CAMERON
A Schlumberger Company

# Control Chokes

The industry standard in flow control technology

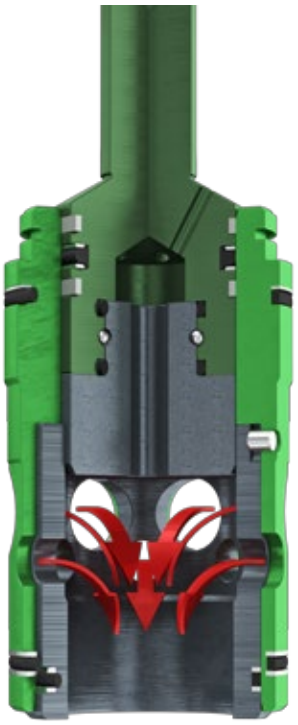
Cameron control choke design incorporates hydrodynamic energy dissipation to reduce erosion problems while ensuring positive flow control.

During service, the flow enters the choke inlet and circulates around the annulus between the body and the cage. The cage has an even distribution of ports that determine the maximum flow capacity.

The high-velocity fluid streams produced by the flow collide in the center of the cage. Since the fluid streams impinge directly with each other, this enables the most erosive energy to be dissipated. This in turn minimizes the risk of erosion damage to downstream components.

Our control chokes are designed to provide precise flow control throughout their entire operating range, with a well-proven track record in the field:

- Suitable for a wide variety of applications, including production, injection, artificial lift, flowback, storage, etc.
- Commonly installed on Christmas trees, manifolds, line heaters, offshore platforms, FPSOs, and other equipment, providing precise flow control under severe service conditions.
- Available with plug & cage, external-sleeve or multistage trim types.
- Multiple flow characteristics, including 'linear' or 'equal percentage', with special trim solutions available in response to specific challenges.
- Special trim solutions include ultra-low $C_v$, low noise, and well cleanup types.
- Control chokes offer a complete solution from startup to late life conditions, with the flexibility to easily retrofit various trim types as conditions evolve.
- Available in manual and actuated configurations, including multiple actuator types.



*Plug & cage trim*

*External sleeve trim*

# Plug & Cage

The plug & cage control choke uses the plug as the controlling element, and throttles the flow on the internal diameter of the ported cage. The ports in the cage are sized and arranged to give the most appropriate combination of controllability and flow capacity for each application.

A major consideration when sizing the choke is the ability to achieve closely managed well startup while also optimizing capacity towards the end of well life to maximize production.

The plug & cage design is highly optimized, and incorporates the largest possible flow area, making it ideal for high-capacity applications.

Plug & cage chokes also are constructed with a solid tungsten carbide plug tip and inner cage for extended resistance to erosion. It may further be configured with a solid tungsten carbide wear sleeve in the outlet of the body to provide enhanced protection in sandy service.

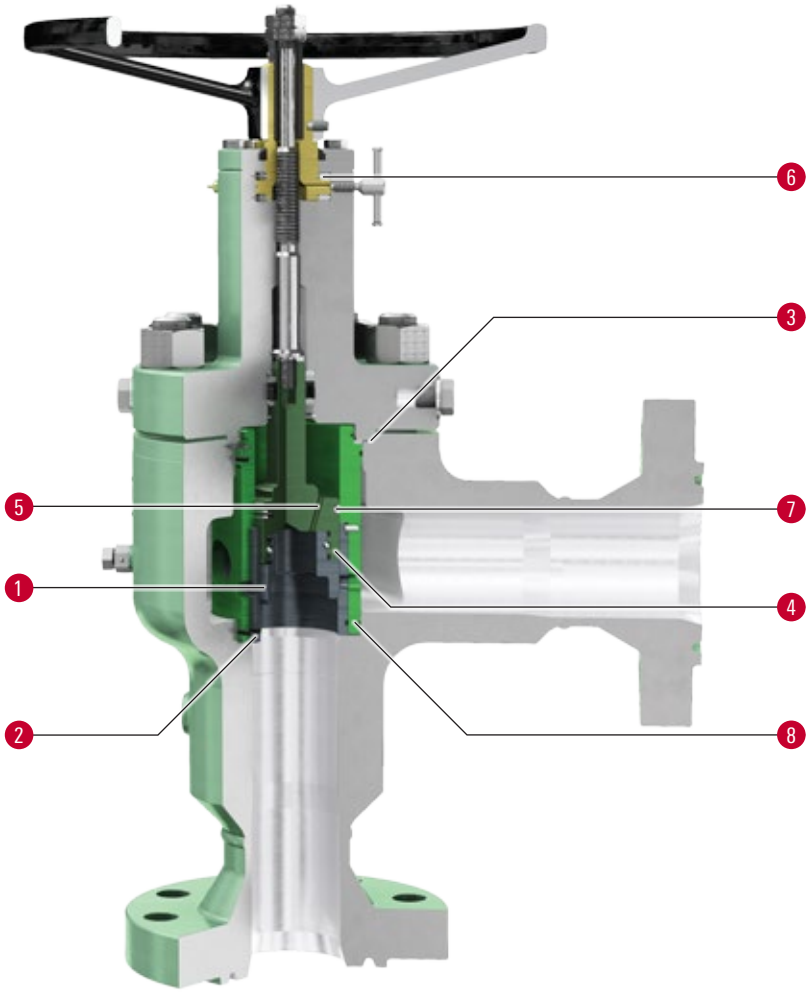
This trim also includes a thick metal outer cage to ensure maximum protection against solid impacts from debris in the flow.

The combined result is a versatile, robust, erosion-resistant trim with suitability for a broad range of challenging applications.

## Additional features include:

- Large visual indicator provides position in 1/64-in bean as standard.
- External grease port lubricates threads and bearings.
- Stem lock maintains set position.
- Bleed plug assembly vents pressure before disassembly.
- Anti-rotation key translates rotation from the drive bushing into linear movement of the lower stem/flow plug assembly.
- Two-piece stem is threaded and locked, and is removed from wellbore fluids.
- Large annulus area reduces the risk of body and trim erosion caused by high velocities.

All control chokes are available in manually operated or actuated models. Custom-designed trim components to suit a wide variety of $C_v$ capacities and flow characteristics also are available.




| Plug & cage control choke features | |
|---|---|
| 1 | Tungsten carbide plug tip |
| 2 | Solid tungsten carbide cage provides optimum wear resistance in erosive conditions |
| 3 | Metal body-to-bonnet gasket for absolute pressure containment |
| 4 | Fully guided plug reduces side loading and vibration |
| 5 | Self-flushing, pressure-balanced ports reduce stem loads and actuator output requirements |
| 6 | Heavy-duty thrust bearings reduce operating torque |
| 7 | Pressure-balanced seals are a key feature of the pressure-balanced trim arrangement, reducing operating forces and enabling greater ease of adjustment |
| 8 | Outer metal cage provides protection from impact damage |

# External Sleeve

The external sleeve control choke has a sleeve that throttles the flow on the external diameter of the ported cage. The external sleeve trim is particularly suited for low-capacity/high pressure-drop applications. The external sleeve is designed specifically for severely erosive service where the combination of high pressure drops and high sand concentrations can reduce the life of a choke.

