

James Walker *Deyol*[®]

Thermoplastic seals & components for the Oil & Gas industry

Issue 3



Innovative Thermoplastic Engineering



Industry expertise

James Walker at the heart of the oil & gas industry

James Walker has long been committed to the provision of sealing solutions for the upstream and downstream oil and gas industries.

As the technology employed to exploit natural resources has developed, the materials and products used have likewise had to evolve in order to provide essential reliability under increasingly arduous operating conditions.

Over the years James Walker has invested in the necessary infrastructure with advanced manufacturing facilities and test laboratories, supported by technologists and engineers, offering maximum production flexibility.

Our staff work closely with many of the world's major oil companies and original equipment manufacturers to develop sealing solutions that deliver optimum performance in a range of hostile operating environments.

This philosophy has fostered the constant development of improved materials, processes and new generations of products that push forward the boundaries. Our comprehensive research, development and testing programmes ensuring that each design or material innovation is verified and validated to industry and customer-specific standards.

By this means, and through bringing new companies with complementary technology, design and manufacturing skills into the James Walker Group, we have maintained and enhanced our reputation as a world leader in the materials and design technology behind the engineering solutions required by today's oil and gas industry.

With key hubs located in the UK, Singapore and Houston, James Walker provides a true global service with the added benefit of local representation and technical service.

The full range of products and services offered by James Walker companies now includes;

James Walker Devol –

Advanced engineered thermoplastics

James Walker & Co –

Elastomeric seals, compression packings and cut gaskets

James Walker Moorflex –

Metallic gaskets and specialist metal machining services

James Walker Townson –

Fabric, metallic and rubber expansion joints

James Walker RotaBolt –

Patented tension control fasteners

James Walker Tiflex –

Vibration attenuation and isolation



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Introduction

The core principle of James Walker Devol is of challenging convention. The fact that something is done in a certain way does not necessarily mean that a better way can't be found... and with this ever present thought in mind Devol engineers begin their work.

Leveraging the inherent strengths and properties of thermoplastic materials, our engineers seek to replace and improve upon the performance levels of existing components manufactured in materials including bronze, brass, hardened steel, laminates and incorrectly specified low performance plastics.

In addition to manufacturing superior performance components, Devol offers an exclusive "idea to innovation" service. Working in tandem with clients, the company's engineering teams explore unique solutions to engineering problems, combining technical expertise, project management and state of the art equipment to offer optimal solutions to difficult application problems.

Serving a global industry

Established in 1966, Devol has served the global oil and gas industry for many years through an established network of international offices and independent agents. Now, as part of the international James Walker Group the company is able to place its products and facilities at the disposal of operators and OEMs through 50 production, engineering, distribution and customer support locations spread across Continental Europe, Australia, New Zealand, SE Asia, South Africa, South America and the USA. These are supported by a further network of James Walker Group companies and official distributors supplying products and services to over 100 countries.

The Devol materials science, products and expertise developed across a range of diverse industries are now an integral part of the James Walker offering, providing additional solutions and new approaches to solving critical engineering issues for industry, end-users and OEMs.

The Devol expertise in engineering plastics creates an additional dimension within the James Walker portfolio of sealing solutions and engineering products. Increasing the available options in some applications and elsewhere extending the James Walker service into new areas, Devol's unique abilities are now backed-up by the group's dynamic international e-commerce systems, logistics operations and technical facilities that provide customers with the surety of supply they require.

In-house capabilities



Design & prototyping

Through our innovative approach Devol identifies areas where our materials will offer performance improvements and cost savings. The relevant grade of material is then selected, based on the requirements of the application, before using CAD technology to model and design components.

Devol works in partnership with clients throughout the development process until the design is signed off and transferred to the manufacturing floor, where our bespoke facilities allow us to cast and machine individually tailored products capable of performing in the most demanding subsea environments.

Where necessary, designs are first manipulated and modified using 3D solid modelling techniques to reduce the necessity for early prototypes and help reduce development costs. Devol also has the facility to carry out finite element analysis and kinematic simulation, which allows components that are intended to fit within other assemblies to be validated at the design stage before any investment in tooling.

Application of these techniques not only allows new designs to be optimised in the most cost effective manner, but can also be used to troubleshoot and improve existing components.

Manufacturing capabilities

Devol's strength lies in its total control of the entire production process, from initial design through to the end of the manufacturing process, every step is undertaken and controlled in-house.

In common with other parts of the James Walker Group, Devol exercises complete control over the formulation and compounding of the basic materials from which its products are manufactured. Devlon® thermoplastic materials are mixed at the point of casting using modern techniques which allow instantaneous switching between formulae and colours of materials being cast. This facility offers optimal production flexibility and allows rapid reaction to urgent requests without unduly disrupting the manufacturing process.

The casting process differs from injection moulding and extrusion in that it produces a product by polymerisation directly in the mould.

Polymerising in the mould produces a material with higher molecular weight and crystallinity. This in turn leads to improved dimensional stability, easier machinability and higher compressive and tensile strengths than those achieved by extruding or moulding.

Quality assurance



The process of polymerisation produces a chemical chain reaction to form Devlon®. Devlon consists of three main components:- the raw material caprolactam plus an activator and a catalyst which are required to control polymerisation. Additives, such as plasticisers, lubricants and heat stabilisers, can be used to modify or improve the material's performance.

The technology behind these additives is what differentiates Devol from the competition. The dosage of additives influences the reaction. By varying the volume of components and additives in the mix, our technologists produce materials with specific properties to suit the requirements of each customer application.

Control over the initial casting or billet material provides the ideal starting point for the machining process. Devol's state of the art machining facilities provide the most expedient and cost effective component production, adding to the speed and flexibility of the whole manufacturing or design to application process.

Dimensional stability within close tolerances for complex components is achieved by interstage annealing, which guarantees that the components delivered to our customers are safe, reliable and will achieve their maximum life expectancy.

Process & quality management

Operating a process-based management system within a lean manufacturing framework and actively supporting a culture of continuous improvement, Devol recognises that quality is of the highest importance.

Extensive quality checks are carried out at all stages of manufacture, from incoming raw materials through casting batches and every step of the machining and finishing process to ensure that the finished product measures up to design criteria, customer specifications and any relevant industry standards. Where necessary, third party witness testing, application testing and destructive testing are carried out at a range of registered facilities.

