Subsea Valve Portfolio

Cameron Subsea Valve Center of Excellence

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The Cameron Subsea Valve Center of Excellence in Colico, northern Italy.

The **Cameron Subsea Valve Center of Excellence** is in Colico, northern Italy, on the shores of Lake Como. It was founded in 1979 as the RING-O* subsea valves manufacturing facility, with a focus on the design and production of gate, globe, and check valves for severe service applications.

Today, the center of excellence is the home of Cameron and RING-O subsea valve manufacturing, covering traditional subsea ball, gate, and check valves; the Cameron subsea choke product line; and the latest Cameron subsea chemical injection metering valve technology.

The location in northern Italy was selected to take advantage of the facility's relationship with a forging company. This pairing of sophisticated materials and knowledge with proven valve designs led to the creation of products that excelled in the most demanding high-pressure steam handling and nuclear services.

Now, the center of excellence is dedicated to the deepwater market, employing industry-leading design and manufacturing technologies. With over 40 years of experience, the facility provides effective, reliable solutions to the challenging environments of subsea pipeline, manifold, and production applications.

Our expert teams of engineers work on custom applications to apply research and development across the product portfolio.

Through many changes over the years, most recently with the merger of Cameron and Schlumberger in 2015, the Cameron Subsea Valve Center of Excellence in Colico continues to play a key role in our pore to pipeline capabilities. We ensure that technology, flow assurance, and reliability are fully integrated via modern project execution to meet and extend the production expectations of our customers.

Subsea Ball Valves

Subsea production and pipeline transmission are considered critical service applications for valves because of the high pressures, extreme temperatures, and remote location of the equipment. Cameron has more than 35 years' experience in subsea valve technology and today offers a range of ball valve sizes and pressure ratings qualified to meet the demanding requirements of subsea applications.

Cameron RING-O subsea valve technology is based on top entry and side entry trunnion-mounted balls that provide superior reliability in comparison with seat-supported floating balls.

In the subsea environment, where maintenance is not feasible, our side entry ball valve delivers the lowest total cost of ownership solution to operators. Its smaller, lighter configuration supports maximum sealing capabilities in even the harshest conditions.

Top entry and fully welded ball valves are also offered per customer preference.

The RING-O valves are available in a wide range of forged low-alloy steel and corrosion-resistant alloy materials with full or partial cladding of wetted bores and configurations to support deepwater customers' requirements for sealing design, seat configuration, and end connections. Our designs are optimized to meet any specific requirement in terms of pigging operations and pipeline-induced loads.

Cameron subsea ball valves are typically operated by either mechanical or hydraulic operators, including rack and pinion or helical spline designs. The hydraulic operators can be configured for any type of failure mode (fail-safe open or closed and fail as is) as requested by the customer and equipped with local and remote position indicators. Hydraulic operators are always equipped with ROV override interfaces. Actuation options can also be made retrievable upon customer request, with the scope including delivery of the running tools.

7-in, 15,000-psi side entry ball valve with manual ROV override.

8-in helical spline fail-close hydraulic quarter-turn actuator.

Quality control during subsea valve manufacturing.

Subsea Ball Valve Specifications		
Top entry and side entry trunnion-mounted ball valves	Size	1-in to 42-in bore
	Pressure class	ASME/ANSI Classes 900–2500 API 5,000–15,000 psi and higher
	Water depth	10,000 ft [3,000 m] and deeper
	Design codes	API 6A, API 17D, API 6DSS
	Operating temperatures	–50.8 degF to 401 degF [–46 degC to 205 degC]
	Design features	Trunnion mounted Seat-to-ball seal: metal-to-metal or thermoplastic Seat design: single piston effect (SPE) or double piston effect (DPE) Stem seal: metal-to-metal or thermoplastic Long design life: >25 years Maintenance free
	Actuation	Manual or ROV: planetary or worm screw gear system Hydraulic quarter turn: rack and pinion or helical spline Electric actuation options also available

Valve components waiting for QC before installation.

RING-O 10-in, 7,500-psi side entry ball valves.

Subsea Gate Valves

RING-O 7⅛-in, 10,000-psi through-conduit slab gate valve with fail-safe-close hydraulic actuator.

Predominantly intended for subsea isolation applications, Cameron gate valves are designed for harsh environments where maintenance is impossible and product life is typically expected to exceed 25 years. Simple, robust, reliable, and proven designs, materials, and elements come together to produce a product that today controls the flow of oil and gas in a majority of the world's deepwater manifold and isolation systems.

Through-conduit slab gate valves provide superior bubble-tight sealing capabilities in gas service and unmatched robustness in harsh and high-pressure, high-temperature service with the presence of solid particles. The bubble-tight double expanding gate valve design incorporates double-block capabilities to ensure zero leakage with pressure on the upstream and downstream side toward the body, even when the valve is fully open.

Manufactured from forged bodies and bonnets with fully or partially clad valve bores and butt weld ends, our valves can be supplied with soft seat or metal-to-metal seat configurations and for manual, ROV, or hydraulic actuation.