**Additional features include:**

- Large visual indicator provides position in 1/64-in bean as standard.
- External grease port lubricates threads and bearings.
- Stem lock maintains set position.
- Bleed plug assembly vents pressure before disassembly.
- Anti-rotation key translates rotation from the drive bushing into linear movement of the lower stem/flow plug assembly.
- Two-piece stem is threaded and locked, and is removed from wellbore fluids.
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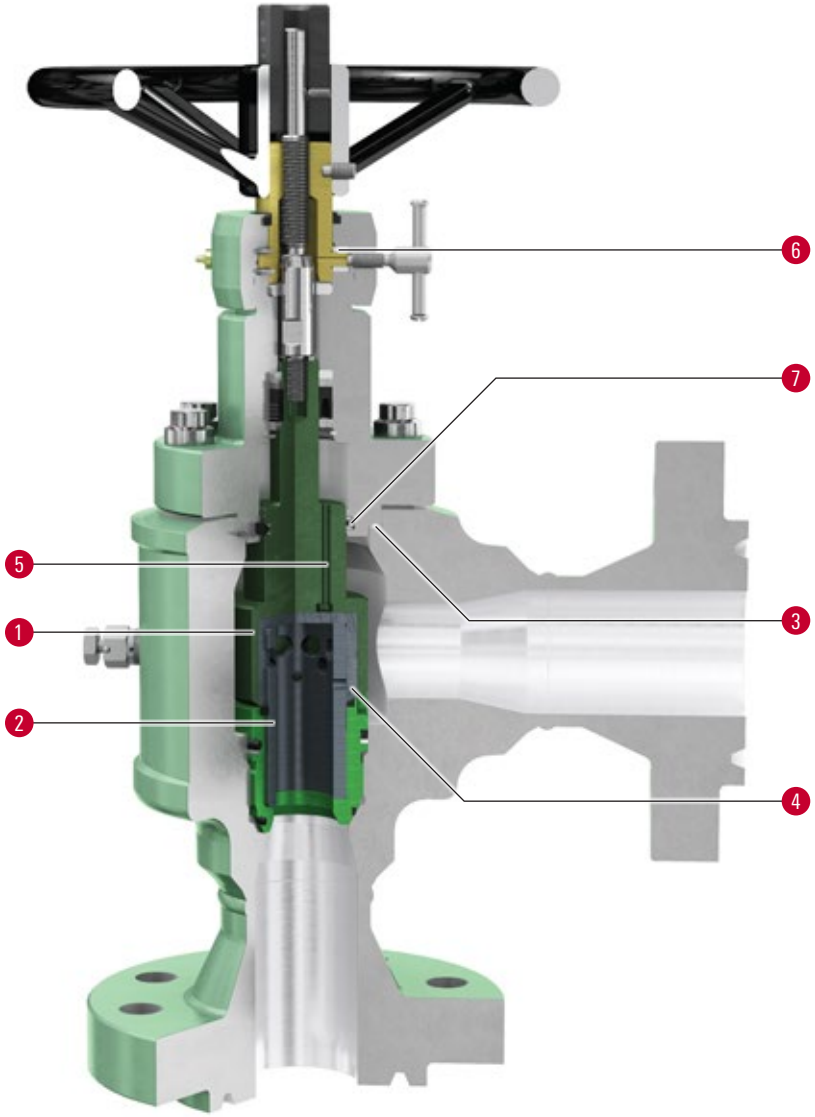


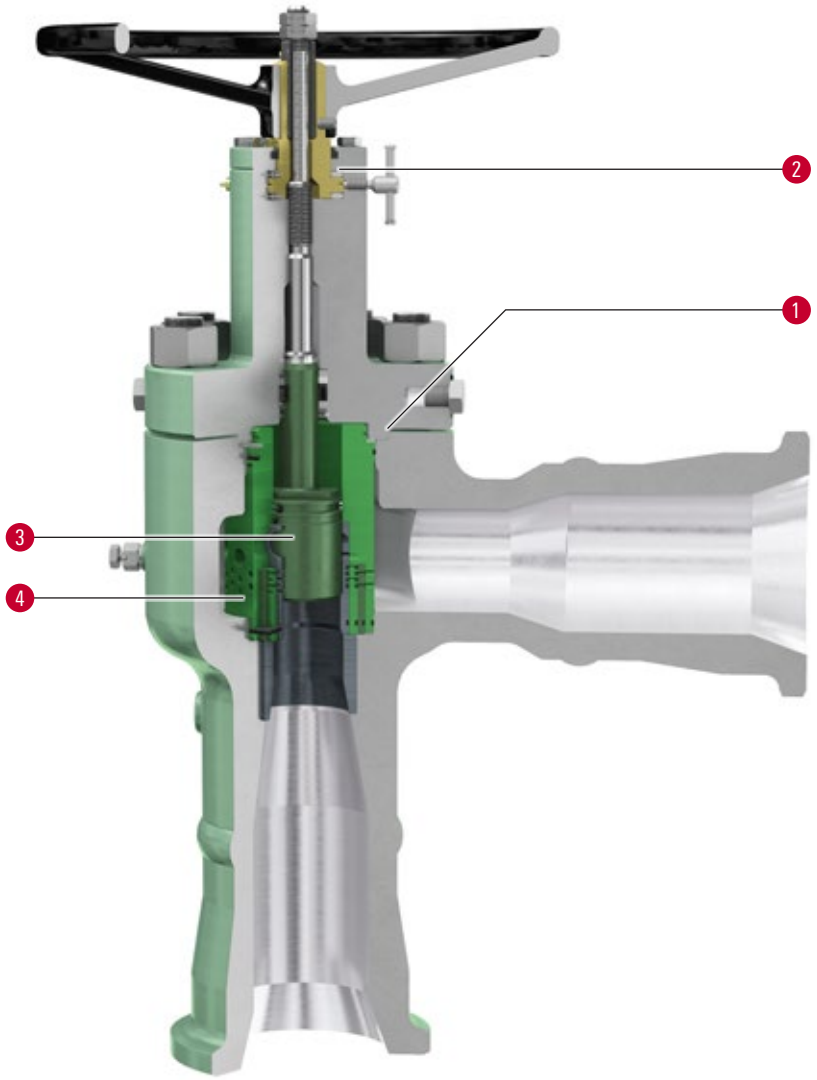

| External sleeve control choke features | |
|---|---|
| 1 | Tungsten carbide-lined external sleeve |
| 2 | Solid tungsten carbide cage/seat provides optimum wear resistance in erosive conditions |
| 3 | Metal body-to-bonnet gasket for absolute pressure containment |
| 4 | Reverse angle external sleeve improves flow dynamics within the trim |
| 5 | Self-flushing, pressure-balanced ports reduce stem loads and actuator output requirements |
| 6 | Heavy-duty thrust bearings reduce operating torque |
| 7 | Pressure-balanced seals are a key feature of the pressure-balanced trim arrangement, reducing operating forces and enabling greater ease of adjustment |

# Multistage Trim

A multistage choke trim is used in applications where high differential pressures result in unacceptably high noise and vibration levels, especially in gas service. Multistage trims also are commonly used to prevent cavitation in the case of liquids, particularly for water injection. The trim works by reducing the pressure over a number of discrete stages, giving a carefully managed pressure profile. Similarly, it manages the velocities within the trim, and prevents the occurrence of undesired flow effects such as sonic velocities and high velocity jetting. In addition to the "concentric cage" type trim illustrated here, Cameron can provide a number of alternative multistage trim options.

