

# Production Chokes

# Our history

**1958**

Best Industries introduces production chokes into the market.

**1977**

Varco International acquires Best Industries, creating Varco/Best Flow Products.

**1980**

The Maximum Performance Cage (MPC) series, capable of handling severe erosive service and featuring trim wear montior, launches into market.

**1982**

Cor-val begins making replacement trim components for all manufacturers of chokes.

**1991**

Cor-val begins manufacturing needle and seat choke assemblies.

**1992**

Varco acquires Shaffer and adds Varco/Best Flow Products to the Shaffer line.

**1994**

Cor-val introduces its first engineering choke, the CVC series with cage style trim.

**1996**

Varco/Best introduces the VBS-1000 Stepping Actuator.

**1997**

In-line MPC chokes are added to the Shaffer product line.

**2001**

Cor-val is acquired by T3 Energy Services and expands its footprint.

**2005**

Varco and National Oilwell merge into National Oilwell Varco (NOV) and the Varco/Best choke like is added into the NOV choke line.

**2008**

T3 Energy Services produces the first and longest lasting frack production choke for the extreme severe service of gas shale plays.

**2011**

Robbins & Myers acquires T3 Energy Services.

**2013**

NOV acquires Robbins & Meyers.

# Get to know our production chokes



We've been in the chokes business for almost 60 years

Installed in over **50 countries** across the globe



**2,000+** configuration combinations



Material | Size | Pressure rating choices

We have used **enough tungsten** in our trim **to supply New York City with light bulbs for over 5 years!**