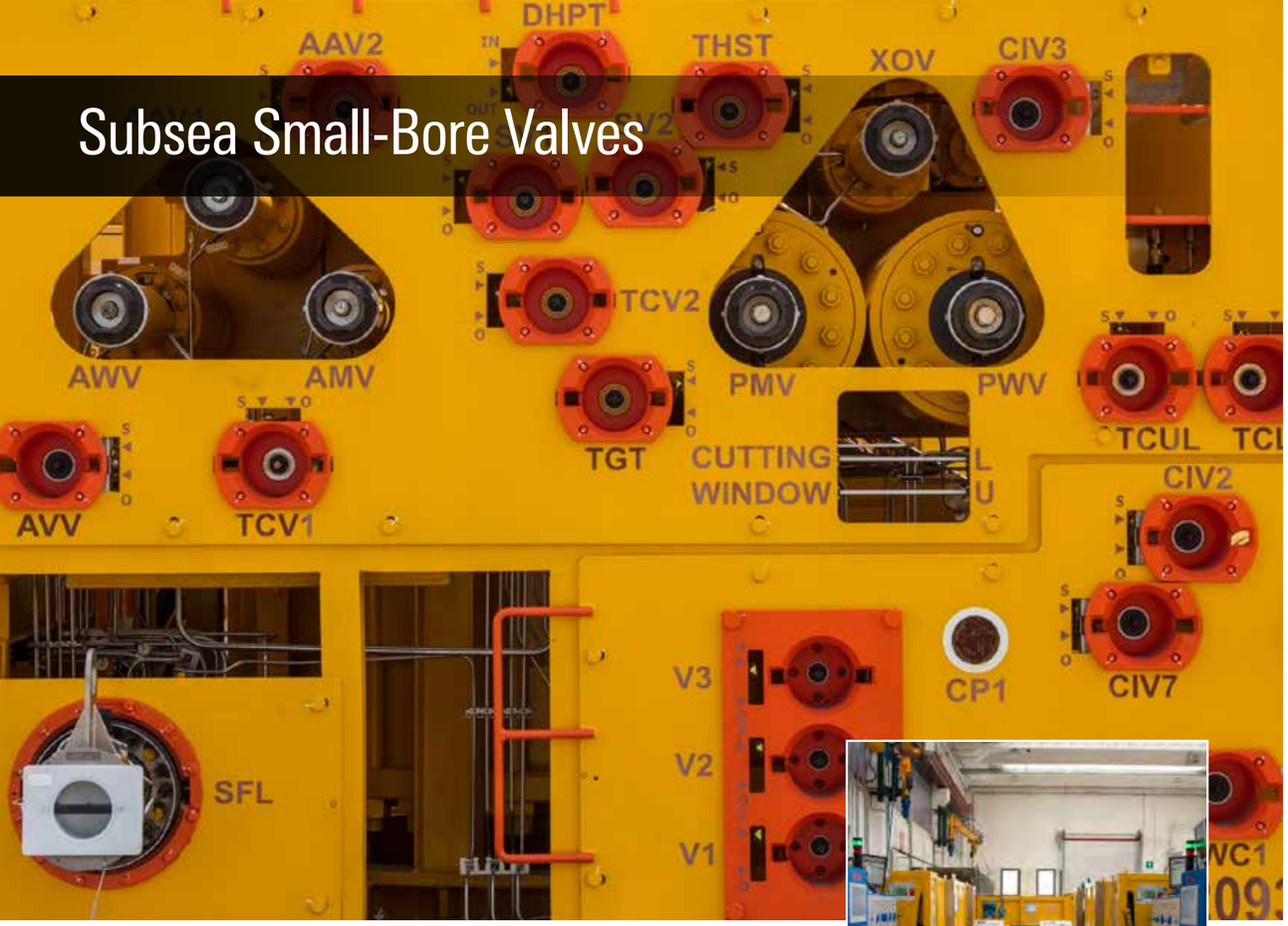
Subsea Gate Valve Specifications		
Through-conduit slab gate valves	Size	½-in to 10-in bore
	Pressure class	ASME/ANSI Classes 900–2500 API 5,000–15,000 psi and higher
	Water depth	10,000 ft [3,000 m] and deeper
	Design codes	API 6A, API 17D, API 6DSS
	Operating temperature range	–50.8 degF to 401 degF [–46 degC to 205 degC]
	Design features	Customized design Downstream sealing All-metal sealing Single or double backseat Rising stem Long design life: >25 years Maintenance free
	Actuation	ROV operated (Class 4) Hydraulic fail-safe closed, open, or as is
Double expanding through-conduit gate valves	Size	2-in to 10-in bore
	Pressure class	API 6A 5,000–15,000 psi
	Water depth	10,000 ft [3,000 m] and deeper
	Design codes	API 6A, API 17D API 6DSS ASME VIII Div. 2, ASME B16.34
	Operating temperature range	–58 to 392 degF [–50 degC to 200 degC]
	Design features	Customized design Mechanical bidirectional sealing All-metal sealing Rising stem Long design life: >25 years Maintenance free
	Actuation	ROV operated (Class 4) Hydraulic fail-safe as is

Gate valve forged body machining operations.

Gate valve body cladding operations.

Final assembly prior to painting operations.

Subsea Small-Bore Valves



Subsea tree ROV panel with multiple small-bore valve ROV interfaces.

Cameron also produces a range of subsea small-bore chemical isolation valves for tree and manifold applications in linear slab gate and rotary gate configurations. Assembly and testing are completed in the latest automated factory acceptance test (FAT) benches in accordance with API Specification 6DSS and API Specification 6A PLS3, to streamline assembly and test activities.

