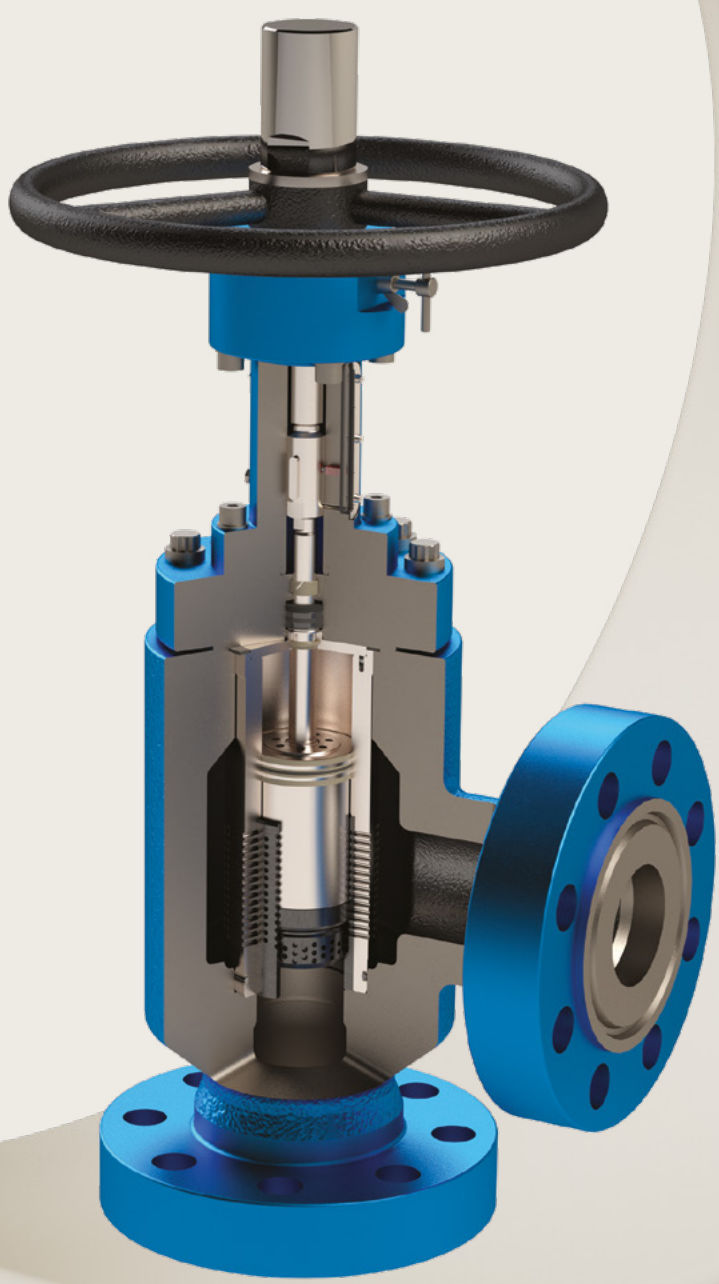
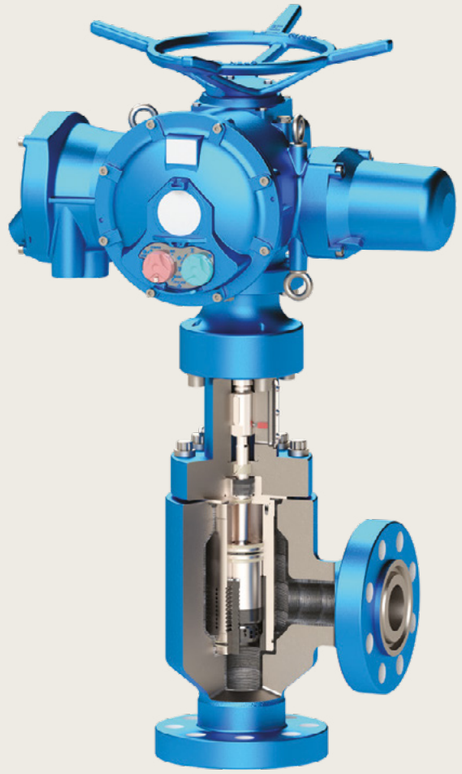
# Process Automation

