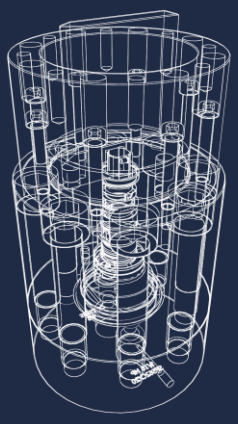
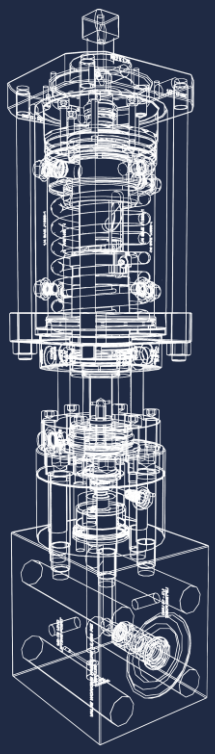
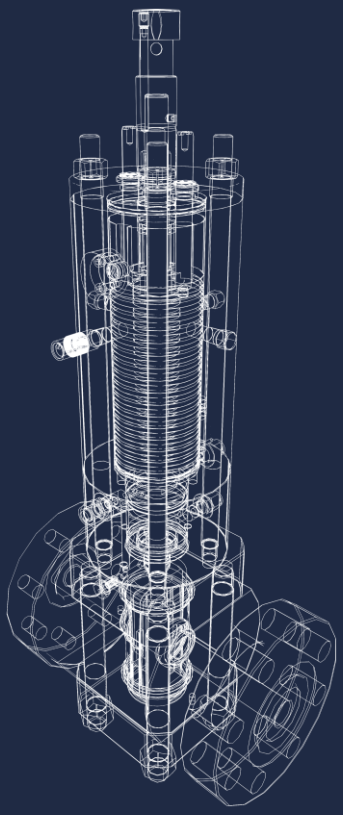
Bentley

Product Overview Brochure







Engineering solutions for extreme environments.

Contents

50 YEARS

Experts in the development of subsea valves

With innovation being part of the foundation on which LB Bentley was built this coupled with our expertise in the subsea oil and gas industry enabled LB Bentley to be the very first company to design, manufacture and qualify the first small bore subsea valve. Our understanding of the relevance of API specifications within the subsea industry meant that our unique valve fully satisfied the requirements of the customer with a design of valve which is still used today and now has 35 years of field proven success.

Over these years we have continually developed our valves in line with the customers' requirements, they are designed to satisfy the applications, specifications and the extreme environments in which they are being used. LB Bentley continue to move forward with the changes and challenges within the industry by building on our past experience to develop new products and deliver expert solutions.

In order to enhance recovery rates cost-effectively, operators rely on their hardware. Reliable valves are a vital component of hardware requirements. With our valves being used on XMT's and manifolds within subsea systems they deliver this reliability with innovative solutions.

With our extensive experience gained over the years, we have the edge when it comes to designing and developing small bore subsea valves. With having the unique advantage of being the first manufacturer to produce small bore subsea valves to the required industry specification this has given us the ability build and develop on our experience and field proven success. The volume and success of our small bore valves delivered to projects globally gives us the confidence of knowing that our products and processes are robust and quality driven.

As LB Bentley pioneered the metal-to-metal sealing technology, used in all of our valves, we have been able to develop designs of valves with a reduced risk of contamination and failure, a technology we continue to use in our newly developed products. This metal-to-metal technology eliminates the need to use elastomer seals as the primary seal this ensures integrity of the sealing capability delivering reliability of the seal and increases the longevity of valve design life.

We employ some of the brightest minds in the industry to stretch the boundaries of design with creative engineering. The outcome is bespoke products that help engineers solve their design challenges. We like to think of it as a partnership approach, working closely with our customers.

