rotork®
Gears

242P Manual Gearboxes

Gearboxes for Outside Containment

Redefining Flow Control

Contents

rotork®
Gears

Rotork is the global market leader in valve automation and flow control. We provide a comprehensive range of valve actuators, controls and associated equipment, as well as a variety of valve actuator services including commissioning, preventive maintenance and retrofit solutions. Rotork Gears specialises in the design, production and support of gear operators and valvekits. We are committed to providing the marketplace with the latest technology, consistent high quality, innovative designs, outstanding reliability and superior performance.

Rotork Gears works directly with both valve and actuator manufacturers and distributors worldwide. We design, assemble and supply complete gearbox assemblies, as well as a wide range of switchboxes, valve position monitors, extensions, locking devices and other adaptation accessories for customised valve configuration. As a sister company of Rotork Controls and Rotork Fluid Systems, we offer all the advantages of big company support and back-up, while remaining firmly focused on the virtues of close customer contact and genuine personal service.

Rotork. Redefining flow control.

1 Introduction

Manually operated valves feature prominently in the centralized control systems of nuclear power generating stations and make a major contribution to the economy, efficiency, reliability and safety of the station in which they operate. The emphasis on safety has raised the level of technology required for a wide range of equipment associated with these systems.

Rotork has been a participant member of the sub-committees of the US Standards Committee responsible for drafting various standards including IEEE 382 since the 1970s.

Generally the categories of safety related duty valve applications are as designated as Class 1E in standard IEEE 323 and defined as equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling and containment and reactor heat removal, or otherwise essential in preventing significant release of radioactive material to the environment:

a Inside containment

b Outside containment

Inside containment valves are subject to a lifetime of high ambient thermal and radiation conditions, but also the severe environment of a Design Basis Event (DBE). Valves placed outside containment are not subject to this harsh environment, and experience only ambient conditions throughout life. It is this outside containment environment to which the 242P gearboxes are qualified.

1.1 Design qualification basis

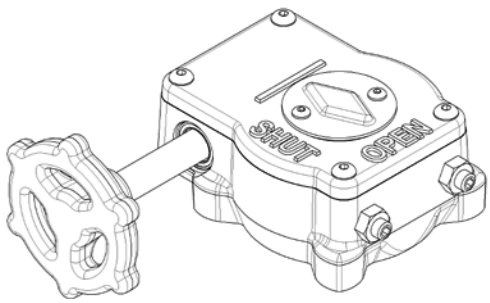
The basis of qualification of Rotork 242P manual gearboxes is the IEEE 382 – 1996 – "IEEE Standard for the Qualification of Actuators for Power-Operated Valves Assemblies with Safety-Related Functions for Nuclear Power Plants".

1.2 Quality assurance

All Rotork nuclear gearboxes are manufactured to a quality assurance programme which meets the requirements of the relevant sections of ISO 9000-2008.

1.3 Non-safety related gearboxes

Where valves are not designated as safety related, according to IEEE 323, normally standard Rotork gearboxes remain the most obvious choice for installed economy and reliability.



2 Design Qualification

The object of nuclear qualification is to provide auditable evidence that the gearboxes are capable of meeting their performance specifications under normal operating conditions and those experienced during an earthquake.

2.1 Qualification tests

Rotork 242P manual gearboxes have been qualified for outside containment according to the methodology and test procedures as prescribed in IEEE-Std-382. Testing has been conducted by TRaC Global in conjunction with the University of Bristol's Earthquake Engineering Laboratory with support from Rotork's specialist test facilities.

