TRELLEBORG
SEALING SOLUTIONS

O-Rings

Your Partner for Sealing Technology

Your Partner for Sealing Technology

Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer dedicated design and development from our market leading product and material portfolio; a one-stop shop providing the best in elastomer, thermoplastic, PTFE and composite technologies for applications in aerospace, industrial, and automotive industries.

With 50-years experience, Trelleborg Sealing Solutions engineers support customers with design, prototyping, production, test and installation using state-of-the-art design tools. An international network of over 70 facilities worldwide includes 30 manufacturing sites, 8 strategically positioned research and development centers, including materials and development laboratories and locations specializing in design and applications.

Developing and formulating materials in-house, we utilize the resource of our material database, including over 2,000 proprietary compounds and a range of unique products.

Trelleborg Sealing Solutions fulfills challenging service requirements, supplying standard parts in volume or a single custom-manufactured component, through our integrated logistical support, which effectively delivers over 40,000 sealing products to customers worldwide.

Facilities are certified to ISO 9001:2000 and ISO/TS 16949:2002, with many manufacturing sites also working to QS9000 and VDA 6.1. Trelleborg Sealing Solutions is backed by the experiences and resources of one of the world's foremost experts in polymer technology, Trelleborg AB.

ISO 9001:2000

ISO/TS 16949:2002

To obtain the best recommendation for a specific application, please contact your local Trelleborg Sealing Solutions marketing company.

This edition supersedes all previous brochures.

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Content

A General information

A.1 Description

O-Rings offer the designer an efficient and economical sealing element for a wide range of static or dynamic applications.

Inexpensive production methods and its ease of use have made the O-Ring the most widely used seal.

A wide choice of elastomer materials for both standard and special applications allow the O-Ring to be used to seal practically all liquid and gaseous media.

O-Rings are vulcanised in moulds and are characterised by their circular form with annular cross section. The dimensions of the O-Ring are defined by the inside diameter d_1 and the cross section d_2 (Figure 1).

Cross sections of approx. 0.35 to 40 mm and inside diameters up to 5,000 mm and more are available.

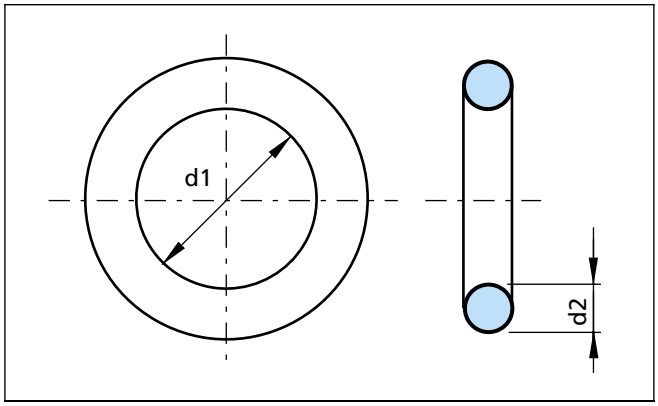


Figure 1 O-Ring dimensioning

Advantages

Compared with other sealing elements, the O-Ring has a wide range of advantages:

- Simple, one piece groove design reduces hardware and design costs
- Compact design allows smaller hardware
- Easy, foolproof installation reduces risk
- Applicable to a wide range of sealing problems, static, dynamic, single or double acting
- Wide compound choice for compatibility with most fluids
- Ex stock availability of many sizes worldwide for easy maintenance and repair.

A.2 Applications

O-Rings are used as sealing elements or as energising elements for hydraulic slipper seals and wipers and thus cover a large number of fields of application. There are no fields of industry where the O-Ring is not used. From an individual seal for repairs or maintenance to a quality assured application in aerospace, automotive or general engineering. The O-Ring is used predominantly for static sealing applications:

- As a radial static seal, e.g. for bushings, covers, pipes, cylinders
- As an axial static seal, e.g. for flanges, plates, caps.

O-Rings in dynamic applications are recommended **only for moderate service conditions**. They are limited by the speed and the pressure against which they are to seal:

- For low duty sealing of reciprocating pistons, rods, plungers, etc.
- For sealing of slowly pivoting, rotating or spiral movements on shafts, spindles, rotary transmission leadthroughs, etc.

A.3 Method of operation

O-Rings are double-acting sealing elements. The inital squeeze, which acts in a radial or axial direction depending on the installation, gives the O-Ring its initial sealing capability. These forces are superimposed by the system pressure to create the total sealing force which increases as the systeme pressure increases (Figure 2).

Under pressure, the O-Ring behaves in a similar way to a fluid with high surface tension. The pressure is transmitted uniformly to all directions.

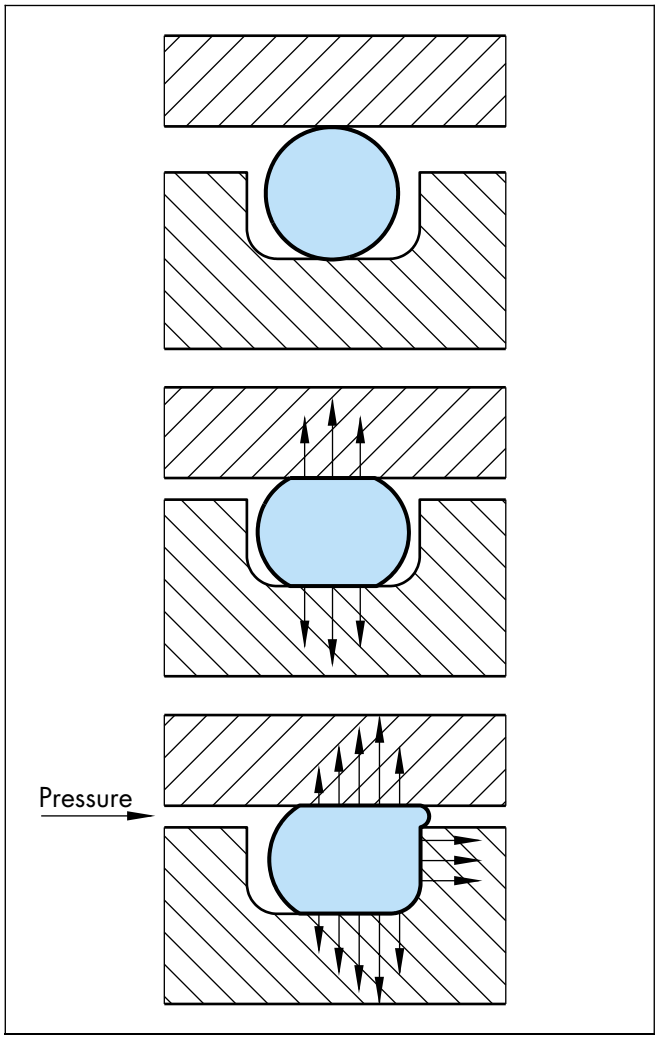


Figure 2 O-Ring sealing forces with and without system pressure

B Technical information

B.1 Materials

B.1.1 Elastomers

Equipment manufacturers and end users expect sealing systems to operate leak free and to maintain long service life. Reliability is crucial to effective low maintenance cost operations. To find the perfect sealing solution in each individual case both material performance and seal design are critically important. One of the main used material groups for sealings are the elastomers. They show good properties like elasticity or good chemical compatibility.

The following tables provide a summary of the various elastomer material groups. Trelleborg Sealing Solutions can offer a large number of materials within each group.

If no particular specifications are given for the material, standard NBR (Nitrile Rubber) in 70 Shore A will be supplied (see chapter "B.1.5 Standard materials").

Table I Elastomers

Designation	Trade Name*	Abbreviation		
		ISO 1629	ASTM 1418	TSS
Acrylonitrile-Butadiene Rubber (Nitrile Rubber)	Europrene® Krynac® Nipol N® Perbunan NT Breon®	NBR	NBR	N
Hydrogenated Acrylonitrile-Butadiene Rubber	Therban® Zetpol®	HNBR	HNBR	H
Polyacrylate Rubber	Noxtite® Hytemp® Nipol AR®	ACM	ACM	A
Chloroprene Rubber	Baypren® Neoprene®	CR	CR	WC
Ethylene Propylene Diene Rubber	Dutral® Keltan® Vistalon® Buna EP®	EPDM	EPDM	E
Silicone Rubber	Elastoseal® Rhodorsil® Silastic® Silopren®	VMQ	VMQ	S
Fluorosilicone Rubber	Silastic®	FVMQ	FVMQ	F
Tetrafluorethylene-Propylene Copolymer Elastomer	Aflas®	FEPM	TFE / P**	WT
Butyl Rubber	Esso Butyl®	IIR	IIR	WI
Styrene-Butadiene Rubber	Buna S® Europrene® Polysar S®	SBR	SBR	WB
Natural Rubber		NR	WR	WR
Fluorocarbon Rubber	Dai-El® Fluorel® Tecnoflon® Viton®	FKM	FKM	V
Perfluoro Rubber	Isolast® Kalrez®	FFKM	FFKM	J
Polyester Urethane Polyether Urethane	Zurcon® Adiprene® Pellethan® Vulcollan® Desmopan®	AU EU	AU EU	WU WU

* Selection of registered trade names
** Abbreviation not yet standardised.

ASTM = American Society for Testing and Materials
ISO = International Organisation for Standardisation

Designation	Trade Name*	Abbreviation		
		ISO 1629	ASTM 1418	TSS
Chlorosulphonated Polyethylene Rubber	Hypalon®	CSM	CSM	WM
Polysulphide Elastomer	Thiokol®	-	TWT	WY
Epichlorohydrin Elastomer	Hydrin®	-	-	WO

* Selection of registered trade names
** Abbreviation not yet standardised.

ASTM = American Society for Testing and Materials
ISO = International Organisation for Standardisation

Table II The most important types of synthetic rubber, their grouping and abbreviations

Chemical name	Abbreviation	
	DIN / ISO 1629	ASTM D - 1418
M - Group (saturated carbon molecules in main macro-molecule-chain)		
- Polyacrylate Rubber	AC**M**	AC**M**
- Ethylene Acrylate Rubber	AE**M**	
- Chlorosulphonated Polyethylene Rubber	CS**M**	CS**M**
- Ethylene Propylene Diene Rubber	EPD**M**	EPD**M**
- Ethylene Propylene Rubber	EP**M**	EP**M**
- Fluorocarbon Rubber	FK**M**	FK**M**
- Perfluoro Rubber	FFK**M**	FFK**M**
O - Group (with oxygen molecules in the main macro-molecule chain)		
- Epichlorohydrin Rubber	C**O**	C**O**
- Epichlorohydrin Copolymer Rubber	EC**O**	EC**O**
R - Group (unsaturated hydrogene carbon chain)		
- Chloroprene Rubber	C**R**	C**R**
- Butyl Rubber	II**R**	II**R**
- Nitrile Butadiene Rubber	NB**R**	NB**R**
- Natural Rubber	N**R**	N**R**
- Styrene Butadiene Rubber	SB**R**	SB**R**
- Hydrogenated Nitrile Butadiene Rubber	HNB**R**	HNB**R**
Q - Group (with Silicone in the main chain)		
- Fluorosilicone Rubber	FVMQ	FVMQ
- Methyl Vinyl Silicone Rubber	VMQ	VMQ
U - Group (with carbon, oxygen and nitrogen in the main chain)		
- Polyester Urethane	A**U**	A**U**
- Polyether Urethane	E**U**	E**U**

B.1.2 Application parameters of elastomers

Elastomers as all other organic chemicals have limited use. External influences such as various media, oxygen or ozone as well as pressure and temperature will affect the material properties and therefore their sealing capability.

Elastomers will amongst others swell, shrink or harden and develop cracks or even tears.
The following information illustrates the different application parameters.

Elastomer heat resistance / swelling in oil

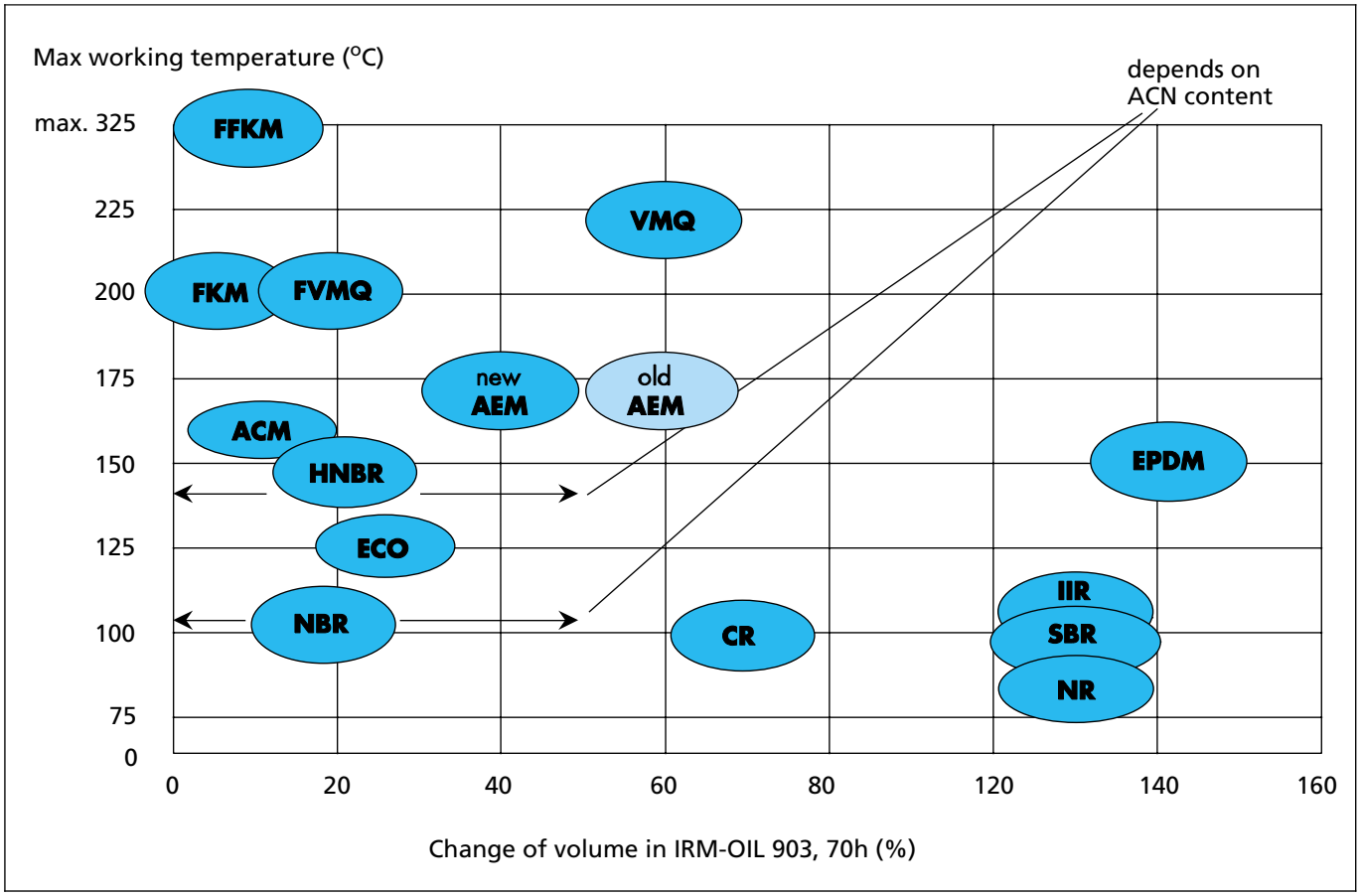


Figure 3 Change of volume in IRM-Oil 903 (old ASTM-Oil No 3)

Temperature range

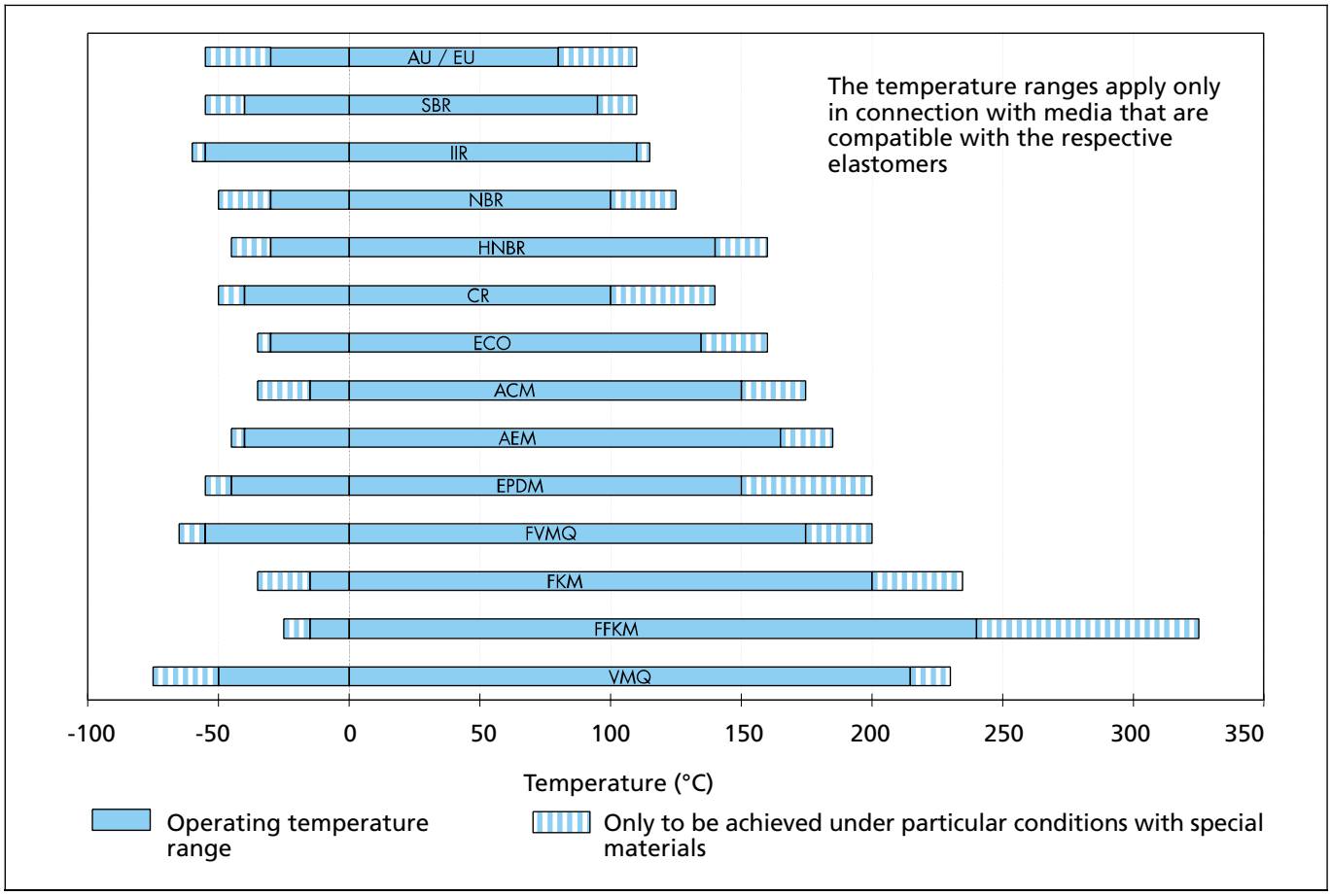


Figure 4 Temperature range of various elastomers

General field of application

Elastomer materials are used to cover a large number of fields of application. Details regarding resistance in special media are shown in chapter "Chemical compatibility", page 9.

The various elastomers can be characterised as follows:

NBR (Nitrile Butadiene Rubber):

The properties of the Nitrile Rubber depend mainly on the ACN content which ranges between 18% and 50%. In general they show good mechanical properties. The operating temperatures range between -30°C and +100°C (for a short period of time up to +120°C). Suitable formulated NBR can be used down to -60°C.
NBR is mostly used with mineral based oils and greases.

FKM (Fluorocarbon Rubber)

Depending on structure and fluorine content FKM materials can differ with regards to their chemical resistance and cold-flexibility.

FKM is known especially for its non-flammability, low gas permeability and excellent resistance to ozone, weathering and aging.
The operating temperatures of the Fluorocarbon Rubber range between -20°C and +200°C (for a short period of time up to +230°C). Suitable formulated FKM can be used down to -35°C. FKM is also often used with mineral based oils and greases at high temperatures.

EPDM (Ethylene Propylene Diene Rubber)

EPDM shows good heat, ozone and aging resistance. In addition they also exhibit high levels of elasticity, good low temperature behaviour as well as good insulating properties.
The operating temperatures of applications for EPDM range between -45°C and +150°C (for a short period of time up to +175°C). With sulphur cured types the range is reduced to -45°C and +120°C (for short period of time up to +150°C).
EPDM can often be found in applications with brake fluids (based on glycol) and hot water.

HNBR (Hydrogenated Nitrile Butadiene Rubber)

HNBR is made via selective hydrogenation of the NBR butadiene groups. The properties of the HNBR rubber depend on the ACN content which ranges between 18% and 50% as well as on the degree of saturation. HNBR shows good mechanical properties.
The operating temperature of HNBR ranges between -30°C and +140°C (for a short period of time up to +160°C) in contact with mineral oils and greases. Special types can be used down to -40°C.

Q (Silicone Rubber)

Silicone rubber shows excellent heat resistance, cold flexibility, dielectric properties and especially good resistance against oxygen and ozone.
Depending on the material the operating temperatures ranges between -60°C and +200°C (for a short period of time even up to +230°C). Special types can be used down to -90°C. There are also some types with narrow temperature ranges. Silicone is often used in the medical- and food industry.

CR (Chloroprene Rubber)

In general the CR materials show relatively good resistances to ozone, weathering, chemicals and aging. Also they show good non-flammability, good mechanical properties and cold flexibility.
The operating temperatures range between -40°C and +100°C (for a short period of time up to +120°C). Special types can be used down to -55°C.
CR materials are found in sealing applications such as refrigerants, for outdoor applications and in the glue industry.

ACM (Polyacrylate Rubber)

ACM shows excellent resistance to ozone, weathering and hot air, although it shows only a medium physical strength, low elasticity and a relatively limited low temperature capability.
The operating temperatures range from -20°C and +150°C (for a short period of time up to +175°C). Special types can be used down to -35°C.
ACM-materials are mainly used in automotive applications which require special resistance to lubricants containing many additives (incl. sulphur) at high temperatures.

FFKM (Perfluoro Rubber)

Perfluoroelastomers show broad chemical resistance similar to PTFE as well as good heat resistance. They show low swelling with almost all media.
Depending on the material the operating temperatures range between -25°C and +240°C. Special types can be used up to +325°C.
Applications for FFKM can be mostly found in the chemical and process industries and in all applications with either aggressive environments or high temperatures.

Chemical compatibility

It is important to recognise that when using this guide, the ratings shown are based on published data and immersion tests. These tests are conducted under laboratory conditions and may not represent adequately the conditions in the field. Relative short term laboratory tests may not pick up all the additives and impurities which may exist in long term service applications.

Care must be taken to ensure that all aspects of the application are considered carefully before a material is selected. For example at elevated temperatures some aggressive fluids can cause a much more marked effect on an elastomer than at room temperature.

Physical properties as well as fluid compatibility need to be considered. Compression set, hardness, abrasion resistance and thermal expansion can influence the suitability of a material for a particular application.

It is recommended that users conduct their own tests to confirm the suitability of the selected material for each application.

Our experienced technical staff can be consulted for further information on specific applications.

Rating system

A Very good suitability
Elastomer shows little or no effect from exposure. Little effect on performance and physical properties. Very good resistance.

B Good suitability.
Some effects from exposure with some loss of physical properties. Some chemical swelling.

C Limited suitability.
Significant swell and loss of physical properties after exposure. Additional tests should be done.

U The elastomer is unsuitable for application in this media.

– Insufficient information available for service in this media.

Table III Chemical Compatibility Guide

A

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Acet Aldehyde	U	U	-	B	U	U	U	U	-
Acet Amide	-	-	A	A	U	A	A	A	B
Acetic Acid	C	U	B	A	C	C	C	C	B
Acetic Acid Chloride	U	U	U	U	A	A	U	U	U
Acetic Acid Vapors	U	U	C	A	U	C	U	U	U
Acetic Acid, 96-99.5% (Glacial)	U	U	U	B	U	U	U	U	B
Acetic Anhydride	U	U	C	B	U	C	U	U	B
Acetone	U	U	U	A	U	U	U	U	U
Acetophenone	U	U	U	A	U	U	U	U	U
Acetyl Acetone	U	U	U	A	U	U	U	U	U
Acetyl Chloride	U	U	U	U	A	A	U	U	U
Acetylene Gas	A	-	B	A	A	A	A	A	B
Acetylene Tetrabromide	-	U	B	A	A	-	U	U	-
Acrolein	U	U	C	A	U	-	C	C	-
Acrylonitrile	U	U	U	U	U	U	U	U	U
Adipic Acid	U	U	A	A	A	A	A	A	A
Adipic Aciddiethylester	-	-	-	A	U	-	U	U	-
Aero Lubriplate	A	A	A	U	A	A	A	A	B
Aero safe 2300	U	U	U	A	U	U	U	U	U
Aero safe 2300 W	U	U	U	A	U	U	U	U	U
Aero Shell 1 AC Grease	A	A	B	U	A	A	A	A	B
Aero Shell 17 Grease	A	A	B	U	A	A	A	A	B
Aero Shell 7 A Grease	A	A	B	U	A	A	A	A	B
Aero Shell 750	B	U	U	U	A	B	B	B	U
Aero Shell Fluid 4	B	B	U	U	A	A	A	A	U
Aerozene 50 (50% Hydrazine, 50% UDMH)	-	U	U	A	U	U	U	U	U
Air	A	A	A	A	A	A	A	A	A
Alcohol (Methanol)	U	U	A	A	U	A	A	A	A
Alkyl Arylsulphonic Acid	U	U	C	A	U	U	C	C	U
Alkyl Benzene	U	U	U	U	A	A	U	U	U
Allyl Alcohol (2-Propene-1-ol)	U	U	A	A	B	U	B	B	U
Allyl Chloride (3-Chloro-1-Propene)	-	U	U	U	-	-	U	U	A
Allyl Ketone	U	U	C	A	U	U	U	U	B
Aluminium Acetate	U	U	B	A	U	U	B	B	U
Aluminium Bromide	A	U	A	A	A	A	A	A	A
Aluminium Fluoride	-	U	A	A	A	A	A	A	B
Aluminium Nitrate	U	U	A	A	A	-	A	A	B
Aluminium Phosphate	A	U	A	A	A	A	A	A	A
Aluminium Sulfate	U	U	A	A	A	A	A	A	A
Aluminium-Potassiumsulfate Solution	-	-	-	A	-	-	-	-	-
Aluminum Chloride Solution	A	C	A	A	A	A	A	A	B
Aluminum Hydroxide Solution	U	U	A	A	A	A	A	A	A
Aluminum Sulphate Solution	U	-	A	A	A	A	A	A	A
Ambrex 33 (Mobile)	A	B	B	U	A	U	A	A	U
Ambrex 830 (Mobile)	A	A	B	U	A	A	A	A	B
Amines, Primary (such as Methyl, Ethyl, Propyl, Allyl)	U	U	U	A	U	U	U	U	C
Aminoacetic Acid	U	U	A	A	A	U	B	B	U
Ammonia - Lithium	U	U	U	B	U	U	B	B	U
Ammonia (gas)	U	U	A	A	U	U	A	A	A
Ammonia (gas, hot)	U	U	B	B	U	U	U	U	U
Ammonia (liquid)	U	U	-	A	U	-	B	B	-
Ammonia Solution	U	U	-	A	U	-	B	B	-
Ammonia, anhydrous	U	U	A	A	U	U	A	A	B
Ammonia, aqueous Solution	U	U	A	A	U	U	C	C	C
Ammonium Acetate	-	U	B	A	U	-	A	A	-
Ammonium Carbonate	-	U	B	A	U	-	A	A	-
Ammonium Carbonate Solution	-	-	B	A	-	-	U	U	-
Ammonium Chloride	B	U	A	A	A	A	A	A	A
Ammonium Chloride Solution	-	-	A	A	-	-	A	A	-

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Ammonium Fluoride	U	U	B	A	B	B	A	A	A
Ammonium Hydroxide	U	U	A	A	U	-	U	U	-
Ammonium Hydroxide Solution	U	U	A	A	U	-	U	U	-
Ammonium Nitrate Solution	U	-	A	A	-	-	A	A	-
Ammonium Nitrite	-	-	B	A	-	-	A	A	B
Ammonium Phosphate, monobasic, etc.	-	-	A	A	-	-	A	A	A
Ammonium Sulfate Solution	U	U	A	A	U	B	A	A	B
Ammonium Sulfide	U	U	B	A	U	B	B	B	B
Ammonium Thiocyanate	-	B	-	A	-	-	A	A	A
Amyl Acetate	U	U	U	A	U	U	U	U	U
Amyl Alcohol	U	U	B	A	B	B	B	B	U
Amyl Borate	-	-	A	U	-	-	A	A	-
Amyl Chloride	U	U	U	U	A	B	U	U	U
Amyl Naphtalene	U	U	U	U	A	A	U	U	U
Anderol L-774	A	U	U	U	A	A	A	A	U
Aniline Chlorohydrate	U	U	B	B	B	B	B	B	U
Aniline Liquid	U	U	U	A	U	U	U	U	U
Animal Fats	A	A	B	B	A	A	A	A	B
Anisole	U	U	U	U	U	U	U	U	U
Antimony Chloride	B	U	B	A	A	A	A	A	B
Antimony Chloride, dry	B	B	A	A	A	A	A	A	A
Aqua Regia (Nitric Acid/Hydrochloric Acid)	U	U	U	U	U	U	U	U	U
Argon Gas	A	A	A	A	A	A	A	A	A
Aromatic Fuels (up to 50% Aromatic)	B	B	U	U	A	A	A	A	U
Aromatic Hydrocarbons (100% Aromatic)	U	U	U	U	A	A	U	U	U
Arsenic Acid	C	C	A	A	A	A	A	A	A
Arsenic Acid Solution	C	C	A	A	A	A	A	A	A
Asphalt, Emulsion	B	B	B	U	A	B	B	B	U
ASTM Test Fuel A	B	A	B	U	A	A	A	A	U
ASTM Test Fuel B	U	U	U	U	A	A	A	A	U
ASTM Test Fuel C	U	U	U	U	A	B	B	B	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
ASTM-Oil IRM 902	A	B	B	U	A	A	A	A	B
ASTM-Oil IRM 903	A	B	U	U	A	A	A	A	B
ASTM-Oil No.1	A	B	B	U	A	A	A	A	A
ASTM-Oil No.2	A	B	B	U	A	A	A	A	B
ASTM-Oil No.3	A	B	U	U	A	A	A	A	B
ATM-Brake Fluid (Glycolbased)	U	U	B	A	U	A	U	U	A
Automatic-Transmission Fluid	U	A	B	U	A	A	A	A	B
Automotive Gasoline	C	B	U	U	A	A	A	A	U

B

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Barium Carbonate	-	A	-	A	A	A	A	A	A
Barium Chloride Solution	U	A	A	A	A	A	A	A	A
Barium Hydroxide Solution	U	U	A	A	A	A	A	A	A
Barium Nitrate Solution	U	A	A	A	A	A	A	A	A
Barium Sulfate	A	A	A	A	A	A	A	A	A
Barium Sulfide Solution	U	A	A	A	A	A	A	A	A
Battery Acid (Sulfuric Acid Diluted)	U	U	U	A	A	U	U	U	U
Beef Tallow	C	-	B	U	A	B	A	A	B
Beer	U	C	A	A	A	A	A	A	A
Beet Sugar Sap	U	-	B	A	A	A	A	A	A
Benzaldehyde	U	U	U	B	U	U	U	U	B
Benzenesulfonic Acid	U	U	B	-	A	B	U	U	U
Benzine (Gasoline)	C	B	U	U	A	A	A	A	U
Benzine 50 / Benzene 30 / Ethanol 20	U	U	U	U	B	B	U	U	U
Benzine 50 / Benzene 50	U	U	U	U	B	B	U	U	U
Benzine 60 / Benzene 40	U	U	U	U	B	B	U	U	U
Benzine 70 / Benzene 30	U	U	U	U	A	A	B	B	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Benzine 80 / Benzene 20	U	U	U	U	A	A	B	B	U
Benzoic Acid, Solution	B	U	B	B	A	A	B	B	B
Benzol (Benzene)	U	U	U	U	B	B	U	U	U
Benzophenone	U	U	-	B	A	A	-	-	-
Benzyl Alcohol	U	U	B	B	A	B	U	U	B
Benzyl Chloride	U	U	U	U	A	A	U	U	U
Biphenyl	U	-	U	U	A	B	U	U	U
Bitumen	U	B	U	U	A	A	U	U	U
Black Liquor	U	U	B	B	B	-	B	B	-
Blast Furnace Gas	B	U	U	U	A	B	U	U	A
Bleach Solution	U	U	U	A	A	B	U	U	U
Bleaching Powder Solution	U	U	B	A	A	B	C	C	B
Boiler Feed Water	U	U	C	A	B	B	B	B	C
Bone Oil	A	A	U	U	A	A	A	A	U
Borax (Sodiumborate)	A	U	B	A	A	A	B	B	A
Borax Solutions	U	U	U	A	B	B	B	B	B
Boric Acid	U	B	B	A	A	A	A	A	A
Brake Fluids (based on glycol ether)	U	U	B	A	U	U	U	U	U
Brake Fluids (based on mineral oil)	-	A	B	-	A	-	A	A	-
Bromine	U	U	U	U	B	B	U	U	U
Bromine Solution in Water	U	U	U	U	A	B	U	U	U
Bromine Vapour	U	U	U	U	B	B	U	U	U
Bromobenzene	U	U	U	U	A	B	U	U	U
Bromochloro Trifluoro Ethan	U	U	U	U	A	B	U	U	U
Bunker Oil	A	B	U	U	A	A	B	B	B
Butadiene	U	U	U	U	B	B	U	U	U
Butandiol	-	U	B	A	U	U	A	A	U
Butane	A	B	B	U	A	A	A	A	U
1-Butanethiol	U	-	U	U	A	U	U	U	U
Butanole	U	U	B	B	A	A	A	A	B
Butantriol	A	B	B	A	A	A	A	A	A
Butene	U	B	U	U	A	B	B	B	U
Buthylphenol	U	U	U	U	B	-	U	U	U
Butter	B	B	B	B	A	A	A	A	B
Buttermilk	U	A	A	A	A	A	A	A	A
Butyl Acetate	U	U	U	B	U	U	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Butyl Acrylate	U	-	U	U	U	U	U	U	-
Butyl Alcohol	U	U	B	A	A	A	A	A	B
Butyl Amine	U	U	U	-	U	U	U	U	C
Butyl Benzoate	U	-	U	A	A	A	U	U	-
Butyl Carbitol	U	-	C	A	C	U	U	U	U
Butyl Cellosolve	U	U	C	A	U	U	C	C	-
Butyl Diglycol	-	-	-	A	A	-	A	A	-
Butyl Ether	U	U	U	U	U	U	U	U	U
Butyl Phthalate	U	U	U	A	U	A	U	U	A
Butyl Pyrocatechol	U	-	-	B	A	B	U	U	-
Butyl Stearate	-	A	U	U	A	B	B	B	B
Butylene	B	B	C	U	A	A	A	A	U
Butyraldehyd	U	-	U	B	U	U	U	U	U
Butyric Acid	U	U	C	U	A	B	B	B	U
Butyric Acid Butyl Ester	U	-	U	B	B	B	U	U	-

C

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Calcium Acetate	U	B	B	A	U	U	B	B	U
Calcium Bisulfate	-	A	-	A	A	A	A	A	A
Calcium Bisulfide Solution	C	C	B	A	B	C	B	B	C
Calcium Carbonate	-	A	A	A	A	-	A	A	A
Calcium Carbonate Slurry	U	U	A	A	A	A	A	A	A
Calcium Chloride	B	B	A	A	A	A	A	A	A
Calcium Chloride, brine	U	B	A	A	A	A	A	A	A
Calcium Cyanide	-	-	A	A	-	-	A	A	A
Calcium Hydroxide Solution	U	B	A	A	A	A	A	A	A
Calcium Hypo-chlorite Solution	U	U	B	A	A	A	C	C	B
Calcium Nitrate	B	B	A	A	A	A	A	A	B
Calcium Oxide	U	A	-	A	A	A	A	A	B
Calcium Phosphate Slurry	U	U	B	A	A	A	A	A	A
Calcium Silikate	-	-	A	A	A	-	A	A	-
Calcium Sulfate	-	A	-	A	A	A	A	A	A
Calcium Sulfide	U	A	A	A	A	A	A	A	B

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Calcium Sulfite	U	A	A	A	A	A	A	A	A
Calcium Thiosulfate	U	A	A	A	A	A	B	B	A
Caliche Solution (Sodium Nitrate)	U	B	B	A	A	A	B	B	B
Campher	U	U	B	U	B	U	A	A	U
Campher Oil	-	-	U	U	B	-	A	A	-
Cane Sugar Sap	U	-	-	A	A	A	A	A	A
Carbitol	-	U	B	B	B	B	B	B	B
Carbolic Acid (Penole)	U	C	U	B	A	A	U	U	U
Carbolineum	U	U	-	B	A	U	B	B	U
Carbon Dioxide, dry	B	U	B	B	A	B	A	A	B
Carbon Dioxide, wet	U	U	B	B	A	B	A	A	B
Carbon Disulfide	U	U	U	U	A	C	U	U	U
Carbon Monoxide	A	A	B	A	B	B	A	A	A
Carbonic Acid	U	B	B	A	A	B	A	A	B
Carboxylic Acids	-	A	A	A	A	A	A	A	A
Casein	-	-	A	B	A	A	A	A	A
Castor Oil	A	A	A	B	A	A	A	A	A
Cellosolve (2-Ethoxyethanol)	U	U	U	B	U	U	U	U	U
Cellulose	U	B	B	B	U	B	B	B	B
Cellulose Acetat	-	A	U	B	U	-	A	A	A
Chile Salpetre (Sodium Nitrate)	U	B	B	A	A	A	B	B	B
Chinawood Oil	-	C	B	U	A	A	A	A	U
Chloracetic Acid	U	U	U	A	U	B	U	U	U
Chloracetic Acid Ethyl Ester	U	U	U	U	A	B	U	U	U
Chloric Acid	U	U	U	B	B	U	U	U	U
Chloride of Lime	U	U	U	A	A	A	U	U	B
Chlorine Dioxide	U	-	U	C	A	B	U	U	-
Chlorine gas, anhydrous	-	-	C	A	A	-	C	C	-
Chlorine Water	U	U	U	B	A	U	U	U	U
Chlorine, liquid	U	U	U	B	A	C	U	U	U
Chloro Aamine	U	U	A	A	U	U	A	A	U
Chloro Acetaldehyde	U	U	U	A	U	C	U	U	U
Chloro Acetone	B	U	U	A	U	U	U	U	U
Chloro Benzene	U	U	U	U	B	B	U	U	U
Chloro Bromo Methane	U	U	U	B	B	B	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Chloro Butadiene	U	U	U	U	B	B	U	U	U
Chloro Methyl Ether	U	U	U	C	U	U	U	U	U
Chloro Naphthalene	U	U	U	U	A	B	U	U	U
Chloro Sulfonic Acid	U	U	U	C	U	U	U	U	U
Chloroform	U	U	U	U	B	C	U	U	U
o-Chlorophenol	U	U	U	U	A	U	U	U	U
Chlorothene	U	U	U	U	B	B	U	U	U
Chlorotoluene	U	U	U	U	A	B	U	U	U
Chrome Alum	U	-	A	A	A	-	A	A	A
Chromic Acid	U	U	U	C	A	C	U	U	C
Chromo sulfuric Acid	U	U	U	U	A	U	U	U	U
Cider	U	U	B	A	B	A	A	A	B
Citric Acid	U	U	A	A	A	A	A	A	A
Citrous Oils	-	U	B	U	A	-	B	B	B
Coal Tar	-	U	-	U	B	A	B	B	B
Cobalt Chlorite	B	B	A	A	A	A	A	A	B
Coca-Cola	U	B	B	A	B	A	A	A	A
Cocoa Butter	-	B	B	U	A	B	A	A	C
Coconut grease	A	B	B	U	A	A	A	A	A
Coconut Oil	A	A	B	U	A	A	A	A	A
Coconut, Fatty Acid	A	A	B	U	A	A	A	A	A
Cod-liver Oil	A	A	B	B	A	A	A	A	B
Coffee	U	U	A	A	A	A	A	A	A
Coffee Extract	U	U	A	A	A	A	A	A	A
Coke Oven Gas	U	U	U	U	A	B	U	U	B
Copper Acetate Solution	U	U	C	B	U	U	U	U	U
Copper Ammonium Acetate	U	U	C	B	U	U	U	U	U
Copper Chloride, Solution	U	B	B	A	A	A	A	A	A
Copper Cyanide	A	B	A	A	A	A	A	A	A
Copper Fluoride	U	-	B	A	A	U	B	B	U
Copper Nitrate	U	U	B	A	A	U	B	B	U
Copper Sulfate (Blue Vitriol) Solution	U	U	A	A	A	A	A	A	A
Corn Oil	B	A	B	U	A	A	A	A	B
Cotton Oil	A	A	C	C	A	A	A	A	A
Cottonseed Oil	A	A	B	U	A	A	A	A	B

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Cresol	U	U	U	U	A	C	U	U	U
Cronton Aldehyde	U	U	U	A	U	U	U	U	U
Crude Oil	-	U	U	U	A	A	B	B	U
Cumene	U	U	U	U	A	U	U	U	U
Cuprous Ammonia Acetate Solution	U	U	U	A	U	U	U	U	U
Cyanic Acid	U	-	B	A	A	B	B	B	-
Cyanic Acid Solution	U	-	B	A	A	B	B	B	-
Cyclo Hexane	B	A	C	U	A	A	A	A	U
Cyclo Hexanole	-	-	U	U	A	A	B	B	-
Cyclo Hexanone	U	U	U	U	U	U	U	U	U
Cyclo Hexylamine	U	U	U	C	U	U	U	U	U
p-Cymene	U	U	U	U	A	B	U	U	U

D

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
DDT Solutions (Kerosene Solvent)	B	B	C	U	A	A	A	A	U
DDT Solutions (Toluene Solvent)	U	U	U	U	A	A	U	U	U
Decalin (Decahydronaphtalene)	B	U	U	U	A	A	U	U	U
Decane	A	U	U	U	A	A	A	A	B
Dextrin	U	U	A	A	A	A	A	A	A
Dextrose	B	B	-	A	A	A	A	A	A
Diacetone	-	B	-	A	U	U	-	-	-
Diacetone Alcohol	U	U	B	A	U	U	U	U	U
1.2-Diaminoethane	U	U	B	A	U	U	B	B	U
Diamylamine	U	U	U	A	U	U	U	U	U
Diazinone	-	-	U	U	B	B	U	U	U
Dibenzyl Ether	C	B	-	B	C	-	U	U	B
Dibenzyl Sebacate	U	B	U	B	B	U	U	U	U
Dibromo Difluoro Methane	U	U	U	B	-	U	U	U	U
Dibromo Methyl Benzene	U	U	U	U	A	B	U	U	U
Dibutyl Amine	U	U	U	U	U	U	U	U	U
Dibutyl Ether	U	U	U	U	U	U	U	U	U
Dibutyl Phthalate	U	-	U	B	C	B	U	U	C
Dibutyl Sebacate	U	U	U	B	B	B	U	U	B