Our choke can handle temperatures



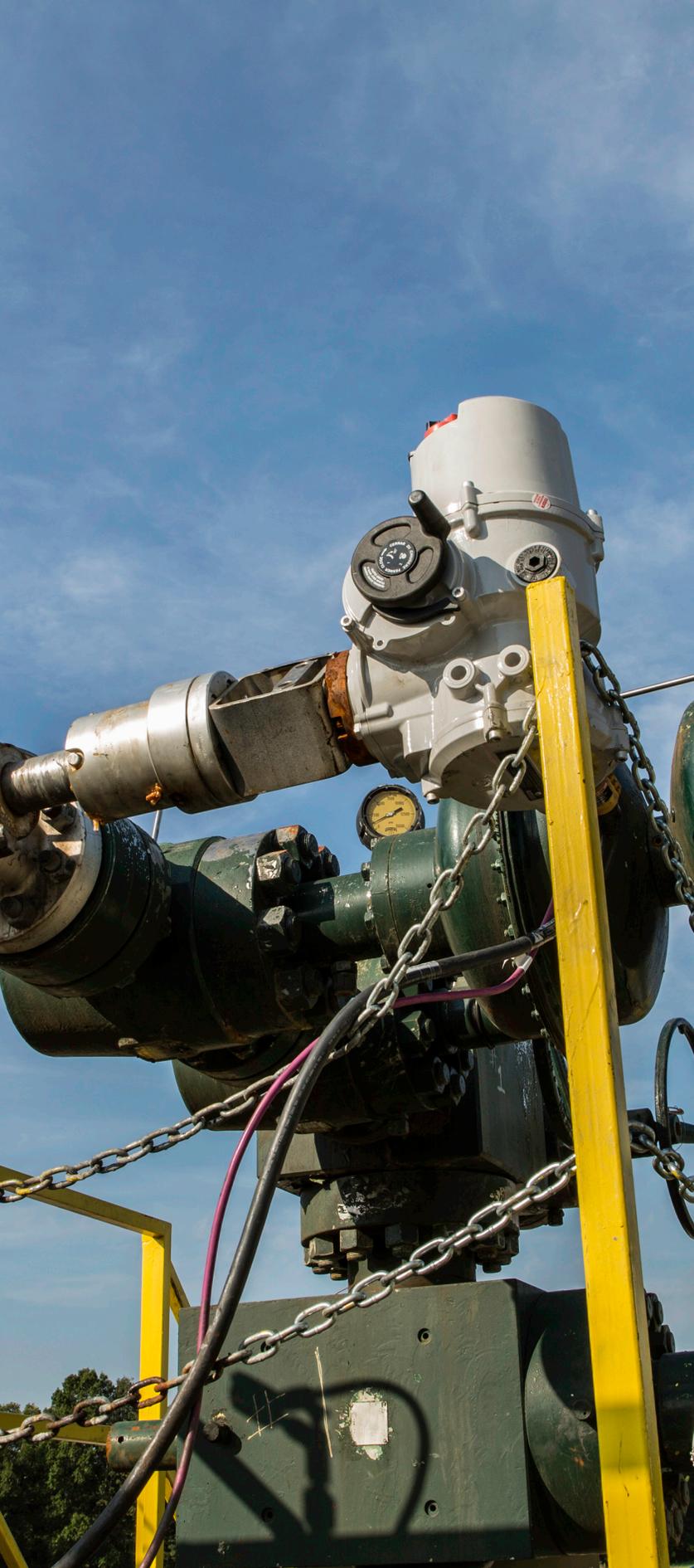
**650°**



**-150°**



With 6,100 of our 2" chokes or 2,800 3" chokes you **could flow the Nile River!**



**We are a worldwide supplier of choke products for the oil and gas production market, providing solutions for a multitude of applications.** As experts in pressure and flow control, we have the most advanced technologies to suit your needs. Our global footprint allows us to be close to nearly every production site. We strive to grow your business and become your strategic partner.

Our products are engineered and manufactured in compliance with the following industry standards:

- API 6A / ISO 10423
- PR1 and PR2
- ANSI B16.5
- NACE Mr0175
- ISO 9001/2008
- EN 10204
- Independent design certifications available upon request (DNV, ABS, Lloyd's, BV)
- CE marking available upon request

Applications:

- Production
- Manifolds
- Water injection
- Gas injection
- Cementing
- Gas processing
- Other industrial applications

We have the history, the expertise, and the resources to help you manage the pressure and flow of your application. We are committed to providing you with the best engineering capabilities and the latest technologies to get the job done right, with trusted products you can depend on—the first time, on time, every time.

### Sizing Options

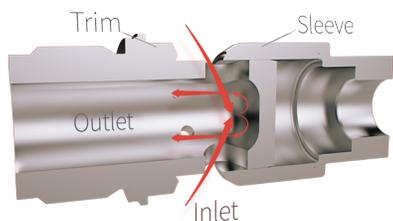
Choke sizing is the most critical part of the choke application and incorrect sizing is the source of most choke issues in the field. Let us work closely with you and employ our expertise to properly size your choke and select the best trim for your application.

Our goal is to provide you with a reliable choke with the proper size and design that will exceed your expectations. If a choke with too small a Cv is specified, the choke will not flow the required volume of fluid. If a choke with too large a Cv is specified, the choke will offer poor controllability and a short operational life. Correct sizing will reduce or eliminate other issues such as high velocities, cavitation, and flashing.

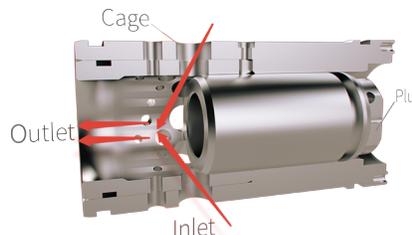
### Trim Options

The heart of the choke is its trim. Our trim is constructed with Tungsten Carbide specially formulated to resist erosion even when under the most severe applications. We have the following geometries:

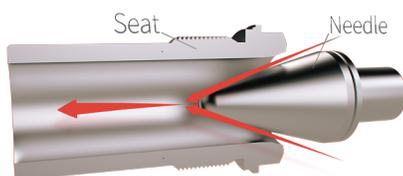
**1) External Sleeve**— a sleeve on the tip of the stem travels up and down the outside of the cage. The sleeve will expose or close the ports as it moves. Typically used for higher pressure and small orifice applications in severe service.



**2) Plug & Cage**— a plug on the tip of a stem travels up and down on the inside of the cage. The plug will expose or close the ports as it moves. Typically used for larger orifice and lower pressure applications where fine control is critical.



