439	9.16	232	185	84
4 in [102 mm] ANSI Class 600 RTJ	17.38	440	9.22	234	185	84
4 in [102 mm] ANSI Class 900 RF	17.82	452	9.66	245	205	93
4 in [102 mm] ANSI Class 900 RTJ	17.88	453	9.72	246	205	93
4 in [102 mm] ANSI Class 1500 RF	18.17	460	10.01	254	251	114
4 in [102 mm] ANSI Class 1500 RTJ	18.23	462	10.07	255	251	114
4 in [102 mm] ANSI Class 2500 RF	20.76	526	12.63	320	398	181
4 in [102 mm] ANSI Class 2500 RTJ	20.95	531	12.82	325	398	181

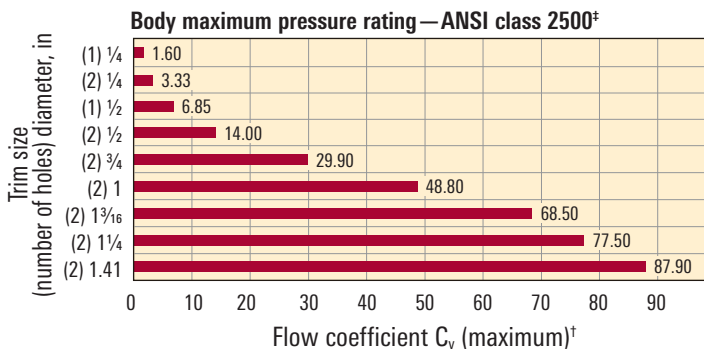
### M3 dimensions



#### Dimensions

C Adj: HW Gear = 15.25 in  
C Positive = 6.12 in

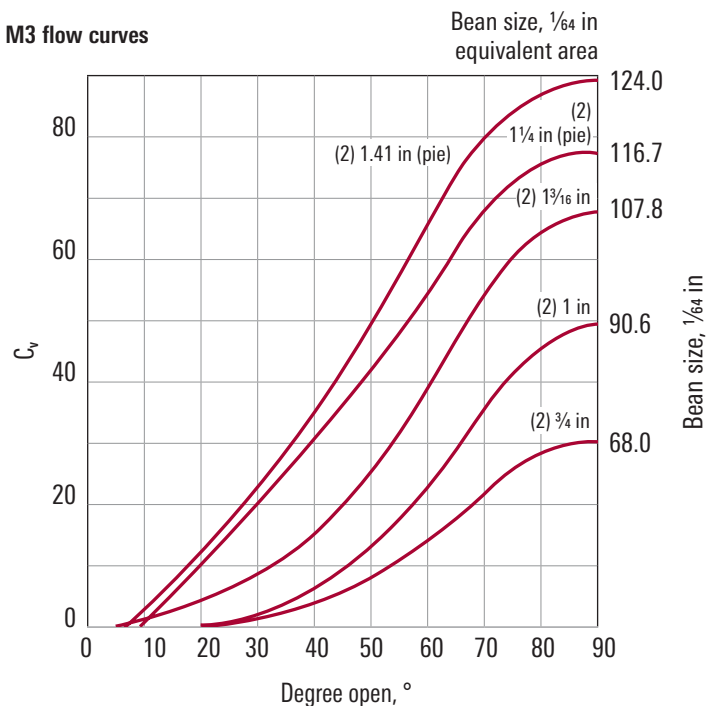
### M3 trim



<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>†</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.

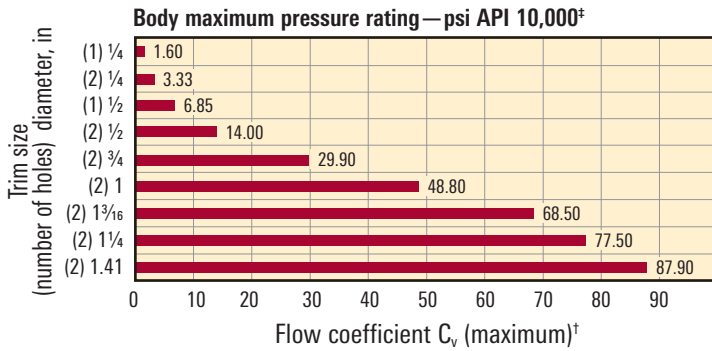
### M3 flow curves



# M3G

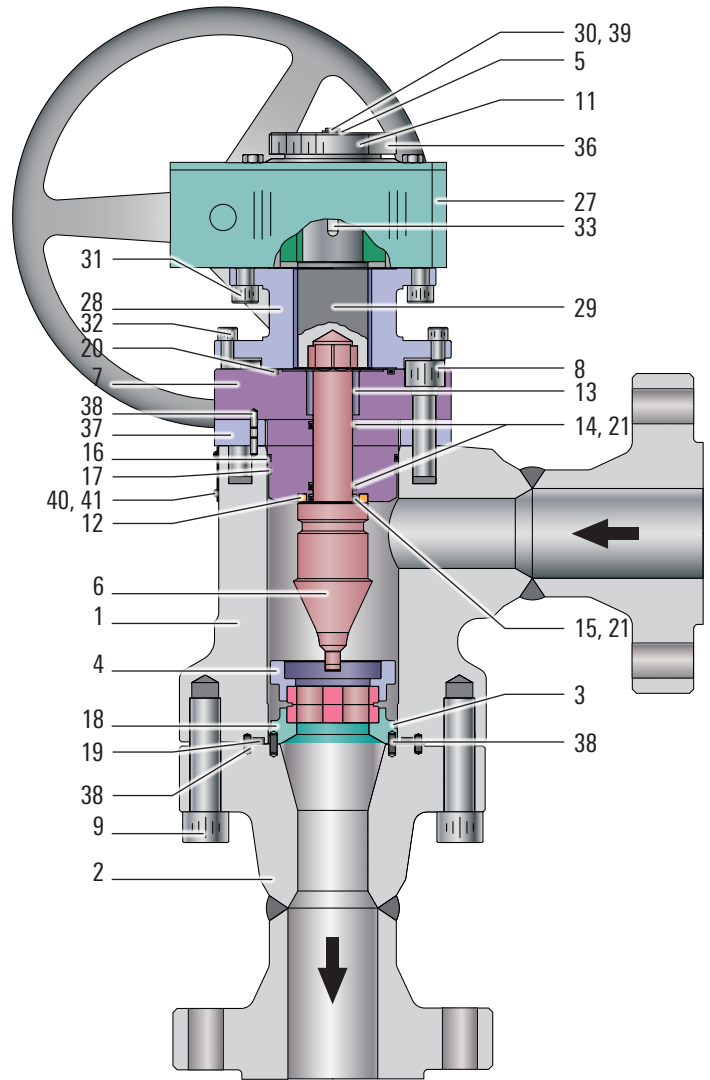
The M3G choke is a specially designed 3-in [76-mm] nominal MOV that has been used in drilling choke applications for more than 15 years. Built for severe abrasive service, it has a working pressure up to 10,000 psi and is capable of taking a full 10,000-psi pressure drop with tungsten-carbide discs. The M3G choke is well suited to high-pressure gas letdown applications thanks to its enlarged outlet design which permits 4- to 6-in [102-to 152-mm] flanges to be attached directly to the body for gas expansion. The discs are located near the enlarged outlet, allowing high velocity fluids and particles to pass through into the expanded cavity. The resulting deceleration reduces wear on the choke outlet.

