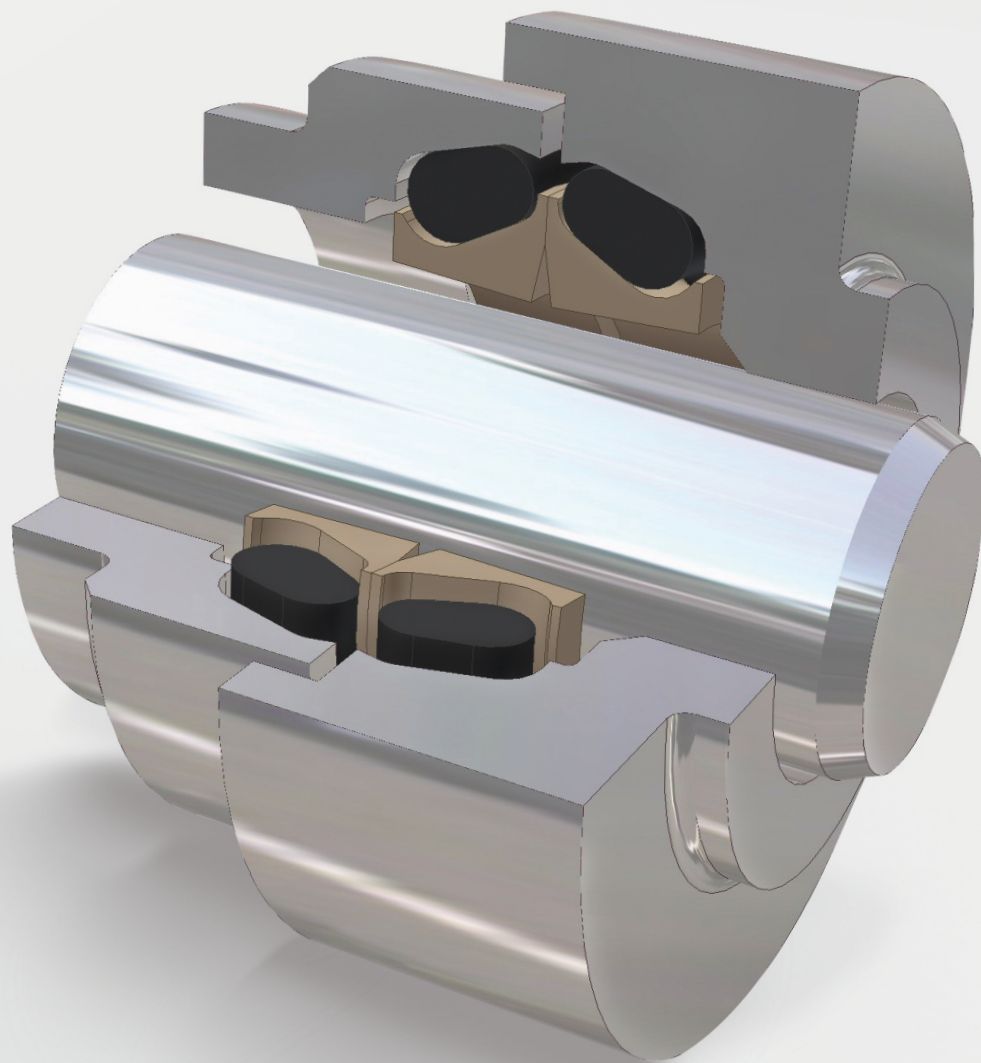
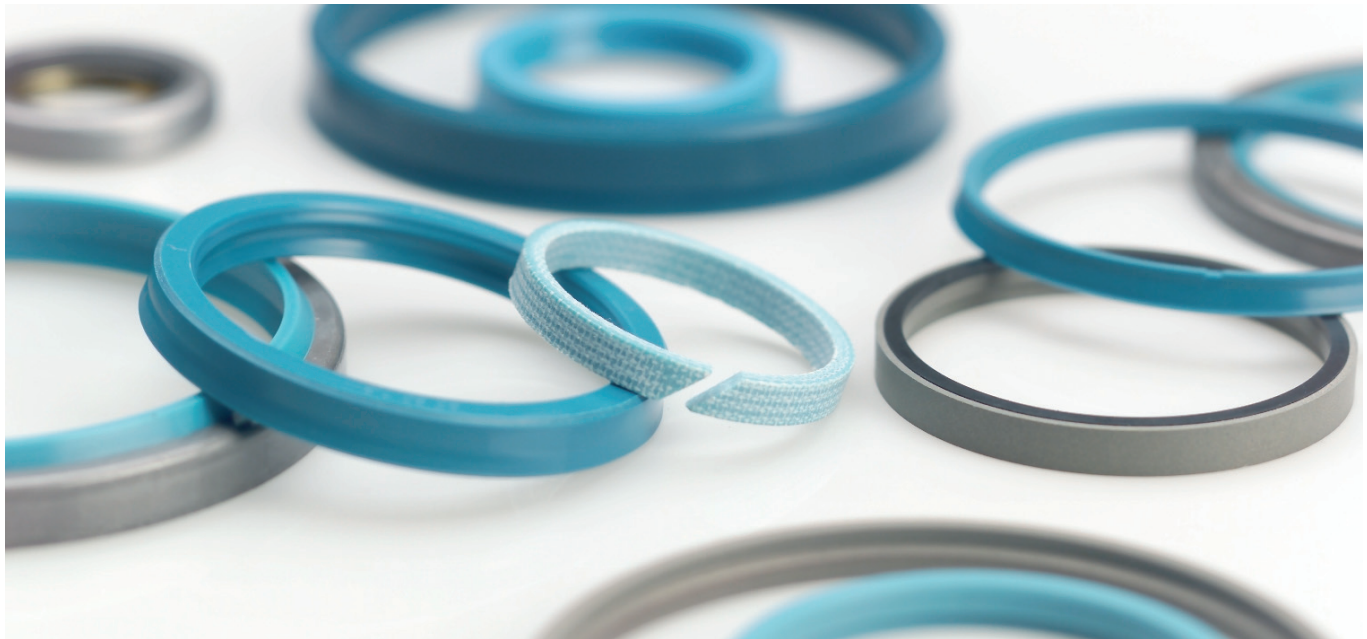


Heavy Duty Seals



Your Partner for Sealing Technology

Busak+Shamban



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Busak+Shamban 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, Busak+Shamban engineers support customers with design, prototyping, production, test and installation using state-of-the-art design tools. An international network of over 60 facilities worldwide includes 32 manufacturing sites, strategically positioned research and development centres, including materials and development laboratories and locations specialising in design and applications.