**Additional features include:**

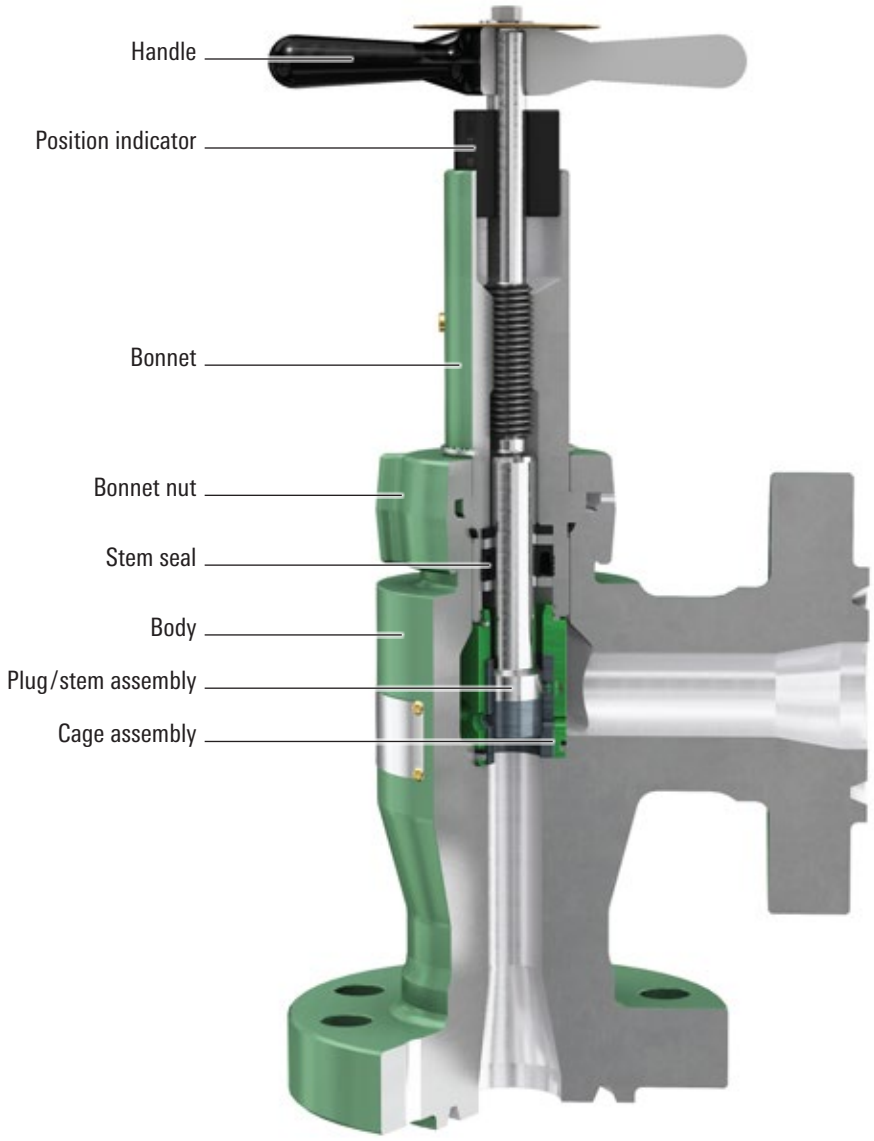
- Trim porting and geometry designed to convert potential energy (i.e., pressure) into kinetic energy and heat as a result of viscous energy dissipation.
- Splits the flow into a number of small streams, reducing the energy levels in each stream.
- Large trim surface area increases wall friction to slow fluid.
- Directional changes in trim reduce energy levels.
- Inter-stage chambers allow fluid expansion to reduce velocities.
- Fluid passes through repeated compression and expansion phases to further reduce energy levels without high velocities.
- Pressure-balanced stem and thrust bearings reduce torque, thus minimizing stem loads, actuator requirements, and handwheel torque.
- Large annulus area reduces the risk of body and trim erosion caused by high velocities.



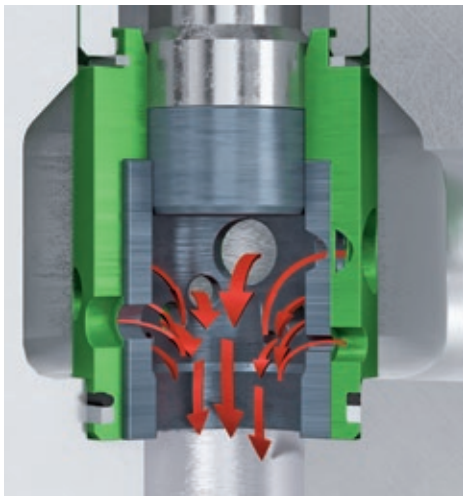

| Multistage control choke and trim features | |
|---|---|
| 1 | Metal body-to-bonnet gasket for absolute pressure containment |
| 2 | Heavy-duty thrust bearings reduce operating torque |
| 3 | Fully guided plug reduces side loading and vibration |
| 4 | Outer flow cage provides protection from impact damage |