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Dichloro Acetic Acid	U	U	U	U	U	-	U	U	U
Dichloro Acetic Acid Methylester	U	U	U	A	U	U	U	U	U
Dichloro Benzene	U	U	U	U	A	B	U	U	U
Dichloro Butane	U	U	U	U	A	B	B	B	U
Dichloro Butylene	U	U	U	U	B	U	U	U	U
Dichloro Ethane	U	U	U	U	B	U	U	U	U
Dichloro Ethylene	-	U	U	U	B	-	U	U	U
Dichloro Methane	U	U	U	U	B	B	U	U	U
Dichloro Pentane	U	U	U	U	A	C	U	U	U
3,1-Dichloropropene	-	U	U	U	-	-	U	U	A
Dichloro Iso-Propylene Ether	U	B	U	U	U	U	U	U	U
Dicyclo Hexyl Amine	U	U	U	U	U	U	U	U	U
Diesel Fuel	U	B	U	U	A	A	A	A	U
Diesel Oil	B	A	U	U	A	A	A	A	U
Diethanol Amine	U	U	U	B	U	U	U	U	U
Diethyl Amin	U	U	U	B	U	U	U	U	B
Diethyl Aniline	U	U	U	A	U	U	U	U	U
Diethyl Benzene	U	U	U	U	A	A	U	U	U
Diethyl Carbonate	U	U	U	U	A	B	U	U	U
Diethyl Ether	U	B	U	U	U	U	U	U	U
Diethyl Formaldehyde	U	U	U	A	U	U	U	U	U
Diethyl Hydrazine	U	U	C	A	U	U	C	C	U
Diethyl Maleate	U	U	C	A	U	U	C	C	U
Diethyl Sebacate	U	U	U	B	B	B	U	U	B
Diethyl Sulfate	-	U	-	-	U	-	U	U	U
Diethylene Glycol	U	U	A	A	A	A	A	A	B
Diethylene Triamine	U	U	U	A	U	U	U	U	U
Diglycolic Acid	U	-	B	A	A	U	U	U	U
Dihexyl Phthalic Acid Ester	U	-	U	-	U	-	U	U	U
1,4-Dihydroxybenzene	B	-	U	B	U	B	U	U	U
Dihydroxy Tartaric Acid (Tartaric Acid)	U	U	A	B	A	A	A	A	A
Di-Isobutyl Ketone	U	U	U	A	U	U	U	U	U
Di-Isobutylene	U	U	U	U	A	C	B	B	U
Di-Isooctyl Sebacate	U	U	U	B	B	U	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Di-Isopropyl Benzene	U	U	U	U	A	A	U	U	U
Di-Isopropyl Ketone	U	U	U	A	U	U	U	U	U
Dimethyl Amine	U	U	U	B	U	U	U	U	U
Dimethyl Aniline	U	U	U	B	U	U	U	U	U
Dimethyl Ether	U	B	U	B	U	U	U	U	U
Dimethyl Formamide	U	U	U	B	U	B	B	B	B
Dimethyl Hydrazine	-	-	B	A	U	U	B	B	U
Dimethyl Ketone	U	U	U	A	U	U	U	U	U
Dimethyl Phenol	-	-	U	U	U	U	U	U	U
Dimethyl Phthalate	U	U	U	B	B	B	U	U	-
Dimethylbutane	A	-	B	U	A	A	A	A	U
Dinitro Toluene	U	U	U	U	U	U	U	U	U
Dinitrogen Oxid	A	A	A	B	A	A	A	A	A
Dioctyl Amine	U	U	U	A	U	U	U	U	U
Dioctyl Phthalate	U	B	U	B	B	B	U	U	B
Dioctyl Sebacate	U	B	U	B	B	U	U	U	U
Dioxane	U	U	U	B	U	U	U	U	U
Dioxolane	-	U	U	B	U	U	U	U	U
Dipentene	U	U	U	U	A	U	B	B	U
Diphenyl	U	U	U	U	A	B	U	U	U
Diphenyl Ether	U	U	U	U	B	B	U	U	U
Diphenyle Oxide	-	U	-	U	A	B	U	U	U
Dipropylene Glycol	B	B	B	B	B	B	B	B	B
Dithionite	-	-	B	A	A	U	B	B	U
Divinyl Benzene	U	U	U	U	A	B	U	U	U
DMT (Dimethyl Terephthalate)	U	U	U	A	A	B	U	U	U
DNCB (Dinitro-chlorobenzene)	U	U	U	U	A	B	U	U	U
Dodecanol	-	-	A	B	A	-	B	B	-
Domestic Fuel Oils	A	A	B	U	A	A	A	A	U
Dowtherm A	U	U	U	U	A	B	U	U	U
Dowtherm E	U	U	U	U	A	B	U	U	U

E

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Epichlor Hydrin	U	U	U	B	U	U	U	U	U
Essential Oils	U	B	U	U	B	B	U	U	U
Ethane	A	B	B	U	A	A	A	A	B
Ethanol Amine	U	U	C	B	U	U	C	C	C
Ether	U	U	U	C	U	U	U	U	U
Ethyl Acetate	U	U	U	B	U	U	U	U	U
Ethyl Acrylate	U	U	U	-	U	U	U	U	U
Ethyl Alcohol, Ethanol	U	U	A	A	U	A	A	A	B
Ethyl Benzene	U	U	U	U	B	B	U	U	U
Ethyl Bromide	U	U	U	U	A	A	B	B	U
Ethyl Cellulose	U	U	B	B	U	U	B	B	U
Ethyl Chloride	U	U	B	B	B	A	U	U	U
Ethyl Chloro Acetate	-	U	B	B	A	U	B	B	U
Ethyl Hexanole	U	U	A	A	A	A	A	A	B
Ethyl Oxalate	U	A	U	B	A	B	U	U	U
Ethyl Pentachloro Benzene	U	U	U	U	A	B	U	U	U
Ethyl Pyridine	U	U	U	A	U	U	U	U	U
Ethyl Sulfate (Diethyl Sulfate)	U	U	A	A	U	C	U	U	A
Ethylene	B	B	C	U	A	A	A	A	U
Ethylene Bromide	U	U	U	C	A	C	U	U	U
Ethylene Chloride	-	-	B	B	B	-	-	-	U
Ethylene Chlorohydrin	U	U	B	B	U	B	U	U	U
Ethylene Diamine	U	U	U	A	U	U	U	U	U
Ethylene Dibromide	U	U	U	U	A	C	U	U	U
Ethylene Dichloride	U	U	U	U	A	C	U	U	U
Ethylene Glycol	C	B	B	A	A	A	A	A	C
Ethylene Glycol Ethyl Ether (Cellosove)	U	U	U	B	U	U	U	U	U
Ethylene Oxide	U	U	U	B	U	U	U	U	U
Ethylene Silicate	-	B	A	A	A	A	A	A	-
Ethylene Trichloride	U	U	U	C	B	B	U	U	U

F

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Fats (animal/vegetable)	A	A	A	U	A	A	A	A	B
Fatty Acids	A	A	B	U	A	A	B	B	B
Ferric Chloride Solution	-	A	B	A	A	A	A	A	B
Ferric Nitrates	B	B	A	A	A	A	A	A	B
Ferric Sulfate (Ferric Vitrinol)	B	B	A	A	A	A	A	A	B
Ferric Sulfate Solution	-	A	A	A	A	A	A	A	B
Fir Oil	U	B	U	U	A	A	B	B	U
Fish Oil	A	B	B	U	A	A	A	A	U
Fluorine	U	-	-	U	C	U	U	U	U
Fluoro Benzene	U	-	U	U	B	B	U	U	U
Fluorosilicic Acid	-	-	B	A	A	U	B	B	U
Formaldehyde (Formalin-Solution)	U	U	U	A	U	U	C	C	C
Formaldehyde (Methanal)	U	U	U	A	B	U	B	B	B
Formamide	-	U	U	B	B	-	B	B	-
Formic Acid	U	U	B	B	U	U	U	U	U
Freon 11	-	U	U	U	B	B	A	A	U
Freon 112	-	B	B	U	B	B	B	B	U
Freon 113	-	B	A	U	B	U	A	A	U
Freon 114	-	A	A	A	B	B	A	A	U
Freon 114 B2	-	B	B	U	B	B	B	B	U
Freon 115	-	B	A	A	B	B	A	A	U
Freon 12	-	B	A	B	B	U	B	B	U
Freon 13	-	B	A	A	B	U	A	A	U
Freon 13 B1	-	B	A	A	B	U	A	A	U
Freon 134 a	-	-	-	A	-	-	A	-	-
Freon 14	-	A	A	A	B	B	A	A	U
Freon 142 b	-	-	A	A	U	-	A	A	U
Freon 152 a	-	-	A	A	U	-	A	A	-
Freon 21	U	B	B	U	U	B	U	U	U
Freon 218	-	-	A	A	A	-	A	A	-
Freon 22	B	U	A	A	U	U	U	U	U
Freon 31	-	B	A	A	U	B	U	U	U
Freon 32	-	B	A	A	U	B	A	A	U
Freon 502	-	-	A	A	B	-	B	B	A
Freon BF	-	U	B	U	A	-	B	B	U
Freon C316	-	-	A	A	-	-	A	A	U
Freon C318	-	-	A	A	B	B	A	A	U
Freon MF	-	B	U	U	B	-	B	B	U
Freon PCA	-	A	A	U	B	-	A	A	U
Freon TA	-	A	A	A	U	-	A	A	A
Freon TC	-	A	A	B	A	-	A	A	U
Freon TF	-	A	A	U	A	U	A	A	U
Freon TMC	-	B	B	B	A	-	B	B	U
Freon T-P35	-	A	A	A	A	-	A	A	A
Freon TWD602	-	A	B	A	A	U	B	B	-
Fruit Juices	U	U	B	A	B	A	B	B	A
Fumaric Acid	U	-	B	-	A	A	A	A	B
Furan	U	U	U	U	U	U	U	U	U
Furfural (Furfuryl-aldehyde)	-	C	-	-	-	-	C	C	-
Furfurylalcohol	-	C	-	-	-	-	-	-	-

G

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Gallic Acid	U	U	B	B	A	A	A	A	A
Gas Oil	A	A	B	U	A	A	A	A	B
Gasoline / Alcohol Mix	U	U	U	U	B	U	B	B	U
Gasoline, 100 Octane	U	B	U	U	A	A	A	A	U
Gasoline, 130 Octane	U	B	U	U	A	A	A	A	U
Gasoline, Aromatic	U	A	U	U	A	A	A	A	U
Gasoline, Ethyl and Regular	U	B	U	U	A	A	A	A	U
Gasoline, Refined	U	B	U	U	A	A	A	A	U
Gasoline, Sour	U	B	U	U	A	A	A	A	U
Gasoline, with Mercaptan	U	B	U	U	A	A	A	A	U
Gelatin	U	U	A	A	A	A	A	A	A
Generator Gas	B	A	B	U	A	B	A	A	B
Glauber's salt	U	U	B	A	B	B	B	B	B
Glucose solution	U	U	A	A	A	A	A	A	A
Glucose, aqueos	C	A	A	A	A	A	A	A	A
Glycerin (Glycerol)	U	U	A	A	A	A	A	A	A
Glycerol	U	U	A	A	A	A	A	A	A

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Glycerol Chlorohydrin	-	-	U	B	B	-	U	U	-
Glycerol Triacetate (Triacetin)	U	U	B	A	U	U	B	B	B
Glycerol Trinitrate (Nitroglycerin)	U	U	B	A	A	U	U	U	U
Glycine	U	U	A	A	A	U	B	B	U
Glycol, Diethylene	U	U	A	A	A	A	A	A	A
Glycol, Ethylene	U	B	A	A	A	A	A	A	A
Glycol, Propylene	U	U	A	A	A	A	A	A	A
Glycolic Acid	U	U	B	A	B	A	A	A	A

H

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
HEF-3	U	U	U	U	A	B	B	B	U
Helium Gas	A	A	A	A	A	A	A	A	A
Heptane	A	B	B	U	A	A	A	A	C
Hexa Fluoro Silicic Acid	U	U	B	B	A/B	-	B	B	U
Hexachloro Acetone	U	U	U	A	U	U	U	U	U
Hexachloro Butadiene	U	B	U	U	A	U	U	U	U
Hexachloro Cyclohexane (Lindane)	U	B	U	U	A	U	-	-	U
1-Hexadecanol	-	-	A	A	-	-	A	A	-
Hexaldehyd	-	U	B	A	U	U	U	U	B
Hexalin, Cyclohexanol	-	-	B	U	A	A	A	A	U
Hexamine	U	U	U	A	U	U	U	U	U
Hexanal (Capronaldehyde)	U	U	-	B	U	U	-	-	B
Hexane	A	B	B	U	A	A	A	A	C
Hexanetriol	B	U	B	A	A	A	A	A	A
Hexene	A	B	B	U	A	A	B	B	U
Hexyl Alcohol	U	U	B	B	A	B	A	A	B
Hydrazine	C	U	B	A	C	B	B	B	U
Hydrazine Hydrate	C	U	B	A	C	B	B	B	U
Hydrobromic Acid	U	U	U	A	A	C	U	U	U
Hydrochlorique Acid (Muriatic Acid) 37%	U	U	U	B	A	U	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Hydrocyanic Acid	U	-	B	A	A	B	B	B	-
Hydrofluoric Acid (cold)	U	U	U	B	B	U	U	U	U
Hydrofluoric Acid (hot)	U	U	-	U	U	U	U	U	U
Hydrogen Chloride Gas	-	-	C	A	A	U	U	U	U
Hydrogen Fluoride	U	U	U	B	-	U	U	U	U
Hydrogen Peroxide, concentrated	U	U	U	U	A	B	U	U	B
Hydrogen Sulfide	U	U	U	C	U	U	U	U	U
Hydrogen, Gas	B	A	A	A	A	C	A	A	C
Hydrogene Bromide, anhydrous	U	U	U	U	A	U	U	U	B
Hydrogensulfite Leach	B	U	B	A	A	-	U	U	-
Hydroquinone	B	-	U	B	U	B	U	U	U
Hydroxy Acetic Acid	U	U	U	A	U	U	U	U	B
Hydroxyl Amine	-	-	-	A	A	A	A	A	A
Hydroxyl Amine Sulfate	-	-	B	A	A	A	A	A	A
Hypochlorous Acid	U	-	U	B	A	-	U	U	-

I

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Ink	A	A	A	A	B	A	A	A	A
Iodine	-	-	U	B	A	A	B	B	-
Iodine tincture	U	U	B	B	A	B	B	B	B
Iodoform	-	-	-	A	A	-	-	-	-
Iso-Butane	A	A	U	U	A	A	A	A	U
Iso-Butyl Alcohol	U	U	A	A	B	A	B	B	A
Iso-Butyl Methyl Ketone	U	U	U	A	U	U	U	U	U
Iso-Butylene	U	U	U	U	A	A	A	A	U
Iso-Butyraldehyde	U	U	U	A	U	U	U	U	U
Iso-Cyanate	-	-	-	A	-	-	-	-	-
Iso-Dodecane	U	U	B	U	A	A	A	A	U
Iso-Octane	A	B	B	U	A	A	A	A	U
Iso-Pentane	A	B	U	U	A	A	A	A	U
Iso-Propyl-Acetate	U	U	U	B	U	U	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Iso-Propyl-Alcohol	U	U	B	A	A	A	B	B	A
Iso-Propyl-Benzene	U	U	U	U	A	B	U	U	U
Iso-Propyl-Chloride	U	U	U	U	A	B	U	U	U
Iso-Propyl-Ether	U	U	U	-	U	U	U	U	U

J

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Jet Fuel JP3	B	B	U	U	A	A	A	A	U
Jet Fuel JP4	B	B	U	U	A	B	A	A	U
Jet Fuel JP5	B	B	U	U	A	B	A	A	U
Jet Fuel JP6	B	B	U	U	A	B	A	A	U
JP3 (Fuel)	U	B	U	U	A	A	A	A	U
JP4 (Fuel)	U	B	U	U	A	B	A	A	U
JP5 (Fuel)	U	B	U	U	A	B	A	A	U
JP6 (Fuel)	B	B	U	U	A	B	A	A	U
JPX (Fuel)	-	-	B	U	U	U	A	A	U

K

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Kerosene	C	B	U	U	A	B	A	A	U
Ketchup	U	B	A	A	A	A	A	A	A

L

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Lactams	U	U	C	U	U	U	U	U	U
Lactic Acid	U	B	A	B	A	A	B	B	B
Lanolin	A	A	B	U	A	A	A	A	B
Latex	U	U	A	A	A	A	A	A	A
Laughing Gas (N2O)	A	A	A	B	A	A	A	A	A
Lavender Oil	B	U	U	U	A	B	B	B	U
Lead Acetate Salt Solution	U	U	U	A	U	U	C	C	U
Lead Arsenate	-	A	-	A	-	-	A	A	A
Lead Nitrate	-	U	B	A	A	A	A	A	B
Lead Nitrate Solution	-	-	A	A	-	A	A	A	B
Lead Sulfate	U	A	A	A	A	A	B	B	B
Lemon Juice	U	-	B	A	A	-	A	A	A
Ligroin	-	B	B	U	A	A	A	A	U
Lindol	U	U	U	A	U	C	U	U	C
Linoleic Acid	-	B	-	U	B	-	B	B	B
Linseed Oil	B	B	B	C	A	B	A	A	B
Liqueurs	B	B	A	A	A	A	A	A	A
Lithium Bromide Brine	U	U	A	A	A	A	A	A	A
Lithium Chloride	U	U	A	A	A	A	A	A	A
Lithium Hydroxide	U	U	U	A	C	U	U	U	U

M

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Machinery Oil (mineral)	A	A	B	U	A	A	A	A	B
Maganese Chloride (Solution)	U	U	A	A	A	A	A	A	A
Magnesium Acetate Solution	U	U	U	A	U	U	U	U	U
Magnesium Chloride Solution	-	U	A	A	A	A	A	A	A
Magnesium Hydroxide (Solution)	U	U	B	A	B	B	B	B	B
Magnesium Silicate (Talcum)	A	A	A	A	A	A	A	A	A
Magnesium Sulfate (Epson Salts)	U	U	A	A	A	A	A	A	A
Maleic Acid	C	C	B	A	A	B	B	B	C
Maleic Anhydride	U	-	U	U	B	-	U	U	-
Malic Acid	U	U	B	B	A	A	A	A	B
Margarine	A	B	B	U	A	A	A	A	B
Mayonaise	-	U	U	U	U	U	A	A	A
Menthol	U	U	B	B	A	U	B	B	U
Mercaptans	U	U	U	A	U	U	U	U	U
Mercuric Chloride Solution	-	-	A	A	A	A	A	A	A
Mercury	A	A	A	A	A	A	A	A	A
Mercury Nitrate	-	-	A	A	-	-	A	A	A

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Mesityl Oxide	U	U	U	A	U	U	U	U	U
Methacrylic Acid	U	U	U	B	U	U	U	U	U
Methanal	U	U	U	A	B	U	B	B	B
Methane	A	U	B	U	A	B	A	A	B
Methanol	U	U	B	A	U	A	B	B	A
Methoxy Benzene	U	U	U	U	U	U	U	U	U
Methoxy Butanol	-	-	B	B	A	-	A	A	-
Methyl Acetate	U	U	B	B	U	U	U	U	U
Methyl Acetoace-tate	U	U	C	B	U	U	U	U	U
Methyl Acrylate	U	U	U	B	U	U	U	U	U
Methyl Alcohol	U	U	B	A	U	A	B	B	A
Methyl Amine	U	U	U	A	U	U	U	U	U
Methyl Aniline	U	U	U	B	B	-	U	U	-
Methyl Bromide	U	U	U	U	A	A	U	U	U
Methyl Butyl Ketone	U	U	U	A	U	U	U	U	U
Methyl Carbonate	U	U	U	U	U	B	U	U	U
Methyl Cellosolve	U	U	U	B	U	U	U	U	U
Methyl Cellulose	U	B	B	B	B	U	B	B	B
Methyl Chloride	U	U	U	U	B	B	U	U	U
Methyl Cyclopentane	U	U	U	U	B	B	U	U	U
Methyl Ethyl Ketone	U	U	U	B	U	U	U	U	U
Methyl Formate	-	-	U	B	U	-	U	U	-
Methyl Glycol	U	U	U	B	U	U	U	U	U
Methyl Glycol Acetate (Ethyleneglycol)	U	U	U	B	U	-	U	U	B
Methyl Iso-Butyl Ketone	U	U	U	B	U	U	U	U	U
Methyl Iso-Propyl Ketone	U	U	U	B	U	U	U	U	U
Methyl Methacrylate	U	U	U	U	U	U	U	U	U
Methyl Methacrylic Acid Ester	U	U	U	U	U	U	U	U	U
Methyl Oleate	-	-	-	B	A	B	U	U	-
2-Methylpentane +A2	A	U	-	U	A	U	A	A	U
3-Methylpentane	A	U	-	U	A	U	A	A	U
Methyl Phenyl Ether (Anisole)	U	U	U	U	U	U	U	U	U
Methyl Pyrrolidone	-	U	-	A	U	-	U	U	B

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Methyl Salicylate	-	-	U	B	-	-	U	U	-
Methylene Chloride	U	U	U	U	B	C	U	U	U
Milk	U	B	A	A	A	A	A	A	A
Milk of Lime	U	U	B	A	B	B	U	U	B
Mine Gas (Methane)	A	U	B	B	A	A	A	A	A
Mineral Oil	A	A	B	U	A	A	A/B	A/B	B
Mineral Spirits	C	B	C	U	A	A	A	A	U
Molasses	U	U	B	A	A	A	A	A	A
Monobromo Benzene	U	U	U	U	B	U	U	U	U
Monochloro Benzene	U	U	U	U	B	B	U	U	U
Monochloroacetic Acid	U	U	U	A	U	U	U	U	U
Monochloroacetic Acid Ethyl Ester	U	U	U	B	U	U	U	U	U
Monoethanol Amine	U	U	U	B	U	U	U	U	U
Mononitro Chloro Benzene	U	U	U	U	A	A	U	U	U
Morpholine	U	U	C	B	-	-	U	U	U
Muriatic Acid (HCl) (Hydrochloric Acid)	U	U	-	B	A	-	U	U	U
Muriatic Acid (HCl), diluted	U	U	B	A	A	-	B	B	B

N

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Naphtha	B	B	U	U	A	B	U	U	U
Naphthalene	U	U	U	U	A	B	U	U	U
Naphthenic Acid	-	-	U	U	A	A	B	B	-
Naphtolen ZD	U	-	U	U	A	-	B	B	U
Natural Gas	A	B	B	U	A	A	A	A	A
Neats Foot Oil	A	A	U	B	A	A	A	A	B
Neon Gas	A	A	A	A	A	A	A	A	A
Nickel Acetate	U	U	B	A	U	U	B	B	U
Nickel Chloride	C	C	B	A	A	A	A	A	A
Nickel Nitrate	-	-	A	A	A	-	A	A	A
Nickel Sulfate	U	C	A	A	A	A	A	A	A
Nitrating Acids	U	U	U	A	U	U	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Nitric Acid, concentrated	U	U	U	U	B	U	U	U	U
Nitric Acid, fuming	U	U	U	U	B	U	U	U	U
Nitro Benzene	U	U	U	U	U	U	U	U	U
Nitro Glycerin	U	U	C	A	A	U	U	U	U
Nitro Glycol	U	U	B	A	A	U	U	U	U
Nitro Methane	U	U	U	B	U	U	U	U	U
Nitro Propane	U	U	U	B	U	U	U	U	U
Nitro Toluene	U	U	U	U	U	U	U	U	U
Nitrogen Gas	A	A	A	A	A	A	A	A	A
Nitrogen Tetroxide	U	U	U	U	U	U	U	U	U
Nonanol	-	U	-	A	A	-	U	U	B
Nut Oil	A	B	B	U	A	A	A	A	B

O

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Octadecane	B	B	B	U	A	A	A	A	U
Octal	U	B	U	B	B	C	U	U	C
Octane	U	U	U	U	A	B	B	B	U
Octanol (Octylalcohol)	U	U	B	A	A	B	B	B	B
Octylcresol	U	U	U	U	B	U	C	C	U
Oil of Turpentine	U	U	U	U	A	B	B	B	U
Olefin, crude	A	A	U	U	A	A	A	A	U
Oleic Acid	-	-	U	U	A	-	A	A	U
Oleic Alcohol	U	U	A	A	A	U	A	A	U
Oleum (Sulfuric Acid, 0 to 50%)	U	U	U	A	A	U	U	U	U
Olive Oil	A	U	B	U	A	B	A	A	B
Ortho Dichloro Benzene	U	U	U	U	A	B	U	U	U
Oxalic Acid	-	-	B	A	A	A	B	B	B
Ozone	B	A	B	A	A	A	B/C	U	A

P

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Palm Kernel Oil	A	-	A	U	A	-	A	A	-
Palm Oil	A	A	U	U	A	A	A	A	U
Palmitic Acid	U	B	B	C	A	A	B	B	U
Para Dichloro Benzene	U	U	-	U	A	B	U	U	U
Paraffin	A	B	A	U	A	A	A	A	B
Paraffin Oil	A	B	A	U	A	A	A	A	B
Peanut Oil	A	A	U	U	A	A	A	A	B
Pectin	A	A	A	A	A	A	A	A	A
Penta Chloro Diphenyl	U	U	U	U	C	U	U	U	U
Penta Chloro Phenol	-	U	-	B	-	-	U	U	U
Pentane	A	U	B	U	A	U	A	A	U
Pentanol	U	U	A	A	B	A	B	B	U
Perchloric Acid	U	U	B	B	A	C	U	U	U
Perchloro Ethylene	U	U	U	U	B	B	U	U	U
Petroleum	B	B	B	U	A	B	A	A	B
Petroleum Ether	A	B	B	U	A	B	A	A	U
Phenol	C	U	U	U	B	-	U	U	U
Phenyl Benzene	-	U	U	U	B	-	U	U	-
Phenyl Ether	U	U	U	U	U	U	U	U	U
Phenyl Hydrazine	U	U	U	U	B	U	U	U	U
Phosphine	U	U	B	A	B	U	U	U	-
Phosphor Trichloride	U	U	U	A	A	-	U	U	U
Phosphoric Acid	-	U	U	B	A	C	U	U	C
Phosphoric Acid 45%	C	U	B	A	A	A	B	B	B
Photgraphic Developing Bath	-	B	A	B	A	A	A	A	A
Phthalic Acid	-	-	B	A	B	-	B	B	A
Phthalic Anhydride	-	-	-	A	-	-	-	-	-
Picoline, alpha	-	-	-	A	U	-	-	-	-
Picric Acid, Aqueous Solution	-	B	A	B	A	B	B	B	-
Pine Oil	A	A	U	U	A	A	B	B	U
Pineapple Juice	U	U	A	A	A	A	A	A	A
Pinene	U	B	B	U	A	B	B	B	U
Piperidine	U	U	U	U	U	U	U	U	U
Polyvinyl Acetates	-	-	B	A	U	-	-	-	-

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Potassium Acetate	U	B	B	A	B	U	B	B	U
Potassium Aluminium Sulfat	-	-	-	A	-	-	-	-	-
Potassium Bicarbonite	U	U	A	A	A	A	A	A	B
Potassium Bisulfate	U	U	B	A	A	B	A	A	B
Potassium Borate	C	U	B	A	A	B	A	A	B
Potassium Bromate	C	U	B	A	A	B	A	A	B
Potassium Bromide	U	U	B	A	A	U	A	A	U
Potassium Carbonate	C	U	B	A	A	A	A	A	A
Potassium Chlorate	U	U	B	A	A	-	U	U	-
Potassium Chloride	C	C	B	A	A	A	A	A	A
Potassium Chromate	U	U	B	A	A	-	B	B	-
Potassium Cyanide	U	U	B	A	A	A	A	A	A
Potassium Dichromate	U	C	B	A	A	U	A	A	B
Potassium Hydroxide (Solution 50%)	U	U	B	A	C	C	B	B	C
Potassium Hydroxide, Potassium Lye	U	U	B	A	U	U	B	B	U
Potassium Hypochlorite (Javelle Water)	U	U	-	B	A	B	B	B	B
Potassium Iodide	U	U	B	A	A	A	A	A	A
Potassium Nitrate	C	C	B	A	A	A	B	B	A
Potassium Perchlorate	U	U	B	A	A	-	U	U	-
Potassium Perfluoroacetate	-	-	B	A	U	U	B	B	-
Potassium Permanganate	C	B	B	A	A	U	U	U	U
Potassium Persulfate	U	U	B	A	A	U	U	U	U
Potassium Phosphate	-	-	-	A	A	-	A	A	U
Potassium Sulfate	U	C	B	A	A	B	A	A	B
Potassium Sulfite	U	C	A	A	A	A	A	A	A
Propane	B	B	B	U	A	B	A	A	U
Propanol	U	U	A	A	A	A	B	B	B
2-Propanone (Acetone)	U	U	U	A	U	U	U	U	U
2-Propene-1-ol	U	U	A	A	A	U	B	B	U
Propinyl Alcohol	U	-	A	A	A	-	A	A	-

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Propion Aldehyde	U	U	U	A	U	U	U	U	U
Propionic Acid	C	U	B	-	A	U	A	A	U
Propyl Acetate	U	U	U	B	U	U	U	U	U
Propyl Acetone	U	U	U	A	U	U	U	U	U
Propyl Amine	U	U	U	U	U	U	U	U	U
Propyl Nitrate	U	U	U	B	U	U	U	U	U
Propylene	U	U	U	U	A	B	U	U	U
Propylene Dichloride	-	-	-	U	-	-	U	U	U
Propylene Glycol	U	U	A	A	A	-	A	A	-
Propylene Oxide	U	U	U	B	U	U	U	U	U
Pyridine	U	U	U	U	U	U	U	U	U
Pyrrole	U	U	U	U	U	B	U	U	B

R

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Rapeseed Oil	B	B	B	U	A	B	B	B	U
Roast Gas (dry)	A	-	B	A	A	A	A	A	A
Rosin (Colophony)	U	U	A	A	A	A	A	A	A

S

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Salicylic Acid	-	A	A	A	A	-	B	B	-
Sea Water	U	U	B	A	B	A	A	A	B
Sewage	-	-	B	A	A	A	A	A	A
Silcone grease	A	A	A	A	A	A	A	A	U
Silicic Acid	U	-	B	A	A	-	A	A	-
Silicon Dioxide	-	A	-	A	A	-	A	A	A
Silicone Oil	A	A	A	A	A	A	A	A	U
Silver Cyanide Solution	U	U	A	U	A	A	U	U	U
Silver Nitrate	B	-	B	A	A	A	B	B	A
Silver Salts	U	U	A	A	A	A	A	A	A
Skydrol 500	U	U	U	A	U	U	U	U	U
Skydrol 7000	U	U	U	A	B	U	U	U	U
Soap Solution	B	B	B	A	A	A	A	A	A

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Soda (Natrium Carbonate)	U	U	A	A	A	A	A	A	A
Sodium Acetate	U	U	B	A	U	U	B	B	B
Sodium Benzoate	U	U	B	A	A	A	A	A	A
Sodium Bicarbonate Solution	U	U	A	A	A	A	A	A	A
Sodium Bisulfate Solution	U	U	A	A	A	A	A	A	A
Sodium Bisulfite Solution	U	U	A	A	A	A	A	A	A
Sodium Borate (Borax)	U	U	A	A	A	A	B	B	A
Sodium Carbonate (Soda Ash)	U	U	A	A	A	A	A	A	A
Sodium Carbonate Solution	-	-	A	A	A	A	A	A	A
Sodium Chlorate	U	B	B	A	A	U	B	B	U
Sodium Chloride (Common Salt)	U	U	A	A	A	A	A	A	A
Sodium Chloride Solution	-	-	A	A	A	-	A	A	-
Sodium Chlorite	-	-	U	A	A	-	U	U	-
Sodium Cyanide Solution	-	-	A	A	-	-	B	B	A
Sodium Dichromate	U	U	A	A	A	-	B	B	B
Sodium Fluoride	-	B	-	A	A	-	A	A	B
Sodium Hydroxide	C	C	B	A	C	C	B	B	C
Sodium Hydroxide, Caustic Soda	B	B	B	A	B	B	B	B	A
Sodium Hypo-chlorite Solution	U	U	B	A	A	B	B	B	B
Sodium Nitrate	U	U	B	A	A	A	B	B	B
Sodium Nitrite	U	U	B	A	A	U	U	U	U
Sodium Peroxide Solution	U	U	B	A	A	A	B	B	U
Sodium Phosphate	-	-	B	A	A	-	A	A	U
Sodium Silicate Solution	-	-	A	A	A	-	A	A	-
Sodium Sulfate (Glauber's salt)	U	U	B	A	B	B	B	B	B
Sodium Sulfhydrate Solution	U	-	A	A	A	A	A	A	A
Sodium Sulphide	U	U	B	A	A	A	B	B	B
Sodium Sulphite Solution	U	U	A	A	A	A	A	A	A

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Sodium Tetraborate Solution	U	-	B	A	A	A	B	B	B
Sodium Thiosulfate (Antichlor)	-	-	A	A	A	-	B	B	-
Soy Bean Oil	B	B	B	U	A	A	A	A	B
Sperm Oil	-	-	-	B	A	-	A	A	-
Spermaceti	U	U	B	U	A	U	A	A	U
Spirits	B	B	A	A	A	B	A	A	A
Stannic Chloride Solution	-	-	U	A	A	A	A	A	B
Starch	B	B	A	A	A	A	A	A	A
Stearic Acid	A	A	B	B	A	A	B	B	B
Stoddard Solvent	A	A	B	U	A	A	A	A	U
Styrene	U	U	U	U	A	C	U	U	U
Succinic Acid	U	U	B	A	A	-	A	A	A
Sucrose Sap	U	U	B	A	A	A	A	A	A
Sugar Solutions	U	U	B	A	A	A	A	A	A
Sulphur	U	-	A	A	A	B	U	U	B
Sulphur Hexafluoride (SF6)	B	-	A	A	B	B	B	B	-
Sulphur Chloride	U	U	U	U	A	B	U	U	U
Sulphur Dioxide (SO2)	U	U	U	A	B	B	U	U	B
Sulphur Dioxide Liquid (anhydrous)	U	-	U	A	U	B	U	U	B
Sulphur Dioxide, gaseous	U	-	U	A	U	B	U	U	B
Sulphuric Acid (0 to 50%)	U	U	U	A/B	A/B	U	U	U	U
Sulphuric Acid, diluted	U	U	U	A	A	U	B	B	U
Sulphurous Acid	U	U	-	B	A	-	-	-	U

T

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Talcum	-	A	-	A	A	A	A	A	A
Tallow	U	B	B	B	A	U	A	A	B
Tannins	U	B	B	B	A	A	B	B	B
Tar	U	U	U	U	B	C	U	U	-
Tartaric Acid	U	U	B	B	A	A	A	A	A
Tetrachloroethane	U	U	U	U	B	C	U	U	U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Tetrachlorome-thane	-	U	U	U	A	B	U	U	U
Tetrachoroethylene	U	U	U	U	A	B	U	U	U
Tetraethyl Lead	-	U	U	U	A	B	B	B	U
Tetrahydrofuran	U	U	U	U	U	U	U	U	U
Thionyl Chloride	U	U	U	B	A	U	U	U	U
Thiophene	U	U	U	U	U	U	U	U	U
Titanium Tetrachloride	U	U	B	B	B	B	B	B	U
Toluene (Toluol)	U	U	U	U	B	B	U	U	U
Town Gas	U	U	U	U	A	B	B	B	B
Transformer Oil	B	A	U	U	A	A	B	B	B
Triacetin (Glycerine Triacetate)	U	U	B	A	U	U	B	B	B
Triaryl Phosphate	U	U	U	A	A	B	U	U	U
Tributoxy Ethyl Phosphate	B	-	B	B	B	-	U	U	U
Tributyl Marcaptane	U	-	U	U	A	U	U	U	U
Tributyl Phosphate	U	U	U	B	U	U	U	U	U
Trichloro Benzene	U	U	U	-	A	U	-	-	U
Trichloro Ethane	U	U	U	U	A	B	U	U	U
Trichloro Ethyl Phosphate	-	-	U	-	U	-	U	U	-
Trichloro Ethylene	U	U	U	U	B	B	U	U	U
Trichloroacetic Acid	U	U	U	B	U	U	B	B	B
Tricresyl Phosphate	U	U	U	B	B	B	U	U	U
Triethanolamine	U	U	-	A	-	-	-	-	U
Triethyl Borane	-	-	-	-	A	-	-	-	-
Triethyl Glycol	C	-	-	A	A	-	A	A	A
Triethylaluminium	-	-	-	U	B	-	-	-	-
Trifluoro Ethane	U	U	U	U	A	B	U	U	U
Tri-Iso-Propyl Benzene	A	A	U	U	A	-	A	A	U
Trinitrotoluene (TNT)	U	B	B	U	B	B	U	U	-
Trioctyl Phosphate	U	U	U	A	B	B	U	U	U
Trisodium Phosphate Solution	C	B	B	A	A	A	A	A	A
Turpentine	B	C	U	U	A	A	A	A	U

U

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Urea	B	U	B	A	A	A	A	A	A

V

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Vaseline	B	B	B	U	A	A	A	A	B
Vaseline Oil	U	U	B	U	A	B	A	A	B
Vegetable Juices	U	U	B	A	A	A	A	A	A
Vegetable Oils	B	-	B	U	A	A	A	A	B
Vinegar	U	U	B	A	B	B	B	B	A
Vinyl Acetate	-	-	-	-	-	-	-	-	-
Vinyl Chloride, liquid	-	-	-	-	-	-	-	-	-
Vinylidene Chloride	U	U	U	U	B	U	U	U	U

W

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Waste Gas (cont. Carbon Dioxide)	A	-	A	A	A	A	A	A	A
Waste Gas (cont. Carbon Monoxide)	A	A	A	A	A	A	A	A	A
Waste Gas (cont. Hydrogen Chloride)	-	-	A	A	A	-	B	B	-
Waste Gas (cont. Hydrogen Fluoride)	-	-	A	A	A	-	A	A	A
Waste Gas (cont. Nitrous Fumes)	U	-	A	A	A	B	-	-	U
Waste Gas (cont. Sulfur Dioxide)	-	-	A	A	A	-	B	B	-
Waste Gas (cont. Sulfuric Acid)	-	-	B	A	A	-	U	U	-
Water 135 °C	U	U	C	A	C	A	C	U	U
Water 80 °C	U	U	B	A	B	A	A	B	B
Water vapour < 140 °C	U	U	U	A	U	B	C	U	B
Water vapour < 150 °C	U	U	U	A	U	B	U	U	B
Water vapour > 140 °C	U	U	U	B	U	B	U	U	B

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Water vapour > 150 °C	U	U	U	B	U	U	U	U	U
Wax Alcohols	A	-	B	U	A	-	A	A	A
Wine + Whiskey	U	U	A	A	A	A	A	A	A
Wood Spirit	U	U	U	B	U	U	U	U	-

X

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Xenon	A	A	A	A	A	A	A	A	A
Xylene (Xylol)	U	U	U	U	B	U	U	U	U
Xylidines (aromatic Amines)	U	U	U	B	U	U	U	U	U

Y

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Yeast	B	U	A	A	A	A	A	A	A

Z

CHEMICAL	ACM	AU	CR	EPDM	FKM	FVMQ	HNBR	NBR	VMQ
Zeolites	-	-	A	A	A	-	A	A	-
Zinc Acetate	U	U	B	A	U	U	B	B	U
Zinc Chloride Solutions	U	U	A	A	A	A	A	A	-
Zinc Sulfate	U	U	A	A	A	A	A	A	A

B.1.3 Characteristics and inspection of elastomers

Hardness

One of the most often named properties regarding Polymer materials is hardness. Even so the values can be quite misleading.

Hardness is the resistance of a body against penetration of an even harder body - of a standard shape defined pressure.

There are two procedures for hardness tests regarding test samples and finished parts made out of elastomer material:

1. Shore A/D
   according to ISO 868 / ISO 7619 / DIN 53 505 / ASTM D 2240
   Measurement for test samples
2. Durometer IRHD (International Rubber Hardness Degree) according to ISO 48 / ASTM 1414 and 1415
   Measurement of test samples and finished parts

The hardness scale has a range of 0 (softest) to 100 (hardest). The measured values depend on the elastic qualities of the elastomers, especially on the tensile strength.

The test should be carried out at temperatures of 23 ±2°C - not earlier than 16 hours after the last vulcanisation process (manufacturing stage). If other temperatures are being used this should be mentioned in the test report.

Tests should only be carried out with samples which have not been previously stressed mechanically.

Hardness tests according to Shore A / D

The hardness test device Shore A (indentor with pyramid base) is a sensible application in the hardness range 10 to 90. Samples with a larger hardness should be tested with the device Shore D (indentor with spike).
Test specimen:
Diameter min. 30 mm
Thickness min. 6 mm
Upper and lower sides smooth and flat
When thin material is being tested it can be layered providing minimal sample thickness is achieved by a maximum of 3 layers. All layers must be at minimum 2 mm thick.

The measurement is done at three different places at a defined distance and time.

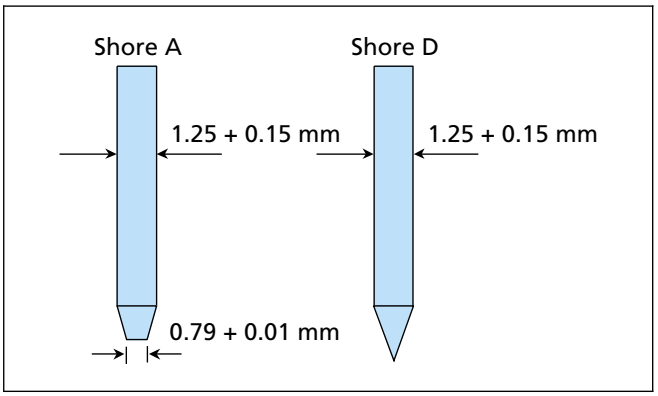


Figure 5 Indentor according to Shore A / D

Hardness test according to IRHD

The test of the Durometer according to IRHD is used with test samples as well as with finished goods.

The thickness of the test material has to be adjusted according to the range of hardness. According to ISO 48 there are two hardness ranges.

Soft:	10 to 35 IRHD	⇒	Sample thickness 10 to 15 mm / procedure “L”
Normal:	over 35 IRHD	⇒	Sample thickness 8 to 10 mm / procedure “N” Sample thickness 1.5 to 2.5 mm / procedure “M”

The hardness determined with finished parts or samples usually vary in hardness determined from specimen samples, especially those with a curved surface.

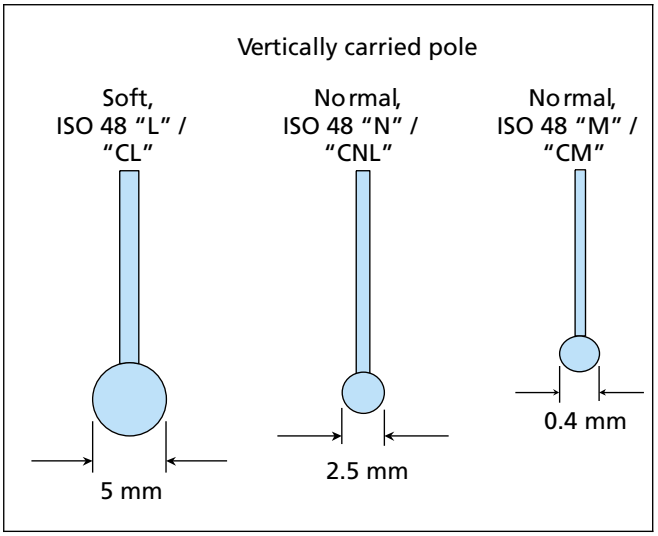


Figure 6 Indentor according to IRHD

Influencing parameters on the hardness test for polymer materials

Various sample thicknesses and geometries as well as various tests can show different hardness values even though the same materials have been used.