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

Busak+Shamban fulfil 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. Busak+Shamban, as the global sales and marketing organisation of 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

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Heavy Duty Seal

Description

Heavy Duty Seals are a special form of mechanical seals. They are also known under other designations, such as lifetime seals, floating seals, duo cone seal or toric seal.

Types

There are two different types of Heavy Duty Seal: the most common form is Type DO which is characterised by the use of an O-Ring as the secondary sealing element (Figure 1).

Type DF, on the other hand, has an elastomer with a diamond-shaped cross-section as a secondary sealing element instead of the O-Ring (Figure 2).

Both types consist of two identical metal seal rings which seal against each other on a lapped seal face.

Seal types can also be divided by the use of different seal materials (see page 4).

Design Features

The seals consist of two metallic seal rings. They are mounted in separate housing face to face. The elastomeric elements are centering the seal in the housing.

There are two tapered cones in the housing and at the O.D. of the seal. The taper increases with the depth of the bore due to the different grade of the cones. The housing shape can normally be machined on a NC machine tool.

Method of Operation

The O-Ring, as well as, the elastomeric washer are providing three different functions:

- They generate a uniform axial face loading because of their elasticity.
- They act as a static seal at the inner diameter and outer diameter.
- They prevent the seal ring from turning with the shaft and transmit the torque from the rotating half of the housing through the faces to the static half.

It is important to know that only on half of the seal rotates; the interface between the two precision lapped mating surfaces rotating against the other at right angles to the shaft. They form a leak proofed seal.

The seal has a wedge shaped gap from the ID to the seal face allowing for easy access to lubricate the seal face. A lubrication is necessary at all times. The lubricant builds a thin film between the sliding faces by a capillary effect and centrifugal force.

The seal face is processed by grinding and lapping.

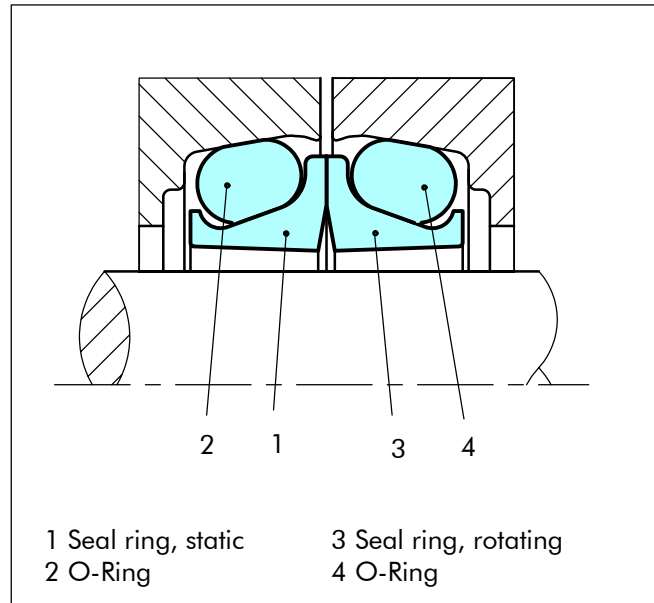


Figure 1 Heavy Duty Seal, Type DO

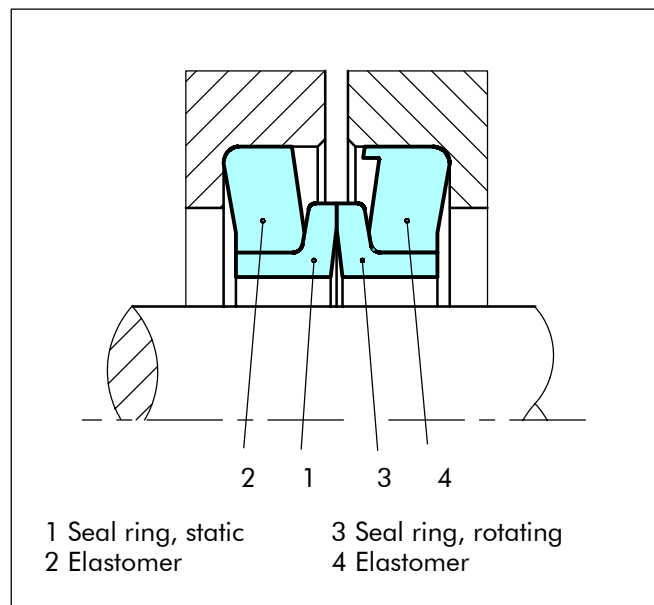


Figure 2 Heavy Duty Seal, Type DF



Advantages:

- Simple, reliable design
- High sealing effect against dirt, dust, water and abrasive media from the outside and against oil and grease from the inside
- Cost-effective
- Long service life
- Self-centering to compensate for shaft eccentricity or misalignment
- Maintenance free
- Easy to assemble

Applications

Heavy Duty Seals are predominantly used for sealing the bearings in construction machinery or production plants operating under extreme arduous conditions and subject to severe wear.

These include:

- Tracked vehicles, such as excavators, bulldozers,
- Conveyor systems
- Heavy trucks
- Axles
- Tunnel boring machines
- Agriculture machines
- Mining machines

Heavy Duty Seals are proven in general machine engineering for gearboxes, mixers, stirrers, wind-driven power stations and other applications with similar conditions or where maintenance free life time sealing is expected.

Technical Data

The seals should not be subjected simultaneously to maximum pressure and maximum speed.

Operating Pressure:

The shaft seal is pressure-free under normal operating conditions.

Pressure loading up to max. 0.3 MPa (3 bar) for shell mould Cast Iron and 0.15 MPa (1.5 bar) for material 100Cr6 accepted. A higher static load up to 0.5MPa (5 bar) is possible.