## M3G trim



<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>†</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.



## M3G Choke Parts List

Key no.	Description	Qty	Standard material	Key no.	Description	Qty	Standard material
1	Body	1	Alloy steel	19	O-ring, outlet spool <sup>†</sup>	1	Viton
2	Outlet flange assembly	1	Alloy steel	20	O-ring, bonnet <sup>†</sup>	1	Buna-N
3	Back disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS	21	Backup ring <sup>†</sup>	3	Teflon
4	Front disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS	27	Gear operator, handwheel	1	Alloy steel
5	Calibration band	1	Stainless steel	28	Adapter for gear assembly	1	Alloy steel
6	Turning fork	1	Alloy steel	29	Drive shaft assembly	1	Alloy steel
7	Bonnet	1	Alloy steel	30	Capscrew	2	High-strength alloy
8	Capscrew	12	Alloy	31	Capscrew	4	High-strength alloy
9	Capscrew	16	Alloy	32	Capscrew	6	High-strength alloy
11	Sheet metal screw <sup>†</sup>	2	Stainless steel	33	Key	1	High-strength alloy
12	Thrust bearing	1	Delrin	36	Indicator head	1	Alloy steel
13	Shaft bushing	1	Turcite-a	37	Spacer ring	1	Alloy steel
14	O-ring, turning fork <sup>†</sup>	2	Viton	38	Dowel pin <sup>†</sup>	7	Stainless steel
15	O-ring, turning fork <sup>†</sup>	1	Viton	39	Flat washer	2	Alloy steel
16	O-ring, bonnet <sup>†</sup>	1	Viton	40	Drive screw	4	Stainless steel
17	O-ring, bonnet <sup>†</sup>	1	Viton	41	Valve ID tag	1	Stainless steel
18	O-ring, back disc assembly <sup>†</sup>	1	Viton				

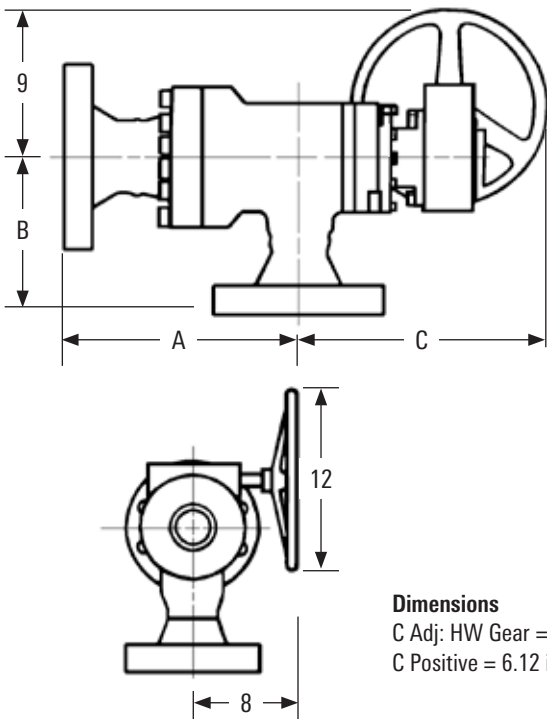
<sup>†</sup> Recommended spare parts for one year of operation.



### M3G Choke Physical Dimensions

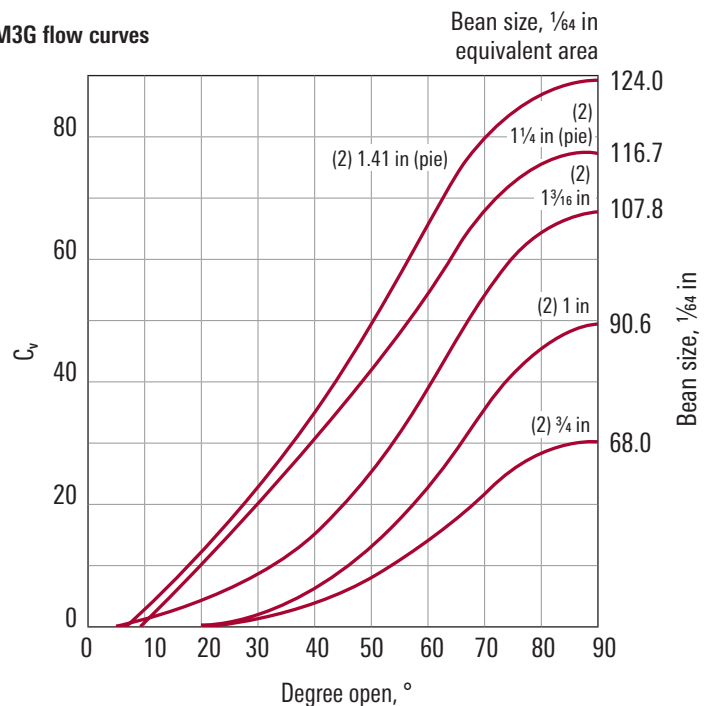
Inlet connections	Outlet connections	A		B		Weight	
		in	mm	in	mm	lb	kg
3 in [76 mm] ANSI 600 RF	4 in [102 mm] ANSI 600 RF	14.22	361	8.41	213	197	90
3 in [76 mm] ANSI 600 RTJ	4 in [102 mm] ANSI 600 RTJ	14.28	362	8.47	215	197	90
3 in [76 mm] ANSI 900 RF	4 in [102 mm] ANSI 900 RF	14.72	373	9.16	231	215	98
3 in [76 mm] ANSI 900 RTJ	4 in [102 mm] ANSI 900 RTJ	14.78	375	9.22	234	215	98
3 in [76 mm] ANSI 1500 RF	4 in [102 mm] ANSI 1500 RF	15.07	382	9.75	248	253	115
3 in [76 mm] ANSI 1500 RTJ	4 in [102 mm] ANSI 1500 RTJ	15.13	384	9.81	249	253	115
3 in [76 mm] ANSI 2500 RF	4 in [102 mm] ANSI 2500 RF	17.72	449	11.75	298	372	169
3 in [76 mm] ANSI 2500 RTJ	4 in [102 mm] ANSI 2500 RTJ	17.91	453	11.87	301	372	169
3 1/8 in [79.4 mm] API 2,000	4 1/8 in [103 mm] API 2,000	14.28	362	8.47	215	197	90
3 1/8 in [79.4 mm] API 3,000	4 1/8 in [103 mm] API 3,000	14.78	375	9.22	234	215	98
3 1/8 in [79.4 mm] API 5,000	4 1/8 in [103 mm] API 5,000	15.13	384	9.82	248	253	115
4 in [102 mm] ANSI 600 RF	6 in [152 mm] ANSI 600 RF	20.27	515	9.16	232	267	121
4 in [102 mm] ANSI 600 RTJ	6 in [152 mm] ANSI 600 RTJ	20.33	516	9.22	234	267	121
4 in [102 mm] ANSI 900 RF	6 in [152 mm] ANSI 900 RF	21.16	537	9.66	245	305	139
4 in [102 mm] ANSI 900 RTJ	6 in [152 mm] ANSI 900 RTJ	21.22	538	9.72	246	305	139
4 in [102 mm] ANSI 1,500 RF	6 in [152 mm] ANSI 1,500 RF	22.38	567	10.01	254	386	175
4 in [102 mm] ANSI 1500 RTJ	6 in [152 mm] ANSI 1500 RTJ	22.50	570	10.07	256	386	175
4 in [102 mm] ANSI 2500 RF	6 in [152 mm] ANSI 2500 RF	26.38	668	12.63	320	675	307
4 in [102 mm] ANSI 2500 RTJ	6 in [152 mm] ANSI 2500 RTJ	26.63	674	12.82	325	675	307
4 1/8 in [103 mm] API 2,000	7 1/8 in [179 mm] API 2,000	20.32	517	9.22	234	267	121
4 1/8 in [103 mm] API 3,000	7 1/8 in [179 mm] API 3,000	21.19	538	9.72	246	305	139
4 1/8 in [103 mm] API 5,000	7 1/8 in [179 mm] API 5,000	22.51	570	10.07	256	386	175
2 9/16 in [65 mm] BX-153 10K	3 1/8 in [78 mm] BX-154 10K	15.41	391	10.56	268	226	103
3 1/8 in [78 mm] BX-154 10K	3 1/8 in [78 mm] BX-154 10K	15.41	391	11.18	284	291	132
4 1/8 in [103 mm] BX-155 10K	4 1/8 in [103 mm] BX-155 10K	16.88	429	11.94	303	444	202

