James Walker®

Marine Propulsion Guide

High performance sealing for Marine Propulsion & associated systems

- Propeller shaft & stern tube
- Azimuth & tunnel thrusters
- Propeller blades
- Rudders & steering gear
- Stabilisers

High Performance Sealing Technology

James Walker

Respected reputation

Contents

Over a century of experience

James Walker has been in the business of fluid sealing and control for over 125 years. From our earliest products we have had close associations with the marine industry and throughout our history the company has developed sealing solutions and components in parallel with advances in marine propulsion technology. As a result, we have amassed specialised knowledge across a broad range of marine propulsion applications and issues.

Bespoke solutions

Backed by in-house testing and manufacturing to world-class standards, James Walker brings practical expertise and leading-edge technology to the custom-design of optimum solutions that match our customers' exact requirements.

Bespoke doesn't necessarily mean expensive. At James Walker our aim is to create the most cost-effective solution and we focus carefully on optimising the lifetime cost of ownership. In the majority of cases we work in partnership with our customers, jointly developing solutions in close co-operation with their own engineering teams.

Worldwide distribution

Our role as a global supplier demands an international manufacturing base, plus highly efficient sales and distribution operations. We have a worldwide family of companies with over 50 production, engineering, distribution and customer support sites spread across Europe, Australasia, Asia Pacific, Africa and the Americas.

At the local level, a close-knit network of James Walker companies and official distributors work in close partnership with customers in well over 100 countries.

A history of innovation

Marine specialists

James Walker products are globally recognised by marine engineers for their quality and reliability. These are assets the James Walker name and Lion logo have fostered in the marine industry since the 1880s when our Scottish engineer founder, Mr James Walker, introduced his innovative packing for high-efficiency steam engines.

Since those early days, our products have increased beyond recognition in range and technical excellence to match the complex and demanding applications of today's hardworking marine equipment.

Today, we manufacture and supply a highly diverse range of fluid sealing items and other specialised products to the world's commercial and naval fleets, as well as to shipyards and original equipment manufacturers.

In addition, we work closely with design engineers of marine equipment to develop sealing products that can be used with confidence in all areas of maritime activity.

Over 125 years of marine industry experience

Delivering quality

Quality design, quality manufacture and quality service are paramount throughout our worldwide operations. We start with the best raw materials and use advanced manufacturing techniques with strict quality control.

This culture is reinforced by top-level technical, sales and logistics support to ensure a total quality service to every customer.

Close links with OEMs has seen James Walker innovations as an integral part of developments in propulsion, steering and stabilising systems

Driving development

Our position as a technology leader, in combination with the vast experience of our applications engineering and materials science teams, helps us to identify and supply the most appropriate and competitive solution for each individual customer's requirement.

We run a structured development programme for each of the industrial markets served by the business, working in partnership with customers to identify the current and future needs to be addressed, and to improve key performance parameters such as cost effectiveness, longevity, safety and environmental care.

Proving performance

Working in close co-operation with customers, industry bodies and academic institutions, our facilities provide some of the most advanced test regimes outside of actual operational application. This gives our customers the confidence that James Walker products have been fully tested to meet the required application conditions.

With our broad range of engineering resources and expertise we design and build custom test-rigs for many of the projects we undertake. In addition, and central to our research and development programmes, the James Walker Technology Centre houses the core of our world-class test facilities.

... a highly structured product development process focused on cost-effective solutions that complement customers' operational demands

James Walker

Propulsion systems

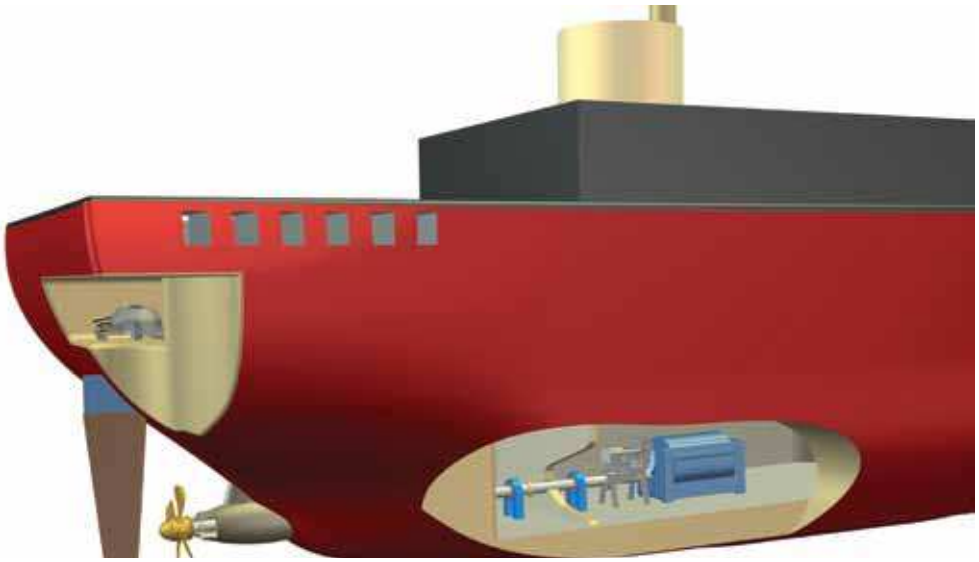
Conventional propulsion

The integrity of the entire propulsion chain from the motive unit (motor or engine) through to the propeller relies on effective sealing systems.

Whether keeping oil in hard working line shaft bearings or preventing seawater ingress through the stern tube, correct seal profile and optimised material selection are vital to efficient equipment operation.

James Walker has developed sealing products specifically for these arduous duties and we are able to design and manufacture solutions tailored to the individual mechanical configurations and operating conditions of each application.

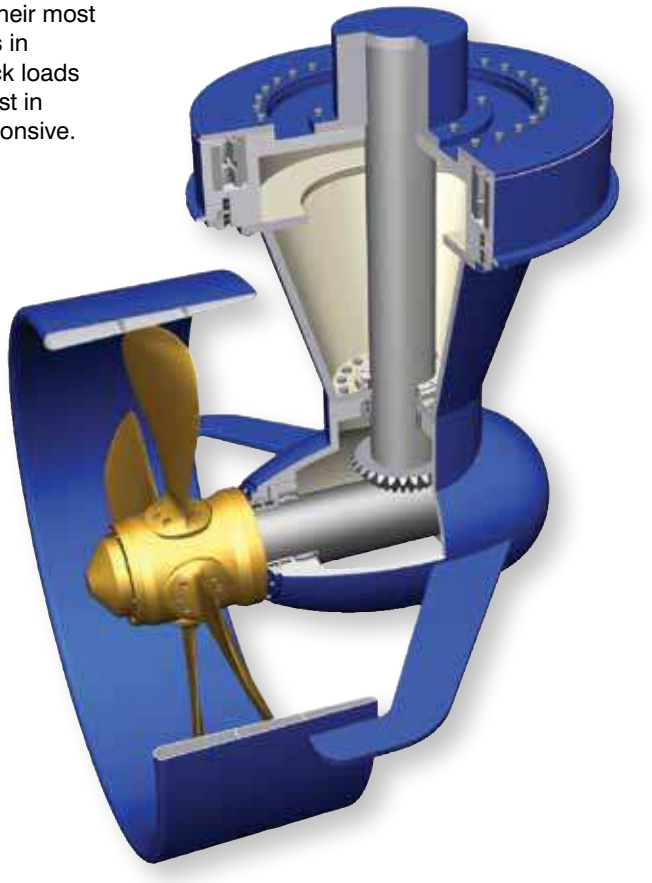
Recommended seal types and configurations for several common applications on conventional propulsion systems are shown on pages 10-11.



Azimuth thrusters

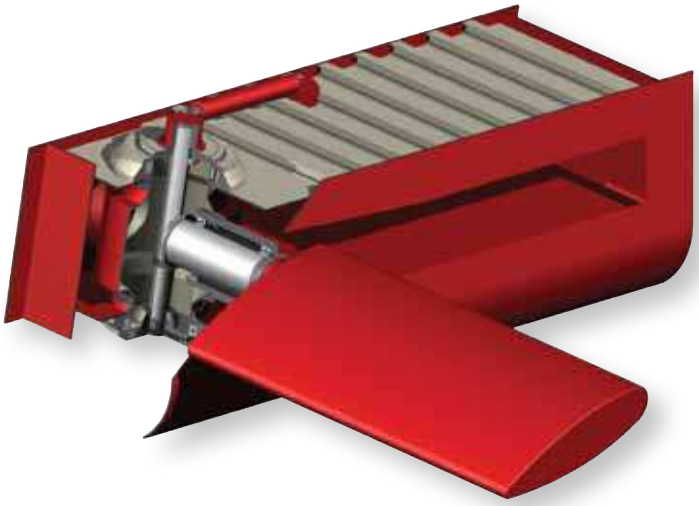
Where propulsion and steering are combined in azimuth thruster or POD propulsion systems the demands on the sealing systems are at their most challenging. Rapid changes in direction of forces and shock loads require the seals to be robust in construction yet highly responsive.

Maximum sealing integrity combined with ease of fitting and maintenance are primary features of the thruster seal arrangements described on pages 12-13.



Advanced sealing systems proven under the most arduous conditions

Steering & stabilising systems



Fin stabilisers

The largest folding fin stabiliser systems on the world's most prestigious cruise liners rely on James Walker seals for reliable operation even in the most extreme conditions.

Full details of our recommendations for seal types and optimum configurations are detailed on pages 14-15.