Our valves undergo rigorous testing, often over and above industry requirements. This includes performing a lifecycle test programme of up to 1,200 cycles, opening against full rated differential pressure and to temperatures ranging from -29°C (-20°F) up to 150°C (300°F). Low and high pressure gas testing is also performed to the requirements of API 6A, as well as hyperbaric testing to a simulated water depth of 3,048m (10,000ft). Valves are designed to be compliant with all aspects of the applicable current industry standards such as API 17D, as a minimum.

Facility and Capability

All design and manufacturing takes place at our UK 5,700m2 purpose built facility. To enhance the quality and service delivered to our customers, over the last few years, LB Bentley has invested in not just state of the art manufacturing machinery and equipment but has been committed to developing our in-house expertise and specialist software. We now have a range of capabilities available that will fully satisfy every customer's requirement.

Our capabilities:

Visual ERP system which is integrated throughout the manufacturing process. This delivers accurate scheduling and planning that enables us to manage and evaluate at every stage of the manufacturing process.

CNC Machine Shop with specialist machines and equipment to deal with the materials we use in an accurate, efficient manner and deliver a high quality finish. Our skilled machinists are highly experienced in dealing with exotic materials such as Duplex, super Duplex, and nickel alloys.

CNC, CMM, 3D Solid modelling CAD System with CAM implementation, and FEA capability.

13 High Pressure Test Cells with the ability to deliver remote witness testing. This is a unique LB Bentley designed system that enables our customers to observe, verify testing and review the test results whilst offsite, either by viewing the test taking place live on-line or by watching the recorded off-line session if required. The delivers the advantage of flexibility and cost saving direct to the customer.

A specialist 20,000psi test cell with testing capabilities to test up to six valves at any one time in a fully enclosed system with no exposure to pressure containing equipment during operation. It also provides the option for remote witnessing.

The vertical lift storage system, Modula, provides an increased storage capacity but with a reduction in the overall footprint in comparison with traditional storage. It gives us a more efficient and timely way to locate parts delivering an increase in productivity.

With our approach and commitment to Health and Safety, Environmental and Quality LB Bentley have achieved recognised certification, with targets in place to improve our delivery year on year. A focus of the company is to reduce our overall carbon footprint, with environmental targets and various initiatives in place, such as the installation of solar panels, sourcing a local supply chain where possible and ensuring recycling is carried out by our teams, we look to develop an ethos of environmental awareness within the company and its employees.

Engineered for reliability

With many years of experience of delivering robust and reliable products to satisfy the requirements driven by the harsh subsea environment, our valve offer optimum design performance and build quality. With our expertise and knowledge of the challenges of subsea environments LB Bentley pioneered metal-to-metal sealing technology, a technology that we still use today in all of our valves designs as it delivers a reliable valve that is notoriously known for its longevity of use in the field.

Robust, compact design, couple with special assembly options ensures our products are optimised for subsea applications.

Through Conduit Split Gate Valve

The first small bore subsea gate valve to go subsea. It is custom designed for use on subsea XMT's and manifolds, pumps and pipeline equipment to accommodate control fluids, well fluids containing H2S/CO2 gas, injection chemicals and methanol.

The through conduit valve design has full metal-to-metal sealing throughout the flow bore, a truly unique design and the only split gate valve to offer this technology. This metal-to-metal sealing technology ensure that the integrity of the valve is not compromised by the potential of elastomeric failure. As elastomers are only used in secondary and tertiary positions this means that the reliability and longevity of the life is increased.

A patented static leaf spring design ensures that the split gates are pre-loaded against the seat face. The pre-load is applied to the gate at the centre line of the seat so that seat/gate contact is maintained at all times. This enables a low-pressure gas-tight seal to be achieved without the aid of a lubricant or sealant injection, whilst also ensuring particles cannot be trapped between the sealing faces.

The valve is available in both 1/2" and 1" sizes, operating pressures of up to 15,000psi, temperature range -29°C up to 150°C and qualified to water depths of up to 3,048 metres (10,000ft). Valves are available in both hydraulically actuated and manual configurations and in FF or HH trims.