### M3G dimensions



**Dimensions**  
 C Adj: HW Gear = 15.25 in  
 C Positive = 6.12 in

### M3G flow curves



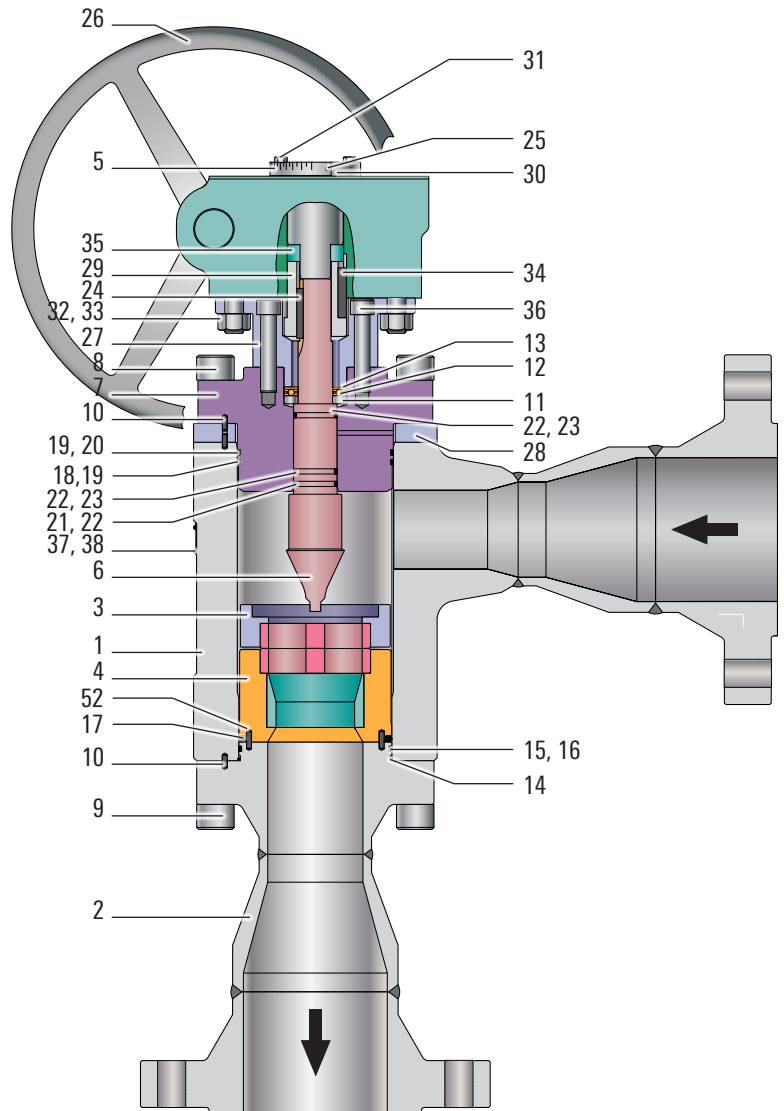
# M4

The M4 choke is a 4-in [102-mm] nominal MOV that has found a great deal of acceptance worldwide, particularly in large volume production and in water-injection applications in the North Sea, Middle East, and Alaskan North Slope. This choke is extensively used in surface wellhead and production applications and has gained wide acceptance as a high-quality subsea choke. The M4 choke affords easy actuation from a variety of pneumatic diaphragm actuators to the Cameron S-15,000 stepping actuator.

## M3 Choke Parts List

Key no.	Description	Qty	Standard material
1	Body	1	Alloy steel
2	Outlet flange assembly	1	Alloy steel
3	Front disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
4	Back disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
5	Calibration band	1	Stainless steel
6	Turning fork	1	Alloy steel
7	Bonnet	1	Alloy steel
8	Capscrew	12	Alloy
9	Capscrew	12	Alloy
10	Dowel pin <sup>†</sup>	6	Stainless steel
11	Bearing race	1	Alloy steel
12	Thrust needle bearing	1	Alloy steel
13	Thrust bearing race	1	Alloy steel
14	O-ring, outlet spool <sup>†</sup>	1	Viton
15	Backup ring, outlet spool <sup>†</sup>	1	Teflon
16	O-ring, outlet spool <sup>†</sup>	1	Viton
17	O-ring, back disc assembly <sup>†</sup>	1	Viton
18	O-ring, bonnet <sup>†</sup>	1	Viton
19	Backup ring <sup>†</sup>	2	Teflon
20	O-ring, bonnet	1	Viton
21	O-ring, turning fork <sup>†</sup>	1	Viton
22	Backup ring <sup>†</sup>	3	Teflon
23	O-ring, turning fork <sup>†</sup>	2	Viton
24	Key	1	High-strength alloy
25	Sheet metal screw	2	Stainless steel
26	Gear operator, handwheel	1	Alloy steel
27	Adapter for gear assembly	1	Alloy steel
28	Spacer ring	1	Alloy steel
29	Drive bushing	1	Alloy steel
30	Indicator head	1	Stainless steel
31	Capscrew	2	High-strength alloy
32	Nut	4	High-strength alloy
33	Stud	4	High-strength alloy
34	Key	1	High-strength alloy
35	Key retainer plug	1	Alloy steel
36	Capscrew	4	High-strength alloy
37	Drive screw	4	Stainless steel
38	Valve ID tag	1	Stainless steel

