FLOWSERVE

Worcester Controls

Products for the Defence Industry

Experience In Motion

Flowserve Flow Control

Quality Statement

It is the policy of the Company to provide products and services that satisfy performance, reliability, safety, customer and legislative requirements so as to ensure the long term satisfaction and loyalty of our customers.

It is the responsibility of all employees to ensure this goal is met by a commitment to professionalism and a pride in the business.

ISO 9001 and the standards specified and detailed in our relevant manuals, procedures and issued work instructions are a minimum requirement and it is incumbent on all employees, from the most senior manager down, not only to strive to exceed them but to ensure that we are able to continually improve the quality of the goods and services we supply and the effectiveness of our Quality Management System.

It is only in this way that we will preserve and continue to maintain our reputation for having the highest quality products and the best available supporting services.

The Quality Policy and Company objectives are reviewed every six months by Senior Management to ensure their suitability, adequacy and effectiveness.

- ***ISO 9001***
- ***ISO 17025***
- ***PED:97/23/EC***
- ***ATEX:94/9/EC***
- ***SIL:BS EN IEC 61508***
- ***Lloyd's Register Type Approval***

UKAS TESTING
No.4180

We are approved to ISO 9001, 97/23/EC and became the first valve manufacturer to obtain ISO 17025 accreditation by UKAS as a testing laboratory (UKAS no. 4180).


Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2000

This is to certify that:

Flowserve Flow Control (UK) Ltd
Burrell Road
Haywards Heath
RH16 1TL
United Kingdom

BSI Management Systems


EC Certificate

of Conformity

No. CE 54844

Flowserve Flow Control
a division of Flowserve GB Limited
Burrell Road
Haywards Heath
RH16 1TL
United Kingdom

Pressure Vessels & Accessories

BSI


United Kingdom Accreditation Service

ACCREDITATION CERTIFICATE

UKAS
UNITED KINGDOM ACCREDITATION SERVICE

TESTING LABORATORY
No. 4180

Flowserve Flow Control (UK) Ltd

Flowserve Capability

Having earned a reputation over 45 years for high performance and reliability, Worcester ball valves and Norbro actuators are installed on all UK submarines and surface ships as well as other navies throughout the world.

We have provided manual and actuated valves in a range of materials including Nickel Aluminium Bronze (NAB), Monel and Titanium for pressures up to 345 bar (5000 p.s.i.) in accordance with Defence Standard 02-360.

Flowserve can provide design and manufacturing capability, quality assurance, project management and through-life support.

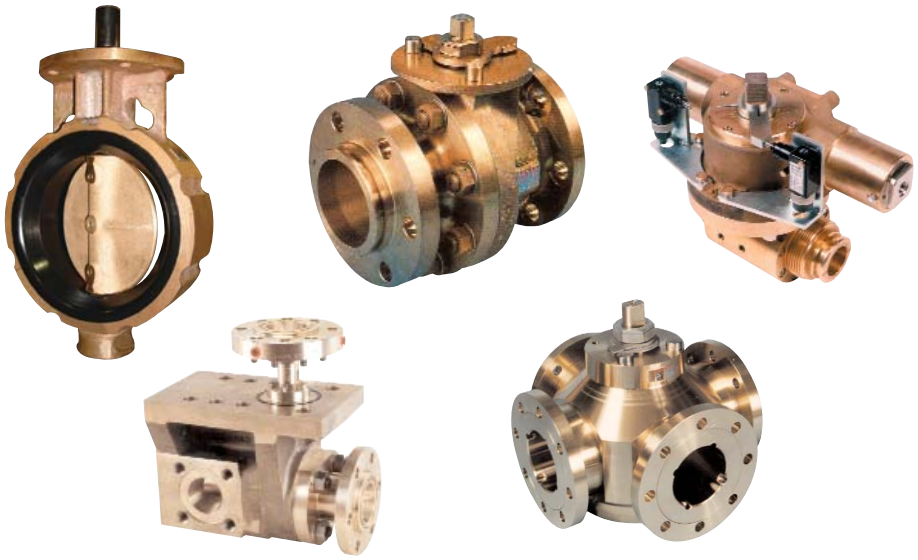
UK Surface Ships & Submarines fitted with Worcester valves plus Norbro pneumatic and/or electric actuators

- Aircraft Carriers (CVS & CVF)
- Assault Ship
- Landing Platform Dock Ship (LPD)
- Destroyers (Type 42 & Type 45)
- Frigates (Type 22 & Type 23)
- Mine Counter Measure - Hunt Class
- Mine Counter Measure Vessels (MCMV) - Sandown Class
- Nuclear Submarines - Swiftsure (SSN), Trafalgar (SSN), Vanguard Class (SSBN)& Astute

Flowserve have design, manufacturing and assembly facilities in the UK, including a new clean room facility, which meets ISO 14644-1 to ISO Class 7 standards (equivalent to FED STD 209E, Class 10,000).