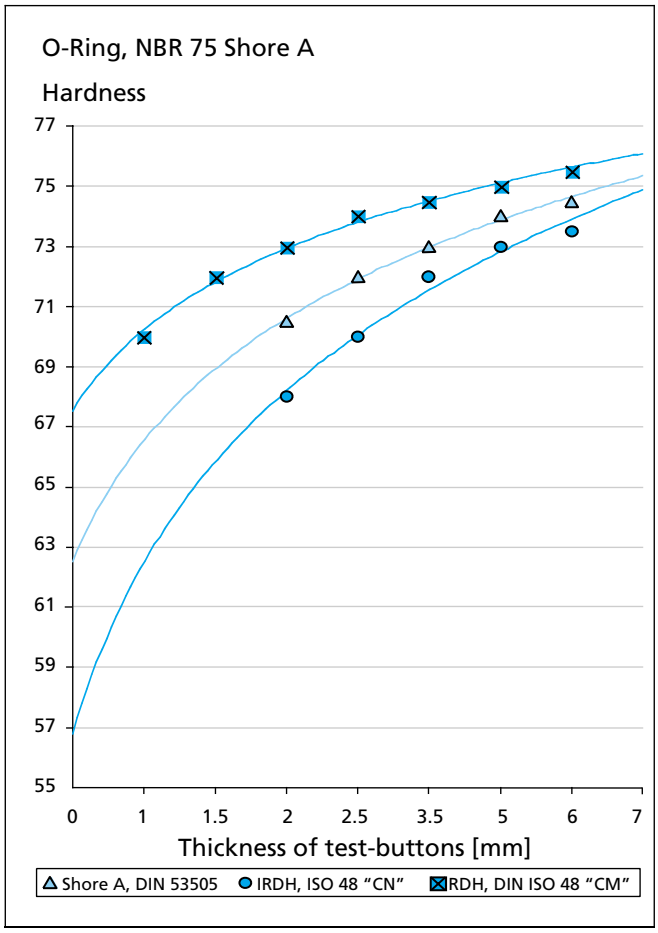


Figure 7 Ranges of hardness depending on sample thickness and test method

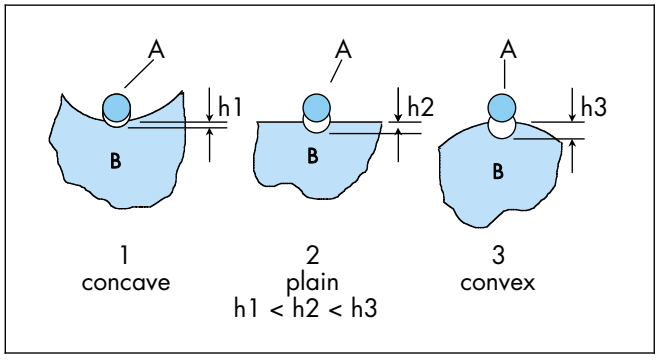


Figure 8 Range of hardness depending on surface geometry for the equivalent material characteristics.

With equivalent material characteristics of the elastomer sample B, the indentor penetrates the deepest at the surface 3 (convex) and therefore establishes the softest area.

As the concave geometry (3) has a stronger effect on smaller width O-Rings, the tolerances on hardness for widths under 2.0 mm should be increased up to +5 / -8 IRHD.

Compression set

An important parameter regarding the sealing capability is the compression set (CS) of the O-Ring material. Elastomers when under compression show aside from an elastic element also a permanent plastic deformation (Figure 9).

The compression set is determined in accordance with ISO 815 as follows:

Standard test piece:	Cylindrical disc, diameter 13 mm and height 6 mm
Deformation:	25%
Tension release time:	30 minutes

$$CS = \frac{h_0 - h_2}{h_0 - h_1} \cdot 100(\%)$$

Where h_0 = Original height (cross section d_2)
h_1 = Height in the compressed state
h_2 = Height after tension release

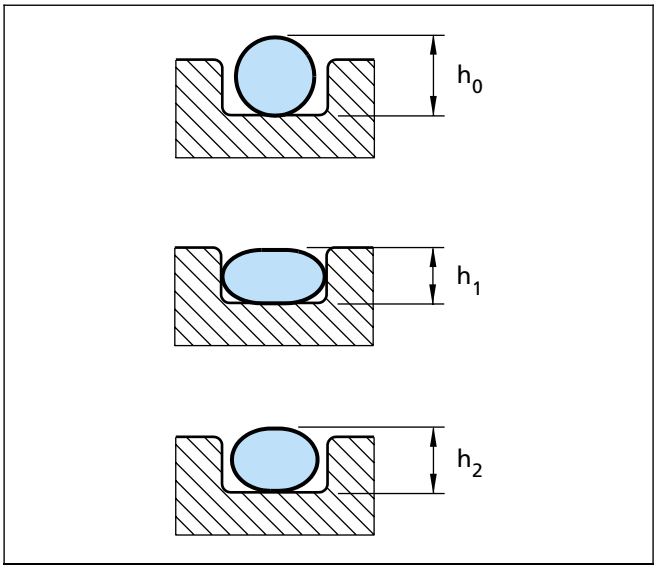


Figure 9 Illustration of the compression set

The accuracy of the measured value depends on:

- Test sample thickness
- Deformation
- Measurement deviations

Therefore the values which have been identified with the test sample cannot be transferred onto the finished part. The result of the measured finished parts are strongly influenced by geometrics and measurements as well as the measuring accuracy of the test equipment.

The following illustration shows the influence of various measuring deviations (in mm) in respect to the established compression set CS depending on the cross section of the measured O-Rings.

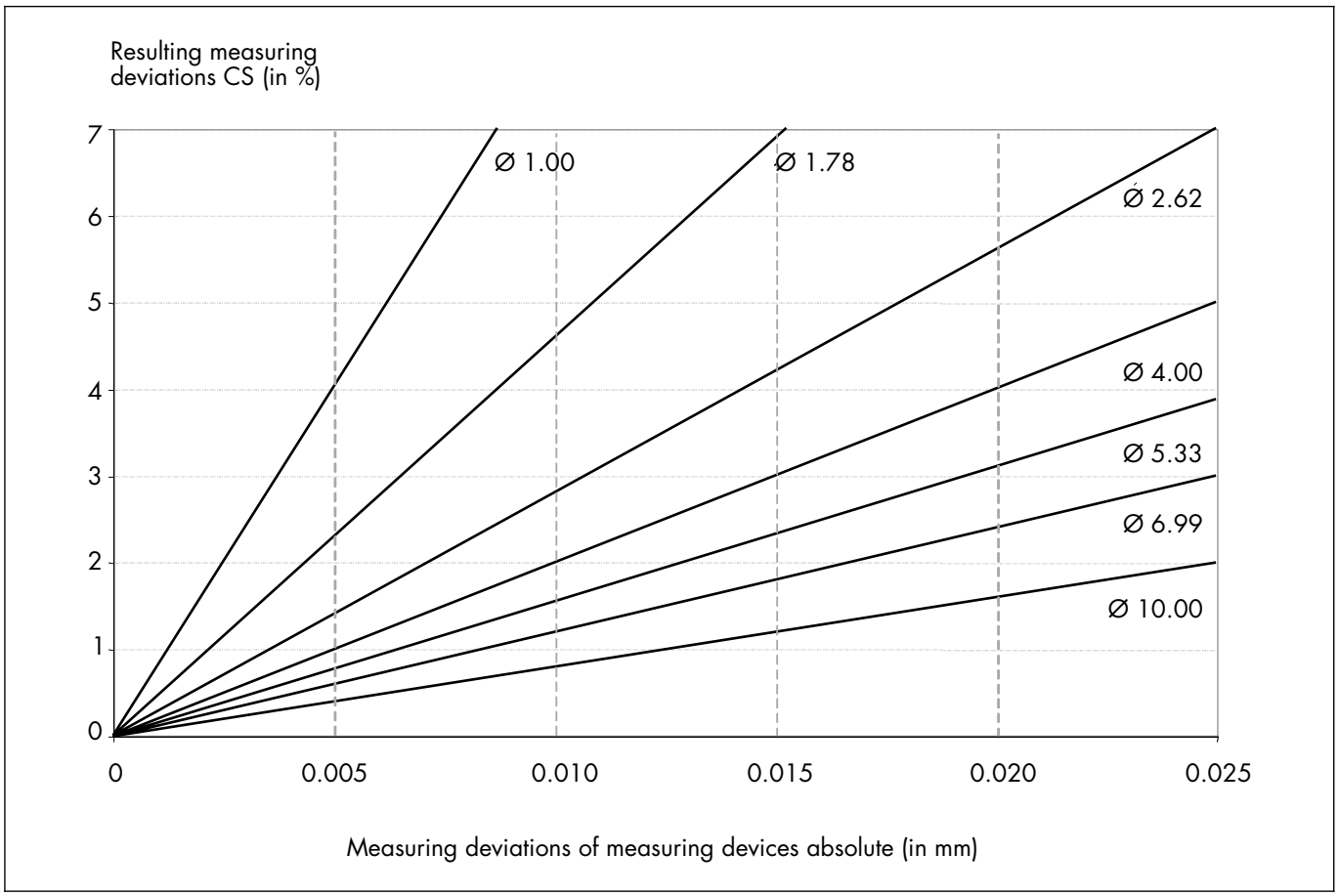


Figure 10 Measuring deviations CS depending on O-Ring cross section and measuring accuracy of the test equipment (schematic illustration)

B.1.4 Special requirements - authorities and approvals

Seals often have to meet the highest performance standards and the most stringent of environment and safety demands.
Also official authorities and associations make great demands on seals or materials which are to be used in their industries. This is often the case if seals are used for water or gas applications.
The following table shows common authorities and their requirements.

Table IV Authorities and approvals

Approval / Examination Certificate / Guideline	Application	Criteria / Standards	Tests / Examinations / Contents	Authorities / Associations	Institutes / Laboratories
ACS Licensing	Polymers exposed to drinking water	French Standard AFNOR XP P41-250, part 1-3 Synoptic Paper 1226	- Analysis of dispensing according "Synoptic Documents" - Storage test (microbe analysis)	ACS (Accréditation de conformité sanitaire)	3 certified test laboratories in France: Paris / Vandoevre / Lille
BAM recommendation	Seals for the use in gas or oxygen fittings	- reactive behaviour with lubricants - limits for pressure and temperature (DIN 4060) - seals and components		BAM (Bundesanstalt für Materialforschung und -prüfung)	BAM, Berlin
BfR Recommendation (former: BgVV)	Polymers exposed to food	BfR Guidelines ("Polymers exposed to food") various paragraphs, depending on the application of the seal	- Chemical and physical tests - Biological tests - Sterilisation tests - Taste tests	BfR (Bundesanstalt für Risikobewertung)	BAM, Berlin HY (Hygiene-Institut, Gelsenkirchen)
DVGW Release for Gas	Seals for gas services and gas applications	EN 549 EN 682		DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	Test Laboratory for Gas, Karlsruhe, MPA NRW, Dortmund
DVGW Release for drinking water	Seals for processing storage and distribution of drinking water	BfR Guidelines ("Polymers exposed to food")	Various classifications and tests - depending on the application	DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	Environmental Hygiene Institute, Gelsenkirchen TZW, Karlsruhe
DVGW W270 recommendation	Materials exposed to drinking water	DVGW, worksheet W 270	Microbiological testing: reproduction of microorganisms on materials	DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	TZW, Karlsruhe HY (Hygiene Institution), Gelsenkirchen
FDA guideline	Materials for food and pharmaceutical	"White List" (Register of permitted dispensing components), e.g. according to 21. CFR Part 177.2600	- Component test according "White List" - Extended for foods containing water or oil - Extraction test for polar / non polar solvents	FDA (Food and Drug Administration)	In house or external laboratories
International Military Releases	Applications for military devices	Various military specifications and standards depending on the application	- Depending on application and specification		Various test laboratories
KTW certificate	Polymers exposed to drinking water, Cold- warm- and hot water	BfR Guidelines ("Polymers exposed to food") part 1.3.13	- Extraction test - Odour- and taste test - Register of permitted components	DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	Environmental Hygiene Institute, Gelsenkirchen TZW, Karlsruhe BAM, Berlin

Approval / Examination Certificate / Guideline	Application	Criteria / Standards	Tests / Examinations / Contents	Authorities / Associations	Institutes / Laboratories
NSF Release	Food and Sanitary	NSF Standard criteria	Depending on application: - Test of components - Test of component group - Physical and chemical Material tests - Toxicological and micro biological tests	NSF (National Sanitation Foundation)	NSF, USA UL, USA
UL Listing	Application of seals for electrical equipment + appliances	UL-guidelines	- Chemical comparability test - Additional tests depending on application	UL (Under-writers Laboratory)	Underwriters laboratory in USA/England
USP examination	For medical and pharmaceutical use	Different specifications: USP 26 et seqq., chapter 87, 88, Class I to VI,...	Depending on specification: - intracutaneous reactive tests - systemic Injections - muscle implantations	USP (United States Pharmacopeia, USA)	Different test laboratories
WRAS Release (former: WRC)	Polymers exposed to drinking water	British Standard BS 6920 BS 2494	- Dispensing test - Microbe test - Extraction test - Hot water test	WRAS (Water Regulations Advisory Scheme)	Various accredited test laboratories in England
18-03 3-A Sanitary	Food Products	18-03 3-A Sanitary Standards for multiple-use rubber and rubber-like materials used as product contact surfaces in dairy equipment	Chemical and physical properties acc. to Class I to III	Organisations: LAFIS, IAFP, USPHS, EHEDG, DIC	Various laboratories

B.1.5 Standard materials

The following tables show the physical properties of Trelleborg Sealing Solutions standard materials. They concern minimum values. That means that a standard material meets at least the given values. Many of the Trelleborg Sealing Solutions materials (even when defined as standard) have better physical properties.

Table V Material specification for standard NBR

				NBR 70 Shore A	NBR 80 Shore A	NBR 90 Shore A
Hardness		DIN 53 505 ASTM D 2240	Shore A	70 ± 5	80 ± 5	90 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm²	> 14	> 12	> 10
Elongation at break		DIN 53 504 ASTM D 412	%	> 200	> 150	> 100
Compression set	24h / 100 °C	DIN ISO 815B ASTM D 395B	%	< 25	< 30	< 30
Heat aging	72h / 100 °C	DIN 53 508 ASTM D 573				
Change of hardness			Shore A	max +8	max +8	max +8
Change of tensile strength			%	max -25	max -25	max -30
Change of elongation at break			%	max -25	max -25	max -30
Resistance in ASTM-OIL # 1	72h / 100 °C	DIN 53 521 ASTM D 471				
Change of hardness			Shore A	max +6	max +6	max +6
Change of volume			%	max -8	max -8	max -8
Resistance in ASTM-OIL # 3	72h / 100 °C	DIN 53 521 ASTM D 471				
Change of hardness			Shore A	max -10	max -10	max -10
Change of volume			%	max +15	max +15	max +15
Temperature range Maximum and minimum operating temperatures depend on the specific application criteria.				-30 °C to +100 °C	-25 °C to +100 °C	-25 °C to +100 °C

Table VI Material specification for standard EPDM

				EPDM 70 Shore A sulphur cured	EPDM 70 Shore A peroxide cured	EPDM 75 Shore A peroxide cured
Hardness		DIN 53 505 ASTM D 2240	Shore A	70 ± 5	70 ± 5	75 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm²	> 10	> 10	> 10
Elongation at break		DIN 53 504 ASTM D 412	%	> 150	> 125	> 125
Compression set	24h / 100 °C	DIN ISO 815B ASTM D 395B	%	< 20		
	24h / 150 °C		%		< 30	< 30
Heat aging	72h / 100 °C	DIN 53 508 ASTM D 573		x		
	72h / 150 °C				x	x
Change of hardness			Shore A	max +10	max +10	max +10
Change of tensile strength			%	max -10	max -20	max -20
Change of elongation at break			%	max -20	max -20	max -20
Resistance in water	72h / 100 °C	DIN 53 521 ASTM D 471				
Change of hardness			Shore A	max -10	max -3	max -3
Change of volume			%	max +10	max +3	max +3
Temperature range Maximum and minimum operating temperatures depend on the specific application criteria.				-45 °C to +120 °C	-45 °C to +140 °C	-45 °C to +140 °C

Table VII Material specification for standard Silicone

				Silicone 60 Shore A	Silicone 70 Shore A
Hardness		DIN 53 505 ASTM D 2240	Shore A	60 ± 5	70 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm²	> 5	> 5
Elongation at break		DIN 53 504 ASTM D 412	%	> 100	> 100
Compression set	24h / 175 °C	DIN ISO 815B ASTM D 395B	%	< 35	< 35
Heat aging	72h / 225 °C	DIN 53 508 ASTM D 573			
Change of hardness			Shore A	max +15	max +15
Change of tensile strength			%	max -40	max -40
Change of elongation at break			%	max -40	max -40
Resistance in ASTM-Oil # 1	72h / 100 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max -10	max -10
Change of volume			%	max +20	max +20
Temperature range Maximum and minimum operating temperatures depend on the specific application criteria.				-55 °C to +200 °C	-55 °C to +200 °C

Table VIII Material specification for standard FKM

				FKM 70 Shore A	FKM 75 Shore A	FKM 80 Shore A	FKM 90 Shore A
Hardness		DIN 53 505 ASTM D 2240	Shore A	70 ± 5	75 ± 5	80 ± 5	90 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm²	> 10	> 10	> 10	> 10
Elongation at break		DIN 53 504 ASTM D 412	%	> 125	> 125	> 120	> 100
Compression set	24h / 175 °C	DIN ISO 815B ASTM D 395B	%	< 20	< 20	< 20	< 20
Heat aging	72h / 250 °C	DIN 53 508 ASTM D 573					
Change of hardness			Shore A	max +10	max +10	max +10	max +10
Change of tensile strength			%	max -25	max -25	max -25	max -25
Change of elongation at break			%	max -25	max -25	max -25	max -25
Resistance in ASTM-Oil # 3	72h / 150 °C	DIN 53 521 ASTM D 471					
Change of hardness			Shore A	max -5	max -5	max -5	max -5
Change of volume			%	max +5	max +5	max +5	max +5
Resistance in ASTM-FUEL C	72h / RT	DIN 53 521 ASTM D 471					
Change of hardness			Shore A	max -5	max -5	max -5	max -5
Change of volume			%	max +10	max +10	max +10	max +10
Temperature range Maximum and minimum operating temperatures depend on the specific application criteria.				-18 °C to +200 °C	-18 °C to +200 °C	-18 °C to +200 °C	-15 °C to +200 °C

Table IX Material specification for standard HNBR

				HNBR 70 Shore A partially saturated	HNBR 75 Shore A partially saturated
Hardness		DIN 53 505 ASTM D 2240	Shore A	70 ± 5	75 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm²	> 15	> 15
Elongation at break		DIN 53 504 ASTM D 412	%	> 250	> 250
Compression set	24h / 125 °C	DIN ISO 815B ASTM D 395B	%	< 35	< 35
Heat aging	72h / 150 °C	DIN 53 508 ASTM D 573			
Change of hardness			Shore A	max +10	max +10
Change of tensile strength			%	max -30	max -30
Change of elongation at break			%	max -30	max -30
Resistance in ASTM-Oil # 1	72h / 150 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max +10	max +10
Change of volume			%	max -10	max -10
Resistance in ASTM-Oil # 3	72h / 150 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max -15	max -15
Change of volume			%	max +20	max +20
Temperature range Maximum and minimum operating temperatures depend on the specific application criteria.				-30 °C to +130 °C	-30 °C to +130 °C

Trelleborg Sealing Solutions offers various materials, which provide additional advantages, in addition to the standard materials previously described. The advantages include a wide range of available molds, special operating temperature range, special media resistance and institutional approvals for the portable water, pharmaceutical and beverage industries.

The following table shows preferred materials, which are characterized by their wide spectrum of use. They can be used for standard applications as well as for special industrial applications.

Table X Preferred materials

Material Type	Hardness Shore A (± 5)	Color	Operating temperature range	Material code	Description
NBR Nitrile Butadiene Rubber	70	black	-30 °C to +100 °C	N7083	Preferable for **sizes acc. to AS 568 B**, preferably used for energizing elements, good overall performance
			-50 °C to +100 °C	N7T40	"Polar", **extremely good low temperature properties**, preferably used for static applications in mineral oil and for energizing elements, preferable for sizes acc. **to AS 568 B**
			-30 °C to +100 °C	N7003	Preferable for metric sizes, good overall performance, wide range of molds available
			-30 °C to +100 °C	N7024	Good overall performance, **preferable for large quantities**
			-30 °C to +100 °C	N7027	Preferable for potable water applications: **KTW, ACS, NSF61, NSF51, DIN EN 549: 0 °C / 80 °C, W270, FDA**, also suitable for use in gas applications
	90	black	-25 °C to +100 °C	N9002	Good overall performance, **wide range of molds available**

Material Type	Hardness Shore A (± 5)	Color	Operating temperature range	Material code	Description
HNBR Hydrogenated Nitrile Butadiene Rubber	70	black	-30 °C to +140 °C	H7671	Good overall performance, **wide range of molds available**
			-35 °C to +140 °C	H7503	**Wide range of operating temperature**, good resistance to mineral oil, good overall performance
FKM Fluorocarbon Rubber	70	green	-20 °C to +200 °C	V70GA	Preferable for **sizes acc. to AS 568 B**, preferably used for energizing elements, good overall performance, **DVGW, BAM**
			-18 °C to +200 °C	V70G2	Preferable for **sizes acc. to AS 568 B**, good overall performance
	80	green	-18 °C to +200 °C	V80G2	Good overall performance, **wide range of molds available**
		black	-18 °C to +200 °C	V8003	Good overall performance, **wide range of molds available**
			-20 °C to +200 °C	V8605	For pharmaceutical and food and beverage industries, **FDA**
	85	black	-20 °C to +200 °C	VC009	Preferable for **sizes acc. to BS 4518** (metric), standard FKM
	90	green	-15 °C to +200 °C	V90G1	Good overall performance, **wide range of molds available**
		black	-15 °C to +200 °C	V9670	Good overall performance, **wide range of molds available**
EPDM Ethylene Propylene Diene Rubber	70	black	-45 °C to +150 °C	E7502	Peroxide cured, for pharmaceutical and food and beverage industries, **KTW, WRAS, FDA, USP Class VI, USP 26**, plasticizer content < 3 %
			-45 °C to +125 °C	E7002	**Sulfur cured**, standard EPDM, wide range of molds available
			-45 °C to +140 °C	E7515	**Peroxide cured**, standard EPDM, wide range of molds available
			-45 °C to +150 °C	E7T41	Peroxide cured, **extremely low compression set** in hot water and steam. Excellent resistance to ozone, can be used in contact with copper and brass
			-45 °C to +140 °C	E7518	Peroxide cured, preferable for the use in potable water: **KTW, WRAS, FDA, NSF61, NSF51, W270, W534, EN 681, ACS, USP Class VI, USP 26**, plasticizer content < 1 %
VMQ Methyl Vinyl Silicon Rubber	60	red	-50 °C to +200 °C	S60R1	Good overall performance, **wide range of molds available**
	70	red	-50 °C to +200 °C	S70R2	**Sulfur cured**, good overall performance, **wide range of molds available**

The stated operating temperatures exclude any kind of load. Actual operating temperatures may differ depending on media and load type.

At time of publication the information contained in this literature, including availability or institutional approvals, is believed to be correct and accurate.

Further materials are available on request.

B.2 Design recommendations

The following design recommendations cannot be used for the special Isolast® materials. Please use the Isolast® brochure or contact our specialists for further details.

B.2.1 Installation recommendations

General recommendations

Before starting installation, check the following points:

- Lead-in chamfers made according to drawing?
- Bores deburred and edges rounded?
- Machining residues, e.g. chips, dirt and foreign particles, removed?
- Screw thread tips covered?
- Seals and components greased or oiled?
  Ensure media compatibility with the elastomer material. Trelleborg Sealing Solutions recommends to use the fluid to be sealed.
- Do not use lubricants with solid additives, e.g. molybdenum disulphide or zinc sulphide.

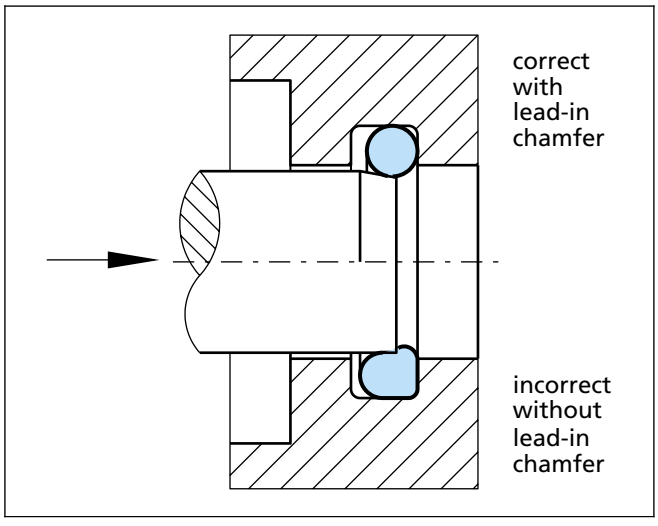


Figure 11 Rod installation with O-Ring

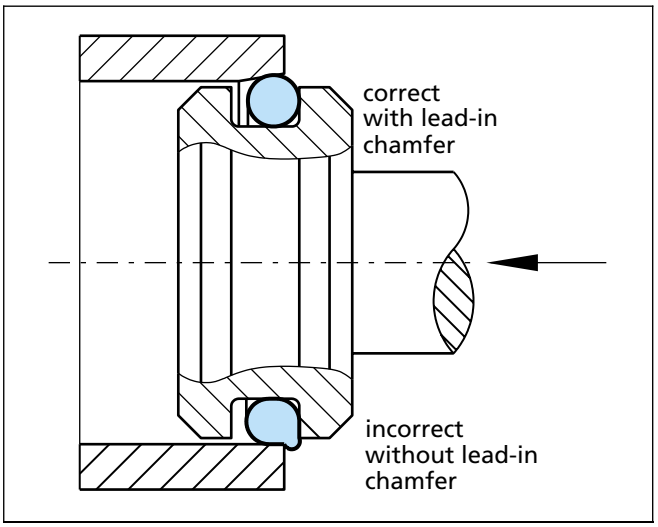


Figure 12 Piston installation with O-Ring

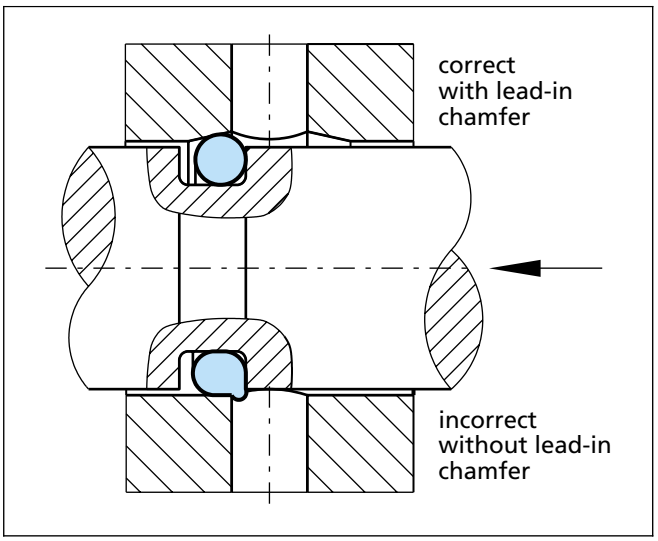


Figure 13 O-Ring installation over transverse bores

Manual installation

- Use tools without sharp edges!
- Ensure that the O-Ring is not twisted, use installation aids to assist correct positioning
- Use installation aids wherever possible
- Do not over stretch O-Rings
- Do not stretch O-Rings made out of cord at the joint.

Installation over threads, splines etc.

Should the O-Ring have to be stretched over threads, splines, keyways etc., then an assembly mandrel is essential. This mandrel can either be manufactured in a soft metal or a plastic material obviously without burrs or sharp edges.

Automatic installation

Automatic O-Ring installation requires good preparation. The surfaces of the O-Rings are frequently treated by several methods (see chapter "O-Ring friction reduced"). This offers a number of benefits during installation by

- Reducing the installation forces
- Non-stick effects, easy removal

The handling and installation of dimensionally unstable components requires a great deal of experience. Reliable automated installation thus demands special handling and packing of the O-Rings.

Please ask our specialists for further details.

B.2.2 Initial compression

An initial compression (squeeze) of the O-Ring in the groove is essential to ensure its function as a primary or secondary sealing element (Figure 14). It serves to:

- Achieve the initial sealing capability
- Bridge production tolerances
- Assure defined frictional forces
- Compensate for the compression set
- Compensate for wear

Depending on the application, the following values apply for the initial squeeze as a proportion of the cross section (d_2):

Dynamic applications: 6 to 20%
Static applications: 15 to 30%

The design of the grooves can be based on the guide values for the initial squeeze shown in the diagrams in Figure 15 and 16. These take into account the relationship between loads and cross sections according to ISO 3601-2 (version 1987).

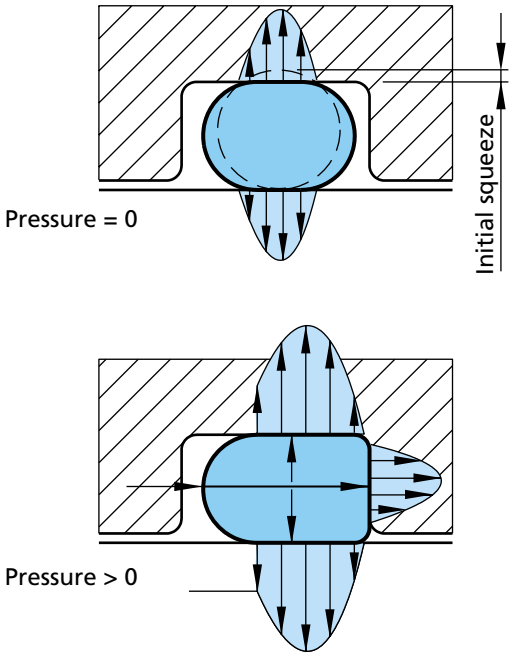


Figure 14 O-Ring contact pressure installed and under service pressure

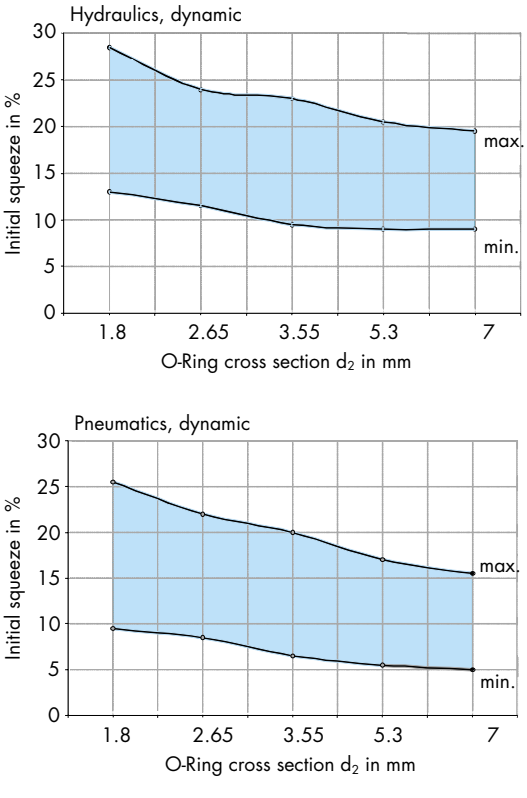


Figure 15 Permissible range of initial squeeze as a function of cross section, radial dynamic

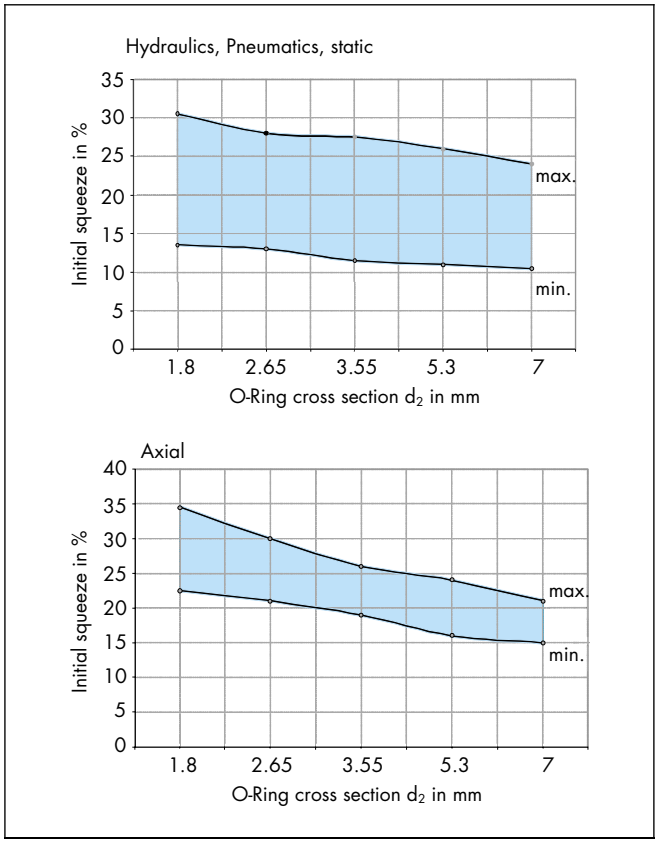


Figure 16 Permissible range of Initial squeeze as a function of cross section, radial static and axial

Compression forces

The deformation forces vary depending on the extent of the initial squeeze and the Shore hardness. Figure 17 shows the specific compression force per cm of the seal circumference as a function of the cross section.

The compression forces shown can be used to estimate the total force to be applied for static installation of O-Rings.

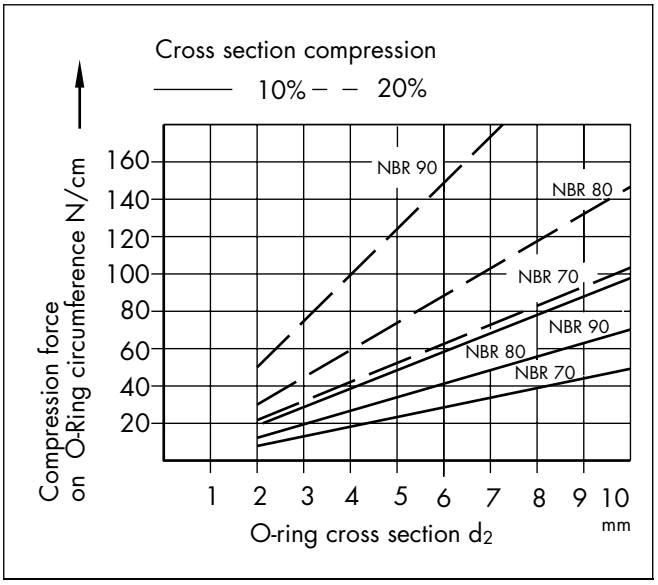


Figure 17 Compression forces on the O-Ring circumference depending on the material

B.2.3 Elongation - compression

With a radial sealing configuration, the O-Ring in an internal groove - "outside sealing" - should be stretched over the diameter of the groove. Maximum elongation in the installed state is 6% for O-Rings with an inner diameter > 50 mm and 8% for O-Rings with an inner diameter < 50 mm.

With external grooves - "inside sealing" - the O-Ring is preferably compressed along its circumference. The maximum circumferential compression in the installed state is 3%.

Exceeding these values will result in too large increase or decrease in the O-Ring cross section. Consequently this can effect the service life of the seal.

The reduction in cross section diameter (d_2) can be calculated as

$$Reduction_{max} = \frac{d_{2min}}{10} \cdot \sqrt{6 \cdot \left(\frac{d_{3max} - d_{1min}}{d_{1min}} \right)}$$

with d_{1min} = minimum inside diameter of the O-Ring
d_{2min} = minimum cross section of the O-Ring
d_{3max} = maximum housing diameter

but for approximation it can be assumed, in percentage, to be half the amount of stretch. An elongation of 1% corresponds to a reduction of the cross section (d_2) of approx. 0.5%.

B.2.4 Methods of installation and design of seal housing

Methods of installation

O-Rings can be used in components in a wide variety of ways.

During the design stage installation must be taken into consideration. In order to avoid damage during installation it should not be necessary to pass the O-Ring over edges or bores. When long sliding movements are involved, the seal seat should be recessed, if possible, or the O-Rings arranged so that they only have to travel short distances during installation to reduce risk of twisting.

Radial installation (static and dynamic)

Inner sealing
The O-Ring size should be selected so that the inside diameter d_1 has the smallest possible deviation from the diameter to be sealed d_5 (Figure 18).

Outer sealing.
The O-Ring size should be selected so that the inside diameter d_1 is equal to or smaller than groove diameter d_3 (Figure 18).

Axial installation, (static)
During axial-static installation, the direction of the pressure should be taken into consideration when choosing the O-Ring size (Figure 19). With internal pressure the O-Ring should be chosen so that the outside diameter of the O-Ring is approx. 1 to 2% larger than the outer groove diameter d_7. With external pressure the O-Ring is chosen approx. 1 to 3% smaller than the inner groove diameter d_8.

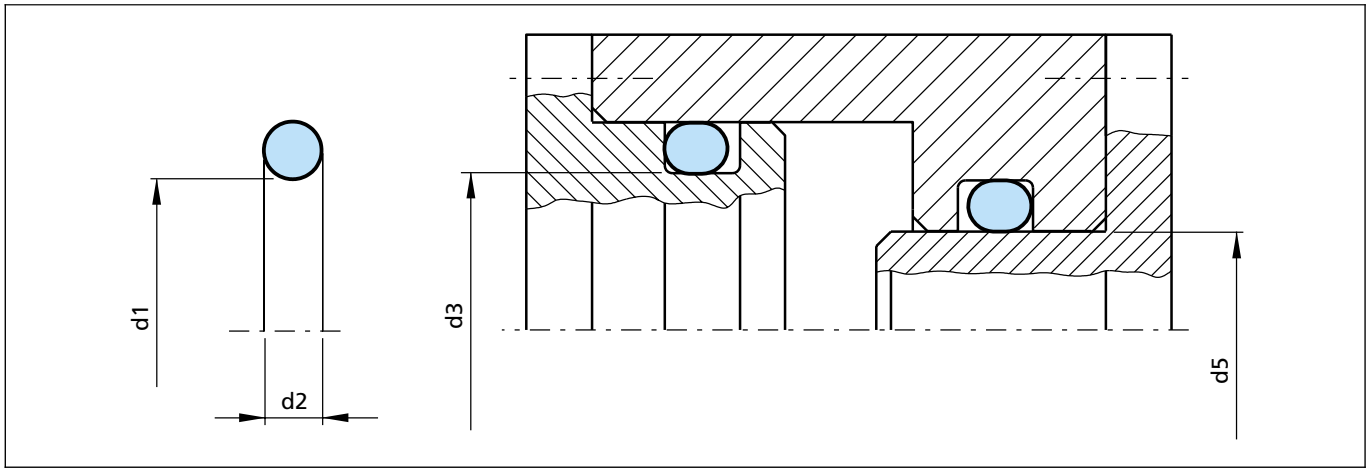


Figure 18 Radial installation, static and dynamic

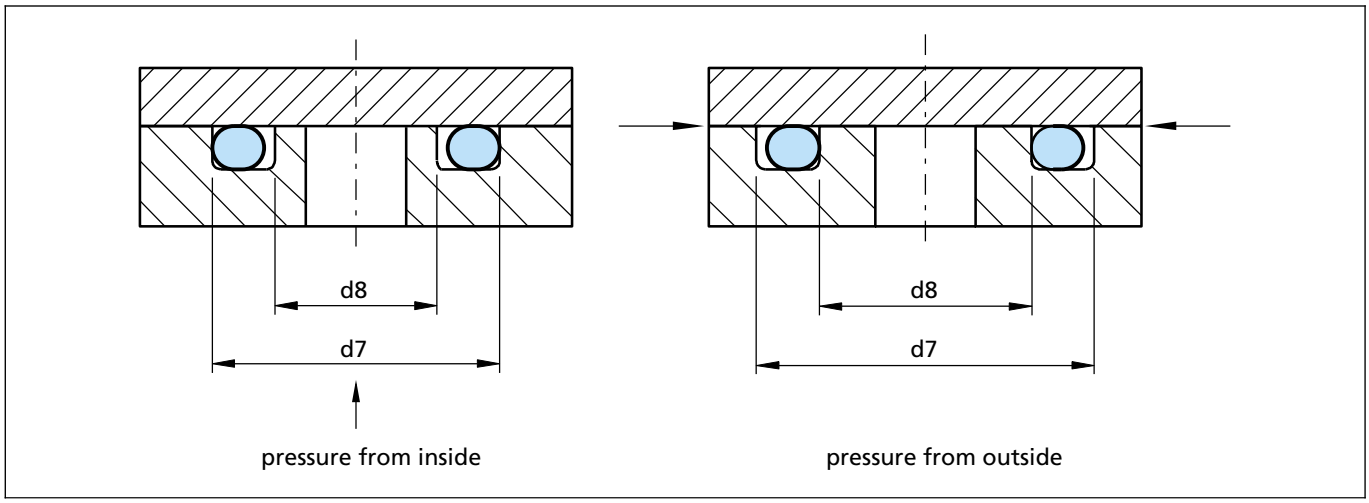


Figure 19 Axial installation, static

O-Ring as a rotary seal

In some applications, e.g. with short running periods, the O-Ring can also be used as a rotary seal for sealing shafts. In this case, the following points should be observed:

In order to be able to function as a rotary seal, O-Rings must be installed in accordance with specific guidelines, the rotary seal principle.

The rotary seal principle is based on the fact that an elongated elastomer ring contracts when heated (Joule effect). With the normal design criteria the O-Ring inside diameter d_1 will be slightly smaller than the shaft diameter, and the heat generated by friction would cause the ring to contract even more. This results in a higher pressure on the rotating shaft so that a lubricating film is prevented from forming under the seal and even higher friction occurs. The result would be increased wear and a premature failure of the seal.

Using the rotary seal principle, this is prevented by the seal ring being selected so that its inside diameter is approximately 2 to 5% larger than the shaft diameter to be sealed. The installation in the groove means that the seal ring is compressed radially and is pressed against the shaft by the groove diameter. The seal ring is thus slightly corrugated in the groove, a fact which helps to improve the lubrication.

Special materials are available for rotary seal applications. Trelleborg Sealing Solutions does not recommend the use of O-Rings as rotary seals. Please contact your local Trelleborg Sealing Solutions company for further details.

Technical data

O-Rings can be used in a wide range of applications. Temperature, pressure and media determine the choice of appropriate materials. In order to be able to assess the suitability of the O-Ring as a sealing element for a given application, the interaction of all the operating parameters have to be taken into consideration.

Working Pressure

Static application
- up to 5 MPa for O-Rings with inside diameter > 50 mm without Back-up Ring
  up to 10 MPa for O-Rings with inside diameter
- < 50 mm without Back-up Ring
  (depends on the material, the cross section and the clearance)
- up to 40 MPa with Back-up Ring
- up to 250 MPa with special Back-up Ring

Please note the permissible extrusion gaps.

Dynamic application
- Reciprocating up to 5 MPa without Back-up Ring
- Higher pressures with Back-up Ring

Speed
Reciprocating up to 0.5 m/s
Rotating up to 0.5 m/s
Depending on material and application.

Temperature
From -60 °C to +325 °C
Depending on material and media resistance.

When assessing the application criteria, the peak and continuous operating temperature and the running period must be taken into consideration. For rotating applications the temperature increase due to frictional heat must be taken into account.

Media
With the wide range of the available materials, each with different properties, it is possible to seal against practically all liquids, gases and chemicals. Please note when selecting the most suitable material the information in chapter “B.1 Materials“, and in our O-Ring Material Guide.

Groove design / Groove dimensions
Lead-in chamfers

Correct design can help to eliminate possible sources of damage and seal failure from the outset.

Since O-Ring are squeezed during installation, lead-in chamfers and rounded edges must be provided (Figure 20 and 21).