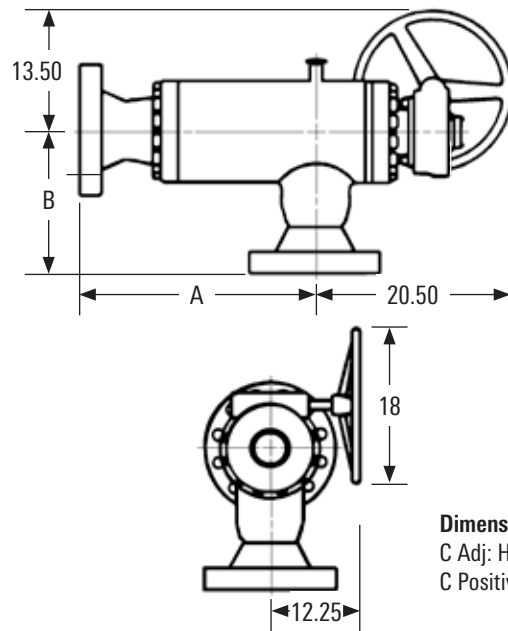
<sup>†</sup>Recommended spare parts for one year of operation.



### M4 Physical Dimensions

Inlet and outlet connections	A ± .12 in		B ± .12 in		Weight	
	in	mm	in	mm	lb	kg
4 in [102 mm] ANSI Class 600 RF	17.22	437	12.34	313	403	183
4 in [102 mm] ANSI Class 600 RTJ	17.28	438	12.40	315	403	183
4 in [102 mm] ANSI Class 900 RF	17.72	450	12.81	326	425	193
4 in [102 mm] ANSI Class 900 RTJ	17.78	451	12.87	327	425	193
4 in [102 mm] ANSI Class 1500 RF	18.07	458	13.19	335	469	213
4 in [102 mm] ANSI Class 1500 RTJ	18.13	460	13.25	336	469	213
4 in [102 mm] ANSI Class 2500 RF	20.69	525	15.81	401	685	311
4 in [102 mm] ANSI Class 2500 RTJ	20.88	530	16.00	406	685	311
4 1/16 in [103 mm] API 2,000	17.28	438	12.40	315	403	183
4 1/16 in [103 mm] API 3,000	17.78	451	12.90	327	425	193
4 1/16 in [103 mm] API 5,000	18.13	460	13.25	336	539	245
6 in [152 mm] ANSI Class 600 RF	23.28	591	18.40	467	414	188
6 in [152 mm] ANSI Class 600 RTJ	23.34	593	18.46	469	414	188
6 in [152 mm] ANSI Class 900 RF	24.16	613	19.28	489	445	202
6 in [152 mm] ANSI Class 900 RTJ	24.22	615	19.34	491	445	202
6 in [152 mm] ANSI Class 1500 RF	25.38	643	20.50	519	504	229
6 in [152 mm] ANSI Class 1500 RTJ	25.51	646	20.62	523	504	229
6 in [152 mm] ANSI Class 2500 RF	29.38	744	24.50	620	790	359
6 in [152 mm] ANSI Class 2500 RTJ	29.63	750	24.75	627	790	359
7 1/16 in [179 mm] API 2,000	23.35	593	18.47	469	414	188
7 1/16 in [179 mm] API 3,000	24.22	615	19.34	491	445	202

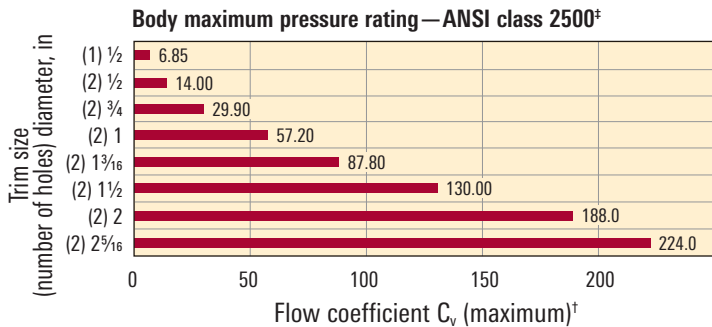
### M4 dimensions



#### Dimensions

C Adj: HW Gear = 20.50 in  
C Positive = 6.25 in

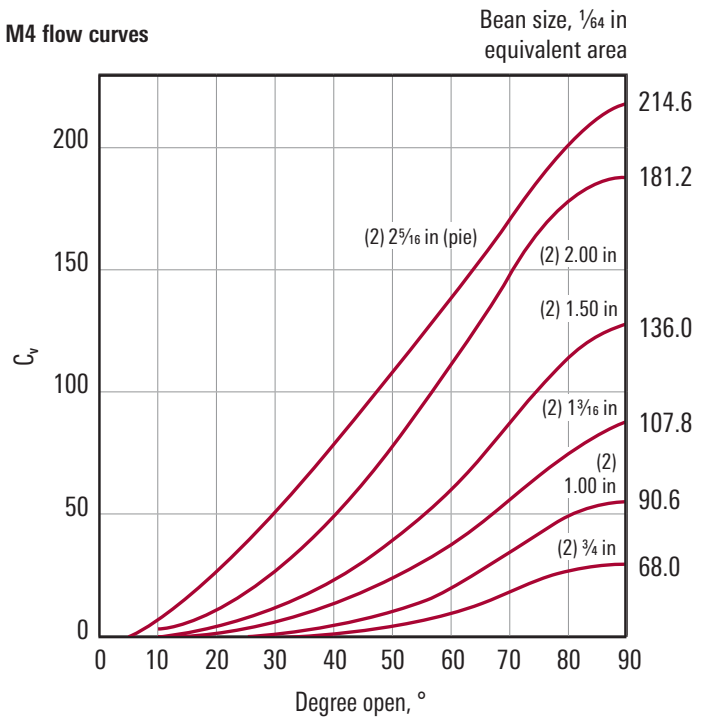
### M4 trim



<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>†</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.