Applications include methanol and chemical injection, annulus wing valves, test lines or pressure/temperature transducer isolation. A full range of accessories are available including ROV buckets, extension rods, compensator, indicator mechanisms etc, together with the option of incorporating the valve assembly into manifold arrangements.

Valve Data Sheet

Through Conduit Gate Valve 1" & 1/2"

Valve Type	Through Conduit Split Gate Valve
Nominal Size	1/2" & 1"
Nominal Bore	12.7mm & 25.4mm
Valve Trim	FF or HH
Body/Bonnet Material	Available in either UNS S32760 25% Duplex, UNS N06625 Nickel Alloy 625 or UNS N09925 Nickel Alloy 925
Seat Material	UNS N06625 Nickel Alloy 625 with Tungsten Carbide hardfaced sealing face
Gate Material	UNS N06625 Nickel Alloy 625 with Tungsten Carbide hardfaced sealing face
Stem Material	UNS N06625 Nickel Alloy 625
Main Pressure Containing Fasteners	API 20E, API 20F or customer specific requirements
Primary Stem Seal	Metal to Metal in the backseat position
Secondary Stem Seal	PTFE/PEEK/ELGILOY
Seawater Ingress Seal	Polymite Shell / HNBR O-Ring
Paint	Two and three coat system available or to customer specific requirements
Check Valve	Integral metal to metal check valve available upon request
Compensator	Available upon request

Design Data

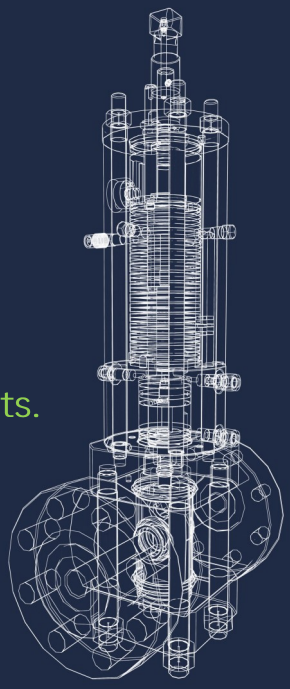
Max Operating Pressure	Up to 15,000 psi (1035 bar)
Rated Water Depth	3,048m (10,000 ft)
Design Temperature (Min)	-29°C (-20°F)
Design Temperature (Max)	Up to 150°C (302°F)
Design Lifetime	25 Years
Design Codes/Qualification	API6A 21st Edition/17D 2nd Edition, ISO 10423, NACE, NORSOK
Design Standard	PSL3, PSL3G

Actuator

Failure Mode	Fail Safe Close
Actuator Operating	Up to 6,000 psi (414 bar)
Actuator Supply Port	3/8" Autoclave MP SF375CX20
Actuator Flushing Port	3/8" Autoclave MP SF375CX20
Design Temperature (Min)	-4°C (25°F)
Design Temperature (Max)	66°C (150°F)
Fluids	Water based , oil based or to customer specific requirements

Interfaces

Connections	Flanged, Welded or Threaded to suit customer specific requirements
ROV Interface	ISO 13628-8 Class 1 - 4, or to customer specific requirements
ROV Receptacle	Mounted or Remote
Extension Rod	Available on request
Turns to Open/Close	1/2" is 8 +/- 1 turns, 1" is 11 +/- 1 turns
Manual Override	Available



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Rotary Gate Valve

Our rotary gate valve is compact, reliable and robust. It is designed to accommodate control fluids, well fluids containing H2S/CO2 gas, injection chemicals and methanol.

The design uses metal-to-metal technology for all primary seals to ensuring that integrity of the valve is upheld and the innovative wipe clean action ensures it performs reliably even with the dirtiest of fluids. This 'wiping' action between the gate and buttons means it is self-cleaning, which further promotes longevity.

