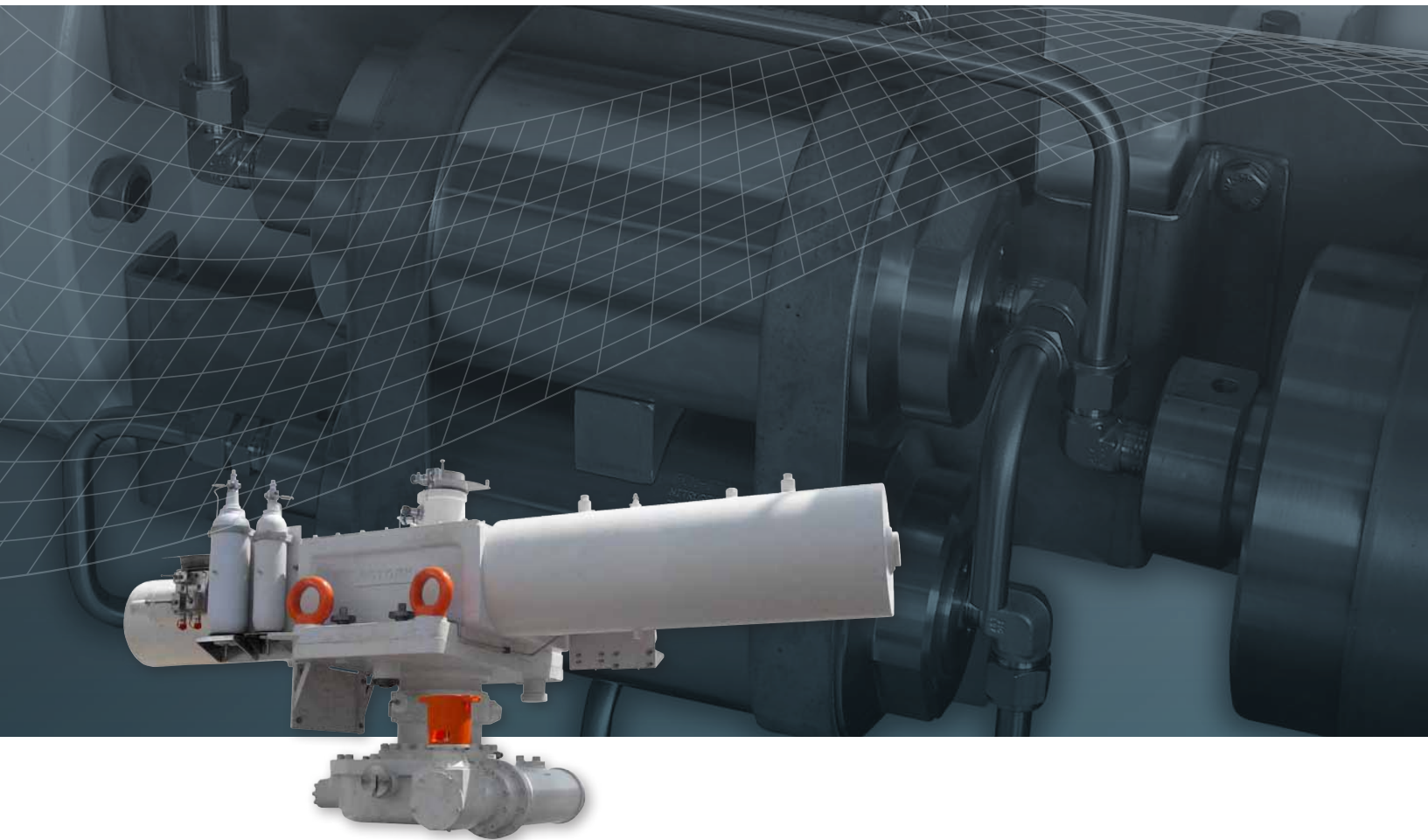


rotork[®]

Subsea Valve Actuation



Redefining Flow Control

Product & Services Overview

With an actuator installed base dating back to 1992 operating at depths ranging from 30m to over 2,400m, Rotork is familiar with supplying subsea products to meet the stringent demands of subsea valve actuation. The installed base covers pressure compensated rack and pinion, scotch yoke and linear subsea actuator designs with ROV or diver operated facilities for both double-acting and spring-return applications.

Complementing our Rotork Fluid Systems subsea actuators is a range of subsea gearboxes, also with diver or ROV operable overrides. These are designed and engineered by the dedicated gearbox manufacturers within the Rotork Gears division. The engineering groups of Rotork Fluid Systems and Rotork Gears share databases, engineering knowledge and test facilities to provide a comprehensive subsea solution.