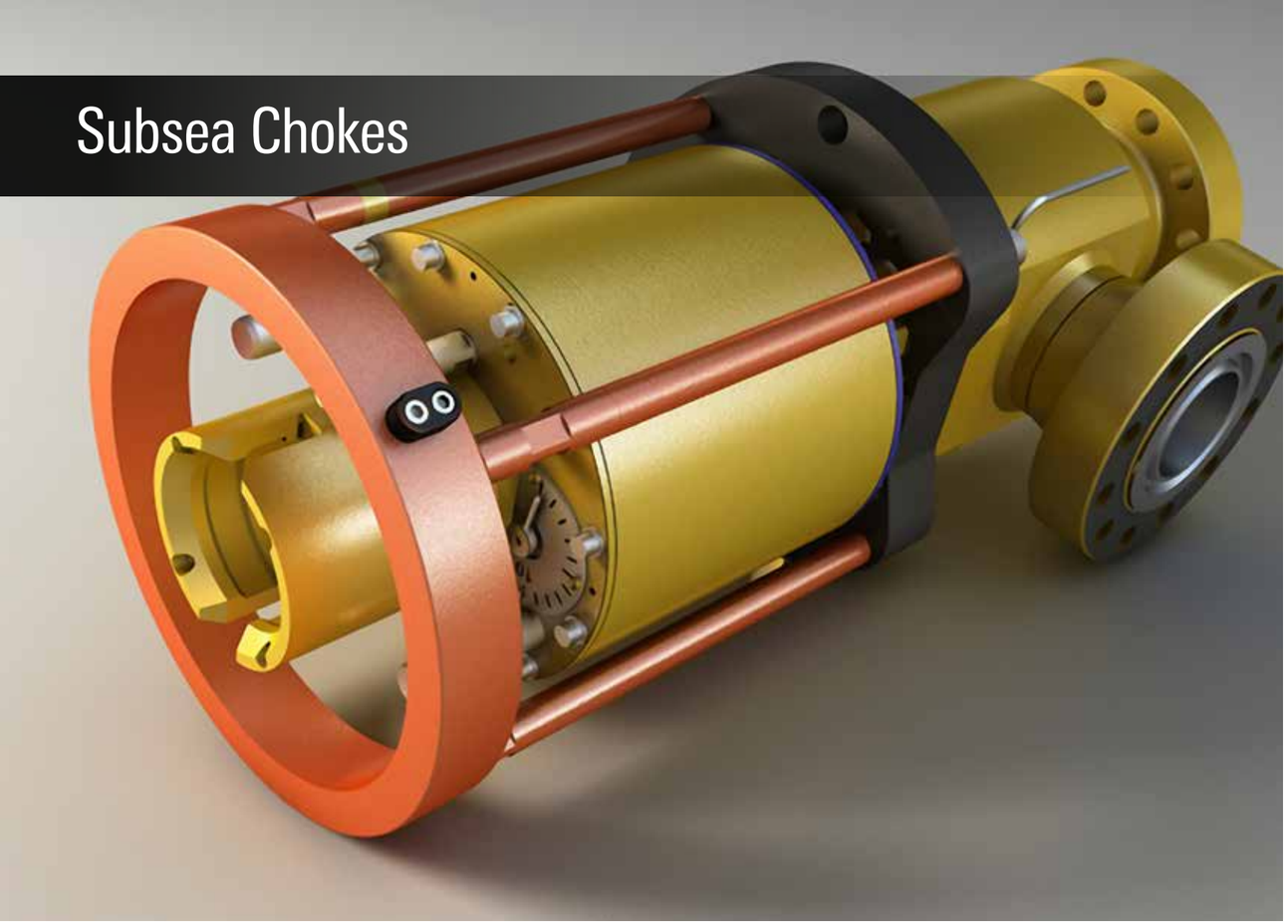
One of the seven automated small-bore valve test benches capable of 30,000-psi hydraulic testing and 20,000-psi gas testing.

Subsea Small-Bore Gate Valve Specifications		
Rotary gate valve	Size	⅜ in
	Pressure class	API 15,000 and 20,000 psi
	Water depth	10,000 ft [3,000 m]
	Design codes	API 6A, API 17D
	Operating temperature range	–50.8 degF to 350.6 degF [–46 degC to 177 degC]
	Design features	Optional integral check Panel or block mounted Material class FF or HH
	Actuation	Hydraulic or manual ROV Electric actuation options also available
Linear slab gate valve	Size	¾ in and ½ in
	Pressure class	API 15,000 and 20,000 psi
	Water depth	10,000 ft [3,000 m]
	Design codes	API 6A, API 17D
	Operating temperature range	–46 degC to 177 degC
	Design features	Optional integral check Panel or block mounted Material class FF or HH Local position indicator
	Actuation	Hydraulic or manual ROV Electric actuation options also available

RING-O ¾-in linear slab gate valve, block mounted with a hydraulic actuator.

RING-O ⅜-in rotary gate valve, panel mounted with a manual Type A paddle interface.

Subsea Chokes



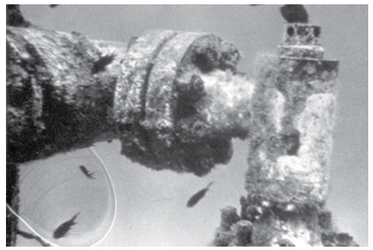
Cameron lightweight insert-retrievable compact subsea choke.

In 1975, Cameron manufactured the world's first subsea choke for the Mobil West Delta Project in the Gulf of Mexico based on the design of manual surface chokes with multiple orifice valve (MOV) trim technology. The MOV controls flow via two rotating discs with circular orifices.

Since then, Cameron subsea chokes have been used in more than 3,600 installations around the globe. They feature leading-edge technology:

- plug-and-cage, external sleeve, and multistage trim styles
- HPHT designs up to 20,000 psi and 400 degF
- insert-retrievable and fixed nonretrievable designs
- hydraulic stepping and electric actuation.

Cameron subsea chokes are designed for use in production, water injection, gas injection, gas lift, and reverse flow. Chokes range from 2-in through 8-in nominal sizes and flow coefficient (C_v) values from less than 1 up to 1,000.



Early WILLIS subsea choke.

Nonretrievable chokes

The first nonretrievable subsea choke was installed in 1975. Today, with more than 1,000 of these rugged chokes installed, they are a proven, reliable choice.

Permanently mounted to a subsea structure such as a Christmas tree or manifold, the choke body may be incorporated into a retrievable flow control module or choke bridge. These chokes are usually fitted with a hydraulic-stepping or drop-in-place electric actuator but can also be adjusted by an ROV or diver.