James Walker sealing solutions are fitted as OEM equipment to some of the world's most prestigious vessels

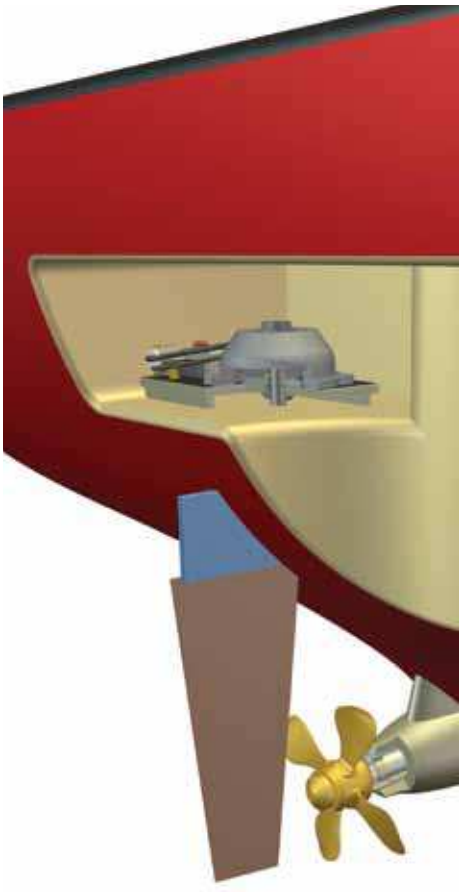
Walkersele® success

Side thrusters & stabilisers

Cunard Line's new 90,000 tonne cruise ship MS Queen Victoria, has Walkerseles fitted as OEM equipment to protect its stabilisers and side thrusters.

Photo by courtesy of Fincantieri SpA

Built at Fincantieri's shipyard in Venice-Marghera, and cruising since December 2007, it is Cunard's second largest ever ship after the Queen Mary 2 — and the first from an Italian yard.



Steering gear

The effective sealing of rudder stocks and posts is particularly demanding as side loads can be extremely high and eccentricity of shaft movement is frequently encountered.

James Walker solutions to these challenges are appreciated by major steering gear manufacturers and are outlined on page 16.

James Walker

Sealing for rotating shafts

Walkersele® — Worldwide reputation

Walkersele® is our well-proven family of radial lip seals for rotating shafts and is widely used in all types of marine propulsion systems including bearings, gearboxes and associated equipment.

In marine applications, these seals are essential to prevent both water ingress and pollution of the marine environment.

Moreover, design engineers and vessel operators rely on our pedigree in high performance fluid sealing technology and full technical back-up to provide the best value solution to their specific sealing problems.

Better efficiency — lower running costs

In most applications the main role of a Walkersele is to retain lubricant within a bearing assembly. It will effectively;

- Extend bearing life and improve reliability
- Cut maintenance costs and downtime
- Reduce lubricant loss and costs
- Cut power consumption with low friction running
- Reduce corrosion caused by dissimilar metal interfaces
- Minimise the risk of contravening strict IMO pollution regulations

In addition, in marine duties, a Walkersele is also required to prevent the external environment, be it fresh or seawater, from entering the equipment and causing damage.

Seal choice has a huge impact on running costs and reliability

Constant development & innovation

When our many standard designs cannot solve a particular problem, we can custom design and manufacture a special lip seal that will.

We use state-of-the-art finite element analysis (FEA) techniques to fine tune the design parameters before prototyping and running the product on our in-house test rigs.

Constant research and development over the past 50 years has produced numerous improvements in materials and design. These ensure Walkersele can operate efficiently for extended periods in the challenging environments above and below the surface on marine vessels of every size.

Special innovative features such as our patented Walkersele OSJ-2 on-site joining technique, SpringCover spring protection system, and Cartridge Walkersele, all provide top level sealing integrity with peace of mind plus easier and swifter installation to minimise assembly times and expensive dry docking.

Flexible manufacturing & stockholding

We have over 7500 mould tools for Walkersele® production, for virtually all shafts of metric and inch standard sizes, plus hundreds of non-standards. The list grows constantly.

Large volumes of Walkersele in popular types and sizes are stocked for same day despatch. We also provide an express manufacturing service to meet industry's most urgent demands.

Our Cockermouth site houses one of Europe's largest elastomer moulding presses for making seals up to 2.2m OD in a single pass. But this does not limit the size of a Walkersele as we mould to unlimited diameters using a special technique — our current record stands at 11m diameter!

Walkersele® is a proven, world-class family of seals for rotating shaft applications

Walkersele® D6 — flexible and versatile

This is the most popular Walkersele® design for non-pressure duties. It is suitable for a large number of bearing protection and other radial lip seal applications.

D6

Special features

- Lip profile minimises heat generation and shaft wear
- Geometry gives lip flexibility to accommodate shaft eccentricity
- Fabric-backed (retained) versions can be supplied in split form, and as Walkersele OSJ-2 for On-Site Joining
- Can be supplied with Walkersele SpringCover for additional corrosion protection
- Not intended for pressure differentials above 0.2bar

Walkersele® success

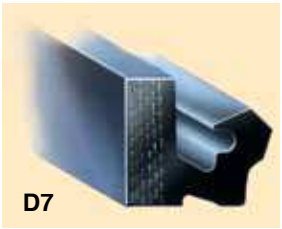
Side thruster repairs

Swift action by James Walker and Blohm + Voss Repair ensured that the Queen Mary 2 cruise liner set sail on time after 11 days of classification work, painting and plant overhaul at Hamburg.

Four 220mm Walkersele® M1/D7 seals were identified, precision moulded in the UK, and delivered to Hamburg in just two days to complete unscheduled work on the ship's starboard bow thrusters.

Walkersele® D7 — pressure resistant lip seal

This is our most popular design for applications where the media to be sealed are under moderate pressure.
Its robust profile is ideally suited to pressure applications, particularly those below the waterline such as propeller shafts and stabilisers.



D7

Special features

- Works at up to 4bar (58psi) pressure differential. To achieve this the heel of the seal lip must always be supported.
- No costly profiled lip-support plates are needed.
- Flexible and robust lip maintains sealing contact on misaligned or eccentric shafts.
- Fabric-backed (retained) version can be supplied as split type, and as Walkersele® OSJ-2 for On-Site Joining.
- Can be supplied with Walkersele SpringCover for additional corrosion protection.

Walkersele® OSJ-2 — On-Site Joining system

Walkersele® OSJ-2 is our highly successful technique for the On-Site Joining of split-type Walkerseles.

The many benefits of the OSJ-2 system include:

- High performance — installed units provide the sealing performance of high-integrity endless Walkerseles
- Worldwide proven — on marine propulsion systems, gearboxes, bearings, etc.
- Cost effective maintenance — the performance and integrity of an endless-type seal is achieved:
  - without major equipment stripdown
  - without expensive on-site vulcanising
  - even in restricted spaces

After just a few hours' hands-on training it is possible to produce a securely bonded join that provides Walkersele OSJ-2 with the integrity of a fully moulded endless seal.

Walkersele® OSJ-2 provides a simple, rapid seal replacement without the need for equipment strip-down. The result of this highly successful on-site joining technique is a seal with the integrity of an endless seal achieved with no specialised tools or skills

James Walker

Materials overview

Materials choice

It is essential that the materials used in the manufacture of your seals are:

- Chemically compatible with the media to be sealed
- Stable at the required working temperature. Note that the seal's 'under-lip' temperature can be substantially higher, by 30°C or more, than that of the fluid being contained
- Wear resistant at the operating conditions
- Suitable for your operating speed

The following brief descriptions outline the key properties for some of our most common materials used in Walkersele® marine propulsion applications:

M1 — nitrile (NBR)

The most popular material for the majority of Walkersele applications. Suits housings fitted with retaining plates.
Media compatibility: Suitable for use with water and the majority of oils and greases.
Seal construction: Flexible back of nitrile-proofed cotton fabric; lip of 80 IRHD nitrile.
Maximum under-lip temperature: 120°C constant.
Maximum surface speed:
15m/s with D6 design.
12m/s with D7 design.

Note: For applications where contact with water is anticipated it is recommended to replace the cotton fabric back material with nitrile proofed aramid/glass fabric for increased long term stability.

M9 — fluoroelastomer (FKM)

For high working temperatures, or where fluoroelastomer is needed to accommodate high operating speed or chemical compatibility. Suits housings fitted with retaining plates.
Media compatibility: Excellent resistance to all lubricating oils, fuels, air, water and dilute acids.
Seal construction: Flexible back of fluoroelastomer-proofed aramid/glass fabric; lip of fluoroelastomer.
Maximum under-lip temperature: 200°C constant.
Maximum surface speed:
25m/s with D6 design.
22m/s with D7 design.

Ultraglide — hydrogenated nitrile (HNBR)

A reformulated HNBR material, the result of a five-year research programme by James Walker, with optimised properties that greatly extend the working life of Walkerseles running for long periods under hot and/or abrasive conditions.

Special features

- Far greater abrasion resistance for highly extended sealing life
- Low coefficient of friction for improved running at higher speeds
- Better heat dissipation to keep the lip cooler for high efficiency sealing
- Broad media capability to operate with a wide range of fluids
- Available as Endless and OSJ-2, but not as split-type seals

Media compatibility: Excellent resistance to all lubricating oils, fuels, air, hot and cold water, dilute acids and alkalis.
Seal construction: Flexible back of HNBR-proofed aramid/ glass fabric; lip of Ultraglide HNBR. Suits housings fitted with retaining plates.
Maximum under-lip temperature: 150°C constant, and 170°C in oil.
Maximum surface speed: 30m/s.

Quality standard & high performance materials

The elastomer-based material grades listed on this page have been specially developed by James Walker Materials Technology Centre for radial lip seal duties.

Our Materials Technology Centre houses one of Europe's most advanced facilities for elastomer batch production. At its heart is a computer controlled internal mixer that holds formulae for over 300 of our elastomeric compounds.

Each batch of compound is subjected to rigorous testing and statistical process control before being converted to the final product.

Customised materials

When our standard materials are unsuitable, we will tailor a compound to meet your specific operational requirements, typically for:

- Higher or lower temperature duties
- Additional ozone resistance
- Additional abrasion resistance
- Eco-friendly fluid compatibility
- Lower power consumption

If you have any special material requirements, or want advice on materials selection, please contact our Technical Support Team.

In view of the wide variety of fluids in use within the marine industry, some of which can be particularly chemically aggressive, we recommend that we carry out tests for elastomer compatibility which we are happy to do free of charge.

Custom design in action

The design of customer-specific seals is a James Walker speciality. We constantly develop, prototype and validate many new sealing configurations in partnership with major equipment manufacturers and end users to solve their fluid sealing problems. This is a service that only a few fluid seal companies can provide.