Internal pressure can lead to misalignment either of the seal or of the O-Ring.

Speed:

Cast Iron: 3 m/s with oil lubrication

100Cr6 1 m/s with oil lubrication

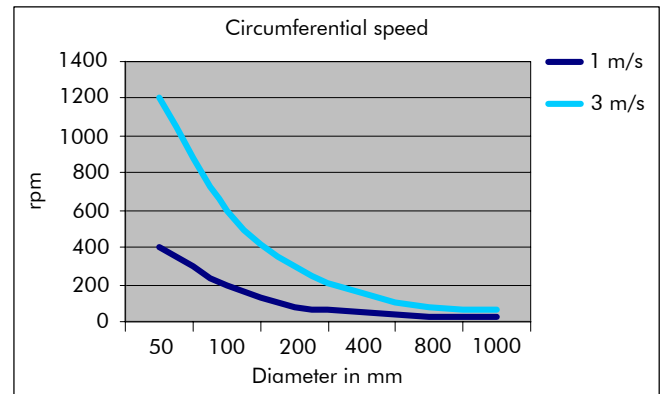


Figure 3 Speed as function of diameter and rpm

Temperature:

-40 °C to +100 °C, depending on the elastomer material on request.

Lubrication, Media:

The lubrication serves two important functions, therefore it is needed in all cases. It reduces the friction between the seal face and the mating faces, and it acts as a cooling agent for the complete shaft and housing.

The best results with regard to wear and service life are achieved with oil lubrication. Grease lubrication is possible but needs special attention. It can only be used for slower motion. It is sufficient if the oil level is 1/2 to 1/3 of the seal inside diameter. Specially recommended is transmission oil e.g. SAE 80 or SAE 90. In other cases a thinner lubricant can be useful like SAE oils 20W20 or 10W40. The oil level should be between center line of the shaft and two thirds of seal diameter.

If environmentally compatible "bio"oils are to be used, please contact us. In this case, the compatibility of the oil with the elastomer materials used must be tested.



Heavy Duty Seal

Materials

Metal Seals Parts

Heavy Duty Seals are available in two different steel grades.

The standard material used for the Heavy Duty Seals is a special shell mould Cast Iron. This material was developed specifically for the extreme operating conditions of the seals. The material is a high-alloy, corrosion-resistant Cast Iron. A natural hardness of 58 HRC is achieved directly after casting, which is increased to min. 65 HRC by heat treatment.

The castings are then further processed by grinding, lapping and polishing. For material specifications, see Table I.

Alternatively a cheaper forged roller Bearing Steel (100Cr6), material number 1.3505, can also be used. Seals made from this material are manufactured by copy turning followed by induction or salt bath hardening. The hardness is 58 to 63 HRC. The seal faces of these parts are also lapped and polished. Material specifications, see Table I.

Table I Material specifications

Material Chemical Composition %	Material No. 1.3505	Shell Mould Cast Iron
C	0.90 - 1.05	2.80 - 3.60
Si	0.15 - 0.35	1.00 - 1.60
Mn	0.25 - 0.45	0.40 - 1.00
P	< 0.03	< 0.04
S	< 0.025	< 0.04
Cr	1.40 - 1.65	16.00 - 21.00
Mo	---	2.00 - 4.00
Ni	< 0.30	---
Fe	balance	balance

Elastomers

Depending on seal type the following standard elastomers are used:

- Type DO - alloy Cast Iron
Acrylonitrile Butadien Rubber (NBR)
Shore Hardness: 65+-5 Shore A
- Type DO - Bearing Steel (1.3505)
Acrylonitrile Butadien Rubber (NBR)
Shore Hardness: 60+-5 Shore A

For higher thermal loads or other reasons Fluorelastomers or Silicone can be supplied.

Please contact your Busak+Shamban representative.

Table II NBR Compounds

	Standard NBR Compounds	
Seal Type	Alloy Cast Iron seal	Bearing Steel Seals
Description	NBR 65	NBR 60
Hardness	65+5 Shore A	60+5 Shore A
Tensile strength	> 12.0	> 12.0
Elongation at break	> 250	> 280
Temperature range*	-30 °C to +100 °C	-20 °C to +100 °C

* Max. and min. operating temperatures depend on specific application criteria and sealed medium.

Corrosion Test

During operation, Heavy Duty Seals can be exposed not only to physical and thermal stresses, but also to extreme environmental stresses.

The behavior and resistance of the material to corrosion is a very important factor; e.g., in contact with seawater or in a maritime climate, when operating in salt plains or on exposure to salt spread on the roads in the winter. A Heavy Duty Seal, unprotected on the side exposed to such atmospheres, must also be able to withstand such conditions. The particular suitability of the high-alloy shell mould cast material from Busak+Shamban was demonstrated under tough test conditions in salt water.

The surface of seals of Bearing Steel 100Cr6 have a special surface protection due to salt bath hardening. It is not as resistant as the alloy materials and therefore not recommended in corrosive atmosphere.



Design Instructions

Seal Housing

The installation dimensions of the seal housing are shown in Table IV and V.

A template can be used to check the housing geometry for Type DO.

The axial gap S in the housing is such that it meets the demands of the construction machinery industry.

For high sliding speeds it may be necessary to reduce the axial compression, thus reducing the load of the seal faces and the heat generation in the seal face. This is achieved by increasing the axial gap S .

The following gaps are possible (Table III), depending on the O-Ring cross-section.

Table III Gaps

O-Ring Cross-Section d_1	Gap S
$d_1 < 8.0$	4
$8 \leq d_1 \leq 12.7$	5
$d_1 > 12.7$	6

We recommend that tests be carried out to find the most appropriate setting.

Since the O-Ring is always oversized to the housing, the edges of the housing must be rounded.

Surfaces

Under pressure, elastomers adapt themselves to irregular surfaces. However, for liquid-tight conditions, certain minimum requirements have to be made on the surface finish of the faces to be sealed.