Nonretrievable Choke Specifications

Choke	Application	Nominal size†, in	Max. working pressure (MPW), psi	Max. C_v‡	Flow curve type
CC30FNR	Gas lift	3	5,000	13.6	P&C EQ%
				38	P&C linear
CC30FNR	Production	3	10,000	86	P&C linear
				64	P&C EQ%
CC40FNR	Production	4	5,000	256	P&C linear
				206	P&C EQ%
CC40FNR HP	Production	4	10,000 or 15,000	256	P&C linear
				206	P&C EQ%
CC50FNR	Production	5	10,000	345	P&C EQ%
				428	P&C linear
CC60FNR	Production	6	5,000	544	P&C EQ%
CC80FNR	Production	8	10,000	1,000	P&C linear
				433	P&C EQ%

† Nominal size refers to the seat nominal diameter, not the inlet or outlet end connection size.
‡ Reduced capacity and custom trims available.
P&C—plug and cage EQ%—equal percentage ES—external sleeve
MS33* multistage control choke—3-in, three-stage, multistage

Nonretrievable choke design highlights

- Pressure ratings up to 15,000 psi
- Temperature ranges from –50 to 400 degF [–46 to 204 degC]
- Trim sizes from 2 through 8 in with controllable C_v from less than 1 up to 1,000
- 25-year+ design life, excluding wearing trim elements

Nonretrievable chokes meet or exceed API 17D, NACE MR-01-75/ISO 15156, and NORSOK requirements.

CC40FNR HP nonretrievable choke with 15,000-psi maximum working pressure (MWP) and stepping linear choke actuator (SLCA).

CC80FNR nonretrievable choke with 10,000-psi MWP, SLCA, and C_v = 1,000.

Insert-retrievable chokes

Cameron supplied the first insert-retrievable choke in 1991. Since then, these highly successful chokes have been installed on subsea systems in varying water depths around the world. A number of insert-retention designs are available, including the totally vertically retrievable lightweight compact choke, with its dog-in-window connector, and the more traditional three-segment clamp-style choke. The latest addition to the family of insert retrievable chokes is the 8-in nominal CC80SR insert-retrievable large-bore gas choke.

Insert-retrievable choke design highlights

- Pressure ratings up to 20,000 psi
- Temperature ranges from –50 to 350 degF [–46 to 177 degC]
- Trim sizes from 2 through 8 in with C_v up to 1,000
- 25-year+ design life, excluding wearing trim elements

Insert-retrievable chokes meet or exceed API 17D, NACE MR-01-75/ISO 15156, and NORSOK requirements.

Insert-Retrievable Choke Specifications

Choke	Description	Application	Nominal size†, in	MWP, psi	Max C_v‡	Flow curve type
CC20SR	Clamp insert choke	Gas lift or MEG injection	2	10,000	6	PNT
CC20SR	Clamp insert choke	Gas lift	2	10,000	14	P&C EQ%
					8	P&C EQ%
CC30SR	Clamp insert choke	Gas lift or production	3	10,000	46	ES linear
					33	P&C EQ%
CC40SR	Clamp insert choke	Production	4	10,000, 15,000, 20,000	288	P&C linear
					200	P&C EQ%
					100	P&C EQ%
CC30SRC	Compact insert choke	Gas lift	3	10,000	84	P&C linear
					33	P&C EQ%
CC40SRC	Compact insert choke	Production	4	10,000	224	P&C EQ%
					288	P&C linear
CC40SRC	Compact insert choke	Reverse-flow water injection	4	10,000	216	MS32 EQ%
CC50SR	Clamp insert choke	Production	5	10,000	500	P&C linear
					345	P&C EQ%
CC80SR	CVC* flowline connector insert choke	Gas production	8	7,500	1,000	P&C linear
					757	P&C EQ%

† Nominal size refers to the seat nominal diameter, not the inlet or outlet end connection size.
‡ Reduced capacity and custom trims available.
PNT—profiled needle trim P&C—plug and cage EQ%—equal percentage ES—external sleeve
MS32 choke—3-in, two-stage, multistage

CC80SR 8-in nominal insert-retrievable choke with CVC flowline connector.

CC40SR clamp choke with clamp running tool funnel.

Clamp-style insert-retrievable chokes

The simple clamp mechanism for latching the insert to the choke body is a robust, ROV- and diver-friendly system developed over many years with capabilities up to 20,000-psi working pressure. Cameron has developed configurations to allow retrieval by the Cameron dedicated clamp running tool (CLRT) or third-party running tools.

Compact insert-retrievable chokes

Being 35% smaller and 45% lighter than a traditional clamp-style insert choke design, ithe compact design offers significant advantages in size and weight on the subsea structure.

Using an internal dog-in-window connector not only reduces the size and weight compared to the clamp equivalent but also results in the choke insert being released for retrieval from above using the running tool—without the need for ROV horizontal access to a clamp connector.

And, because it requires no horizontal access, the choke can be more centrally placed, potentially reducing the size and weight of the Christmas tree or manifold.

High-performance actuators for every purpose

Cameron provides a variety of subsea choke actuators, including hydraulic stepping fail-fixed actuators in operating pressures of 3,000 and 5,000 psi and compatible with water- or mineral-oil-based control fluids. Our hydraulic stepping actuators include the SLCA and Aqua-Torq* hydraulic stepping choke actuator, both of which are fitted with electrical position feedback sensors. We also provide electric choke solutions pairing our chokes with OneSubsea Rotary eActuators. These actuators are controlled via standard communication protocols, SIIS level 2, and provide increased precision movement and control.

CC40SRC compact choke.

Dog-in-window connector.

OneSubsea Rotary eActuator.

Subsea Chemical Injection Metering Valves

Subsea installation of a PULSE LF CIMV.

Low-flow PULSE CIMV testing facility.

PULSE ultrasonic chemical injection metering valves

The Cameron PULSE* ultrasonic chemical injection metering valve (CIMV) is a remotely operated, ROV-retrievable, self-regulating subsea chemical delivery system. Combining the latest nonintrusive ultrasonic flow metering technology in closed-loop control with a throttling element that requires only one user-defined input (flow rate), the system continually monitors and controls chemical injection into a subsea production system, while continuously reporting injection parameters and system health.