The rotary gate valve was designed with space saving simplicity in mind. As the demands of the industry is to reduce the size of their XMT's and manifolds the rotary gate valve design offers small, compact and reliable option that can fit into a small space envelope and be used in an orientation being unaffected by side loading, a truly flexible valve design. In addition, the rotary gate valve has minimal moving parts and a time-saving quarter-turn mechanism that can be operated manually or with hydraulics. In the event of an over-torque situation against either the open or closed end-stop position, internal components cannot be damaged; load is transmitted through the rotary stop shear pin, not the valve stem.

The design can suit multiple applications, from isolation to block before/after bleed to diverter, plus a no-volume displacement design makes the product less sensitive to water depth.

A wide range of operating pressures, working pressures and operating temperatures can be catered for. Porting and mounting arrangements can be tailored according to need. Body size, stems, seals and ROV interfaces can be rationalised if required. The rotary gate valve is available in FF and HH trims, it can operate with pressures of up to 15,000psi, temperature range -29°C up to 150°C and qualified to water depths of up to 3,048 metres (10,000ft).

The rotary gate valve is available in both hydraulically actuated and manual configurations. Our purpose built OPTItork™ actuator is designed to cope with any demands that our valves are exposed to, with valve sizes ranging from 3/8" to 3/4". The OPTItork™ actuator operates to a performance level unmatched in the industry.

Valve Data Sheet

Rotary Gate Valve 3/8", 1/2" & 3/4"

Valve Type	Rotary Gate Valve
Nominal Size	3/8", 1/2" & 3/4"
Nominal Bore	9.53mm, 12.7mm & 20mm
Valve Trim	FF or HH
Body/Bonnet Material	Available in either UNS S32760 25% Duplex, UNS N06625 Nickel Alloy 625 or UNS N09925 Nickel Alloy 925
Seat Material	Available in either UNS S32760 25% Duplex, UNS N06625 Nickel Alloy 625 or UNS N09925 Nickel Alloy 925 with a Tungsten Carbide hard faced sealing face
Gate Material	Solid Nickel Bonded Tungsten Carbide
Stem Material	Available in either UNS N07718 Nickel Alloy 718 or UNS N07725 Nickel Alloy 725
Main Pressure Containing Fasteners	API 20E, API 20F or customer specific requirements
Primary Stem Seal	Metal to Metal in the back seat position
Secondary Stem Seal	PTFE/PEEK/ELGILOY
Seawater Ingress Seal	Polymite Shell / HNBR O-Ring
Paint	Two and three coat system available or to customer specific requirements
Check Valve	Integral metal to metal check valve available upon request
Compensator	Available upon request

Design Data

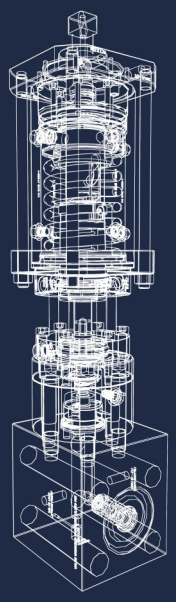
Max Operating Pressure	15,000 psi (1035 bar)
Rated Water Depth	3,048m (10,000 ft)
Design Temperature (Min)	-29°C (-20°F)
Design Temperature (Max)	Up to 150°C (302°F)
Design Lifetime	25 Years
Design Codes/Qualification	API6A 21st Edition/17D 2nd Edition, ISO 10423, NACE, NORSOK
Design Standard	PSL3, PSL3G

Actuator

Failure Mode	Fail Safe Close
Actuator Operating Pressure	Up to 6,000 psi (414 bar)
Actuator Supply Port	3/8" Autoclave MP SF375CX20
Actuator Flushing Port	3/8" Autoclave MP SF375CX20
Design Temperature (Min)	-4°C (25°F)
Design Temperature (Max)	66°C (150°F)
Fluids	Water based , oil based or to customer specific requirements