Scores, scratches, pores and concentric or spiral machining scores are not permissible. For the surface of the seal installation chamber we recommend a machining quality of :

$$\begin{aligned} R_a &< 3.2 \mu\text{m} \\ R_z &< 10.0 \mu\text{m} \\ R_{\text{max}} &< 16.0 \mu\text{m}. \end{aligned}$$

Shaft

The Heavy Duty Seal does not contact the shaft. For this reason, no particular demands have to be met on the hardness or surface finish.

To ensure correct operation a minimum gap must be maintained between the shaft and the inside diameter. This gap serves to supply the seal with lubricant. In order to

dissipate the heat of friction, a good exchange of medium must be assured. Furthermore, tolerances, shaft deflections, etc. must be bridged by the gap.

Attention should be paid to the slight geometric deviation between the forged and the cast design. Figure 4 shows a bevel on the cast seal ring typical of the casting process. The forged version, on the other hand, has a cylindrical inner diameter (Figure 5).

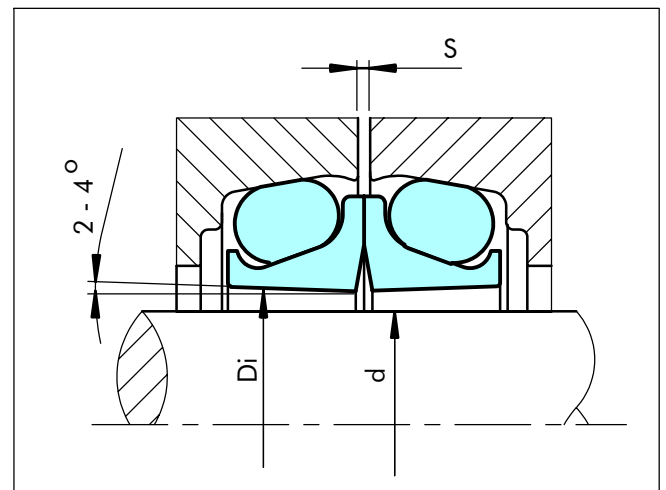


Figure 4 Cast design with inclination at the inside diameter

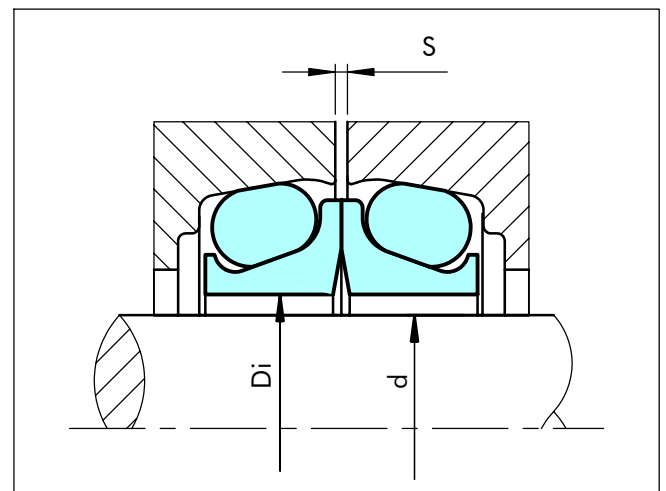


Figure 5 Roller Bearing Steel design with smooth and cylindrical treatment at the inside diameter



Heavy Duty Seal

■ Installation Instructions

Preparation for Installation

Heavy Duty Seals must be installed with great care. Damage to the precision lapped seal faces must be avoided at all costs. The installation location must be kept free from dust and dirt.

The installation should be carried out in the following steps.

Preparation before Installation

- Remove the seal from its packing only immediately before installation.
- Do not stand the seal on the lapped surface.
- Coat the seal face with a thin film of oil using clean oil and a lint-free cloth, e.g. chamois leather.
- Check that the housing is free of nick or burr on installation radii.
- Check if O-Ring or washer is properly placed back on the seal. The O-Ring must be seated in the throat radius (Type DO) inside the retaining lip.

Installation Instructions for the Type DO

- Make sure that the O-Ring is not twisted. A twisted O-Ring may cause a looped effect.
- Installation, particularly of large O-Rings, requires a great deal of force. We recommend that the O-Ring be coated with lubricant (soapy water, water/spirits mixture or an oil film) before installation.
- Assemble the two halves of the seal in the housing by using an installation tool. Center the O-Ring in the housing. Use two hands on the tool to press the seal into the housing with a firm push.
- Check if tool is touching the housing all around the circumference.
- Remove the tool and make a visual check for position of O-Ring and seal. Make sure that everything is seated symmetrically.
- Clean both seal faces with denatured alcohol and apply a thin film of clean oil to the faces.
- Tilt the two parts together bringing the slide faces carefully into contact.
- Adjust the gap S.
- Fill the housing with oil and bleed, if necessary.

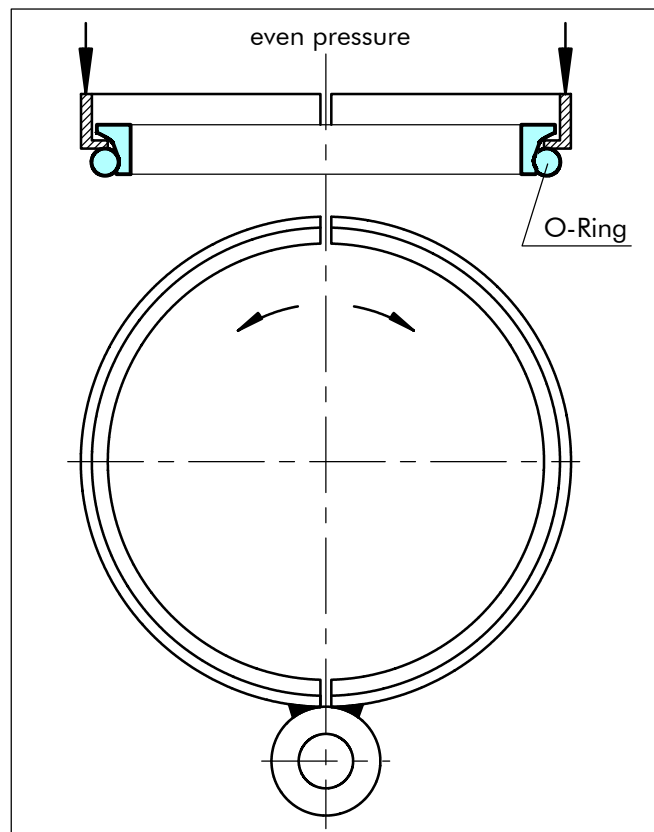


Figure 6 Fitting Tool

In the event that the installation tool cannot be withdrawn or where the seal is of a special design, in this case an installation O-Ring can be used. The installation O-Ring is placed between the O-Ring of the seal and rear of the ramp on the Seal Ring. As force is applied to the Seal Ring during installation the spring backs up the O-Ring and will not allow it to roll up the ramp. After installation the O-Ring is easily removed- (see Figure 7).