The low-flow PULSE CIMV provides injection and control of low-dose inhibitors (LDIs) such as corrosion, scale, and wax inhibitors in the range of 0.25 L/h to 600 L/h. The medium- and high-flow PULSE CIMVs target hydrate mitigation via regenerated monoethylene glycol (MEG) or methanol injection in the range of 80 L/h to 26,500 L/h. The particulate-tolerant, highly reliable, and accurate technology enables significant capex and opex saving to operators throughout the life of the field.

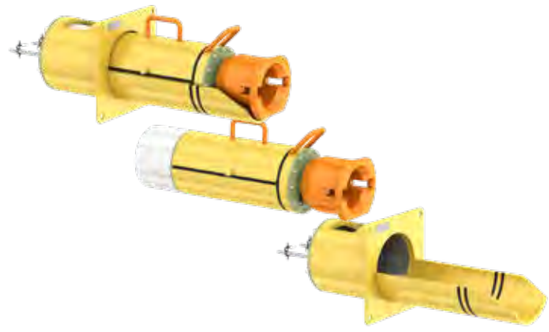
This industry-leading CIMV technology is manufactured at the Cameron dedicated CIMV build and test facility at Colico, with the latest flow rig, hyperbaric test, and calibration equipment.

CIMV preparation.

CIMV assembly clean room.

Low-Flow PULSE CIMV Specifications	
Technical Details	
Model	Remotely operated, ROV-retrievable low-flow PULSE CIMV
Application	LDIs (corrosion, scale, wax, asphaltene, demulsifiers, and others)
Installation orientation	Horizontal or vertical
Design standard	API 17D; API 17F
Design life	25 years
Failure mode	Fail as is; will continue to inject on loss of power or communication
Pressure rating	10,000 psi [68.9 MPa] or 15,000 psi [103.4 MPa]
Max. differential pressure†	3,500 psi [24.1 MPa] for flow rates < 0.26 galUS/h [1 L/h]
Min. differential pressure†	< 50 psi [0.34 MPa] for flow rates up to 26 galUS/h [100 L/h]
	< 500 psi [3.45 MPa] for flow rates up to 159 galUS/h [600 L/h]
Hydraulic connection	Hunting® RS-4 hydraulic couplers (two off) poppetted with weld tails (size and material per project)
Electrical connection	Seven-way electrical connector (OneSubsea Diamould* electric connectors, Siemens Tronic®, Teledyne ODI®, stab and ROV mate options)
Envelope dimensions	
Total length	Approximatelytely 41.7 in [1,059 mm]
Insert diameter	Approximately 10 in [254 mm]
Insert weight	Approximately 154 lbm [70 kg] in water, suitable for ROV deployment
ROV lockdown interface	API 17H/ISO 13628-8 Class 4
Temperature rating electronics	
Operational	23 to 104 degF [–5 to 40 degC]
Working depth	13,123 ft [4,000 m]
Flow range	
Standard	0.25–100 L/h [0.07–26 galUS/h]
Extended	1–600 L/h [0.26–159 galUS/h]
Turndown	400:1
Cleanliness	Particulate-tolerant system; recommended SAE AS4059 Class 12 B-F (supplied flushed to SAE AS4059 Class 6 B-F)
Accuracy	Better than ±2% of reading above 0.53 galUS/h [2 L/h]
Pressure sensors	Two off (used to determine secondary flow)
Additional features	Secondary flow system and onboard status indicators (e.g., zero flow, max. flow, reverse flow, totalizer, and diagnostics)
Pressure-Containing and Pressure-Controlling Component Materials	
Valve trim	Nickel alloy 718 and Stellite® 6 stainless steel
Valve body	Duplex stainless steel
Valve seals (stem)	Polytetrafluoroethylene (PTFE) based stack
Flowmeter	22% chromium duplex body with nickel alloy 718 transducers
Pressure seals	Metal-to-metal nickel alloy with elastomeric backups
Electrical Controlling Components	
Motor	Stepper
Minimum, normal, and maximum power	<6W, <8.6 W (motor operating), and <14.5 W
Interface protocol	CANOpen, CiA 443 Version 3, SIIS Level 2 fault-tolerant CANbus, or Modbus

† Max. and min. differential pressures are based on a 40-cP fluid at minimum and maximum flow rates, respectively, to maintain controllability. Higher or lower differential pressures are possible dependent on flowing conditions.



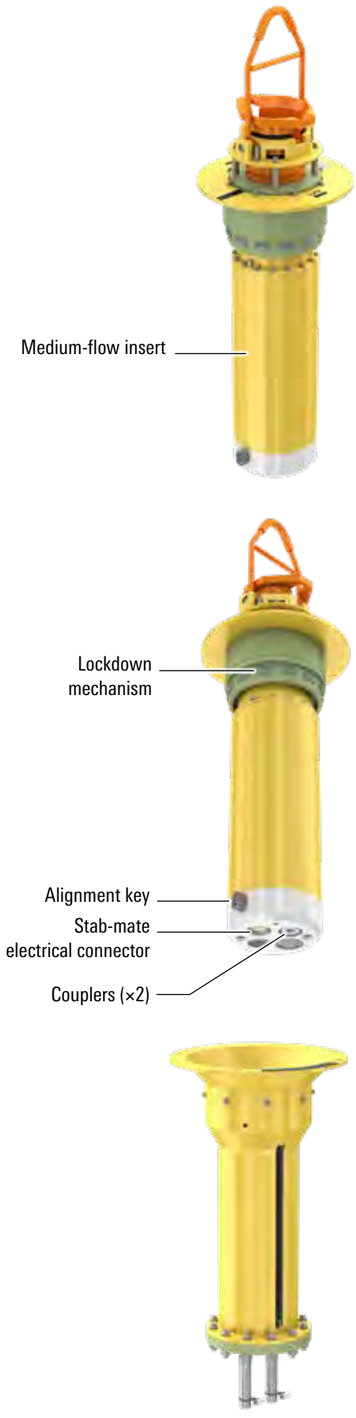
Horizontal installation: insert with stab-mate electrical connector and receptacle.