James Walker custom solutions are being developed at the forefront of marine propulsion, providing world renowned OEMs with the competitive advantage they seek

We carry a global reputation for solving sealing problems backed by testing and manufacturing to world-class standards. Our custom design operation is led by the James Walker Technology Centre engineering teams who carry many years' experience of working closely with engineers from every sector of industry plus a fundamental understanding of all types of equipment that need fluid sealing components.

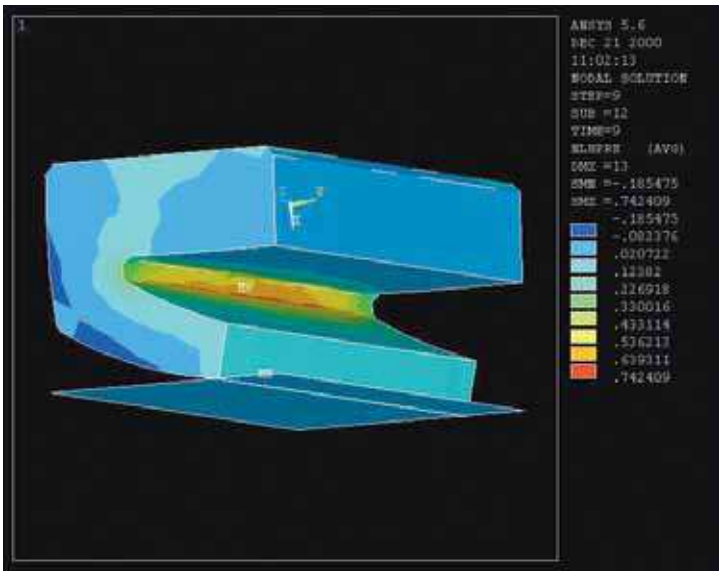
Early involvement of our applications engineering team can eliminate many potential operational problems at the design stage

FEA (finite element analysis) techniques are used for modelling seal designs and fine tuning different aspects, such as lip geometry and materials specification, to obtain the required performance.

These developments then move to prototypes that can be fully tested on a suite of static and dynamic test rigs to simulate, as closely as possible, the anticipated operating conditions.

Only when both the James Walker Technology Centre and our client are fully satisfied with test rig results will a new seal be subjected to field trials on operational vessels.

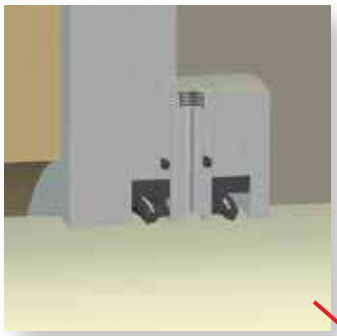
Successes on high-profile development projects produce very positive feed back. The resulting improvements achieved in seal performance — in terms of operational life, sealing integrity, and the ability to work under extreme conditions — are greatly appreciated by James Walker customers on a worldwide basis.



Conventional propulsion systems

Bulkhead seal

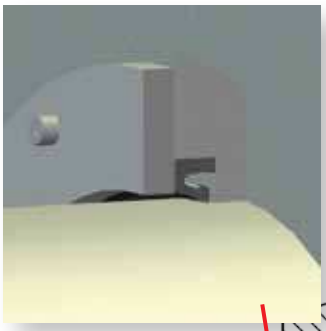
The bulkhead seal normally consists of a cartridge arrangement bolted to the bulkhead and its purpose is to prevent water passing between the adjacent chambers should a flooded condition occur.

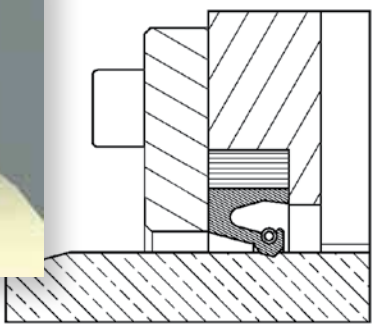


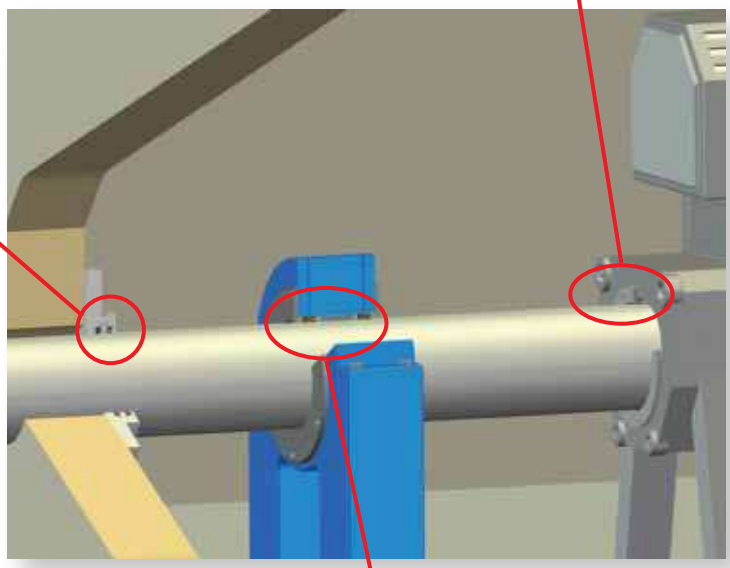
Should the seals be called upon to operate there is likely to be a positive pressure on one side therefore Walkersele® D7 profile is recommended. As no other lubrication is present it is important to ensure that the inter-seal space is well packed with grease on assembly.

Gearbox seal

Both the input and output shafts of the gearbox are usually fitted with a single seal of D6 profile. The graphic shows our preferred configuration of a retained seal but due to space restrictions these seals are frequently of the self-retaining type. We can supply these on request.



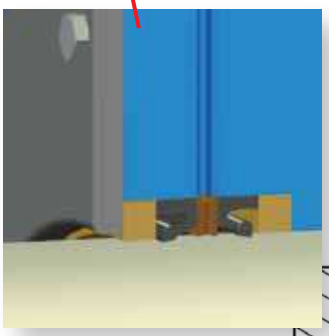


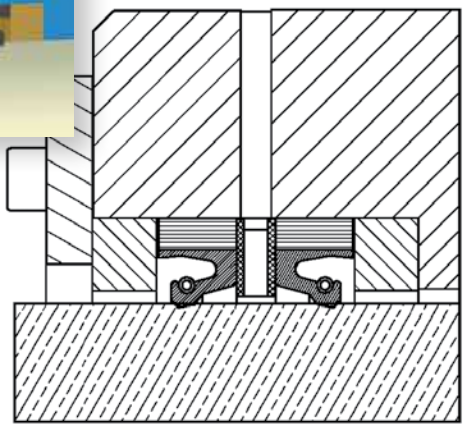


Line shaft bearing seal

The line shaft bearings are vital in supporting the propulsion shaft and can be subject to a wide variety of uneven and shock loads. The seals therefore must be capable of dealing with these same conditions and therefore flexible Walkersele® D6 seals are recommended both to retain bearing lubricant and exclude contaminants in a back-to-back arrangement. They may be simply grease packed on assembly or for more arduous conditions an automatic grease feed may be employed.

Whilst D6 seals are not intended for pressure conditions, our in-house tests have proved that they will operate successfully under a flooded condition at a pressure of 1.5bar and a surface speed of 5m/s for a period of 72 hours, thus enabling the vessel to reach port if it finds itself in difficulties.





When two seals are housed with spacer rings of different axial lengths as shown, it is possible to adjust the position of the seal lips on the shaft to move them to run on an unworn area of shaft surface. This is particularly useful when operating with relatively soft shaft materials and can significantly extend service life.

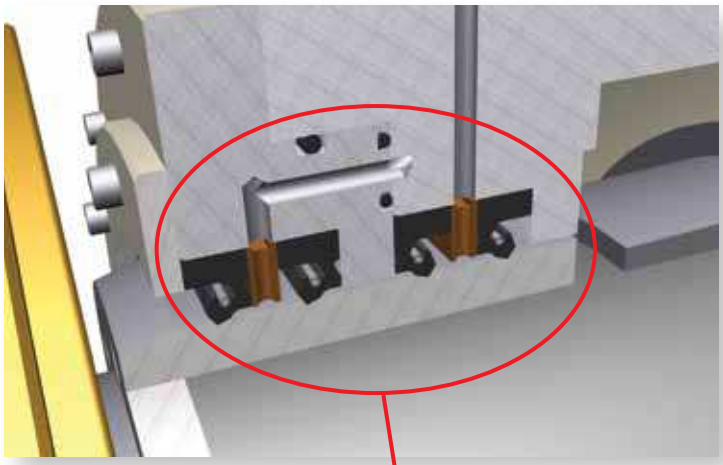
Propeller shaft seal

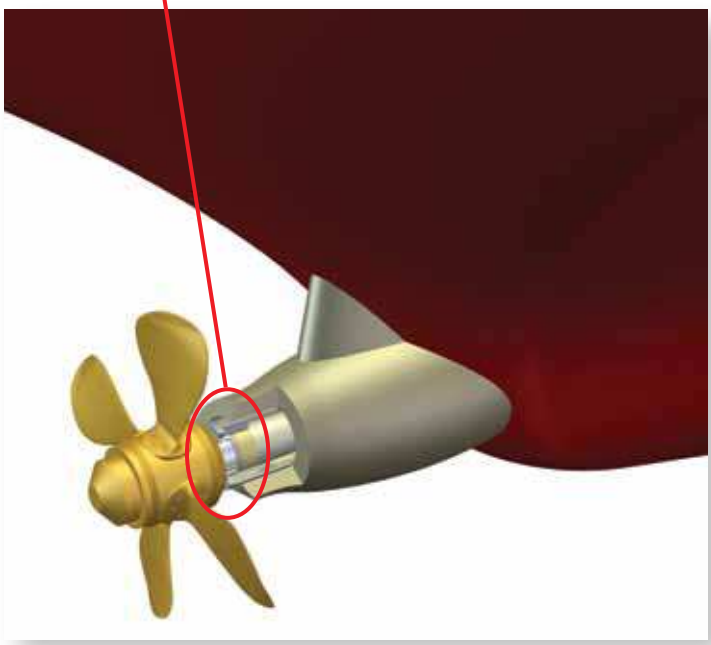
The sealing of the aft end of the propeller shaft as it exits the vessel beyond the stern tube is probably the most arduous to be encountered throughout the propulsion train.