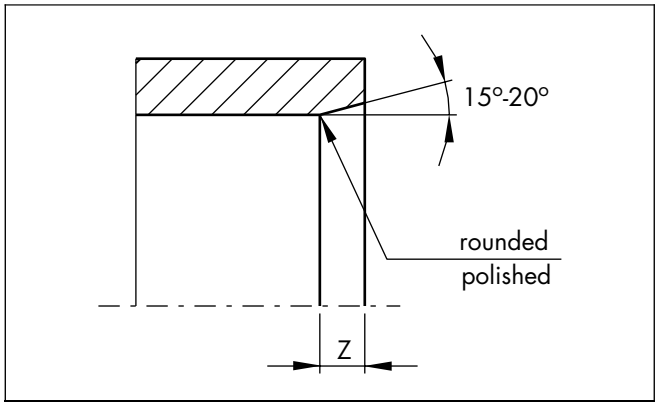


Figure 20 Lead-in chamfers for bores, tubes

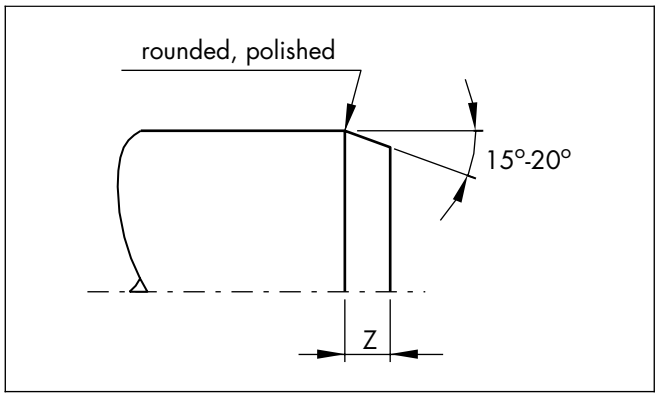


Figure 21 Lead-in chamfers for shafts, rods

The minimum length of the lead-in chamfer is listed in table XI as a function of the cross section d_2.

Table XI Lead-in chamfers

Lead-in chamfers length Z min.		O-Ring cross section d_2
15°	**20°**	
2.5	1.5	up to 1.78 1.80
3.0	2.0	up to 2.62 2.65
3.5	2.5	up to 3.53 3.55
4.5	3.5	up to 5.33 5.30
5.0	4.0	up to 7.00
6.0	4.5	above 7.00

The surface roughness of a lead-in chamfer is:
$R_Z \leq 6.3$ µm $R_a \leq 0.8$ µm

Radial clearance

The tolerances given in table XV and the maximum permissible radial clearance S (extrusion gap) given in the table XII must be maintained.

If the clearance is too large, there is a risk of seal extrusion which can result in the destruction of the O-Ring (Figure 22).

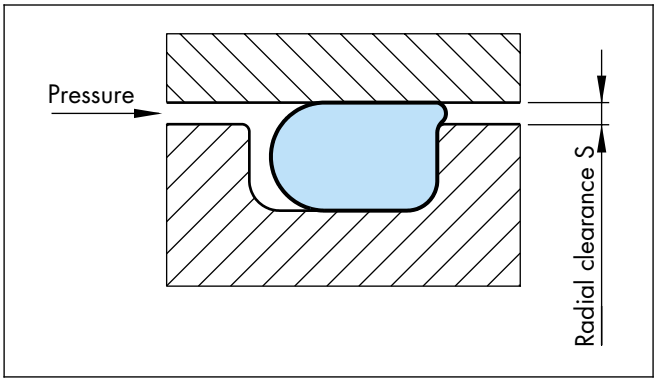


Figure 22 Radial clearance "S"

The permissible radial clearance S between the sealed parts depends on the system pressure, the cross section and the hardness of the O-Ring.

Table XII contains recommendations for the permissible clearance S as a function of O-Ring cross section and shore hardness. The table is valid for elastomeric materials with the exception of polyurethane and FEP encapsulated O-Rings.

For pressure above 5 MPa for O-Rings with Inside diameter > 50 mm and above 10 MPa for O-Rings with Inside diameter < 50 mm we recommend the use of Back-up Rings.

Table XII Radial clearance S

O-Ring cross section d_2	up to 2	2 - 3	3 - 5	5 - 7	above 7
O-Rings with hardness of 70 Shore A					
Pressure MPa	Radial clearance S				
≤ 3.50	0.08	0.09	0.10	0.13	0.15
≤ 7.00	0.05	0.07	0.08	0.09	0.10
≤ 10.50	0.03	0.04	0.05	0.07	0.08
O-Rings with hardness of 90 Shore A					
Pressure MPa	Radial clearance S				
≤ 3.50	0.13	0.15	0.20	0.23	0.25
≤ 7.00	0.10	0.13	0.15	0.18	0.20
≤ 10.50	0.07	0.09	0.10	0.13	0.15
≤ 14.00	0.05	0.07	0.08	0.09	0.10
≤ 17.50	0.04	0.05	0.07	0.08	0.09
≤ 21.00	0.03	0.04	0.05	0.07	0.08
≤ 35.00	0.02	0.03	0.03	0.04	0.04

These values assume that the parts are fitted concentrically to one another and do not expand under pressure. If this is not the case, the clearance should be kept correspondingly smaller.

For static applications we recommend a fit of H8/f7.

O-Rings made from polyurethane can bridge larger clearances thanks to their high extrusion resistance and greater dimensional stability. See also chapter "Polyurethane O-Rings".

Surfaces

Under pressure, elastomers adapt to irregular surfaces. For gas or liquid tight joints, however, certain minimum demands must be made on the surface quality of the surfaces to be sealed.

Fundamentally grooves, scratches, pit marks, concentric or spiral machining scores, etc. are not permissible. Higher demands must be placed on dynamic mating surfaces than on static surfaces.

At present no uniform definitions exist for describing the mating surfaces. In practice, the specification of the R_a value is not sufficient to permit an assessment of the surface quality. Our recommendations therefore contain amongst others various terms and definitions in accordance with DIN 4768 and DIN EN ISO 4287.

Table XIII Surface finish

Type of Load	Surface	R_t µm	R_z µm	R_a µm
Radial-dynamic	Mating surface * (bore, rod, shaft)	1.0 - 2.5	0.63 - 1.6	0.1 - 0.4
	groove flanks, groove diameter	≤ 10.0	≤ 6.3	≤ 1.6
Radial-static Axial-static	Maiting surface groove flanks, groove diameter	≤ 10.0 ≤ 16.0	≤ 6.3	≤ 1.6
	For pulsating pressures Mating surface groove flanks, groove diameter	 ≤ 6.3 ≤ 10.0	 ≤ 6.3	 ≤ 0.8 ≤ 1.6

* spiralfree grinding

The above is for guidance only and covers the majority of sealing applications. However Trelleborg Sealing Solutions should be consulted in areas of particular concern.

Trapezoidal groove

The trapezoidal (dovetail) groove should only be used in special cases, e.g. overhead installation, in order to retain the O-Ring (Figure 23). The installation dimensions are summarised in table XIV. The trapezoidal groove is only recommended for O-Ring cross section from 3.53 mm. The inside diameter of the O-Ring results from the mean groove diameter minus the cross section.

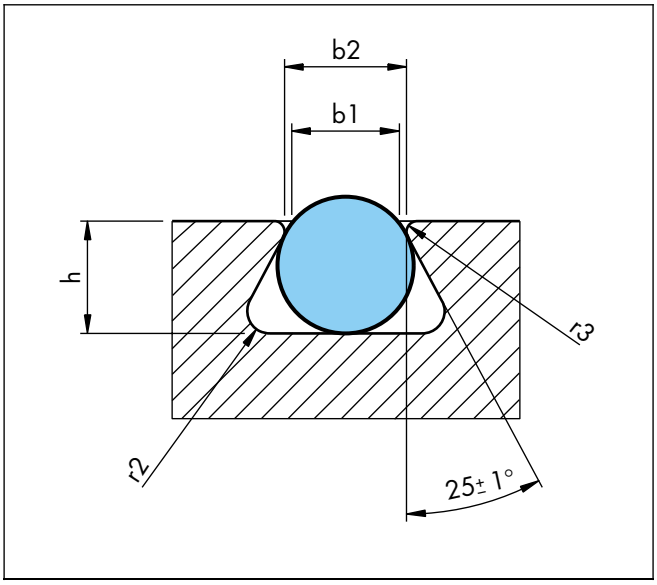


Figure 23 Installation in trapezoidal groove

Table XIV Installation dimensions for trapezoidal groove

O-Ring cross section d2	Groove dimensions				
	Groove width **b1** ±0.05	Groove width **b2** ±0.05	Groove depth **h** ±0.05	Radius (max.)	
				r3	**r2**
3.53 3.55	2.90	3.20	2.90	0.25	0.80
4.00	3.40	3.70	3.20	0.25	0.80
5.00	4.30	4.60	4.20	0.25	0.80
5.33 5.30	4.60	4.90	4.60	0.25	0.80
5.70	4.75	5.25	4.80	0.40	0.80
6.00	5.05	5.55	5.10	0.40	0.80
7.00	6.00	6.50	6.00	0.40	1.60
8.00	6.85	7.45	6.90	0.50	1.60
8.40	7.25	7.85	7.30	0.50	1.60

Rectangular groove

A rectangular groove is preferred for all new designs. Designs with bevelled groove flanks up to 5° are permissible. If Back-up Rings are used, straight groove flanks are necessary.

To reduce risk of extrusion the radius r ideally should not exceed the maximum permissible radial clearance S (see table XII).

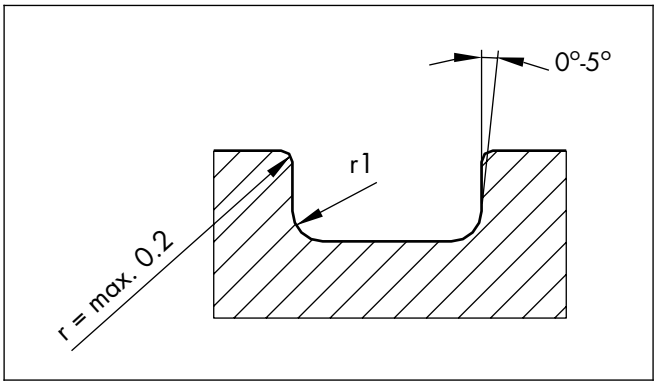


Figure 24 Groove specifications

Installation recommendations

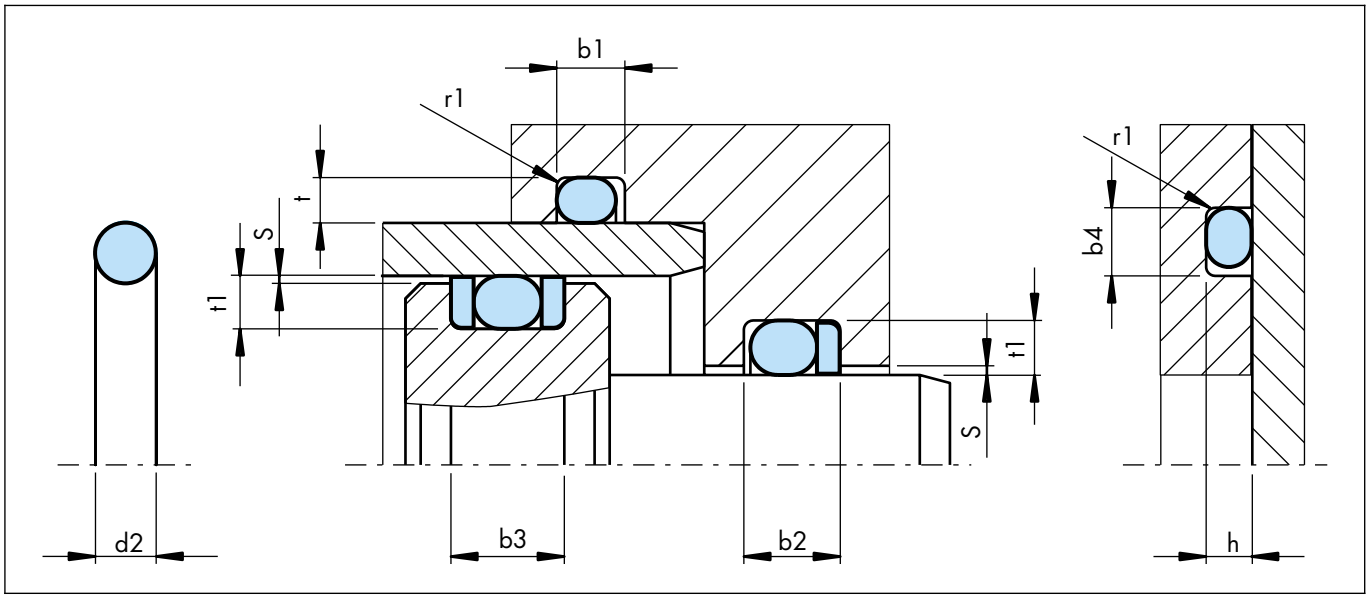


Figure 25 Installation drawing

Gap dimensions, see chapter “Design Recommendations“, page 40

Surface specifications, see chapter “Design Recommendations“, page 41

Table XV Installation dimensions

Cross section	Radial installation			Axial installation		Radius[2)]
	Groove depth		Groove width[1)]	Groove depth	Groove width	
d2	**Dynamic t1** +0.05	**Static t** +0.05	**b1** +0.2	**h** +0.05	**b4** +0.2	**r1**± 0.2
0.50	-	**0.35**	0.80	0.35	0.80	0.20
0.74	-	**0.50**	1.00	0.50	1.00	0.20
1.00	-	**0.70**	1.40	0.70	1.40	0.20
1.02	-	**0.70**	1.40	0.70	1.40	0.20
1.20	-	**0.85**	1.70	0.85	1.70	0.20
1.25	-	**0.90**	1.70	0.90	1.80	0.20
1.27	-	**0.90**	1.70	0.90	1.80	0.20
1.30	-	**0.95**	1.80	0.95	1.80	0.20
1.42	-	**1.05**	1.90	1.05	2.00	0.30
1.50	1.25	**1.10**	2.00	1.10	2.10	0.30
1.52	1.25	**1.10**	2.00	1.10	2.10	0.30
1.60	1.30	**1.20**	2.10	1.20	2.20	0.30
1.63	1.30	**1.20**	2.10	1.20	2.20	0.30
1.78*	1.45	**1.30**	2.40	1.30	2.60	0.30
1.80	1.45	**1.30**	2.40	1.30	2.60	0.30
1.83	1.50	**1.35**	2.50	1.35	2.60	0.30
1.90	1.55	**1.40**	2.60	1.40	2.70	0.30
1.98	1.65	**1.50**	2.70	1.50	2.80	0.30

Cross section	Radial installation			Axial installation		Radius[2)]
	Groove depth		Groove width[1)]	Groove depth	Groove width	
d2	Dynamic t1 +0.05	Static t +0.05	b1 +0.2	h +0.05	b4 +0.2	r1± 0.2
2.00	1.65	**1.50**	2.70	1.50	2.80	0.30
2.08	1.75	**1.55**	2.80	1.55	2.90	0.30
2.10	1.75	**1.55**	2.80	1.55	2.90	0.30
2.20	1.85	**1.60**	3.00	1.60	3.00	0.30
2.26	1.90	**1.70**	3.00	1.70	3.10	0.30
2.30	1.95	**1.75**	3.10	1.75	3.10	0.30
2.34	1.95	**1.75**	3.10	1.75	3.10	0.30
2.40	2.05	**1.80**	3.20	1.80	3.30	0.30
2.46	2.10	**1.85**	3.30	1.85	3.40	0.30
2.50	2.15	**1.90**	3.30	1.85	3.40	0.30
2.62*	2.25	**2.00**	3.60	2.00	3.80	0.30
2.65	2.25	**2.00**	3.60	2.00	3.80	0.30
2.70	2.30	**2.05**	3.60	2.05	3.80	0.30
2.80	2.40	**2.10**	3.70	2.10	3.90	0.60
2.92	2.50	**2.20**	3.90	2.20	4.00	0.60
2.95	2.50	**2.20**	3.90	2.20	4.00	0.60
3.00	2.60	**2.30**	4.00	2.30	4.00	0.60
3.10	2.70	**2.40**	4.10	2.40	4.10	0.60
3.50	3.05	**2.65**	4.60	2.65	4.70	0.60
3.53*	3.10	**2.70**	4.80	2.70	5.00	0.60
3.55	3.10	**2.70**	4.80	2.70	5.00	0.60
3.60	3.15	**2.80**	4.80	2.80	5.10	0.60
4.00	3.50	**3.10**	5.20	3.10	5.30	0.60
4.50	4.00	**3.50**	5.80	3.50	5.90	0.60
5.00	4.40	**4.00**	6.60	4.00	6.70	0.60
5.30	4.70	**4.30**	7.10	4.30	7.30	0.60
5.33*	4.70	**4.30**	7.10	4.30	7.30	0.60
5.50	4.80	**4.50**	7.10	4.50	7.30	0.60
5.70	5.00	**4.60**	7.20	4.60	7.40	0.60
6.00	5.30	**4.90**	7.40	4.90	7.60	0.60
6.50	5.70	**5.40**	8.00	5.40	8.20	1.00
6.99*	6.10	**5.80**	9.50	5.80	9.70	1.00
7.00	6.10	**5.80**	9.50	5.80	9.70	1.00
7.50	6.60	**6.30**	9.70	6.30	9.90	1.00
8.00	7.10	**6.70**	9.80	6.70	10.00	1.00
8.40	7.50	**7.10**	10.00	7.10	10.30	1.00
9.00	8.10	**7.70**	10.60	7.70	10.90	1.50
9.50	8.60	**8.20**	11.00	8.20	11.40	1.50
10.00	9.10	**8.60**	11.60	8.60	12.00	2.00
12.00	11.00	**10.60**	13.50	10.60	14.00	2.00

▭ * Preferred sizes

1) When using Back-up Rings the groove is to be widened by the corresponding Back-up Ring thickness (b2: one Back-up Ring, b3: two Back-up Rings, see figure 25).
2) If a Back-up Ring is used the recommended radius r1 should always be r1=0.25 ±0.2mm.

The given installation dimensions cannot be used for FFKM materials (Isolast®). Please use the Isolast® brochure or contact our specialists for further details.

C Dimensions and product range

C.1 Dimensions and international standards

C.1.1 O-Ring range of sizes

The following table provides a summary of available O-Ring dimensions, TSS part numbers and valid standards.

The table represents a guide to common dimensions with or without a valid standard and makes no claim to be exhaustive. The complete range of sizes is more extensive. Special dimensions are also available on request. Please contact our specialists for further details.

For the given dimensions moulds generally exist. Due to different shrinkage factors of various materials, it may not be possible to process certain materials with the existing moulds.

To guarantee a high and constant quality level it might be necessary to produce new or additional moulds with the corresponding costs.

At the time of publication O-Ring moulds for the dimensions according to AS 568 B (ORAR . . .) exist for standard NBR 70 Shore A and standard FKM 70 Shore A. Subject to alterations.

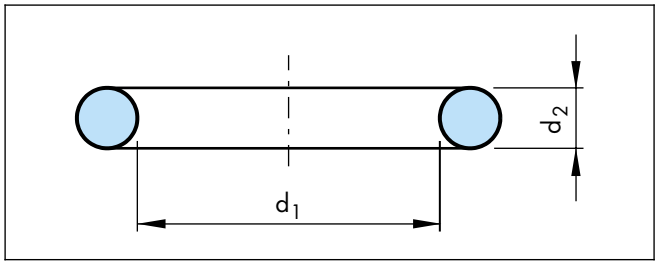
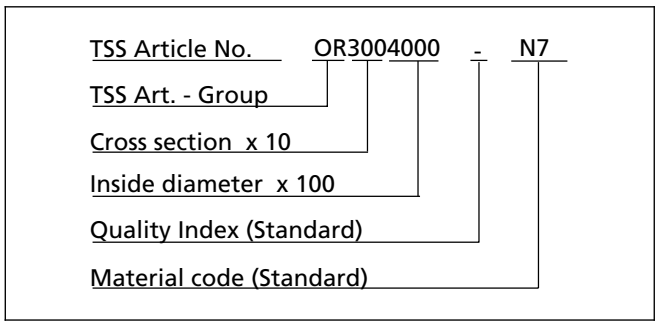


Figure 26 O-Ring dimensions

Ordering example 1

O-Ring, metric 40 x 3

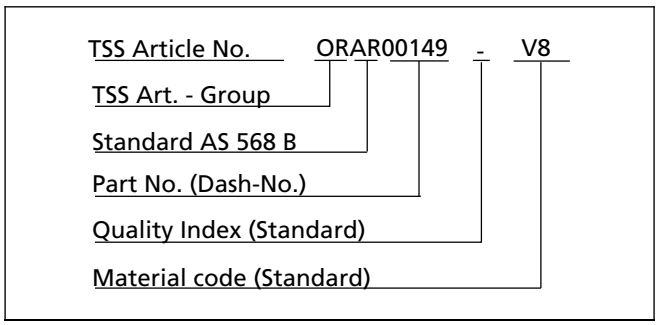
Dimensions:	Inside diameter	= 40.0 mm
	Cross section	= 3.0 mm
Material:	NBR 70 (Nitrile-Butadiene Rubber 70 Shore A)	



Ordering example 2

O-Ring, American Standard AS 568 B, ref. 149

Dimensions:	Inside diameter	= 71.12 mm
	Cross section	= 2.62 mm
Material:	FKM 80 (Fluorocarbon Rubber 80 Shore A)	



O-Ring dimensions and TSS part numbers see tables XVI to XIX.

Material codes (elastomer type) for standard product order see table I (last column).

The required Shore hardness must be given with the order.

When a special material is required the exact five-digit Trelleborg Sealing Solutions material code must be given with the order. In this respect please refer to the information provided in Table X Preferred materials or contact your local Trelleborg Sealing Solutions company.

Table XVI Dimensions / TSS part numbers

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
0.50	1.00	OR1000050									
0.74	1.02	ORAR00001	001	x							
1.00	1.50	OR1500100									
1.07	1.27	ORAR00002	002	x							
1.20	1.00	OR1000120									
1.24	2.62	ORAR00102	102	x							
1.42	1.52	ORAR00003	003	x							
1.50	1.00	OR1000150									
1.50	1.50	OR1500150									
1.78	1.02	ORAR90212		x							
1.78	1.78	ORAR00004	004	x							
1.80	1.00	OR1000180									
1.80	1.20	OR1200180									
1.80	1.80	ORIA00180			x			x			
2.00	1.00	OR1000200									
2.00	1.50	OR1500200									
2.00	1.80	ORIA00200			x			x			
2.06	2.62	ORAR00103	103	x							
2.20	1.00	OR1000220									
2.24	1.80	ORIA00224			x			x			
2.40	1.90	OR1900240							R0		
2.50	1.00	OR1000250									
2.50	1.20	OR1200250									
2.50	1.30	OR1300250									
2.50	1.50	OR1500250									
2.50	1.60	OR1600250									
2.50	1.80	ORIA00250			x			x			
2.57	1.78	ORAR00005	005	x							
2.60	1.00	OR1000260									
2.60	1.20	OR1200260									
2.60	1.30	OR1300260									
2.60	1.90	OR1900260							R1		
2.70	1.60	OR1600270									
2.80	1.60	OR1600280									
2.80	1.80	ORIA00280			x			x			
2.80	1.90	OR1900280					P3				

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
2.84	2.62	ORAR00104	104	x							
2.90	1.78	ORAR00006	006	x							
3.00	1.00	OR1000300									
3.00	1.50	OR1500300									
3.00	2.00	OR2000300									
3.00	2.40	OR2400300									
3.00	2.70	OR2700300									
3.00	3.00	OR3000300									
3.10	1.60	OR1600310				x					x
3.15	1.80	ORIA00315			x			x			
3.20	1.60	OR1600320									
3.20	1.80	ORIA00320									
3.20	2.50	OR2500320									
3.30	1.00	OR1000330									
3.30	1.50	OR1500330									
3.30	2.40	OR2400330				x					x
3.40	1.90	OR1900340							R2		
3.50	1.00	OR1000350									
3.50	1.20	OR1200350									
3.50	1.50	OR1500350									
3.50	2.00	OR2000350									
3.55	1.80	ORIA00355			x			x			
3.60	2.40	OR2400360									x
3.63	2.62	ORAR00105	105	x							
3.68	1.78	ORAR00007	007	x							
3.70	1.90	OR1900370									
3.80	1.50	OR1500380									
3.80	1.90	OR1900380					P4				
3.90	1.80	ORIA00390									
4.00	1.00	OR1000400									
4.00	1.20	OR1200400									
4.00	1.50	OR1500400									
4.00	1.80	ORIA00400			x			x			
4.00	2.00	OR2000400									
4.00	2.50	OR2500400									
4.00	3.00	OR3000400									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
4.00	4.00	OR4000400									
4.10	1.60	OR1600410				x					x
4.20	1.90	OR1900420							R3		
4.30	2.40	OR2400430									x
4.34	3.53	ORAR00201	201	x							
4.42	2.62	ORAR00106	106	x							
4.47	1.78	ORAR00008	008	x							
4.50	1.00	OR1000450									
4.50	1.50	OR1500450									
4.50	2.00	OR2000450									
4.50	2.50	OR2500450									
4.60	2.00	OR2000460									
4.60	2.40	OR2400460									x
4.70	1.00	OR1000470									
4.70	1.42	ORAR00901	901	x							
4.80	1.80	ORIA00480									
4.80	1.90	OR1900480					P5				
4.87	1.80	ORIA00487			x			x			
4.90	1.90	OR1900490							R4		
5.00	1.00	OR1000500									
5.00	1.20	OR1200500									
5.00	1.50	OR1500500									
5.00	1.80	ORIA00500			x			x			
5.00	2.00	OR2000500									
5.00	2.50	OR2500500									
5.00	3.00	OR3000500									
5.00	5.00	OR5000500									
5.10	1.60	OR1600510				x					x
5.15	1.80	ORIA00515			x			x			
5.23	2.62	ORAR00107	107	x							
5.28	1.78	ORAR00009	009	x							
5.30	1.80	ORIA00530			x			x			
5.30	2.40	OR2400530				x					x
5.50	1.00	OR1000550									
5.50	1.50	OR1500550									
5.50	1.60	OR1600550									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
5.50	2.00	OR2000550									
5.60	1.80	ORIA00560			x			x			
5.60	2.40	OR2400560									x
5.70	1.90	OR1900570							R5		
5.80	1.90	OR1900580					P6				
5.94	3.53	ORAR00202	202	x							
6.00	1.00	OR1000600									
6.00	1.50	OR1500600									
6.00	1.80	ORIA00600			x			x			
6.00	2.00	OR2000600									
6.00	2.20	OR2200600									
6.00	2.50	OR2500600									
6.00	3.00	OR3000600									
6.02	2.62	ORAR00108	108	x							
6.07	1.63	ORAR00902	902	x							
6.07	1.78	ORAR00010	010	x							
6.10	1.60	OR1600610				x				x	x
6.30	1.80	ORIA00630			x			x			
6.30	2.40	OR2400630				x					x
6.40	1.90	OR1900640							R5A		
6.50	1.50	OR1500650									
6.50	1.60	OR1600650									
6.50	2.00	OR2000650									
6.50	3.00	OR3000650									
6.50	5.00	OR5000650									
6.60	1.60	OR1600660									
6.60	2.40	OR2400660									x
6.70	1.80	ORIA00670			x			x			
6.80	1.90	OR1900680					P7				
6.90	1.80	ORIA00690			x			x			
7.00	1.00	OR1000700									
7.00	1.20	OR1200700									
7.00	1.30	OR1300700									
7.00	1.50	OR1500700									
7.00	1.80	ORIA00700									
7.00	2.00	OR2000700									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
7.00	2.50	OR2500700									
7.00	3.00	OR3000700									
7.00	4.00	OR4000700									
7.10	1.60	OR1600710				x					x
7.10	1.80	ORIA00710			x			x			
7.20	1.90	OR1900720							R6		
7.30	2.40	OR2400730				x					x
7.50	1.50	OR1500750									
7.50	1.80	ORIA00750			x			x			
7.50	2.00	OR2000750									
7.50	2.50	OR2500750									
7.52	3.53	ORAR00203	203	x							
7.59	2.62	ORAR00109	109	x							
7.60	2.40	OR2400760									x
7.65	1.63	ORAR00903	903	x							
7.65	1.78	ORAR00011	011	x							
7.80	1.90	OR1900780					P8				
8.00	1.00	OR1000800									
8.00	1.50	OR1500800									
8.00	1.60	OR1600800									
8.00	1.80	ORIA00800			x			x			
8.00	1.90	OR1900800							R6A		
8.00	2.00	OR2000800									
8.00	2.20	OR2200800									
8.00	2.40	OR2400800									
8.00	2.50	OR2500800									
8.00	3.00	OR3000800									
8.00	3.50	OR3500800									
8.00	4.00	OR4000800									
8.00	4.50	OR4500800									
8.00	5.00	OR5000800									
8.10	1.60	OR1600810				x				x	x
8.30	2.40	OR2400830				x					x
8.50	1.00	OR1000850									
8.50	1.50	OR1500850									
8.50	1.80	ORIA00850			x			x			

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
8.50	2.00	OR2000850									
8.50	2.50	OR2500850									
8.50	3.00	OR3000850									
8.60	2.40	OR2400860									x
8.75	1.80	ORIA00875			x			x			
8.80	1.90	OR1900880					P9				
8.90	1.90	OR1900890							R7		
8.90	2.70	OR2700890							R8		
8.92	1.83	ORAR00904	904	x							
9.00	1.00	OR1000900									
9.00	1.20	OR1200900									
9.00	1.50	OR1500900									
9.00	1.80	ORIA00900			x			x			
9.00	2.00	OR2000900									
9.00	2.50	OR2500900									
9.00	3.00	OR3000900									
9.00	4.00	OR4000900									
9.00	4.50	OR4500900									
9.00	6.00	OR6000900									
9.10	1.60	OR1600910				x					x
9.12	3.53	ORAR00204	204	x							
9.19	2.62	ORAR00110	110	x							
9.25	1.78	ORAR00012	012	x							
9.30	2.20	OR2200930								x	
9.30	2.40	OR2400930				x					x
9.50	1.00	OR1000950									
9.50	1.50	OR1500950									
9.50	1.60	OR1600950									
9.50	1.80	ORIA00950			x			x			
9.50	2.00	OR2000950									
9.50	2.50	OR2500950									
9.50	3.00	OR3000950									
9.60	2.40	OR2400960									x
9.80	1.90	OR1900980					P10				
9.80	2.40	OR2400980					P10A				
10.00	1.00	OR1001000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
10.00	1.50	OR1501000									
10.00	1.80	ORIA01000			x			x			
10.00	2.00	OR2001000									
10.00	2.40	OR2401000									
10.00	2.50	OR2501000									
10.00	3.00	OR3001000									
10.00	3.50	OR3501000									
10.00	4.00	OR4001000									
10.00	5.00	OR5001000									
10.10	1.60	OR1601010				x					x
10.30	2.40	OR2401030				x					x
10.46	5.33	ORAR00309	309	x							
10.50	1.50	OR1501050									
10.50	2.70	OR2701050							R9		
10.52	1.83	ORAR00905	905	x							
10.60	1.80	ORIA01060			x			x			
10.60	2.40	OR2401060									x
10.69	3.53	ORAR00205	205	x							
10.77	2.62	ORAR00111	111	x							
10.80	2.40	OR2401080					P11				
10.82	1.78	ORAR00013	013	x							
11.00	1.00	OR1001100									
11.00	1.50	OR1501100									
11.00	2.00	OR2001100									
11.00	2.40	OR2401100					P11.2				
11.00	2.50	OR2501100									
11.00	3.00	OR3001100									
11.00	3.50	OR3501100									
11.00	4.00	OR4001100									
11.10	1.60	OR1601110				x					x
11.20	1.80	ORIA01120			x			x			
11.30	2.20	OR2201130								x	
11.30	2.40	OR2401130				x					x
11.60	2.40	OR2401160									x
11.80	1.80	ORIA01180			x			x			
11.80	2.40	OR2401180					P12				

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
11.89	1.98	ORAR00906	906	x							
12.00	1.00	OR1001200									
12.00	1.50	OR1501200									
12.00	2.00	OR2001200									
12.00	2.50	OR2501200									
12.00	3.00	OR3001200									
12.00	4.00	OR4001200									
12.00	4.50	OR4501200									
12.00	5.00	OR5001200									
12.07	5.33	ORAR00310	310	x							
12.10	1.60	OR1601210				x					x
12.10	2.70	OR2701210							R10		
12.29	3.53	ORAR00206	206	x							
12.30	2.40	OR2401230				x					x
12.37	2.62	ORAR00112	112	x							
12.42	1.78	ORAR00014	014	x							
12.50	1.50	OR1501250									
12.50	1.80	ORIA01250			x			x			
12.50	2.00	OR2001250									
12.50	2.50	OR2501250									
12.60	2.40	OR2401260									x
13.00	1.00	OR1001300									
13.00	1.50	OR1501300									
13.00	2.00	OR2001300									
13.00	2.50	OR2501300									
13.00	3.00	OR3001300									
13.00	3.50	OR3501300									
13.00	4.00	OR4001300									
13.10	1.60	OR1601310				x					x
13.20	1.80	ORIA01320			x			x			
13.30	2.20	OR2201330								x	
13.30	2.40	OR2401330				x					x
13.46	2.08	ORAR00907	907	x							
13.60	2.40	OR2401360									x
13.60	2.70	OR2701360							R11		
13.64	5.33	ORAR00311	311	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
13.80	2.40	OR2401380					P14				
13.87	3.53	ORAR00207	207	x							
13.94	2.62	ORAR00113	113	x							
14.00	1.00	OR1001400									
14.00	1.50	OR1501400									
14.00	1.60	OR1601400									
14.00	1.78	ORAR00015	015	x							
14.00	1.80	ORIA01400			x			x			
14.00	2.00	OR2001400									
14.00	2.40	OR2401400									
14.00	2.50	OR2501400									
14.00	2.65	ORIB01400			x			x			
14.00	2.70	OR2701400									
14.00	3.00	OR3001400									
14.00	4.00	OR4001400									
14.00	5.00	OR5001400									
14.10	1.60	OR1601410				x					x
14.30	2.40	OR2401430				x					x
14.80	2.40	OR2401480					P15				x
15.00	1.00	OR1001500									
15.00	1.50	OR1501500									
15.00	1.80	ORIA01500			x			x			
15.00	2.00	OR2001500									
15.00	2.50	OR2501500									
15.00	2.65	ORIB01500			x			x			
15.00	3.00	OR3001500									
15.00	3.50	OR3501500									
15.00	4.00	OR4001500									
15.00	5.00	OR5001500									
15.00	6.00	OR6001500									
15.00	7.00	OR7001500									
15.10	1.60	OR1601510				x					x
15.10	2.70	OR2701510							R12		
15.24	5.33	ORAR00312	312	x							
15.30	2.20	OR2201530								x	
15.30	2.40	OR2401530				x					x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
15.47	3.53	ORAR00208	208	x							
15.54	2.62	ORAR00114	114	x							
15.60	1.78	ORAR00016	016	x							
15.60	2.40	OR2401560									x
15.80	2.40	OR2401580					P16				
16.00	1.00	OR1001600									
16.00	1.50	OR1501600									
16.00	1.80	ORIA01600			x			x			
16.00	2.00	OR2001600									
16.00	2.50	OR2501600									
16.00	2.65	ORIB01600			x			x			
16.00	3.00	OR3001600									
16.00	3.50	OR3501600									
16.00	4.00	OR4001600									
16.00	4.50	OR4501600									
16.00	5.00	OR5001600									
16.10	1.60	OR1601610				x					x
16.30	2.40	OR2401630				x					x
16.36	2.20	ORAR00908	908	x							
16.81	5.33	ORAR00313	313	x							
16.90	2.70	OR2701690							R13		
17.00	1.00	OR1001700									
17.00	1.50	OR1501700									
17.00	1.80	ORIA01700			x			x			
17.00	2.00	OR2001700									
17.00	2.50	OR2501700									
17.00	2.65	ORIB01700			x			x			
17.00	3.00	OR3001700									
17.00	3.50	OR3501700									
17.00	4.00	OR4001700									
17.00	5.00	OR5001700									
17.04	3.53	ORAR00209	209	x							
17.10	1.60	OR1601710				x					x
17.12	2.62	ORAR00115	115	x							
17.17	1.78	ORAR00017	017	x							
17.20	3.00	OR3001720								x	