**3) Needle & Seat**— a cone shaped stem tip travels in and out of a stationary seat. Typically used for lower pressure differential and small orifice applications



**4) Positive Seat**— This trim has a set orifice size that cannot be externally adjusted. To change the orifice size the seat must be removed from the body and replaced with a seat with a different orifice size. A cage version of the positive seat is also available for severe service.

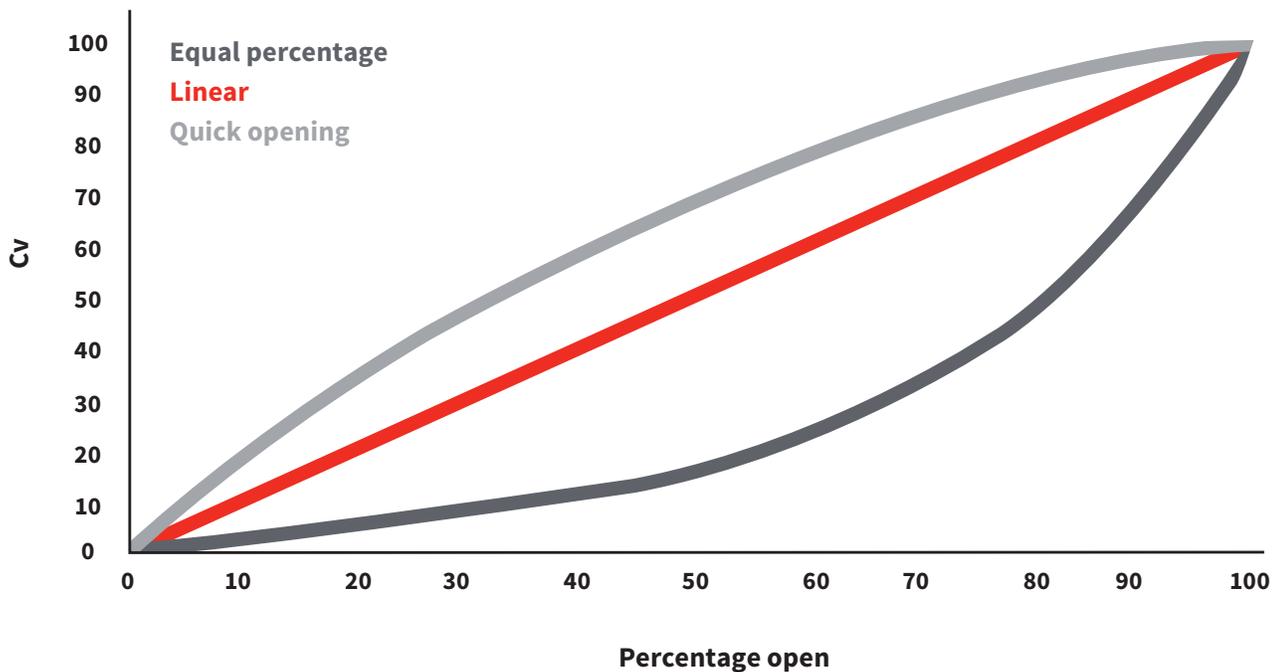
**5) Multi-Stage Stacked Disc**— Multistage trim chokes are primarily for two types of service: very high pressure drops with the risk of cavitation, and high pressure gas service for noise abatement. Our stacked disk is designed with a semi-circular porting pattern that offers longer wear life. Circular flow cross sections are more wear resistant than rectangular cross sections, especially for hard materials such as tungsten carbide.

## Trim Flow Characteristics

The characteristic curve or flow curve of a choke shows the relationship between Cv and percent open. The graphs show the Cv increasing as the choke is opened. There are three types of characteristic curves available.

- Quick Opening– opens up very quickly and does not offer good control. It is used mostly for on-off applications. A needle and seat style choke would inherently have this type of flow curve.
- Linear– produces equal changes in flow per unit of choke stroke. It produces the same controllability throughout the stroke.
- Equal Percentage– offers superior control on the low end of the stroke while providing less control — but much more capacity — at the end of the stroke.

A cage style choke can be tailored to have any of these type curves as needed. Most cage style chokes have a curve that is between a linear and an equal percentage style curve.