Our combined subsea product range encompasses designs for both retrievable and non-retrievable applications. For retrievable applications such as some SSIV requirements, the designs manufactured and supplied provide for interchangeability of the actuator with a gearbox. This is achieved using transition spools and quick release methods.

Typical RFS Subsea Actuator Applications

- FPSO (Floating Production Storage Offloading)
- Manifold Systems
- Tie-backs
- Ballast Systems
- Turrets
- CALM Buoys (Catenery Leg Mooring)
- ESD or riser valves
- PLET (Pipeline End Terminal)
- PLEM (Pipeline End Manifold)
- SSIV (Subsea Isolation Valve)
- HIPPS (High-Integrity Pipeline Protection System)



Actuator Range



GSH SCOTCH YOKE
Torque to 1,300,000 Nm

Gearbox Range



WGS - WORM WHEEL
Torque to 1,000,000 Nm



GSR - RACK AND PINION
Torque to 5,600,000 Nm

GSR - LINEAR
Thrust to 5,500,000 Nm (double-acting)
Thrust to 400,000 Nm (spring-return)



DS - DIRECT GEAR
Torque to 19,000 Nm

SGS - SPUR GEAR
Torque to 44,000 Nm

BGS - BEVEL GEAR
Torque to 50,000 Nm



Key Design Features

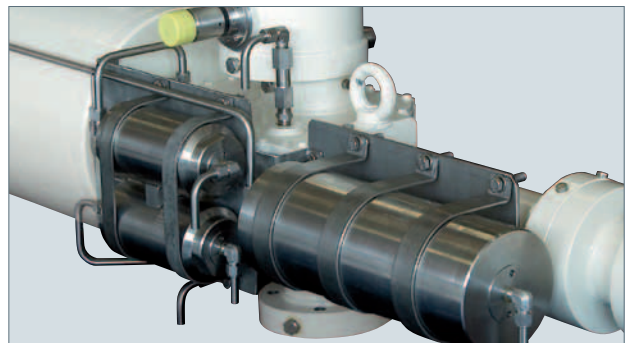
Rotork Fluid Systems' experience with subsea applications and product design extends to incorporate a variety of subsea controls items. The following is an extract of our designs, features, facilities and capabilities.

Design Options

- Actuator declutch system for operation of the actuator independent of the valve.
- Actuator and gearbox declutch system to provide interchangeability between similar pipeline valves.
- ROV and diver operated actuator manual override via an ISO 13628-8 torque tool receptacle.
- ROV torque tool operated override lock-out.
- Diver operated handwheel multiplier that inserts into the ISO receptacle for manual operation.
- Subsea gearbox for dedicated valve operation with ISO 13628-8 receptacle for ROV torque tool.
- Adjustable extensions to facilitate remote fixing of ISO receptacle.
- Remote ISO receptacle valve position indicators showing true actuator/gearbox position via local gearbox at the remote receptacle.
- Transition spool with end-of-stroke position stops, flushing facility, internal relief and stem cap protection.
- Double block & bleed control manifold.
- Position transducers and limit switch assemblies that allow fitting of subsea electrical connectors.
- Torque test equipment to confirm actuator and override performance.
- ISO 4406 Class 6 (NAS 6) flushing capabilities with fluid sampling device.
- Subsea & splashzone trims.



Position transducer assembly with electrical instrumentation connector.



Pressure compensation system.



Stainless steel drive extensions for remote location of ISO 13628-8 rotary torque tool receptacle.



Actuator declutch system.



Actuator trimmed for subsea & splashzone.

Manual Override Options

ISO 13628 is the standard for design and operation of subsea production systems. Class 1-4 is dependent upon the torque required to operate the actuator – the larger the actuator the larger ROV bucket required.

Rotork has a manual override tool suitable for diver use on smaller size actuators and gearboxes. It's designed to mate with an ISO 13628/API 17D receptacle.



Diver Operated Handwheel



Hand Operated Gearbox



Gearbox with ISO 13628/API 17D ROV torque tool receptacle

Exclusive Features

- Gearbox will back drive the whole assembly.
- Actuator can be removed for maintenance or repair.
- Valve end stops contained within the spool piece.

Benefits

- Full operation of the valve at all times.
- Financial savings (lifting vessels, divers and logistics).

Quality Assurance and Testing

Rotork Fluid Systems has engineered custom test systems to ensure proper operation and functionality of our products as well as assist in our research and product development efforts. Our subsea actuators have successfully completed ST-028 hyperbaric testing at simulated operating depths of 2,400 metres.