### M4 flow curves





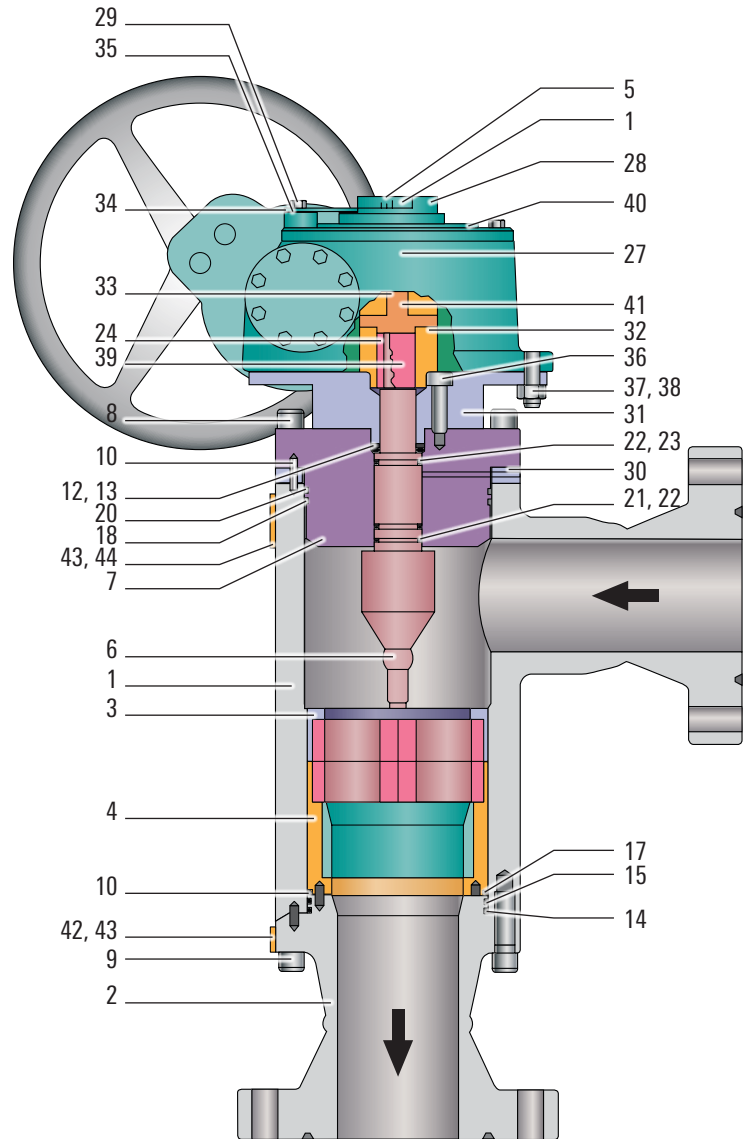
# M6

The M6 choke is a 6-in [152-mm] nominal MOV choke, and is the largest MOV-style choke provided by Cameron. It has all the features and benefits of the smaller MOVs but at a greatly increased working capacity. As with all MOV models, the M6 choke is available with multiple actuation options including the S-15,000 stepping actuator. It also is available with various end connection options to suit specific requirements.

## M6 Choke Parts List

Key no.	Description	Qty	Standard material
1	Body	1	Alloy steel
2	Outlet flange assembly	1	Alloy steel
3	Front disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
4	Back disc assembly <sup>†</sup>	1	Ceramic/SS or tungsten carbide/SS
5	Calibration band	1	Stainless steel
6	Turning fork	1	Alloy steel
7	Bonnet	1	Alloy steel
8	Capscrew	16	Alloy
9	Capscrew	16	Alloy
10	Dowel pin <sup>†</sup>	6	Stainless steel
11	Sheet metal screw	2	Stainless steel
12	Thrust needle bearing	1	Alloy steel
13	Thrust bearing race	2	Alloy steel
14	O-ring, outlet spool <sup>†</sup>	1	Viton
15	O-ring, outlet spool <sup>†</sup>	1	Viton
17	O-ring, back disc assembly <sup>†</sup>	1	Viton
18	O-ring, bonnet <sup>†</sup>	1	Viton
20	O-ring, bonnet <sup>†</sup>	1	Viton
21	O-ring, turning fork <sup>†</sup>	1	Viton
22	Backup ring <sup>†</sup>	3	Teflon
23	O-ring, turning fork <sup>†</sup>	2	Viton
24	Key	1	High-strength alloy
27	Gear operator, handwheel	1	Alloy steel
28	Indicator head	1	Alloy steel
29	Capscrew	2	Stainless steel
30	Spacer ring	1	Alloy steel
31	Gear operator adapter	1	Alloy steel
32	Drive bushing	1	Alloy steel
33	Key	1	High-strength alloy
34	Pointer	1	Stainless steel
35	Pointer riser	1	Alloy steel
36	Capscrew	4	High-strength alloy
37	Stud	8	High-strength alloy
38	Nut	8	High-strength alloy
39	Set screw	1	High-strength alloy
40	Capscrew	4	High-strength alloy
41	Key retainer plug	1	Alloy steel
42	Flow direction label	1	Stainless steel
43	Drive screw	6	Stainless steel
44	Valve ID Tag	1	Stainless Steel

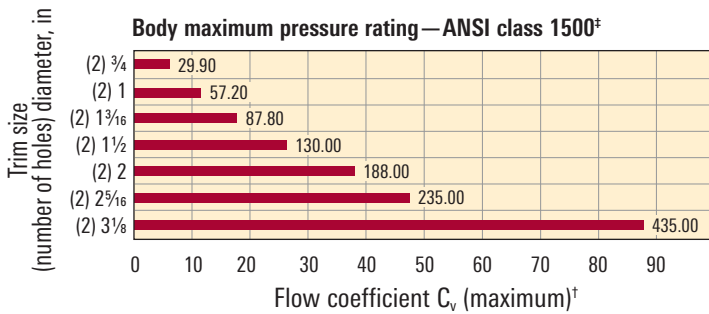
<sup>†</sup>Recommended spare parts for one year of operation.



### M6 Choke Physical Dimensions

Inlet and outlet connections	A ± .12 in		B ± .12 in		Weight	
	in	mm	in	mm	lb	kg
6 in [152 mm] ANSI Class 600 RF	26.31	669	15.31	389	826	375
6 in [152 mm] ANSI Class 600 RTJ	26.37	670	15.37	391	826	375
6 in [152 mm] ANSI Class 900 RF	27.19	691	16.19	411	880	400
6 in [152 mm] ANSI Class 900 RTJ	27.25	692	16.25	413	880	400
6 in [152 mm] ANSI Class 1500 RF	28.44	721	17.44	442	939	427
6 in [152 mm] ANSI Class 1500 RTJ	28.57	724	17.57	445	939	427
7½ in [179 mm] API 3,000	27.25	692	16.25	413	880	400
8 in [203 mm ] ANSI Class 600 RF	32.88	835	21.88	555	934	425
8 in [203 mm ] ANSI Class 600 RTJ	32.94	836	21.94	557	934	425
8 in [203 mm ] ANSI Class 900 RF	34.01	863	23.03	584	1086	494
8 in [203 mm ] ANSI Class 900 RTJ	34.07	865	23.07	586	1086	494
8 in [203 mm ] ANSI Class 1500 RF	36.01	912	25.01	632	1258	572
8 in [203 mm ] ANSI Class 1500 RTJ	36.20	916	25.20	637	1258	572