Not only does the sealing system have to exclude ingress of water but it must also prevent oil leakage whilst dealing with significant mechanical loads and vibration.

The recommended seal arrangement consists of four seals as shown: two seals facing the seawater and a second pair to retain the bearing lubricant. The space between each seal pair must be lubricated to prevent dry running, overheating and premature wear, preferably with a constant supply of grease.

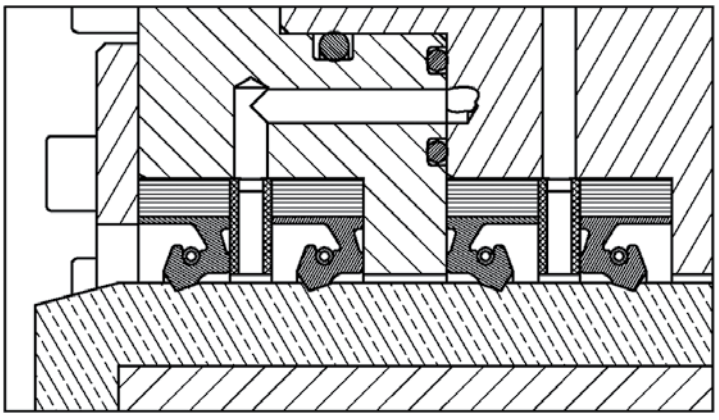
Research indicates stern tubes to be the biggest single source of lubricant discharges to the marine environment*





Walkersele® D7 profile seals are recommended for this position as there will usually be a certain amount of pressure from the head of seawater. A leak detection port is recommended between the central seals to collect any leakage and give early warning of the need to replace the seals.

For recommended housing dimensions please see page 19.



*Source: Environmental Research Consulting

Azimuth thrusters

Propeller shaft seal

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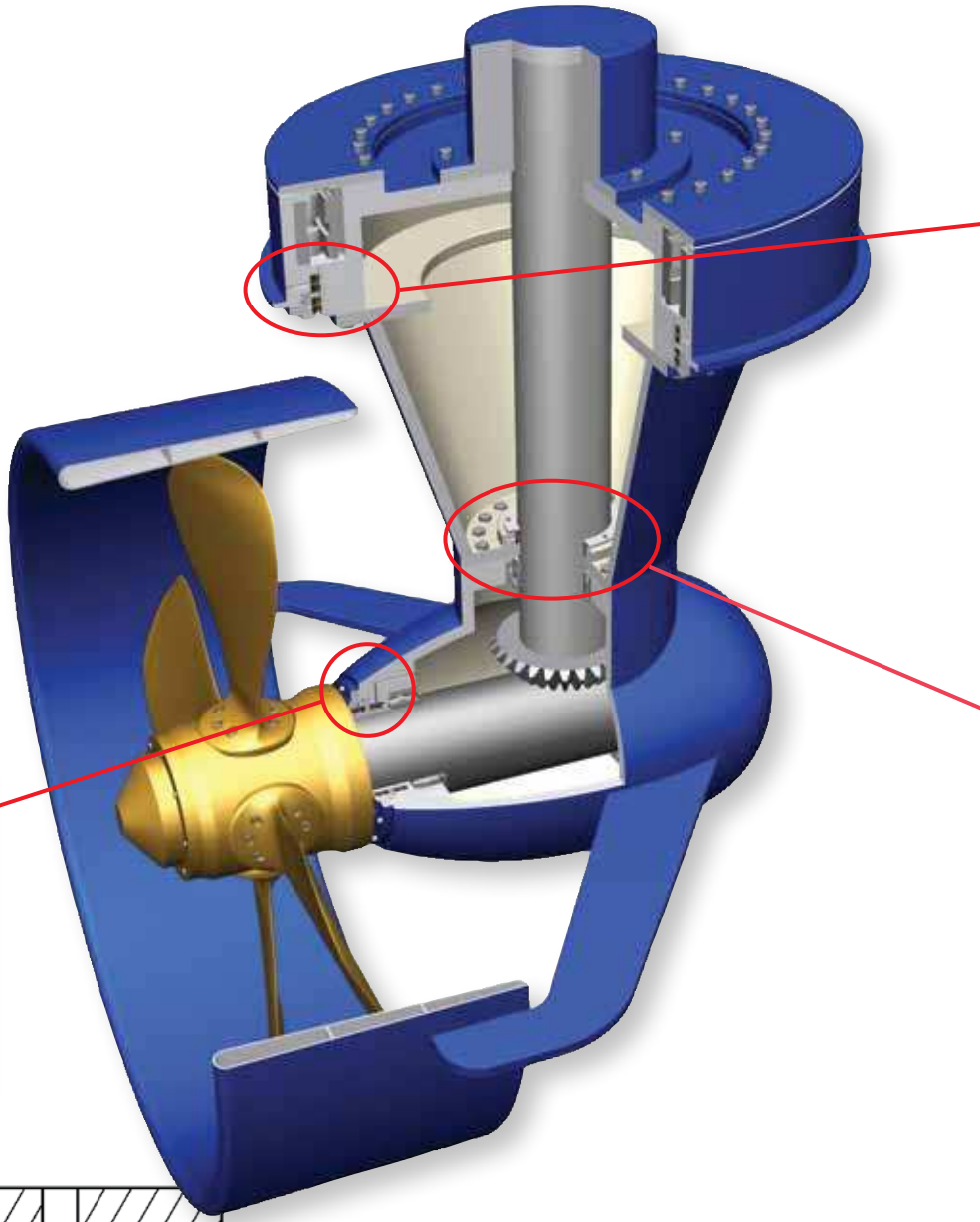
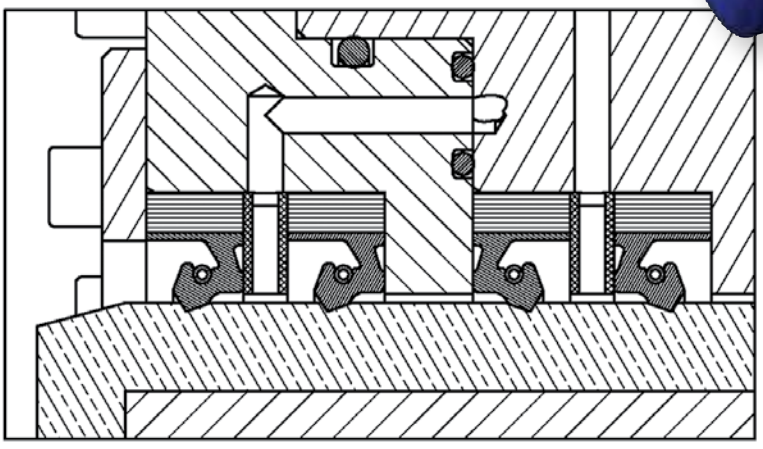
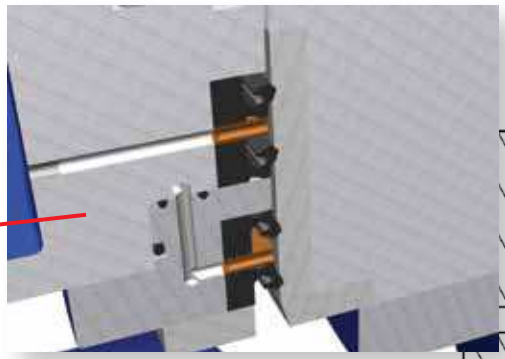
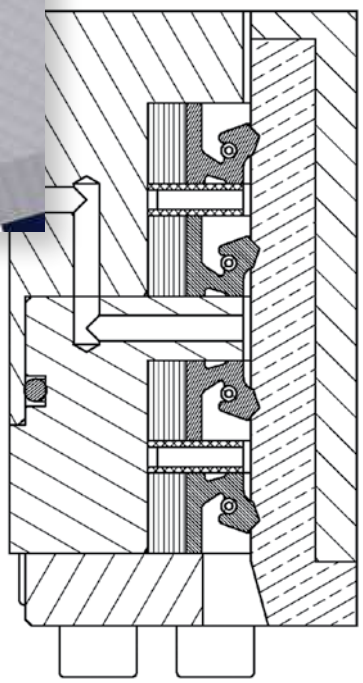




For recommended housing dimensions please see page 19.

Azimuth thrusters





Azimuth swivel seal

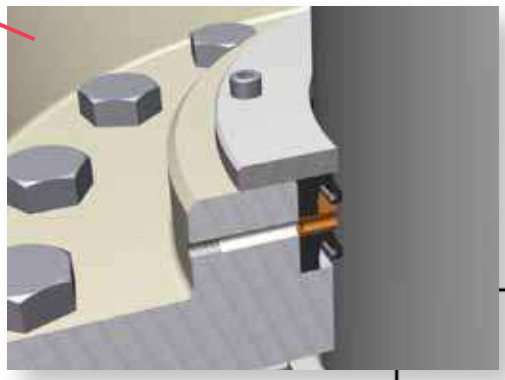
Robust Walkersele® D7 profile seals are ideally suited to the pressures and demanding mechanical conditions encountered in this application. The seal configuration is similar to that employed on the propeller shaft and the same lubrication regime is recommended.

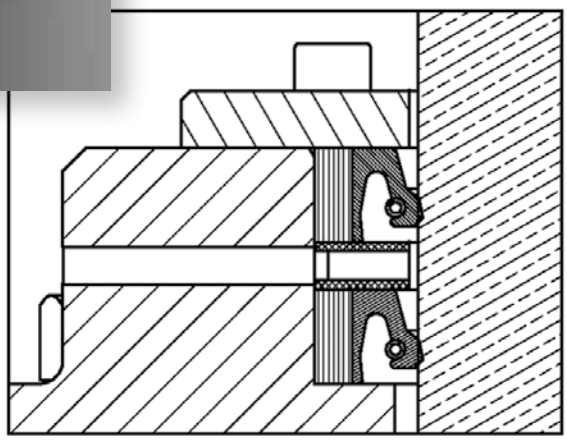
In larger units the bearing clearances and side loadings which may be encountered in operation can lead to quite high levels of eccentricity. If the expected eccentricity exceeds the guideline figures shown on page 18, please consult our Technical Support Team as we can normally design seals to suit.