The company is certified to, and operates within, the scope of BS EN ISO 9001:2008 (registered firm reference number FM09064). As part of our drive for continual improvement we are currently working towards the Environmental Management Systems BS EN ISO 14001:1996 standard.

Specific to the oil and gas industry Devol Engineering is a fully registered company under the FPAL (First Point Assessment Limited) database scheme (supplier number 10044371).

The Devlon® advantage



The Devlon® range of thermoplastics has distinct advantages over other materials...

Devlon® thermoplastic materials are amongst the toughest and hardest wearing available. Produced by monomer casting and extrusion, they provide a comprehensive range of wear resistance, impact strength and toughness with almost limitless application potential.

The advantages are clear:

- **lower cost**
- **1/6th the weight of bronze**
- **zero corrosion**
- **low friction**
- **resistant to shock loading**
- **significantly improved lifespan**
- **exceptional resistance to wear**
- **does not support marine growth**

A range of materials capable of tackling the toughest applications...

Devlon®

Devlon is designed to solve the problems of wear, corrosion and lubrication, directly replacing traditional engineering components manufactured from materials such as bronze, brass, hardened steel, laminates and incorrectly specified low performance plastics.

The material can be produced by extrusion or monomer casting, providing a comprehensive range of impact strength and moisture absorption properties. These properties are linked to the molecular weight; the higher the value, the greater the toughness and wear resistance of the material.

In addition to offering substantial benefits over traditional materials, our components are manufactured precisely to customer specification and as such are directly interchangeable with existing parts.

Devlon® T100 is our proprietary cast material which covers a wide range of applications. With its inherently stress free and excellent wear properties, low friction and improved impact strength, it is a proven work horse in a range of applications and industries.

Typical applications include bushes, crane sheaves, rollers/wheels, racks and pinions, clamps and bearing rings.

The Devlon® advantage



Devlon® S Grade has the highest molecular weight which gives superior mechanical properties, rendering it our premium engineering grade thermoplastic. Particularly suited for larger sized components, it yields optimum performance in rigorous and abrasive applications at ambient temperatures.

Typical applications include bearings, rollers, pulleys, thrust plates, seal rings and gears.

Devlon® V-API gives similar performance levels to S-grade, but has been specifically tailored for high temperature/high pressure applications. Dimensional stability is a particular feature of this material due to its particularly low moisture absorption, making it ideal for offshore applications where weightsaving, non-corrosive and impact wear properties are imperative.

Typical applications include valve seat inserts, bundle spacers, tubing hanger centralisers, cable protectors and hot stabs.

Devlube® is a self-lubricating material ideally suited for dry-running applications requiring low friction and where lubrication is not possible. Reduced wear through lower friction means excellent retention of physical properties and very little maintenance is required for this material.

Typical applications include wear pads, cam followers, worm screws, bearing blocks and conveyor components.

Devlon® A153 is a specially formulated high viscosity Nylon 6/6, giving superior wear characteristics, improved impact strength and rigidity, providing greater design reliability when strength, weight and size are critical.

A153 has a significantly lower linear coefficient of thermal expansion than standard grade Nylon 6/6 and therefore maintains dimensional tolerances and clearances more accurately in applications involving thermal cycling. A153 has a

maximum operating temperature of between 90°C and 120°C, compared to 85°C for standard grade Nylon 6/6.

Typical applications include journal bearings, thrust washers, bearing cages, rollers/wheels, piston seats and wear pads.

In addition to our Devlon® range of specifically formulated materials and where applications dictate, Devlon can supply over 50 different materials including:

Polypropylene – low density (buoyant in water), excellent chemical resistance, good electrical insulator, low tensile strength and elastic modulus.

UHMWPE – exceptional toughness, low friction, high impact strength, good abrasion resistance.

Acetal – reasonable load capacity, easily machined, dimensional stability, high strength and stiffness.

PTFE – chemically inert, wide temperature range, low friction, limited load capacity, high thermal co-efficient of expansion.

PEEK™ – good radiation resistance, high operating temperature, good electrical properties, chemical resistance, good load bearing, but can be expensive.

Material technical data

Chemical resistance

Thermoplastic materials are used in various applications throughout most industries, therefore their resistance to corrosion or chemical attack is well documented.

If a thermoplastic material absorbs or is attacked by a particular chemical either in liquid or gaseous form, then the effect on that material will depend on four factors:

1. The chemical concentration
2. Temperature
3. Applied stress
4. Duration of exposure

When absorption only occurs, the changes in the material are generally reversible if the chemical is removed, however if chemical attack takes place the changes are permanent.

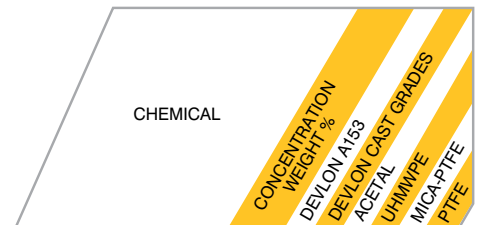
When in a chemical environment allowances must be made for possible reductions in mechanical properties of plastic materials. The exception to this rule may be in the case of a bearing where the presence of liquids on the bearing surface may act as a lubricant and increase the PV limit of the material in question.

Key to chart

- 'A' No attack, possibly slight absorption. Negligible effect on mechanical properties.
- 'B' Slight attack by absorption. Some swelling and a small reduction in mechanical properties likely.
- 'C' Moderate attack or appreciable absorption. Material will have limited life.
- 'D' Material will decompose or dissolve in a short time.
- '-' No data available.

Where aqueous solutions are shown the concentration as a weight percentage is given.