Interfaces

Connections	Flanged, Welded or Threaded to suit customer specific requirements
ROV Interface	ISO 13628-8 Type A Class 1 - 4, or to customer specific requirements
ROV Receptacle	Mounted or Remote
Extension Rod	Available on request
Turns to Open/Close	1/4 turn
Manual Override	Available—Requires 240N push to disengage



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Medium Duty Rotary Gate Valve

The Medium Duty Rotary (MDR) Gate Valve delivers the reliability and performance of LB Bentley's field proven valve with the economic benefit of a simplified design. Our valves are designed to accommodate control fluids, well fluids containing H2S/CO2 gas, injection chemicals and methanol.

Following the success of our rotary gate design the MDR was developed as a more cost effective solution where a simplified valve design would deliver to the customers' requirements but also fully satisfy the requirements of API 6A and 17D.

The valve has been designed with panel mounted applications in mind, such as specific fluid control and test lines on XT, Manifold panels and Subsea Distribution Units. The MDR has been developed using the field proven technology of our rotary gate valve and it has been designed for applications where traditionally needle and ball valve products are used, but the desire and requirements for a metal-to metal sealing gate valve would provide increased reliability without the need for additional expense.

The direct quarter turn operation allows for positive indication through a provided integral ROV receptacle, with an ROV interface to ISO 13628-8 Type A or Class 2. The low friction interface results in consistent operating torques and by using the meta-to-metal sealing technology the gate button to seat faced has a wipe clean action.

The MDR is available in FF trim, the material is to BS EN 10201 3.1 certification, DNV RPF112 HISC analysis. It is PR2 temperature rated to API 6A, -29°C (-20°F) to 82°C (180°F) with hyperbaric qualification to a maximum water depth of up to 3,048 metres (10,000ft).

As with our other valve design the MDR has a range of connections that can be supplied in either side or bottom orientation, or a combination of both.

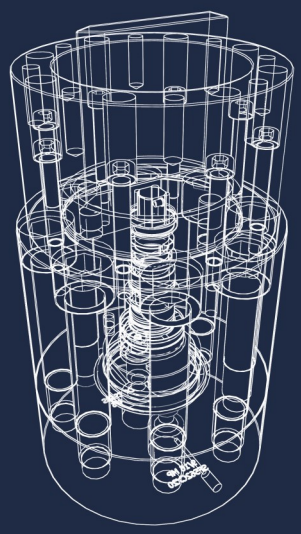
Valve Data Sheet

Medium Duty Rotary Gate Valve 1/2"

Valve Type	Medium Duty Rotary Gate Valve
Nominal Size	1/2"
Nominal Bore	12.7mm
Valve Trim	FF
Body/Bonnet Material	22% Chrome Duplex, material to BS EN 10201 3.1 certification, DNV RPF112 HISC analysis
Seat Material	22% Chrome Duplex, material to BS EN 10201 3.1 certification, DNV RPF112 HISC analysis
Gate Material	Solid Nickel Bonded Tungsten Carbide
Stem Material	UNS N07718 Nickel Alloy 718
Operation	Manual
Main Pressure Containing Fasteners	API 20E, API 20F or customer specific requirements
Primary Stem Seal	Metal to Metal
Secondary Stem Seal	PTFE/PEEK/ELGILOY
Seawater Ingress Seal	Polymite Shell / HNBR O-Ring
Paint	Two and three coat system available or to customer specific requirements

Design Data

Max Operating Pressure	15,000 psi (1035 bar)
Rated Water Depth	3,048m (10,000 ft)
Design Temperature (Min)	-29°C (-20°F)
Design Temperature (Max)	82°C (179°F)
Design Lifetime	25 Years
Design Codes/Qualification	API6A 21st Edition/17D 2nd Edition, ISO 10423, NACE, NORSOK
Design Standard	PSL3, PSL3G