## IMI CCI

### 100 DWI
Water injection choke for enhanced oil recovery



Breakthrough engineering for a better world



# 100 DWI

# Water injection choke for enhanced oil recovery

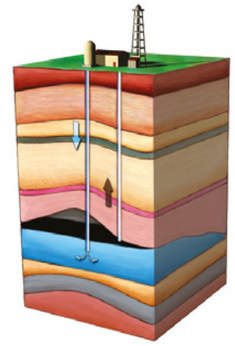
Water-flooding or water injection is applied to increase pressure and thereby stimulate production in oil fields. The water injection valve is located at the injection site and is responsible for controlling the injection flow and pressure. The primary value of the 100DWI is the greatly increased valve service life thanks to our enhanced cavitation and erosion control mechanisms.
Our two technology options are:

- Advanced cavitation control
  – A cost effective single - or multi stage cage trim (metal, tungsten carbide or Stellite™ + metal), anti-cavitation choke valve range. This solution is predominantly for clean water applications and for low pressure differentials in general (~200-250 bar).
- Multi-stage/multi-path anti-cav solution - Our well known and field proven premium trim design, ensures velocity and erosion control in a tungsten carbide trim.
  The technology is further optimised for cavitation service, designed for dirty water and/or high severity applications.

These solutions build on our already existing high-quality technology offering but have been engineered to bring that same excellence to the water injection application.

## Product features

- Increase valve service life by up to 100%
- Increase controllability by up to 50%
- Reduce end-user overall lifecycle costs by an estimated 40% (not including loss of production)
- Integral yoke design, no exposed stem
- Ease of maintenance due to minimum amount of parts
- Additional pressure reduction stages at small opening for long-lasting startup conditions



## Product specification

**Connections (larger sizes on request)**
1.5" to 6"

**Design temperature**
-29°C to 121°C

**Shut-off class**
Up to class V

**Quality**
3.1 material cert standard
3.2 material cert optional

**Noise prediction**
ISA S75.17; IEC 534-8-3

**Design codes**
API 6A
ISO 10423
ASME B16.34

**Certifications**
PR2, NACE, fugitive emission optional, fire safe by design

**Optional special testing**
Capacity, fugitive emissions

**Pressure ratings**
Up to ASME 1500 or API 5000

## Damage mechanisms

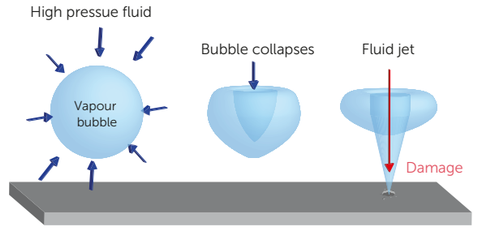
The severity of the conditions water injection chokes have to handle are typically driven by three contributing factors, varying in their importance and based on your application:

1. Severe corrosion risk
2. High potential for cavitation erosion due to a high pressure drop in combination with a low downstream pressure during start-up
3. High potential for particle erosion especially in case of produced water with higher sand content

IMI addresses these damage mechanisms in the 100DWI water injection chokes with superior material selection and multistage technology to reduce fluid velocities within the choke trim. A flow path specifically designed to minimise cavitation damage has been developed to tackle the main influencing factors of cavitation damage and intensity as well as fluid velocity. With that we are able to offer high protection against material loss on the main control and seating elements caused by cavitation erosion. CFD flow simulations and physical laboratory tests validate the enhanced cavitation control. The appropriate configuration for your operational demands will be selected to maximise the durability of the valve.