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
17.30	2.20	OR2201730								x	
17.30	2.40	OR2401730				x					x
17.60	2.40	OR2401760									x
17.80	2.40	OR2401780					P18				
17.93	2.46	ORAR00909	909	x							
18.00	1.00	OR1001800									
18.00	1.50	OR1501800									
18.00	2.00	OR2001800									
18.00	2.50	OR2501800									
18.00	2.65	ORIB01800			x			x			
18.00	3.00	OR3001800									
18.00	3.50	OR3501800									
18.00	3.55	ORIC01800			x			x			
18.00	4.00	OR4001800									
18.00	4.50	OR4501800									
18.00	5.00	OR5001800									
18.10	1.60	OR1601810				x					x
18.20	3.00	OR3001820									x
18.30	2.40	OR2401830									x
18.30	3.60	OR3601830							R15		
18.40	2.70	OR2701840							R14		
18.42	5.33	ORAR00314	314	x							
18.60	2.40	OR2401860									x
18.64	3.53	ORAR00210	210	x							
18.72	2.62	ORAR00116	116	x							
18.77	1.78	ORAR00018	018	x							
19.00	1.00	OR1001900									
19.00	1.50	OR1501900									
19.00	1.80	ORIA01900									
19.00	2.00	OR2001900									
19.00	2.50	OR2501900									
19.00	2.65	ORIB01900			x			x			
19.00	3.50	OR3501900									
19.00	3.55	ORIC01900			x			x			
19.00	4.00	OR4001900									
19.00	5.00	OR5001900									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
19.00	6.00	OR6001900									
19.10	1.60	OR1601910				x					x
19.18	2.46	ORAR00910	910	x							
19.20	3.00	OR3001920				x					x
19.30	2.20	OR2201930								x	
19.30	2.40	OR2401930									x
19.50	3.00	OR3001950									x
19.60	2.40	OR2401960									x
19.80	2.40	OR2401980					P20				
19.80	3.60	OR3601980							R16		
19.99	5.33	ORAR00315	315	x							
20.00	1.00	OR1002000									
20.00	1.30	OR1302000									
20.00	1.50	OR1502000									
20.00	2.00	OR2002000									
20.00	2.50	OR2502000									
20.00	2.65	ORIB02000			x			x			
20.00	3.00	OR3002000									
20.00	3.50	OR3502000									
20.00	3.55	ORIC02000			x			x			
20.00	4.00	OR4002000									
20.00	4.50	OR4502000									
20.00	5.00	OR5002000									
20.00	6.00	OR6002000									
20.10	1.60	OR1602010									x
20.20	3.00	OR3002020									x
20.22	3.53	ORAR00211	211	x							
20.29	2.62	ORAR00117	117	x							
20.30	2.40	OR2402030									x
20.35	1.78	ORAR00019	019	x							
20.60	2.40	OR2402060									x
20.80	2.40	OR2402080					P21				
21.00	2.00	OR2002100									
21.00	2.50	OR2502100									
21.00	3.00	OR3002100									
21.00	4.00	OR4002100									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
21.00	6.00	OR6002100									
21.10	1.60	OR1602110									x
21.20	2.65	ORIB02120			x			x			
21.20	3.00	OR3002120									x
21.20	3.55	ORIC02120			x			x			
21.30	2.40	OR2402130									
21.30	3.60	OR3602130							R17		
21.50	3.00	OR3002150									x
21.59	5.33	ORAR00316	316	x							
21.60	2.40	OR2402160									x
21.70	3.50	OR3502170					P22A				
21.80	2.40	OR2402180					P22				
21.82	3.53	ORAR00212	212	x							
21.89	2.62	ORAR00118	118	x							
21.92	2.95	ORAR00911	911	x							
21.95	1.78	ORAR00020	020	x							
22.00	1.00	OR1002200									
22.00	1.30	OR1302200									
22.00	1.50	OR1502200									
22.00	2.00	OR2002200									
22.00	2.50	OR2502200									
22.00	3.00	OR3002200									
22.00	3.50	OR3502200									
22.00	4.00	OR4002200									
22.00	4.50	OR4502200									
22.00	5.00	OR5002200									
22.00	6.00	OR6002200									
22.10	1.60	OR1602210				x					x
22.10	3.50	OR3502210					P22.4				
22.20	3.00	OR3002220				x					x
22.30	2.40	OR2402230									x
22.40	2.65	ORIB02240			x			x			
22.40	3.55	ORIC02240			x			x			
22.50	3.00	OR3002250									x
23.00	1.00	OR1002300									
23.00	1.50	OR1502300									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
23.00	2.00	OR2002300									
23.00	2.50	OR2502300									
23.00	3.00	OR3002300									
23.00	3.60	OR3602300							R18		
23.00	4.00	OR4002300									
23.00	5.00	OR5002300									
23.00	5.50	OR5502300									
23.00	6.00	OR6002300									
23.16	5.33	ORAR00317	317	x							
23.30	2.40	OR2402330									x
23.39	3.53	ORAR00213	213	x							
23.47	2.62	ORAR00119	119	x							
23.47	2.95	ORAR00912	912	x							
23.52	1.78	ORAR00021	021	x							
23.60	2.65	ORIB02360			x			x			
23.60	2.90	OR2902360								x	
23.60	3.55	ORIC02360			x			x			
23.70	3.50	OR3502370					P24				
24.00	1.00	OR1002400									
24.00	1.50	OR1502400									
24.00	2.00	OR2002400									
24.00	2.50	OR2502400									
24.00	3.00	OR3002400									
24.00	3.50	OR3502400									
24.00	4.00	OR4002400									
24.00	5.00	OR5002400									
24.00	6.00	OR6002400									
24.20	3.00	OR3002420				x					x
24.40	3.10	OR3102440					G25				
24.50	3.00	OR3002450									x
24.60	2.40	OR2402460									x
24.60	3.60	OR3602460							R19		
24.70	3.50	OR3502470					P25				
24.77	5.33	ORAR00318	318	x							
24.99	3.53	ORAR00214	214	x							
25.00	1.00	OR1002500									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
25.00	1.50	OR1502500									
25.00	2.00	OR2002500									
25.00	2.50	OR2502500									
25.00	2.65	ORIB02500			x			x			
25.00	3.00	OR3002500									
25.00	3.55	ORIC02500			x			x			
25.00	4.00	OR4002500									
25.00	4.50	OR4502500									
25.00	5.00	OR5002500									
25.00	6.00	OR6002500									
25.04	2.95	ORAR00913	913	x							
25.07	2.62	ORAR00120	120	x							
25.10	1.60	OR1602510				x					x
25.12	1.78	ORAR00022	022	x							
25.20	3.00	OR3002520									x
25.20	3.50	OR3502520					P25.5				
25.30	2.40	OR2402530									x
25.50	3.00	OR3002550									x
25.70	3.50	OR3502570					P26				
25.80	2.65	ORIB02580			x			x			
25.80	3.55	ORIC02580			x			x			
26.00	1.00	OR1002600									
26.00	1.50	OR1502600									
26.00	2.00	OR2002600									
26.00	2.50	OR2502600									
26.00	3.50	OR3502600									
26.00	4.00	OR4002600									
26.00	5.00	OR5002600									
26.00	6.00	OR6002600									
26.20	3.00	OR3002620				x					x
26.20	3.60	OR3602620							R20		
26.34	5.33	ORAR00319	319	x							
26.50	3.00	OR3002650									x
26.57	3.53	ORAR00215	215	x							
26.62	2.95	ORAR00914	914	x							
26.64	2.62	ORAR00121	121	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
26.70	1.78	ORAR00023	023	x							
27.00	1.50	OR1502700									
27.00	2.00	OR2002700									
27.00	2.50	OR2502700									
27.00	3.00	OR3002700									
27.00	4.00	OR4002700									
27.00	4.50	OR4502700									
27.00	5.00	OR5002700									
27.00	6.00	OR6002700									
27.10	1.60	OR1602710				x					x
27.30	2.40	OR2402730									x
27.50	3.00	OR3002750									x
27.60	2.40	OR2402760									x
27.70	3.50	OR3502770					P28				
27.80	3.60	OR3602780							R21		
27.94	5.33	ORAR00320	320	x							
28.00	1.00	OR1002800									
28.00	1.50	OR1502800									
28.00	2.00	OR2002800									
28.00	2.50	OR2502800									
28.00	2.65	ORIB02800			x			x			
28.00	3.00	OR3002800									
28.00	3.55	ORIC02800			x			x			
28.00	4.00	OR4002800									
28.00	5.00	OR5002800									
28.00	6.00	OR6002800									
28.17	3.53	ORAR00216	216	x							
28.24	2.62	ORAR00122	122	x							
28.30	1.78	ORAR00024	024	x							
28.70	3.50	OR3502870					P29				
29.00	1.50	OR1502900									
29.00	2.00	OR2002900									
29.00	2.50	OR2502900									
29.00	3.00	OR3002900									
29.00	3.50	OR3502900									
29.00	5.00	OR5002900									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
29.10	1.60	OR1602910				x					x
29.20	3.00	OR3002920				x					x
29.20	3.50	OR3502920					P29.5				
29.30	3.60	OR3602930							R22		
29.40	3.10	OR3102940					G30				
29.50	1.50	OR1502950									
29.50	3.00	OR3002950									x
29.50	4.50	OR4502950									
29.51	5.33	ORAR00321	321	x							
29.60	2.40	OR2402960									x
29.60	2.90	OR2902960								x	
29.70	3.50	OR3502970					P30				
29.74	2.95	ORAR00916	916	x							
29.74	3.53	ORAR00217	217	x							
29.82	2.62	ORAR00123	123	x							
29.87	1.78	ORAR00025	025	x							
30.00	1.00	OR1003000									
30.00	1.50	OR1503000									
30.00	2.00	OR2003000									
30.00	2.50	OR2503000									
30.00	2.65	ORIB03000			x			x			
30.00	3.00	OR3003000									
30.00	3.50	OR3503000									
30.00	3.55	ORIC03000			x			x			
30.00	4.00	OR4003000									
30.00	4.50	OR4503000									
30.00	5.00	OR5003000									
30.00	6.00	OR6003000									
30.00	7.00	ORIE03000									
30.20	3.00	OR3003020									x
30.30	2.40	OR2403030									x
30.70	3.50	OR3503070					P31				
30.80	3.60	OR3603080							R23		
31.00	1.50	OR1503100									
31.00	2.00	OR2003100									
31.00	2.50	OR2503100									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
31.00	3.00	OR3003100									
31.00	3.50	OR3503100									
31.00	4.00	OR4003100									
31.12	5.33	ORAR00322	322				P31.5				
31.20	3.00	OR3003120									x
31.20	3.50	OR3503120									
31.34	3.53	ORAR00218	218	x							
31.42	2.62	ORAR00124	124	x							
31.47	1.78	ORAR00026	026	x							
31.50	2.65	ORIB03150			x			x			
31.50	3.00	OR3003150									x
31.50	3.55	ORIC03150			x			x			
31.60	2.40	OR2403160									x
31.70	3.50	OR3503170					P32				
32.00	1.00	OR1003200									
32.00	1.50	OR1503200									
32.00	2.00	OR2003200									
32.00	2.50	OR2503200									
32.00	3.00	OR3003200									
32.00	3.50	OR3503200									
32.00	4.00	OR4003200									
32.00	5.00	OR5003200									
32.10	1.60	OR1603210				x					x
32.20	3.00	OR3003220				x					x
32.50	2.65	ORIB03250			x			x			
32.50	3.00	OR3003250									x
32.50	3.55	ORIC03250			x			x			
32.50	3.60	OR3603250							R24		
32.69	5.33	ORAR00323	323	x							
32.92	3.53	ORAR00219	219	x							
32.99	2.62	ORAR00125	125	x							
33.00	1.50	OR1503300									
33.00	2.00	OR2003300									
33.00	2.50	OR2503300									
33.00	3.00	OR3003300									
33.00	3.50	OR3503300									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
33.00	4.00	OR4003300									
33.05	1.78	ORAR00027	027	x							
33.30	2.40	OR2403330									x
33.50	2.65	ORIB03350			x			x			
33.50	3.55	ORIC03350			x			x			
33.70	3.50	OR3503370					P34				
34.00	1.00	OR1003400									
34.00	2.00	OR2003400									
34.00	2.30	OR2303400									
34.00	2.50	OR2503400									
34.00	3.00	OR3003400									
34.00	4.00	OR4003400									
34.00	5.00	OR5003400									
34.00	6.00	OR6003400									
34.10	3.60	OR3603410							R25		
34.20	3.00	OR3003420				x					x
34.29	5.33	ORAR00324	324	x							
34.40	3.10	OR3103440					G35				
34.42	2.95	ORAR00918	918	x							
34.50	2.65	ORIB03450			x			x			
34.50	3.00	OR3003450									x
34.50	3.55	ORIC03450			x			x			
34.52	3.53	ORAR00220	220	x							
34.59	2.62	ORAR00126	126	x							
34.60	2.40	OR2403460									x
34.65	1.78	ORAR00028	028	x							
34.70	3.50	OR3503470					P35				
35.00	1.50	OR1503500									
35.00	2.00	OR2003500									
35.00	2.50	OR2503500									
35.00	3.00	OR3003500									
35.00	3.50	OR3503500									
35.00	4.00	OR4003500									
35.00	5.00	OR5003500									
35.00	6.00	OR6003500									
35.00	7.00	ORIE03500									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
35.10	1.60	OR1603510				x					x
35.20	3.00	OR3003520									x
35.20	3.50	OR3503520					P35.5				
35.20	5.70	OR5703520									x
35.50	2.65	ORIB03550			x			x			
35.50	3.00	OR3003550									x
35.50	3.55	ORIC03550			x			x			
35.60	2.40	OR2403560									x
35.60	3.60	OR3603560							R26		
35.70	3.50	OR3503570					P36				
36.00	1.50	OR1503600									
36.00	2.00	OR2003600									
36.00	2.50	OR2503600									
36.00	3.00	OR3003600									
36.00	4.00	OR4003600									
36.00	4.50	OR4503600									
36.00	5.00	OR5003600									
36.00	6.00	OR6003600									
36.09	3.53	ORAR00221	221	x							
36.17	2.62	ORAR00127	127	x							
36.20	3.00	OR3003620				x					x
36.20	5.70	OR5703620									x
36.50	2.65	ORIB03650			x			x			
36.50	3.55	ORIC03650			x			x			
37.00	2.00	OR2003700									
37.00	2.50	OR2503700									
37.00	3.00	OR3003700									
37.00	3.50	OR3503700									
37.10	1.60	OR1603710				x					x
37.20	3.00	OR3003720									x
37.20	5.70	OR5703720									x
37.30	3.60	OR3603730							R27		
37.47	3.00	ORAR00920	920	x							
37.47	5.33	ORAR00325	325	x					R28		
37.50	2.65	ORIB03750			x			x			
37.50	3.00	OR3003750									x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
37.50	3.55	ORIC03750			x			x			
37.60	2.40	OR2403760									x
37.69	3.53	ORAR00222	222	x							
37.70	3.50	OR3503770					P38				
37.77	2.62	ORAR00128	128	x							
37.82	1.78	ORAR00029	029	x							
38.00	1.00	OR1003800									
38.00	1.50	OR1503800									
38.00	2.00	OR2003800									
38.00	2.50	OR2503800									
38.00	3.00	OR3003800									
38.00	3.50	OR3503800									
38.00	4.00	OR4003800									
38.00	4.50	OR4503800									
38.00	5.00	OR5003800									
38.00	6.00	OR6003800									
38.00	7.00	ORIE03800									
38.60	2.90	OR2903860								x	
38.70	2.65	ORIB03870			x			x			
38.70	3.50	OR3503870					P39				
38.70	3.55	ORIC03870			x			x			
39.00	1.50	OR1503900									
39.00	2.00	OR2003900									
39.00	2.50	OR2503900									
39.00	3.00	OR3003900									
39.00	4.00	OR4003900									
39.00	5.50	OR5503900									
39.20	3.00	OR3003920				x					x
39.20	5.70	OR5703920									x
39.34	2.62	ORAR00129	129	x							
39.40	3.10	OR3103940					G40				
39.50	3.00	OR3003950									x
39.60	2.40	OR2403960									x
39.70	3.50	OR3503970					P40				
40.00	1.00	OR1004000									
40.00	1.50	OR1504000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
40.00	2.00	OR2004000									
40.00	2.50	OR2504000									
40.00	3.00	OR3004000									
40.00	3.50	OR3504000									
40.00	3.55	ORIC04000			x			x			
40.00	4.00	OR4004000									
40.00	4.50	OR4504000									
40.00	5.00	OR5004000									
40.00	5.30	ORID04000			x			x			
40.00	5.50	OR5504000									
40.00	6.00	OR6004000									
40.00	7.00	ORIE04000									
40.00	7.50	OR7504000									
40.20	3.00	OR3004020									x
40.64	5.33	ORAR00326	326	x					R29		
40.70	3.50	OR3504070					P41				
40.87	3.53	ORAR00223	223	x							
40.94	2.62	ORAR00130	130	x							
41.00	1.78	ORAR00030	030	x							
41.00	2.00	OR2004100									
41.00	3.00	OR3004100									
41.00	4.00	OR4004100									
41.00	7.50	OR7504100									
41.20	3.55	ORIC04120			x			x			
41.20	5.30	ORID04120			x			x			
41.20	5.70	OR5704120									x
41.50	3.00	OR3004150									x
41.60	2.40	OR2404160									x
41.70	3.50	OR3504170					P42				
42.00	1.00	OR1004200									
42.00	1.50	OR1504200									
42.00	2.00	OR2004200									
42.00	2.50	OR2504200									
42.00	3.00	OR3004200									
42.00	3.50	OR3504200									
42.00	4.00	OR4004200									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
42.00	4.50	OR4504200									
42.00	5.00	OR5004200									
42.00	6.00	OR6004200									
42.20	3.00	OR3004220				x					x
42.50	3.55	ORIC04250			x			x			x
42.50	5.30	ORID04250			x			x			
42.52	2.62	ORAR00131	131	x							
43.00	1.60	OR1604300									
43.00	2.00	OR2004300									
43.00	2.50	OR2504300									
43.00	3.00	OR3004300									
43.00	3.50	OR3504300									
43.00	6.00	OR6004300									
43.69	3.00	ORAR00924	924	x							
43.70	3.50	OR3504370					P44				
43.70	3.55	ORIC04370			x			x			
43.70	5.30	ORID04370			x			x			
43.82	5.33	ORAR00327	327	x					R30		
44.00	2.00	OR2004400									
44.00	2.50	OR2504400									
44.00	3.00	OR3004400									
44.00	4.00	OR4004400									
44.00	4.50	OR4504400									
44.00	5.00	OR5004400									
44.00	6.00	OR6004400									
44.04	3.53	ORAR00224	224	x							
44.12	2.62	ORAR00132	132	x							
44.17	1.78	ORAR00031	031	x							
44.20	3.00	OR3004420				x					x
44.30	5.70	OR5704420				x					x
44.40	3.10	OR3104440					G45				
44.50	3.00	OR3004450									x
44.60	2.40	OR2404460									x
44.60	2.90	OR2904460								x	
44.70	3.50	OR3504470					P45				
45.00	1.00	OR1004500									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
45.00	1.50	OR1504500									
45.00	2.00	OR2004500									
45.00	2.50	OR2504500									
45.00	3.00	OR3004500									
45.00	3.50	OR3504500									
45.00	3.55	ORIC04500			x			x			
45.00	4.00	OR4004500									
45.00	4.50	OR4504500									
45.00	5.00	OR5004500									
45.00	5.30	ORID04500			x			x			
45.00	5.50	OR5504500									
45.00	6.00	OR6004500									
45.00	7.00	ORIE04500									
45.20	3.00	OR3004520									x
45.30	5.70	OR5704530									x
45.60	2.40	OR2404560									x
45.69	2.62	ORAR00133	133	x							
45.70	3.50	OR3504570					P46				
46.00	2.00	OR2004600									
46.00	2.50	OR2504600									
46.00	3.00	OR3004600									
46.00	3.50	OR3504600									
46.00	4.00	OR4004600									
46.00	4.50	OR4504600									
46.00	5.00	OR5004600									
46.00	6.00	OR6004600									
46.20	3.00	OR3004620									x
46.20	3.55	ORIC04620			x			x			
46.20	5.30	ORID04620			x			x			
46.99	5.33	ORAR00328	328	x					R31		
47.00	2.00	OR2004700									
47.00	2.50	OR2504700									
47.00	3.00	OR3004700									
47.00	4.00	OR4004700									
47.00	5.00	OR5004700									
47.20	5.70	OR5704720									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
47.22	3.53	ORAR00225	225	x							
47.29	2.62	ORAR00134	134	x							
47.30	5.70	OR5704730									x
47.35	1.78	ORAR00032	032	x							
47.50	3.55	ORIC04750			x			x			
47.50	5.30	ORID04750			x			x			
47.60	2.40	OR2404760									x
47.60	5.70	OR5704760					P48A				
47.70	3.50	OR3504770					P47				
48.00	1.00	OR1004800									
48.00	1.50	OR1504800									
48.00	2.00	OR2004800									
48.00	2.50	OR2504800									
48.00	3.00	OR3004800									
48.00	4.00	OR4004800									
48.00	4.50	OR4504800									
48.00	5.00	OR5004800									
48.00	6.00	OR6004800									
48.00	7.00	ORIE04800									
48.70	3.50	OR3504870					P49				
48.70	3.55	ORIC04870			x			x			
48.70	5.30	ORID04870			x			x			
48.90	2.62	ORAR00135	135	x							
49.00	1.50	OR1504900									
49.00	2.50	OR2504900									
49.00	3.00	OR3004900									
49.00	3.50	OR3504900									
49.00	4.00	OR4004900									
49.20	5.70	OR5704920				x					x
49.40	3.10	OR3104940					G50				
49.50	3.00	OR3004950				x					x
49.60	2.40	OR2404960									x
49.60	5.70	OR5704960					P50A				
49.70	3.50	OR3504970					P50				
50.00	1.50	OR1505000									
50.00	2.00	OR2005000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
50.00	2.50	OR2505000									
50.00	3.00	OR3005000									
50.00	3.55	ORIC05000			x			x			
50.00	4.00	OR4005000									
50.00	4.50	OR4505000									
50.00	5.00	OR5005000									
50.00	5.30	ORID05000			x			x			
50.00	5.50	OR5505000									
50.00	6.00	OR6005000									
50.00	6.50	OR6505000									
50.00	7.00	ORIE05000									
50.17	5.33	ORAR00329	329	x					R32		
50.20	3.00	OR3005020									x
50.39	3.53	ORAR00226	226	x							
50.47	2.62	ORAR00136	136	x							
50.52	1.78	ORAR00033	033	x							
51.00	2.50	OR2505100									
51.00	3.00	OR3005100									
51.00	4.00	OR4005100									
51.00	4.50	OR4505100									
51.00	5.50	OR5505100									
51.20	5.70	OR5705120									x
51.50	1.50	OR1505150									
51.50	3.55	ORIC05150			x			x			
51.50	5.30	ORID05150			x			x			
51.60	2.40	OR2405160									x
51.60	5.70	OR5705160					P52				
52.00	1.50	OR1505200									
52.00	2.00	OR2005200									
52.00	2.50	OR2505200									
52.00	3.00	OR3005200									
52.00	3.50	OR3505200									
52.00	4.00	OR4005200									
52.00	5.00	OR5005200									
52.00	6.00	OR6005200									
52.07	2.62	ORAR00137	137	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
52.30	5.70	OR5705230									x
52.60	5.70	OR5705260					P53				
53.00	1.50	OR1505300									
53.00	2.00	OR2005300									
53.00	2.50	OR2505300									
53.00	3.00	OR3005300									
53.00	3.50	OR3505300									
53.00	3.55	ORIC05300			x			x			
53.00	5.00	OR5005300									
53.00	5.30	ORID05300			x			x			
53.00	6.00	OR6005300									
53.00	7.00	ORIE05300									
53.09	3.00	ORAR00928	928	x							
53.34	5.33	ORAR00330	330	x					R33		
53.57	3.53	ORAR00227	227	x							
53.64	2.62	ORAR00138	138	x							
53.70	1.78	ORAR00034	034	x							
54.00	1.50	OR1505400									
54.00	2.50	OR2505400									
54.00	3.00	OR3005400									
54.00	4.00	OR4005400									
54.00	5.00	OR5005400									
54.00	5.50	OR5505400									
54.00	6.00	OR6005400									
54.20	5.70	OR5705420				x					
54.30	5.70	OR5705430									x
54.40	3.10	OR3105440					G55				
54.50	3.00	OR3005450				x					x
54.50	3.55	ORIC05450			x			x			
54.50	5.30	ORID05450			x			x			
54.60	2.40	OR2405460									x
54.60	5.70	OR5705460					P55				
55.00	1.50	OR1505500									
55.00	2.00	OR2005500									
55.00	2.50	OR2505500									
55.00	3.00	OR3005500									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
55.00	3.50	OR3505500									
55.00	4.00	OR4005500									
55.00	5.00	OR5005500									
55.00	6.00	OR6005500									
55.20	3.00	OR3005520									x
55.25	2.62	ORAR00139	139	x							
55.30	5.70	OR5705530									x
55.50	3.00	OR3005550									x
55.60	2.40	OR2405560									x
55.60	5.70	OR5705560					P56				x
56.00	2.00	OR2005600									
56.00	2.50	OR2505600									
56.00	3.00	OR3005600									
56.00	3.55	ORIC05600			x			x			
56.00	4.00	OR4005600									
56.00	4.50	OR4505600									
56.00	5.20	OR5205600									
56.00	5.30	ORID05600			x			x			
56.20	3.00	OR3005620									x
56.52	5.33	ORAR00331	331	x					R34		
56.60	2.90	OR2905660								x	
56.74	3.53	ORAR00228	228	x							
56.82	2.62	ORAR00140	140	x							
56.87	1.78	ORAR00035	035	x							
57.00	1.50	OR1505700									
57.00	2.00	OR2005700									
57.00	2.50	OR2505700									
57.00	3.00	OR3005700									
57.00	4.00	OR4005700									
57.00	4.50	OR4505700									
57.00	8.00	OR8005700									
57.20	3.00	OR3005720									x
57.20	5.70	OR5705720									
57.30	5.70	OR5705730									x
57.50	3.00	OR3005750									x
57.60	2.40	OR2405760									x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
57.60	5.70	OR5705760					P58				
58.00	2.00	OR2005800									
58.00	2.50	OR2505800									
58.00	3.00	OR3005800									
58.00	3.55	ORIC05800			x			x			
58.00	4.00	OR4005800									
58.00	5.00	OR5005800									
58.00	5.30	ORID05800			x			x			
58.00	5.50	OR5505800									
58.00	6.00	OR6005800									
58.00	7.00	ORIE05800									
58.42	2.62	ORAR00141	141	x							
58.60	2.40	OR2405860									x
59.00	1.50	OR1505900									
59.00	2.50	OR2505900									
59.00	3.00	OR3005900									
59.20	5.70	OR5705920				x					
59.30	5.70	OR5705930									x
59.36	3.00	ORAR00932	932	x							
59.40	3.10	OR3105940					G60				
59.50	3.00	OR3005950				x					x
59.60	2.40	OR2405960									x
59.60	5.70	OR5705960					P60				
59.69	5.33	ORAR00332	332	x					R35		
59.92	3.53	ORAR00229	229	x							
59.99	2.62	ORAR00142	142	x							
60.00	1.50	OR1506000									
60.00	2.00	OR2006000									
60.00	2.50	OR2506000									
60.00	3.00	OR3006000									
60.00	3.50	OR3506000									
60.00	3.55	ORIC06000			x			x			
60.00	4.00	OR4006000									
60.00	4.50	OR4506000									
60.00	5.00	OR5006000									
60.00	5.30	ORID06000			x			x			

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
60.00	6.00	OR6006000									
60.00	7.00	ORIE06000									
60.05	1.78	ORAR00036	036	x							
60.50	3.00	OR3006050									x
61.00	5.00	OR5006100									
61.20	5.70	OR5706120									
61.30	5.70	OR5706130									x
61.50	3.55	ORIC06150			x			x			
61.50	5.30	ORID06150			x			x			
61.60	2.40	OR2406160									x
61.60	2.62	ORAR00143	143	x							
61.60	5.70	OR5706160					P62				
62.00	1.50	OR1506200									
62.00	2.00	OR2006200									
62.00	2.50	OR2506200									
62.00	3.00	OR3006200									
62.00	4.00	OR4006200									
62.00	5.00	OR5006200									
62.00	6.00	OR6006200									
62.20	3.00	OR3006220									x
62.20	5.70	OR5706220									
62.30	5.70	OR5706230									x
62.60	2.40	OR2406260									x
62.60	5.70	OR5706260					P63				
62.87	5.33	ORAR00333	333	x					R36		
63.00	1.50	OR1506300									
63.00	2.00	OR2006300									
63.00	2.50	OR2506300									
63.00	3.00	OR3006300									
63.00	3.55	ORIC06300			x			x			
63.00	4.00	OR4006300									
63.00	4.50	OR4506300									
63.00	5.00	OR5006300									
63.00	5.30	ORID06300			x			x			
63.00	7.00	ORIE06300									
63.09	3.53	ORAR00230	230	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
63.17	2.62	ORAR00144	144	x							
63.22	1.78	ORAR00037	037	x							
64.00	3.00	OR3006400									
64.00	3.50	OR3506400									
64.00	4.00	OR4006400									
64.00	5.00	OR5006400									
64.00	6.00	OR6006400									
64.20	5.70	OR5706420				x					
64.30	5.70	OR5706430									x
64.40	3.10	OR3106440					G65				
64.50	3.00	OR3006450				x					x
64.60	2.40	OR2406460									x
64.60	5.70	OR5706460					P65				
64.77	2.62	ORAR00145	145	x							
65.00	1.50	OR1506500									
65.00	2.00	OR2006500									
65.00	2.50	OR2506500									
65.00	3.00	OR3006500									
65.00	3.50	OR3506500									
65.00	3.55	ORIC06500			x			x			
65.00	4.00	OR4006500									
65.00	4.50	OR4506500									
65.00	5.00	OR5006500									
65.00	5.30	ORID06500			x			x			
65.00	5.50	OR5506500									
66.00	2.00	OR2006600									
66.00	3.00	OR3006600									
66.00	5.00	OR5006600									
66.04	5.33	ORAR00334	334	x					R37		
66.27	3.53	ORAR00231	231	x							
66.34	2.62	ORAR00146	146	x							
66.40	1.78	ORAR00038	038	x							
66.60	5.70	OR5706660					P67				
67.00	1.50	OR1506700									
67.00	2.00	OR2006700									
67.00	2.50	OR2506700									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
67.00	3.00	OR3006700									
67.00	3.55	ORIC06700			x			x			
67.00	4.00	OR4006700									
67.00	5.30	ORID06700			x			x			
67.20	3.00	OR3006720									
67.20	5.70	OR5706720									
67.30	5.70	OR5706730									x
67.60	2.40	OR2406760									x
67.95	2.62	ORAR00147	147	x							
68.00	2.00	OR2006800									
68.00	2.50	OR2506800									
68.00	3.00	OR3006800									
68.00	4.00	OR4006800									
68.00	5.00	OR5006800									
68.00	5.50	OR5506800									
68.00	6.00	OR6006800									
68.00	7.00	ORIE06800									
69.00	1.50	OR1506900									
69.00	3.00	OR3006900									
69.00	3.55	ORIC06900			x			x			
69.00	4.50	OR4506900									
69.00	5.30	ORID06900			x			x			
69.00	6.00	OR6006900									
69.20	5.70	OR5706920				x					
69.22	5.33	ORAR00335	335	x					R38		
69.30	5.70	OR5706930									x
69.40	3.10	OR3106940					G70				
69.44	3.53	ORAR00232	232	x							
69.50	3.00	OR3006950				x					x
69.52	2.62	ORAR00148	148	x							
69.57	1.78	ORAR00039	039	x							
69.60	2.40	OR2406960									x
69.60	5.70	OR5706960					P70				
70.00	2.00	OR2007000									
70.00	2.50	OR2507000									
70.00	3.00	OR3007000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
70.00	4.00	OR4007000									
70.00	4.50	OR4507000									
70.00	5.00	OR5007000									
70.00	5.50	OR5507000									
70.00	6.00	OR6007000									
70.00	7.00	ORIE07000									
70.60	5.70	OR5707060					P71				
71.00	2.00	OR2007100									
71.00	3.00	OR3007100									
71.00	3.55	ORIC07100			x			x			
71.00	5.30	ORID07100			x			x			
71.12	2.62	ORAR00149	149	x							
71.20	5.70	OR5707120									
71.30	5.70	OR5707130									x
71.50	1.50	OR1507150									
72.00	2.00	OR2007200									
72.00	2.50	OR2507200									
72.00	3.00	OR3007200									
72.00	4.00	OR4007200									
72.00	5.00	OR5007200									
72.00	5.50	OR5507200									
72.00	7.00	ORIE07200									
72.30	5.70	OR5707230									x
72.39	5.33	ORAR00336	336	x					R39		
72.62	3.53	ORAR00233	233	x							
72.69	2.62	ORAR00150	150	x							
72.75	1.78	ORAR00040	040	x							
73.00	2.00	OR2007300									
73.00	2.50	OR2507300									
73.00	3.00	OR3007300									
73.00	3.55	ORIC07300			x			x			
73.00	5.00	OR5007300									
73.00	5.30	ORID07300			x			x			
74.00	1.00	OR1007400									
74.00	1.50	OR1507400									
74.00	2.00	OR2007400									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
74.00	2.50	OR2507400									x
74.00	3.00	OR3007400									
74.00	4.00	OR4007400									
74.00	4.50	OR4507400									
74.00	6.00	OR6007400									
74.20	5.70	OR5707420				x					
74.30	5.70	OR5707430									x
74.40	3.10	OR3107440					G75				
74.50	3.00	OR3007450				x					x
74.60	5.70	OR5707460					P75				
75.00	2.00	OR2007500									
75.00	2.50	OR2507500									
75.00	3.00	OR3007500									
75.00	3.50	OR3507500									
75.00	3.55	ORIC07500			x			x			
75.00	4.00	OR4007500									
75.00	4.50	OR4507500									
75.00	5.00	OR5007500									
75.00	5.30	ORID07500			x			x			
75.00	5.50	OR5507500									
75.00	6.00	OR6007500									
75.00	7.00	ORIE07500									
75.57	5.33	ORAR00337	337	x					R40		
75.79	3.53	ORAR00234	234	x							
75.87	2.62	ORAR00151	151	x							
75.92	1.78	ORAR00041	041	x							
76.00	1.50	OR1507600									
76.00	2.00	OR2007600									
76.00	2.50	OR2507600									
76.00	3.00	OR3007600									
76.00	4.00	OR4007600									
76.00	4.50	OR4507600									
76.00	5.00	OR5007600									
77.00	5.00	OR5007700									
77.30	5.70	OR5707730									x
77.50	3.55	ORIC07750			x			x			

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
77.50	5.30	ORID07750			x			x			
78.00	1.50	OR1507800									
78.00	2.00	OR2007800									
78.00	3.00	OR3007800									
78.00	3.50	OR3507800									
78.00	4.00	OR4007800									
78.00	5.00	OR5007800									
78.00	6.00	OR6007800									
78.74	5.33	ORAR00338	338	x					R41		
78.97	3.53	ORAR00235	235	x							
79.00	2.00	OR2007900									
79.00	3.00	OR3007900									
79.20	5.70	OR5707920				x					
79.30	5.70	OR5707930									x
79.40	3.10	OR3107940					G80				
79.50	3.00	OR3007950									x
79.50	7.00	ORIE07950									
79.60	5.70	OR5707960					P80				
80.00	1.50	OR1508000									
80.00	2.00	OR2008000									
80.00	2.50	OR2508000									
80.00	3.00	OR3008000									
80.00	3.55	ORIC08000			x			x			
80.00	4.00	OR4008000									
80.00	4.50	OR4508000									
80.00	5.00	OR5008000									
80.00	5.30	ORID08000			x			x			
80.00	5.50	OR5508000									
80.00	6.00	OR6008000									
80.50	1.50	OR1508050									
81.00	7.00	ORIE08100									
81.30	5.70	OR5708130									x
81.92	5.33	ORAR00339	339	x					R42		
82.00	3.00	OR3008200									
82.00	4.00	OR4008200									
82.00	5.00	OR5008200									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
82.14	3.53	ORAR00236	236	x							
82.20	5.70	OR5708220									
82.22	2.62	ORAR00152	152	x							
82.27	1.78	ORAR00042	042	x							
82.50	3.55	ORIC08250			x			x			
82.50	5.30	ORID08250			x			x			
83.00	2.00	OR2008300									
83.00	3.00	OR3008300									
84.00	2.00	OR2008400									
84.00	3.00	OR3008400									
84.00	4.00	OR4008400									
84.00	6.00	OR6008400									
84.10	5.70	OR5708410				x					
84.20	5.70	OR5708420									
84.30	5.70	OR5708430									x
84.40	3.10	OR3108440					G85				
84.50	3.00	OR3008450				x					x
84.60	5.70	OR5708460					P85				
85.00	2.00	OR2008500									
85.00	2.50	OR2508500									
85.00	3.00	OR3008500									
85.00	3.55	ORIC08500			x			x			
85.00	4.00	OR4008500									
85.00	4.50	OR4508500									
85.00	5.00	OR5008500									
85.00	5.30	ORID08500			x			x			
85.00	5.50	OR5508500									
85.00	6.00	OR6008500									
85.00	7.00	ORIE08500									
85.09	5.33	ORAR00340	340	x					R43		
85.32	3.53	ORAR00237	237	x							
85.50	2.50	OR2508550									
86.00	2.00	OR2008600									
86.00	3.00	OR3008600									
86.00	4.00	OR4008600									
86.00	4.50	OR4508600									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
87.00	4.00	OR4008700									
87.00	5.00	OR5008700									
87.20	5.70	OR5708720									
87.30	5.70	OR5708730									x
87.50	3.55	ORIC08750			x			x			
87.50	5.30	ORID08750			x			x			
88.00	1.50	OR1508800									
88.00	3.00	OR3008800									
88.00	4.00	OR4008800									
88.00	5.00	OR5008800									
88.00	6.00	OR6008800									
88.27	5.33	ORAR00341	341	x					R44		
88.49	3.53	ORAR00238	238	x							
88.57	2.62	ORAR00153	153	x							
88.62	1.78	ORAR00043	043	x							
89.00	3.00	OR3008900									
89.00	4.50	OR4508900									
89.00	7.00	ORIE08900									
89.10	5.70	OR5708910				x					
89.30	5.70	OR5708930									x
89.40	3.10	OR3108940					G90				
89.50	3.00	OR3008950				x					x
89.60	5.70	OR5708960					P90				
90.00	1.00	OR1009000									
90.00	2.00	OR2009000									
90.00	2.50	OR2509000									
90.00	3.00	OR3009000									
90.00	3.55	ORIC09000			x			x			
90.00	4.00	OR4009000									
90.00	4.50	OR4509000									
90.00	5.00	OR5009000									
90.00	5.30	ORID09000			x			x			
90.00	5.50	OR5509000									
90.00	6.00	OR6009000									
90.00	7.00	ORIE09000									
91.44	5.33	ORAR00342	342	x					R45		

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
91.67	3.53	ORAR00239	239	x							
92.00	1.50	OR1509200									
92.00	3.00	OR3009200									
92.00	4.00	OR4009200									
92.00	4.50	OR4509200									
92.00	5.00	OR5009200									
92.00	5.50	OR5509200									
92.00	7.00	ORIE09200									
92.30	5.70	OR5709230									x
92.50	3.55	ORIC09250			x			x			
92.50	5.30	ORID09250			x			x			
93.00	2.00	OR2009300									
93.00	3.00	OR3009300									
93.00	4.00	OR4009300									
93.50	4.50	OR4509350									
94.00	2.50	OR2509400									
94.00	3.00	OR3009400									
94.00	4.00	OR4009400									
94.00	5.00	OR5009400									
94.00	7.00	ORIE09400									
94.10	5.70	OR5709410				x					
94.30	5.70	OR5709430									x
94.40	3.10	OR3109440					G95				
94.50	3.00	OR3009450				x					x
94.60	5.70	OR5709460					P95				
94.62	5.33	ORAR00343	343	x					R46		
94.84	3.53	ORAR00240	240	x							
94.92	2.62	ORAR00154	154	x							
94.97	1.78	ORAR00044	044	x							
95.00	2.00	OR2009500									
95.00	2.50	OR2509500									
95.00	3.55	ORIC09500			x			x			
95.00	4.00	OR4009500									
95.00	4.50	OR4509500									
95.00	5.00	OR5009500									
95.00	5.30	ORID09500			x			x			

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
95.00	5.50	OR5509500									
95.00	6.00	OR6009500									
95.00	7.00	ORIE09500									
96.00	2.50	OR2509600									
96.00	3.00	OR3009600									
96.00	4.00	OR4009600									
96.00	5.00	OR5009600									
96.00	6.00	OR6009600									
96.50	6.50	OR6509650									
97.00	3.50	OR3509700									
97.00	5.00	OR5009700									
97.30	5.70	OR5709730									x
97.50	3.55	ORIC09750			x			x			
97.50	5.30	ORID09750			x			x			
97.79	5.33	ORAR00344	344	x					R47		
98.00	2.50	OR2509800									
98.00	3.00	OR3009800									
98.00	4.00	OR4009800									
98.02	3.53	ORAR00241	241	x							
99.00	3.00	OR3009900									
99.00	7.00	ORIE09900									
99.10	5.70	OR5709910				x					
99.30	5.70	OR5709930									x
99.40	3.10	OR3109940					G100				
99.50	3.00	OR3009950				x					x
99.60	5.70	OR5709960					P100				
100.00	1.00	OR1010000									
100.00	1.50	OR1510000									
100.00	2.00	OR2010000									
100.00	2.50	OR2510000									
100.00	3.00	OR3010000									
100.00	3.55	ORIC10000			x			x			
100.00	4.00	OR4010000									
100.00	5.00	OR5010000									
100.00	5.30	ORID10000			x			x			
100.00	5.50	OR5510000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
100.00	6.00	OR6010000									
100.00	7.00	ORIE10000									
100.00	8.00	OR8010000									
100.97	5.33	ORAR00345	345	x					R48		
101.19	3.53	ORAR00242	242	x							
101.27	2.62	ORAR00155	155	x							
101.32	1.78	ORAR00045	045	x							
101.60	5.70	OR5710160					P102				
102.00	3.00	OR3010200									
102.00	4.00	OR4010200									
103.00	2.00	OR2010300									
103.00	3.55	ORIC10300			x			x			
103.00	5.30	ORID10300			x			x			
103.00	6.00	OR6010300									
104.00	2.50	OR2510400									
104.00	3.00	OR3010400									
104.00	4.00	OR4010400									
104.00	5.00	OR5010400									
104.00	6.00	OR6010400									
104.10	5.70	OR5710410				x					
104.14	5.33	ORAR00346	346	x					R49		
104.30	5.70	OR5710430									x
104.37	3.53	ORAR00243	243	x							
104.40	3.10	OR3110440					G105				
104.50	3.00	OR3010450				x					x
104.60	5.70	OR5710460					P105				
105.00	2.00	OR2010500									
105.00	2.50	OR2510500									
105.00	3.00	OR3010500									
105.00	3.50	OR3510500									
105.00	4.00	OR4010500									
105.00	4.50	OR4510500									
105.00	5.00	OR5010500									
105.00	6.00	OR6010500									
106.00	2.00	OR2010600									
106.00	3.00	OR3010600									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
106.00	3.55	ORIC10600			x			x			
106.00	4.50	OR4510600									
106.00	5.30	ORID10600			x			x			
106.00	6.00	OR6010600									
106.00	7.00	ORIE10600									
107.00	2.50	OR2510700									
107.00	5.00	OR5010700									
107.32	5.33	ORAR00347	347	x					R50		
107.54	3.53	ORAR00244	244	x							
107.62	2.62	ORAR00156	156	x							
107.67	1.78	ORAR00046	046	x							
108.00	3.00	OR3010800									
108.00	4.00	OR4010800									
108.00	6.00	OR6010800									
108.00	7.00	ORIE10800									
108.80	8.40	OR8410880									
109.00	3.55	ORIC10900			x						
109.00	5.30	ORID10900			x						
109.10	5.70	OR5710910				x					
109.20	5.70	OR5710920									
109.30	5.70	OR5710930									x
109.40	3.10	OR3110940					G110				
109.50	3.00	OR3010950				x					x
109.60	5.70	OR5710960					P110				
110.00	2.00	OR2011000									
110.00	3.00	OR3011000									
110.00	3.50	OR3511000									
110.00	4.00	OR4011000									
110.00	4.50	OR4511000									
110.00	5.00	OR5011000									
110.00	5.50	OR5511000									
110.00	6.00	OR6011000									
110.00	8.00	OR8011000									
110.49	5.33	ORAR00348	348	x					R51		
110.72	3.53	ORAR00245	245	x							
111.60	5.70	OR5711160					P112				