Overseas Navies supplied include

	Submarines	Surface Ships
Australia	✓	✓
Brazil	✓	✓
Canada	✓	✓
Chile		✓
India		✓
Malaysia		✓
Netherlands	✓	✓
Norway		✓
Oman		✓
Pakistan		✓
Singapore	✓	
Spain		✓
Sweden	✓	✓
UAE		✓
USA		✓



Applications - Valve Specialists for Navies Worldwide

We have supplied valves and actuators in both submarines and surface ships for many applications. The numbers in brackets below refer to the page featuring the product(s) typically used for these specific applications:

- AFFF System (16)
- AVCAT Fuel Systems (9)
- Air Conditioning Systems (10 & 11)
- Air Independent Propulsion (AIP) (10)
- Air Induction and Exhaust Gas Systems (10 & 11)
- Air Purification Systems (10 & 11)
- Auxiliary Vent and Blow (12)
- Ballast Tank Drain and Vent (6 & 7)
- Battery Ventilation (12)
- Bilge and Tank Pumping (8)
- Built-in Breathing Systems (10)
- Compensating Systems (6 & 7)
- Condenser System Hull Valves (6 & 7)
- Depth Gauge and Salinometer Systems (10)
- Diesel Engines (Lubrication & Fuel Supply) (9)
- Fire Protection (10, 11 & 16)
- Freshwater Systems (10)
- High and Low Pressure Air Systems (10 & 13)
- Hull Valves (6 & 7)
- High and Low Pressure Hydraulic Systems (10 & 13)
- Lubricating Oil Systems (9 & 12)
- Reverse Osmosis Plants (16)
- Seawater Cooling Systems (6, 7 & 11)
- Signal Ejectors (7)
- Torpedo Flood and Drain Systems (6, 7 & 12)
- Trim and Stabilising Equipment (10 & 13)

Hull Valves

High Integrity, Class 1, shock tested Worcester ball valves

FLANGED BALL VALVE 65mm - 200mm

Manual and with mounting pad for actuator mounting, available in Nickel Aluminium Bronze (NAB) with either NAB or Titanium ball.

Series 55

HP44-P261

BALLAST TANK HULL VALVE (periodically submerged) 50mm

Nickel Aluminium Bronze valve, fitted with mounting pad for in-board actuator mounting (other sizes available on request).

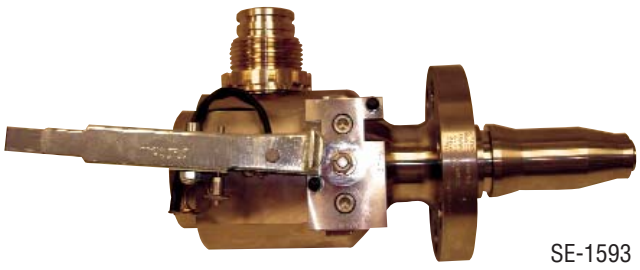
COMPENSATING VALVE with extended coupling and pad for actuator mounting 65mm

Nickel Aluminium Bronze valve with 925mm extension stem. The stem extension with splined shaft and universal joints provides remote actuation and allows for offset by up to 75mm from the valve centre line, which overcomes any potential misalignment. Other valve sizes and stem extension lengths available on request.

H55-P260

TANK-SIDE ANGLE HULL VALVE 25mm

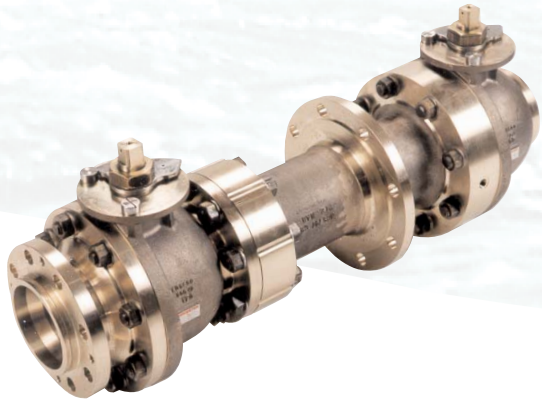
One-piece body design, manufactured in Monel 400, with lockable handle.



SE-1593

Hull Valves

High Integrity, Class 1, shock tested Worcester ball valves



SIGNAL EJECTOR TUBE VALVE ASSEMBLY

Available in various sizes up to 200mm in Nickel Aluminium Bronze.