The applicable qualification test reports are: -

Laboratory	Report number
TRaC Global Report	TRA-012313-24-CR-01
BEELAB Report	TRC1212_RP
Rotork Report	T1732-LT, T1733-LT, T1734-LT T1735-LT, T1736-LT

2.2 Qualification test parameters for 242P

a) Mechanical wear aging - 1000 cycles. An operating cycle is defined as moving the valve from the open to closed position and back to the open position.

b) Resonant search - A random excitation with frequency content between 1 Hz and 100 Hz at a level of 0.1 g RMS in each orthogonal axis.

c) Plant induced vibration aging - Biaxial sinusoidal motion of 0.75 g with a frequency of 5 to 100 to 5 Hz at a rate of two octaves per minute. Ninety minutes of vibration in each orthogonal axis.

d) Seismic - RMF test - A triaxial time-history seismic test, where the excitation waveform is random motion. For each test, the duration of the strong part of motion is over 30 seconds. The Required Response Spectra (RRS) for the 242P range is shown in fig 2.1. Five OBE tests and one SSE test were completed, with the highest levels seen in the Z axis of the SSE test. A typical test response spectra is shown in fig 2.2.

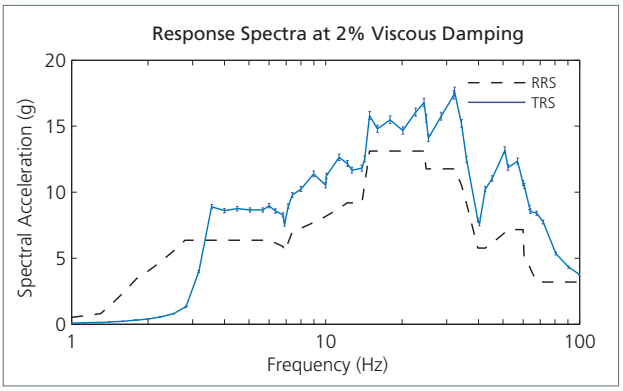


Fig 2.2 Typical Test Response Spectra - SSE, X Axis

2.3 Additional qualification test parameters for 242P

e) Resonant Frequency Search - Finite Element Analysis. Vibration and seismic aging were completed using a fabricated handwheel design. To expand the range, a cast version was developed. To justify the use of this improved design, it is specified that the handwheel construction must be of the same materials already passed test and may not generate a fundamental frequency below 33 Hz. When analysed, each handwheel's first natural frequency was found to be far in excess of 33Hz. Reports detailing the analysis conducted on each size handwheel are available on request.

2.4 Site Specific Qualification

A comprehensive generic qualification programme has been carried out on the 242P range for outside containment, passive duty in Nuclear power stations. Where site specific requirements for the RRS profile exist, these may be compared to fig 2.1 to assess gearbox suitability.

For further assistance on test levels, please contact Rotork.