Interfaces

Connections	3/8" Autoclave Medium Pressure SF375CX20, 9/16" Autoclave Medium Pressure SF562CX20, 3/4" Autoclave Medium Pressure SF750CX20. Butt Weld preparation available for 3/8", 1/2" and 3/4" tubing. All the above connections in either side or bottom orientation or a combination of both.
ROV Interface	ISO 13628-8 Type A
ROV Receptacle	Mounted
Turns to Open/Close	1/4 turn

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Check Valves

Our check valves are built to enhance the range of products offered by LB Bentley and can be integral, built into our valves inlet or outlet to provide a double barrier against the well fluid. Alternatively, the check valves can be a stand-alone valve used within the fluid control system to perform a vital function by preventing reverse flow of fluid that increases efficiency of operations and negates the potential for damage to the fluid control system.

As with our valves, all check valves fully satisfy API 6A and 17D requirements and testing principles. We offer both FF and HH trims to match and enhance the host valve requirements.

Our check valves come in a range of designs depending on the requirements of the application. The stand-alone designs are varying shapes, we have the bean can, the top hat and the rolling pin. If the check valve is integral, built into the inlet or outlet of the valve, then the valve design dictates the design of the check valve, they can be supplied with welded, flanged or threaded connections, to satisfy the customer requirements.

The spool-to-body primary seal is metal-to-metal, with a PTFE secondary seal. Lift pressures can be customer specified – typically 1 to 4 bar which support the pressure requirements of the fluid control system.

Recognising that soft-faced Check Valves are susceptible to contamination, field servicing of the valve by simple replacement of the spool assembly has been designed to be as simple a process as possible. Crucially, installation in a gate valve assembly is carried out without affecting the integrity of any seat to body interface, which is a major issue for other design solutions.

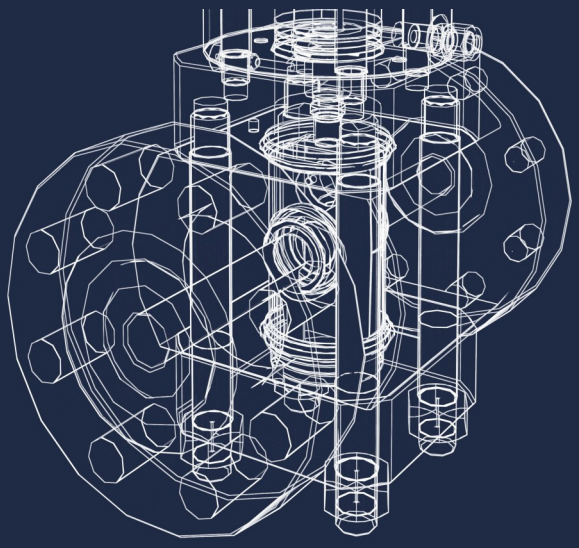
Valve Data Sheet

Check Valve 1" & 1/2"

Valve Type	Check Valve
Nominal Size	1/2" & 1"
Nominal Bore	12.7mm & 25.4mm
Valve Trim	FF or HH
Body Material	Available in either UNS S32760 25% Duplex, UNS N06625 Nickel Alloy 625 or UNS N09925 Nickel Alloy 925
Spool Material	Available in either UNS S32760 25% Duplex, UNS N06625 Nickel Alloy 625 or UNS N09925 Nickel Alloy 925
Secondary Seal	PTFE - Teflon
Set up	Built integrally into the Rotary Gate Valve or Through Conduit Gate Valve, or as a standalone unit
Styles/Interfaces	Threaded, butt weld, flange mounted, sandwich design, bean can
Paint	Two and three coat system available or to customer specific requirements

Design Data

Max Operating Pressure	15,000 psi (1035 bar)
Rated Water Depth	3,048m (10,000 ft)
Design Temperature (Min)	-29°C (-20°F)
Design Temperature (Max)	Up to 150°C (302°F)
Design Lifetime	25 Years
Design Codes/Qualification	API6A 21st Edition/17D 2nd Edition, ISO 10423, NACE, NORSOK
Design Standard	PSL3, PSL3G



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Supporting Products

LB Bentley understand the challenges of subsea production and push the boundaries of engineering design to offer our customers a range of additional bespoke products that enhance their subsea system requirements.