Series ET_55

SCREWED HULL VALVE

20 - 50mm in Nickel Aluminium Bronze complete with mounting pad for actuation

Series H44

Hull Valve Options and Developments

SINGLE HULL VALVE with integral hydraulic actuator

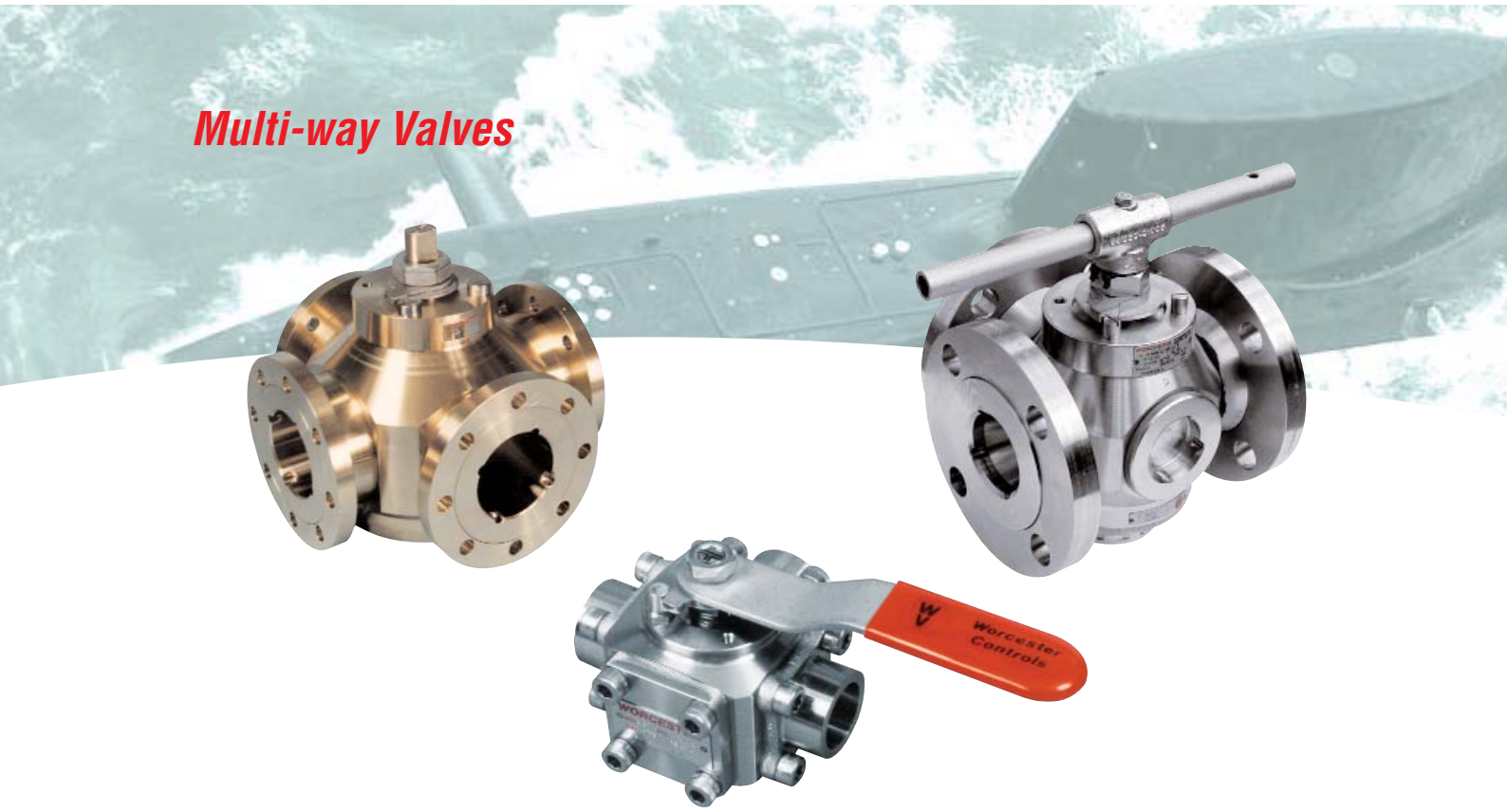
- Flange connection and ports can be customised for specific applications
- Valve materials of construction include Nickel Aluminium Bronze with options for balls in titanium and other materials
- Compact design as actuator housing is integral with valve body
- Drive from actuator to valve ball is achieved with a one piece shaft, minimising hysteresis
- Manual override available on actuators. Sizes available up to 250mm

DOUBLE BALL HULL VALVE with integral hydraulic actuators

The double ball hull valve has all the features listed above for the single hull valve, plus the following:

- Hull valve with back-up valve contained within the same body casting
- Overall length and weight is less than installing two separate actuated valves
- Actuators operate independently
- Symmetrical weight distribution
- Sizes available up to 250mm

Multi-way Valves



SERIES 18/19 MULTI-WAY BALL VALVES 3, 4 or 5 port options 15 - 150mm

Nickel Aluminium Bronze, Carbon Steel and Stainless Steel.
Flanged, screwed, butt weld or socket weld ends.

SERIES 13/14 DIVERTER BALL VALVES 8 - 50mm

Nickel Aluminium Bronze, Carbon Steel and Stainless Steel with screwed, butt weld or socket weld ends. Bottom entry or side entry available.

Multi-way face to face dimensions include:

Face to Face Dimensions (of 2 opposing flanges on a 3-way valve)	BS EN 558-2 Table 6 ISO 5752 - Table 6 ASME B16.10 - Tables 1 and 2 API 6D/ISO 14313 - Table 4.3 DIN 3202 - Table 5.1
Non preferred face to face dimensions can be accommodated.	

Firesafe Valves

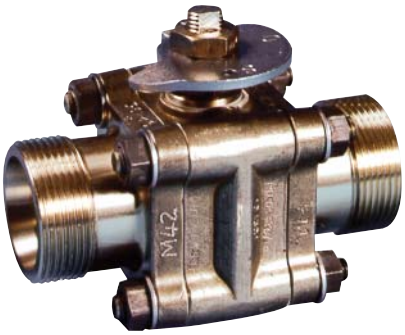
3-PIECE FIRESAFE BALL VALVE 8 - 150mm

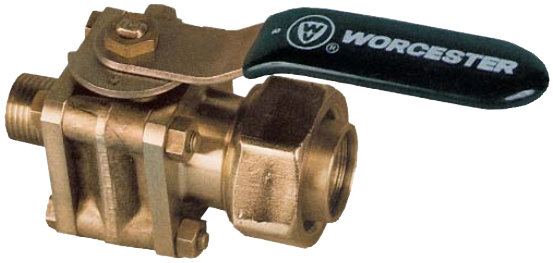
Carbon Steel and Stainless Steel with screwed, butt weld and socket weld ends, reduced and full bore.

FLANGED FIRESAFE BALL VALVES 15 - 250mm

Carbon Steel and Stainless Steel. Full bore and reduced bore. Class 150, 300 and PN flanges.

General Service In-Line Valves





SERIES 44 3-PIECE BALL VALVES 8 - 50mm

in Nickel Aluminium Bronze, Carbon Steel and Stainless Steel. End connections include screwed (male and female), butt weld, socket weld, flanged or customised to specific requirements.

SERIES 911 HIGH PERFORMANCE TOP ENTRY BALL VALVE 15 - 150mm

Available in Stainless Steel with cartridge assembly for ease of maintenance.

CRYOGENIC BALL VALVE 8 - 50mm

Manufactured in Stainless Steel and Brass for temperatures down to minus 196°C. Suitable for media such as Oxygen and Nitrogen. Ideal for AIP systems. Can be supplied without extended bonnet if required.