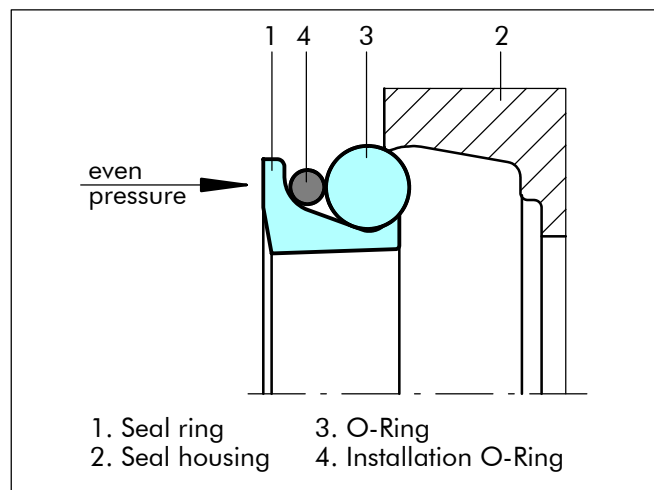


Figure 7 O-Ring as installation aid



■ Installation Recommendations for Type DO in Bearing Steel

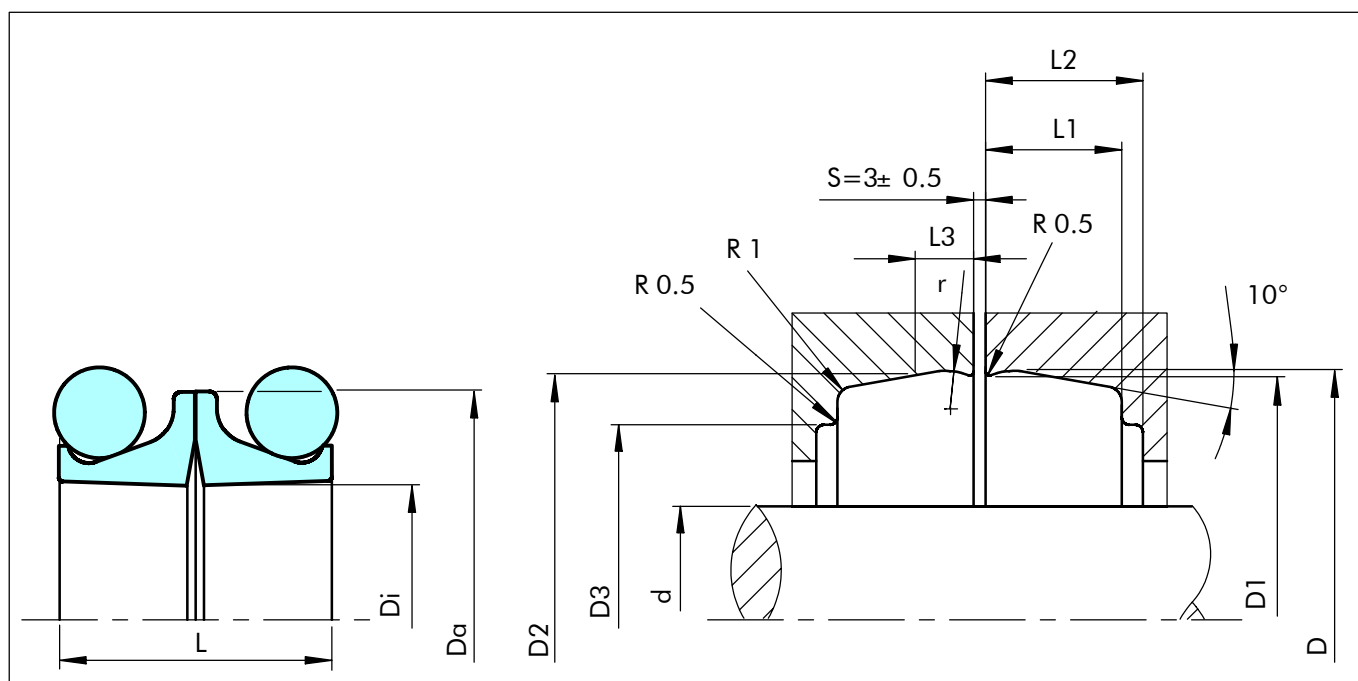


Figure 8 Installation Drawing

Table IV Installation Dimensions

Part No.	D_i	D_a	L	$d_{max.}$	$D \pm 0.1$	$D_1 \pm 0.1$	$D_2 \pm 0.1$	D_3	L_1	$L_2 \text{ min.}$	L_3	r
TLDOA0580	58.0	75.5	26.0	55.0	80.0	79.1	78.0	67.0	11.5	13.5	7.5	4.0
TLDOA0635	63.5	82.0	32.0	60.0	87.0	86.0	85.5	74.5	14.5	17.5	7.5	5.0
TLDOA0710	71.0	90.0	29.0	68.0	95.2	94.5	93.6	81.0	12.5	15.0	7.5	5.0
TLDOA0730	73.0	92.0	32.0	70.0	96.5	95.5	95.0	84.0	14.5	17.5	7.5	5.0
TLDOB0900	90.0	105.0	26.0	86.0	107.5	106.5	106.0	100.0	11.5	14.0	7.5	5.0
TLDOA0900	90.0	109.5	32.0	86.0	114.0	113.0	112.5	101.5	14.5	17.5	7.5	5.0
TLDOA1000	100.0	119.0	32.0	96.0	123.5	122.5	122.0	112.0	14.5	17.5	7.5	5.0
TLDOA1110	111.0	133.0	32.0	108.0	137.0	136.5	136.0	124.5	14.5	18.0	7.5	5.0
TLDOA1160	116.0	137.0	31.8	113.0	142.5	141.5	141.0	132.0	14.5	18.0	7.5	5.0
TLDOA1200	120.0	139.0	32.0	116.0	143.8	142.8	142.3	132.0	14.5	17.0	7.5	5.0
TLDOA1250	125.0	144.0	32.0	120.0	148.5	147.5	147.0	136.0	14.5	17.0	7.5	5.0
TLDOC1270	127.0	141.0	29.0	124.0	144.0	143.0	142.3	138.5	12.0	14.5	7.5	3.0
TLDOB1270	127.0	141.0	29.0	124.0	147.0	146.0	145.5	138.5	13.0	15.5	7.5	5.0
TLDOA1270	127.0	146.0	31.8	124.0	150.5	149.5	149.0	138.0	14.5	17.5	7.5	5.0
TLDOA1300	130.0	151.0	32.0	127.0	155.5	154.5	154.0	145.0	15.0	19.0	7.5	5.0
TLDOA1430	143.0	160.0	27.0	140.0	164.0	163.0	162.5	154.0	12.0	14.5	7.5	5.0
TLDOA1440	144.0	157.0	26.0	140.0	160.0	159.0	158.2	154.5	12.0	14.5	7.5	5.0
TLDOA1460	146.0	172.0	38.0	142.0	177.0	176.0	175.1	159.0	18.0	20.5	9.0	6.5
TLDOB1540	154.0	168.0	27.0	151.0	171.0	170.0	169.2	162.5	12.0	14.5	7.5	3.0



Heavy Duty Seal

Part No.	D _i	D _a	L	d _{max.}	D ±0.1	D ₁ ±0.1	D ₂ ±0.1	D ₃	L ₁	L ₂ min.	L ₃	r
TLDOC1540	154.0	173.5	32.0	151.0	178.0	177.0	176.5	166.0	14.5	17.0	7.5	5.0
TLDOA1630	163.0	191.5	38.0	160.0	196.5	195.5	194.6	178.5	18.0	20.5	9.0	6.5