Approvals and Testing

- API 17D & 6A PR2 certified.
- ROV gearbox life tests.
- Hyperbaric tests in accordance with API 17D-307.3, API 17D-908.2c(4).
- Load test in accordance with API 17D-307.5.
- Spring balance testing.
- Hydrostatic test in accordance with API 17D:307.
- Hydrostatic pressure cycle test in accordance with API 17D-307.4 (Tbl 307.1).
- Life-cycle test in accordance with API 17D-307.
- Actuator seal test in accordance with API 6A-PR2-F2.5.1(a).
- Minimum and maximum temperature test (PR2-F2.5.1-(c) (d), Table F2.2).
- Temperature cycling test (PR2-F2.5.1-(e), Table F2.2 and F1.12.3 (e) to (q)).



Engineering expertise in subsea actuation technology

Subsea valve applications, which usually involve vital failsafe and associated safety related duties, represent an area of technology demanding the very highest levels of quality and product integrity to ensure reliable long-term performance. Rotork's engineering group works closely with contractor and end-user engineers to meet specific project requirements. In this task, the company can also draw upon the experience of an installed base of designs encompassing pressure compensated rack and pinion, scotch-yoke and linear actuators for both double-acting and spring-return duties, equipped with ROV and/or diver operated facilities.

Material selection and certification of key components or assemblies is important when providing a subsea actuation solution. We have extensive experience providing stainless steel hydraulic cylinder assemblies, stainless steel torque tool

drive extensions, inconel overlays or inserts for the override drive and indicator drive on seawater exposed areas and, stainless steel position transducer assemblies with electrical connectors.

Part of the Rotork subsea solution for ROV operated overrides includes the ability to provide adjustable extensions between the ISO torque tool receptacle (bucket) and override input/drive shaft located on the actuator. This allows the receptacle to be positioned remote from the actuator to facilitate easier ROV or diver access with the tool.

Furthermore, Rotork has two important unique capabilities, its declutchable mounting option for retrievable applications and a simple yet sophisticated system for monitoring of valve and actuator performance that includes partial stroke testing.

rotork Fluid Systems

ACTUATOR PERFORMANCE TABLE BY HYDRAULIC CONTROL IN NM @ 150 Barg (Table A1)

ITEM DISPLACEMENT IN VALVE NEOLCLASS	VALVE TAG	ACTUATOR MODEL	1/2 STROKE TIME / REQUIRED SAFETY FACTOR 2		VALVE B70		VALVE B70		VALVE B70		VALVE B70		VALVE B70	VALVE B70	VALVE B70
			Max B.T.C.	Min B.T.C.	Max B.T.C.	Min B.T.C.	Max B.T.C.	Min B.T.C.	Max B.T.C.	Min B.T.C.					
11	11	GSN-1000-200/1-C3	2.772	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
12	12	GSN-1300-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
13	13	GSN-1500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
14	14	GSN-1800-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
15	15	GSN-2000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
16	16	GSN-2500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
17	17	GSN-3000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
18	18	GSN-3500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
19	19	GSN-4000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
20	20	GSN-4500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
21	21	GSN-5000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
22	22	GSN-5500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
23	23	GSN-6000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
24	24	GSN-6500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
25	25	GSN-7000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
26	26	GSN-7500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
27	27	GSN-8000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
28	28	GSN-8500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
29	29	GSN-9000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
30	30	GSN-9500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
31	31	GSN-10000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233

ACTUATOR PERFORMANCE TABLE BY ROV CONTROL IN NM @ MIN. ROV INPUT TORQUE (See Table A1) (Table A2)

ITEM DISPLACEMENT IN VALVE NEOLCLASS	VALVE TAG	ACTUATOR MODEL	1/2 STROKE TIME / REQUIRED SAFETY FACTOR 2		VALVE B70		VALVE B70		VALVE B70		VALVE B70		VALVE B70	VALVE B70	VALVE B70
			Max B.T.C.	Min B.T.C.	Max B.T.C.	Min B.T.C.	Max B.T.C.	Min B.T.C.	Max B.T.C.	Min B.T.C.					
11	11	GSN-1000-200/1-C3	2.772	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
12	12	GSN-1300-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
13	13	GSN-1500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
14	14	GSN-1800-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
15	15	GSN-2000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
16	16	GSN-2500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
17	17	GSN-3000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
18	18	GSN-3500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
19	19	GSN-4000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
20	20	GSN-4500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
21	21	GSN-5000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
22	22	GSN-5500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
23	23	GSN-6000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
24	24	GSN-6500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
25	25	GSN-7000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
26	26	GSN-7500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
27	27	GSN-8000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
28	28	GSN-8500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
29	29	GSN-9000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
30	30	GSN-9500-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233
31	31	GSN-10000-200/1-C3	2.818	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233	1.130	1.233	1.233