5 SERIES FLANGED BALL VALVE 15 - 200mm

in a range of yellow metal alloys (see p.15)
One piece body design 15mm - 50mm.
Two piece body design 65mm - 200mm.

Series S3300

BUTTERFLY VALVES 50 - 225mm

Nickel Aluminium Bronze / Copper Alloy body and disc with Nitrile liner.

Series S3300 with Norbro 40R pneumatic actuator

Customised Products

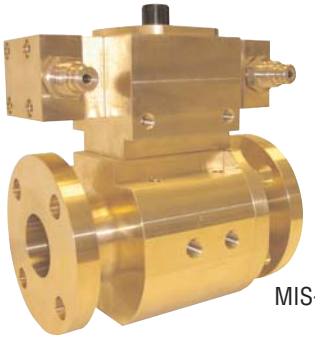
Worcester Controls have over forty five years experience in the conception, design and manufacture of unique valves to meet precisely our customers' exacting requirements. Our policy is to provide new, advanced-design valves and actuation which has put us in the forefront when products are required for critical applications of a highly specialised nature. Some of these customised valves are shown below.

MANIFOLD BLOCKS fitted with varying sizes of Worcester Series 44 ball valves

Can be supplied in various materials. Examples shown are in Carbon Steel and Nickel Aluminium Bronze.

FLOOD AND DRAIN VALVE 50mm

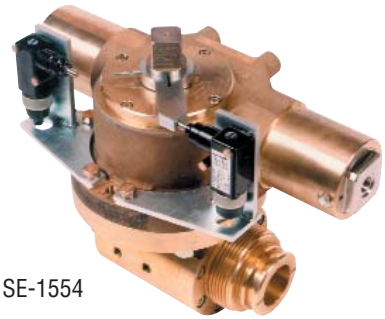
Nickel Aluminium Bronze valve with integral hydraulic actuator.



MIS-4180

EMERGENCY BLOW HIGH PRESSURE BALL VALVE 40mm

Nickel Aluminium Bronze complete with integral pneumatic actuator.



SE-1554

Series H44 Series H55

SUBMERGED BALL VALVES AND HYDRAULIC ACTUATORS

Nickel Aluminium Bronze valves and actuators for submerged seawater applications in submarines.

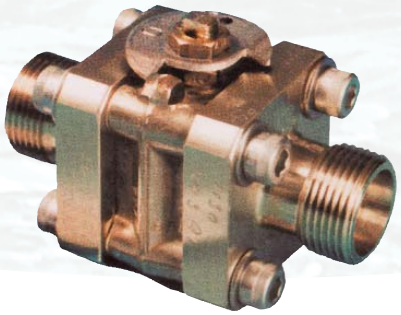
Series H97

FULL BORE BALL VALVE 250mm

Stainless Steel with customised flange connections.

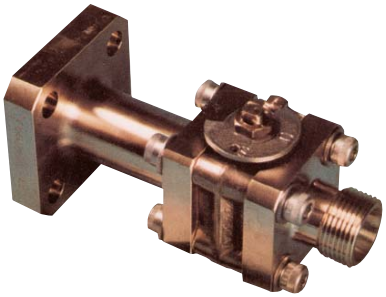
High Pressure Valves

HP44 Series



3-PIECE HIGH PRESSURE BALL VALVE HP44 8 - 50mm

Nickel Aluminium Bronze, Carbon Steel and Stainless Steel with screwed ends, male or female.



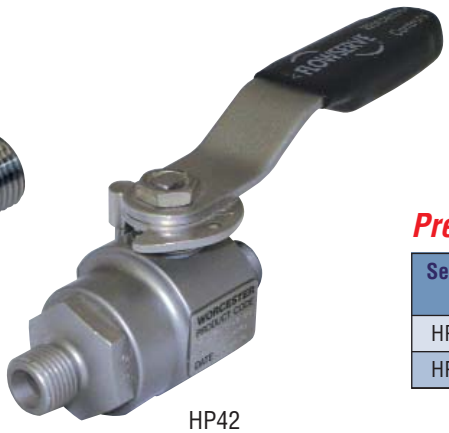
HIGH PRESSURE HP 44 SERIES BALL VALVE with dissimilar ends

Ball valve in Nickel Aluminium Bronze. One end has an extended flanged connector and the other is fitted with a male threaded connector.

HP42/HP43 SERIES BALL VALVE suitable for high pressure instrumentation systems up to 250 bar. Valve size 8 - 50mm

Manufactured in Stainless Steel and Nickel Aluminium Bronze.