- Aq = Aqueous Solution
- SAT = Saturated Aqueous Solution
- CONC = Concentrated Aqueous Solution



	CONCENTRATION WEIGHT %	DEVYON AT163	DEVYON CAST GRADES	ACETAL	UHMWPE	MICA-PTFE	PTFE
Acetaldehyde Aq	40	B	B	A	A	A	A
Acetamide Aq	50	A	A	-	-	A	A
Acetic Acid Aq	10	C	C	B	A	A	A
Acatone		A	A	B	A	A	A
Acrylonitrile		-	A	-	-	A	A
Alcohols Aliphatic		B	-	A	A	A	A
Allyl Chloride		C	-	-	A	A	A
Ally Alcohol		-	A	-	A	A	A
Aluminium Chloride Aq	10	-	-	-	A	A	A
Aluminium Sulphate Aq	10	-	-	-	A	A	A
Ammonia Aq	10	B	A	D	A	A	A
Ammonia Gas		C	B	-	A	A	A
Ammonium Carbonate Aq	10	A	A	-	A	A	A
Ammonium Chloride Aq	10	A	-	-	A	A	A
	37	A	-	-	A	A	A
Amyl Acetate		A	A	-	A	A	A
Amyl Alcohol		-	A	-	A	A	A
Aniline		C	C	A	A	A	A
Antimony Trichloride Aq	10	C	C	-	A	A	A
Barium Chloride Aq	10	A	A	-	A	A	A
Barium Sulphate Aq	10	-	A	-	A	A	A
Barium Sulphide Aq	10	A	-	-	A	A	A
Benzaldehyde		B	B	-	A	A	A
Benzene		A	A	A	B	A	A
Benzene Sulphonic Acid		D	-	-	A	A	A
Benzyl Alcohol		C	C	-	A	A	A
Benzoic Acid Aq	SAT	C	C	-	A	A	A
Beverages Aq Alcoholic		B	B	-	A	A	A
Carbonated		B	B	-	A	A	A
Bitumen		B	B	-	A	A	A
Bleaching Lye	10	C	B	-	A	A	A
	100	C	B	C	A	A	A
Boric Acid Aq	10	A	A	-	A	A	A
Boron Trifluoride		D	-	-	-	-	-
Bromine Aq	30	D	-	-	-	-	-
Bromine Liq		D	-	-	-	-	-
Butanol		B	-	-	A	A	A
Butyl Acetate		B	B	-	A	A	A
Butyl Phthalate		A	-	-	A	A	A
Butylene Glycol		A	-	-	A	A	A
Butylamine		-	-	C	-	A	A
Butyric Acid Aq	20	B	B	-	A	A	A
Butyric Acid	CONC	C	B	-	A	A	A
Butyrolactone		-	A	-	-	A	A
Calcium Chloride Aq	10	B	-	-	A	A	A
Calcium Chloride (in Alcohol)	20	-	A	-	A	A	A
Calcium Hypochlorite		D	-	-	A	A	A
Camphor		A	A	-	A	A	A
Carbon Disulphide		A	A	-	B	A	A
Carbon Tetrachloride		A	A	A	B	A	A
Carbonic Acid Aq	10	A	-	-	A	A	A
Carnailite Aq	10	-	A	-	-	A	A
Catechol		-	C	-	-	-	-
Chloracetic Acid Aq	10	D	C	-	-	A	A
Chloral Hydrate		D	C	-	-	A	A
Chlorine Aq	10	D	C	-	B	A	A
Chlorine Gas	100	-	C	-	B	A	A
Chlorobenzene		A	A	-	B	A	A
Chloroform		D	C	-	B	A	A
Chlorosulphonic Acid Aq	10	D	C	-	B	A	A
Chrome Alum Aq	10	A	-	-	A	A	A
Chromic Acid Aq	1	C	B	-	-	A	A
Citric Acid Aq	10	C	B	-	-	A	A
	SAT	-	C	-	-	A	A
Castor Oil		A	-	-	-	A	A

Material technical data



CHEMICAL	CONCENTRATION WEIGHT%	DEVOLON A153	DEVOLON CAST GRADES	ACETAL	UHMWPE	MICA-PTFE	PTFE
Coconut Oil		A	A	-	A	A	A
Creosote		A	-	-	A	A	A
Cresols		D	D	-	A	A	A
Cresylic Acid		D	-	-	-	A	A
Cupric Chloride Aq	10	B	-	-	A	A	A
Cupric Sulphate Aq	0.1	-	B	-	-	A	A
	10	B	-	A	A	A	A
	SAT	-	B	-	-	A	A
Cyclohexane		A	A	-	A	A	A
Cyclohexanol		B	B	-	A	A	A
Cyclohexanone		A	A	-	A	A	A
Decalin		A	A	-	A	A	A
Detergents, Organic		A	-	-	A	A	A
Dibutylphthalate		A	A	-	A	A	A
Dichlorodifluoro Methane		A	A	-	-	A	A
Dichlorpethylene		-	A	-	C	A	A
Diethyleneglycol Aq	90	A	A	-	A	A	A
Diesel Oil		A	A	-	A	A	A
Dimethyl Carbinol		B	B	A	A	A	A
Dimethyl Aniline		A	-	-	A	A	A
Dimethyl Formamide		A	A	A	A	A	A
Diocetyl Phthalate		A	A	-	-	A	A
Dioxan		A	A	A	A	A	A
Edible Oils		A	A	A	A	A	A
Ethanol Aq	96	B	B	A	A	A	A
Ether Diethyl		A	A	A	A	A	A
Ethyl Acetate		A	A	A	A	A	A
Ethyl Butyrate		A	-	-	-	A	A
Ethyl Chloride		-	A	-	-	A	A
Ethylene Chlorhydrin		D	-	-	-	A	A
Ethylene Chloride		B	B	A	B	A	A
Ethylene Diamine		B	A	A	A	A	A
Ethylene Dichloride		B	-	-	-	A	A
Ethylene Glycol Aq	96	B	B	-	-	A	A
Ethylene Propionate		A	-	-	-	A	A
Ferric Chloride Aq	5	-	B	-	-	A	A
	10	C	-	-	-	A	A
	SAT	C	C	-	-	A	A
Ferrous Chloride Aq	10	C	C	-	-	A	A
Fluorine		D	-	-	C	C	C
Fluosilicic Acid Aq	10	D	C	-	A	-	-
Flourthane		A	A	-	-	A	A
Freon 12 (Arcton 12)		A	A	-	-	A	A
Formaldehyde Aq	40	B	B	A	A	A	A
Formic Acid Aq	3	C	B	D	A	A	A
	10	D	C	D	A	A	A
	CONC	B	B	-	-	A	A
Fruit Juices		A	B	-	-	A	A
Furfural		A	-	-	-	A	A
Glycerine		A	-	-	-	A	A
Heptane		A	A	A	A	A	A
Hexane		A	A	A	A	A	A
Hydrobromic Acid Aq	10	D	C	-	-	A	A
Hydrochloric Acid Aq	0.4	-	B	-	-	A	A
	2	C	C	D	A	A	A
	10	D	D	D	A	A	A
Hydrofluoric Acid Aq	4	D	C	D	A	B	A
Hydrogenated Vegetable Oils		A	-	-	-	A	A
Hydrogen Peroxide Aq	0.5	C	-	-	-	A	A
	1	-	C	C	A	A	A
	3	D	-	D	A	A	A
	SAT	B	A	C	A	A	A
Hydrogen Sulphide Aq		B	B	-	-	A	A
Hydroquinone		D	C	-	-	A	A
Iodine (in Alcohol)		D	-	-	-	A	A
Iodine (in Pot. Iodine) Aq	3	D	-	-	-	A	A