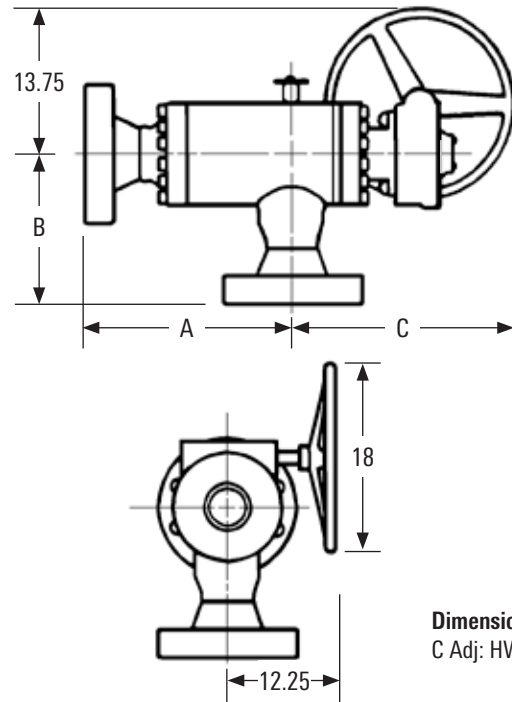
### M6 trim



<sup>†</sup>  $C_v$  values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

<sup>‡</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic or tungsten-carbide trim.

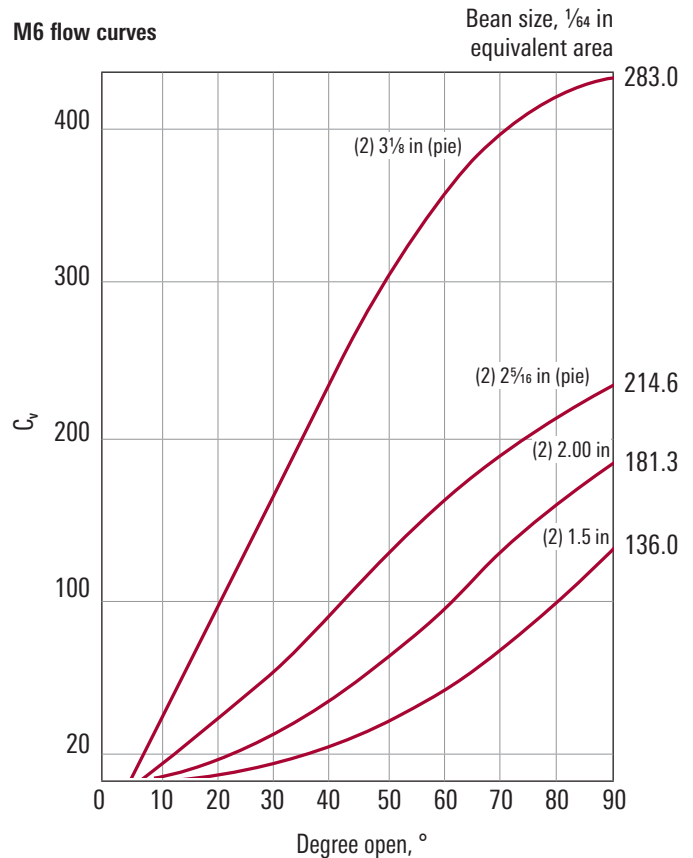
### M6 dimensions



#### Dimension

C Adj: HW Gear = 22.50 in

### M6 flow curves



# MOV Positive Chokes

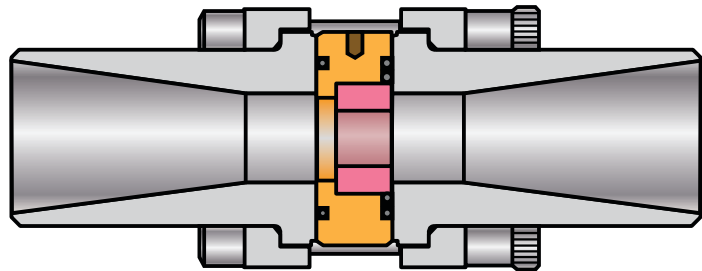
Most of our MOV chokes have the capability of being field converted from the standard rotating disc design to a positive configuration. Conversely, positive chokes can be field converted to adjustable rotating discs when desired. Removal of beans requires no special tools and each bean is marked in 64th of an inch for easy identification.

## In-line positive chokes

In-line positive chokes are available for either standard service or high-temperature applications. Standard chokes are constructed with O-ring seals and are recommended for temperatures less than 225 degF [107 degC]. High-temperature positive chokes are furnished with spiral-wound flexitallic gaskets and are designed for temperatures up to 750 degF [399 degC]. Servicing is a simple matter of loosening the hub flange bolts and partially disassembling the connection to allow the bean to be removed or replaced as required.

### In-line Positive Choke

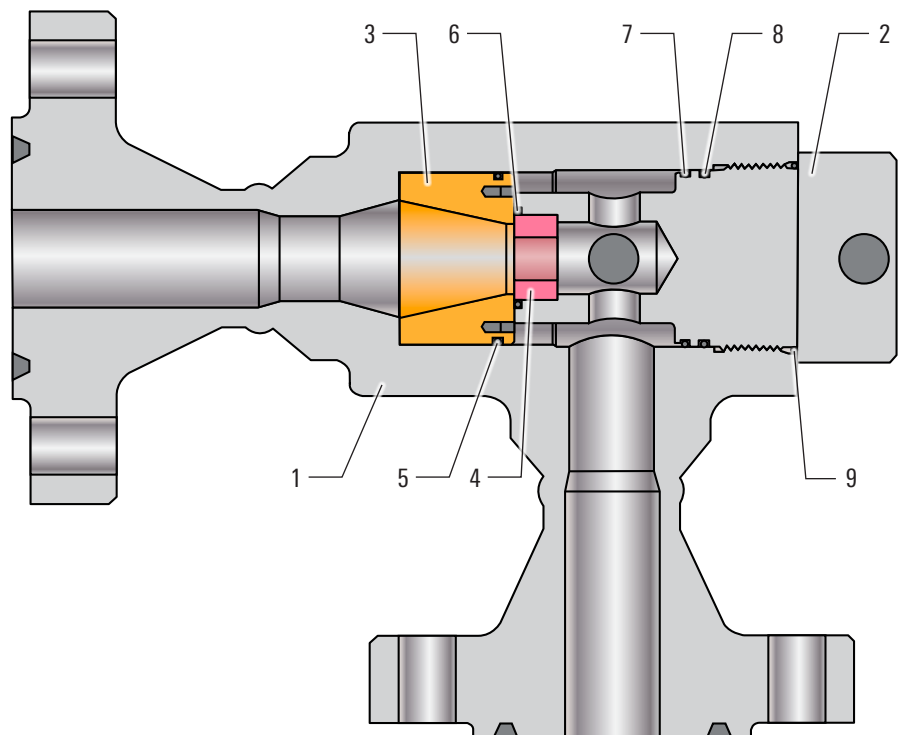
Size	Standard connections	Max. CWP	Max. bean	Bean material
2 in [51 mm]	1-in female threaded	5,000 psi	74/64s	Either stainless steel or tungsten carbide come in sizes up to 66/64s. All larger orifice sizes come in stainless steel.
1 in [25 mm] or 2 in [51 mm]	2-in male threaded butt weld			
3 in [76 mm]	3-in butt weld	6,000 psi	128/64s	
4 in [102 mm]	4-in butt weld	5,000 psi	176/64s	