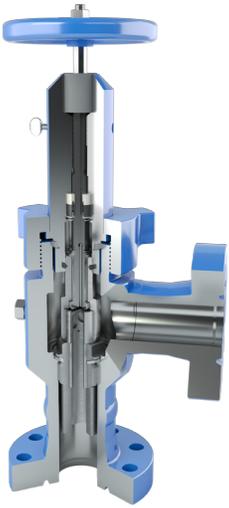


## Production Chokes

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### CVC-ME External Sleeve

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**The CVC-ME is designed for severe service applications and high pressure drops.**

Our external sleeve cage concept uses the principle of flow impingement to dissipate energy. This model is commonly installed on Christmas trees, manifolds and in-line with other production equipment. It offers extended service life with superior efficiency and added safety. With submicron grade carbide, metal bonnet seal, and proprietary trim geometry, the CVC-ME offers the most reliable performance in erosive, sandy and other harsh applications. Our field-proven design has consistently outlasted the competition.

### CVC-MP Plug & Cage

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**The CVC-MP is designed to flow large volumes of production fluid and for applications where a high level of controllability is desired.**

This model is commonly installed on Christmas trees, manifolds, and in-line with other production equipment. Features include its submicron grade carbide, metal bonnet seal, threadless body, fully guided cage trim and high Cv capacity.

### MPC External Sleeve

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**With a long history of proven performance worldwide, the MPC (Maximum Performance Cage) choke is a highly engineered design suitable for a wide variety of applications.** This model can be customized for extreme temperature conditions as low as -150°F to as high as 575°F. Features include the Wear Monitor which reduces the chance of a washout by facilitating seat seal and seat wear leakage detection. Like the CVC-ME design, the trim is an external sleeve cage suitable high pressure drops. However, in MPC models, the rated capacity or curve characteristic can be modified by exchanging only the seat assembly. This can greatly reduce the quantity of spares in inventory.

### MPC-S Plug & Cage

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**The MPC-S model boasts the same history of proven performance worldwide as the MPC - external sleeve choke with the difference being that this is the internal cage version.** It is rare in the industry to find large internal cage style chokes suitable to high pressures, however this model can be customized to sustain up to 20,000 psi. Like the MPC-External sleeve, this design also includes the Wear Monitor which reduces the chance of a washout by facilitating seat seal and seat wear leakage detection. Furthermore, MPC-S chokes also allow for modification of the rated capacity or curve characteristic by a simple swap of the seat assembly. Like the CVC-MP, MPC-S models are recommended to flow a large volume of fluid with superior controllability.

## Production Chokes

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### MPC In-Line

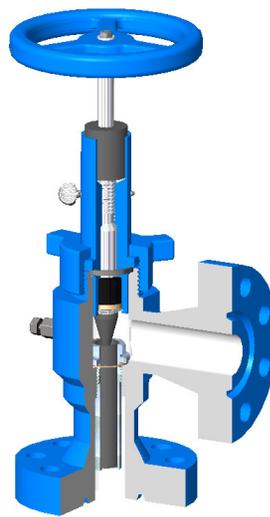
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This series shares in the same successful, world-wide history as all the MPC models, but with an in-line body for cases where it best suits our customer's piping needs. Components are interchangeable between angled bodied MPCs and in-line MPCs.

### CH2 & CH2M

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Our most economic offering, this needle-and-seat model is used in the broadest range of applications: from drilling manifolds to production trees and everything in between.

The needle and seat series is interchangeable with the legacy Best B-H2 chokes and industry standard H2 needle and seat style models. There are two possible configurations: Positive or Adjustable. A positive CH2 can be converted into an adjustable CH2 and vice-versa. In addition, the CH2M boasts a metal bonnet seal and is field convertible to a cage choke.

### PLF Choke

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Our Precise Low Flow (PLF) Choke is uniquely suitable for applications with very low flow rates, where customer's require precise high-resolution flow control, versatile pressure capabilities, proprietary pressure assisted shutoff seal technology, and wear resistance that provides five times longer life than the competition. The PLF choke is designed to work in low Cv, highly erosive applications, with pressures ranging up to 15,000 psi.