Input shaft seal

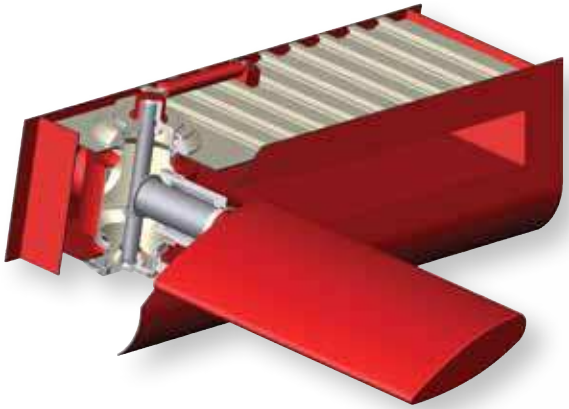
The normal recommendation for this sealing position would be for Walkersele® D6 profile. In view of its inaccessibility it is common to fit two seals in tandem as shown, but care must be taken to ensure that the back-up seal is lubricated by either packing the interseal space with grease or providing an oil feed.

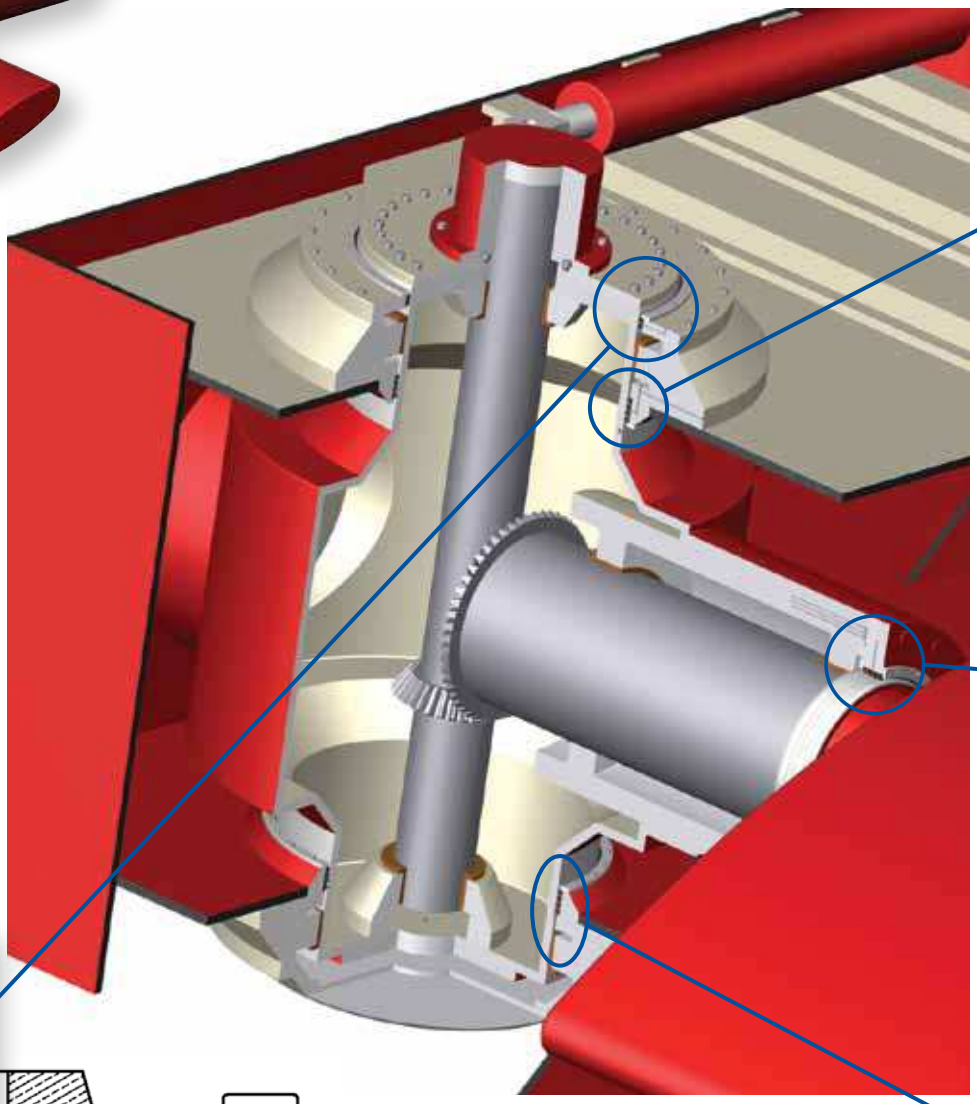
An alternative method is to hold the back-up seal clear of the shaft by means of a thin-walled metal sleeve which can be removed when the primary seal wears allowing the second seal to operate.





Fin stabilisers



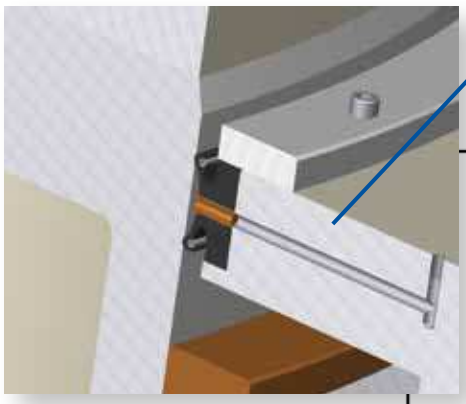


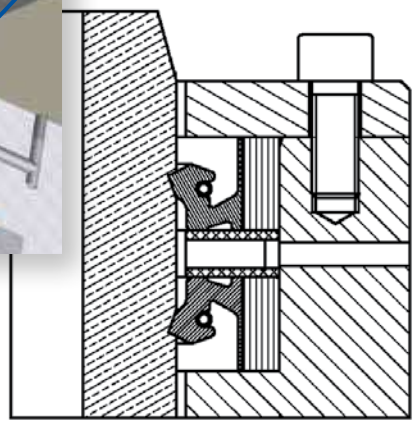
Bearing seals

The standard arrangement for the top bearing seal is for a pair of opposed Walkersele® D6 profile seals. The inner seal prevents any loss of lubricant from the bearing assembly whilst the outer seal protects the assembly from foreign matter, dirt, etc.

The central lantern ring gives provision for additional grease lubrication to the seals and this can also act as an additional barrier to contamination.

For recommended housing dimensions please see page 19.



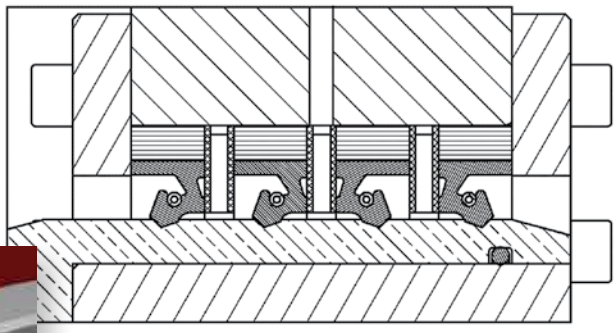


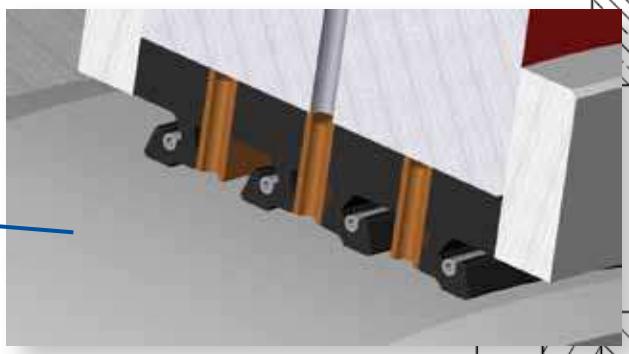
Fin & Crux seals

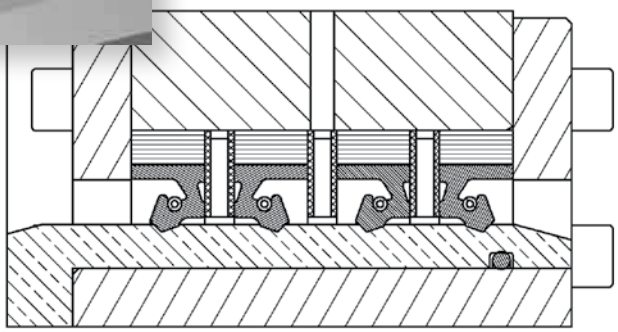
The seal arrangements recommended for both upper and lower crux positions and for the fin itself are similar, consisting of four Walkersele® D7 profile seals with each pair grease lubricated.
Two alternative configurations are possible, with either both of the outer seals facing externally and the two inners facing internally, or the option of the inner two seals facing each other.

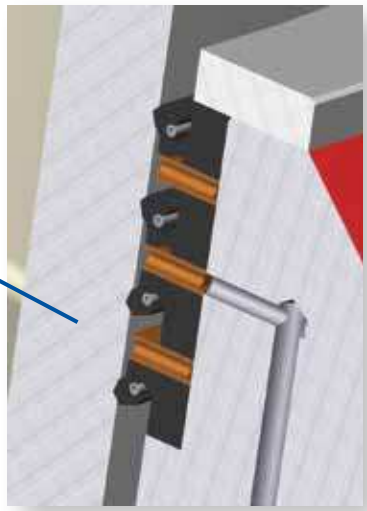
The former arrangement affords maximum protection from seawater ingress and oil loss, whereas the latter can provide early warning of primary seal failure by collecting any leakage through the central leak detection port.

It is usually only necessary to grease pack the seals on assembly for these applications.