Stem Extensions

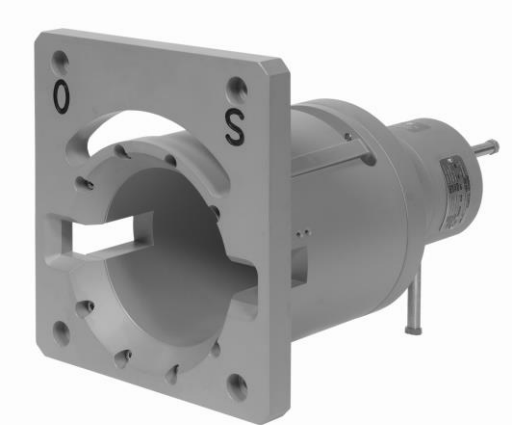
Where the design of the customers XMT demands the need to overcome space envelope challenges we can help achieve their requirements. For example, where the small bore subsea valve is required to be placed deep within the XMT due to these space challenges, LB Bentley can design and build bespoke stem extensions that still enable ROV access to operate the valve in such a position, without compromising the reliability of the valve operations.

Compensators

Where necessary, we can provide purpose-designed hydraulic compensators. They connect directly to the actuators without the need for external pipework, they use a rolling diaphragm that delivers a displacement function if a sea chest is not available.

ROV Receptacles

ROV receptacles can be supplied in all the usual interfaces, for example, ISO 13628-8 Class 2, 3 and 4, High Torque/Low Torque or interfaces personalised to customers' requirements or specifications. The ROV receptacle may be mounted to the valve, the actuator or the panel at the end of a stem extension, they may also be supplied as a stand-alone unit.



Research & Development

The “can do” attitude of our R&D department reflects our belief that there is always a way to achieve what the subsea environment and the industry demands from our products.