CHEMICAL	CONCENTRATION WEIGHT%	DEVOLON A153	DEVOLON CAST GRADES	ACETAL	UHMWPE	MICA-PTFE	PTFE
Isooctane		A	A	-	A	A	A
Isopropylalcohol		B	B	A	A	A	A
Isopropyl Ether	-	A	-	-	A	A	A
Lactic Acid Aq	10	C	-	B	A	A	A
	90	-	B	-	-	A	A
Lead Acetate Aq	10	B	B	-	-	A	A
Lead Stearate		A	A	-	-	A	A
Linseed Oil		A	A	A	A	A	A
Lubricating Oils (Petroleum)		A	A	A	A	A	A
Lithium Bromide Aq	50	D	D	-	-	A	A
Magnesium Chloride Aq	10	A	A	A	A	A	A
Magnesium Hydroxide Aq	10	A	A	A	A	A	A
Magnesium Sulphate Aq	10	A	A	A	A	A	A
Maleic Acid Aq	CONC	-	C	-	-	A	A
Malonic Acid Aq	CONC	-	C	-	-	A	A
Manganese Sulphate Aq	10	-	A	A	-	-	A
Mercuric Chloride Aq	6	C	C	B	A	A	A
Mercury		A	A	A	A	A	A
Methanol		B	B	A	A	A	A
Methyl Acetate		A	A	B	-	-	A
Methyl Ethyl Ketone		A	A	B	A	A	A
Methyl Pyrrolidone		A	A	-	-	-	A
Methylene Chloride		C	B	C	B	A	A
Methyl Phenyl Ether		A	-	-	-	-	A
Milk		A	A	-	-	A	A
Mineral Oils		A	A	A	A	A	A
Naphthalene		A	A	-	-	A	A
Nickel Sulphate Aq	10	A	-	-	-	A	A
Nitric Acid Aq	0.1	C	C	D	A	A	A
	10	D	D	D	A	A	A
Nitrobenzene		C	B	B	A	A	A
Nitromethane		-	B	-	-	-	A
Oleic Acid		A	A	C	A	A	A
Oleum		D	D	D	C	A	A
Oxalic Acid Aq	10	C	B	C	A	A	A
Ozone		C	C	C	B	A	A
Paraffin		A	A	A	A	A	A
Perchloroethylene		B	B	A	-	-	A
Perchloric Acid Aq		D	C	C	A	A	A
Petrol		A	A	A	A	A	A
Petroleum Ether		A	A	A	A	A	A
Phenol Aq	6	-	C	D	A	A	A
	75	D	D	D	A	A	A
Phenol (Molten)		-	D	D	A	A	A
Phosphoric Acid Aq	0.3	-	B	-	-	A	A
	3	-	C	C	A	A	A
	10	D	D	C	A	A	A
Phthalic Acid Aq	SAT	B	-	-	-	A	A
Potassium Acetate Aq	50	-	A	A	A	A	A
Potassium Bicarb. Aq	60	A	A	-	-	A	A
Potassium Bromide Aq	10	A	A	-	-	A	A
Potassium Carbonate Aq	60	A	A	-	-	A	A
Potassium Chloride Aq	90	A	A	-	-	A	A
Potassium Dichromate Aq	5	C	B	-	-	A	A
Potassium Ferricyanide Aq	30	A	B	-	-	-	A
Potassium Ferrocyanide Aq	30	A	B	-	-	-	A
Potassium Hydroxide Aq	10	A	A	-	-	A	A
	50	C	C	-	-	A	B
Potassium Nitrate Aq	10	A	-	-	B	A	A
Potassium Permanganate Aq	1	D	C	A	A	A	A
Potassium Sulphate Aq	CONC	A	A	-	-	A	A
Potassium Sulphide Aq	90	A	-	-	-	-	A
Pyridine		A	A	A	A	A	A
Propane Gas		A	A	-	-	-	A