### C20

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This series was designed to handle the most corrosive flow media, high pressures, and extreme temperatures in the safest, most efficient, and effective way possible. The C20 is built with an integral body design and with no elastomeric seals. The C20 trim design is meant to reduce the torque necessary for operation, allow for fine control, low noise, while withstanding severe erosion service.

We have a field-proven history designing chokes for extreme conditions including high sand, high pressure drop applications, highly erosive service, temperatures from -150°F to 650°F and rated pressures up to 30,000 psi. Contact our expert sales team to help you identify the choke model best suited to your application.

## Automation Options

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We can provide automation solutions to suit any application on our standard choke models, or we can provide a customized solution that suits your project specifications. Our manual chokes are designed with future automation in mind, so these models can be converted to automated operations in a simple, efficient, and economical manner.

Most of our series have a unique operator system with a lower nonrotating rising stem and yoke assembly. This assembly allows for quick adaptation to any manufacturer's actuator. In most cases, this conversion can be performed in the field and without the need to open the choke or remove it from the line. In some cases, it may be necessary to replace the choke bonnet and stem to accommodate some manufacturers' actuator models. We can provide a fully engineered and preassembled bonnet assembly as a complete upgrade kit. Automation upgrade kits will keep downtime for the conversion to an absolute minimum.

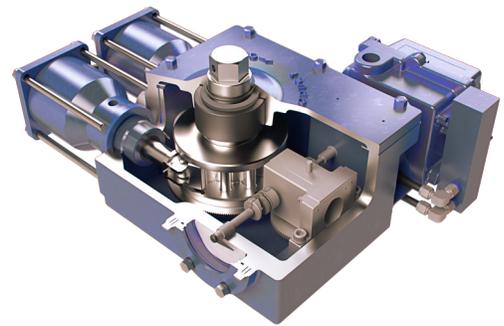
Various control and position feedback options are available with electrical components certified for use in hazardous areas. FM/UL Class 1 Div 1, CSA, ATEX EExd, EExia are available. We can also provide interface to major international standard communication and control protocols such as Foundation Fieldbus, Profibus, Device Net, Modbus, and HART.

### Automation options include:

- Pneumatic or Hydraulic VBS-100 Stepping Actuator
- Electric
- Pneumatic Diaphragm/Piston
- Hydraulic

## VBS Stepping Actuator

The VBS-100 Stepping Actuator has a highly reliable design for remote control and automation of production chokes. The VBS-100 steps in 36° increments for opening and closing the choke in the most controlled manner. This is accomplished by a pawl and drive spool arrangement that directly drives the choke stem coupling. A pulse signal to the piston moves the pawl in contact with the drive spool and produces a 36° rotation of the stem coupling.



## Services and Aftermarket

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Within the Process and Flow Technologies business group, we provide the following services and aftermarket support for our choke products:

- **GoConsult:** Consulting and Engineering Services– We provide consulting and engineering services across product lines and competitive equipment.
- **GoSpares:** Spare and Universal Parts– We provide original factory replacements for our chokes as well as upgrades.
- **GoServe:** Field Services– We support customers onsite after equipment purchase providing local field services.
- **GoConnect:** Automation and Technology Support– We provide support for all automated and onsite control systems and remote monitoring services.