TLDOA1780	178.0	199.0	32.0	175.0	203.6	202.4	202.2	190.0	23.0	16.0	7.5	5.0
TLDOA1830	183.0	211.0	38.0	180.0	215.5	214.5	213.5	197.5	18.0	20.5	9.0	6.5
TLDOA1910	191.0	210.0	28.0	187.0	214.0	213.0	212.6	203.0	12.5	14.5	7.5	5.0
TLDOA2000	200.0	228.5	38.0	196.0	233.5	232.5	231.6	215.5	18.0	20.5	9.0	6.5
TLDOA2050	205.0	227.0	30.0	198.0	231.5	230.5	230.0	219.0	14.5	17.0	7.5	5.0
TLDOA2200	220.0	239.5	32.0	216.0	244.0	243.0	242.5	232.0	14.5	16.5	7.5	5.0
TLDOA2240	224.0	252.0	38.0	220.0	256.5	255.5	254.6	238.5	18.0	20.5	9.0	6.5
TLDOA2380	238.0	261.0	32.0	231.0	265.5	264.5	264.0	254.0	14.5	17.0	7.5	5.0
TLDOA2450	245.0	264.5	32.0	241.0	268.9	267.9	267.4	255.0	14.5	17.0	7.5	5.0
TLDOA2650	265.0	293.0	38.0	261.0	298.0	297.0	296.1	280.0	18.0	20.5	9.0	6.5
TLDOA2750	275.0	303.0	38.0	271.0	308.0	307.0	306.0	290.0	18.0	20.5	9.0	6.5
TLDOA3000	300.0	325.0	38.0	295.0	335.5	334.5	333.3	318.0	17.5	20.5	10.0	6.5
TLDOA3180	318.0	341.0	38.0	315.0	351.5	350.5	349.2	334.0	18.0	20.5	10.0	6.5
TLDOA3185	318.5	346.0	38.0	315.5	351.5	350.5	349.2	334.0	18.0	20.5	10.0	6.5
TLDOA3400	340.0	368.0	40.0	337.0	374.8	373.8	372.1	358.0	19.0	21.5	11.0	4.0
TLDOA3500	350.0	375.0	38.0	345.0	385.0	384.5	383.5	368.0	17.5	20.5	10.0	6.5
TLDOA3650	365.0	395.0	37.0	360.0	400.0	399.0	398.0	381.0	18.0	20.5	9.5	6.5
TLDOA3870	387.0	415.0	38.0	382.0	419.5	418.6	417.5	400.0	18.0	20.5	9.5	6.5
TLDOA4290	429.0	457.0	38.0	425.0	462.3	461.3	460.2	444.0	18.0	20.5	9.5	6.5
TLDOA4700	470.0	500.0	50.0	465.0	512.2	510.2	509.1	490.0	23.5	25.5	13.0	6.0
TLDOA5050	505.0	535.0	44.0	495.0	538.3	536.5	536.7	522.0	19.7	21.7	9.0	6.5
TLDOA5910	591.0	623.0	50.0	585.0	635.2	633.2	632.1	613.0	23.5	25.5	13.0	6.0



Ordering Example

Heavy Duty Seal Type DO in Bearing Steel

Inside diameter Di = 125.0 mm

Materials: Seal rings of Bearing Steel (1.3505)
 O-Rings of NBR

Order-No.	TLDOA1250 - 2CP
Part-Number	
Inside Ø x 10	
Quality Index (Standard)	
Material No.	

Dimensions and Part-Number see Table IV, page 7.

Materials see page 4.