HP43



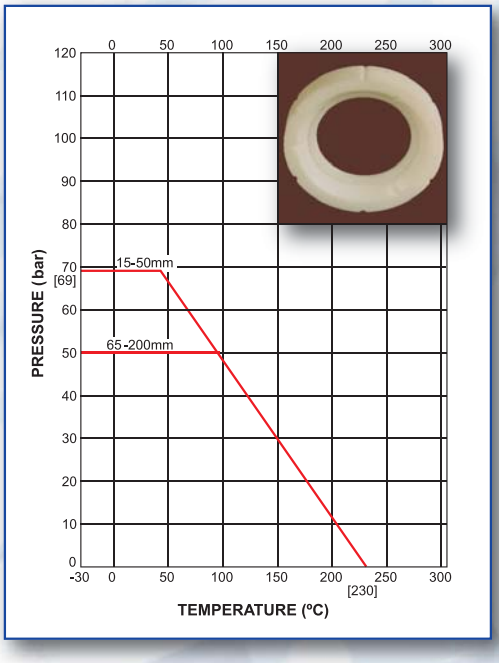
HP42

Pressure Capabilities

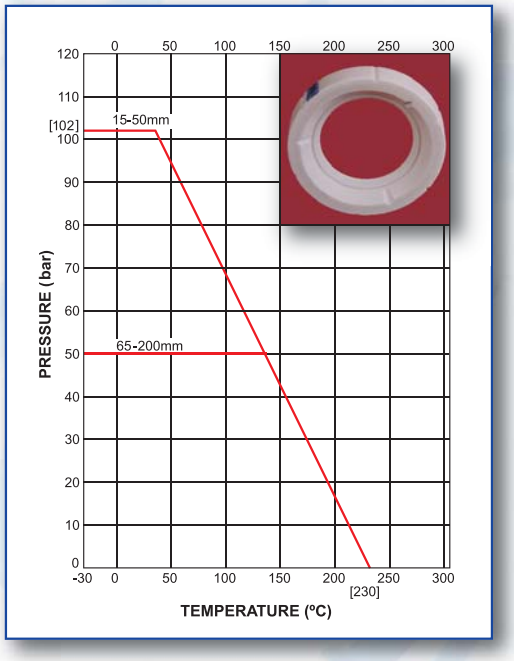
Series	Size [DN]	Material	Maximum Working Pressure (Bar)
HP42	8	NAB/S.Steel	210
HP43	8	NAB/S.Steel	250

Valve Seat Options

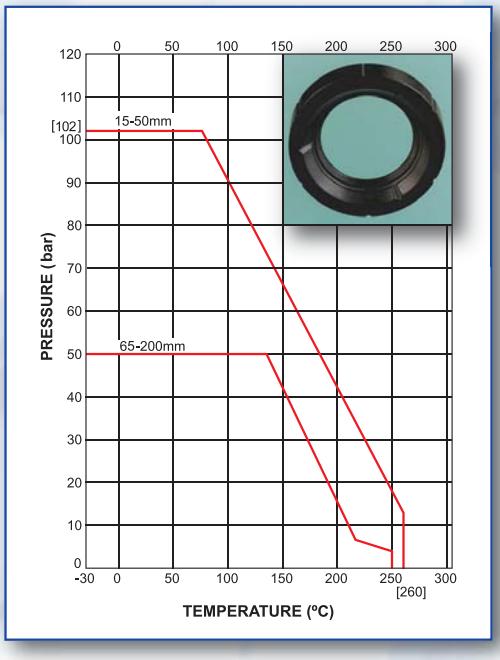
VIRGIN PTFE (T)
Virgin PTFE is the most common sealing material and is suitable for almost all media as it has excellent chemical resistance.



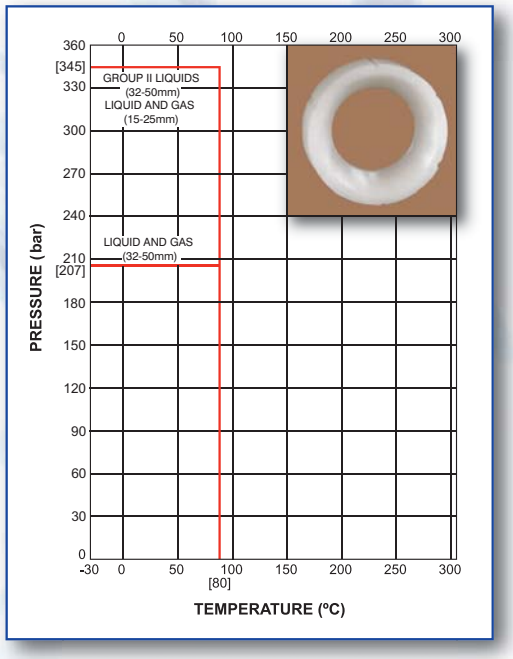
15% GLASS FILLED PTFE (R)
Glass re-inforced PTFE seats are stronger than virgin and have higher pressure/temperature ratings.
Chemical resistance as per virgin PTFE.



FLUOROFILL (P)
Carbon, glass and graphite filled PTFE material, an excellent seat material for steam and thermal services. Due to its high cycling capabilities, it is the recommended soft seat for modulating control applications.

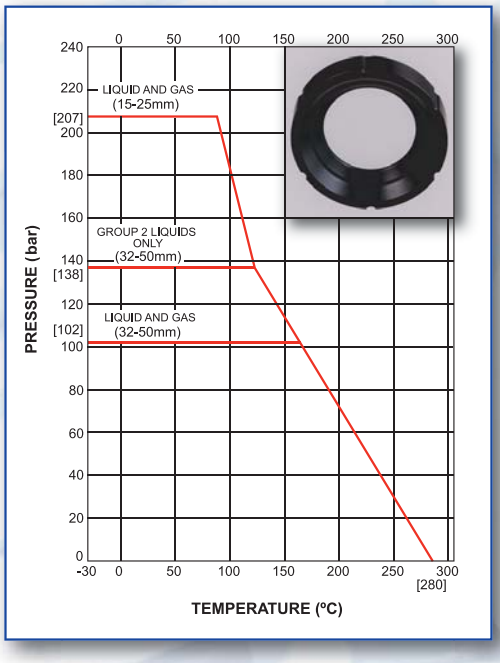


ACETAL (D) 5HP44
Machined from acetal homopolymer, these seats are capable of handling extremely high pressures. Please note this material should not be used on oxygen service.



Pressure/Temperature Ratings

PEEK (A - DN15-25) (X - DN32-50)
PEEK is Poly Ether Ether Ketone, a material which demonstrates outstanding pressure capabilities at elevated temperatures.
PEEK has excellent chemical and abrasion resistance.



Other Seat Materials Include:

25% GLASS FILLED PTFE (H)
Glass reinforced PTFE material offering a greater pressure / temperature capability than the R seat.