Vertical installation: insert with stab-mate electrical connector and receptacle.

Medium-Flow PULSE CIMV Specifications

Technical Details	
Model	Cameron remotely operated, insert-retrievable medium-flow PULSE CIMV
Application	MEG, regenerated MEG, and methanol dosing
Installation orientation	Vertical
Design standard	API 17D; API 17F
Design life	25 years
Failure mode	Fail as is; will continue to inject on loss of power or communication
Pressure rating	10,000 psi [68.9 MPa]
Max. differential pressure†	3,500 psi [24.1 MPa]
Min. differential pressure†	< 150 psi [1.03 MPa]
Hydraulic connection	1-in [25.4-mm] Hunting RS-16 hydraulic couplers (two off) poppeted or nonpoppeted with weld tails (size and material as per project)
Electrical connection	Seven-way electrical connector (OneSubsea Diamould, Siemens Tronic, Teledyne ODI, stab, and ROV mate options)
Envelope dimensions	
Total length	Approximately 44.9 in [1,141 mm]
Insert diameter	Approximately 10 in [254 mm]
Insert weight	Approximately 551 lbm [250 kg] in water, suitable for ROV deployment with buoyancy or wireline
ROV lockdown interface	API 17H/ISO 13628-8 Class 4
Electronics temperature rating	
Storage	0 to 122 degF [–18 to 50 degC]
Operational	23 to 104 degF [–5 to 40 degC]
Working depth	10,000 ft [3,048 m]
Filter	None required
Flow range	21–2,906+ galUS/h [80–11,000+ L/h]
	Turndown: 137:1
Cleanliness	No filtration necessary; particulate-tolerant design with large throughbores, nonintrusive flowmeter, and erosion-resistant choke trim technology
Accuracy	Better than ±3% of reading over entire flow range
Pressure sensors	Two off (used for secondary flow measurement)
Additional features	Secondary flow determination system and onboard status indicators (e.g., zero flow, maximum flow, reverse flow, flow totalizer, and diagnostics)
Pressure-Containing and Pressure-Controlling Component Materials	
Valve trim	Nickel alloy 718 and tungsten carbide with tungsten carbide wear sleeve
Valve body	Duplex stainless steel
Valve seals (stem)	Spring-energized PTFE seal
Flowmeter	Nickel alloy 625
Pressure seals	Metal-to-metal nickel alloy with inert elastomeric backups
Electrical Controlling Components	
Motor	High-efficiency stepper
Minimum, normal, and maximum power consumption	<4 W (quiescent), 9.6 W (motor operating), and <12 W
Interface protocol	CANOpen, CiA 443 Ver 3, SIIS Level 2 fault-tolerant CANbus, or Modbus

† Max. and min. differential pressures are based on a 25-cP fluid at minimum and maximum flow rates, respectively, to maintain controllability. Higher or lower differential pressures are possible dependent on flowing conditions.

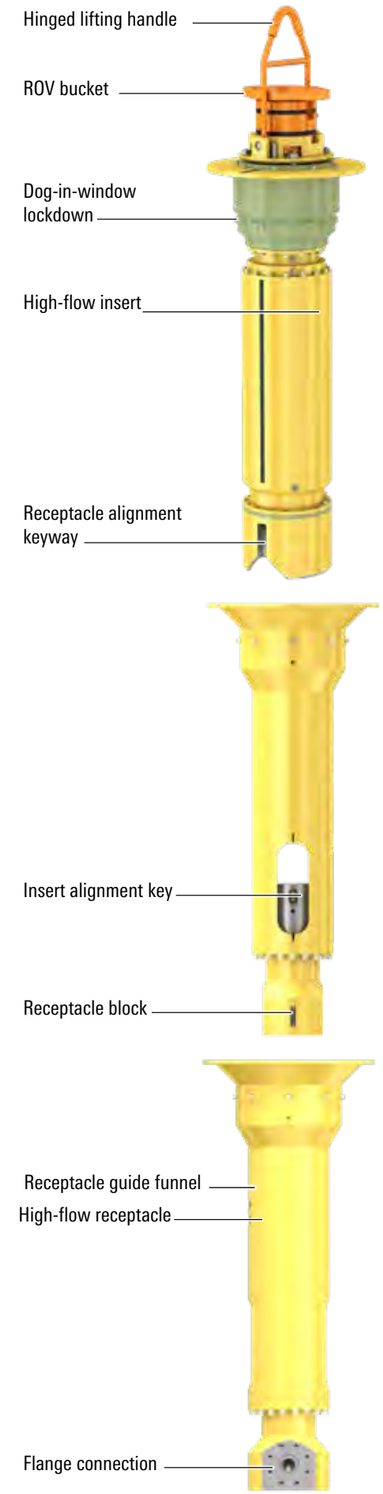


Medium-flow receptacle.