### Cavitation

Cavitation phenomena occur when the local pressure in the liquid changes rapidly. If it decays below the vapor pressure of the fluid, steam filled cavities are formed.
These bubbles are transported with the flow and collapse once they reach an area of higher pressure. Collapsing bubbles form a jet which leads to wearing of the material if the void implodes close to a metal surface.
Additionally to the multistage technology, a special pressure reduction stage in the plug in IMI's 100DWI product line is provided in the most cavitation resistant materials available to maximize the lifetime of the choke trims.

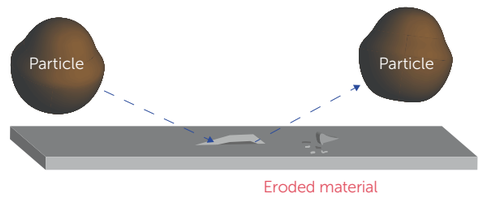



Cavitation erosion

### Particle Erosion

Particles carried with the high velocity fluid stream can erode the trim and lead to the reduced life time of water injection chokes.
The severity of particle erosion is dependant upon the nature of the particles, the fluid velocities, the material hardness and the impact direction.

Additionally to the multistage technology which is reducing the fluid velocities within the trim, IMI's 100DWI is minimising erosion damage by providing very hard trim material options developed to handle as much sand as experienced in production chokes.



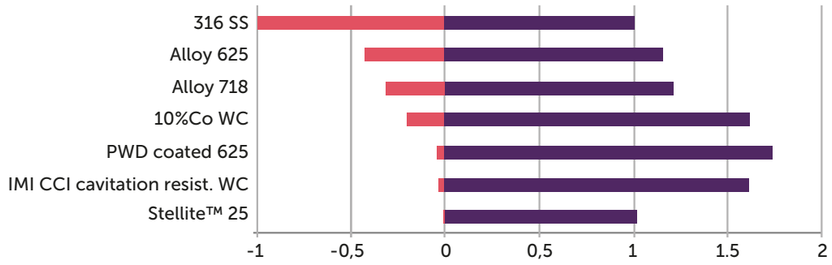

Particle erosion

## Material volume loss test

The material volume loss (red colour in the diagram) was determined in artificial seawater on the basis of ASTM G32 method for cavitation erosion and then related to the literature value of 316 SS. It's clearly visible that the materials listed are performing  better than 316 SS.

There are also differences in tungsten carbide grades, where the IMI CCI choosen grade performs in cavitating environments about five times better than standard 10%Co binder tungsten carbide at similar hardness values (blue colour in the diagram).

The relative hardness of the material is important, as it influences the rate of erosion due to impact of hard and abrasive particles.