UHMWPE (U)
Ultra High Molecular Weight Polyethylene offers good performance characteristics in applications where PTFE is not suitable. It also has good abrasion resistance.

METAL – ALPHA (N)
A 316L sintered metal seat impregnated with PTFE, this material combines the strength and abrasion resistance of metal with the lubrication properties of PTFE. A graphite-impregnated metal seat is also available.

Typical Valve Materials of Construction

Duplex Stainless Steel (forged / wrought)	UNS S31803/1.4462 or equivalent
Austenitic Stainless Steel (cast)	ASTM A351: CF3M, CF8M
Austenitic Stainless Steel (forged / wrought)	AISI 316, 316L, 304, 304L
Carbon Steel (cast)	ASTM A216: WCB ASTM A352: LCB
Titanium	ASTM B348
Monel	Monel 400, Monel K-500
Nickel Aluminium Bronze	DEF STAN 02-833, Class II & III Grade I & II DEF STAN 02-747, Class I, II & III EN1982: CC333G (CuAl10Fe5Ni5-C)
Aluminium Bronze	BS EN 1982 CC 49IK
Gunmetal	DEF STAN 02-830
Other materials can be supplied on request	

Standards of Compliance

Valve Specification	BS 5351 and ISO 17292, valves for the petroleum industry. Lloyds Register type approved.
Flanges	BS 1560 and EN 1759-3 Class 150 / Class 300 BS 4504 and EN 1092-1 PN16 / PN40
Face to Face Lengths	ANSI B16.10 BS 2080 and EN 558
Pressure Test Specification	BS 6755 Part 1 and EN 12266-1
Firesafe Specification	BS 6755 Part 2, ISO 10497, API 6FA, API 607
Quality Assurance	ISO 9001 and AQAP 2120 (if specified)
Other face to face dimensions and flange ratings can be supplied to customer specific requirements	

Norbro Actuation

SERIES 40R NORBRO PNEUMATIC ACTUATOR

Norbro's rack and pinion design, combined with its reliability, ease of maintenance and quality of construction, has established the 40R as one of the world's leading quarter turn actuators. In addition, its modular design allows for simple attachment of a variety of ancillaries (eg. solenoids, switches, etc).

The Norbro 40R Series actuators have been successfully shock tested.

- 12 sizes of actuator
- Double and Single Acting
- Available as 90° as standard (180° option 33 series with spring return option also)
- Torque output up to 4175 Nm at 5 bar (Double Acting Version)

Norguard surface treatment can also be supplied for additional protection. Norguard coating complies with:

- MIL-A-63576A-Type 1-Aluminium Oxide Coating - Lubrication
- MIL-A-8625 (Anodic Coatings)
- ASTM B 117 (Salt Spray Testing)

SERIES 75 ELECTRIC ACTUATOR

The Norbro Series 75 electric actuator is a compact, versatile unit designed to provide direct positive automatic operation of valves requiring 90° (and 180°) operation.

The Series 75 combines efficiency, safety and reliability and operates from either AC supplies or with DC motors.

It is constructed from lightweight materials and is available with a variety of housings designed to IP66, NEMA and CSA standards.

Easy to install and maintain, the Series 75 electric actuator provides the answer for a variety of low cost automated packages, and of course with the benefit of low energy consumption.

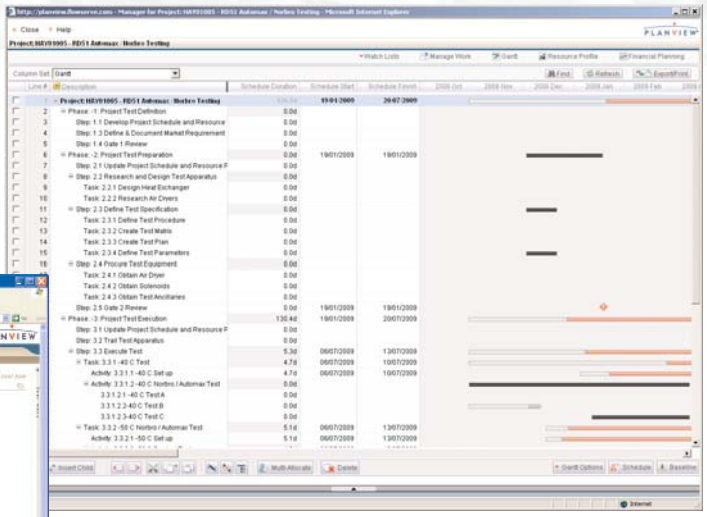
The Series 75 electric actuator has also been successfully shock tested.

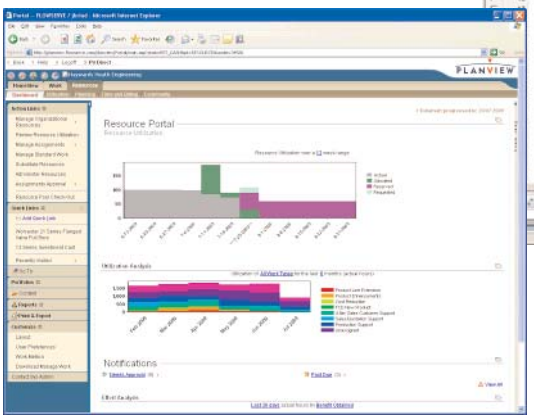
Project Management & Integrated Logistic Support

Project planning and scheduling
Resource utilisation management
Progress tracking and monitoring

Flowserve has the experience and knowledge to assist with logistic support for all valve systems on board surface ships and submarines.