Heavy Duty Seal

■ Installation Recommendations for Type DO in Cast Iron

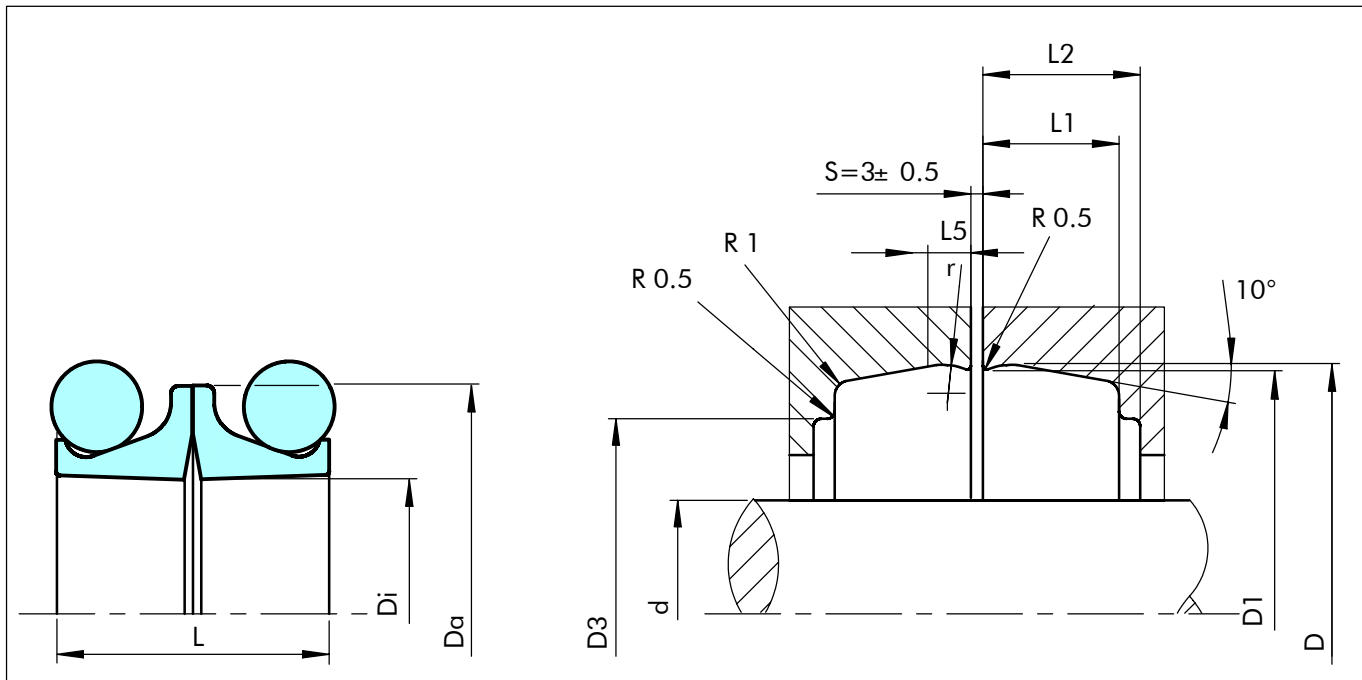


Figure 9 Installation Drawing

Table V Installation Dimensions

Part No.	D_i	D_a	L	$d_{max.}$	$D \pm 0.1$	$D_1 \pm 0.1$	D_3	L_1	$L_2 \text{ min.}$	L_5	r
TLDOA0380	38.0	51.0	20.0	35.0	53.7	53.0	46.0	9.0	11.0	1,6	2.0
TLDOA0430	43.0	58.0	24.0	40.0	62.0	61.3	51.0	10.5	12.5	2.0	2.0
TLDOA0450	45.0	58.0	21.0	42.0	61.6	60.8	53.4	10.0	12.0	1.8	2.5
TLDOA0480	48.0	62.0	25.0	45.0	68.0	67.2	58.0	12.0	14.0	2.0	3.0
TLDOA0555	55.5	70.0	22.0	53.0	73.8	73.1	65.5	10.0	11.5	2.4	5.0
TLDOA0560	56.0	70.0	25.0	53.0	70.0	75.2	66.0	12.0	14.0	2.0	3.0
TLDOA0580	58.0	74.0	27.0	55.0	79.4	78.6	67.0	13.5	15.5	2.0	3.0
TLDOA0600	60.0	74.0	20.6	57.0	78.4	77.4	70.0	9.0	11.0	1.9	2.5
TLDOA0610	61.0	73.0	27.0	58.0	75.8	75.4	68.5	8.0	9.5	1.37	1.5
TLDOA0635	63.5	82.5	31.8	60.0	86.8	85.9	74.0	15.0	17.0	3.0	2.5
TLDOA0640	64.0	78.0	25.0	61.0	84.6	83.6	74.0	12.5	14.5	2.0	3.0
TLDOA0660	66.0	85.0	28.0	63.0	90.0	89.2	78.0	14.0	16.0	2.0	3.0
TLDOA0690	69.0	84.0	24.0	66.0	89.6	88.6	78.5	11.0	13.0	1.9	3.0
TLDOA0710	71.0	90.0	29.0	68.0	95.5	94.7	84.0	13.5	15.5	1.8	3.0
TLDOA0730	73.0	92.0	31.8	70.0	96.2	95.4	84.0	15.0	17.0	3.0	2.5
TLDOA0740	74.0	86.6	22.0	71.0	91.4	90.7	80.0	9.5	11.5	2.0	3.0
TLDOA0760	76.0	94.0	29.0	73.0	101.4	100.8	89.0	14.5	16.5	2.0	2.5
TLDOA0800	80.5	99.5	29.0	77.5	105.0	104.2	92.0	14.5	16.5	2.0	3.0
TLDOA0810	81.0	98.0	28.0	78.0	102.3	101.1	91.0	12.5	14.5	2.8	5.0