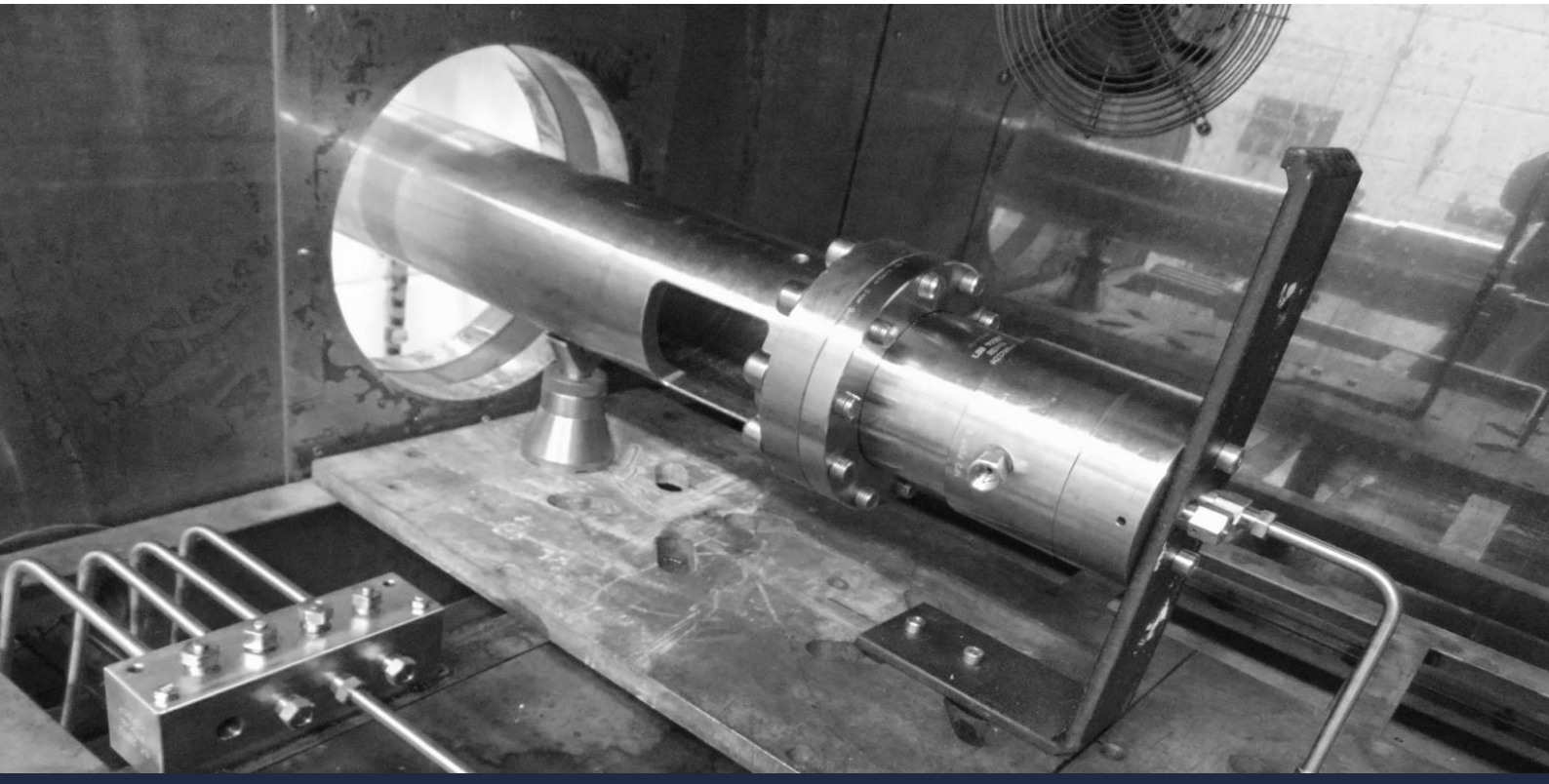
Our skilled team of R&D engineers and technicians push the boundaries of technology to develop and improve the right products for the right environment whilst endeavouring to fully satisfy the customers specifications.

Whilst most of the Qualification testing is performed in excess of industry standard requirements, wherever possible testing is also carried out in a manner that replicates field operating conditions as closely as is feasible. This is done to provide customers with total confidence in the reliability of the product.

In recent years, the number of R&D test cells has increased, allowing LB Bentley to develop and implement new and improved products. The capabilities and boundaries of existing products are constantly being explored and re-defined, whilst the opportunity to evaluate new concepts is also being exploited.

To speed the test cycles, automation is increasingly utilised, which, coupled with electronic acquisition of the data allows detailed and rapid analysis and evaluation of results.

Improvements in materials, coatings and designs are evaluated in smaller feature proving ‘satellite tests’ prior to incorporating them into new or enhanced products. To ensure that testing is clearly focussed and directed, engineering analysis is used to simulate numerous “what if” scenarios, thus achieving increased efficiencies throughout the development cycle.



Aftermarket & Service

The Aftermarket and Service Department specialise in supporting the full LB Bentley product range whether it be at our purpose facility or where our customers need us.

This aftermarket service covers all aspects of refurbishment and warranty, this covers work both on and offshore. We have a specialised team of Aftermarket Service Technicians who are fully trained to carry out work on all valve designs.

For valves returned to our facility there is a secure and controlled area where the customers collateral is kept. Our committed and specialised team have dedicated equipment for the repair or refurbishment of any of our products. There is also a bespoke testing area available enabling work to be turned around quickly to ensure as little inconvenience to customers as possible.

Alternatively, if onsite service or repair is required then our specialist technicians can be mobilised for both UK and international work, assisting customers with the onsite installation of equipment, testing and potentially training.