*Multistage cage designs*

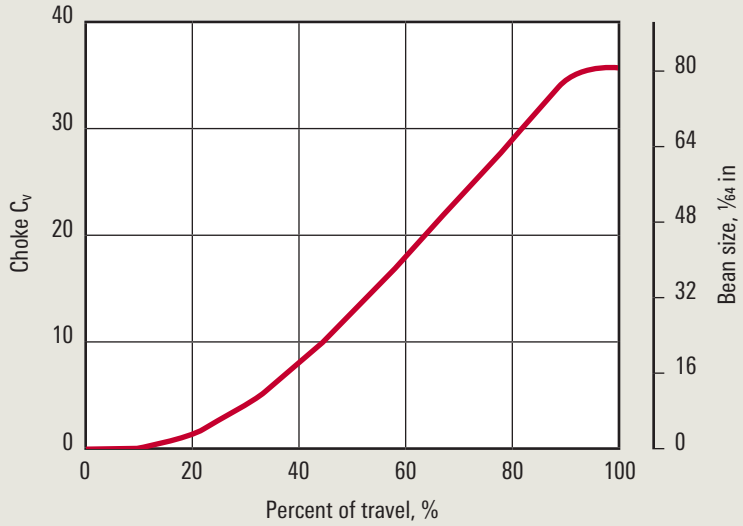
# CC15 Control Choke




*CC15 choke with linear hydraulic actuation*



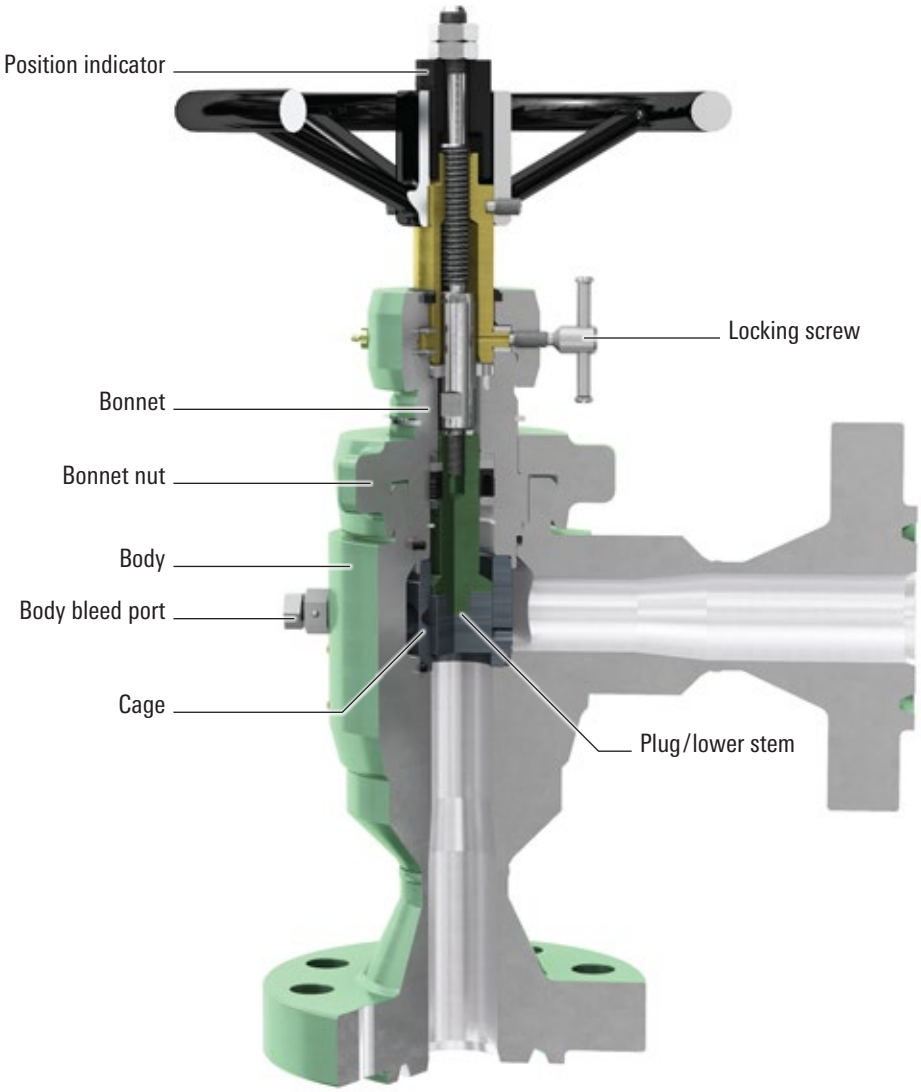
*CC15 choke plug & cage trim*



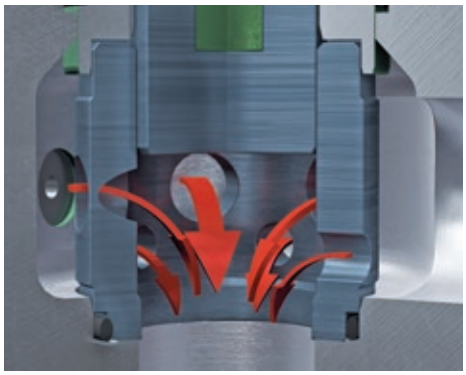

## CC15 Choke Flow Curves

CC15 control choke
API 5K/10K, plug & cage

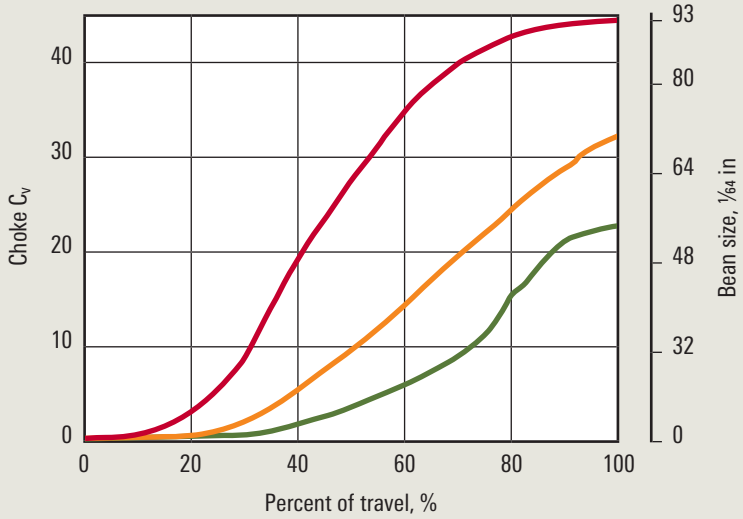
# CC20 Control Choke




*CC20 choke with pneumatic diaphragm actuation*



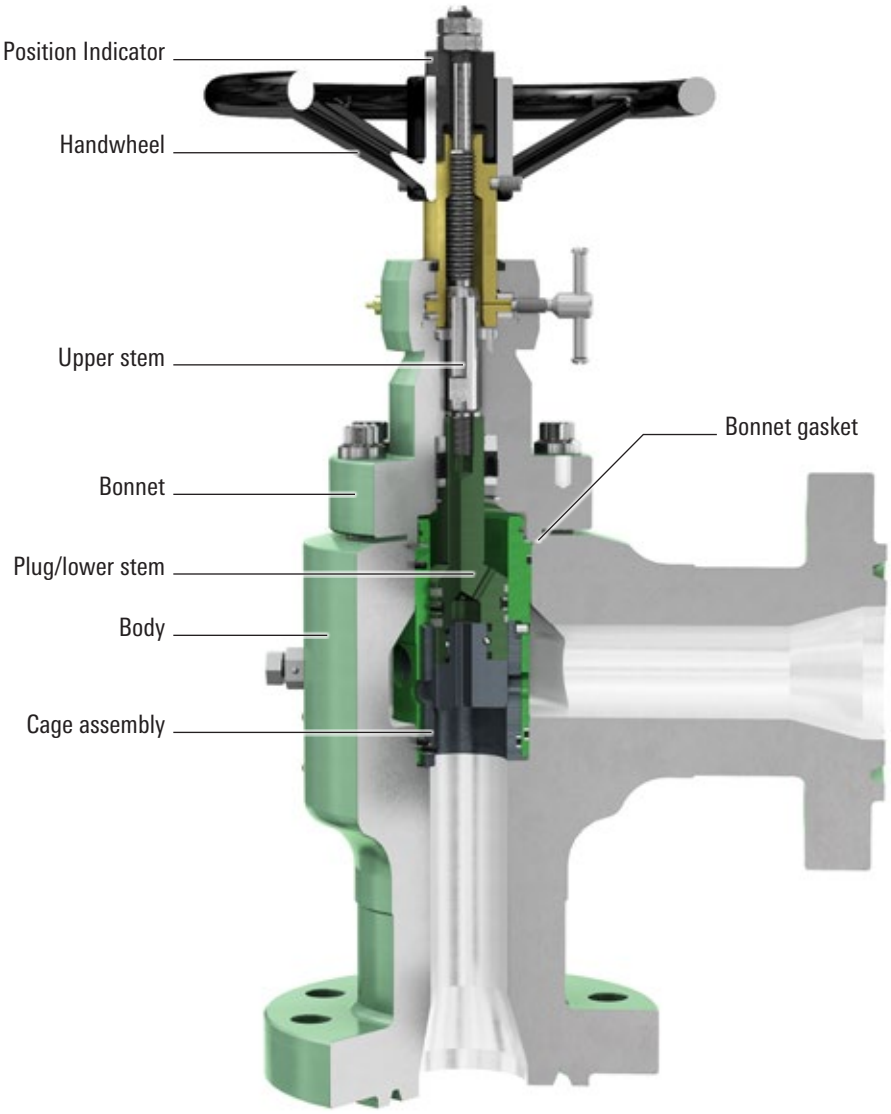
*CC20 choke plug & cage trim*



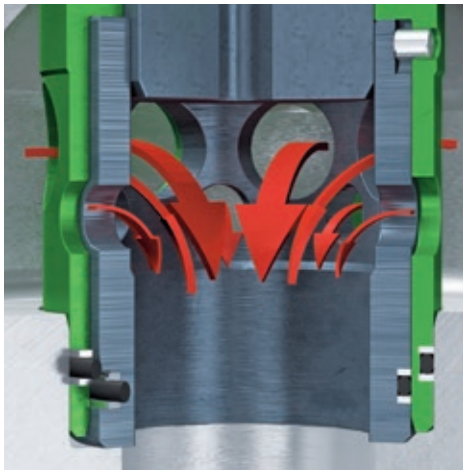

## CC20 Choke Flow Curves

- CC20 control choke API 5K/10K, plug & cage
- CC20 control choke API 5K/10K, external sleeve
- CC20HP HP/HT API 15K/20K, external sleeve