### M2 Positive Choke Parts List

Key no.	Description	Quantity
1	Body	1
2	Bonnet	1
3	Seat†	1
4	Bean insert†	1
5	O-ring, seat†	1
6	O-ring, bean†	1
7	O-ring, bonnet†	1
8	O-ring, bonnet†	1
9	O-ring, bonnet†	1

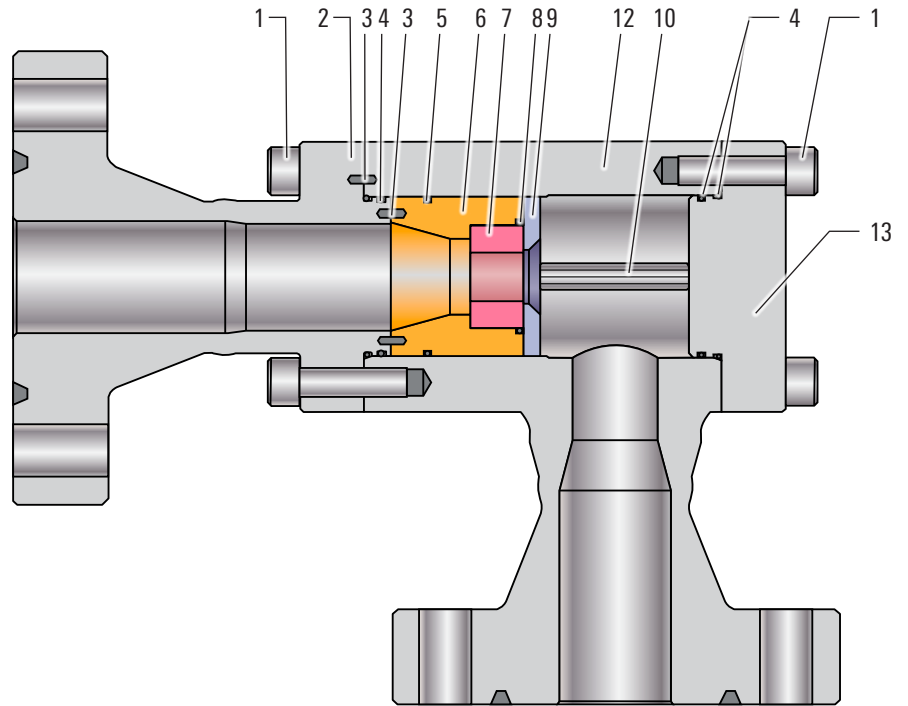
†Recommended spare parts for one year of operation.



### M3 Positive Choke Parts List

Key no.	Description	Quantity
1	Capscrew	16
2	Outlet flange assembly	1
3	Dowel pins <sup>†</sup>	3
4	O-ring, outlet spool and bonnet <sup>†</sup>	4
5	O-ring, bean carrier <sup>†</sup>	1
6	Bean carrier <sup>†</sup>	1
7	Bean insert <sup>†</sup>	1
8	O-ring, bean <sup>†</sup>	1
9	Retainer plate	1
10	Retainer post	2
12	Body	1
13	Bonnet	1

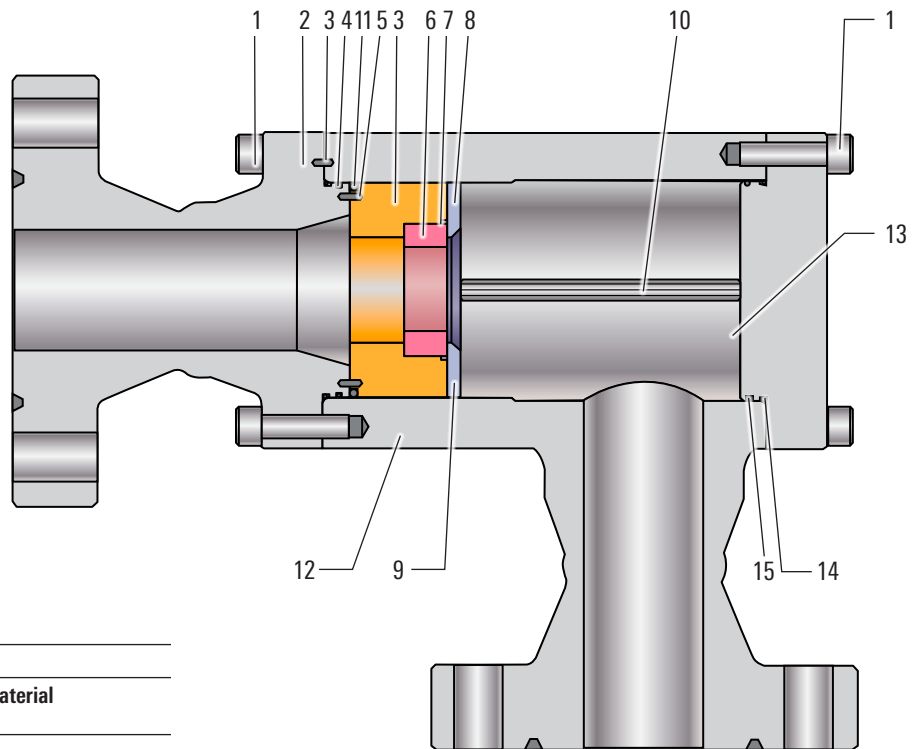
<sup>†</sup>Recommended spare parts for one year of operation.



### M4 Positive Choke Parts List

Key no.	Description	Quantity
1	Capscrew	24
2	Outlet flange assembly	1
3	Dowel pins <sup>†</sup>	3
4	O-ring, outlet spool <sup>†</sup>	1
5	O-ring, bean carrier <sup>†</sup>	1
6	Bean carrier <sup>†</sup>	1
7	Bean assembly <sup>†</sup>	1
8	O-ring, bean <sup>†</sup>	1
9	Retainer plate	1
10	Retainer post	2
11	O-ring, outlet spool <sup>†</sup>	1
12	Body	1
13	Bonnet	1
14	O-ring, bonnet <sup>†</sup>	1
15	O-ring, bonnet <sup>†</sup>	1

<sup>†</sup>Recommended spare parts for one year of operation.