ROV Interface ISO-10383-CL 4 - OUTPUT DATA (Table A3)

ACTUATOR MODEL	MIN. ROV INPUT TORQUE	MAX. ROV INPUT TORQUE	NO. OF TURN	NO. OF STROKE
GSN-1000-200/1-C3	750	1500	1	1
GSN-1300-200/1-C3	420	840	1	1
GSN-1500-200/1-C3	390	780	1	1
GSN-1800-200/1-C3	360	720	1	1
GSN-2000-200/1-C3	330	660	1	1
GSN-2500-200/1-C3	300	600	1	1
GSN-3000-200/1-C3	270	540	1	1
GSN-3500-200/1-C3	240	480	1	1
GSN-4000-200/1-C3	210	420	1	1
GSN-4500-200/1-C3	180	360	1	1
GSN-5000-200/1-C3	150	300	1	1
GSN-5500-200/1-C3	120	240	1	1
GSN-6000-200/1-C3	90	180	1	1
GSN-6500-200/1-C3	60	120	1	1
GSN-7000-200/1-C3	30	60	1	1
GSN-7500-200/1-C3	0	0	1	1
GSN-8000-200/1-C3	0	0	1	1
GSN-8500-200/1-C3	0	0	1	1
GSN-9000-200/1-C3	0	0	1	1
GSN-9500-200/1-C3	0	0	1	1
GSN-10000-200/1-C3	0	0	1	1

CYLINDERS / SPRINGS CHARACTERISTICS (Table A4)

ACTUATOR MODEL	CYLINDER DIAMETER	START THRUST	SPRING ENDING THRUST
GSN-1000-200/1-C3	50	41.788	20.894
GSN-1300-200/1-C3	60	48.678	24.339
GSN-1500-200/1-C3	65	54.678	27.339
GSN-1800-200/1-C3	70	60.678	30.339
GSN-2000-200/1-C3	75	66.678	33.339
GSN-2500-200/1-C3	80	72.678	36.339
GSN-3000-200/1-C3	85	78.678	39.339
GSN-3500-200/1-C3	90	84.678	42.339
GSN-4000-200/1-C3	95	90.678	45.339
GSN-4500-200/1-C3	100	96.678	48.339
GSN-5000-200/1-C3	105	102.678	51.339
GSN-5500-200/1-C3	110	108.678	54.339
GSN-6000-200/1-C3	115	114.678	57.339
GSN-6500-200/1-C3	120	120.678	60.339
GSN-7000-200/1-C3	125	126.678	63.339
GSN-7500-200/1-C3	130	132.678	66.339
GSN-8000-200/1-C3	135	138.678	69.339
GSN-8500-200/1-C3	140	144.678	72.339
GSN-9000-200/1-C3	145	150.678	75.339
GSN-9500-200/1-C3	150	156.678	78.339
GSN-10000-200/1-C3	155	162.678	81.339

SUMMARY TABLE

Ambient temp	-20° C / + 60° C	I.P. rating	
Electric power supply	TBA		
Hazardous area	TBA		
Electric connections	TBA		
Supply medium	HYDRAULIC	Pressure	150 Barg
Supply pressure (Barg)	Min 130 Barg	Norm.	150
Orientation	Line HORIZONTAL	Valve stem	
Coating specification	NORSOK 7		
Back up reservoir	Code N/A	Charging	
R.F.S. Code	Q.3	Tag n.	
Actuator model	GSN-1000-200/1-C3	Fail pos.	Close
Fail pos.	Close	Stroke	1
Stroke	1	Stroke	1
Stroke	1		