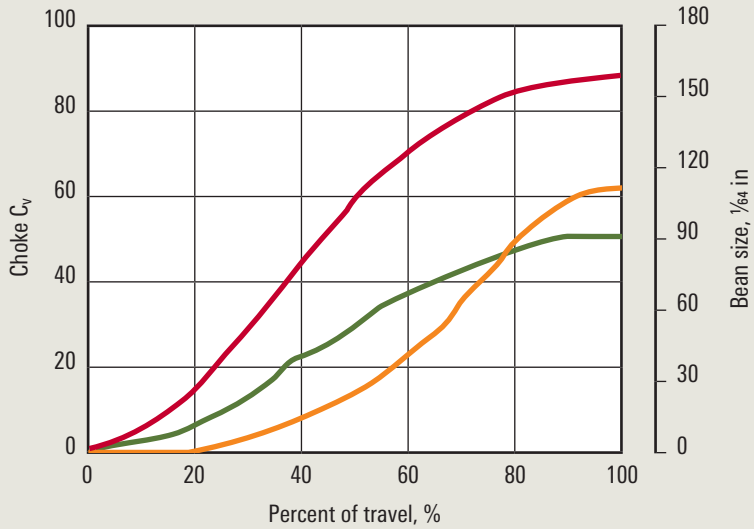
# CC30 Control Choke




*CC30 choke with linear hydraulic actuation*



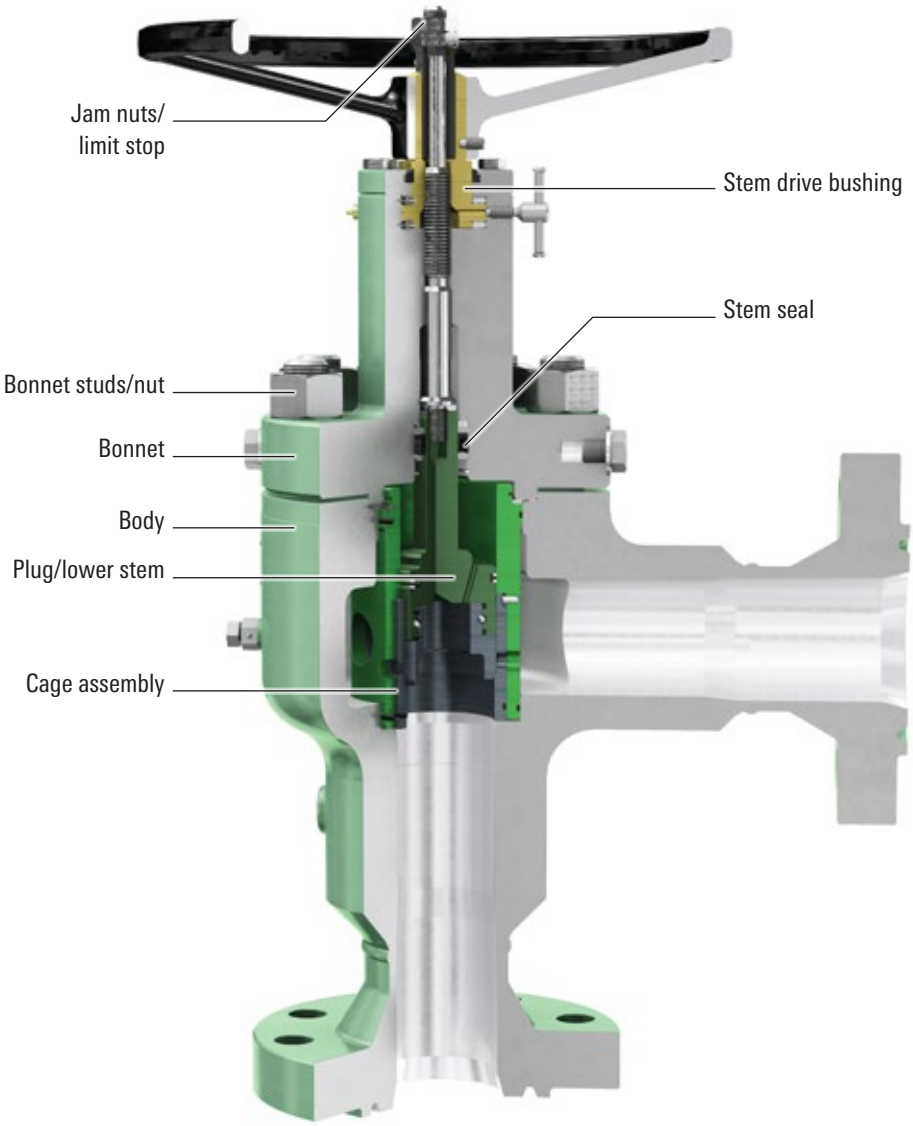
*CC30 choke plug & cage trim*



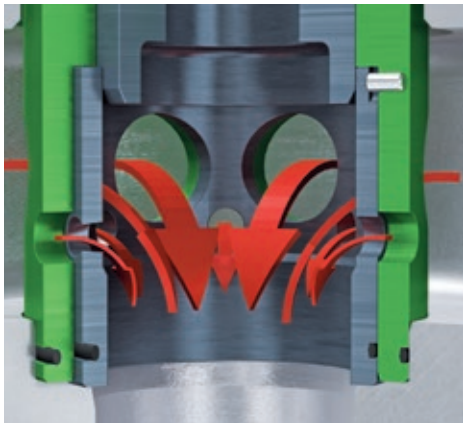

## CC30 Choke Flow Curves

- CC30 control choke API 5K/10K/15K, plug & cage
- CC30 control choke API 5K, external sleeve
- CC30HP HP/HT control choke API 10K/15K, external sleeve

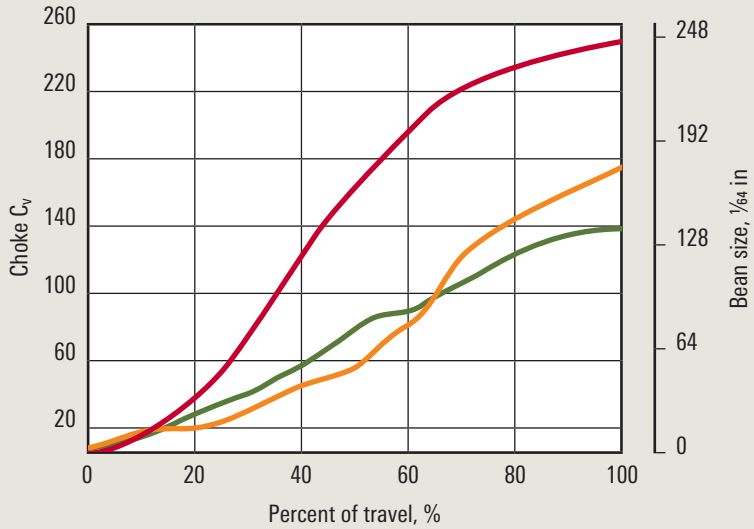
# CC40 Control Choke




*CC40 choke with hydraulic stepping actuation*



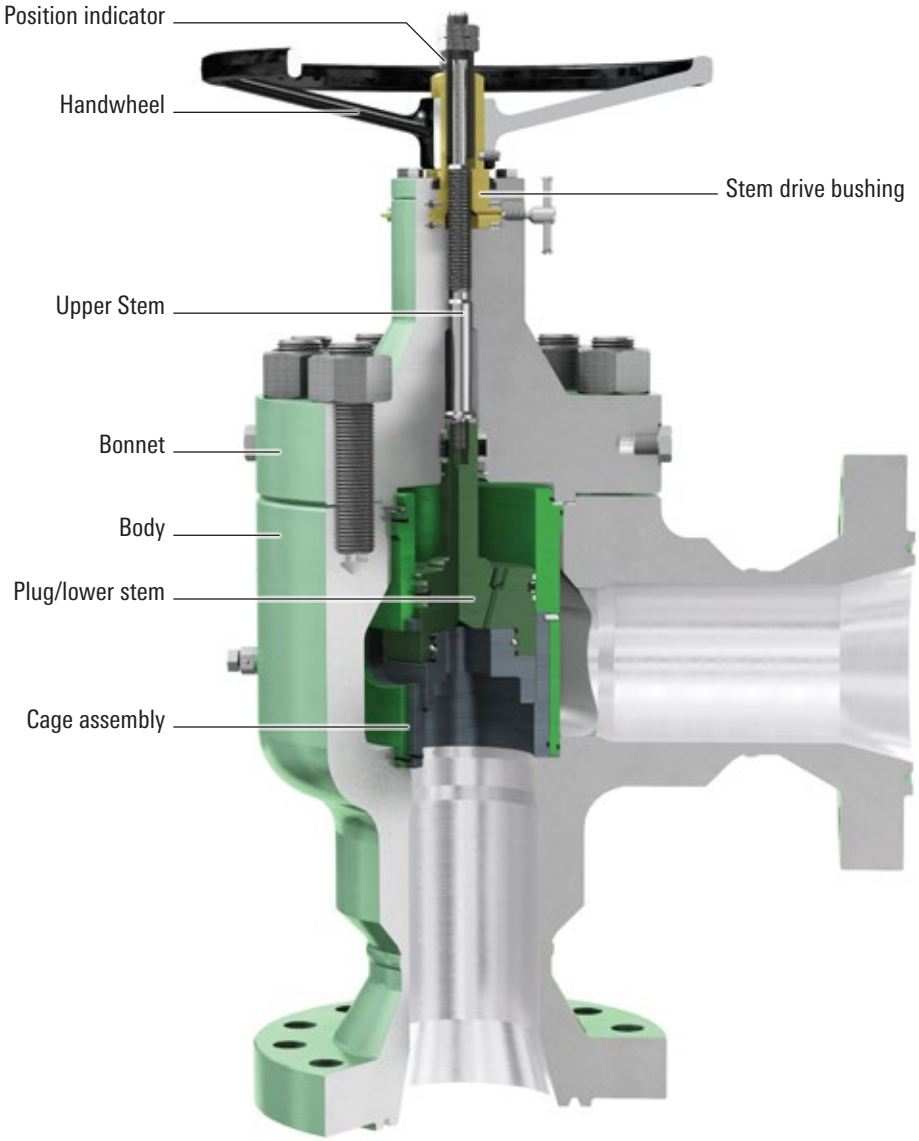
*CC40 choke plug & cage trim*



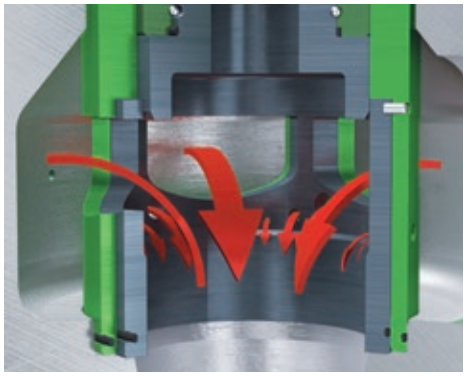

## CC40 Choke Flow Curves

- CC40 choke API 5K/10K/15K, plug & cage
- CC40 choke API 5K, external sleeve
- CC40HP HP/HT choke API 10K/15K/20K, external sleeve