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
112.00	1.50	OR1511200									
112.00	2.50	OR2511200									
112.00	3.00	OR3011200									
112.00	3.55	ORIC11200			x			x			
112.00	4.00	OR4011200									
112.00	5.00	OR5011200									
112.00	5.30	ORID11200			x			x			
112.00	6.00	OR6011200									
112.00	8.00	OR8011200									
113.00	3.50	OR3511300									
113.00	4.00	OR4011300									
113.67	5.33	ORAR00349	349	x					R52		
113.67	6.99	ORAR00425	425	x					R53		
113.89	3.53	ORAR00246	246	x							
113.97	2.62	ORAR00157	157	x							
114.00	3.00	OR3011400									
114.00	4.00	OR4011400									
114.00	6.00	OR6011400									
114.00	8.00	OR8011400									
114.02	1.78	ORAR00047	047	x							
114.30	5.70	OR5711430				x					x
114.40	3.10	OR3111440					G115				
114.50	3.00	OR3011450				x					x
114.60	5.70	OR5711460					P115				
115.00	2.00	OR2011500									
115.00	2.50	OR2511500									
115.00	3.00	OR3011500									
115.00	3.55	ORIC11500			x			x			
115.00	4.00	OR4011500									
115.00	4.50	OR4511500									
115.00	5.00	OR5011500									
115.00	5.30	ORID11500			x			x			
115.00	6.00	OR6011500									
115.00	7.00	ORIE11500			x			x			
116.00	3.00	OR3011600									
116.00	4.00	OR4011600									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
116.84	5.33	ORAR00350	350	x							
116.84	6.99	ORAR00426	426	x					R54		
117.00	2.50	OR2511700									
117.00	4.00	OR4011700									
117.00	8.00	OR8011700									
117.07	3.53	ORAR00247	247	x							
118.00	2.00	OR2011800									
118.00	3.00	OR3011800									
118.00	3.55	ORIC11800			x			x			
118.00	4.00	OR4011800									
118.00	4.50	OR4511800									
118.00	5.00	OR5011800									
118.00	5.30	ORID11800			x			x			
118.00	6.00	OR6011800									
119.00	3.00	OR3011900									
119.30	5.70	OR5711930				x					x
119.40	3.10	OR3111940					G120				
119.50	3.00	OR3011950				x					x
119.60	5.70	OR5711960					P120				
120.00	2.00	OR2012000									
120.00	2.50	OR2512000									
120.00	3.00	OR3012000									
120.00	3.50	OR3512000									
120.00	4.00	OR4012000									
120.00	4.50	OR4512000									
120.00	5.00	OR5012000									
120.00	6.00	OR6012000									
120.02	5.33	ORAR00351	351	x					R55		
120.02	6.99	ORAR00427	427	x							
120.24	3.53	ORAR00248	248	x							
120.32	2.62	ORAR00158	158	x							
120.37	1.78	ORAR00048	048	x							
122.00	2.00	OR2012200									
122.00	3.00	OR3012200									
122.00	3.55	ORIC12200			x			x			
122.00	4.00	OR4012200									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
122.00	5.30	ORID12200			x			x			
123.00	6.00	OR6012300									
123.19	5.33	ORAR00352	352	x							
123.19	6.99	ORAR00428	428	x					R56		
123.42	3.53	ORAR00249	249	x							
124.00	4.00	OR4012400									
124.00	4.50	OR4512400									
124.30	5.70	OR5712430				x					x
124.40	3.10	OR3112440					G125				
124.50	3.00	OR3012450				x					x
124.60	5.70	OR5712460					P125				
125.00	2.00	OR2012500									
125.00	2.50	OR2512500									
125.00	3.00	OR3012500									
125.00	3.50	OR3512500									
125.00	3.55	ORIC12500			x			x			
125.00	4.00	OR4012500									
125.00	5.00	OR5012500									
125.00	5.30	ORID12500			x			x			
125.00	6.00	OR6012500									
125.00	8.00	OR8012500									
126.00	4.00	OR4012600									
126.00	4.50	OR4512600									
126.37	5.33	ORAR00353	353	x							
126.37	6.99	ORAR00429	429	x					R57		
126.59	3.53	ORAR00250	250	x							
126.67	2.62	ORAR00159	159	x							
126.72	1.78	ORAR00049	049	x							
127.00	4.00	OR4012700									
127.00	5.00	OR5012700									
128.00	2.00	OR2012800									
128.00	2.50	OR2512800									
128.00	3.00	OR3012800									
128.00	3.55	ORIC12800			x			x			
128.00	5.30	ORID12800			x			x			
128.00	6.00	OR6012800									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
129.00	4.00	OR4012900									
129.30	5.70	OR5712930				x					x
129.40	3.10	OR3112940					G130				
129.50	3.00	OR3012950				x					x
129.54	5.33	ORAR00354	354	x							
129.54	6.99	ORAR00430	430	x					R58		
129.60	5.70	OR5712960					P130				
129.77	3.53	ORAR00251	251	x							
130.00	2.00	OR2013000									
130.00	2.50	OR2513000									
130.00	3.00	OR3013000									
130.00	4.00	OR4013000									
130.00	4.50	OR4513000									
130.00	5.00	OR5013000									
130.00	5.50	OR5513000									
130.00	6.00	OR6013000									
130.00	7.50	OR7513000									
131.50	4.50	OR4513150									
131.60	5.70	OR5713160					P132				
132.00	2.00	OR2013200									
132.00	3.00	OR3013200									
132.00	3.55	ORIC13200			x			x			
132.00	4.00	OR4013200									
132.00	5.00	OR5013200									
132.00	5.30	ORID13200			x			x			
132.00	8.00	OR8013200									
132.72	5.33	ORAR00355	355	x							
132.72	6.99	ORAR00431	431	x					R59		
132.94	3.53	ORAR00252	252	x							
133.00	4.00	OR4013300		x							
133.02	2.62	ORAR00160	160	x							
133.07	1.78	ORAR00050	050	x							
134.00	3.00	OR3013400									
134.00	4.00	OR4013400									
134.00	5.00	OR5013400									
134.30	5.70	OR5713430				x					x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
134.40	3.10	OR3113440					G135				
134.50	3.00	OR3013450				x					x
135.00	2.00	OR2013500									
135.00	2.50	OR2513500									
135.00	3.00	OR3013500									
135.00	4.00	OR4013500									
135.00	5.00	OR5013500									
135.00	6.00	OR6013500									
135.60	5.70	OR5713560					P135				
135.89	5.33	ORAR00356	356	x							
135.89	6.99	ORAR00432	432	x					R60		
136.00	3.55	ORIC13600			x			x			
136.00	5.30	ORID13600			x			x			
136.00	8.00	OR8013600									
136.12	3.53	ORAR00253	253	x							
138.00	3.00	OR3013800									
138.00	5.00	OR5013800									
138.00	6.00	OR6013800									
139.07	5.33	ORAR00357	357	x							
139.07	6.99	ORAR00433	433	x					R61		
139.29	3.53	ORAR00254	254	x							
139.30	5.70	OR5713930				x					x
139.37	2.62	ORAR00161	161	x							
139.40	3.10	OR3113940					G140				
139.50	3.00	OR3013950				x					x
139.60	5.70	OR5713960					P140				
140.00	2.00	OR2014000									
140.00	2.50	OR2514000									
140.00	3.00	OR3014000									
140.00	3.55	ORIC14000			x			x			
140.00	4.00	OR4014000									
140.00	4.50	OR4514000									
140.00	5.00	OR5014000									
140.00	5.30	ORID14000			x			x			
142.00	4.00	OR4014200									
142.00	6.00	OR6014200									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
142.24	5.33	ORAR00358	358	x							
142.24	6.99	ORAR00434	434	x					R62		
142.47	3.53	ORAR00255	255	x							
143.00	2.00	OR2014300									
144.00	4.00	OR4014400									
144.00	5.00	OR5014400									
144.00	8.00	OR8014400									
144.10	8.40	OR8414410				x					x
144.30	5.70	OR5714430				x					x
144.40	3.10	OR3114440					G145				
144.50	3.00	OR3014450				x					x
144.60	5.70	OR5714460					P145				
145.00	2.50	OR2514500									
145.00	3.55	ORIC14500			x			x			
145.00	4.00	OR4014500									
145.00	4.50	OR4514500									
145.00	5.30	ORID14500			x			x			
145.00	6.00	OR6014500									
145.42	5.33	ORAR00359	359	x							
145.42	6.99	ORAR00435	435	x					R63		
145.64	3.53	ORAR00256	256	x							
145.72	2.62	ORAR00162	162	x							
146.00	2.00	OR2014600									
146.00	3.00	OR3014600									
146.00	4.00	OR4014600									
148.00	4.00	OR4014800									
148.00	6.00	OR6014800									
148.59	5.33	ORAR00360	360	x							
148.59	6.99	ORAR00436	436	x					R64		
148.82	3.53	ORAR00257	257	x							
149.00	3.00	OR3014900									
149.00	5.00	OR5014900									
149.10	8.40	OR8414910				x					x
149.20	5.70	OR5714920									
149.30	5.70	OR5714930					G150				x
149.50	3.00	OR3014950									x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
149.50	8.40	OR8414950					P150A				
149.60	5.70	OR5714960					P150				
150.00	2.00	OR2015000									
150.00	2.50	OR2515000									
150.00	3.00	OR3015000									
150.00	3.55	ORIC15000			x			x			
150.00	4.00	OR4015000									
150.00	4.50	OR4515000									
150.00	5.00	OR5015000									
150.00	5.30	ORID15000			x			x			
150.00	6.00	OR6015000									
150.00	8.00	OR8015000									
151.77	5.33	ORAR00361	361	x							
151.77	6.99	ORAR00437	437	x					R65		
151.99	3.53	ORAR00258	258	x							
152.00	7.50	OR7515200									
152.07	2.62	ORAR00163	163	x							
153.00	4.50	OR4515300									
153.00	6.00	OR6015300									
153.50	1.60	OR1615350									
154.00	3.00	OR3015400									
154.10	8.40	OR8415410				x					x
154.30	5.70	OR5715430					G155				x
154.50	3.00	OR3015450									x
154.50	8.40	OR8415450					P155				
155.00	2.50	OR2515500									
155.00	3.00	OR3015500									
155.00	3.55	ORIC15500			x			x			
155.00	4.00	OR4015500									
155.00	4.50	OR4515500									
155.00	5.00	OR5015500									
155.00	5.30	ORID15500			x			x			
155.00	8.00	OR8015500									
155.60	6.99	ORA415560									x
156.00	2.00	OR2015600									
156.00	2.50	OR2515600									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
156.00	3.00	OR3015600									
156.00	4.00	OR4015600									
157.00	3.00	OR3015700									
158.00	5.00	OR5015800									
158.00	6.00	OR6015800									
158.12	5.33	ORAR00362	362	x							
158.12	6.99	ORAR00438	438	x					R66		
158.34	3.53	ORAR00259	259	x							
158.42	2.62	ORAR00164	164	x							
159.10	8.40	OR8415910				x					x
159.30	5.70	OR5715930				x	G160				x
159.50	3.00	OR3015950									x
159.50	8.40	OR8415950					P160				
160.00	2.00	OR2016000									
160.00	2.50	OR2516000									
160.00	3.00	OR3016000									
160.00	3.55	ORIC16000			x			x			
160.00	4.00	OR4016000									
160.00	4.50	OR4516000									
160.00	5.00	OR5016000									
160.00	5.30	ORID16000			x			x			
160.00	6.00	OR6016000									
160.00	8.00	OR8016000									
162.00	3.00	OR3016200									
164.00	3.00	OR3016400									
164.00	4.00	OR4016400									
164.00	5.00	OR5016400									
164.10	8.40	OR8416410				x					x
164.30	5.70	OR5716430				x	G165				x
164.47	5.33	ORAR00363	363	x							
164.47	6.99	ORAR00439	439	x					R67		
164.50	3.00	OR3016450									x
164.50	8.40	OR8416450					P165				
164.69	3.53	ORAR00260	260	x							
164.77	2.62	ORAR00165	165	x							
165.00	2.00	OR2016500									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
165.00	2.50	OR2516500									
165.00	3.00	OR3016500									
165.00	3.55	ORIC16500			x			x			
165.00	4.00	OR4016500									
165.00	4.50	OR4516500									
165.00	5.00	OR5016500									
165.00	5.30	ORID16500			x			x			
165.00	6.00	OR6016500									
165.00	8.00	OR8016500									
166.00	6.00	OR6016600									
166.00	8.00	OR8016600									
167.00	2.50	OR2516700									
168.00	4.00	OR4016800									
168.00	5.00	OR5016800									
169.10	8.40	OR8416910				x					x
169.30	5.70	OR5716930				x	G170				x
169.50	3.00	OR3016950									x
169.50	8.40	OR8416950					P170				
170.00	2.00	OR2017000									
170.00	2.50	OR2517000									
170.00	3.00	OR3017000									
170.00	3.50	OR3517000									
170.00	3.55	ORIC17000			x			x			
170.00	4.00	OR4017000									
170.00	5.00	OR5017000									
170.00	5.30	ORID17000			x			x			
170.00	6.00	OR6017000									
170.00	8.00	OR8017000									
170.82	5.33	ORAR00364	364	x							
170.82	6.99	ORAR00440	440	x					R68		
171.04	3.53	ORAR00261	261	x							
171.12	2.62	ORAR00166	166	x							
172.00	4.00	OR4017200									
172.00	6.00	OR6017200									
174.00	3.00	OR3017400									
174.10	8.40	OR8417410				x					x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
174.30	5.70	OR5717430				x	G175				x
174.50	3.00	OR3017450									x
174.50	8.40	OR8417450					P175				
175.00	2.00	OR2017500									
175.00	3.55	ORIC17500			x			x			
175.00	4.00	OR4017500									
175.00	5.00	OR5017500									
175.00	5.30	ORID17500			x			x			
175.00	6.00	OR6017500									
175.00	7.00	ORIE17500			x						
175.00	8.00	OR8017500									
177.17	5.33	ORAR00365	365	x							
177.17	6.99	ORAR00441	441	x							
177.39	3.53	ORAR00262	262	x							
177.47	2.62	ORAR00167	167	x							
179.10	8.40	OR8417910									x
179.30	5.70	OR5717930				x					x
179.50	3.00	OR3017950									x
183.52	5.33	ORAR00366	366	x							
183.52	6.99	ORAR00442	442	x							
183.74	3.53	ORAR00263	263	x							
183.82	2.62	ORAR00168	168	x							
184.10	8.40	OR8418410				x					x
184.30	5.70	OR5718430				x					x
184.50	3.00	OR3018450									x
189.10	8.40	OR8418910				x					x
189.30	5.70	OR5718930				x					x
189.50	3.00	OR3018950									x
189.87	5.33	ORAR00367	367	x							
189.87	6.99	ORAR00443	443	x							
190.09	3.53	ORAR00264	264	x							
190.17	2.62	ORAR00169	169	x							
194.10	8.40	OR8419410									x
194.30	5.70	OR5719430				x					x
194.50	3.00	OR3019450									x
196.22	5.33	ORAR00368	368	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
196.22	6.99	ORAR00444	444	x							
196.44	3.53	ORAR00265	265	x							
196.52	2.62	ORAR00170	170	x							
199.10	8.40	OR8419910				x					x
199.30	5.70	OR5719930				x					x
199.50	3.00	OR3019950									x
202.57	5.33	ORAR00369	369	x							
202.57	6.99	ORAR00445	445	x							
202.79	3.53	ORAR00266	266	x							
202.87	2.62	ORAR00171	171	x							
204.30	5.70	OR5720430				x					
208.92	5.33	ORAR00370	370	x							
209.10	8.40	OR8420910				x					x
209.14	3.53	ORAR00267	267	x							
209.22	2.62	ORAR00172	172	x							
209.30	5.70	OR5720930				x					x
209.50	3.00	OR3020950									x
210.00	4.00	OR4021000									
210.00	5.00	OR5021000									
210.00	6.50	OR6521000									
210.00	7.00	ORIE21000									
210.00	8.00	OR8021000									
212.00	2.50	OR2521200									
212.00	5.30	ORID21200			x			x			
212.00	6.00	OR6021200									
212.00	7.00	ORIE21200			x			x			
213.00	3.00	OR3021300									
213.00	7.00	ORIE21300									
214.00	5.00	OR5021400									
214.50	8.40	OR8421450					P215				
215.00	3.00	OR3021500									
215.00	5.00	OR5021500									
215.00	8.00	OR8021500									
215.27	5.33	ORAR00371	371	x							
215.27	6.99	ORAR00446	446	x					R74		
215.49	3.53	ORAR00268	268	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
215.57	2.62	ORAR00173	173	x							
216.00	2.00	OR2021600									
216.00	4.00	OR4021600									
217.00	5.00	OR5021700									
218.00	5.30	ORID21800			x			x			
218.00	6.00	OR6021800									
218.00	7.00	ORIE21800			x			x			
218.50	4.50	OR4521850									
219.10	8.40	OR8421910				x					x
219.30	5.70	OR5721930				x	G220				
219.50	3.00	OR3021950									x
219.50	8.40	OR8421950					P220				
220.00	2.00	OR2022000									
220.00	3.00	OR3022000									
220.00	4.00	OR4022000									
220.00	5.00	OR5022000									
220.00	7.00	ORIE22000									
220.00	8.00	OR8022000									
221.62	5.33	ORAR00372	372	x							
221.84	3.53	ORAR00269	269	x							
221.92	2.62	ORAR00174	174	x							
222.00	4.00	OR4022200									
224.00	5.30	ORID22400			x			x			
224.00	7.00	ORIE22400			x			x			
224.50	8.40	OR8422450					P225				
225.00	3.00	OR3022500									
225.00	4.00	OR4022500									
225.00	5.00	OR5022500									
225.00	6.00	OR6022500									
225.00	7.00	ORIE22500									
225.00	8.00	OR8022500									
226.00	6.00	OR6022600									
227.97	5.33	ORAR00373	373	x							
227.97	6.99	ORAR00447	447	x					R75		
228.00	4.00	OR4022800									
228.00	7.00	ORIE22800									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
228.19	3.53	ORAR00270	270	x							
228.27	2.62	ORAR00175	175	x							
229.00	6.00	OR6022900									
229.10	8.40	OR8422910				x					x
229.30	5.70	OR5722930				x	G230				x
229.50	8.40	OR8422950					P230				
230.00	2.00	OR2023000									
230.00	3.00	OR3023000									
230.00	4.00	OR4023000									
230.00	5.00	OR5023000									
230.00	5.30	ORID23000			x			x			
230.00	7.00	ORIE23000			x			x			
230.00	8.00	OR8023000									
233.00	3.00	OR3023300									
234.10	8.40	OR8423410									x
234.32	5.33	ORAR00374	374	x							
234.50	8.40	OR8423450					P235				
234.54	3.53	ORAR00271	271	x							
234.62	2.62	ORAR00176	176	x							
235.00	4.00	OR4023500									
235.00	5.00	OR5023500									
235.00	6.00	OR6023500									
235.00	7.00	ORIE23500									
235.00	8.00	OR8023500									
236.00	5.30	ORID23600			x			x			
236.00	7.00	ORIE23600			x			x			
238.00	2.00	OR2023800									
238.00	4.00	OR4023800									
238.00	5.00	OR5023800									
238.00	8.00	OR8023800									
239.10	8.40	OR8423910				x					x
239.30	5.70	OR5723930				x	G240				x
239.50	3.00	OR3023950									x
239.50	8.40	OR8423950					P240				
240.00	3.00	OR3024000									
240.00	4.00	OR4024000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
240.00	5.00	OR5024000									
240.00	6.00	OR6024000									
240.67	5.33	ORAR00375	375	x							
240.67	6.99	ORAR00448	448	x					R76		
240.89	3.53	ORAR00272	272	x							
240.97	2.62	ORAR00177	177	x							
242.00	5.00	OR5024200									
242.00	6.00	OR6024200									
242.00	8.00	OR8024200									
243.00	5.30	ORID24300			x			x			
243.00	7.00	ORIE24300			x			x			
244.00	2.00	OR2024400									
244.00	7.00	ORIE24400									
244.50	3.00	OR3024450									x
244.50	8.40	OR8424450					P245				
245.00	3.00	OR3024500									
245.00	5.00	OR5024500									
246.00	4.00	OR4024600									
247.00	6.00	OR6024700									
247.00	7.00	ORIE24700									
247.02	5.33	ORAR00376	376	x							
247.24	3.53	ORAR00273	273	x							
247.32	2.62	ORAR00178	178	x							
248.00	5.00	OR5024800									
249.10	8.40	OR8424910				x					x
249.30	5.70	OR5724930				x	G250				x
249.50	3.00	OR3024950									x
249.50	8.40	OR8424950					P250				
250.00	3.00	OR3025000									
250.00	3.55	ORIC25000									
250.00	4.00	OR4025000									
250.00	5.00	OR5025000									
250.00	6.00	OR6025000									
250.00	7.00	ORIE25000			x			x			
250.00	8.00	OR8025000									
253.37	5.33	ORAR00377	377	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
253.37	6.99	ORAR00449	449	x					R77		
253.59	3.53	ORAR00274	274	x							
254.00	3.00	OR3025400									
254.50	8.40	OR8425450					P255				
255.00	2.00	OR2025500									
255.00	3.00	OR3025500									
255.00	4.00	OR4025500									
255.00	5.00	OR5025500									
258.00	5.30	ORID25800			x			x			
258.00	6.00	OR6025800									
258.00	7.00	ORIE25800			x			x			
259.10	8.40	OR8425910									
259.30	5.70	OR5725930				x	G260				x
259.50	8.40	OR8425950					P260				
260.00	2.50	OR2526000									
260.00	3.00	OR3026000									
260.00	4.00	OR4026000									
260.00	5.00	OR5026000									
260.00	6.00	OR6026000									
260.00	7.00	ORIE26000									
260.00	8.00	OR8026000									
262.00	2.00	OR2026200									
262.00	4.00	OR4026200									
264.50	8.40	OR8426450					P265				
265.00	3.00	OR3026500									
265.00	4.00	OR4026500									
265.00	5.00	OR5026500									
265.00	5.30	ORID26500			x			x			
265.00	6.50	OR6526500									
265.00	7.00	ORIE26500			x			x			
265.00	8.00	OR8026500									
266.00	6.00	OR6026600									
266.07	5.33	ORAR00378	378	x							
266.07	6.99	ORAR00450	450	x					R78		
266.29	3.53	ORAR00275	275	x							
267.00	4.50	OR4526700									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
268.80	8.40	OR8426880									
269.00	2.50	OR2526900									
269.30	5.70	OR5726930				x	G270				
269.50	8.40	OR8426950					P270				
270.00	2.50	OR2527000									
270.00	3.00	OR3027000									
270.00	4.00	OR4027000									
270.00	5.00	OR5027000									
270.00	6.00	OR6027000									
270.00	8.00	OR8027000									
272.00	4.00	OR4027200									
272.00	5.30	ORID27200			x			x			
272.00	7.00	ORIE27200			x			x			
274.00	2.00	OR2027400									
274.00	3.00	OR3027400									
274.00	6.50	OR6527400									
274.50	8.40	OR8427450					P275				
275.00	4.00	OR4027500									
275.00	5.00	OR5027500									
276.00	2.00	OR2027600									
278.77	5.33	ORAR00379	379	x							
278.77	6.99	ORAR00451	451	x					R79		
278.99	3.53	ORAR00276	276	x							
279.10	8.40	OR8427910									
279.30	5.70	OR5727930				x	G280				x
279.50	8.40	OR8427950					P280				
280.00	2.50	OR2528000									
280.00	3.00	OR3028000									
280.00	4.00	OR4028000									
280.00	5.00	OR5028000									
280.00	5.30	ORID28000			x			x			
280.00	6.00	OR6028000									
280.00	7.00	ORIE28000			x			x			
280.00	8.00	OR8028000									
282.00	4.00	OR4028200									
284.50	8.40	OR8428450					P285				

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
285.00	3.00	OR3028500									
285.00	4.00	OR4028500									
285.00	5.00	OR5028500									
285.10	7.00	ORIE28510									
288.00	6.00	OR6028800									
289.10	8.40	OR8428910									
289.30	5.70	OR5728930				x	G290				x
289.50	8.40	OR8428950					P290				
290.00	2.00	OR2029000									
290.00	3.00	OR3029000									
290.00	5.00	OR5029000									
290.00	5.30	ORID29000			x			x			
290.00	6.00	OR6029000									
290.00	7.00	ORIE29000			x			x			
290.00	8.00	OR8029000									
291.47	5.33	ORAR00380	380	x							
291.47	6.99	ORAR00452	452	x					R80		
291.69	3.53	ORAR00277	277	x							
292.00	4.00	OR4029200									
292.60	8.40	OR8429260									
294.00	4.00	OR4029400									
294.00	6.00	OR6029400									
294.50	8.40	OR8429450					P295				
295.00	6.00	OR6029500									
296.00	2.50	OR2529600									
297.00	4.00	OR4029700									
299.30	5.70	OR5729930				x	G300				x
299.50	8.40	OR8429950					P300				
300.00	3.00	OR3030000									
300.00	5.00	OR5030000									
300.00	5.30	ORID30000			x			x			
300.00	6.00	OR6030000									
300.00	7.00	ORIE30000			x			x			
300.00	8.00	OR8030000									
304.00	8.00	OR8030400									
304.17	5.33	ORAR00381	381	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
304.17	6.99	ORAR00453	453	x					R81		
304.39	3.53	ORAR00278	278	x							
305.00	4.00	OR4030500									
305.00	5.00	OR5030500									
307.00	5.30	ORID30700			x			x			
307.00	7.00	ORIE30700			x			x			
309.30	5.70	OR5730930									x
310.00	3.00	OR3031000									
310.00	4.00	OR4031000									
310.00	5.00	OR5031000									
310.00	7.00	ORIE31000									
310.00	8.00	OR8031000									
314.00	8.00	OR8031400									
314.50	8.40	OR8431450					P315				
315.00	2.50	OR2531500									
315.00	4.00	OR4031500									
315.00	5.00	OR5031500									
315.00	5.30	ORID31500			x			x			
315.00	6.00	OR6031500									
315.00	7.00	ORIE31500			x			x			
316.87	6.99	ORAR00454	454	x					R82		
319.30	5.70	OR5731930				x					x
319.50	8.40	OR8431950					P320				
320.00	3.00	OR3032000									
320.00	4.00	OR4032000									
320.00	5.00	OR5032000									
320.00	6.00	OR6032000									
320.00	7.00	ORIE32000			x						
320.00	8.00	OR8032000									
324.00	4.00	OR4032400									
325.00	5.00	OR5032500									
325.00	5.30	ORID32500			x			x			
325.00	6.00	OR6032500									
325.00	7.00	ORIE32500			x			x			
329.57	5.33	ORAR00382	382	x							
329.57	6.99	ORAR00455	455	x					R83		

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
329.79	3.53	ORAR00279	279	x							
330.00	4.00	OR4033000									
330.00	5.00	OR5033000									
330.00	6.00	OR6033000									
330.00	7.00	ORIE33000			x						
330.00	8.00	OR8033000									
331.00	3.00	OR3033100									
333.00	4.00	OR4033300									
334.50	8.40	OR8433450					P335				
335.00	5.00	OR5033500									
335.00	5.30	ORID33500			x			x			
335.00	6.00	OR6033500									
335.00	7.00	ORIE33500			x			x			
338.00	6.00	OR6033800									
339.30	5.70	OR5733930				x					x
339.50	8.40	OR8433950					P340				
340.00	3.50	OR3534000									
340.00	4.00	OR4034000									
340.00	5.00	OR5034000									
340.00	6.00	OR6034000									
340.00	8.00	OR8034000									
342.00	8.00	OR8034200									
342.27	6.99	ORAR00456	456	x					R84		
345.00	5.00	OR5034500									
345.00	5.30	ORID34500			x			x			
345.00	7.00	ORIE34500			x			x			
348.00	4.00	OR4034800									
348.00	6.00	OR6034800									
349.10	8.40	OR8434910									
350.00	2.50	OR2535000									
350.00	5.00	OR5035000									
350.00	6.00	OR6035000									
350.00	8.00	OR8035000									
354.50	8.40	OR8435450					P355				
354.97	5.33	ORAR00383	383	x							
354.97	6.99	ORAR00457	457	x					R85		

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
355.00	4.00	OR4035500									
355.00	5.00	OR5035500									
355.00	5.30	ORID35500			x			x			
355.00	7.00	ORIE35500			x			x			
355.19	3.53	ORAR00280	280	x							
358.00	6.00	OR6035800									
359.10	8.40	OR8435910									
359.30	5.70	OR5735930				x					x
359.50	8.40	OR8435950					P360				
360.00	4.00	OR4036000									
360.00	5.00	OR5036000									
360.00	8.00	OR8036000									
365.00	5.00	OR5036500									
365.00	5.30	ORID36500			x			x			
365.00	7.00	ORIE36500			x			x			
367.00	3.50	OR3536700									
367.00	5.00	OR5036700									
367.67	6.99	ORAR00458	458	x					R86		
368.00	2.50	OR2536800									
368.00	6.00	OR6036800									
370.00	4.00	OR4037000									
370.00	5.00	OR5037000									
372.00	8.40	OR8437200									
374.00	8.00	OR8037400									
374.50	8.40	OR8437450					P375				
375.00	5.00	OR5037500									
375.00	5.30	ORID37500			x			x			
375.00	7.00	ORIE37500			x			x			
376.00	6.00	OR6037600									
379.10	8.40	OR8437910									
379.20	5.70	OR5737920									
379.30	5.70	OR5737930				x					x
380.00	3.00	OR3038000									
380.00	4.00	OR4038000									
380.00	5.00	OR5038000									
380.00	6.00	OR6038000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
380.00	8.00	OR8038000									
380.37	5.33	ORAR00384	384	x							
380.37	6.99	ORAR00459	459	x					R87		
380.59	3.53	ORAR00281	281	x							
382.00	8.00	OR8038200									
384.50	8.40	OR8438450					P385				
385.00	5.00	OR5038500									
386.00	6.00	OR6038600									
387.00	5.30	ORID38700			x			x			
387.00	7.00	ORIE38700			x			x			
388.00	6.00	OR6038800									
388.00	7.00	ORIE38800									
389.00	8.00	OR8038900									
389.30	5.70	OR5738930									x
390.00	3.00	OR3039000									
390.00	4.00	OR4039000									
393.07	6.99	ORAR00460	460	x					R88		
394.00	6.00	OR6039400									
394.00	8.00	OR8039400									
395.00	5.00	OR5039500									
399.10	8.40	OR8439910									
399.30	5.70	OR5739930				x					x
399.50	8.40	OR8439950					P400				
400.00	2.00	OR2040000									
400.00	3.00	OR3040000									
400.00	4.00	OR4040000									
400.00	5.00	OR5040000									
400.00	5.30	ORID40000			x			x			
400.00	7.00	ORIE40000			x			x			
400.00	8.00	OR8040000									
405.26	3.53	ORAR00282	282	x							
405.26	5.33	ORAR00385	385	x							
405.26	6.99	ORAR00461	461	x							
410.00	4.00	OR4041000									
410.00	5.00	OR5041000									
410.00	6.50	OR6541000									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
412.00	7.00	ORIE41200			x			x			
412.00	8.00	OR8041200									
415.00	5.00	OR5041500									
417.96	6.99	ORAR00462	462	x							
419.30	5.70	OR5741930									x
420.00	4.00	OR4042000									
420.00	5.00	OR5042000									
422.00	6.00	OR6042200									
424.00	5.00	OR5042400									
425.00	4.00	OR4042500									
425.00	7.00	ORIE42500			x			x			
425.00	8.00	OR8042500									
427.00	5.00	OR5042700									
429.00	6.00	OR6042900									
430.00	4.00	OR4043000									
430.66	3.53	ORAR00283	283	x							
430.66	5.33	ORAR00386	386	x							
430.66	6.99	ORAR00463	463	x							
433.00	4.00	OR4043300									
437.00	7.00	ORIE43700			x			x			
438.00	4.00	OR4043800									
439.30	5.70	OR5743930				x					x
440.00	3.00	OR3044000									
440.00	4.00	OR4044000									
443.36	6.99	ORAR00464	464	x							
444.00	8.00	OR8044400									
445.00	5.00	OR5044500									
448.00	6.00	OR6044800									
450.00	5.00	OR5045000									
450.00	7.00	ORIE45000			x			x			
450.00	8.00	OR8045000									
451.00	7.00	ORIE45100									
456.06	3.53	ORAR00284	284	x							
456.06	5.33	ORAR00387	387	x							
456.06	6.99	ORAR00465	465	x							
459.30	5.70	OR5745930				x					x

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
460.00	4.00	OR4046000									
460.00	5.00	OR5046000									
460.00	8.00	OR8046000									
462.00	7.00	ORIE46200			x			x			
465.00	5.00	OR5046500									
465.00	9.00	OR9046500									
468.76	6.99	ORAR00466	466	x							
470.00	4.00	OR4047000									
470.00	5.00	OR5047000									
470.00	6.00	OR6047000									
470.00	8.00	OR8047000									
472.00	8.00	OR8047200									
475.00	4.00	OR4047500									
475.00	7.00	ORIE47500			x			x			
479.30	5.70	OR5747930				x					x
480.00	4.00	OR4048000									
480.00	5.00	OR5048000									
480.00	6.00	OR6048000									
480.00	8.00	OR8048000									
481.38	5.33	ORAR00388	388	x							
481.46	6.99	ORAR00467	467	x							
487.00	7.00	ORIE48700			x			x			
487.00	8.00	OR8048700									
489.20	5.70	OR5748910									
489.30	5.70	OR5748930									x
490.00	5.00	OR5049000									
490.00	8.00	OR8049000									
492.00	4.00	OR4049200									
494.16	6.99	ORAR00468	468	x							
499.30	5.70	OR5749930									x
500.00	5.00	OR5050000									
500.00	6.00	OR6050000									
500.00	7.00	ORIE50000			x			x			
500.00	8.00	OR8050000									
504.00	6.00	OR6050400									
506.78	5.33	ORAR00389	389	x							

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
506.86	6.99	ORAR00469	469	x							
508.00	6.00	OR6050800									
510.00	5.00	OR5051000									
515.00	7.00	ORIE51500			x			x			
520.00	5.00	OR5052000									
525.00	8.00	OR8052500									
530.00	4.00	OR4053000									
530.00	5.00	OR5053000									
530.00	7.00	ORIE53000			x			x			
532.18	5.33	ORAR00390	390	x							
532.26	6.99	ORAR00470	470	x							
540.00	3.00	OR3054000									
540.00	4.00	OR4054000									
540.00	5.00	OR5054000									
540.00	8.00	OR8054000									
542.00	7.00	ORIE54200									
545.00	3.00	OR3054500									
545.00	7.00	ORIE54500			x			x			
549.00	6.00	OR6054900									
550.00	5.00	OR5055000									
557.58	5.33	ORAR00391	391	x							
557.66	6.99	ORAR00471	471	x							
560.00	4.00	OR4056000									
560.00	5.00	OR5056000									
560.00	6.00	OR6056000									
560.00	7.00	ORIE56000			x			x			
569.00	6.00	OR6056900									
579.00	6.00	OR6057900									
580.00	7.00	ORIE58000			x			x			
580.00	8.00	OR8058000									
582.68	5.33	ORAR00392	392	x							
582.68	6.99	ORAR00472	472	x							
585.00	4.00	OR4058500									
585.00	5.00	OR5058500									
590.00	5.00	OR5059000									
592.00	8.00	OR8059200									

Inside diameter d_1	Cross section d_2	TSS Part No.	Standard								
			Reference No. AS 568 B	AS 568 B / BS 1806	ISO 3601	SMS 1586	JIS B 2401	NFT47 – 501	French recommendation	ISO 6149 – 2	BS4518
600.00	4.00	OR4060000									
600.00	5.00	OR5060000									
600.00	7.00	ORIE60000			x			x			
600.00	8.00	OR8060000									
608.08	5.33	ORAR00393	393	x							
608.08	6.99	ORAR00473	473	x							
615.00	7.00	ORIE61500			x			x			
630.00	7.00	ORIE63000			x			x			
633.48	5.33	ORAR00394	394	x							
633.48	6.99	ORAR00474	474	x							
649.00	8.40	OR8464900									
650.00	7.00	ORIE65000			x			x			
658.88	5.33	ORAR00395	395	x							
658.88	6.99	ORAR00475	475	x							
670.00	7.00	ORIE67000			x			x			
680.00	8.40	OR8468000									
715.00	8.40	OR8471500									
740.00	8.40	OR8474000									
774.10	8.40	OR8477410									
810.00	8.40	OR8481000									
845.00	8.40	OR8484500									
865.00	8.40	OR8486500									
888.00	8.40	OR8488800									
934.10	8.40	OR8493410									
959.10	8.40	OR8495910									

Further sizes on request! The given standards are valid for nominal sizes only. Tolerances, see the following pages.

C.1.2 O-Ring Dimensions according to AS 568 B

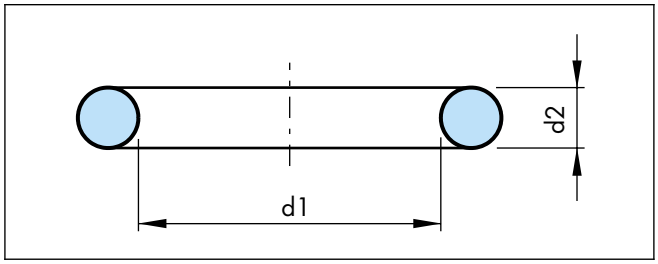


Figure 27 O-Ring dimensions

Table XVII Dimensions / TSS part numbers AS

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00001	0.74	1.02	.029	.040
ORAR00002	1.07	1.27	.042	.050
ORAR00003	1.42	1.52	.056	.060
ORAR00004	1.78	1.78	.070	.070
ORAR00005	2.57	1.78	.101	.070
ORAR00006	2.90	1.78	.114	.070
ORAR00007	3.68	1.78	.145	.070
ORAR00008	4.47	1.78	.176	.070
ORAR00009	5.28	1.78	.208	.070
ORAR00010	6.07	1.78	.239	.070
ORAR00011	7.65	1.78	.301	.070
ORAR00012	9.25	1.78	.364	.070
ORAR00013	10.82	1.78	.426	.070
ORAR00014	12.42	1.78	.489	.070
ORAR00015	14.00	1.78	.551	.070
ORAR00016	15.60	1.78	.614	.070
ORAR00017	17.17	1.78	.676	.070
ORAR00018	18.77	1.78	.739	.070
ORAR00019	20.35	1.78	.801	.070
ORAR00020	21.95	1.78	.864	.070
ORAR00021	23.52	1.78	.926	.070
ORAR00022	25.12	1.78	.989	.070
ORAR00023	26.70	1.78	1.051	.070
ORAR00024	28.30	1.78	1.114	.070
ORAR00025	29.87	1.78	1.176	.070
ORAR00026	31.47	1.78	1.239	.070
ORAR00027	33.05	1.78	1.301	.070

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00028	34.65	1.78	1.364	.070
ORAR00029	37.82	1.78	1.489	.070
ORAR00030	41.00	1.78	1.614	.070
ORAR00031	44.17	1.78	1.739	.070
ORAR00032	47.35	1.78	1.864	.070
ORAR00033	50.52	1.78	1.989	.070
ORAR00034	53.70	1.78	2.114	.070
ORAR00035	56.87	1.78	2.239	.070
ORAR00036	60.05	1.78	2.364	.070
ORAR00037	63.22	1.78	2.489	.070
ORAR00038	66.40	1.78	2.614	.070
ORAR00039	69.57	1.78	2.739	.070
ORAR00040	72.75	1.78	2.864	.070
ORAR00041	75.92	1.78	2.989	.070
ORAR00042	82.27	1.78	3.239	.070
ORAR00043	88.62	1.78	3.489	.070
ORAR00044	94.97	1.78	3.739	.070
ORAR00045	101.32	1.78	3.989	.070
ORAR00046	107.67	1.78	4.239	.070
ORAR00047	114.02	1.78	4.489	.070
ORAR00048	120.37	1.78	4.739	.070
ORAR00049	126.72	1.78	4.989	.070
ORAR00050	133.07	1.78	5.239	.070
ORAR00102	1.24	2.62	.049	.103
ORAR00103	2.06	2.62	.081	.103
ORAR00104	2.84	2.62	.112	.103
ORAR00105	3.63	2.62	.143	.103
ORAR00106	4.42	2.62	.174	.103
ORAR00107	5.23	2.62	.206	.103
ORAR00108	6.02	2.62	.237	.103
ORAR00109	7.59	2.62	.299	.103
ORAR00110	9.19	2.62	.362	.103
ORAR00111	10.77	2.62	.424	.103
ORAR00112	12.37	2.62	.487	.103
ORAR00113	13.94	2.62	.549	.103
ORAR00114	15.54	2.62	.612	.103

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00115	17.12	2.62	.674	.103
ORAR00116	18.72	2.62	.737	.103
ORAR00117	20.29	2.62	.799	.103
ORAR00118	21.89	2.62	.862	.103
ORAR00119	23.47	2.62	.924	.103
ORAR00120	25.07	2.62	.987	.103
ORAR00121	26.64	2.62	1.049	.103
ORAR00122	28.24	2.62	1.112	.103
ORAR00123	29.82	2.62	1.174	.103
ORAR00124	31.42	2.62	1.237	.103
ORAR00125	32.99	2.62	1.299	.103
ORAR00126	34.59	2.62	1.362	.103
ORAR00127	36.17	2.62	1.424	.103
ORAR00128	37.77	2.62	1.487	.103
ORAR00129	39.34	2.62	1.549	.103
ORAR00130	40.94	2.62	1.612	.103
ORAR00131	42.52	2.62	1.674	.103
ORAR00132	44.12	2.62	1.737	.103
ORAR00133	45.69	2.62	1.799	.103
ORAR00134	47.29	2.62	1.862	.103
ORAR00135	48.90	2.62	1.925	.103
ORAR00136	50.47	2.62	1.987	.103
ORAR00137	52.07	2.62	2.050	.103
ORAR00138	53.64	2.62	2.112	.103
ORAR00139	55.25	2.62	2.175	.103
ORAR00140	56.82	2.62	2.237	.103
ORAR00141	58.42	2.62	2.300	.103
ORAR00142	59.99	2.62	2.362	.103
ORAR00143	61.60	2.62	2.425	.103
ORAR00144	63.17	2.62	2.487	.103
ORAR00145	64.77	2.62	2.550	.103
ORAR00146	66.34	2.62	2.612	.103
ORAR00147	67.95	2.62	2.675	.103
ORAR00148	69.52	2.62	2.737	.103
ORAR00149	71.12	2.62	2.800	.103
ORAR00150	72.69	2.62	2.862	.103
ORAR00151	75.87	2.62	2.987	.103

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00152	82.22	2.62	3.237	.103
ORAR00153	88.57	2.62	3.487	.103
ORAR00154	94.92	2.62	3.737	.103
ORAR00155	101.27	2.62	3.987	.103
ORAR00156	107.62	2.62	4.237	.103
ORAR00157	113.97	2.62	4.487	.103
ORAR00158	120.32	2.62	4.737	.103
ORAR00159	126.67	2.62	4.987	.103
ORAR00160	133.02	2.62	5.237	.103
ORAR00161	139.37	2.62	5.487	.103
ORAR00162	145.72	2.62	5.737	.103
ORAR00163	152.07	2.62	5.987	.103
ORAR00164	158.42	2.62	6.237	.103
ORAR00165	164.77	2.62	6.487	.103
ORAR00166	171.12	2.62	6.737	.103
ORAR00167	177.47	2.62	6.987	.103
ORAR00168	183.82	2.62	7.237	.103
ORAR00169	190.17	2.62	7.487	.103
ORAR00170	196.52	2.62	7.737	.103
ORAR00171	202.87	2.62	7.987	.103
ORAR00172	209.22	2.62	8.237	.103
ORAR00173	215.57	2.62	8.487	.103
ORAR00174	221.92	2.62	8.737	.103
ORAR00175	228.27	2.62	8.987	.103
ORAR00176	234.62	2.62	9.237	.103
ORAR00177	240.97	2.62	9.487	.103
ORAR00178	247.32	2.62	9.737	.103
ORAR00201	4.34	3.53	.171	.139
ORAR00202	5.94	3.53	.234	.139
ORAR00203	7.52	3.53	.296	.139
ORAR00204	9.12	3.53	.359	.139
ORAR00205	10.69	3.53	.421	.139
ORAR00206	12.29	3.53	.484	.139
ORAR00207	13.87	3.53	.546	.139
ORAR00208	15.47	3.53	.609	.139
ORAR00209	17.04	3.53	.671	.139

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00210	18.64	3.53	.734	.139
ORAR00211	20.22	3.53	.796	.139
ORAR00212	21.82	3.53	.859	.139
ORAR00213	23.39	3.53	.921	.139
ORAR00214	24.99	3.53	.984	.139
ORAR00215	26.57	3.53	1.046	.139
ORAR00216	28.17	3.53	1.109	.139
ORAR00217	29.74	3.53	1.171	.139
ORAR00218	31.34	3.53	1.234	.139
ORAR00219	32.92	3.53	1.296	.139
ORAR00220	34.52	3.53	1.359	.139
ORAR00221	36.09	3.53	1.421	.139
ORAR00222	37.69	3.53	1.484	.139
ORAR00223	40.87	3.53	1.609	.139
ORAR00224	44.04	3.53	1.734	.139
ORAR00225	47.22	3.53	1.859	.139
ORAR00226	50.39	3.53	1.984	.139
ORAR00227	53.57	3.53	2.109	.139
ORAR00228	56.74	3.53	2.234	.139
ORAR00229	59.92	3.53	2.359	.139
ORAR00230	63.09	3.53	2.484	.139
ORAR00231	66.27	3.53	2.609	.139
ORAR00232	69.44	3.53	2.734	.139
ORAR00233	72.62	3.53	2.859	.139
ORAR00234	75.79	3.53	2.984	.139
ORAR00235	78.97	3.53	3.109	.139
ORAR00236	82.14	3.53	3.234	.139
ORAR00237	85.32	3.53	3.359	.139
ORAR00238	88.49	3.53	3.484	.139
ORAR00239	91.67	3.53	3.609	.139
ORAR00240	94.84	3.53	3.734	.139
ORAR00241	98.02	3.53	3.859	.139
ORAR00242	101.19	3.53	3.984	.139
ORAR00243	104.37	3.53	4.109	.139
ORAR00244	107.54	3.53	4.234	.139
ORAR00245	110.72	3.53	4.359	.139
ORAR00246	113.89	3.53	4.484	.139

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00247	117.07	3.53	4.609	.139
ORAR00248	120.24	3.53	4.734	.139
ORAR00249	123.42	3.53	4.859	.139
ORAR00250	126.59	3.53	4.984	.139
ORAR00251	129.77	3.53	5.109	.139
ORAR00252	132.94	3.53	5.234	.139
ORAR00253	136.12	3.53	5.359	.139
ORAR00254	139.29	3.53	5.484	.139
ORAR00255	142.47	3.53	5.609	.139
ORAR00256	145.64	3.53	5.734	.139
ORAR00257	148.82	3.53	5.859	.139
ORAR00258	151.99	3.53	5.984	.139
ORAR00259	158.34	3.53	6.234	.139
ORAR00260	164.69	3.53	6.484	.139
ORAR00261	171.04	3.53	6.734	.139
ORAR00262	177.39	3.53	6.984	.139
ORAR00263	183.74	3.53	7.234	.139
ORAR00264	190.09	3.53	7.484	.139
ORAR00265	196.44	3.53	7.734	.139
ORAR00266	202.79	3.53	7.984	.139
ORAR00267	209.14	3.53	8.234	.139
ORAR00268	215.49	3.53	8.484	.139
ORAR00269	221.84	3.53	8.734	.139
ORAR00270	228.19	3.53	8.984	.139
ORAR00271	234.54	3.53	9.234	.139
ORAR00272	240.89	3.53	9.484	.139
ORAR00273	247.24	3.53	9.734	.139
ORAR00274	253.59	3.53	9.984	.139
ORAR00275	266.29	3.53	10.484	.139
ORAR00276	278.99	3.53	10.984	.139
ORAR00277	291.69	3.53	11.484	.139
ORAR00278	304.39	3.53	11.984	.139
ORAR00279	329.79	3.53	12.984	.139
ORAR00280	355.19	3.53	13.984	.139
ORAR00281	380.59	3.53	14.984	.139
ORAR00282	405.26	3.53	15.955	.139
ORAR00283	430.66	3.53	16.955	.139

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00284	456.06	3.53	17.955	.139
ORAR00309	10.46	5.33	.412	.210
ORAR00310	12.07	5.33	.475	.210
ORAR00311	13.64	5.33	.537	.210
ORAR00312	15.24	5.33	.600	.210
ORAR00313	16.81	5.33	.662	.210
ORAR00314	18.42	5.33	.725	.210
ORAR00315	19.99	5.33	.787	.210
ORAR00316	21.59	5.33	.850	.210
ORAR00317	23.16	5.33	.912	.210
ORAR00318	24.77	5.33	.975	.210
ORAR00319	26.34	5.33	1.037	.210
ORAR00320	27.94	5.33	1.100	.210
ORAR00321	29.51	5.33	1.162	.210
ORAR00322	31.12	5.33	1.225	.210
ORAR00323	32.69	5.33	1.287	.210
ORAR00324	34.29	5.33	1.350	.210
ORAR00325	37.47	5.33	1.475	.210
ORAR00326	40.64	5.33	1.600	.210
ORAR00327	43.82	5.33	1.725	.210
ORAR00328	46.99	5.33	1.850	.210
ORAR00329	50.17	5.33	1.975	.210
ORAR00330	53.34	5.33	2.100	.210
ORAR00331	56.52	5.33	2.225	.210
ORAR00332	59.69	5.33	2.350	.210
ORAR00333	62.87	5.33	2.475	.210
ORAR00334	66.04	5.33	2.600	.210
ORAR00335	69.22	5.33	2.725	.210
ORAR00336	72.39	5.33	2.850	.210
ORAR00337	75.57	5.33	2.975	.210
ORAR00338	78.74	5.33	3.100	.210
ORAR00339	81.92	5.33	3.225	.210
ORAR00340	85.09	5.33	3.350	.210
ORAR00341	88.27	5.33	3.475	.210
ORAR00342	91.44	5.33	3.600	.210
ORAR00343	94.62	5.33	3.725	.210