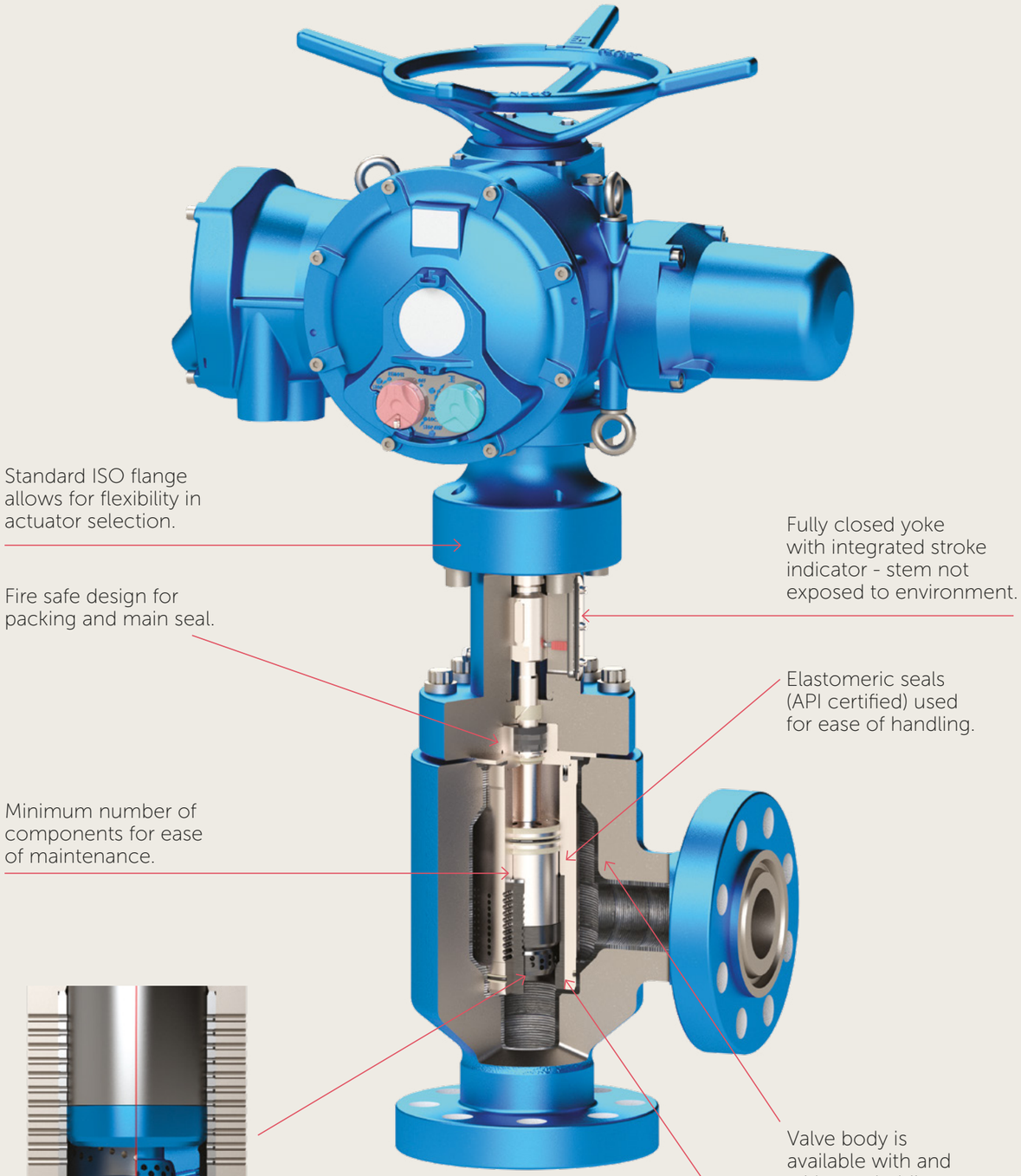



## Sizing and material selection

| Materials | | | | | |
|---|---|---|---|---|---|
| Body | Castings:  ASTM A487 Gr.4C / ASTM A352 LCB / A995 4A (duplex)<br>Forgings:  AISI 4130 / ASTM A182 F51 (duplex) / A182 F22 | | | With and without cladding (Ni Alloy N06625) | |
| Bonnet (forged) | AISI 4130 / ASTM A182 F22<br>A182 F51 (duplex) | | | | |
| Trim | Ni alloy N06625 + Stellite™  / 17-4PH + Stellite™ / F51 + Stellite™  / Solid Tungsten Carbide | | | Stem surface PVD-coated | |
| Actuator | Handwheel (travel stop optional), electric | | | Integrated stroke indicator | |

| Sizing | | | | | |
|---|---|---|---|---|---|
| Plug size (in) | 1.25 | 1.75 | 2.5 | 3.25 | 4 |
| Connections (in) | 1.5, 2, 3, 4 | 2, 3, 4 | 3, 4, 6 | 4, 6 | 6 |
| Target Valve Cv* | 18 | 33.5 | 75.7 | 140.4 | 222 |

* Valve Cv values can be adapted to the particular requirements of the application






The additional shroud on the plug acts as an **additional pressure reduction stage** at low valve openings, and reduces the differential pressure taken by the cage. This is crucial for low back pressure conditions.

The shroud also provides a protection function for the seat area to guarantee tightness over a long life time.

# Process Automation



## IMI CCI

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