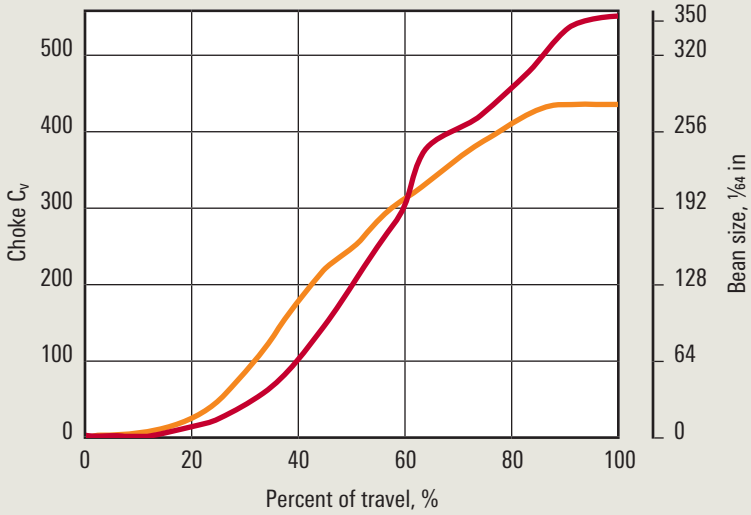
# CC60 Control Choke




*CC60 choke with electric actuation*



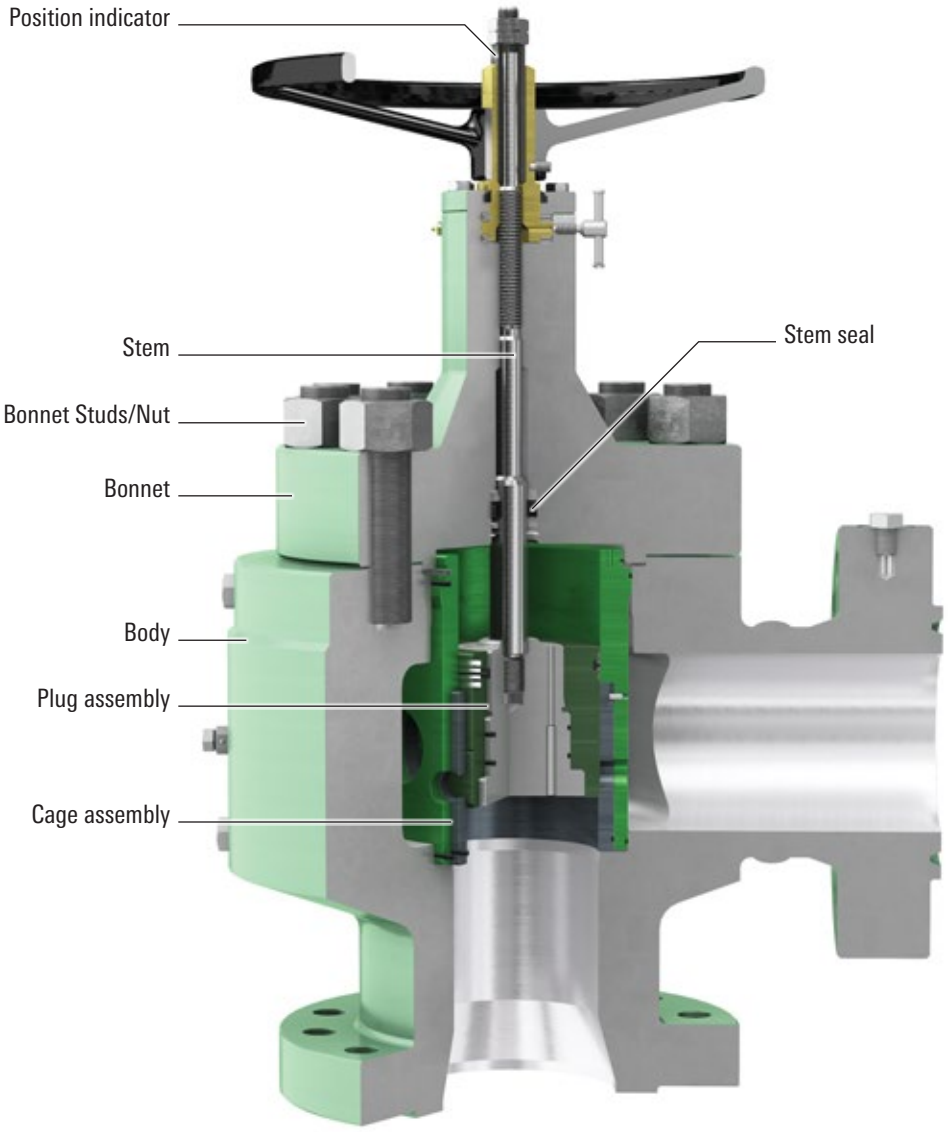
*CC60 choke plug & cage trim*

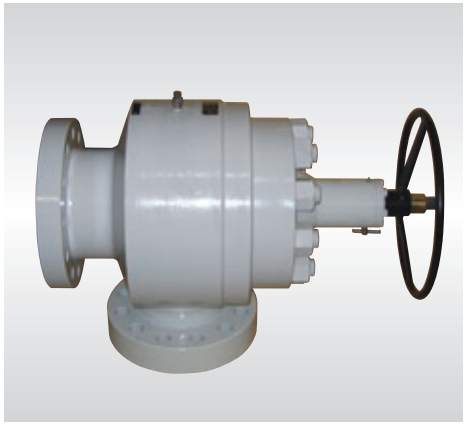



## CC60 Choke Flow Curves

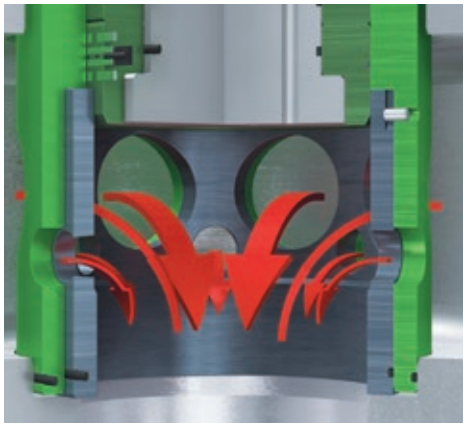
- CC60 choke API 5K/10K, plug & cage, equal percent trim
- CC60 choke plug & cage, linear trim