### MOV Positive Bean

Valve type	Available positive bean sizes, in	Bean material
M2	$\frac{2}{64}$ to $\frac{7}{64}$	Either stainless steel or tungsten carbide come in sizes up to $\frac{66}{64}$ s. All larger orifice sizes come in stainless steel.
M3	$\frac{2}{64}$ to $\frac{96}{64}$	
M3G	$\frac{2}{64}$ to $\frac{96}{64}$	
M4	$\frac{2}{64}$ to $\frac{176}{64}$	
M6	$\frac{176}{64}$ to $\frac{304}{64}$	



# Technical reference

**Cameron Body Material Chart (Subject to change per O.A./Engineering Evaluation)**

Service temperature range, degF [degC]	Style 0		Style 8		Style 4			Sea water	HCl environment
	Standard service ASTM API Type: 1,2,3		H <sub>2</sub> S NACE MR-01-75		CO <sub>2</sub> with or without H <sub>2</sub> S				
					Partial pressure, psi				
				0-3	(3-30)	30+			
-50 to 230 degF [-46 to 110 degC] Style C	A350 LF2	8620 } 8720 } 4130 }	A352LCB/LCC <sup>†</sup> } 8620 } 8720 } A350 LF2 <sup>†</sup> } 4130 }	8620 } 8720 } 4130 }	8620 } 8720 } 4130 }	A182 F6NM Inconel 625 Inconel 600 A487 CA6NM Incoloy 825 Alloy 20 Duplex <sup>§</sup> A351 CF8M } 316 SS } 8351 CF3 A487 CA6NM } A182 F6NM }	Inconel 625 Inconel 600 Incoloy 825 Alloy 20 Duplex <sup>§</sup> 316 8620 8720 4130	Inconel 625 Hastelloy C276 Inconel 625 Alloy 20 Duplex <sup>§</sup>	
-20 to 230 degF [-29 to 110 degC]	A 487 4N	8620 } 8720 } 4130 }	A 487 4N <sup>†</sup>	8620 } 8720 } 4130 }	8620 } 8720 } 4130 }	410 SS Inconel 625 Inconel 600 A182 F6a } Incoloy 825 Alloy 20 Duplex <sup>§</sup> 316* 410 SS	Inconel 625 Inconel 600 Incoloy 825 Alloy 20 Duplex <sup>§</sup> 316 8620 8720 4130 NAIA Bronze <sup>‡</sup>	Hastelloy C276 Inconel 625 Alloy 20 Duplex <sup>§</sup>	
	A105 A216 WCB }		AA352LCC } A352LCB }	8620 } 8720 } 4130 }	8620 } 8720 } 4130 }	A105 <sup>†</sup>			
-20 to 350 degF [-29 to 110 degC]	A105	8620 } 8720 } 4130 }	A105 <sup>†</sup>	8620 } 8720 } 4130 }	8620 } 8720 } 4130 }	410 SS Inconel 625 Inconel 600 A182 F6a } Incoloy 825 Alloy 20 Duplex <sup>§</sup> 316 <sup>†</sup> 410 SS	Inconel 625 Inconel 600 Incoloy 825 Alloy 20 Duplex <sup>§</sup> 316 8620 8720 4130 NAIA Bronze <sup>‡</sup>	Hastelloy C276 Inconel 625 Alloy 20 Duplex <sup>§</sup>	
	A216 WCB }				A105 <sup>†</sup>				

<sup>†</sup> Additional requirement: Hardness HRC22 max. as heat-treated seawater without H<sub>2</sub>S.

<sup>\*</sup> 316 SS for high CO<sub>2</sub> plus chloride.

<sup>§</sup> Ferralium 255 or Sandvik 2205.

<sup>††</sup> Includes Charpy impact testing for Style C.

<sup>≡</sup> Equivalent regarding corrosive resistance.

## MOV Trim Selection, Flow Coefficient C<sub>v</sub> (Maximum)<sup>‡</sup>

Valve type	Body maximum pressure rating, psi <sup>†</sup>	Trim size (number of holes, diameter)																
		1, 1/8	2, 1/8	1, 1/4	2, 1/4	1, 1/2	2, 1/2	2, 3/4	2, 3/4	2, 7/8	2, 1	2, 1 1/16	2, 1 1/4	2, 1.41	2, 1 1/2	2, 2	2, 2 5/16	2, 3 1/8
MC20	API 5,000	—	—	—	2.98	6.22	13.73	—	32.30	—	56.60	—	77.10	—	—	—	—	—
MIA	API 5,000	0.33	0.67	1.54	3.12	5.71	11.20	14.50 <sup>§</sup>	—	—	—	—	—	—	—	—	—	—
MC10	ANSI Class 1500	0.33	0.70	1.60	3.33	6.85	13.50	19.60 <sup>§</sup>	—	—	—	—	—	—	—	—	—	—
M2	API 10,000	—	0.65	1.46	3.21	6.22	14.00	17.70	27.20	30.20	36.10 <sup>§</sup>	—	—	—	—	—	—	—
M3	API 6,250	—	—	1.60	3.33	6.85	14.00	17.70	29.90	—	48.80	68.50	77.50 <sup>§</sup>	87.90 <sup>§</sup>	—	—	—	—
M3G	API 10,000	—	—	1.60	3.33	6.85	14.00	17.70	29.90	—	48.80	68.50	77.50 <sup>§</sup>	87.90 <sup>§</sup>	—	—	—	—
M4	API 6,250	—	—	—	—	6.85	14.00	17.70	29.90	—	57.20	87.80	—	—	130.00	188.00	218.00 <sup>§</sup>	—
M6	API 3,750	—	—	—	—	—	—	—	29.90	—	57.20	87.80	—	—	130.00	188.00	235.00 <sup>§</sup>	435.00

<sup>†</sup> Valve pressure rating for specific configurations can be less depending on end connections, valve style and use of ceramic- or tungsten-carbide trim.

<sup>‡</sup> C<sub>v</sub> values given in table are subject to variation depending on valve end connections and options such as wear sleeves and backpressure beans.

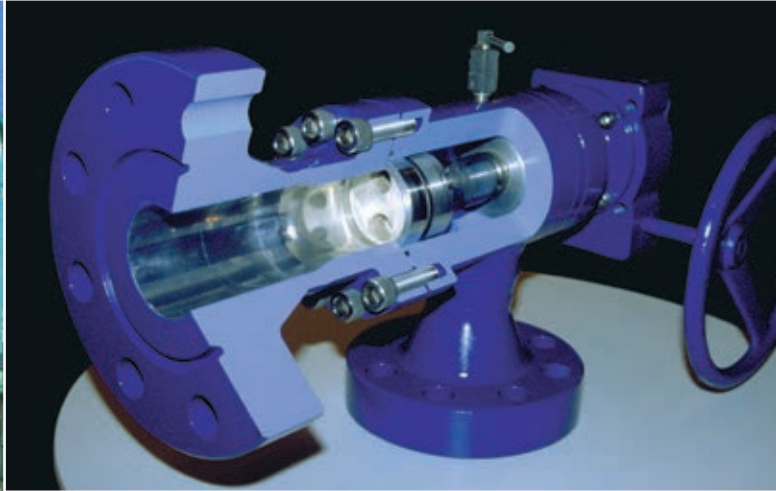
<sup>§</sup> Pie-shaped holes.

Because of continued research, testing and product improvement programs and flow coefficient, C<sub>v</sub> values are subject to change.



*M2 choke with pneumatic actuator.*

**WILLIS**



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