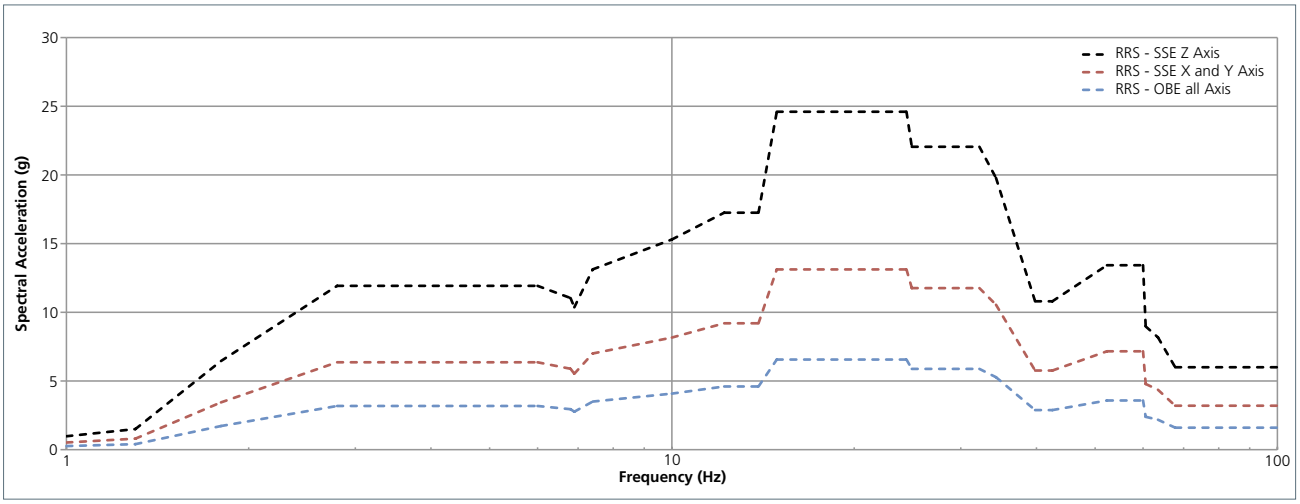


Fig 2.1 Required Response Spectra for 242P

3 Dedication of Manufactured Gearboxes

From the generic qualification, 242P manual gearboxes have been demonstrated as suitable for use in Nuclear power stations in locations outside of containment. To ensure that the manufactured gearbox is to the qualification standard, each assembled unit is subject to the 242P Nuclear dedication procedure.

a) The gearbox is built according to ISO 9000-2008 quality procedures.

b) The complete unit is subject to verification testing

3.1 Quality Assurance Program

The Rotork Gears quality system details all the procedures and documentation utilised for both standard and nuclear gearboxes. The program for 242P gearboxes has been evolved in co-operation with utilities and architect-engineers responsible for construction and operation of nuclear power stations.

The Rotork Gears 242P quality assurance program is designed to ensure:

1 Specific application requirements and sizing data for each gearbox are recorded.

2 Assembly of each nuclear gearbox is carried out under specific procedures in line with ISO 9000-2008 and internal standards.

3 Each unit is subject to a one and a half time overload test. This is conducted on the stops and handwheel rimpull, to verify the gearbox strength and build.

4 A certificate of compliance is signed by the quality manager or designee only when they have auditable evidence that all these requirements have been satisfied.

3.2 Dedication records

Records are maintained via the manufacturing system and are available for the life of the plant.

4 Rotork Gears 242P Nuclear Safety Related Gearboxes

The 242P range has been designed to optimise robustness and durability, whilst minimising non-structural mass and reducing the overall gearbox envelope by using the latest lean engineering principles and analytical design tools. The 242P series is based on the design and quality of the FB series which was designed to meet strict specifications. The 242P's simple, rugged construction makes it the gearbox of choice for low torque applications.

Application

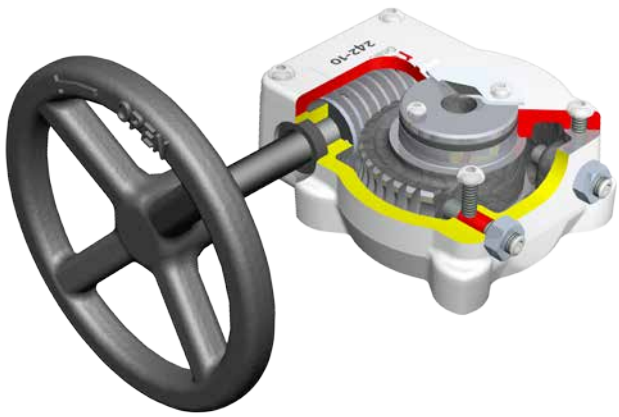
The 242P series manual quarter-turn worm gearboxes are intended for the operation of ball, butterfly, plug and any other quarter-turn valves.

Features

- Mounting options according to ISO 5211 and MSS SP-101
- Cast handwheels
- Cast iron housing
- Ductile iron quadrant
- Stroke 0-90° (±5° adjustable at open and closed)