### Contact information:

#### Sales

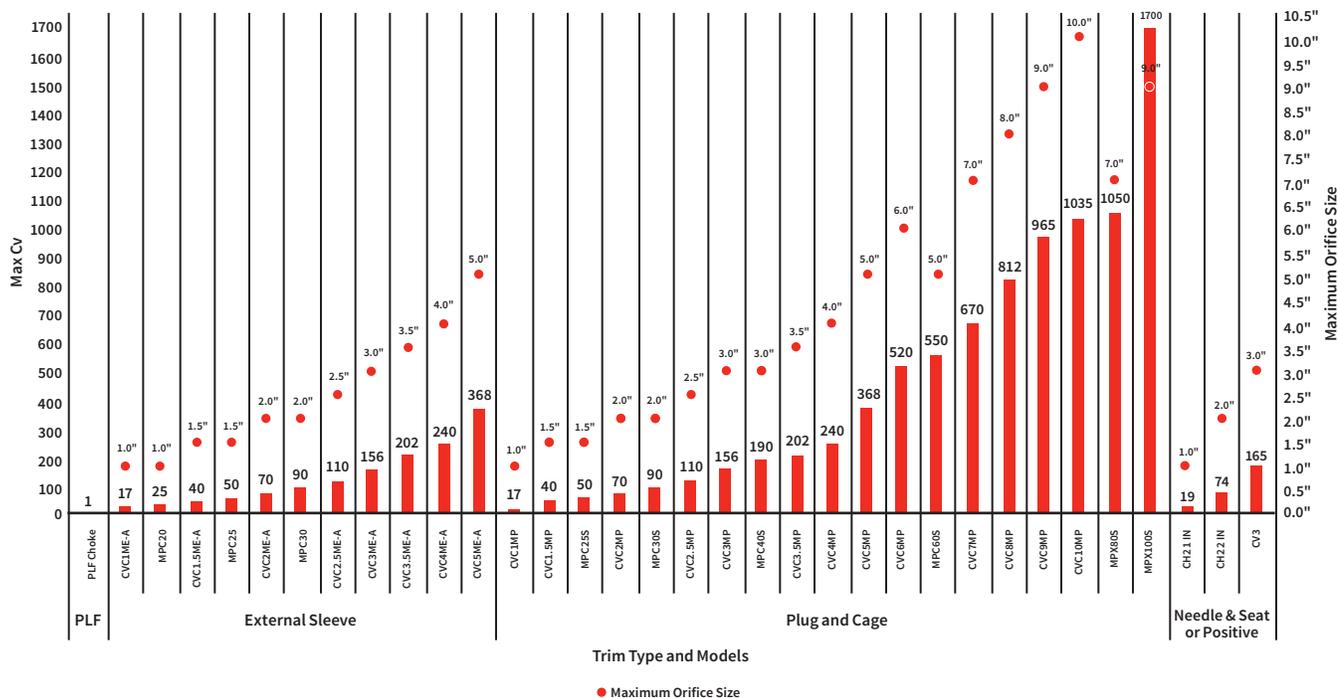
To reach our sales department, please email us at [productionchokes@nov.com](mailto:productionchokes@nov.com).

#### Service and Spare Parts

To reach our service department, please email us at [pftservice@nov.com](mailto:pftservice@nov.com).

## Choke Models and Cv Values

### Model Selection by Cv and Trim Type



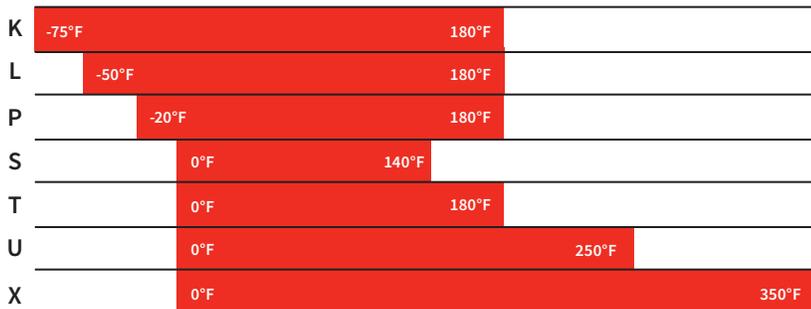
Note: Our range of capability exceeds what is show on this chart. Whatever your production flow and pressure control need is, we have a solution that will meet it.

## API 6A Temperature Ratings

In accordance to API 6A, the minimum temperature is the lowest ambient temperature the choke will encounter. The maximum temperature is the highest temperature of the fluid that may directly contact the choke.

### API 6A Temperature Ratings °F

-75°F -50°F -25°F 0°F 25°F 50°F 75°F 100°F 125°F 150°F 175°F 200°F 225°F 250°F 275°F 300°F 325°F 350°F



## Appendix

### Standard Materials

These are our standard materials of construction but we are pleased to consider and accommodate other material requirements you might have.