# CC70 Control Choke

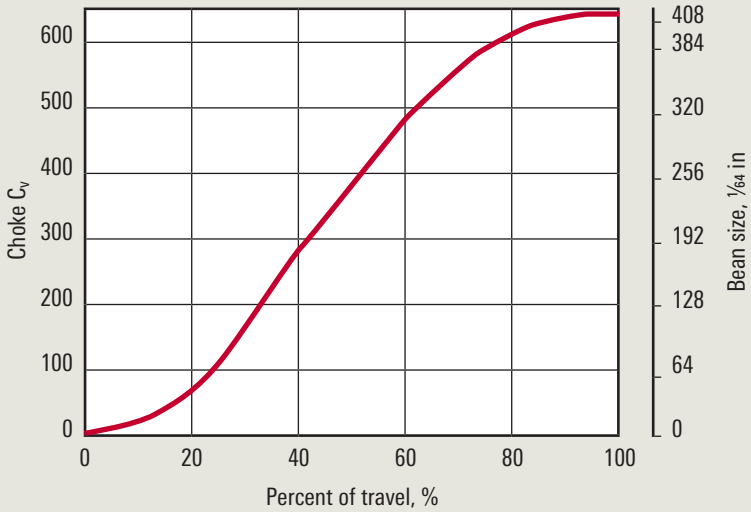


*CC70 choke*



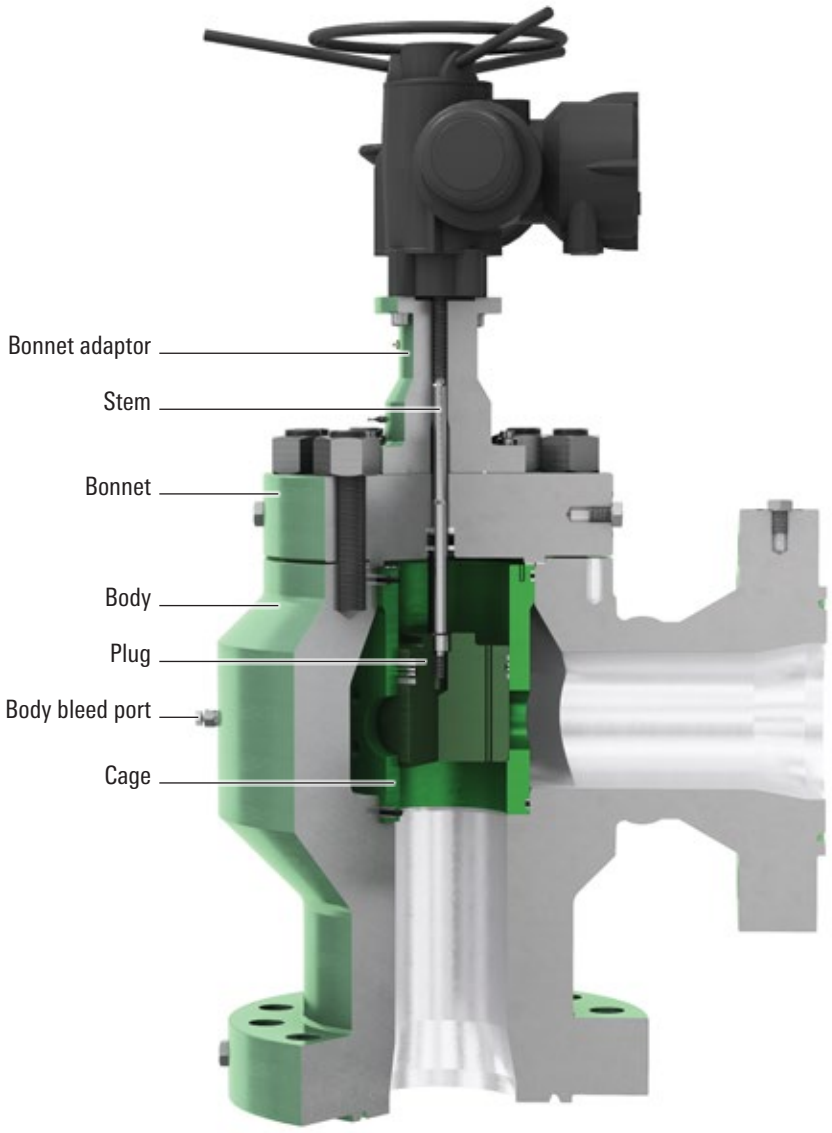
*CC70 choke plug & cage trim*



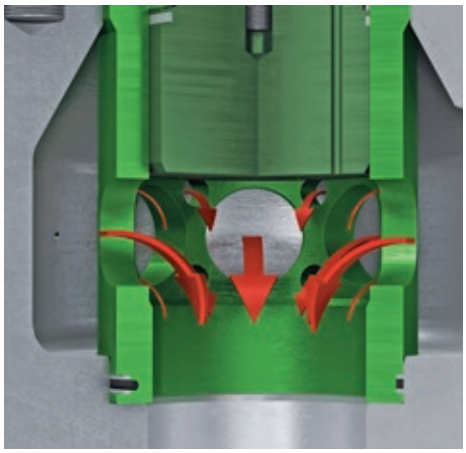

## CC70 Choke Flow Curves

CC70 choke API 5K, plug & cage, linear trim

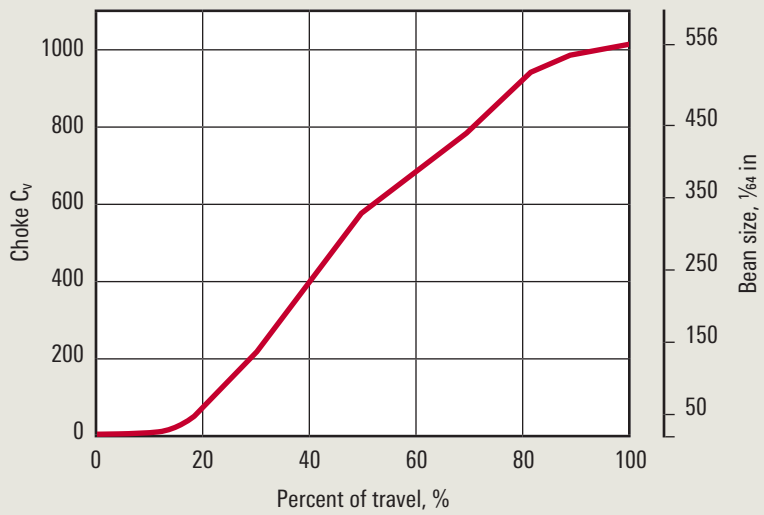
# CC80 Control Choke




*CC80 choke with electric actuation*



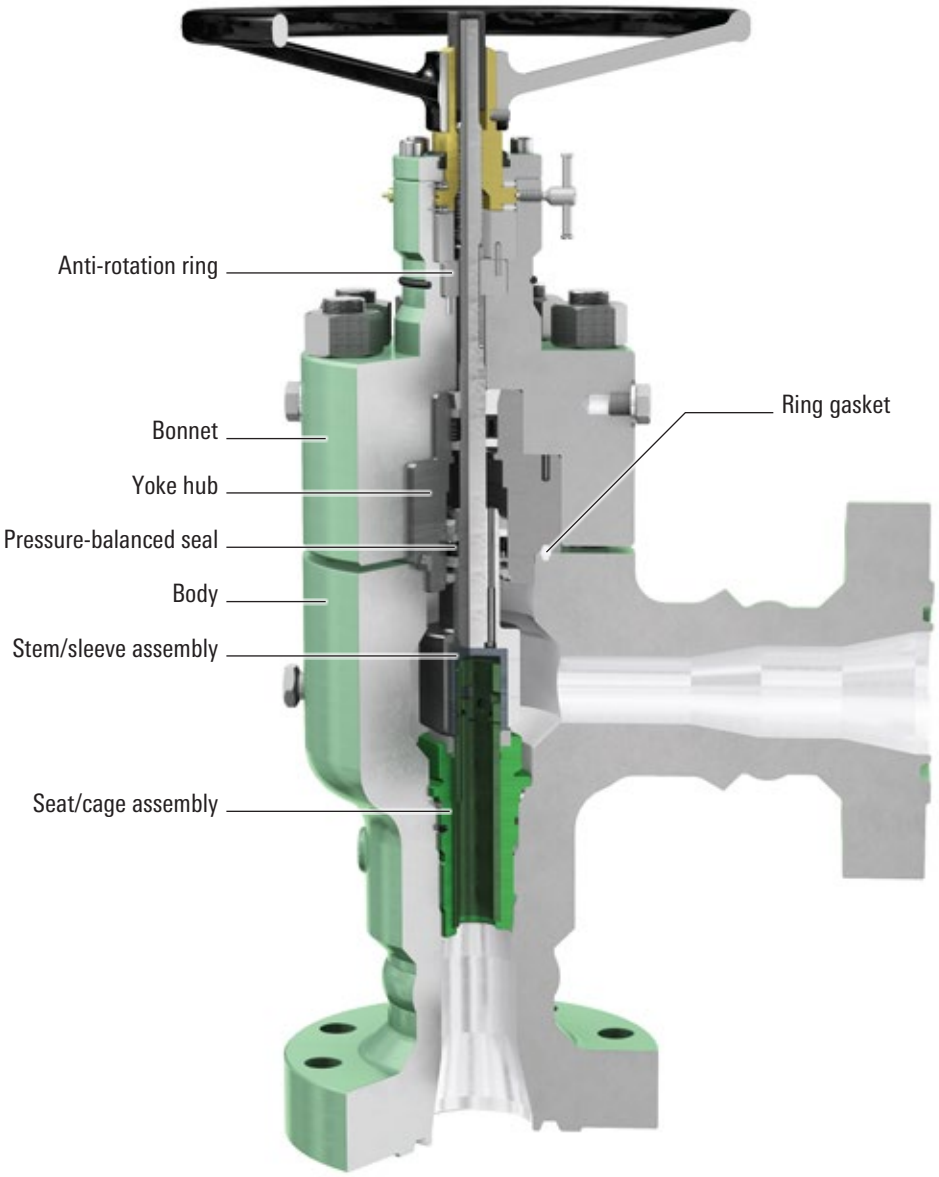
*CC80 choke plug & cage trim*



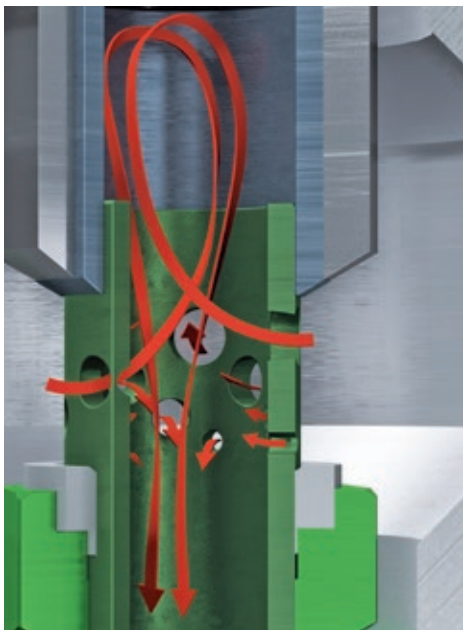

## CC80 Choke Flow Curves

CC80 choke API 5K, plug & cage, linear trim

# High Temperature and High Pressure




*CC20 external sleeve 15k choke with electric actuation*



*CC20 external sleeve HPHT trim choke*

Our range of control chokes includes a series of models engineered specifically for use in high-pressure, high-temperature service in corrosive/erosive environments. The high-pressure, high-temperature designs utilize metal seals and non-elastomeric seals. These seals are tested and qualified to provide high performance and reliability in sour service, with temperatures up to 400 degF (204 degC) and pressures up to 20,000 psi.

Our chokes are used in high $CO_2$ and $H_2S$, high-chloride, and high-temperature environments, and employ modern corrosion-resistant alloys (CRAs) to provide trouble-free service life. Low-alloy steel bodies are lined with nickel alloy 625 in a weld cladding process, providing a thick, impervious layer of the CRA bonded to the base material.

The other components employ similar corrosion-resistant alloys in their construction.

# Control Choke Sizing and Flow Testing

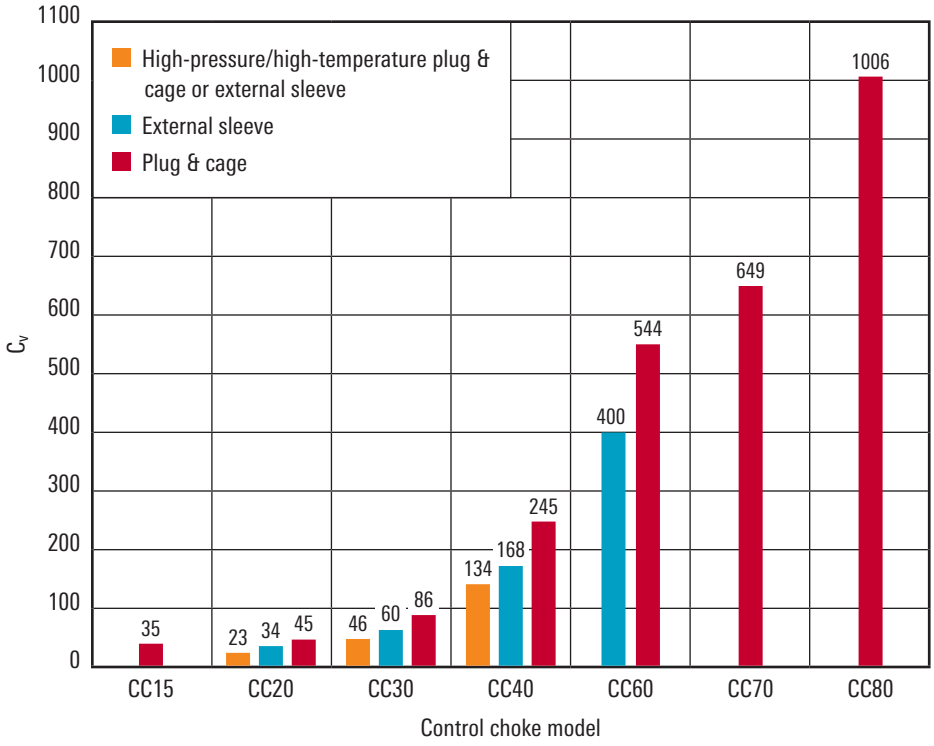
## Choke sizing program

Selection of the correct trim size and type is vital to the successful and reliable operation of a choke. Cameron offers a computer-based choke sizing program to optimize choke sizing and selection for the customer. Based on flow and pressure requirements of the application, the program analyzes and specifies the optimum choke size and trim configuration. Features of the choke sizing program include:

- Capability to size a large number of chokes and flow conditions
- Modular sizing program structure that enables the addition of new choke and choke trim data updates as needed
- Graphics capabilities
- Project worksheet and $C_v$ curve printouts
- Choke valve sizing per ANSI/ISA S75.01 specifications
- Flow testing per ANSI/ISA S75.02 specifications
- Noise prediction and testing per ANSI/ISA S75.07 specifications