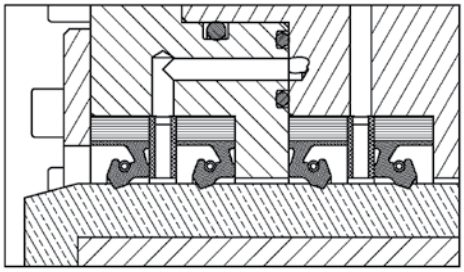




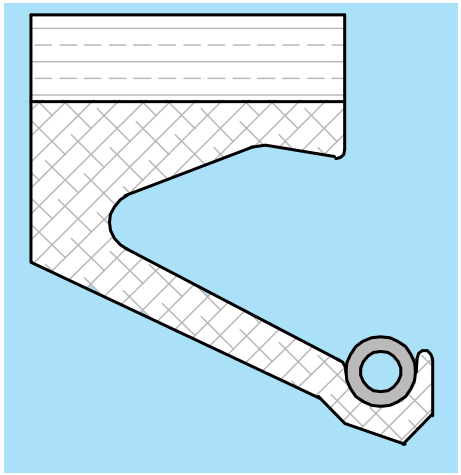
Steering gear / Propeller seals

Rudders

Our standard recommended arrangement for rudder stocks and posts is, as shown below, incorporating Walkersele® D7 profile seals in a back-to-back configuration.



In cases where high shaft eccentricity is anticipated special designs are available, including Walkersele® D6 variants with extended flexible lips as shown below.



Oil Distribution (OD) box

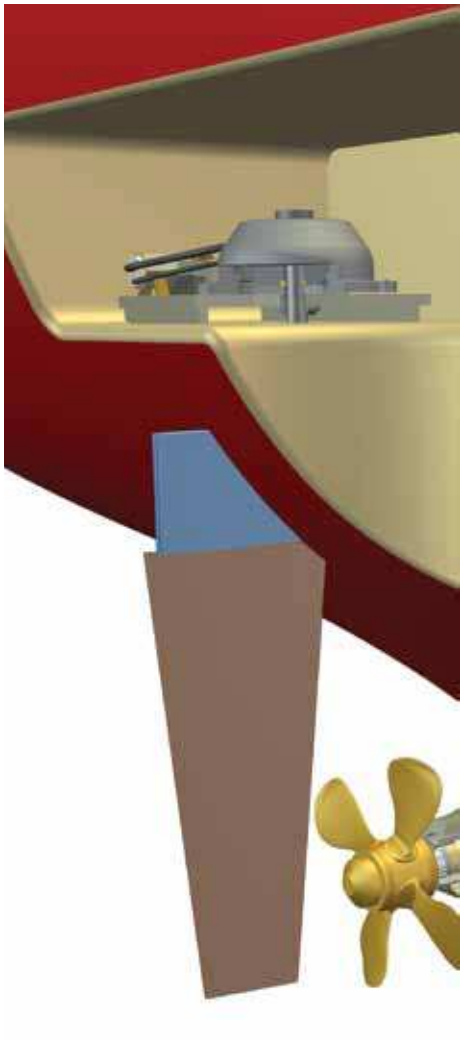
Sealing of the primary oil pressure between the chambers of the oil distribution box, which controls the movement of the CP propeller blades, is normally achieved by means of close fitting bush elements.

However, at the points where the shaft enters and exits the unit there will be a low residual pressure which is readily sealed using Walkerseles of D7 profile, typically in a single seal arrangement.

Actuators

Steering gear actuation mechanisms vary widely and are often hydraulically operated.

James Walker is able to offer an extensive range of hydraulic seals to suit any particular regime and set of operating conditions, as shown on page 20.



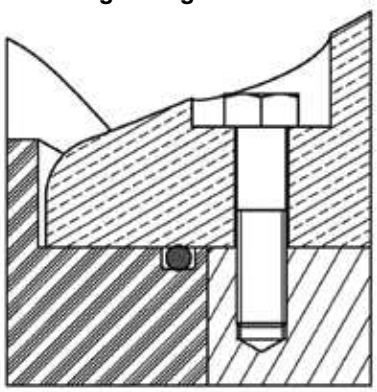
Blade seals

The choice of seal for the base of the blade of controllable pitch (CP) propellers is dependent on the orientation required.

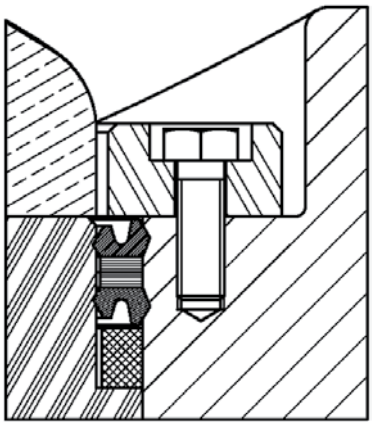
James Walker is able to offer face seal designs such as ‘O’ rings, X-section rings, ‘D’ seals and sponge filled profiles which afford resilience combined with ease of compression.

Radial options are normally based on our proven Solosele® KB concept, originally developed for Kaplan turbine blades for the hydroelectric industry. These options are also suitable for on-site joining if required, thus minimising down-time for seal replacement.

Typical propeller blade face seal housing arrangement



Typical propeller blade axial seal housing arrangement



James Walker

Specialist solutions

Walkersele® OSJ-2

The key to the popularity of our Walkersele® OSJ-2 system is that it allows seal replacement without the need for disassembly. This saves time and in many instances can be done at sea, with no need to dock for specialist services or equipment.

The resulting seal is no short-term, 'get you home' fix, but a permanent seal with the same performance levels and continuity as the original endless version fitted by OEMs.

- Simple, rapid fitting – no specialised skills required
- Cuts fitting costs and downtime; above water applications can be completed at sea
- Fully moulded endless-seal performance with split-seal assembly convenience

Profiles:
All Walkersele designs that incorporate seal backs moulded from rubberised fabric are suitable for OSJ-2.

Materials:
M1, M9 and Ultraglide seals are all suitable for supply in OSJ-2 form.

Temperature limit:
Dependent on the seal material, although the bonding technique imposes an upper limit of 150°C.

Sizes:
Shaft sizes from 60mm to 2000mm. For diameters outside this range, please contact our Technical Support Team for advice.

Walkersele® success

Propulsion shafts

All M-Class frigates of the Dutch Royal Navy now have Walkerseles installed on their propulsion shafts, following a technical review of the support bearing seals.

The arrangement is based on two Walkersele® lip seals with James Walker's patented OSJ® (On-Site Joining) technique, plus an automatic lubricant dispenser and new bearing cover. It replaces a labyrinth system that scored the propulsion shaft.

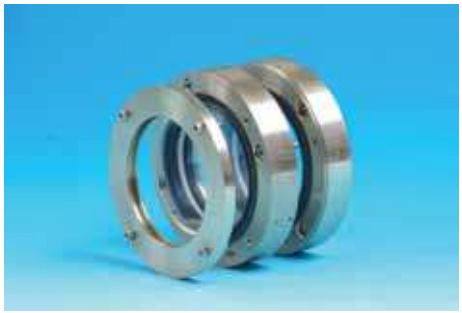
Cartridge seals

All of the recommended sealing arrangements featured in this brochure can be supplied as custom designed and manufactured cartridge seals.

Working in close liaison with your engineering staff we undertake the complete design and manufacturing process, which includes:

- Custom design of a tailored solution based on a metal cartridge that houses one or more sealing elements, and includes lubrication facilities where required.
- Sealing elements carefully selected from our full family of products — including Walkersele radial lip seals, other rotary seals, gland packings or 'O' rings — to meet precise operational parameters. We will custom design sealing elements specifically for your application, where this is necessary.
- Cartridges are designed to match the pressure rating of the sealing application and provide full housing support for the sealing element/s under all operational conditions.
- Manufacture, assembly, test and supply of your cartridge seal.
- Maintenance and refurbishment of your custom designed cartridge seal.

Specialised cartridges can be designed to overcome particular application issues. One such example is a 'floating' cartridge containing axial and radial bearing elements to allow the seal assembly to follow large eccentric movements of a worn or misaligned shaft.



Walkersele® shaft sleeves

Our sleeves will protect your shaft from wear and present the optimum running surface for Walkersele radial lip seals. We can provide them in either endless or split form.

The sleeves are precision manufactured in corrosion-resistant steel or non-ferrous alloys, to suit the operating conditions, and can be supplied with hard surface layers when required.

Our split-type sleeves feature a taper-wedge location and locking system that ensures perfect alignment of the split halves.

Shaft sleeve availability
Custom-designed and manufactured to suit each specific application. Please contact our Technical Support Team.

Operational considerations

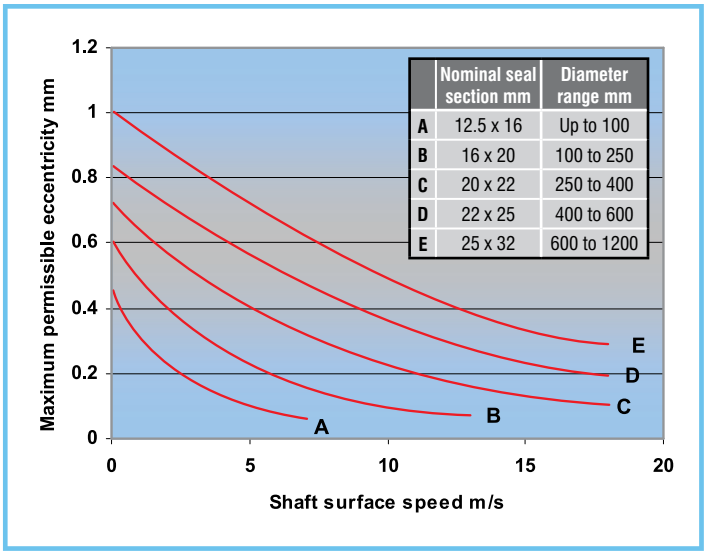
Eccentricity limits

A worn or misaligned rotating shaft assembly requires the lip seal to 'follow' the offset movement.