CHEMICAL	CONCENTRATION WEIGHT%	DEVOLON A153	DEVOLON CAST GRADES	ACETAL	UHMWPE	MICA-PTFE	PTFE
Resorcinol		D	D	-	-	-	A
Salicylic Acid		A	A	-	-	-	A
Silicone Fluids		A	A	-	-	-	A
Silver Nitrate		A	A	A	A	A	A
Soap Solutions		A	A	A	A	A	A
Sodium (Molten)		-	-	-	-	-	B
Sodium Acetate Aq	60	B	B	-	-	-	A
Sodium Benzoate Aq	10	A	-	-	-	-	A
Sodium Bicarbonate Aq	50	A	-	-	-	-	A
Sodium Bisulphite Aq	10						
Sodium Bromide Aq	10	A	A	-	-	-	A
Sodium Carbonate Aq	20	A	A	A	A	A	A
	50	A	-	-	-	-	A
Sodium Chlorate Aq	10	A	-	-	-	-	A
Sodium Chloride Aq	10	A	A	A	A	A	A
Seawater	90	A	-	-	-	-	A
Sodium Cyanide Aq	10	A	-	-	-	-	A
Sodium Hydroxide Aq	10	A	A	C	A	A	A
	50	C	B	C	A	B	A
Sodium Hypochlorite 15% Cl		D	C	C	A	A	A
Sodium Nitrate Aq	50	A	A	A	A	A	A
Sodium Perborate Aq	10	B	-	-	-	-	A
Sodium Phosphate Aq	90	A	-	-	-	-	A
Sodium Silicate		A	A	-	-	-	A
Sodium Sulphate Aq	90	A	A	-	-	-	A
Sodium Sulphide Aq	90	A	-	-	-	-	A
Sodium Thiosulphate Aq	10	A	A	A	A	A	A
Stannic Chloride Aq	10	C	-	-	-	-	A
Stannic Sulphate Aq	10	C	C	-	-	-	A
Stearic Acid		A	-	-	-	-	A
Styrene (Monomer)		A	A	-	-	-	A
Sulphur		A	A	A	A	A	A
Sulphur Dioxide (Dry Gas)	100	B	-	B	A	A	A
Sulphuric Acid Aq	2	C	C	D	A	A	A
	5	D	D	D	A	A	A
Sulphurous Acid Aq	10	D	-	C	A	A	A
Tallow		A	A	-	-	-	A
Tar		B	B	-	-	-	A
Tartaric Acid Aq	10	B	B	-	-	-	A
Tetrachlorethylene		A	-	-	-	-	B
Tetrahydrofuran		A	A	A	B	B	A
Tetralin		A	A	-	-	-	A
Thionyl Chloride		D	C	B	C	A	A
Thiophene		A	-	-	-	-	B
Toluene		A	A	A	B	A	A
Transformer Oil		A	A	B	A	A	A
Trichlorethylene		B	B	B	B	A	A
Triethanolamine		A	A	-	-	-	A
Turpentine		A	-	-	-	-	A
Trisodium Phosphate Aq	95	-	B	-	-	-	A
Urea		A	A	A	A	A	A
Vaseline		A	A	A	A	A	A
Vegetables Oils		A	A	A	A	A	A
Vinegar		C	-	B	A	A	A
Vinyl Chloride		A	A	-	-	-	A
Water		A	A	A	A	A	A
Wax (Molten)		A	A	A	A	A	A
White Spirit		A	A	A	A	A	A
Wines & Spirits		B	B	-	-	-	A
Xylene		A	A	-	-	-	A
Xylenol		D	-	-	-	-	A
Zinc Chloride Aq	10	C	B	-	-	-	A
Zinc Oxide		A	A	-	-	-	A
Zinc Sulphate Aq	10	A	-	-	-	-	A

Material technical data

ASTM Specification	Physical Property	Units	DEVLON® T100	DEVLON® S GRADE	DEVLON® V-API	DEVLON® A153	DEVLUBE®	DEVLON® 6GF30	NYLON 6G
D638	Tensile strength at 23°C	MPa psi	73.9 10721	81.18 11774	79.92 11592	82.74 12000	70 10153	180 26106	60.8 8818
D638	Tensile strength at -40°C	MPa psi	116.56 16906	109.78 15925	109.52 15885	• •	• •	• •	• •
D638	Elongation at 23°C	%	3.66	3.75	5.37	10	4.1	3	20
D638	Elongation at break	%	70	•	•	•	•	•	200
D785	Hardness	Shore D Rockwell R	76/78 113	78/80 114	78/80 112	80/85 112/120	80/84 112/118	84 118	77 110
D790	Flexural Strength	MPa psi	127.48 18490	125.28 18170	121.55 17630	82.37 14100	90 13053	• •	87.2 12658
D621	Deformation Under Load 140 kgf/cm² at 23°C for 24 hours	%	1.0/2.0	1.0/2.0	1.0/2.0	1.0/3.0	•	•	2.0/3.5
D256	Charpy Impact Strength at 23°C	J/m ftlbs/inch	63.9 14.3	57.5 12.9	54.8 12.3	• •	• •	• •	• •
D256	Charpy Impact Strength at -40°C	J/m ftlbs/inch	20.2 4.5	20.3 4.6	19.8 4.5	• •	15 3.372	• •	• •
D638	Modulus of elasticity	MPa psi	3798 550862	4055 588137	4138 600175	2746 398252	2800 406105	9500 1377859	2745 398253
D695	Compressive strength	MPa psi	140 20305	140 20305	140 20305	• •	122.69 17794.68	• •	• •
D695	Compressive yield strength	MPa psi	88.9 12894	91.2 13227	91.2 13227	• •	• •	• •	• •
E831	Linear thermal expansion coefficient 30–100°C	mm/mm/°C	1.43 x 10 ⁻⁴	1.42 x 10 ⁻⁴	1.11 x 10 ⁻⁴	0.7 x 10 ⁻⁴	0.75 x 10 ⁻⁴	0.25 x 10 ⁻⁴	0.85 x 10 ⁻⁴
D3418	Melt point	°C	217	214	216	260	220	220	213
D648	Heat distortion temperature °C	264 psi 66 psi	79 207	98 209	93 209	100 190	120 210	210 220	60 145
D570	Service temperature (short term)	°C	170	180	190	170	•	180	•
D570	Service temperature (long term)	°C	100	105	125	100	•	-30 to +120	•
D149	Dielectric strength	kV/mm	>15	>15	>15	>12	20	25	>12
D792	Specific gravity	g/cm³	1.14	1.14	1.14	1.14	1.15	1.35	1.14
D570	Water absorption 24 hours	%	0.12	0.1	0.105	0.6/1.5	1	0.1	2.9
D570	Water absorption	%	3	3	3	•	•	1.5-2	9
UL 94	Flammability	Burn rate	SE	V2	V2	SE	V2	HB	SE

Notes:

1. This is not an extensive list of the materials available but is merely a summary of the properties of the most commonly specified grades. For filled or alternative grades please contact James Walker Devol.
2. The test figures stated are typical values and their aim is to assist the specifier in material selection. They are not intended to represent exact specifications.
3. • Denotes no data available at the time of publication. Please contact James Walker Devol for further information.