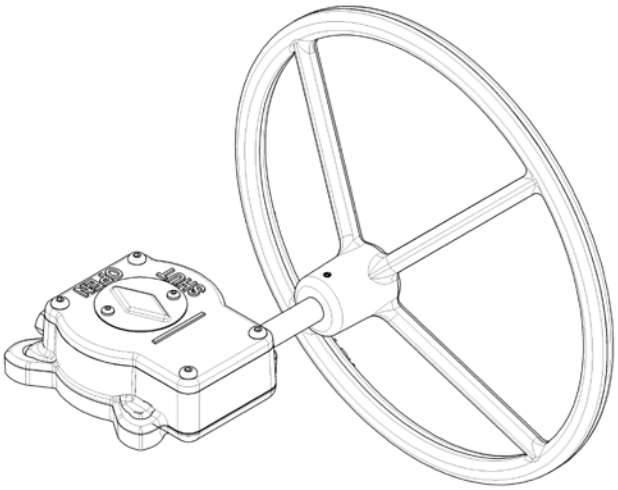
Environmental Specification

- Designed for working life of 1,000 operating cycles
- Sealed to IP67
- Temperature range: -40 to 120 °C



4 Rotork Gears 242P Nuclear Safety Related Gearboxes

Part	Description
Thrust washer	Low friction running surface
Lip seal	Nitrile
Formed worm	Steel
Cover screws	Low profile
Indicator	Stainless steel
Cover plate	Cast Iron
Quadrant	Ductile iron - direct machining to suit valve stem
Housing	Cast Iron - ISO spigot sealing base
Stop screw	Pre-sealed and plated
Lock Nut	Zinc plated
Input shaft	Electrophoretically plated
Spirol Pin	Carbon steel
Handwheel	Ductile iron



Type		Output Torque Nm (lbf.in)	Ratio:1	M.A. ±10%	Handwheel size mm (inch)	Weight incl. Handwheel kg (lbs)	Max Stem Bore BS4235/ANSI Rect. Key mm (inch)	Max Stem Bore Metric/ ANSI Square Key mm (inch)	Max DD mm (inch)	Max Stem Height mm (inch)	ISO / MSS Base Options
242P-10	S	80 (708)	40	10	Ø50 (2")	1.0 (2.2)	Ø20 + 6K (Ø0.812 + 0.25K)	19AF (Ø0.78 + 0.24K)	Ø26 x 19AF (Ø1 x 0.75AF)	36.5 (1.44)	F05 / FA05
	M					1.1 (2.4)					F05 + F07 / FA05 + FA07
242P-20	S	140 (1239)	40	10	Ø100 (4")	1.8 (4.0)	Ø24 + 8K (Ø1 + 0.312K)	22AF (Ø0.95 + 0.32K)	Ø31 x 22AF (Ø1.22 + 0.86AF)	40 (1.58)	F07 / FA07
	M					2.3 (5.1)				46 (1.81)	F07 + F10 / FA10 + FA07
	L					2.5 (5.5)					F12 / FA12 ONLY
242P-30	S	330 (2921)	40	10	Ø200 (8")	4.4 (9.7)	Ø36 + 10K (Ø1.437 + 0.375K)	31AF (Ø1.42 + 0.39K)	Ø44 x 31AF (Ø1.73 + 1.22F)	50.5 (1.99)	F07 + F10 / FA07 + FA10
	M					4.9 (10.8)				56.5 (2.22)	F07 + F10 + F12 / FA10 + FA07 + FA12
	L					5.1 (11.2)					F14 / FA14 ONLY
242P-40	S	660 (5841)	40	10	Ø400 (16")	11.6 (25.6)	Ø47 + 14K (Ø1.75 + 0.5K)	40AF (Ø1.85 + 0.55K)	Ø56 x 40AF (Ø2.21 + 1.57AF)	62.5 (2.46)	F10 + F12 / FA10 + FA12
	M					11.9 (26.2)				66.5 (2.61)	F10 + F12 OR F14 / FA12 + FA10 OR FA14
	L					12.3 (27.1)				62.5 (2.46)	F16 / FA16 ONLY
242P-50	S	1000 (8851)	60	15	Ø400 (16")	15.5 (34.2)	Ø70 + 20K (Ø2.625 + 0.75K)	58AF (Ø2.76 + 0.78K)	Ø82 x 58AF (Ø3.23 + 2.28AF)	70.5 (2.77)	F14 / FA14
	M					17.3 (38.1)				81.5 (3.21)	F14 OR F16 / FA14 OR FA16
	L					19.1 (42.1)					F25 / FA25 ONLY

5 Documentation

All customer specific documentation requirements can be supplied at extra cost.