The highly flexible lips of Walkerseles will continue to perform satisfactorily under certain levels of eccentricity dependent on the seal diameter and the operating surface speed.

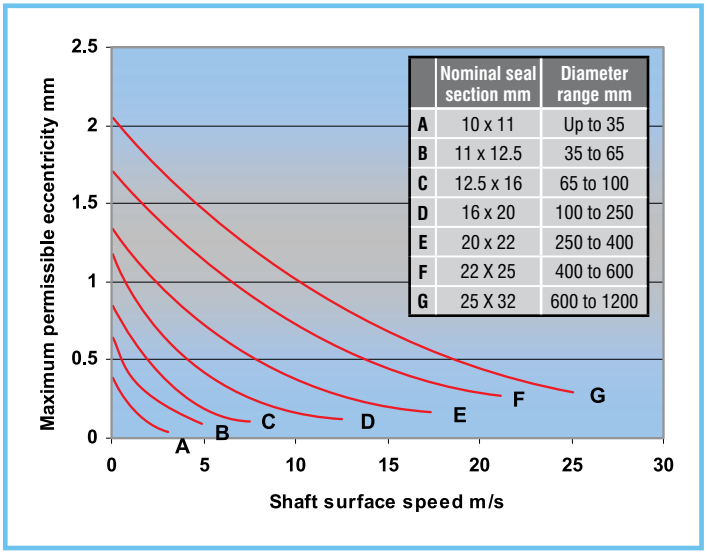
The following eccentricity graphs were prepared based upon the performance of endless and OSJ® Walkerseles in M1 material but will also act as a guide for other material combinations. Where eccentricity levels exceed the maximum values shown or for split seals, please discuss with our Technical Support Team.

Limits of eccentricity: endless M1/D7 Walkersele®



	Nominal seal section mm	Diameter range mm
A	12.5 x 16	Up to 100
B	16 x 20	100 to 250
C	20 x 22	250 to 400
D	22 x 25	400 to 600
E	25 x 32	600 to 1200

Limits of eccentricity: endless M1/D6 Walkersele®



	Nominal seal section mm	Diameter range mm
A	10 x 11	Up to 35
B	11 x 12.5	35 to 65
C	12.5 x 16	65 to 100
D	16 x 20	100 to 250
E	20 x 22	250 to 400
F	22 X 25	400 to 600
G	25 X 32	600 to 1200

Shaft surfaces

The sealing area of the shaft or shaft sleeve should have a fine ground finish of 0.2 to 0.8 μm Ra for the majority of Walkersele® applications.

Where higher speeds are involved — ie, in excess of 8 m/s —- we recommend the range 0.2 to 0.4 μm Ra.

It is strongly recommended in all cases that the surface be plunge ground and free from machining marks, dents, burrs, scratches and single pass grinding wetness patterns.

Shaft hardness

For applications where there is no water contact, conventional mild steel shafts will generally give satisfactory results under normal operating conditions provided lubrication is adequate and abrasives are not present. A hardness level of 40-50 HRC (Rockwell C) is generally acceptable in these circumstances.

However, where shaft wear has to be kept to the absolute minimum — particularly with high speed, abrasive or pressurised applications — a minimum hardness of 60 HRC is recommended.

When necessary, we advise that nitrogen case hardening (nitriding) treatment be applied to certain types of steel shaft or shaft sleeve to provide about 0.5 mm depth of surface hardened to around 68 HRC (1100 VPN).

Other methods of shaft hardening can include ceramic plasma coating or the application of thin dense chrome, tungsten carbide or other hard deposition materials.

For applications where the shaft is in water contact, corrosion resistant steels or other alloys must be used, either as shafts themselves or more often as sleeves which can be replaced when worn out.

Certain of these coatings, chrome oxide for example, whilst very tough and resilient can also be abrasive and thermally insulating requiring higher temperature resistant grades of elastomer to prevent thermal degradation of the seal lip.

James Walker carries out extensive research into the relationship between seal materials and shaft surfaces; please consult our Technical Support Team for advice for any particular application.

Seal storage

All precision manufactured elastomeric seals should be stored carefully to avoid damage or degradation. They should be kept in a cool, dark and dry environment and without stress, preferably laid flat and not tied together with string or wire or suspended from hooks which can lead to damage to sealing lips or edges and reducing sealing efficiency.

Please refer to BS ISO 2230 *Rubber products — guidelines for storage for further detailed advice.*

Operational considerations

Housing sizes

For guidance purposes the following tables give our recommended housing sizes for each shaft diameter range for both D6 and D7 design seals.

Please note — These dimensions relate to retained seals which require a retaining plate to apply axial compression. This is our preferred type for marine applications.

For further details and dimensions for self-retaining types please consult our Walkersele Radial Lip Seals brochure.

Housing sizes: D7 Walkersele®

Shaft diameter A mm		Nominal housing sizes mm			
		Radial section D	Axial depth C		
Above	Up to & inc		Single seal	2 seals & lantern	2 seals & spacers*
30	100	17.5	15	34	46
100	250	20	16	37	49
250	400	22	20	47	61
400	600	25	22	52	68
600	1200**	32	25	60	74

Housing sizes: D6 Walkersele®

Shaft diameter A mm		Nominal housing sizes mm			
		Radial section D	Axial depth C		
Above	Up to & inc		Single seal	2 seals & lantern	2 seals & spacers*
	35	11	10	24	36
35	65	12.5	11	26	38
65	100	16	12.5	30	42
100	250	20	16	37	49
250	400	22	20	47	61
400	600	25	22	52	68
600	1200**	32	25	60	74

* to allow for changing seal position after sleeve/shaft wear
** for larger sizes please consult our Technical Support Team

Housing surfaces and tolerances

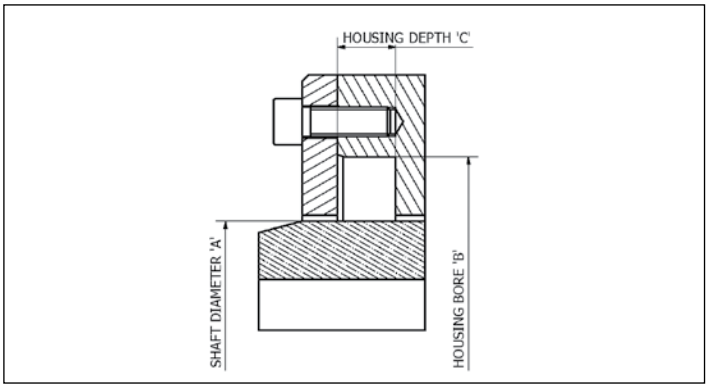
A fine machined finish, free of dents and scratches is recommended for the housing bore with a H9 tolerance.

The maximum shaft or sleeve diameter tolerance recommended is h11, thus allowing for reconditioning of shafts.

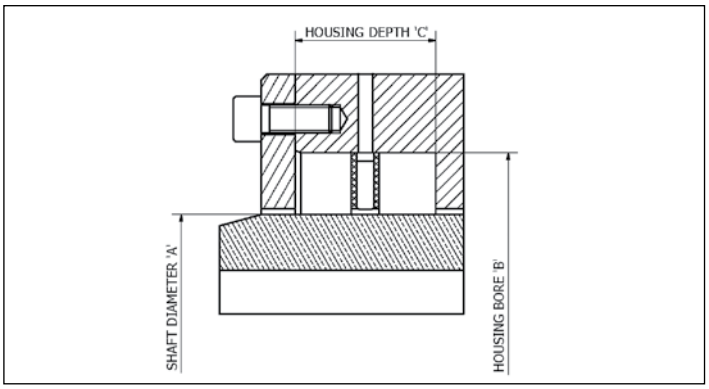
Housing tolerances should be ±0.1 for single seals and +0.2/0 for housings containing two seals.

Housing arrangements

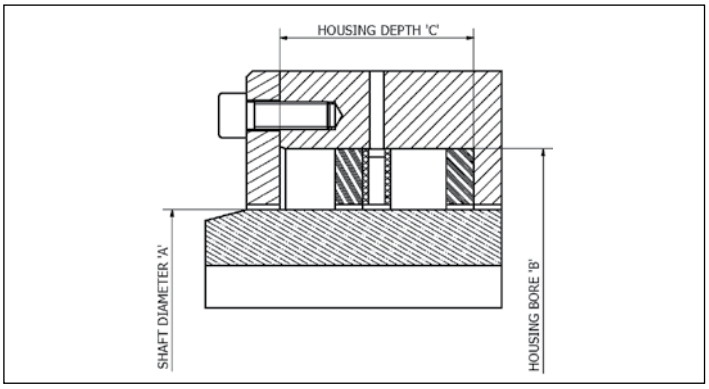
Single seal



Two seals and lantern ring



Two seals and spacer rings



For further details including recommended retaining plate and bolting information please consult our *Walkersele® Radial Lip Seals* brochure.

James Walker

‘O’ Rings & Hydraulic seals

‘O’ Rings

‘O’ rings offer many benefits to design engineers and plant operators. They:

- Suit static and dynamic duties
- Occupy little space
- Seal efficiently in both directions
- Are compatible with most fluid media
- Can work between –65°C and +315°C when made of elastomer – according to material type

James Walker holds moulds for more than 8,000 different ‘O’ Ring sizes and formulae for over 300 compounds

With design engineers faced by a bewildering array of ‘O’ ring statistics and advice, James Walker applications engineers and publications provide concise information on suitable materials and size configurations to ensure the best possible seal configuration and performance.

For comprehensive details, request or download the James Walker *‘O’ Ring Guide.*

Hydraulic seals

We use the term hydraulic sealing products to describe the wide variety of devices used to seal components in reciprocating hydraulic equipment.

Nowadays, hydraulic cylinders appear in numerous forms and sizes depending on the duties they must perform. Whatever your application, James Walker hydraulic sealing products cover the fundamental requirements of:

Rod/gland seals: to seal around the emerging rod or ram.

Piston seals: to seal around the piston used to generate motive force.

Wipers, scrapers or protector bellows: where the ingress of external contaminants such as dust, dirt or water must be eliminated.

Bearing strips: where insufficient provision has been made to support lateral loads.