Material technical data

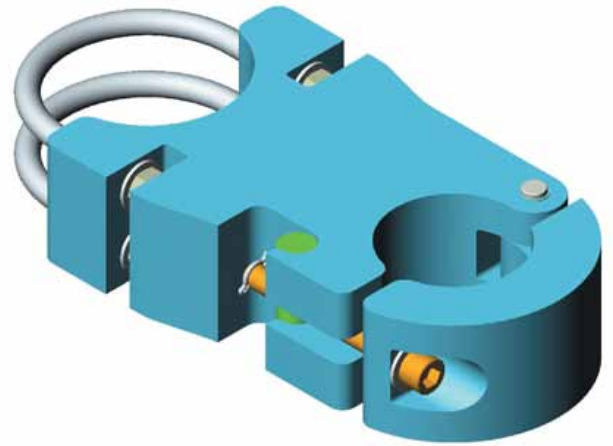
NYLON 6/6	NYLON 12	ACETAL COPO	ACETAL HOMO	PTFE	UHMWPE	PEEK™	PVC	POLYPROP	ABS	25% GF PTFE	PET
60.8 8960	52 7542	64.12 9300	70.33 10200	24.82 3100	24.55 3560	97 14068	62 9000	41.37 6000	45 6526	4.9/19.6 711/2845	81 11748
•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•
20	13	60	30	•	•	•	40	120/900	20	10	•
200	240	•	•	500	450	25	•	•	•	300	70
83 116	• •	85 120	86 122	65 •	64/67 •	88 •	83 •	73 •	• •	• •	84 118
89.2 12943	• •	89.73 13725	94.14 14400	• •	26.48 4050	170 24656	107.87 16000	49.03 7500	• •	75 •	• •
1.0/3.0	•	1	0.5	14/28	•	•	•	•	•	•	•
•	•	•	•	•	No break	•	•	•	•	•	•
•	•	•	•	•	No break	•	•	•	•	•	•
•	•	•	•	•	•	7	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•
1716 248908	1800 259533	2841 409631	2841 409631	637 92451	785 113931	3900 1400686	3432 497815	981 142233	2400 348090	735 106675	2800 •
•	•	103.4	110	•	•	118	•	•	•	•	•
•	•	15000	16000	•	•	17114	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•
1 x 10 ⁻⁴	1 x 10 ⁻⁴	9.5 x 10 ⁻⁴	10 x 10 ⁻⁴	1.2 x 10 ⁻⁴	2.0 x 10 ⁻⁴	0.47 x 10 ⁻⁴	8 x 10 ⁻⁴	9 x 10 ⁻⁴	0.9 x 10 ⁻⁴	Anisotropic	0.7 x 10 ⁻⁴
260	175	165	175	327	137	343	150	163	•	327	255
93 204	50 140	110 158	125 170	49 132	• 95	• •	76 82	60 107/121	• •	95 250	170
170	140	140	145	300	•	300	•	•	100	•1	80
100	80	100	105	200	•	260	•	•	80	•	110
>12	33	>16	20	>24	>28	20	50	80	20	•	60
1.14	1.03	1.42	1.42	2.3	0.94	1.49	1.6	0.915	1.07	•	1.37
1.5	1	0.22	0.25	0.01	WR	0.2	0.04	0.01	•	•	0.2
8	1.6	•	•	•	WR	0.5	•	•	0.3	•	0.5
SE	V2	HB	HB	VO	V2	VO	•	•	HB	VO	HB

SE = Self Extinguishing

WR = Water Repellent

PEEK™ is the trademark of Victrex plc.

A history of successful innovation



Clamping systems

Riser clamps

- Vast weight reduction when replacing steel
- Does not support marine growth
- Single operative assembly
- Cost reduction versus steel
- Zero corrosion

Umbilical clamps

- Lightweight
- Cost effective
- Simple and quick installation
- Ensures adequate support for umbilical
- Enables simple running of umbilical in congested area

Piggy back clamps

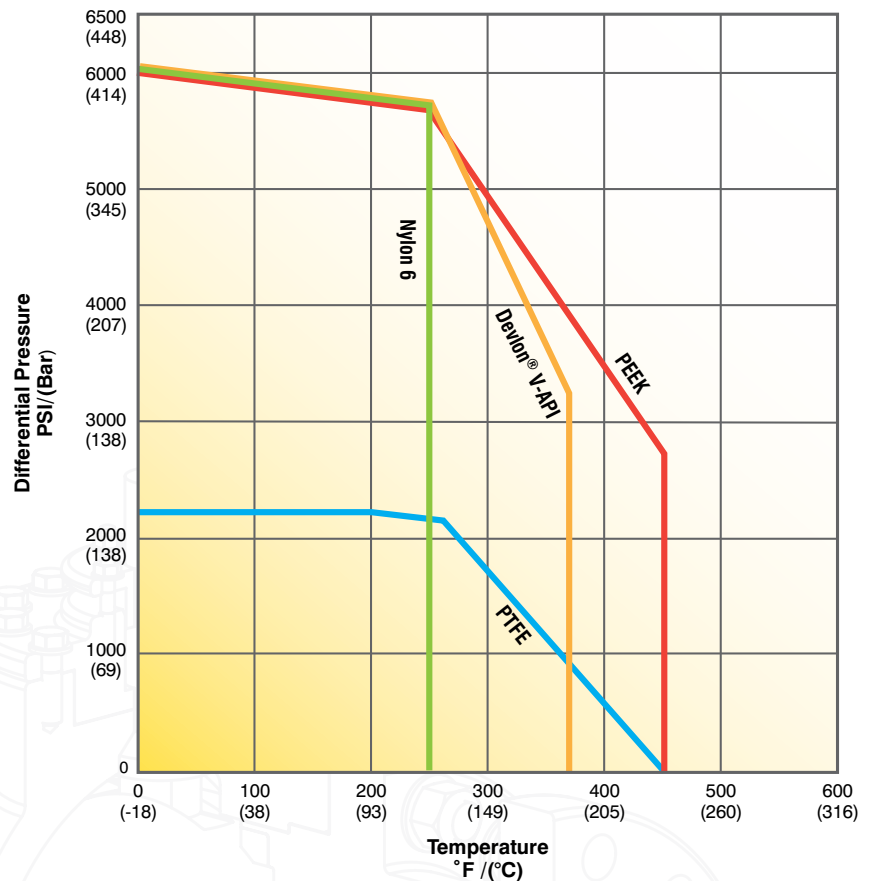
- Lightweight
- Robust construction
- Easy to assemble
- Corrosion free
- Tailored to dimensions of main line