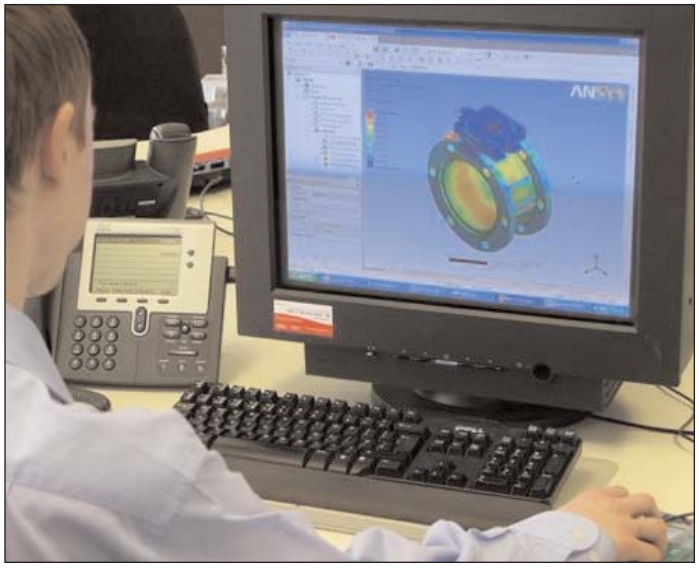
- Logistic Support Analysis (LSA)
- Reliability, Maintainability and Testability (RM&T)
- Data Item Descriptions (DID)
- Failure Mode Effects and Criticality Analysis (FMECA)
- Contractor Data Requirements List (CDRL)