High-Flow PULSE CIMV Specifications

Technical Details	
Model	Cameron remotely operated, insert-retrievable high-flow PULSE CIMV
Application	MEG, regenerated MEG, and methanol dosing
Installation orientation	Vertical
Design standard	API 17D; API 17F
Design life	25 years
Failure mode	Fail as is; will continue to inject on loss of power or communication
Pressure rating	10,000 psi [68.9 MPa]
Max. differential pressure†	3,500 psi [24.1 MPa]
Min. differential pressure†	<100 psi [0.69 MPa]
Hydraulic connection	1.45-in [37-mm] nominal throughbore; nonpoppeted couplers with metal-to-metal sealing
Electrical connection	Seven-way electrical connector (OneSubsea Diamould, Siemens Tronic, Teledyne ODI, stab and ROV mate options)
Envelope dimensions	
Total length	Approximately 69 in [1,753 mm]
Insert diameter	Approximately 10 in [254 mm]
Insert weight	Approximately 551 lbm [250 kg] in water, suitable for ROV deployment with buoyancy or wireline
ROV lockdown interface	API 17H/ISO 13628-8 Class 4
Temperature rating electronics	
Storage	0 to 122 degF [–18 to 50 degC]
Operational	23 to 104 degF [–5 to 40 degC]
Working depth	10,000 ft [3,048 m]
Filter	None required
Flow range	42–7,000+ galUS/h [160–26,500+ L/h]
	Turndown: 165:1
Cleanliness	No filtration necessary; particulate-tolerant design with large throughbores, nonintrusive flowmeter, and erosion-resistant choke trim technology
Accuracy	Better than ± 3% of reading over entire flow range
Pressure sensors	Two off (used for secondary flow measurement)
Additional features	Secondary flow determination system and onboard status indicators (e.g., zero flow, max flow, reverse flow, flow totalizer, and diagnostics)
Pressure-Containing and Pressure-Controlling Component Materials	
Valve trim	Nickel alloy 718 and tungsten carbide with tungsten carbide wear sleeve
Valve body	Duplex stainless steel
Valve seals (stem)	Spring-energized PFTE seal
Flowmeter	Nickel alloy 625
Pressure seals	Metal-to-metal nickel alloy with inert elastomeric backups
Electrical Controlling Components	
Motor	High-efficiency stepper
Minimum, normal, and maximum power consumption	<4 W (quiescent), 9.6 W (motor operating), and <12 W
Interface protocol	CANOpen, CiA 443 Ver. 3, SIIS Level 2 fault-tolerant CANbus, or Modbus

† Max. and min. differential pressures are based on a 25-cP fluid at minimum and maximum flow rates, respectively, to maintain controllability. Higher or lower differential pressures are possible dependent on flowing conditions.



Subsea Check Valves

Subsea inline nozzle check valves.

For a full range of applications including subsea production, processing, flowlines, pipeline end manifolds (PLEMs), and pipeline end terminations (PLETs), Cameron slam and nonslam check valves are available in sizes ranging from 1 in to 26 in and larger, in pressure ratings up to 15,000 psi and ANSI Class 2500, and for water depths up to 10,000 ft [3,000 m].

The slam check valves, characterized by a swing check valve design, are available in fullbore designs to facilitate pig operations in the pipeline. The designs incorporate an ROV-operated clapper lifting device with local position indicators.

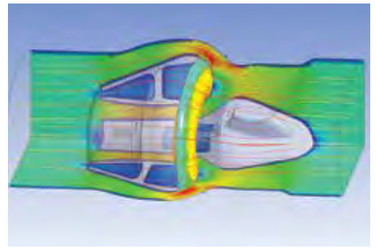
The nonslam axial check valves feature a low-pressure-drop nozzle check design with high-speed response time. This configuration provides the most cost-effective backflow prevention when pipeline pigging is not required.

Manufactured from forged bodies and bonnets, where applicable, with fully or partially clad valve bores and butt weld ends, Cameron subsea check valves are supplied with hard-faced sealing surfaces.

Subsea Check Valve Specifications		
Axial flow nozzle check valve	Size	1 in to 8 in
	Pressure class	ASME/ANSI Classes 900–2500 API 5,000–15,000 psi
	Design codes	API 6A, API 17D
	Operating temperature range	–50.8 degF to 401 degF [–46 degC to 205 degC]
	Design features	Customized design Metal-to-metal seated Long design life: >30 years Maintenance free
Swing check valve	Size	2 in to 26 in and larger
	Type	Bolted bonnet
	Pressure class	ASME/ANSI Classes 600–2500 API 3,000–10,000 psi
	Water depth	10,000 ft [3,000 m]
	Design codes	API 6A, API 17D API 6DSS ASME VIII Div. 2, ASME B16.34
	Operating temperature range	–50.8 degF to 352 degF [–46 degC to 178 degC]
	Design features	Customized design Metal-to-metal seated Long design life: >30 years Redundant sealing design Maintenance free Severe service conditions Lock-open device or free swing

Swing check valve with ROV override.

Inline nonslam nozzle check valve.



Axial design that helps to deliver streamlined flow, low pressure drops, and high-dynamic performances.

Manufacturing and Test Capabilities

The manufacturing plant at the Cameron Subsea Valve Center of Excellence covers more than 376,000 ft^2 [35,000 m^2] and is positioned conveniently for access to some of the finest-quality and most capable raw material sources in the world as a solid, experienced foundation for our products.

Every activity necessary to take raw materials and turn them into a complete subsea valve is performed in-house. Across rough machining, nondestructive examination, premachining, cladding, postweld heat treatment, final machining, assembly, test, and paint, all steps are conducted at our modern manufacturing facility with more than 20 computer numerical control (CNC) machining centers and 20 welding stations, including 4 robotic gas metal art welding (GMAW) and 2 narrow gap units. Support is provided by in-house supply chain management and project execution.

Twenty test pits with capabilities up to 30,500 psi, three hyperbaric chambers, and seven automated small-bore valve test cells are available for production. Also at the plant are one of the world's largest and most modern self-contained clean environment assembly areas and a test cell for the CIMV product line.