A history of successful innovation

Devlon® V-API offers better performance than Nylon or PTFE and is significantly more cost-effective than PEEK

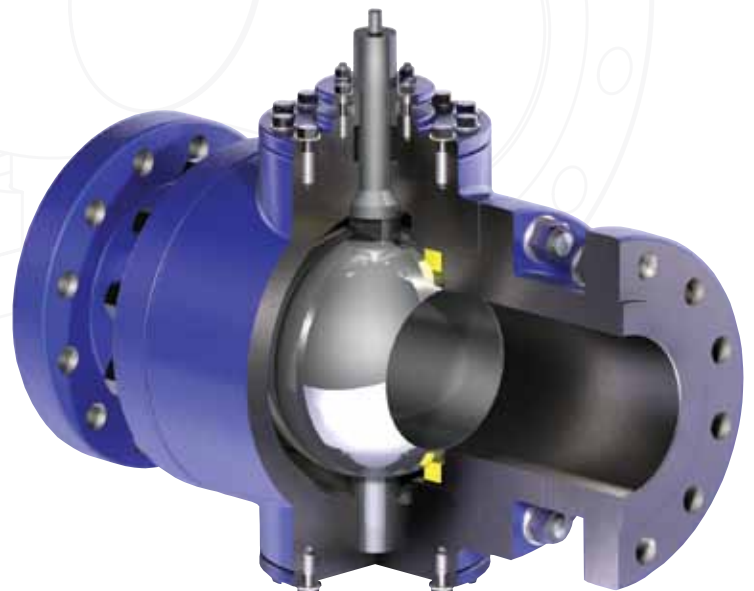
Pressure / temperature performance comparison



Valve components

Ball valve seat inserts and insert materials

- Shell approval (MESC 77/130) for use in high pressure valves conforming to API 6D
- Approval to Total GS EP PVV 142 rev4
- Proven in operation at temperatures as low as -196°C and up to +200°C, subject to valve and seat design
- Can withstand a pressure of 41MPa/414bar (6,000 psi) at +176°C
- Available in diameters of 1" (25.4mm) to 77" (1950mm)
- Highly cost effective
- OEM specified
- Third party witnessed qualification to Norsok M-710 for RGD resistance
- Available in semi/finished machined and billet formats



A history of successful innovation



Custom components

Tensioner pads

- 1/7th the weight of steel
- Modular design reduces tensioner pad change outs
- Non corrosive
- Huge operational cost saving due to reduced downtime
- Covers a wide range of pipe diameters

ROV components

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

Spacer unit and guide element

- Safety critical component for drilling rig safety cables
- Specified on Heidrun Platform
- Lightweight simple construction
- Will travel 31,000km over 20 year lifespan
- Cost effective solution

A history of successful innovation



Pipelines / Flowlines

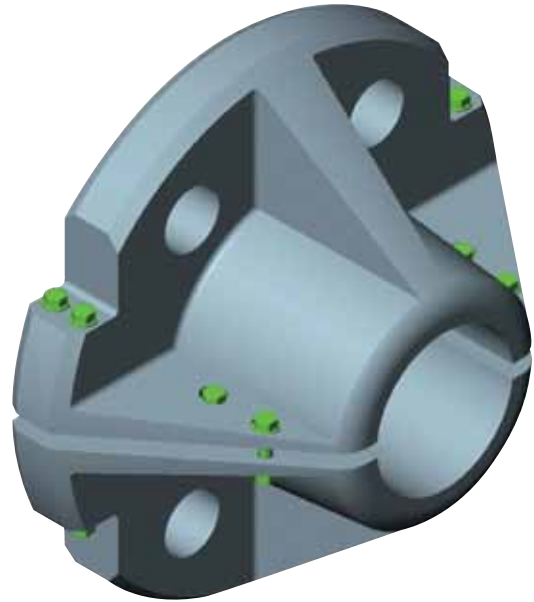
Pipe-in-pipe centralisers

- Low thermal conductivity
- Exceptional creep characteristics – even at elevated temperatures
- Excellent abrasion resistance
- Low drag co-efficient at pull through
- No measurable deflection on reeling trials

Flowline bundle spacers

- Replaces traditional steel spacers
- Reduced weight, reduced cost
- Exceptional wear resistance at pull through
- Low thermal conductivity
- Maximum utilisation of restricted space
- Zero corrosion

A history of successful innovation



Rig components

Top tension riser centralisers

- Lightweight, low cost solution
- Simple and quick installation
- 25+ year life performance
- Non corrosive and wear resistant
- No slippage under load

Stress joint / keel joint guides

- Ensures connectors do not snag on stem
- Maximises efficiency when running riser
- Reduces installation time
- Simple assembly

Tubing hanger centraliser

- Ensures correct centralisation of tubing hanger as it is installed into the Christmas tree
- Provides equivalent flow area to match block annulus
- Robust and impact resistant
- Lightweight

James Walker products & services

James Walker & Co
Advanced elastomer science

With James Walker you have access to leading edge development in elastomeric sealing products.

Our in-house capabilities and expertise extend from materials chemistry and applications engineering, through prototyping and manufacture, to some of the most comprehensive testing facilities currently available.

Our ability to carry out exhaustive RGD testing and simulate operational conditions in extreme environments helps ensure James Walker elastomeric sealing solutions remain at the forefront of sealing technology within the oil and gas industry.



James Walker RotaBolt
Tension control technology

RotaBolt® is alternative engineering at its very best.

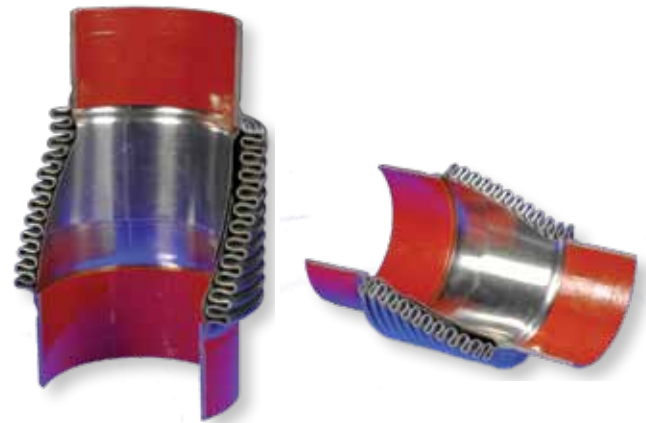
Replacing traditional engineering practice, this unique product guarantees installation to a pre-set tension and continues to accurately measure the tension maintained across the bolted joint.