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00344	97.79	5.33	3.850	.210
ORAR00345	100.97	5.33	3.975	.210
ORAR00346	104.14	5.33	4.100	.210
ORAR00347	107.32	5.33	4.225	.210
ORAR00348	110.49	5.33	4.350	.210
ORAR00349	113.67	5.33	4.475	.210
ORAR00350	116.84	5.33	4.600	.210
ORAR00351	120.02	5.33	4.725	.210
ORAR00352	123.19	5.33	4.850	.210
ORAR00353	126.37	5.33	4.975	.210
ORAR00354	129.54	5.33	5.100	.210
ORAR00355	132.72	5.33	5.225	.210
ORAR00356	135.89	5.33	5.350	.210
ORAR00357	139.07	5.33	5.475	.210
ORAR00358	142.24	5.33	5.600	.210
ORAR00359	145.42	5.33	5.725	.210
ORAR00360	148.59	5.33	5.850	.210
ORAR00361	151.77	5.33	5.975	.210
ORAR00362	158.12	5.33	6.225	.210
ORAR00363	164.47	5.33	6.475	.210
ORAR00364	170.82	5.33	6.725	.210
ORAR00365	177.17	5.33	6.975	.210
ORAR00366	183.52	5.33	7.225	.210
ORAR00367	189.87	5.33	7.475	.210
ORAR00368	196.22	5.33	7.725	.210
ORAR00369	202.57	5.33	7.975	.210
ORAR00370	208.92	5.33	8.225	.210
ORAR00371	215.27	5.33	8.475	.210
ORAR00372	221.62	5.33	8.725	.210
ORAR00373	227.97	5.33	8.975	.210
ORAR00374	234.32	5.33	9.225	.210
ORAR00375	240.67	5.33	9.475	.210
ORAR00376	247.02	5.33	9.725	.210
ORAR00377	253.37	5.33	9.975	.210
ORAR00378	266.07	5.33	10.475	.210
ORAR00379	278.77	5.33	10.975	.210
ORAR00380	291.47	5.33	11.475	.210

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00381	304.17	5.33	11.975	.210
ORAR00382	329.57	5.33	12.975	.210
ORAR00383	354.97	5.33	13.975	.210
ORAR00384	380.37	5.33	14.975	.210
ORAR00385	405.26	5.33	15.955	.210
ORAR00386	430.66	5.33	16.955	.210
ORAR00387	456.06	5.33	17.955	.210
ORAR00388	481.38	5.33	18.952	.210
ORAR00389	506.78	5.33	19.952	.210
ORAR00390	532.18	5.33	20.952	.210
ORAR00391	557.58	5.33	21.952	.210
ORAR00392	582.68	5.33	22.940	.210
ORAR00393	608.08	5.33	23.940	.210
ORAR00394	633.48	5.33	24.940	.210
ORAR00395	658.88	5.33	25.940	.210
ORAR00425	113.67	6.99	4.475	.275
ORAR00426	116.84	6.99	4.600	.275
ORAR00427	120.02	6.99	4.725	.275
ORAR00428	123.19	6.99	4.850	.275
ORAR00429	126.37	6.99	4.975	.275
ORAR00430	129.54	6.99	5.100	.275
ORAR00431	132.72	6.99	5.225	.275
ORAR00432	135.89	6.99	5.350	.275
ORAR00433	139.07	6.99	5.475	.275
ORAR00434	142.24	6.99	5.600	.275
ORAR00435	145.42	6.99	5.725	.275
ORAR00436	148.59	6.99	5.850	.275
ORAR00437	151.77	6.99	5.975	.275
ORAR00438	158.12	6.99	6.225	.275
ORAR00439	164.47	6.99	6.475	.275
ORAR00440	170.82	6.99	6.725	.275
ORAR00441	177.17	6.99	6.975	.275
ORAR00442	183.52	6.99	7.225	.275
ORAR00443	189.87	6.99	7.475	.275
ORAR00444	196.22	6.99	7.725	.275
ORAR00445	202.57	6.99	7.975	.275

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)	
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2
ORAR00446	215.27	6.99	8.475	.275
ORAR00447	227.97	6.99	8.975	.275
ORAR00448	240.67	6.99	9.475	.275
ORAR00449	253.37	6.99	9.975	.275
ORAR00450	266.07	6.99	10.475	.275
ORAR00451	278.77	6.99	10.975	.275
ORAR00452	291.47	6.99	11.475	.275
ORAR00453	304.17	6.99	11.975	.275
ORAR00454	316.87	6.99	12.475	.275
ORAR00455	329.57	6.99	12.975	.275
ORAR00456	342.27	6.99	13.475	.275
ORAR00457	354.97	6.99	13.975	.275
ORAR00458	367.67	6.99	14.475	.275
ORAR00459	380.37	6.99	14.975	.275
ORAR00460	393.07	6.99	15.475	.275
ORAR00461	405.26	6.99	15.955	.275
ORAR00462	417.96	6.99	16.455	.275
ORAR00463	430.66	6.99	16.955	.275
ORAR00464	443.36	6.99	17.455	.275
ORAR00465	456.06	6.99	17.955	.275
ORAR00466	468.76	6.99	18.455	.275
ORAR00467	481.46	6.99	18.955	.275
ORAR00468	494.16	6.99	19.455	.275
ORAR00469	506.86	6.99	19.955	.275
ORAR00470	532.26	6.99	20.955	.275
ORAR00471	557.66	6.99	21.955	.275
ORAR00472	582.68	6.99	22.940	.275
ORAR00473	608.08	6.99	23.940	.275
ORAR00474	633.48	6.99	24.940	.275
ORAR00475	658.88	6.99	25.940	.275

C.1.3 O-Ring dimensions for straight thread tube fitting sizes, AS 568 B

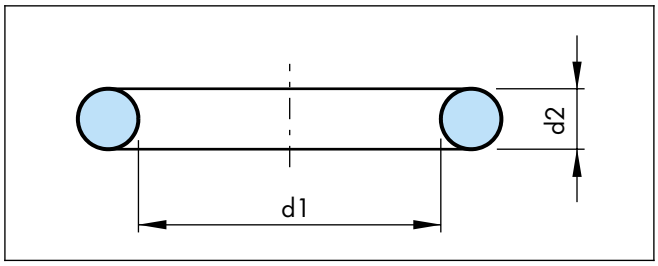
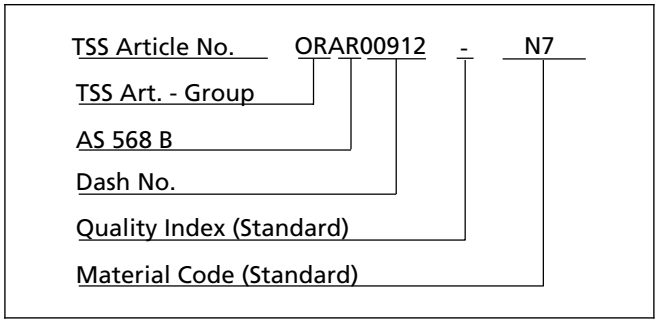


Figure 28 O-Ring dimensions

Ordering example

O-Ring according to AS 568 B
Dimensions: Inside diameter d_1 = 23.47 mm
Cross section d_2 = 2.95 mm
Compound: NBR 70
Nitrile-Butadiene Rubber 70 Shore A)



O-Ring dimensions and TSS part numbers see table XVIII. Material codes (elastomer type) for standard product order see table I (last column). The required Shore hardness must be given with the order.

When a special material is required the exact five-digit Trelleborg Sealing Solutions material code must be given with the order. In this respect please refer to the information provided in table X Preferred materials or contact your local Trelleborg Sealing Solutions company.

Table XVIII Dimensions / TSS part numbers

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)		Tube size (inch)
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2	Outside diameter OD
ORAR00901	4.70	1.42	.185	.056	3/32
ORAR00902	6.07	1.63	.239	.064	1/8
ORAR00903	7.65	1.63	.301	.064	3/16
ORAR00904	8.92	1.83	.351	.072	1/4
ORAR00905	10.52	1.83	.414	.072	5/16
ORAR00906	11.89	1.98	.468	.078	3/8
ORAR00907	13.46	2.08	.530	.082	7/16
ORAR00908	16.36	2.20	.644	.087	1/2
ORAR00909	17.93	2.46	.706	.097	9/16
ORAR00910	19.18	2.46	.755	.097	5/8
ORAR00911	21.92	2.95	.863	.116	11/16
ORAR00912	23.47	2.95	.924	.116	3/4
ORAR00913	25.04	2.95	.986	.116	13/16

TSS Part No.	Metric dimensions (mm)		Imperial dimensions (inch)		Tube size (inch)
	Inside diameter d_1	Cross section d_2	Inside diameter d_1	Cross section d_2	Outside diameter OD
ORAR00914	26.62	2.95	1.048	.116	7/8
ORAR00916	29.74	2.95	1.171	.116	1
ORAR00918	34.42	2.95	1.355	.116	1 1/8
ORAR00920	37.47	3.00	1.475	.118	1 1/4
ORAR00924	43.69	3.00	1.720	.118	1 1/2
ORAR00928	53.09	3.00	2.090	.118	1 3/4
ORAR00932	59.36	3.00	2.337	.118	1 3/4

C.1.4 O-Ring dimensions for metric thread with conical recess according to ISO 6149

Table XIX O-Ring dimensions for metric thread with conical recess according to ISO 6149

TSS Part No.	Metric dimensions (mm)		Thread (metric)
	Inside diameter d_1	Cross section d_2	
OR1600610	6.10	1.60	M8 x 1
OR1600810	8.10	1.60	M10 x 1
OR2200930	9.30	2.20	M12 x 1.5
OR2201130	11.30	2.20	M14 x 1.5
OR2201330	13.30	2.20	M16 x 1.5
OR2201530	15.30	2.20	M18 x 1.5
OR2201730	17.30	2.20	M20 x 1.5
OR2201930	19.30	2.20	M22 x 1.5
OR2902360	23.60	2.90	M27 x 2
OR2902960	29.60	2.90	M33 x 2
OR2903860	38.60	2.90	M42 x 2
OR2904460	44.60	2.90	M48 x 2
OR2905660	56.60	2.90	M60 x 2

C.2 Tolerances of dimensions

During vulcanisation, elastomers are subject to dimensional changes due to shrinkage. The degree of shrinkage depends on material, mould geometry and on the vulcanisation process employed.

The following tables XX and XXI show the tolerances for the inside diameter (d_1) and cross section (d_2). The tables are valid for all 70 Shore A Nitrile (NBR) elastomer materials; other materials may exhibit different dimensional tolerances if they are produced from moulds designed for NBR 70 materials. To guarantee a high and constant quality level it might be necessary to produce new or additional moulds with the corresponding costs.

Precision O-Rings with reduced tolerances are available if required - please contact your local Trelleborg Sealing Solutions company. O-Ring dimensions not included in the tables are manufactured acc. to tolerances based on ISO 3601, version 1987.

Table XX Cross section tolerances based on ISO 3601-1 (version 1987)

Cross section d2	Tolerances ±
$\leq$ 1.80	0.08
1.80 < d_2 $\leq$ 2.65	0.09
2.65 < d_2 $\leq$ 3.55	0.10
3.55 < d_2 $\leq$ 5.30	0.13
5.30 < d_2 $\leq$ 7.00	0.15
7.00 < d_2 $\leq$ 8.00	0.18
8.00 < d_2 $\leq$ 10.00	0.21
10.00 < d_2 $\leq$ 12.00	0.25
d_2 > 12.00	on request

Table XXI Tolerances for O-Ring inside diameters d_1 based on ISO 3601-1 (version 1987)

Inside diameter d_1	Tolerances ±
d_1 $\leq$ 2.50	0.13
2.50 < d_1 $\leq$ 4.50	0.14
4.50 < d_1 $\leq$ 6.30	0.15
6.30 < d_1 $\leq$ 8.50	0.16
8.50 < d_1 $\leq$ 10.00	0.17
10.00 < d_1 $\leq$ 11.20	0.18
11.20 < d_1 $\leq$ 14.00	0.19
14.00 < d_1 $\leq$ 16.00	0.20
16.00 < d_1 $\leq$ 18.00	0.21
18.00 < d_1 $\leq$ 20.00	0.22
20.00 < d_1 $\leq$ 21.20	0.23
21.20 < d_1 $\leq$ 23.60	0.24
23.60 < d_1 $\leq$ 25.00	0.25
25.00 < d_1 $\leq$ 26.50	0.26
26.50 < d_1 $\leq$ 28.00	0.28
28.00 < d_1 $\leq$ 30.00	0.29
30.00 < d_1 $\leq$ 31.50	0.31
31.50 < d_1 $\leq$ 33.50	0.32
33.50 < d_1 $\leq$ 34.50	0.33
34.50 < d_1 $\leq$ 35.50	0.34
35.50 < d_1 $\leq$ 36.50	0.35
36.50 < d_1 $\leq$ 37.50	0.36
37.50 < d_1 $\leq$ 38.70	0.37
38.70 < d_1 $\leq$ 40.00	0.38
40.00 < d_1 $\leq$ 41.20	0.39

Inside diameter d_1	Tolerances ±
41.20 < d_1 $\leq$ 42.50	0.40
42.50 < d_1 $\leq$ 43.70	0.41
43.70 < d_1 $\leq$ 45.00	0.42
45.00 < d_1 $\leq$ 46.20	0.43
46.20 < d_1 $\leq$ 47.50	0.44
47.50 < d_1 $\leq$ 48.70	0.45
48.70 < d_1 $\leq$ 50.00	0.46
50.00 < d_1 $\leq$ 51.50	0.47
51.50 < d_1 $\leq$ 53.00	0.48
53.00 < d_1 $\leq$ 54.50	0.50
54.50 < d_1 $\leq$ 56.00	0.51
56.00 < d_1 $\leq$ 58.00	0.52
58.00 < d_1 $\leq$ 60.00	0.54
60.00 < d_1 $\leq$ 61.50	0.55
61.50 < d_1 $\leq$ 63.00	0.56
63.00 < d_1 $\leq$ 65.00	0.58
65.00 < d_1 $\leq$ 67.00	0.59
67.00 < d_1 $\leq$ 69.00	0.61
69.00 < d_1 $\leq$ 71.00	0.63
71.00 < d_1 $\leq$ 73.00	0.64
73.00 < d_1 $\leq$ 75.00	0.66
75.00 < d_1 $\leq$ 77.50	0.67
77.50 < d_1 $\leq$ 80.00	0.69
80.00 < d_1 $\leq$ 82.50	0.71
82.50 < d_1 $\leq$ 85.00	0.73

Inside diameter d_1	Tolerances ±
85.00 < d_1 ≤ 87.50	0.75
87.50 < d_1 ≤ 90.00	0.77
90.00 < d_1 ≤ 92.50	0.79
92.50 < d_1 ≤ 95.00	0.81
95.00 < d_1 ≤ 97.50	0.83
97.50 < d_1 ≤ 100.00	0.84
100.00 < d_1 ≤ 103.00	0.87
103.00 < d_1 ≤ 106.00	0.89
106.00 < d_1 ≤ 109.00	0.91
109.00 < d_1 ≤ 112.00	0.93
112.00 < d_1 ≤ 115.00	0.95
115.00 < d_1 ≤ 118.00	0.97
118.00 < d_1 ≤ 122.00	1.00
122.00 < d_1 ≤ 125.00	1.03
125.00 < d_1 ≤ 128.00	1.05
128.00 < d_1 ≤ 132.00	1.08
132.00 < d_1 ≤ 136.00	1.10
136.00 < d_1 ≤ 140.00	1.13
140.00 < d_1 ≤ 145.00	1.17
145.00 < d_1 ≤ 150.00	1.20
150.00 < d_1 ≤ 155.00	1.24
155.00 < d_1 ≤ 160.00	1.27
160.00 < d_1 ≤ 165.00	1.31
165.00 < d_1 ≤ 170.00	1.34
170.00 < d_1 ≤ 175.00	1.38
175.00 < d_1 ≤ 180.00	1.41
180.00 < d_1 ≤ 185.00	1.44
185.00 < d_1 ≤ 190.00	1.48
190.00 < d_1 ≤ 195.00	1.51
195.00 < d_1 ≤ 200.00	1.55
200.00 < d_1 ≤ 206.00	1.59
206.00 < d_1 ≤ 212.00	1.63
212.00 < d_1 ≤ 218.00	1.67
218.00 < d_1 ≤ 224.00	1.71
224.00 < d_1 ≤ 230.00	1.75
230.00 < d_1 ≤ 236.00	1.79
236.00 < d_1 ≤ 243.00	1.83
243.00 < d_1 ≤ 250.00	1.88
250.00 < d_1 ≤ 258.00	1.93
258.00 < d_1 ≤ 265.00	1.98
265.00 < d_1 ≤ 272.00	2.02
272.00 < d_1 ≤ 280.00	2.08

Inside diameter d_1	Tolerances ±
280.00 < d_1 ≤ 290.00	2.14
290.00 < d_1 ≤ 300.00	2.21
300.00 < d_1 ≤ 307.00	2.25
307.00 < d_1 ≤ 315.00	2.30
315.00 < d_1 ≤ 325.00	2.37
325.00 < d_1 ≤ 335.00	2.43
335.00 < d_1 ≤ 345.00	2.49
345.00 < d_1 ≤ 355.00	2.56
355.00 < d_1 ≤ 365.00	2.62
365.00 < d_1 ≤ 375.00	2.68
375.00 < d_1 ≤ 387.00	2.76
387.00 < d_1 ≤ 400.00	2.84
400.00 < d_1 ≤ 412.00	2.91
412.00 < d_1 ≤ 425.00	2.99
425.00 < d_1 ≤ 437.00	3.07
437.00 < d_1 ≤ 450.00	3.15
450.00 < d_1 ≤ 462.00	3.22
462.00 < d_1 ≤ 475.00	3.30
475.00 < d_1 ≤ 487.00	3.37
487.00 < d_1 ≤ 500.00	3.45
500.00 < d_1 ≤ 515.00	3.54
515.00 < d_1 ≤ 530.00	3.63
530.00 < d_1 ≤ 545.00	3.72
545.00 < d_1 ≤ 560.00	3.81
560.00 < d_1 ≤ 580.00	3.93
580.00 < d_1 ≤ 600.00	4.05
600.00 < d_1 ≤ 615.00	4.13
615.00 < d_1 ≤ 630.00	4.22
630.00 < d_1 ≤ 650.00	4.34
650.00 < d_1 ≤ 670.00	4.46
d_1 > 670.00	approximately ± 0,7%

C.3 O-Ring quality acceptance criteria

ISO 3601-3 defines permissible form and surface deviations of elastomeric O-Rings.

Distinctions are made in the table between permissible flaw sizes according to type characteristics.

Type characteristic N
O-Rings falling under this characteristic meet the requirements made on a standard quality. They satisfy the demands made on static and dynamic seals.

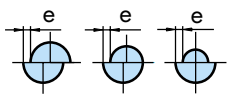
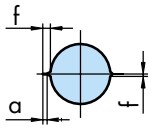
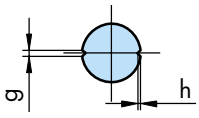
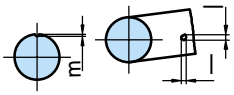
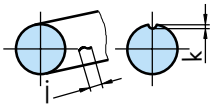
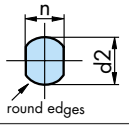
Type characteristic S
O-Rings falling under type characteristic S are subject to exceptional demands, e.g. for safety relevant components in automobile engineering. The permissible flaw sizes are very limited. This demands a greater process technology and stricter quality control procedures.

The following tables define the form and surface deviations of Trelleborg Sealing Solutions Elastomer O-Rings for standard quality as well as for reduced tolerances. The given values are based on ISO 3601-3, grade N and S.

If no quality requirements are specified with the order, O-Rings are supplied with standard quality according to table XXII (based on ISO 3601-3, grade N).

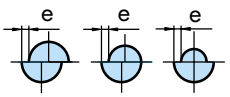
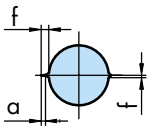
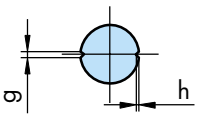
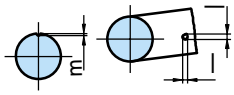
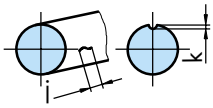
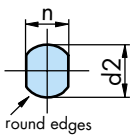
For surface deviations AQL 1.0 is supplied as standard. Higher quality levels are available on request.

Table XXII Surface specification for O-Rings - standard

Standard												
Type of defects based on ISO 3601-3***		Schematic illustration		maximum acceptable limits based on ISO 3601-3***, **Grade N**								
				Cross section d_2								
				≤0.80	≤2.25	≤3.15	≤4.50	≤6.30	≤8.40	≤10.00	≤15.00	>15.00
1.	Offset		e	by agreement	0.08	0.10	0.13	0.15	0.15	0.20	0.25	by agreement
2.	Flash		f		0.10	0.12	0.14	0.16	0.18	0.20	0.25	
			a		When the flash can be differentiated, it shall not exceed 0.07 mm							
3.	Backrind		g		0.18	0.27	0.36	0.53	0.70	0.90	1.20	
			h		0.08	0.08	0.10	0.10	0.13	0.13	0.15	
4.	Non-fills and indentations		l		0.60	0.80	1.00	1.30	1.70	2.00	2.50	
			m		0.08	0.08	0.10	0.10	0.13	0.13	0.15	
5.	Flow marks (radial orientation is not permitted)		j**		1.50	1.50	6.50	6.50	6.50	6.50	8.00	
					or 0.05 x d_1*							
			k		0.08	0.08	0.08	0.08	0.08	0.10	0.10	
6.	Area of excessive trimming (radial tool marks not allowed)		n		Trimming is allowed provided the dimension n is not reduced below the minimum diameter d_2 for the O-Ring							
7.	Foreign material		-	not permitted when viewed 2-times-magnified								
8.	Straightness tolerance		-	-								
9.	Roundness		-	-								
10.	The O-Ring surface shall be free from cracks, ruptures, blisters and other imperfections that are greater than the limits given in the table when inspected at 2-times-magnification with adequate illumination. The unstretched Ring is viewed.											
11.	Flow marks, non-fills and indentations within the limits given in the table shall not be allowed if a) there are more than three in any 25 mm length of circumference, b) they interconnect c) there are more than three that are separated from each other by a distance that is less than the maximum length of such imperfection											

all dimensions in mm * d_1 = Inside Diameter ** whichever is the greater *** ISO 3601-3:2005

Table XXIII Surface specification for O-Rings - reduced

Reduced											
Type of defects based on ISO 3601-3***		Schematic illustration		maximum acceptable limits based on ISO 3601-3***, **Grade S**							
				Cross section d_2							
				≤0.80	≤2.25	≤3.15	≤4.50	≤6.30	≤8.40	≤10.00	≤15.00	>15,00
1.	Offset		e	by agreement	0.08	0.08	0.10	0.12	0.13	0.15	0.20	by agreement
2.	Flash		f		0.10	0.10	0.13	0.15	0.15	0.18	0.20	
			a		When the flash can be differentiated, it shall not exceed 0.05 mm							
3.	Backrind		g		0.10	0.15	0.20	0.20	0.30	0.50	0.75	
			h		0.05	0.08	0.10	0.10	0.13	0.13	0.15	
4.	Non-fills and indentations		l		0.15	0.25	0.40	0.63	1.00	1.50	2.00	
			m		0.08	0.08	0.10	0.10	0.13	0.13	0.15	
5.	Flow marks (radial orientation is not permitted)		j**		1.50	1.50	5.00	5.00	5.00	5.00	7.00	
					or 0.05 x d_1*							
			k		0.05	0.05	0.05	0.05	0.05	0.08	0.08	
6.	Area of excessive trimming (radial tool marks not allowed)		n		Trimming is allowed provided the dimension n is not reduced below the minimum diameter d_2 for the O-Ring							
7.	Foreign material		-	not permitted when viewed 2-times-magnified								
8.	Straightness tolerance		-	-								
9.	Roundness		-	-								
10.	The O-Ring surface shall be free from cracks, ruptures, blisters and other imperfections that are greater than the limits given in the table when inspected at 2-times-magnification with adequate illumination. The unstretched Ring is viewed.											
11.	Flow marks, non-fills and indentations within the limits given in the table shall not be allowed if a) there are more than three in any 25 mm length of circumference, b) they interconnect c) there are more than three that are separated from each other by a distance that is less than the maximum length of such imperfection											

all dimensions in mm * d_1 = Inside Diameter ** whichever is the greater *** ISO 3601-3:2005

C.4 Seal set

The rapid availability of spare parts is very important during the servicing maintenance and repair of machines and equipment.

We offer a variety of standard ranges which are supplied in sturdy cases as a set with foam inlays.

O-Ring Set, Type A

390 O-Rings in 24 different Sizes to American Standard AS 568 B and British Standard BS 1806				
TSS Article No. ORSETAASS-N7 (NBR 70)				
Quantity	**Dimensions (mm)**		**Quantity**	**Dimensions (mm)**
30	2.90 x 1.78		10	18.77 x 1.78
30	3.69 x 1.78		15	9.20 x 2.62
30	4.47 x 1.78		15	10.78 x 2.62
30	5.28 x 1.78		15	12.37 x 2.62
30	6.07 x 1.78		10	17.12 x 2.62
30	7.65 x 1.78		10	18.72 x 2.62
30	9.25 x 1.78		10	20.30 x 2.62
20	10.82 x 1.78		5	18.64 x 3.53
20	12.42 x 1.78		5	20.22 x 3.53
10	14.00 x 1.78		5	21.82 x 3.53
10	15.60 x 1.78		5	23.38 x 3.53
10	17.17 x 1.78		5	24.99 x 3.53

O-Ring Set, Type B

295 O-Rings in 24 different Sizes to American Standard AS 568 B and British Standard BS 1806				
TSS Article No. ORSETBASS-N7 (NBR 70)				
Quantity	**Dimensions (mm)**		**Quantity**	**Dimensions (mm)**
15	20.35 x 1.78		15	34.52 x 3.53
15	21.95 x 1.78		10	36.09 x 3.53
15	25.07 x 2.62		10	37.69 x 3.53
15	26.64 x 2.62		10	40.87 x 3.53
15	28.24 x 2.62		10	44.04 x 3.53
15	29.82 x 2.62		10	47.22 x 3.53
15	31.42 x 2.62		10	50.39 x 3.53
15	32.99 x 2.62		10	37.47 x 5.33
15	34.59 x 2.62		10	40.64 x 5.33
15	29.74 x 3.53		10	43.82 x 5.33
15	31.34 x 3.53		5	46.99 x 5.33
15	32.92 x 3.53		5	50.17 x 5.33

O-Ring Set, Type C

380 O-Rings in 24 different Sizes, common Metric Sizes				
TSS Article No. ORSETCMET-N7 (NBR 70)				
Quantity	**Dimensions (mm)**		**Quantity**	**Dimensions (mm)**
20	4.00 x 2.00		15	10.30 x 2.40
20	6.00 x 2.00		15	11.20 x 2.40
20	8.00 x 2.00		15	12.30 x 2.40
20	10.00 x 2.00		15	13.30 x 2.40
20	12.00 x 2.00		15	14.30 x 2.40
20	3.30 x 2.40		10	10.00 x 3.00
20	4.30 x 2.40		10	12.00 x 3.00
20	5.30 x 2.40		10	14.00 x 3.00
20	6.30 x 2.40		10	16.00 x 3.00
20	7.30 x 2.40		10	18.00 x 3.00
20	8.30 x 2.40		10	19.20 x 3.00
20	9.20 x 2.40		5	20.00 x 3.00

O-Ring Set, Type D

295 O-Rings in 24 different Sizes, common Metric Sizes				
TSS Article No. ORSETDMET-N7 (NBR 70)				
Quantity	**Dimensions (mm)**		**Quantity**	**Dimensions (mm)**
15	18.00 x 2.00		15	35.00 x 4.00
15	20.00 x 2.00		15	38.00 x 4.00
15	25.00 x 3.00		15	40.00 x 4.00
15	26.20 x 3.00		10	42.00 x 4.00
15	28.00 x 3.00		10	45.00 x 4.00
15	29.20 x 3.00		10	46.00 x 4.00
15	32.20 x 3.00		10	48.00 x 4.00
15	34.20 x 3.00		10	35.00 x 5.00
15	36.20 x 3.00		10	40.00 x 5.00
15	30.00 x 4.00		10	45.00 x 5.00
15	32.00 x 4.00		5	48.00 x 5.00
15	34.00 x 4.00		5	50.00 x 5.00

D Special O-Rings

D.1 Isolast® (FFKM) O-Rings

Information about our Isolast® (FFKM) O-Rings are available either in our special Isolast® brochure or through your local Trelleborg Sealing Solutions company.

D.2 FEP encapsulated O-Rings

FEP encapsulated O-Rings consist of an elastomer inner ring and a seamless FEP sheath which surrounds the elastomer ring.

Similar to PTFE O-Rings FEP encapsulated O-Rings are used wherever the chemical resistance of normal elastomer O-Rings are not sufficient.

The required elasticity is provided by the elastomer ring, the chemical resistance by the seamless FEP sheath.

Advantages

- Very good chemical resistance to most liquids and chemicals, with the exception of liquid alkaline metals and some fluorine compounds
- Temperature application range from approx. -60 °C to +200 °C (depending on the material for the inner ring)
- Can be used with foodstuffs, pharmaceutical and medicinal products
- Physiologically safe and can be sterilised
- Low friction, no adhesion or stick-slip effect
- Adequate elastic behaviour for improved sealibility.

Versions

Standard versions:	Elastomer O-Ring with FEP sheath
Special versions:	Hollow elastomer ring with FEP sheath

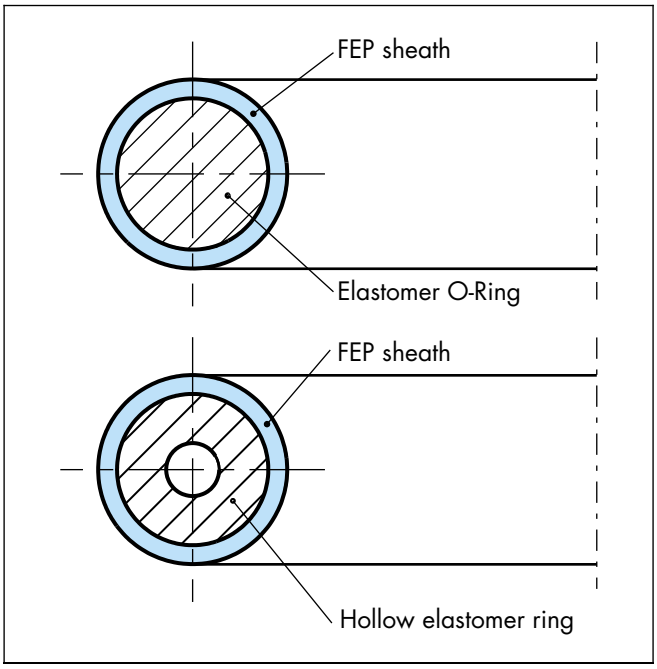


Figure 29 Different versions of FEP O-Ring

Applications

Fields of application

FEP encapsulated O-Rings are ideally suited for use in the chemical, petrochemicals, medical technology, foodstuffs, water, sewage and similar sectors of industry. A typical application for FEP encapsulated O-Rings is the sealing of valve spindles and as secondary sealing elements for mechanical seals.

FEP encapsulated O-Rings are used primarily as static seals. They are also suitable for use as sealing elements for slow switching and rotary movements.

In the chemical process industry, seals with special sealing profiles are frequently required. For such applications, we manufacture special seals for various flange cross sections either from drawings or from templates (Figure 30).

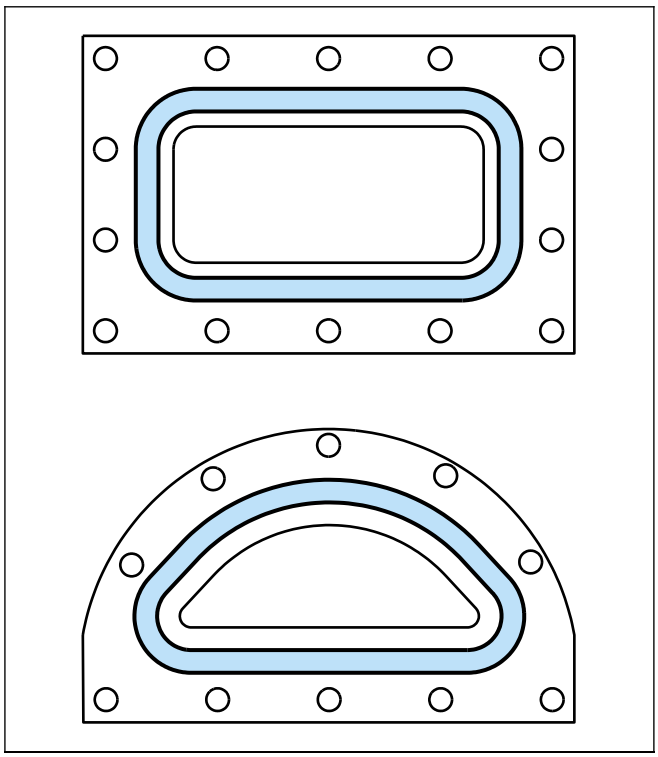


Figure 30 Seals for special flange cross sections

Technical data

Working pressure:	Up to 25 MPa
Temperature:	- 60 °C to + 200 °C - depending on the elastomer material
Media:	Practically all liquids, gases and chemicals

Materials

FEP sheath

FEP is the abbreviated designation for Tetrafluoroethylene-hexafluoropropylene. This material has similar properties to those of Polytetrafluoroethylene (PTFE). It also has a very high chemical resistance and exhibits a good resistance to abrasion.

In contrast to PTFE, however, FEP is thermoplastically mouldable. This allows the material to be processed to form flexible semifinished products, such as thin-walled hoses.

Inner ring

A choice of two materials is available for the elastomer inner rings. The choice of the material also determines the service temperature range.

- Fluoroelastomer (FKM), material code VZ00R temperature range: - 20 °C up to + 200 °C
- Silicone elastomer (VMQ), material code SZ00R temperature range: - 60 °C up to + 200 °C

The specified temperature ranges are limits which must always be considered in conjunction with the medium to be sealed and the working pressure. The permissible continous operating temperatures are always lower than the upper limits.

Design recommendations

FEP encapsulated O-Rings are fully interchangeable with standard O-Ring seals. There is no need to modify the groove dimensions. The FEP sheath is relatively thin-walled.

All the specifications given in this catalogue therefore refer to the installation dimensions of elastomer O-Rings.

As a result of the FEP sheath, the O-Rings are less flexible than elastomer O-Rings. They have limited stretch and higher permanent deformation.

Split grooves are recommended, especially for outside sealing FEP encapsulated O-Rings, in order to avoid overstretching during installation.

The general information on the construction, design and surfaces given for the elastomer O-Rings applies also to FEP encapsulated O-Rings.

At higher pressures, additional concave Back-up Rings should be used.

Application in gases

Where the O-Ring is used to seal gases, the permeation rate must be taken into consideration. In this case the material of the inner ring must also have a good resistance to the medium to be sealed. The permeation rate depends on the exposed surface area, the temperature, the working pressure and the thickness of the FEP sheath.

The thickness of the FEP sheath can be found in table XXIV.

Table XXIV Thickness of the FEP sheath

O-Ring		Thickness of the FEP Sheath
Cross section d_2	Tolerance ±	
1.78 1.80	0.10	0.20
2.62 2.65	0.10	0.30
3.53 3.55	0.12	0.38
5.34 5.30	0.25	0.50
7.00	0.38	0.50

The diagram (Figure 31) gives guide values for the permeation of different gases.

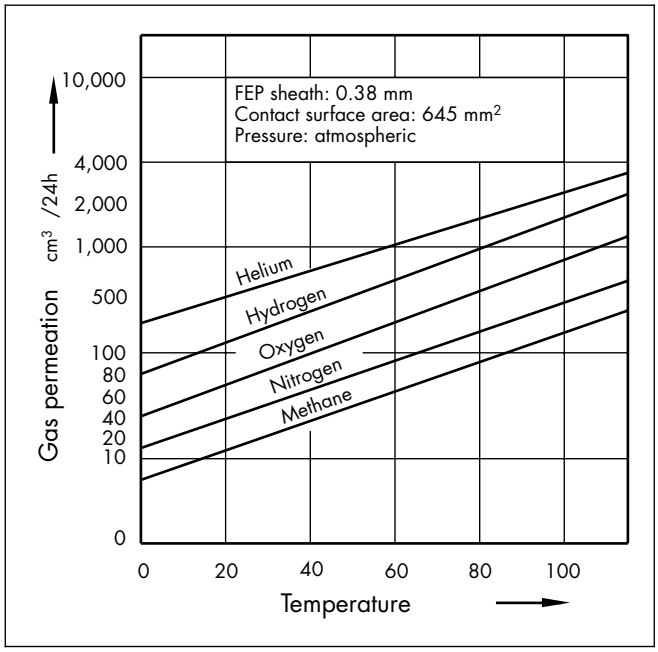


Figure 31 Gas permeation rates for FEP O-Rings

The diagram (Figure 32) gives guide values for the permeation of water vapour.

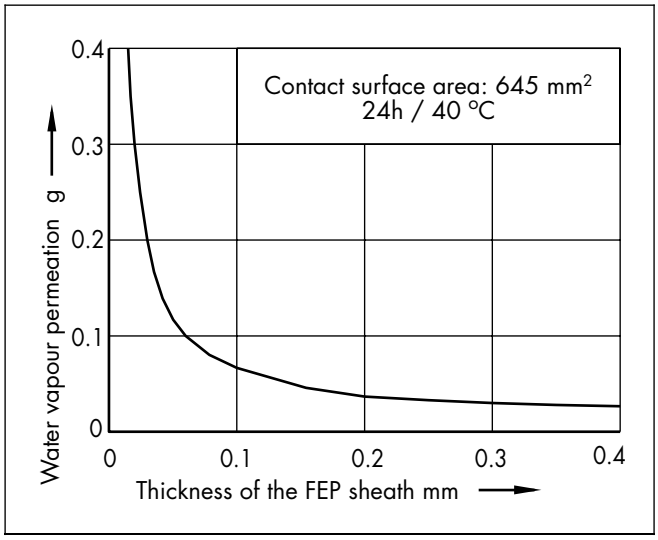


Figure 32 Water vapour permeation for FEP O-Rings

Methods of installation

The same recommendations apply to the installation of FEP encapsulated O-Rings as for standard elastomer O-Rings. It should be noted, however, that the O-Rings have only limited stretch due to the FEP sheath.

If, for design reasons, a split groove is not possible, auxiliary tools must be used for installation.

For inside sealing applications (e.g. rod), FEP encapsulated O-Rings can be installed with larger diameters without tools. On no account should the seal ring be forced into the groove (e. g. by bending), otherwise the sealing function cannot be assured.

Dimensions

FEP encapsulated O-Rings are available in the same sizes as the elastomer O-Rings. Table XXVI shows the smallest available inside diameters for the different cord diameters.

Table XXV Tolerances inside diameter

Inside diameter (mm)	Tolerance ID (± mm)
d1 < 7.64	not available
7.64 ≤ d1 ≤ 30.00	0.25
30.00 < d1 ≤ 130.00	0.38
130.00 < d1 ≤ 170.00	0.51
170.00 < d1 ≤ 380.00	0.64
380.00 < d1 ≤ 650.00	0.76
650.00 < d1 ≤ 1000.00	1.52
d1 >1000.00	on request

Table XXVI Smallest available sizes and cross section tolerances

O-Ring		Minimum inside diameter (mm)
Cross section (mm)	Tolerance CS (± mm)	
1.60	0.10	7.60
1.78		7.64
2.00		8.00
2.40		9.30
2.50		10.00
2.62		9.19
2.80		10.50
3.00	0.13	10.00
3.10		10.00
3.20		12.00
3.53		12.00
3.75		12.00
4.00	0.25	12.00
4.20		15.00
4.50		15.00
4.70		18.00
5.00		18.00
5.33		18.42
5.50		30.00
5.70		30.00

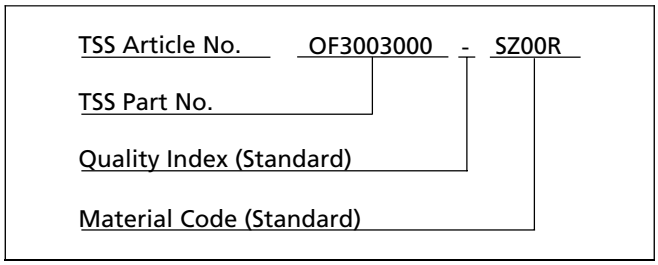
O-Ring		Minimum inside diameter (mm)
Cross section (mm)	Tolerance CS (± mm)	
6.00	0.38	30.00
6.30		41.00
6.50		41.00
7.00		41.00
7.50		101.60
8.00		70.00
8.40		102.00
9.00	0.51	102.00
9.50		102.00
10.00		108.00
10.50		127.00
11.00		127.00
12.00		152.40
12.70		177.80
13.00		254.00
14.00		254.00
15.00		254.00
16.00		305.00
18.00		422.00
19.00		422.00
20.00		508.00

Ordering example

O-Ring 30 x 3, FEP sheathed

Dimensions: Inside diameter d_1 = 30.0 mm
Cross section d_2 = 3.0 mm

Material of the inner ring: Silicone Rubber (VMQ)

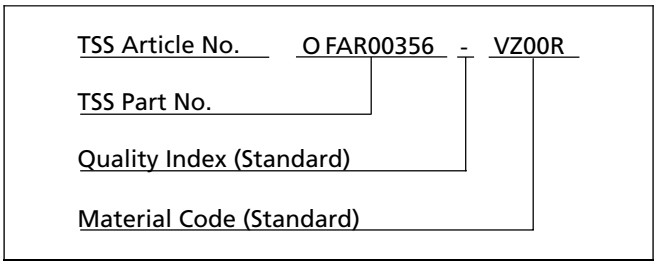


Further information see page 46

Ordering example

O-Ring, FEP sheathed
American Standard AS 568 B, ref. 356
Dimensions: Inside diameter d_1 = 135.89 mm
Cross section d_2 = 5.33 mm

Material of the inner ring: Fluorocarbon Rubber (FKM)



Further information see page 46

O-Ring dimensions and TSS Part No. see Table XVI, page 47-112.
Installation dimensions, see Table XV, page 43.

Ordering can also be made according to O-Ring dimensions and material.

D.3 PTFE O-Rings

O-Rings in Polytetrafluoroethylene (PTFE) are closed, circular rings with annular cross section. The dimensions are - as with the elastomer O-Ring - characterised by the inside diameter d_1 and the cord diameter d_2 (Figure 33). PTFE O-Rings are not moulded but produced by machining. The rings can therefore be manufactured in all sizes.

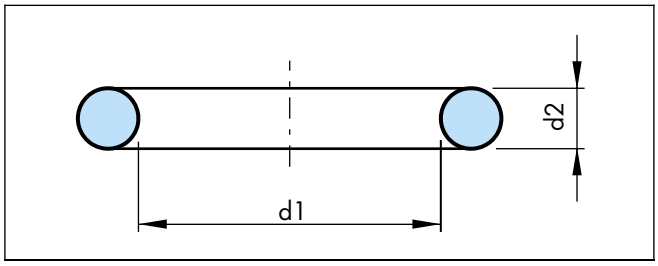


Figure 33 O-Ring dimensions

Advantages

- Very good chemical resistance, compatible with most liquids and chemicals, with the exception of liquid alkaline metals and some fluorine compounds.
- Wide temperature range from approx. -200 °C to +260 °C
- Suitable for contact with foodstuffs, pharmaceutical and medicinal products
- Physiologically safe, can be sterilised
- Low friction, no adhesion
- Available for all diameters up to approx. 1,000 mm.