#### API 6A Material Class and Material Selection<sup>3</sup>

	AA, BB	EE-0.51, EE-1.5 <sup>1</sup>	EE-3601, EE-NL <sup>2</sup>	CC, FF-0.51, FF-1.5 <sup>1</sup>	FF-3601, FF-NL <sup>2</sup>	HH-3601, HH-NL <sup>2</sup>
<b>Body &amp; Bonnet</b>	AISI 4130	AISI 4130	AISI 4130	AISI 410 SS or Grade F6NM SS	AISI 410 SS or Grade F6NM SS	AISI 4130 w/ Alloy 625 Cladding
<b>Stem (Wetted)</b>	AISI 410 SS or Grade 17-4 PH SS	AISI 410 SS, Grade 17-4 PH SS, or Grade F6NM SS	Alloy 718 or Alloy 725	AISI 410 SS, Grade 17-4 PH SS, or Grade F6NM SS	Alloy 718 or Alloy 725	Alloy 718 or Alloy 725
<b>Bolting</b>	ASTM A193 B7 or ASTM A320 L7	ASTM A193 B7 or ASTM A320 L7	ASTM A193 B7 or ASTM A320 L7	ASTM A193 B7 or ASTM A320 L7	ASTM A193 B7 or ASTM A320 L7	ASTM A193 B7 or ASTM A320 L7
<b>Seat, Cage, External Sleeve, Plug</b>	AISI 410 SS and Tungsten Carbide	AISI 410 SS and Tungsten Carbide	AISI 410 SS and Tungsten Carbide	AISI 410 SS and Tungsten Carbide	AISI 410 SS and Tungsten Carbide	Alloy 718 and Tungsten Carbide
<b>Stem Packing</b>	PTFE and Elgiloy® (Co-Cr-Ni-Mo Alloy)	PTFE and Elgiloy® (Co-Cr-Ni-Mo Alloy)	PTFE and Elgiloy® (Co-Cr-Ni-Mo Alloy)	PTFE and Elgiloy® (Co-Cr-Ni-Mo Alloy)	PTFE and Elgiloy® (Co-Cr-Ni-Mo Alloy)	PTFE and Elgiloy® (Co-Cr-Ni-Mo Alloy)

Notes:

<sup>1</sup> H<sub>2</sub>S concentration as defined by ISO 15156 (NACE MR0175).

<sup>2</sup> H<sub>2</sub>S no limit as defined by ISO 15156 (NACE MR0175).

<sup>3</sup> This material selection is subject to change without notice.

### API 6A Material Requirements

Material Class <sup>a</sup>		Minimum Material Requirements	
		Body, bonnet, inlet and outlet connections	Pressure-controlling parts and stems
<b>AA</b>	General Service	Carbon or low-alloy steel	Carbon or low-alloy steel
<b>BB</b>	General Service	Carbon or low-alloy steel	Stainless steel
<b>CC</b>	General Service	Stainless steel	Stainless steel
<b>DD</b>	Sour Service <sup>a</sup>	Carbon or low-alloy steel <sup>b</sup>	Carbon or low-alloy steel <sup>b</sup>
<b>EE</b>	Sour Service <sup>a</sup>	Carbon or low-alloy steel <sup>b</sup>	Stainless steel <sup>b</sup>
<b>FF</b>	Sour Service <sup>a</sup>	Stainless steel <sup>b</sup>	Stainless steel <sup>b</sup>
<b>HH</b>	Sour Service <sup>a</sup>	Corrosion-resistant alloys (CRAs) <sup>bcd</sup>	Corrosion-resistant alloys (CRAs) <sup>bcd</sup>

<sup>a</sup> As defined by ISO 15156 (all parts) (NACE MR0175).

<sup>b</sup> In accordance with ISO 15156 (all parts) (NACE MR0175).

<sup>c</sup> CRA required on retained fluid-wetted surfaces only; CRA cladding of low-alloy or stainless steel is permitted.

<sup>d</sup> CRA as defined in API 6A Clause 3; ISO 15156 (all parts) (NACE MR0175) definition of CRA does not apply.

<sup>e</sup> Material classes DD, EE, FF and HH shall include as part of the designation and marking the maximum allowable partial pressure of H<sub>2</sub>S in units consistent with the rated working pressure markings and prefixes consistent with ISO 15156 (all parts) (NACE MR0175; see Clause 2).

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