Providing a simple visual or tactile check of tension, RotaBolt technology has been instrumental in improving safety and reducing maintenance costs and is fast becoming the industry standard bolting system for critical applications in harsh conditions.

James Walker products & services

**James Walker Moorflex
Metallic gaskets & specialist machining**

Moorflex has over 40 years of experience in the production of API metal ring joints and other metallic gasket products. The proven reliability of these items, displayed by their ability to operate the full oilfield life cycle, is at the heart of our success. For the past 25 years, the company has developed special in-house machining techniques for the production of precision components from high-nickel and standard alloys for the OEM market where innovation and long-term reliability are imperative.



**James Walker Townson
Custom expansion joint service**

Our focus is on optimising the life and performance of expansion joint technology.

From on-site thermographic surveying through design, materials selection and testing to manufacture, our design and production teams ensure that our field installation engineers will be installing a bespoke solution that will exceed performance and reliability expectations, whatever the location or operational conditions.

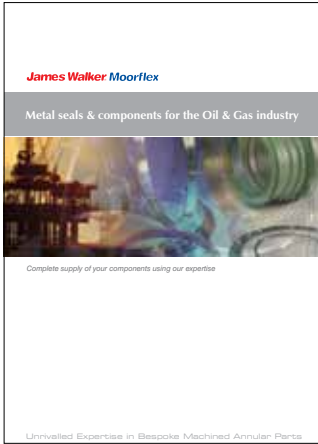
**Tiflex
Vibration attenuation & isolation**

As a James Walker Group company, Tiflex has over 50 years of experience in the manufacture and distribution of a wide range of polymer based materials and components, specialising in the manufacture of products which are made from cork-elastomer composites.

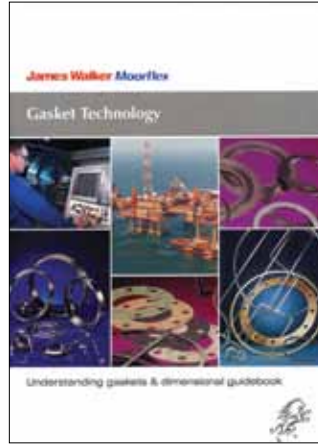
The company's in-house research facilities are a centre of excellence for the development of solutions to eliminate vibration and sound transmission.



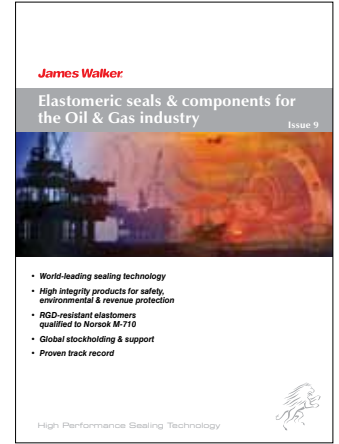
Technical guides



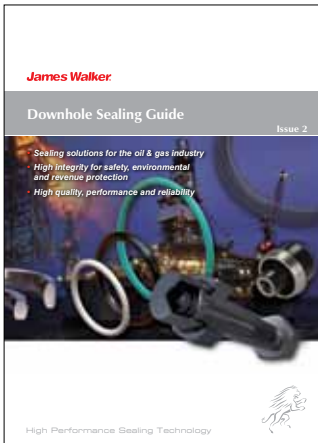
Metal seals & components



Gasket technology guide



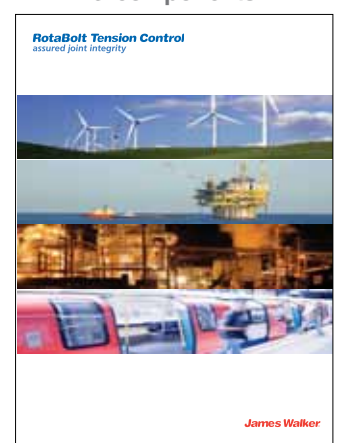
Elastomeric seals & components



Downhole sealing guide



Wellhead sealing guide



RotaBolt® tension control

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James Walker worldwide oilfield support

Aberdeen (UK)

Tel: +44 (0)1270 536140
Fax: +44 (0)1270 536065
Email: oilandgas@jameswalker.biz

Bergen (Norway)

Tel: +47 5 5112950
Fax: +47 5 5138005
Email: sales.no@jameswalker.biz

Hamburg (Germany)

Tel: +49 (0)40 386 0810
Fax: +49 (0)40 389 3230
Email: sales.de@jameswalker.biz

Lyon (France)

Tel: +33 (0)437 497 480
Fax: +33 (0)437 497 483
Email: sales.fr@jameswalker.biz

Milan (Italy)

Tel: +39 02 257 8308
Fax: +39 02 263 00487
Email: sales.it@jameswalker.biz

Perth (Australia)

Tel: +61 8 9457 9666
Fax: +61 8 9354 2675
Email: jwperth@jameswalker.com.au

James Walker do Brasil Tecnologia em Vedações Industriais Ltda

Av. Nilo Peçanha
50 SL 3204
Rio de Janeiro
Brasil - 20010-100
Tel: +55 21 2220 2152
Fax: +55 21 253 11704
Email: sales.br@jameswalker.biz

James Walker Devol

Clarence Street,
Greenock,
Scotland, PA15 1LR
Tel: +44(0) 1475 725 320
Fax: +44(0) 1475 787 873
Email: sales@devol.com



CERTIFICATE No. FM09064
BS EN ISO 9001:2008

James Walker Oil & Gas Co

16619 W. Hardy Road
Houston
TX 77060, USA
Tel: +1 281 875 0002
Fax: +1 281 875 0188
Email: oilandgas@jameswalker.biz



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James Walker Asia Pacific Ltd

192 Pandan Loop #05-11/12
Pantech Industrial Complex
Singapore 128381
Tel: +65 6777 9896
Fax: +65 6777 6102
Email: sales.sg@jameswalker.biz



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