Applications

Fields of application

PTFE O-Rings are used wherever the chemical and thermal resistance of the normal elastomer O-Rings is no longer sufficient. These are primarily applications in the chemical industry, foodstuffs industry, pharmaceuticals and medical technology. PTFE O-Rings are used only as static seals, e.g. on flange connections, on covers, etc.

Technical data

Working pressure:	Up to 40 MPa
Temperature:	-200 °C to +260 °C
Media:	Practically all liquids, gases and chemicals

Materials

Standard material: Virgin, unfilled PTFE (polytetrafluoroethylene), Material Code PT00

PTFE is a partially crystalline thermoplastic characterised by a very high chemical and thermal resistance. PTFE has the highest resistance to chemicals of all plastics and can be used for almost any application. It has a slightly limited resistance to molten alkaline metals, to elementary fluorine and to certain halogen materials.

The material undergoes no changes on exposure to ageing, light and ozone. The water absorption rate is less than 0.01%.

Design recommendations

PTFE O-Rings have low elasticity. The O-Ring size should therefore be chosen to suit the nominal diameter (rod or bore) to be scaled. Installation in axial easily accessible and radial split grooves is to be preferred.

The general information on the construction, design and surfaces given for the elastomer O-Rings applies also to PTFE O-Rings.

Methods of installation

PTFE O-Ring can only be stretched or compressed to a very limited extent during installation.

During installation, e.g. on flanges, the cold flow tendency of the thermoplastic PTFE should be taken into consideration. Under pressure, PTFE deforms plastically also in the cold state, i.e. a permanent deformation takes place. If flange seals are not tightened sufficiently to give metal/metal contact, the elastic deformation and thus the elastic tension can deteriorate.

Installation rocommendations

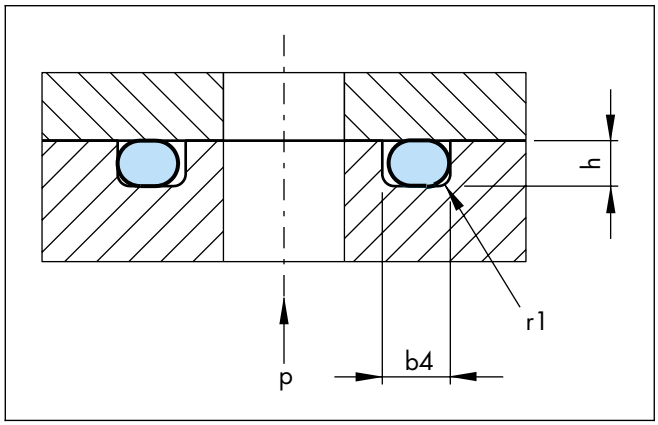


Figure 34 Axial installation, static, inside pressure

Table XXVII Installation dimensions

Cross section	Groove dimensions		Radius
d_2	Groove depth **h** +0.05	Groove width b_4 +0.1	r_1
1.50	1.30	1.7	0.2
1.60	1.40	1.8	0.3
1.78 1.80	1.60	2.0	0.4
2.00	1.80	2.2	0.5
2.40	2.15	2.6	0.5
2.50	2.25	2.8	0.5
2.62 2.65	2.35	2.9	0.6
3.00	2.70	3.3	0.8
3.53 3.55	3.15	3.9	1.0
4.00	3.60	4.4	1.0
5.00	4.50	5.5	1.0
5.33 5.30	4.80	5.9	1.2
5.70	5.10	6.3	1.2
6.00	5.60	6.6	1.2
7.00	6.30	7.7	1.5
8.00	7.20	8.8	1.5
8.40	7.55	9.2	2.0

Available dimensions

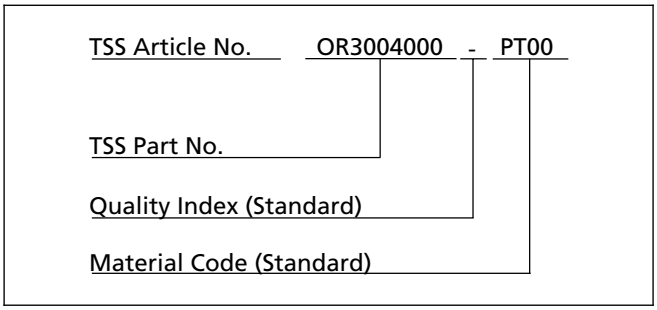
PTFE O-Rings are available in the same dimensions as the elastomer O-Rings. See O-Ring dimensions, page 47-112.

Ordering example

O-Ring, 40 x 3
Dimensions: Inside diameter d_1 = 40.0 mm
Cross section d_2 = 3.0 mm

O-Ring dimensions and TSS Part No. see Table XVI, page 47-112.

Ordering can also be made according to O-Ring dimensions and material.



D.4 Polyurethane O-Rings

Polyurethane is becoming more and more widely used as a sealing material due to its exceptionally high abrasion resistance and high extrusion resistance.

The polyurethane materials from Trelleborg Sealing Solutions have a number of improved properties.

Polyurethane is therefore an ideal material for O-Rings and sealing elements.

The outstanding properties of the materials play a major role particularly in our Zurcon® materials.

Polyurethane O-Rings are available in dimensions to American Standard AS 568 B (see dimension list, table XXVIII, page 139).

The dimensions are given with the inside diameter "d_1" and the cord diameter "d_2" (Figure 35, page 138).

Advantages

The main adavantages of a polyurethane material for O-Rings compared with other elastomer are the outstanding mechanical properties:

- High abrasion and wear resistance tolerates aggressive operating conditions
- High extrusion resistance allows increased pressures or extrusion gaps
- Good mechanical properties improve service life
- Low friction reduces breakout forces on start up

Applications

Fields of application

Polyurethane O-Rings are especially suited wherever O-Rings are subject to dynamic loads.

This includes for example, applications in hydraulics, pneumatics and in a wide range of other critical areas. In many cases, polyurethane O-Rings are used instead of NBR in view of their high mechanical strengths.

Due to their particularly high abrasion resistance, polyurethane O-Rings are more suitable than other materials in applications where bores have to be crossed or where frequent opening and closing is demanded, e.g. plug connectors and couplings.

Polyurethane O-Rings in 70 Shore A hardness material WU7TI can, with advance, be used in applications such as pneumatics where low compression set and low friction are essential.

Technical data

Working pressure:	Static up to approx. 60 MPa without Back-up Ring (depending on the extrusion gap) Dynamic up to 25 MPa
Speed:	Reciprocating up to $\leq$ 0.2 m/s
Temperature:	-45 °C up to +100 °C depending on the material
Media:	Hydraulic fluids and mineral oil-based greases and air.

Materials

The most important characteristics of these polyurethanes are:

- High tensile strength
- Low compression set
- Very good cold flexibility
- Constant shear modulus even at high temperatures
- Resistant to weathering and ageing
- High damping properties
- Low gas permeability
- Good hydrolysis resistance
- High tear propagation resistance
- Free from substances which hinder paint coverage

Polyurethane materials are resistant in:
Mineral oils and greases, oxygen, ozone.

Polyurethane compounds are not resistant in:
Esters, aromatic and chlorinated hydrocarbons, concentrated acids and lyes.

Polyurethane O-Rings are available on request in the following grades:

Polyurethane, 70 Shore A
Material code WU7T1

Polyurethane, 92 Shore A
Material code WU9T2

Polyurethane, 93 Shore A, Zurcon®:
Material code Z22 and Z24

Polyurethane, 94 Shore A, Zurcon®:
Material code Z20

Depending on the production method Zurcon® O-Rings can have an injection point on the inside diameter. This marking is placed at a 45° angle from the flash.

Ordering Example

O-Ring, American Standard AS 568 B, ref. 214

Dimensions: Inside diameter d_1 = 24.99 mm
Cross section d_2 = 3.53 mm

Material: Polyurethane (AU 70 Shore A)

O-Ring dimensions and TSS Part No. see table XXVIII.

Installation dimensions, see table XV, page 43.

Ordering can also be made according to O-Ring dimensions and material.

Design instructions

The same design rules apply to polyurethane O-Rings as to other elastomer O-Rings, i.e. the same installation dimensions (groove depth, groove width), see Table XV, page 43.

Radial clearance

In view of the high extrusion resistance of polyurethane, larger clearances can be bridged with polyurethane O-Rings than with other elastomers, without the additional installation of Back-up Rings.

The permissible radial clearance is depending on the used material, on the O-Ring cross section and on the application properties, e. g. the temperature.

O-Ring dimensions

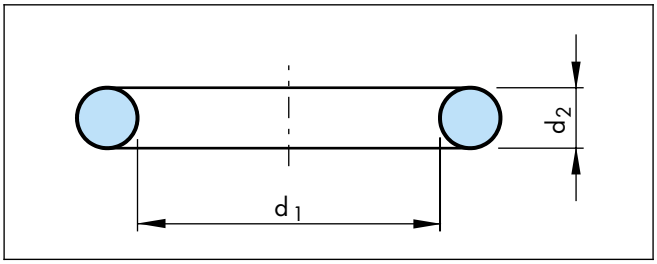


Figure 35 O-Ring dimensions

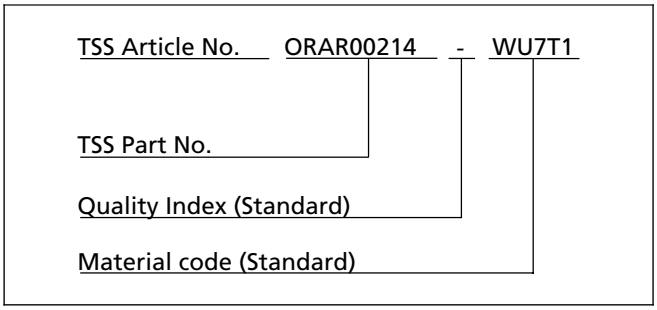


Table XXVIII Dimensions according to AS 568 B (Further sizes on request)

TSS Part No.	Inside-Ø d_1	Cross Section d_2
ORAR00005	2.57	1.78
ORAR00006	2.90	1.78
ORAR00008	4.47	1.78
ORAR00009	5.28	1.78
ORAR00010	6.07	1.78
ORAR00011	7.65	1.78
ORAR00012	9.25	1.78
ORAR00013	10.82	1.78
ORAR00014	12.42	1.78
ORAR00015	14.00	1.78
ORAR00017	17.17	1.78
ORAR00018	18.77	1.78
ORAR00019	20.35	1.78
ORAR00020	21.95	1.78
ORAR00022	25.12	1.78
ORAR00023	26.70	1.78
ORAR00025	29.87	1.78
ORAR00027	33.05	1.78
ORAR00029	37.82	1.78
ORAR00034	53.70	1.78
ORAR00036	60.05	1.78
ORAR00039	69.57	1.78
ORAR00040	72.75	1.78
ORAR00041	75.92	1.78
ORAR00045	101.32	1.78
ORAR00046	107.67	1.78
ORAR00047	114.02	1.78
ORAR00050	133.07	1.78
ORAR00110	9.19	2.62
ORAR00111	10.77	2.62
ORAR00112	12.37	2.62
ORAR00113	13.94	2.62
ORAR00114	15.54	2.62
ORAR00115	17.12	2.62
ORAR00116	18.72	2.62
ORAR00117	20.29	2.62
ORAR00118	21.89	2.62
ORAR00119	23.47	2.62
ORAR00120	25.07	2.62
ORAR00122	28.24	2.62
ORAR00124	31.42	2.62
ORAR00125	32.99	2.62
ORAR00126	34.59	2.62
ORAR00127	36.17	2.62
ORAR00128	37.77	2.62
ORAR00129	39.34	2.62
ORAR00132	44.12	2.62
ORAR00133	45.69	2.62
ORAR00134	47.29	2.62
ORAR00135	48.90	2.62
ORAR00136	50.47	2.62
ORAR00137	52.07	2.62
ORAR00138	53.64	2.62
ORAR00141	58.42	2.62
ORAR00142	59.99	2.62
ORAR00145	64.77	2.62
ORAR00146	66.34	2.62
ORAR00147	67.95	2.62
ORAR00210	18.64	3.53
ORAR00211	20.22	3.53
ORAR00213	23.39	3.53
ORAR00214	24.99	3.53
ORAR00215	26.57	3.53
ORAR00216	28.17	3.53
ORAR00217	29.74	3.53
ORAR00218	31.34	3.53
ORAR00220	34.52	3.53
ORAR00222	37.69	3.53
ORAR00224	44.04	3.53
ORAR00225	47.22	3.53
ORAR00226	50.39	3.53
ORAR00227	53.57	3.53

TSS Part No.	Inside-Ø d_1	Cross Section d_2
ORAR00228	56.74	3.53
ORAR00229	59.92	3.53
ORAR00230	63.09	3.53
ORAR00231	66.27	3.53
ORAR00232	69.44	3.53
ORAR00234	75.79	3.53
ORAR00235	78.97	3.53
ORAR00236	82.14	3.53
ORAR00237	85.32	3.53
ORAR00238	88.49	3.53
ORAR00239	91.67	3.53
ORAR00240	94.84	3.53
ORAR00325	37.47	5.33
ORAR00326	40.64	5.33
ORAR00327	43.82	5.33
ORAR00328	46.99	5.33
ORAR00329	50.17	5.33
ORAR00330	53.34	5.33
ORAR00331	56.52	5.33
ORAR00332	59.69	5.33
ORAR00334	66.04	5.33
ORAR00336	72.39	5.33
ORAR00337	75.57	5.33
ORAR00338	78.74	5.33
ORAR00339	81.92	5.33
ORAR00340	85.09	5.33

Tolerances based on ISO 3601. See tables XX and XXI.

D.5 Round cord rings (butt vulcanised)

Round cords are produced by extrusion. They are supplied as cut lengths. The most common materials are NBR 70 Shore A, EPDM 65 Shore A and FKM 75 Shore A. Other materials are available on request.

In contrast to mould-vulcanised O-Rings, round cord rings made from continuously extruded cord can be made up to any desired diameter. The junction point always has poorer mechanical properties than the basic material.

For this reason, round cord rings should not be used for dynamic seals, gaseous media or vacuum.

The O-Ring tolerances according to ISO 3601-1 for cross section d_2 are not applicable.

Table XXIX Available cross sections and valid tolerances for FKM 75 Shore A

Cross section (mm)	Tolerance
1.78	+ 0.3 / - 0.1
2.00	
2.50	+ 0.3 / - 0.2
2.60	
3.00	
3.50	
4.00	+ 0.4 / - 0.2
4.50	
5.00	
5.30	
5.70	
6.00	
6.50	+ 0.5 / - 0.3
7.00	
8.00	
8.40	
9.00	
10.00	+ 0.6 / - 0.4
11.00	
12.00	
14.00	
15.00	
18.00	+ 0.8 / - 0.6
20.00	

Table XXX Available cross sections and valid tolerances for NBR 70 Shore A

Cross section (mm)	Tolerance
1.00	± 0.20
1.50	
1.78	
2.00	
2.50	
3.00	± 0.25
3.20	
3.53	
4.00	
4.75	± 0.35
5.00	
5.33	
5.70	
6.00	
6.40	± 0.40
7.00	
7.50	
8.00	
8.40	
9.00	
9.50	
10.00	
11.00	± 0.50
12.00	
12.70	
13.00	
14.00	
15.00	
16.00	
18.00	± 0.70
20.00	
22.00	
25.00	
30.00	± 0.80

Table XXXI Available cross sections and valid tolerances for EPDM 70 Shore A

Cross section (mm)	Tolerance
2.00	± 0.30
2.50	
3.00	± 0.35
3.50	
4.00	
5.00	± 0.40
5.30	
5.70	
6.00	± 0.45
7.00	± 0.50
8.00	
9.00	
9.50	
10.00	
11.00	± 0.70
12.00	
13.00	
14.00	
15.00	
18.00	± 0.90
20.00	

The tolerances stated are valid for round cord rings (butt-vulcanised) only and refer to the cross section. Due to the applied pressure during the vulcanisation process the junction point can be thinner than the cord. In general this has no negative effect on the sealing function.

The article number of round cord rings starts wih OV.

D.6 O-Ring surface treatments

In many cases standard elastomeric O-Rings cannot be used without a modified surface. Friction can be one of the reasons. Also the possible contamination of the systems through extraction of material components is often not acceptable.

Therefore O-Rings can be surface-treated by special ways of cleaning, dipping, spraying or coating in order to reduce friction and adhesion, achieve permanent lubrication or facilitate installation.

Depending on the desired effect several high-quality surface treatments or coatings can be used. These are described in the following sections.

D.6.1 O-Rings free of substances affecting the lacquer coating - “Labs-free“

In the automotive supply industry, it is important to assure that components are clean, principally for processes involving varnishing technology. No substances, which could affect the lacquer coating or cause so called “dimples“ on the lacquer surface, are allowed in the system.

Due to the production system, elastomeric seals in particular may introduce such “dimple creators“. They may possibly contain processing aids, softeners or similar ingredients not necessarily based on silicone, which might affect the lacquer coating. The results are similar to the effects from well-known silicone oils.

The seals must be cleaned through a special process before using them in varnishing fields.

In a high-tech cleaning process the seals are rid of contaminating substances in or upon the surface. The result of the cleaning process is evaluated by a test following the VW test specification, “Colours and Lacquers“ P-VW 3.10.7 for each batch. Subsequent exudation of mixture components is prevented. The seals cleaned through this process are labelled as “Labs-free“.

A special packaging and the respective labelling provide for easy storage.

Labs-free seals are also applied in the field of medical technology.

Article group OC.

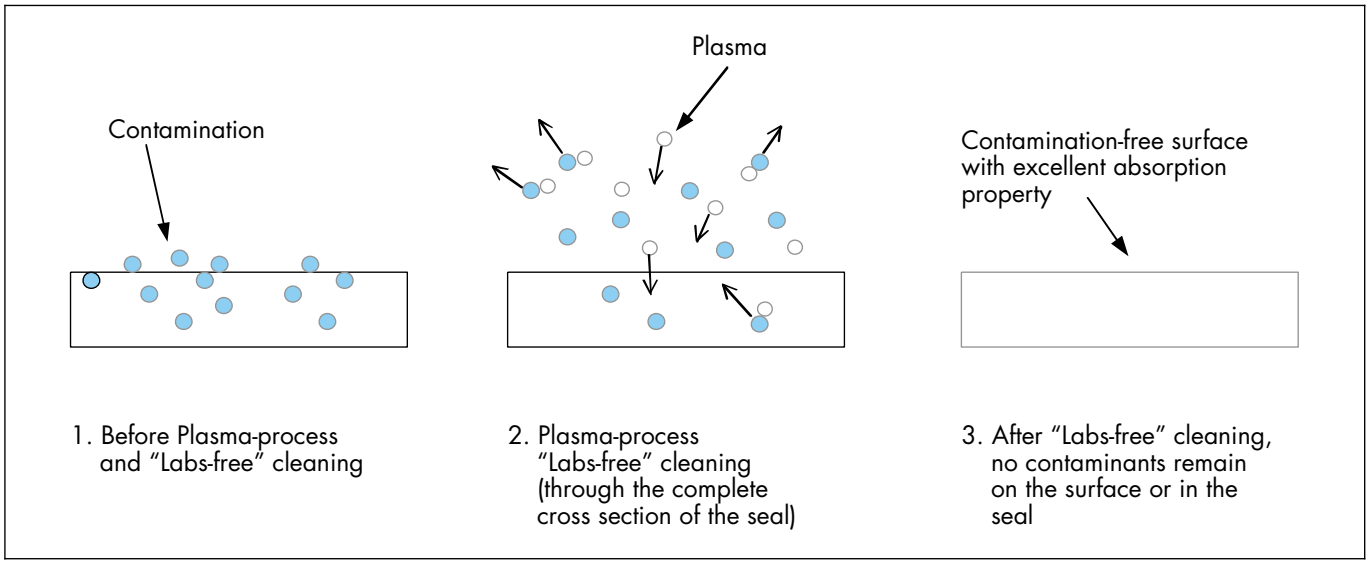


Figure 36 Schematic course of the labs-free treatment

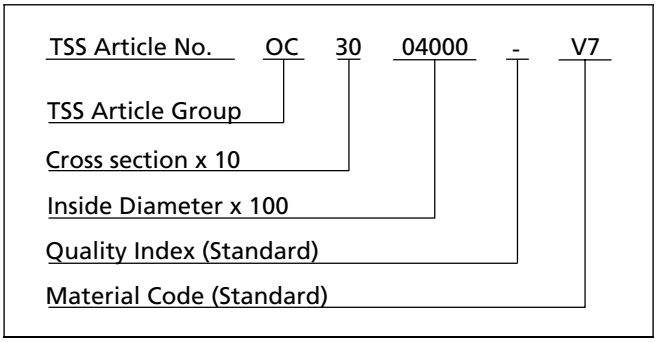
Ordering example

(Further information see page 46)

O-Ring metric 40 x 3 - FKM 70

Dimensions: Inside diameter = 40.0 mm
Cross section = 3.0 mm

Material: FKM 70
(Fluorocarbon Rubber 70 Shore A)



D.6.2 O-Ring friction reducing processes

The strong trend towards automatic assembly in all areas of production places completely new requirements on O-Rings. The elements must be treated in such a way that they can be separated without problems. Depending on the application area, stick-slip phenomena and high breakaway forces need to be prevented. Particularly in the transmission of dynamic functions, as in the case of short strokes and infrequent switch operation, or in the reduction of assembly forces, e. g. plug connections, a reduction of friction is demanded.

The table XXXII provides a summary of different surface treatments and the selection criteria. The treatments are described in the following sections.

Table XXXII Selection criteria for friction reducing processes

Procedure	Article group	Elastomers	Adhesion prevention (packing)	Reduction of assembly force (plug-in systems)	Automatic assembly (separation)	Dynamic application (valves)
Talcum coating	OT	All	A	C	B	C
Elastolub 013 coating	OE	All except Silicones	C	A	C	C
Molycote treatment	OM	All	A	A	B	C
MaxWax®	-	All	A	A	A	C
DF treatment	OI	NBR	A	A	A	A
LF coating	OJ	All except Silicones	A	A	A	A
MF coating	OQ	All except Silicones	A	B	A	C
FF coating	OY	All except Silicones	A	A	A	B
SF coating	OS	All except Silicones	A	A	A	A

A = Very Good
B = Good
C = Satisfactory

This table is for guidance only. It represents a selection of the most important variants. Further proposals are available on request. Please contact your local Trelleborg Sealing Solutions company.

LF coating

The LF coating is a transparent, dry coating based on PTFE which is applied to the elastomer surface in a computerised process. The seal surface remains elastic.

To ensure permanent surface bonding the parts are pre-treated with plasma.

LF is primarily used to reduce surface friction among other things for dynamic applications and beyond that for the strong reduction up to the prevention of the gluing inclination of elastomeric seals.

- Flexible coating with surface bond
- Transparent with a slight milkiness
- UV-indicator allows 100% inspection
- Water-based, solvent-free
- Coating thickness about 2 - 6 µm (deviations depending on part geometry are possible)
- Operating temperature range of the coating material -40 °C to +150 °C
- Containes no substances with duty of declaration according to VDA 232-101
- Constant process-secure quality
- Reduced mounting forces through friction reduction
- Pieces remain separate in the packing
- Reduction of the gluing inclination of elastomeric seals in the application
- Excellent usage for automated assembly
- Suitable for dynamic applications, preferred at low rate or for short strokes
- Suitable for various types of elastomers except silicones
- **Article group OJ**

MF coating

The MF coating is a dry coating which is applied to the elastomer surface in a computerised process. Similar to the LF coating MF is transparent and based on PTFE.

The good surface bond is achieved owing to a prior elevation of surface energy in the seal through a plasma treatment.

MF is primarily used to facilitate assembly of elastomeric seals and provides a better separating of parts. Due to its composition it is suited for one-time assembly only.

- Elastic, dry coating
- Transparent with a slight milkiness
- UV-indicator allows 100% inspection
- Water-based, solvent-free
- Coating thickness about 2 - 6 µm (deviations depending on part geometry are possible)
- Containes no substances with duty of declaration according to VDA 232-101
- Constant process-secure quality
- Prevents contamination of the assembly facilities
- Pieces remain separate in the packing
- Excellent usage for automated assembly
- Suitable for various types of elastomers except silicones
- **Article group OQ**

SF coating

SF coating is a black, dry coating based on PTFE particularly intended for the use in dynamic applications.

To ensure permanent surface bonding the parts are pre-treated with plasma.

Signs of wear at the seal's surface are effectively reduced. Gluing phenomenon and stick-slip effects are nearly eliminated.

- Flexible coating with surface bond
- Black with UV indicator (allows 100 % inspection)
- Water-based, solvent-free
- Coating thickness about 2 - 6 µm (deviations depending on part geometry are possible)
- Containes no substances with duty of declaration according to VDA 232-101
- Constant, process-secure quality
- Operating temperature range of the coating material -40 °C to +150 °C
- Pieces remain separate in the packing
- Reduces mounting forces
- Reduction of the gluing inclination of elastomeric seals in the application
- Excellent usage for automated assembly
- Friction reduction in dynamic use
- Reduces the seal surface's signs of wear in dynamic use
- Suitable for various types of elastomers except silicones
- **Article group OS**

FF coating

The transparent FF coating for elastomeric seals is especially suitable for the reduction of mounting resp. plugging forces and to ease assembly.

Through the FDA compliance FF can be used in corresponding applications of the food or the potable water industry.

As well as with SF coating the permanent surface bonding is assured through a pre-treatment with plasma.

- Flexible coating with surface bond based on PTFE
- Transparent resp. milky or dull
- Water-based, solvent free
- FDA compliant ("White list")
- approved acc. to the Foodstuffs and Commodities Act (LMBG, § 5, paragraph 1)
- complies with the standards of the German Federal Environmental Agency (FEA), valid for the area D2 (seals)
- Coating thickness about 2-10 µm (deviations depending on part geometry are possible)
- Contains no substances with duty of declaration according to VDA 232-101
- Constant process-sure quality
- Operating temperature range of the coating material -40 °C to +150 °C
- Pieces remain separate in the packing
- Reduces considerably mounting resp. plugging forces
- Reduces the risk of the seal shearing off during assembly
- Friction reduction for gentle dynamic use, e.g. infrequent switching operations with short strokes and at low rate
- Suitable for various types of elastomers except silicones
- **Article group OY**

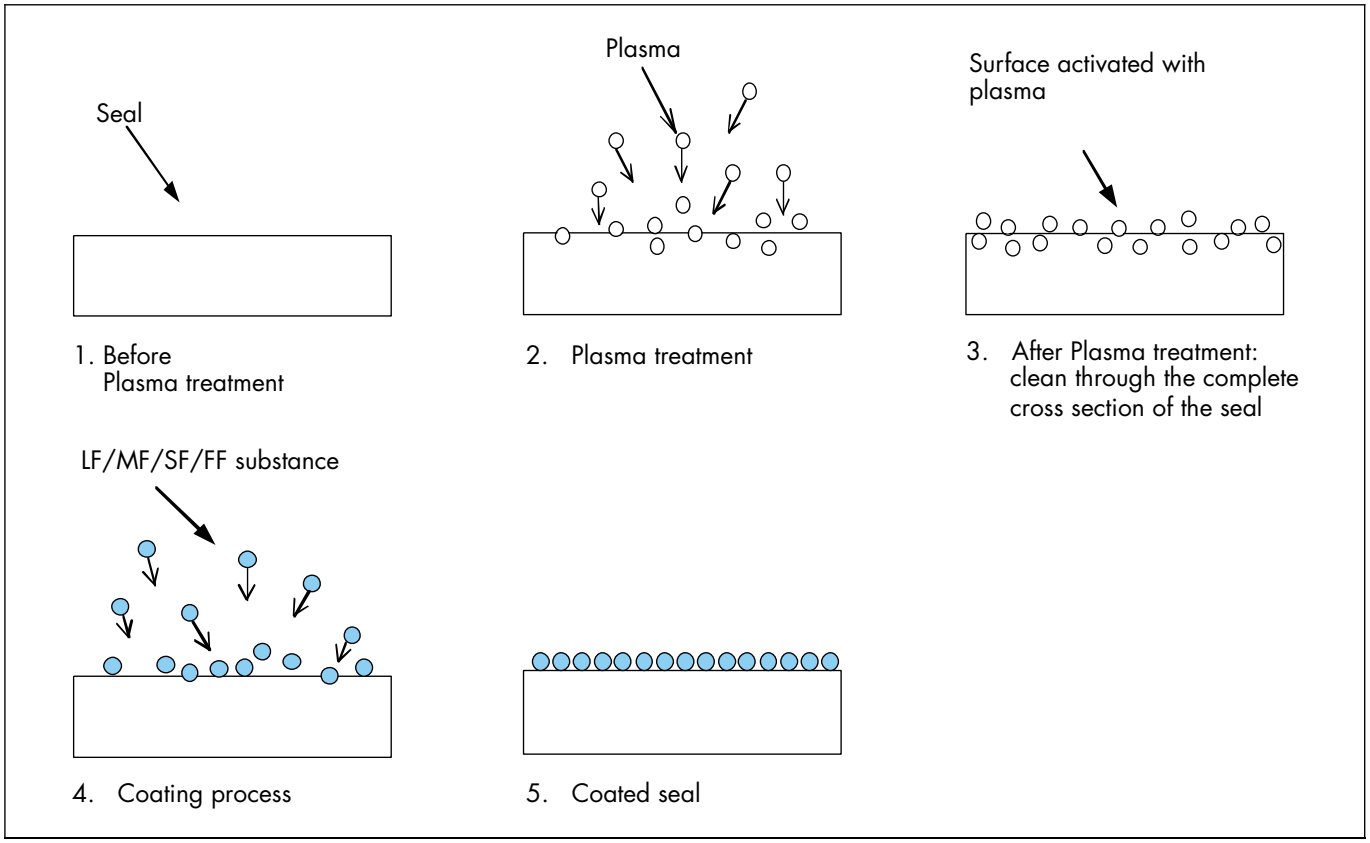


Figure 37 Schematic course of the LF, MF, SF and FF coating

Ordering example LF coating

(Further information see page 46)

O-Ring, metric 40 x 3 - NBR 70, LF coated

Dimensions:	Inside diameter	= 40.0 mm
	Cross section	= 3.0 mm
Material:	NBR 70 (Nitrile-Butadiene Rubber 70 Shore A)	

TSS Article No. OJ 30 04000 - N7

- TSS Article Group
- Cross section x 10
- Inside diameter x 100
- Quality Index (Standard)
- Material Code (Standard)

Ordering example MF coating

(Further information see page 46)

O-Ring, American Standard AS 568 B, ref. 27, MF coated

Dimensions:	Inside diameter	= 33.05 mm
	Cross section	= 1.78 mm
Material:	FKM 80 (Fluorocarbon Rubber 80 Shore A)	

TSS Article No. OQ AR 00027 - V8

- TSS Article Group
- Standard AS 568 B
- Part No. (Dash-Nr.)
- Quality Index (Standard)
- Material Code (Standard)

DF treatment

In this computer-controlled process, especially developed for NBR, the surface of the O-Ring is modified in the µm range. The physical properties of the elastomer change only slightly as a result. One important aspect of this process is its particular enviromentally-friendly nature and the dirt-free handling of the seals without odour nuisance.

- Surface modification
- No coating ⇒ no negative effect on the initial squeeze of the O-Ring
- Change of hardness up to +4 IRHD after treatment
- Temperature range equivalent to NBR material
- Constant process ensured quality
- No aditional oil/grease coating necessary
- KTW approval possible in combination with special materials
- Parts remain separated in the packaging
- Dry surface
- Low mounting force
- Suitable to dynamic applications if squeeze of the O-Ring cross section is < 10%
- Excellent usage with automatic installation
- "Labs-free" quality available on request

- Only for NBR (sulphur curde types)
- **Article group OI**

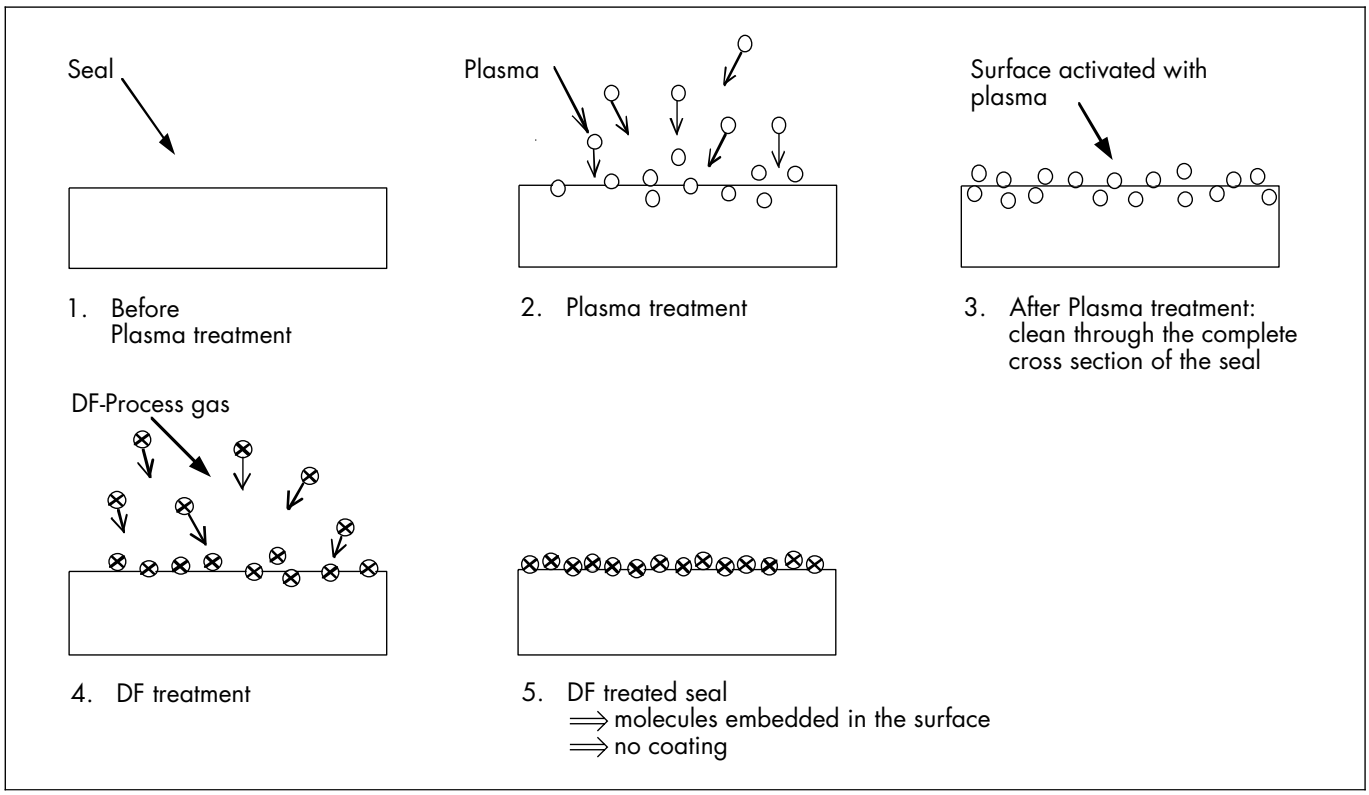


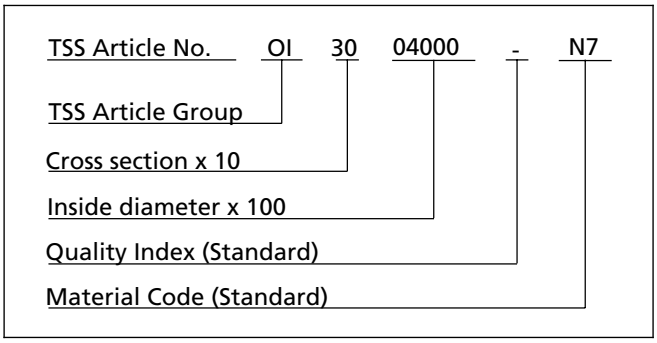
Figure 38 Schematic course of the DF treatment

Ordering example

(If the product is also to be free from substances causing problems with paint wetting, state "labs-free" in the order. Further information see page 46)

O-Ring, metric 40 x 3 - NBR 70

Dimensions:	Inside diameter	= 40.0 mm
	Cross section	= 3.0 mm
Material:	NBR 70	
	(Nitrile-Butadiene Rubber 70 Shore A)	



Other variants of friction reducing processes

Molycote treatment

In Molycote treatment, high-purity, micro-fine molybdenum disulphide (MoS_2) is applied to the surface of the elastomere. The MoS_2 is incorporated as a dry lubricating film by tumbling onto the sealing surface. This gives rise to mechanical interlocking, which over a long period, brings about a reduction in friction and wear under dynamic stresses.

- Dry lubricating film by tumbling into the sealing surface (silvery colour)
- Friction force reduction in conjunction with low dynamic stresses
- Long-term friction reduction can be achieved by deposition of the slide-promoting substances in hollows in the opposing surface
- Improved separation in automatic assembly
- Low abrasion resistance of MoS_2 layer
- Rubbing of the surface layer can lead to dirt build up on the automatic assembly machine peripherals

- For all types of elastomers
- **Article group OM**

Elastolub 013 coating

Elastolub 013 is a silicone fluid-based lubricant. The substance is applied to the rings in a drum and combines very well with the elastomere surface. Elastolub 013 forms a thin lubricating film.

- A thin lubricating film by tumbling
- Reduction of assembly forces
- Tendency for such O-Rings to stick together slightly

- For all types of elastomers, exept silicone rubber
- **Article group OE**

Talcum coating

The talcum is applied to the seal in a drum as a loose powder coating. No interlocking with the surface of the elastomere takes place.

- Loose powder coating
- Prevent components from sticking together after packing
- Not suitable for dynamic applications

- For all types of elastomers
- **Article group OT**

MaxWax® coating

Ready made parts are covered with a quick-drying synthetic hard wax of polythylene in a diffusion process. No changes are made in the material composition.

- Dry surface
- No changes in material composition
- Replaces lubrication at installation
- Reduces friction
- Gives good results in dynamic applications specifically with short- or medium-length strokes

- For all types of materials
- Only available for Skega materials

Further coating variants are available on request.

E General quality criteria and storage guidelines

E.1 Quality criteria

The cost-effective use of seals and bearings is highly influenced by the quality criteria applied in production. Seals and bearings from Trelleborg Sealing Solutions are continuously monitored according to strict quality standards from material acquisition through to delivery.

Certification of our production plants in accordance with international standards QS 9000 / ISO 9000 meets the specific requirements for quality control and management of purchasing, production and marketing functions.

Our quality policy is consistently controlled by strict procedures and guidelines which are implemented within all strategic areas of the company.

All testing of materials and products is performed in accordance with accepted test standards and specifications, e.g. random sample testing in accordance with DIN ISO 2859, part 1.

Inspection specifications correspond to standards applicable to individual product groups (e.g. for O-Rings: ISO 3601).

Our sealing materials are produced free of chlorofluorinated hydrocarbons and carcinogenic elements.

The tenth digit of our part number defines the quality characteristics of the part. A hyphen indicates compliance with standard quality criteria outlined in this catalogue. Customer-specific requirements are indicated by a different symbol in this position. Customers who require special quality criteria should contact their local Trelleborg Sealing Solutions sales office for assistance. We have experience in meeting all Customer quality requirements.

E.2 Storage and shelf life

Seals and bearings are often stored as spare parts for prolonged periods. Most rubbers change in physical properties during storage and ultimately become unserviceable due, e.g., to excessive hardening, softening, cracking, crazing or other surface degradation. These changes may be the result of particular factors or combination of factors, such as the action of deformation, oxygen, ozone, light, heat, humidity or oils and solvents.

With a few simple precautions, the shelf life of these products can be considerably lengthened.

Fundamental instructions on storage, cleaning and maintenance of elastomeric seal elements are described in international standards, such as:
DIN 7716 / BS 3F68:1977,
ISO 2230 or
DIN 9088

The standards give several recommendations for the storage and the shelf life of elastomers, depending on the material classes.

The following recommendations are based on the several standards and are intended to provide the most suitable conditions for storage of rubbers. They should be observed to maintain the optimum physical and chemical values of the parts:

Heat

The storage temperature should preferable be between +5 °C and +25 °C. Direct contact with sources of heat such as boilers, radiators and direct sunlight should be avoided.

If articles are taken from low temperature storage, care should be taken to avoid distorting them during handling at that temperature as they may have stiffened. In this case the temperature of the articles should be raised to approximately +20 °C before they are put into service.

Humidity

The relative humidity in the store room should be below 70 %. Very moist or very dry conditions should be avoided. Condensation should not occur.

Light

Elastomeric seals should be protected from light sources, in particular direct sunlight or strong artificial light with an ultraviolet content. The individual storage bags offer the best protection as long as they are UV resistant.

It is advisable to cover any windows of storage rooms with a red or orange coating or screen.

Radiation

Precaution should be taken to protect stored articles from all sources of ionising radiation likely to cause damage to stored articles.

Oxygen and ozone

Where possible, elastomeric materials should be protected from circulating air by wrapping, storage in airtight containers or by other suitable means.

As ozone is particular deleterious to some elastomeric seals, storage rooms should not contain any equipment that is capable of generating ozone, such as mercury vapour lamps, high voltage electrical equipment, electric motors or other equipment which may give rise to electric sparks or silent electrical discharges. Combustion gases and organic vapour should be excluded from storage rooms as they may give rise to ozone via photochemical processes.

Deformation

Elastomeric materials should, wherever possible, be stored in a relaxed condition free from tension, compression or other deformation. Where articles are packed in a strain-free condition they should be stored in their original packaging.

Contact with liquid and semi-solid materials

Elastomeric seals should not be allowed to come into contact with solvents, oils, greases or any other semi-solid materials at any time during storage, unless so packed by the manufacturer.

Contact with metal and non-metals

Direct contact with certain metals, e.g. manganese, iron and particularly copper and its alloys, e.g. brass and compounds of these materials are known to have deleterious effects on some rubbers. Elastomeric seals should not be stored in contact with such metals.

Because of possible transfer of plasticisers or other ingredients, rubbers must not be stored in contact with PVC. Different rubbers should preferably be separated from each other.

Cleaning

Where necessary, cleaning should be carried out with the aid of soap and water or methylated spirits. Water should not, however, be permitted to come into contact with fabric reinforced components, bonded seals (because of corrosion) or polyurethane rubbers. Disinfectants or other organic solvents as well as sharp-edged objects must not be used. The articles should be dried at room temperature and not placed near a source of heat.

Shelf life and shelf life control

The useful life of a elastomeric seals will depend to a large extend on the type of rubber. When stored under the recommended conditions (above sections) the below given shelf life of several materials should be considered.

AU, thermoplastics	4 years
NBR, HNBR, CR	6 years
EPDM	8 years
FKM, VMQ, FVMQ	10 years
FFKM, Isolast®	18 years
PTFE	unlimited

Elastomeric seals should be inspected after the given period. After this giving an extension period is possible.

Rubber details and components less than 1.5 mm thick are liable to be more seriously affected by oxidation degradation even when stored in satisfactory conditions as recommended. Therefore they may be inspected and tested more frequently than it is mentioned above.

Rubber details / seals in assembled components

It is recommended that the units should be exercised at least every six months and that the maximum period a rubber detail be allowed to remain assembled within a stored unit, without inspection, be a total of the initial period stated above and the extension period. Naturally this will depend on the design of the unit concerned.

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For further information:

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