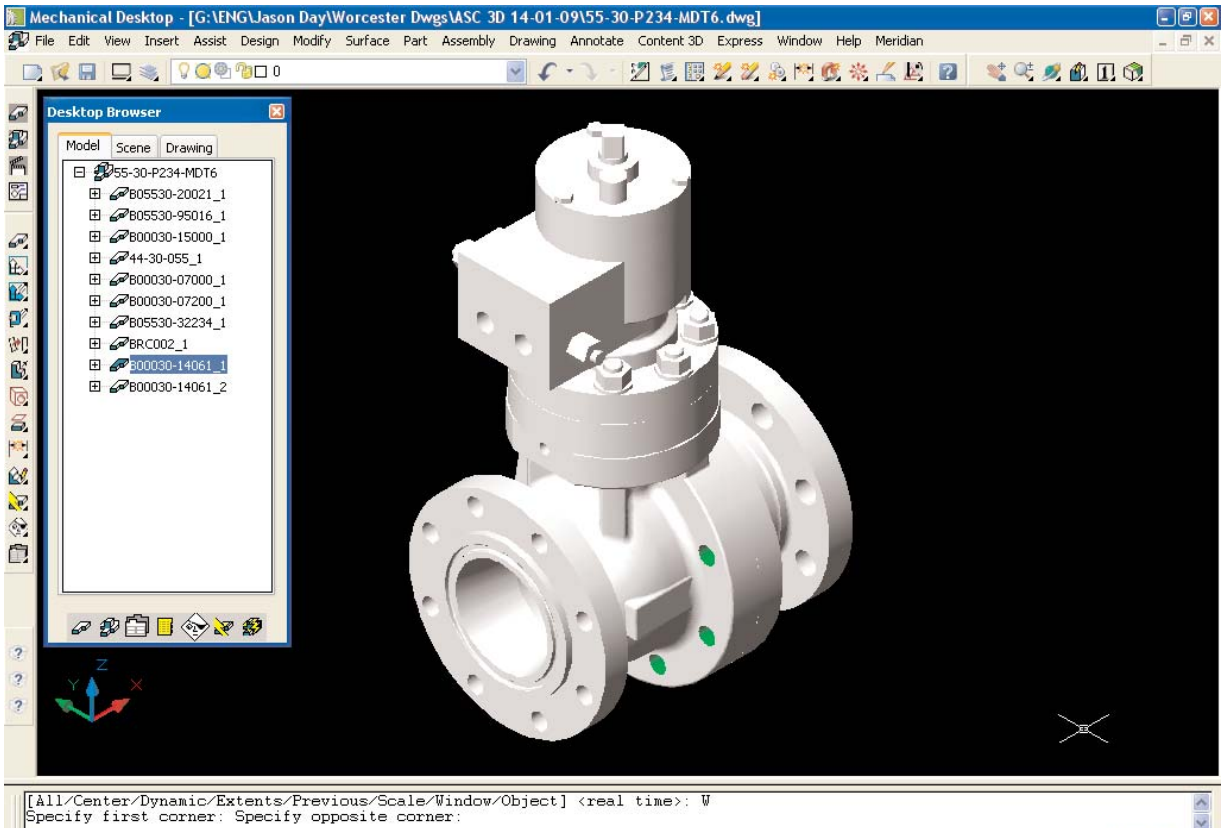
Finite Element Analysis

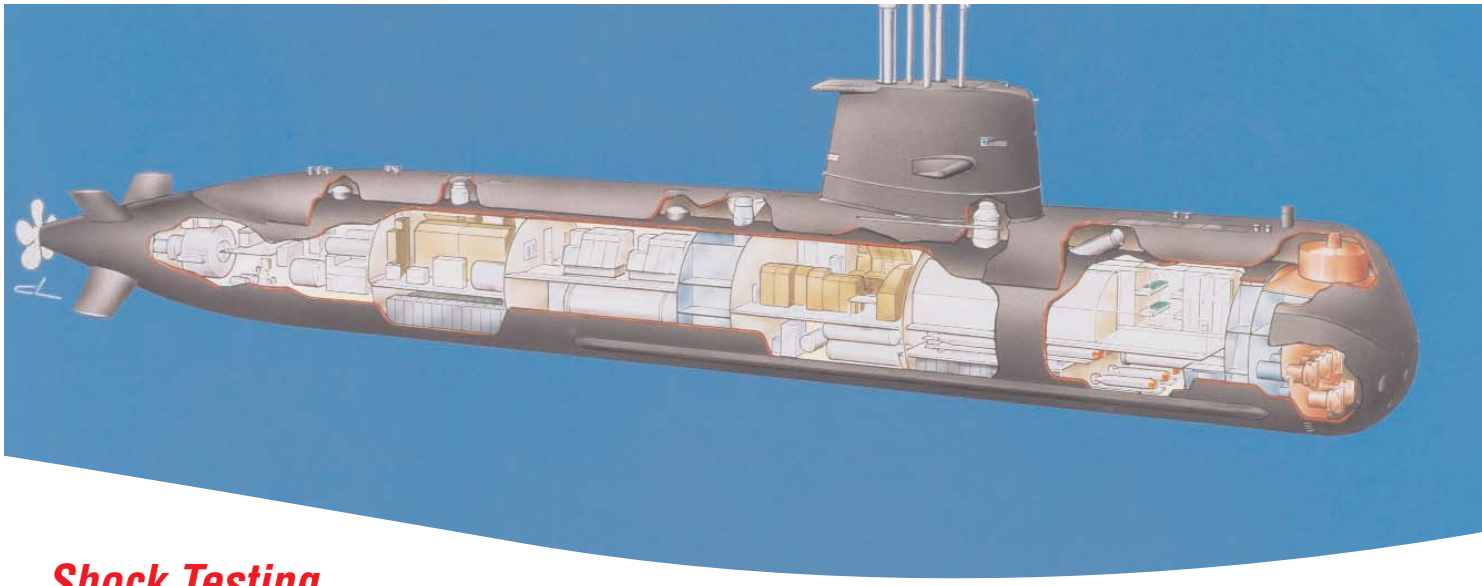
- Material reduction / optimisation
- Component analysis and verification
- Simulated component deformation under varying load conditions
- Body stress plot mapping (single / multiple components)



3D Valve and Actuator Modelling

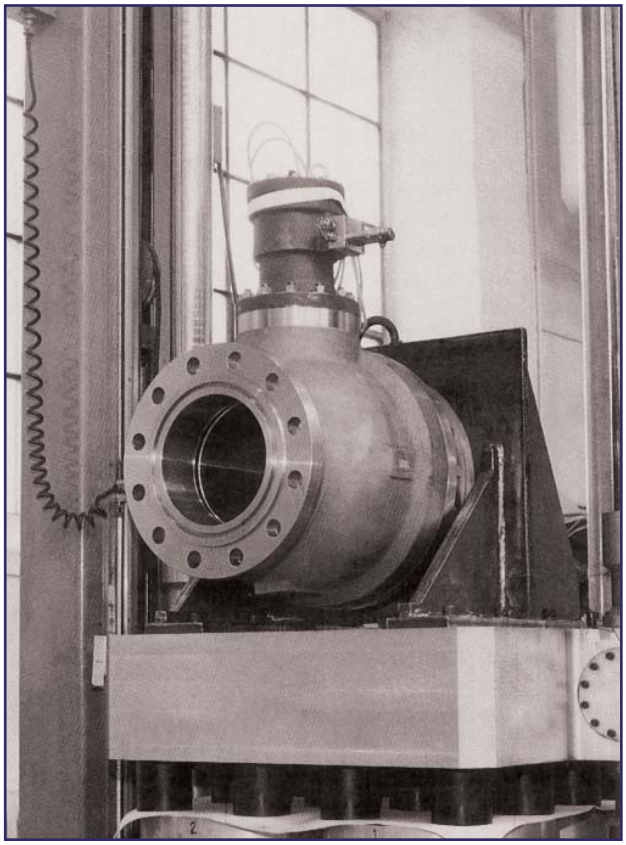
- Parametric modelling
- 3D visualisation and rendering
- Complex profile creation
- Accurate weight and centre of gravity analysis
- Export models in most formats





Shock Testing

To meet the stringent Defence requirements, Worcester valves and Norbro actuators have been subjected to a wide range of shock tests over the last forty five years. The successful results of these tests have enabled Worcester Controls to become an approved supplier to navies throughout the world.

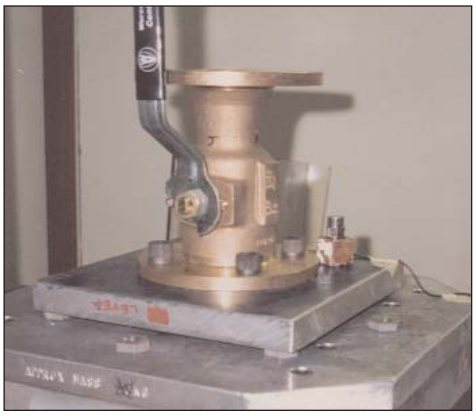


A 10" (250mm) full bore Worcester valve undergoing shock tests.

Shock tests have been carried out on our equipment to meet the Class I and Class II requirements of both submarines and surface warships including the conditions of BR 3021 Grade B and IEC 68-2-27 (1987 edition) MIL-S-901 D.

Shock tests have been successfully carried out up to 2000 G, followed by functional cycle and pressure tests.

Approval has also been obtained on Worcester valves which have been subjected to underwater explosion tests.



FLOWSERVE

Quality
Manufacturing Capability
Flexibility
Innovation
Over 45 Years Experience

FCD WCEBR0021-04

To find your local Flowserve representative:

For more information about Flowserve Corporation, visit www.flowserve.com

For further information on specific requirements please contact our Contract Sales Team.

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