Part No.	D _i	D _a	L	d _{max.}	D ±0.1	D ₁ ±0.1	D ₃	L ₁	L ₂ min.	L ₅	r
TLDOA0820	82.0	98.0	22.0	79.0	102.3	101.3	91.0	9.0	11.0	2.8	5.0
TLDOB0900	90.5	105.0	25.4	86.0	107.5	106.5	100.0	11.5	14.0	3.0	5.0
TLDOA0900	90.5	109.5	31.8	86.0	114.0	113.0	101.5	14.5	17.5	3.0	5.0
TLDOA0920	92.0	108.8	22.0	89.0	113.8	113.0	105.0	9.5	11.5	1.78	3.0
TLDOA0940	94.0	106.5	22.0	91.0	111.6	110.8	102.0	9.5	11.5	2.0	3.0
TLDOB0950	95.0	114.0	31.0	32.0	120.0	119.2	107.0	15.0	17.0	2.5	3.0
TLDOA0990	99.0	120.0	28.0	96.0	123.5	122.5	112.0	12.5	14.5	2.8	5.0
TLDOA1000	100.0	119.0	31.8	97.0	123.2	122.4	111.0	14.5	16.5	2.5	2.5
TLDOB1000	100.0	120.0	29.4	97.0	125.0	124.2	111.0	14.0	16.0	2.9	3.0
TLDOA1020	102.0	122.0	32.0	99.0	127.2	126.2	115.0	15.5	17.5	2.5	3.0
TLDOB1040	104.0	116.7	21.2	101.0	121.0	120.2	107.0	9.5	11.5	2.0	3.0
TLDOC1040	104.0	121.4	22.0	101.0	125.5	125.2	117.5	9.5	11.5	2.0	3.0
TLDOA1090	109.0	132.0	32.0	106.0	136.6	135.6	124.0	15.5	17.5	2.5	3.0
TLDOB1100	109.0	127.0	32.0	106.0	133.0	132.0	121.0	15.0	17.0	2.5	3.0
TLDOA1150	115.0	137.0	31.0	112.0	141.8	140.8	130.0	14.5	16.5	2.5	3.0
TLDOA1240	124.0	141.0	22.0	121.0	145.8	145.0	136.0	9.5	11.5	2.0	3.0
TLDOA1270	127.0	146.0	31.8	124.0	150.2	149.5	138.0	14.5	17.5	2.5	5.0
TLDOA1300	130.0	150.0	32.0	128.0	155.6	154.6	144.6	14.5	16.5	2.5	3.0
TLDOA1430	143.0	157.0	25.0	140.0	159.7	158.9	154.5	12.0	14.5	2.5	5.0
TLDOA1460	146.0	168.0	38.0	143.0	177.0	176.0	159.0	18.0	20.0	2.5	3.0
TLDOC1500	150.0	172.0	40.0	147.0	179.0	178.0	165.0	18.0	20.0	2.5	3.0
TLDOB1530	154.0	168.0	25.0	151.0	171.0	170.2	164.0	11.5	13.5	2.5	2.8
TLDOA1630	163.0	191.0	38.0	160.0	196.4	195.5	179.0	18.0	20.0	3.1	6.4
TLDOA1830	183.0	211.0	38.0	180.0	215.5	214.5	197.5	18.0	20.5	3.0	6.5
TLDOA1910	191.0	210.0	28.0	187.0	214.0	213.0	203.0	12.5	14.5	2.8	5.0
TLDOA1920	192.0	215.0	33.0	189.0	220.8	219.8	207.0	16.5	18.5	3.0	4.0
TLDOA2090	209.0	234.0	42.0	206.0	242.6	241.6	224.0	19.5	21.5	3.0	4.0
TLDOA2200	220.0	239.5	31.8	217.0	244.0	243.0	232.0	14.5	16.5	2.8	5.0
TLDOA2240	223.5	252.0	38.0	220.0	256.6	255.7	238.0	18.0	20.0	3.1	6.4
TLDOA2390	240.0	268.0	38.0	237.0	274.2	273.2	257.0	19.0	21.0	3.0	4.0
TLDOA2400	240.0	262.8	38.0	237.0	273.5	272.5	257.0	19.0	21.0	3.0	4.0
TLDOA2500	250.0	276.0	41.0	247.0	284.6	283.6	266.0	20.5	22.5	3.0	4.0
TLDOA2650	265.0	293.0	38.0	262.0	298.0	297.0	280.0	19.0	21.0	3.0	6.4
TLDOA2750	275.0	303.0	38.0	271.0	308.0	307.0	290.0	18.0	20.5	3.1	6.5
TLDOA3000	300.0	325.0	39.0	295.0	335.5	334.5	318.0	17.5	20.5	3.0	6.5
TLDOA3000	300.0	328.0	38.0	297.0	308.0	307.0	315.0	19.5	22.0	3.0	4.0
TLDOA3180	318.0	341.0	38.0	315.0	351.5	350.5	334.0	18.0	20.5	3.0	6.5
TLDOA3185	318.5	346.5	38.0	315.0	351.6	350.7	335.0	19.0	21.5	3.0	6.4
TLDOA3400	340.0	368.0	38.0	337.0	374.8	373.8	358.0	19.0	21.5	3.11	4.0
TLDOA3665	366.5	394.5	37.0	363.0	399.5	398.6	382.0	18.5	21.0	3.0	6.4
TLDOB3665	366.5	391.0	37.0	363.0	399.5	398.5	382.0	18.5	21.0	3.0	4.0



Heavy Duty Seal

Part No.	D_i	D_a	L	$d_{max.}$	$D \pm 0.1$	$D_1 \pm 0.1$	D_3	L_1	$L_2 \text{ min.}$	L_5	r
TLDOA3870	387.0	415.0	38.0	384.0	419.5	418.5	400.0	18.0	20.5	3.0	4.0
TLDOA4290	429.0	457.0	38.0	426.0	463.5	462.5	444.0	18.0	20.5	3.0	4.0

Ordering Example

Heavy Duty Seal Type DO in Cast Iron

Inside diameter $D_i = 115.0 \text{ mm}$

Materials: Seal rings of Cast Iron
O-Rings of NBR

Order-No.	TLDOA1150 - 2FP
Part-Number	
Inside $\varnothing \times 10$	
Quality Index (Standard)	
Material No.	

Dimensions and Part-Number see Table V, page 10.

Materials see page 4.

For further information:

Europe	Telephone	America	Telephone
AUSTRIA - Vienna (ALBANIA, BOSNIA AND HERZEGOVINA, CROATIA, HUNGARY, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)	+43 (1) 406 47 33	AMERICAS - Fort Wayne, IN	+1 (260) 749 9631
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