6 Maintenance of Qualified Gearboxes

Rotork Gears is responsible for the generic and specific qualification of safety related gearboxes up to the expiry of the warranty period.

Any modifications required as a result of changes in customer specification may necessitate retesting of the gearboxes by qualified personnel and test equipment for the qualification documentation to be maintained. Similarly, repairs arising from transit or site damage to components likely to affect performance may also involve retesting to enable qualification to be maintained.

Any repairs under warranty will be carried out by Rotork using only qualified personnel. On completion of the warranty repair revised documentation if required will be provided. If retesting is required to maintain the qualification Rotork will undertake this and include the test report in the revised documentation pack. A certificate of conformance for the repair work will be provided as a matter of course.

From expiry of the warranty period, responsibility for the equipment, including maintenance of the qualification if required, passes to the owner. Rotork can provide qualified service engineers for site work, and can also provide training courses for customer personnel.

All 242P gearboxes are sealed and qualified for service life through type testing and dedication of every unit.

As each 242P gearbox is dedicated as a complete assembly, should component replacement or inspection be desired, the unit will require re-testing by Rotork to retain its Nuclear qualification.

7 Ordering Information for any Nuclear Duty Gearbox

The following information must be given to Rotork to enable a bid to be made and an order to be processed for any Nuclear gearboxes.

7.1 General

1 Project details (title, utility, NSSS supplier, contractor).

2 Reactor type.

3 Environmental conditions, normal and abnormal (ambient temperature and pressure, radiation, seismic).

4 Gearbox - general specification details and paint finish.

5 Approximate delivery required.

6 Documentation requirements.

7.2 For each Valve

1 Type of Valve.

2 Valve stem details (diameter and lead).

3 Valve Stroke or Turns for full travel.

4 Valve Torque and Thrust requirements.

5 Location in Plant (inside or Outside reactor Containment).

6 Is valve on Safety Related duty or is it non-Safety Related? If Safety Related, is it active or passive.

7 Seismic Category (active or passive).

8 Operating time.

9 Safety function.

10 Motorised or manual operation. If motorised, actuator information (model/speed or full details if non-Rotork actuator).

rotork®

Redefining Flow Control

Rotork Gears UK
9 Brown Lane West
Holbeck, Leeds
LS12 6BH
England

tel +44 (0)113 256 7922
email sales@rotorkgears.com

Rotork Gears BV
Nijverheidstraat 25
7581 PV Losser
P.O. Box 98
7580 AB Losser
The Netherlands

tel +31 (0)53 - 5388677
fax +31 (0)53 - 5383939
email info@rotorkgears.nl

Rotork Gears India
165/166, Bommasandra,
Jigani Link Road,
Kiadb Industrial Area,
Anekal Thaluk,
Jigani Hobli, Bangalore 562106
India

tel +91 80 3098 1600
fax +91 80 3098 1610
email sales@rotork.co.in

Rotork Gears Americas
1811 Brittmoore
Houston
Texas 77043
USA

tel +1 713 9837381
fax +1 713 8568022
email gears@rotorkgears.com

Rotork Gears Shanghai
No. 260 Lian Cao Road
Xin Mei Urban Industrial Park
Min Hang District
Shang Hai 201108
China

tel 0086-21-64348388
fax 0086-21-64348366
email info@rotorkgears.com.cn

Rotork Valvekits
Brookside Way
Nunn Park
Huthwaite
Nottinghamshire NG17 2NL
England

tel +44 (0)1623 440211
fax +44 (0)1623 440214
email sales@rotorkvalvekits.com

www.**rotork**.com

A full listing of our worldwide sales and service network is available on our website

Scan with your smart phone for more information on this product range

PUB105-001-00
Issue 07/14