From control actuators right up to the heaviest cylinders, our hydraulic seals have been specifically developed to offer:

- Optimum equipment performance
- Reduced leakage
- Low friction operation
- Long trouble-free operating life

These products are also exceptionally well proven in less demanding roles, where their superior quality provides best value benefits in terms of improved reliability plus reduced equipment downtime and maintenance costs.

The James Walker hydraulic seal range offers customers the ultimate service for high performance seals:

- Top level technical support worldwide
- One-stop-shop for all your hydraulic sealing needs
- Comprehensive family of products in a vast range of sizes
- Conformity to national and international standards
- Non-standard sections and sizes to match precisely your requirements
- Products that are third-party tested, and thoroughly tested in-house by James Walker Technology Centre

For comprehensive details, request or download the James Walker *Hydraulic Sealing Products Guide.*

Thermoplastic components

Broad capability

James Walker has the capabilities to mould, cast, extrude and machine a broad range of thermoplastic materials, many of which are ideally suited to marine applications and environments.

Replacing heavy, expensive metallic components with lightweight, resilient engineering plastics provides significant operational and cost benefits

Extensive material choice

Our application and materials engineering teams work with customers to design seals and components for specific application requirements using the most suitable and cost-effective materials.
In addition to a wide range of commercial engineering plastics, we formulate and manufacture our own range of Devlon® thermoplastics including;

- Devlon® T100
- Devlon® S Grade
- Devlon® V-API
- Devlon® A153
- Devlube®

Because we have complete control over our casting facility, the Devlon range has been developed and modified to suit most applications. However, we can, where certain applications dictate, use other materials or incorporate different fillers.

Bespoke manufacture

Our facilities can produce anything from a single bespoke item machined out of solid billet to millions of injection moulded components, all with the back-up of 3D design, FEA analysis and rapid prototyping facilities.

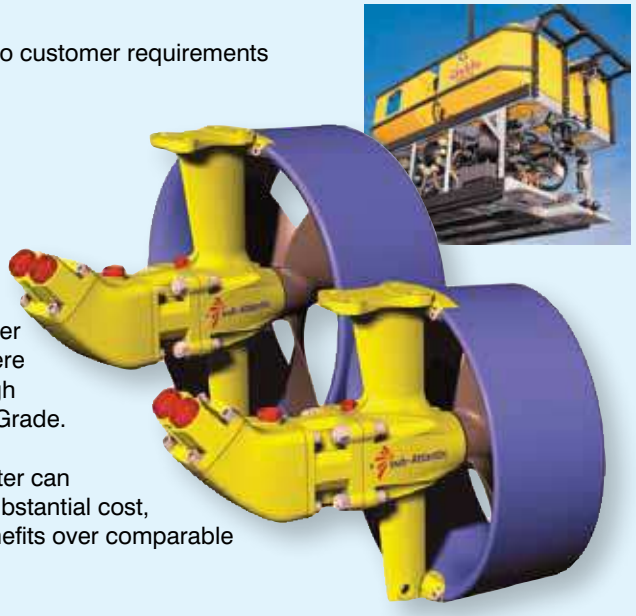
We do not simply manufacture components to customer specification however. Working in tandem with clients, we identify and analyse areas in which we think our materials could offer performance improvements and cost savings. We are then able to offer unique solutions to engineering problems, combining technical expertise, project management and state of the art equipment to offer optimal solutions to difficult application problems.

Bespoke manufacturing facilities mean that James Walker has complete control of the manufacturing process, from casting of the material through to finished machined components. Using the most modern CNC equipment housed in a customised manufacturing set-up, we can machine individually tailored products on both small and large scales.

Engineering plastics prove their strength at depth

ROV components

- Designed specifically to customer requirements
- Lightweight
- Simple assembly
- Corrosion free
- Cost effective



The nozzles on these submersible propulsion units, along with a number of other components, were precision moulded in high performance Devlon® S Grade.

Nozzles up to 2m diameter can be produced, offering substantial cost, weight and handling benefits over comparable metallic versions.

James Walker

Assured bolting integrity

Leading technology

Tension control is essential in achieving 100% reliability. Our unique RotaBolt® fasteners not only achieve the correct tension at installation, they maintain this throughout the life of the bolted joint

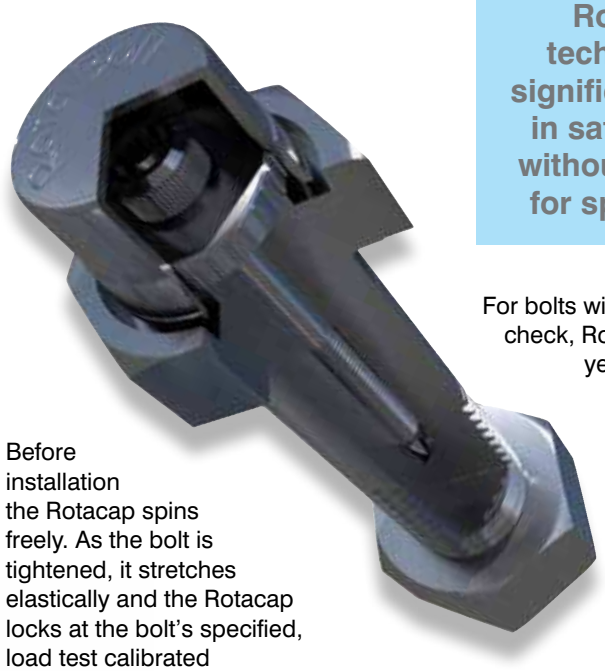
RotaBolt tension control fasteners are individually 100% load test calibrated and every bolt's extension measurement is individually certified.

Critical safety

Shaft coupling bolts on main propulsion shafts are a typical application where RotaBolt® can offer huge benefits in terms of safety. Failure of these critical components can result in massive damage to the vessel and severe risk of injury to personnel. RotaBolt ensures that correct tightening results in the bolts operating at the correct load and prevents danger of stress failure. Occasional checking that correct tension is being maintained could not be easier.

RotaBolt® — How it works

- Standard bolts are converted by inserting the RotaBolt indicator, which incorporates an integral gauge pin and grease filled control cap.
- The unique RotaBolt design incorporates internal air gap technology and 100% load test calibration. The consistency of the design criteria guarantees an indicator accuracy of +/- 5% throughout the life of the bolt.



- Before installation the Rotacap spins freely. As the bolt is tightened, it stretches elastically and the Rotacap locks at the bolt's specified, load test calibrated tension value
- As soon as any tension is lost across the bolted joint, the Rotacap immediately rotates freely to give a clear indication of tension loss.

Marine applications

Many critical bolted joints in marine propulsion systems are extremely difficult to access for bolt replacement, tightening or even checking – particularly those below the waterline.

In these instances, RotaBolt fasteners not only guarantee initial installation to the correct tension, they also provide a simple visual or tactile check that the correct tension is being maintained.

RotaBolt® bolting technology provides significant improvements in safety and reliability without any requirement for specialist expertise

For bolts without easy access for a tactile check, RotaBolt Vision – with its bold yellow indicator line – is ideal. The indicator can be seen from up to 25m away and is often used on subsea and seabed applications in the oil and gas industry where it allows bolt tightness checks to be carried out by camera equipped ROVs.

Global customer support

Global supply

Our role as a global supplier to the marine sector demands an international manufacturing base, plus highly efficient sales and distribution operations.

Our products and services are available through an international network of James Walker companies and official distributors at most principal ports worldwide.
We back this network with our highly developed logistics operation that gives customers the secure supply chain they need.

Our extensive range of other products for marine applications is detailed in this dedicated guide: *High Performance Sealing for all Marine Applications.*

Working in partnership

Much of our work within the marine propulsion industry is carried out in partnership or close co-operation with system manufacturers, in many cases under strict confidentiality agreements.

Our work incorporates design consultation, the formulation and testing of suitable sealing materials, plus in-house testing and validation of seal components prior to operational trials.

The early involvement of our materials and applications engineering teams can save a great deal of time and money, helping to identify and resolve potential issues at the design stage, avoiding the need for re-engineering and retro-fitting once equipment is in operation.

Over 50 production, engineering, distribution and customer support sites spread across Europe, Australasia, Asia Pacific, Africa and the Americas

Test facilities

Our world-class elastomer development and test facilities enable us to carry out in-depth studies into the interactions between our seal materials and the environments in which they are used. As well as analysing the effects of contact media on the materials, we are also able to study how these properties are affected by extremes of temperature, both high and low.

But beyond this we can fully test the functionality of the seals themselves on dynamic test rigs specifically designed to mirror the full range of marine propulsion applications. Test regimes of thousands of hours duration at high speed or elevated temperatures are carried out to fully validate the seals' operational capabilities using the actual media that they will encounter in application. Sophisticated instrumentation and data logging facilities allow complete analysis of performance which can be used by our Applications Engineering specialists to optimise designs.

James Walker solutions have provided many benefits including:

- Extending seal and equipment life
- Reducing maintenance costs
- Simplifying fitting procedures
- Cutting power consumption
- Minimising environmental pollution

James Walker

James Walker worldwide support and distribution

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Email: sales.za@jameswalker.biz

General Information

Health warning: *If PTFE or fluoroelastomer (eg, FKM, FFKM, FEPM) products are heated to elevated temperatures, fumes will be produced which may give unpleasant effects, if inhaled. Whilst some fumes are emitted below 250°C from fluoroelastomers or below 300°C from PTFE, the effect at these temperatures is negligible. Care should be taken to avoid contaminating tobacco with particles of PTFE or fluoroelastomer, or with PTFE dispersion, which may remain on hands or clothing. Material Safety Data Sheets (MSDS) are available on request.*

Information in this publication and otherwise supplied to users is based on our general experience and is given in good faith, but because of factors which are outside our knowledge and control and affect the use of products, no warranty is given or is to be implied with respect to such information. Unless governed by type approval or contract, specifications are subject to change without notice. Statements of operating limits quoted in this publication are not an indication that these values can be applied simultaneously.

To ensure you are working with the very latest product specifications, please consult the relevant section of the James Walker website: www.jameswalker.biz.

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