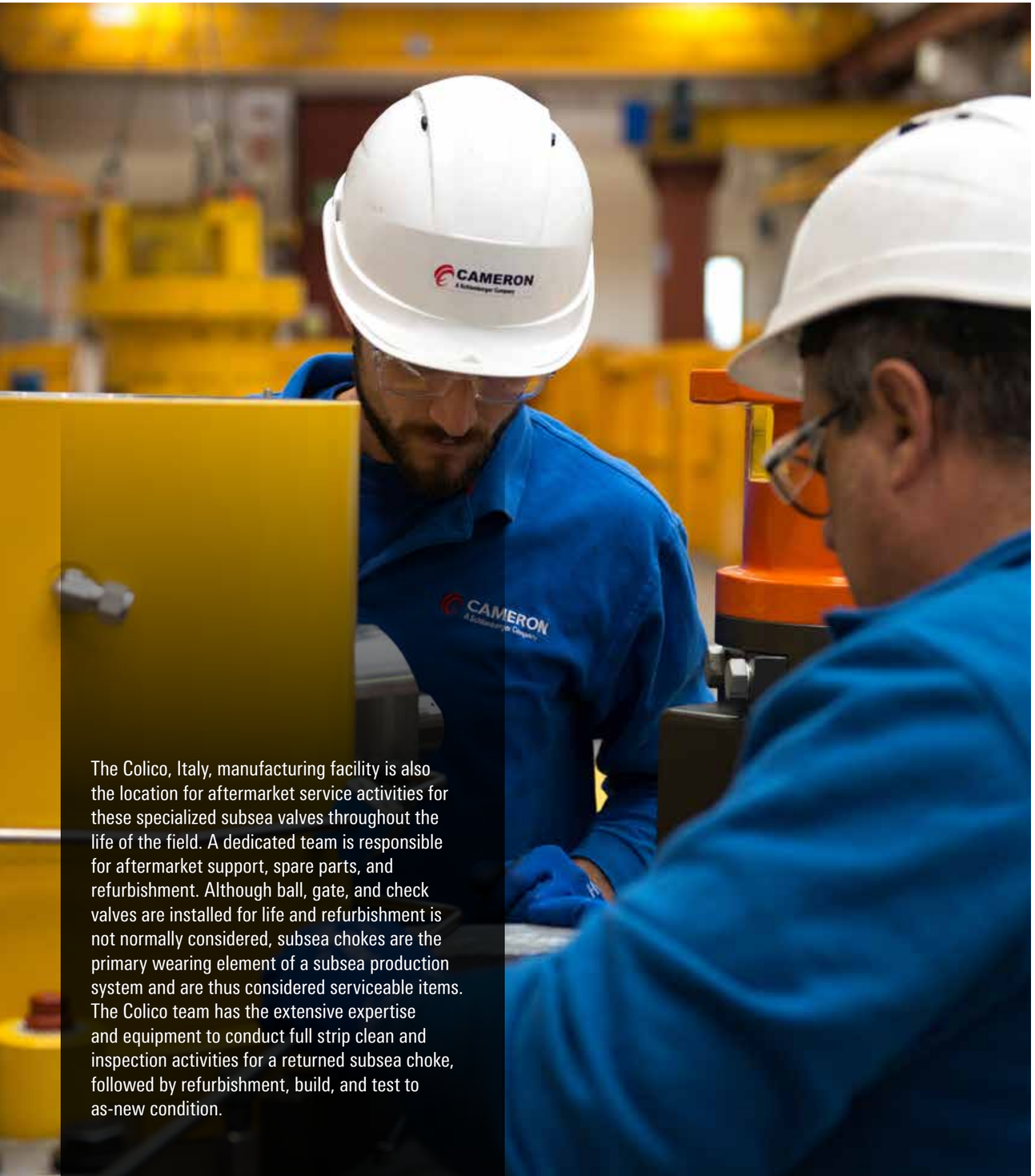
With continued investment in R&D, the center of excellence also houses advanced test and qualification facilities, with two large test bunkers for API 6A Appendix F PR2 qualification, bending testing, or customer-specific type testing; a sand slurry flow loop; and one of the largest hyperbaric chambers in the world, capable of simulating water depth up to 13,123 ft [4,000 m].

Hyperbaric test center control room.

Robotic cladding process on a ball valve body.

CNC operations on a chemical injection metering valve manifold.

Aftermarket Services and Support



The Colico, Italy, manufacturing facility is also the location for aftermarket service activities for these specialized subsea valves throughout the life of the field. A dedicated team is responsible for aftermarket support, spare parts, and refurbishment. Although ball, gate, and check valves are installed for life and refurbishment is not normally considered, subsea chokes are the primary wearing element of a subsea production system and are thus considered serviceable items. The Colico team has the extensive expertise and equipment to conduct full strip clean and inspection activities for a returned subsea choke, followed by refurbishment, build, and test to as-new condition.

Quality, HSE, and Certification

The Colico plant at the Cameron Subsea Valve Center of Excellence was the first in the world to receive the API 6DSS (subsea valves) license in 2007. It previously earned the API 6A and API 17D licenses in 2005 and ISO 9001 certification in 1990. Today the plant also holds ISO 14001 and OHS 18001 certifications, accounting for operational efficiency and HSE for the environment and our people.

Operating with a robust quality and HSE management system ensures the plant consistently meets customer and regulatory requirements through continuous improvement processes.

The plant's capabilities include a complete suite of nondestructive examination (NDE) techniques such as a coordinate-measuring machine (CMM), baroscopic inspection, phased-array automatic ultrasonic technology, and cleanroom assembly areas. The highly skilled QC inspection team has earned multiple qualifications covering painting, NDE inspection, welding, and testing.

The plant is well recognized as a leading supplier of high-quality technologies for the deepwater subsea market, with its many achievements in new product development, manufacturing technologies, and qualifications underpinning its position.

CERTIFICATIONS

- API 6DSS (subsea valves) license number 001
- API 6A
- API 17D
- ISO 9001
- ISO 14001
- OHS 18001
- ISO 3834-2
- IEC EN 61508
- IEC EN 61511

Subsea Valve Portfolio

Subsea manifold.

products.slb.com/valves

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