Unique Capabilities

Mounting Declutch System

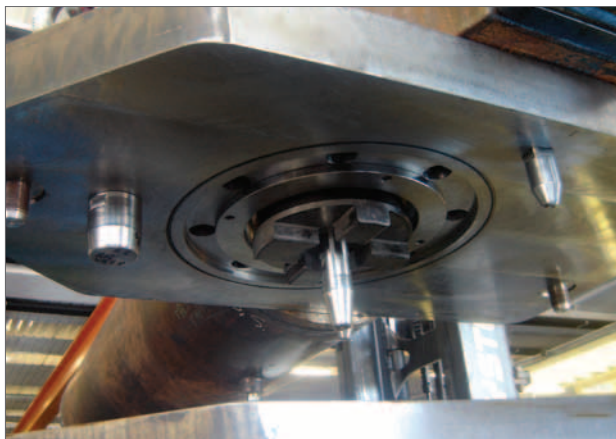
On retrievable applications such as some SSIV duties, one design option provides for interchangeability between the actuator and a ROV operated gearbox by means of transition spools and quick release methods. For total valve control this design has been further developed to provide the ability to declutch the actuator and remove it completely without affecting the valve position, whilst maintaining full local valve control by means of the gearbox.

Rotork has developed this declutch actuator system to provide complete flexibility for the operator. It has been specified for deep water applications including SSIV and other critical valve duties, including projects where the valve has been deployed separately from the actuator and when one actuator is required to operate more than a single valve installation.

In addition to the above, the functional and safety advantages of the declutch actuator include the following: simplification of actuator removal with associated cost economies, the ability to fully stroke the actuator independently of the valve or commission the actuator without operating the valve, partial stroke testing without risking valve closure, and ability to operate the valve in the event of a hydraulic power failure.

How does it work?

The automatic clutch system consists of two coupling joints with a dog-tooth mechanism, one assembled on the actuator and the other on the spool piece. When the coupling joint is engaged, the actuator can cycle the valve. When disengaged, the actuator can be stroked freely without cycling the valve. When the actuator is commissioned, the clutch is lowered into place. The actuator is fully stroked and automatically finds the correct position to engage with the valve. The valve can be operated by the ROV override on the spool piece if the actuator is removed or remains installed but disconnected from its remote power source.



De-clutch system and alignment pins.

The Smart Valve Monitor

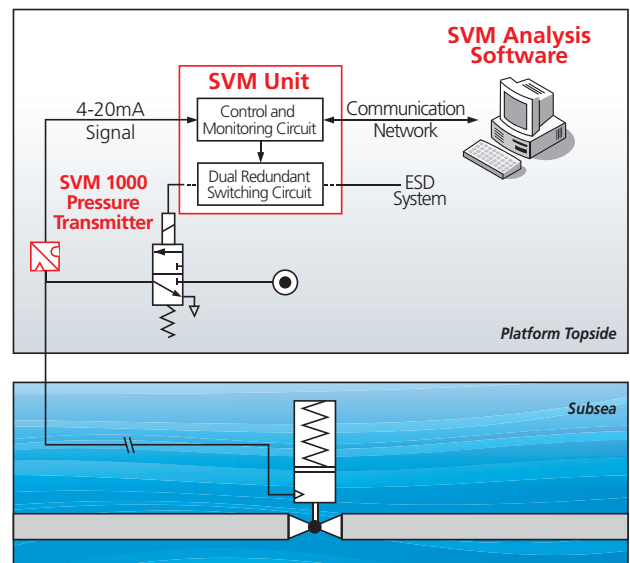
Rotork's patented, Smart Valve Monitor (SVM) is the most versatile and comprehensive partial stroke valve testing system for hydraulically or pneumatically actuated on/off valves available. It tests every element of the valve/actuator/control system and has several unique features that set it apart from the solutions offered by many competing products. SVM facilitates strategic preventive maintenance and extended shutdown intervals. Typical applications include ESD, blow-down, subsea, HIPPS and process shutdown valves.

Subsea isolation valves (SSIV) have historically not utilised partial stroke testing because the benefit provided by the limited scope of available testing techniques was not sufficient to offset the installation costs associated with shutdown and diving to attach control and monitoring equipment directly to the valve/actuator. This is a major hindrance for operators because the failure of an SSIV presents a significant maintenance task. Ideally, operators would be able to diagnose potential failures well in advance to allow for more strategically planned preventative maintenance activities.

The Smart Valve Monitoring System connects only to the hydraulic instrument supply and the SOV supply with nothing fitted to either the valve or actuator. This ensures that all test equipment can be located topside allowing operators easy installation to existing SSIVs. Use of SVM on SSIVs is facilitated by the fact that most SSIV actuators are hydraulically operated. Since hydraulic fluid is non-compressible there is no loss of resolution of data by monitoring topside.



SVM200 rack mount unit.



Typical SSIV with SVM system.



Electric Actuators and Control Systems
Fluid Power Actuators and Control Systems
Gearboxes and Gear Operators
Precision Control Instruments
Projects, Services and Retrofit



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