Consult Cameron for additional information.

### Control Choke Flow Capacity (Cv) Comparison




*Note: Standard trims are shown. A full range of trim sizes are available.*


*The research and testing facility in Houston, Texas.*

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

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

# Material Specifications for Choke and Trim

**Control Choke Valve Standard Materials of Construction**

| Component | API 6A materials class | | |
|---|---|---|---|
| | AA, BB, DD†, EE† | CC†, FF | HH† |
| Valve body/bonnet‡ | AISI 4130 | AISI 410, Duplex SS UNS 31803, Super Duplex SS UNS 32760, A182 F6NM SS | AISI 4130 with Ni-alloy clad |
| Flange‡ | AISI 4130/ASTM A350 LF2 | AISI 410, Duplex SS UNS 31803, Super Duplex SS UNS 32760, A182 F6NM SS | AISI 4130 with Ni-alloy clad/ ASTM A350 LF2 with Ni-alloy clad |
| Stem (wetted) | 17-4 pH SS | 17-4 pH SS | 718 Ni-alloy |
| Bolting§ | ASTM 320 L7M | ASTM 320 L7M | ASTM 320 L7M |
| Slip-fit gasket | PTFE | PTFE | PTFE |
| Bonnet gasket | 316 SS | 316 SS | 825 Ni-alloy |
| Junk ring | 316 SS | 316 SS | 825 Ni-alloy |
| Retaining ring | Ni-alloy, X-750 | Ni-alloy, X-750 | Ni-alloy, X-750 |

† Materials meet the requirements of NACE MR-01-75/ISO 15156 specifications.

‡ Pressure-containing components are Charpy impact-tested at or below designed temperature.

§ Bolting can be zinc plated, Xylan® coated, or hot-dip galvanized.

Note: Specifications are subject to change without notice.

**Trim Material Selection Based on Material Class and Flow Service**

| Material class | Service | Wear components | Non-wear components |
|---|---|---|---|
| AA, BB, CC, DD, EE, FF | Non-erosive | 17-4 SS | 17-4 SS |
| | Erosive | Tungsten carbide | 17-4 SS |
| | Cavitation† | Stellite® | 17-4 SS |
| HH | Non-erosive | Ni-alloy 718 | Ni-alloy 718 |
| | Erosive | Tungsten carbide | Ni-alloy 718 |

† Cavitation available by special order.

**Available Material for Seals**

| Seal type | Sealing materials |
|---|---|
| Static-bore O-rings | Nitrile†, Viton®, PTFE, CAMLAST* |
| Static-bore backup rings | Nitrile, PTFE |
| Dynamic-bore T-seals | Nitrile†, Viton, Epichloro-Hydrin, CAMLAST |
| Dynamic-bore wear rings | Virgin Peek |
| Spring-energized lip seal | PTFE Elgiloy Spring |

† Includes low-temperature nitrile.

*We provide a wide variety of control choke trims capable of Class IV and Class V shutoff per ANSI B16.104 specifications.*

# Control Chokes

cameron.slb.com/controlchokes

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