



Aerospace part number guide



Your Partner for Sealing Technology



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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 of 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, 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. Trelleborg Sealing Solutions is backed by the experiences and resources of one of the world's foremost experts in polymer technology: the Trelleborg Group.

ISO 9001:2008

ISO/TS 16949:2009

The information in this brochure is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this brochure. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

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

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Trelleborg Sealing Solutions Aerospace

Sealing Solutions for Demanding Aerospace Applications

As a global market leader in the supply of aerospace sealing solutions, with over 50 years of experience in the industry, Trelleborg Sealing Solutions can provide the optimum seal for your requirements. They can be fitted on anything from two-seater light aircraft to heavy-duty long-range commercial airliners, from military planes to spacecraft and satellites. Our seals provide proven performance in a wide variety of systems including flight controls, actuation, landing gear, wheels, brakes, fuel controls, engines and airframe.

Industry-Specific Products

We have the largest sealing product portfolio in the industry. With this and our engineered solutions, we can solve almost any sealing challenge.

Seals and Back-up Rings for AS4716 grooves

- **Turcon® VL Seal®:** Next generation unidirectional rod seal
- **Turcon® Variseal®:** Spring-energized seal
- **Turcon® Plus Seal® II:** Superior slipper seal
- **Turcon® Double Delta® II:** Original slipper seal

- **Turcon® Wedgpak® II:** With triangular elastomer
- **Turcon® T-Seal:** With T-shaped elastomer
- **Turcon® AQ-Seal® 5:** Incorporating elastomer X-Ring
- **Back-up Rings and Stakbak®:** Optimizing O-Ring performance

Seals for AS4716 grooves – Rod and bore sizes only

- **Turcon® Dual Piston Ring:** With metal expander
- **Turcon® Glyd Ring®:** Simple and reliable
- **Turcon® Stepseal® 2K:** Double-acting tandem seal

Rotary seals for AS4716 grooves

- **Turel® Radial Oil Seal:** Elastomer bonded to metal
- **Turcon® Roto Variseal®:** Spring-energized seal
- **Turcon® Varilip® PDR:** Mechanically retained Turcon® sealing element
- **Turcon® Roto Glyd Ring®:** Original slipper seal
- **Polymer bearings:** Enhanced friction capabilities
- **Turcon® Excluder® and Scrapers:** Prevent system contamination
- **Turcon® Face Seals:** Seal variations for face seal applications
- **O-Rings:** Versatile elastomer sealing elements

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S11052	PF00_B	Turcon® Dual Piston Ring (S13126 is preferred design)	Piston	Trelleborg Standard Fractional
	S11065	WM650S	Turcon® Scraper Ring (S34382 is preferred design)	Rod	MS33675 MIL-P-5514 thru MIL-G-5514; All Revisions
	S11109	BP090A	Turcon® Back-up Ring Spiral	Rod/Piston	MIL-P-5514; Revisions A, B, C, D, E One or Two Back-up Rings
	S11114	PF01_B	Turcon® Dual Piston Ring (S13126 is preferred design)	Piston	Trelleborg Standard Fractional
	S11214	OC140M	PTFE O-Ring (S13126 is preferred design)	Piston	Trelleborg Standard Fractional
	S11242	N/A	Turcon® Delta Back-up Ring Single Turn (S33823 is preferred design)	Rod	LS4652 MIL-P-5514: Revisions C, D, E One or Two Back-up Rings
	S11243	N/A	Turcon® Delta Back-up Ring Single Turn (S33823 is preferred design)	Piston	LS4653 MIL-P-5514: Revisions C, D, E One or Two Back-up Rings
	S11248	BG480M	Turcon® Back-up Ring Single Turn	Rod/Piston	MIL-P-5514 thru MIL-G-5514; All Revisions One or Two Back-up Rings
	S11338	PD130M	Turcon® Cap Seal	Piston	MIL-P-5514: Revisions A, B, C, D, E Zero Back-up Rings
	S11370	N/A	Turcon® Channel Seal	Rod	MIL-P-5514: Revisions A, B Two Back-up Rings
	S11395	N/A	Turcon® Back-up Ring	Rod/Piston	Trelleborg Standard
	S11399	N/A	Turcon® Back-up Ring	Rod/Piston	Trelleborg Standard
	S11413	N/A	Turcon® Back-up Ring	Rod/Piston	Trelleborg Standard

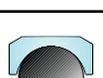
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	S11589	RD890M	Turcon® Cap Seal	Rod	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S11717	RG00_B	Turcon® Glyd Ring®	Rod	Trelleborg Standard Fractional Rod
	S11718	PG00_B	Turcon® Glyd Ring®	Piston	Trelleborg Standard Fractional Bore
	S11732	OC320M	PTFE O-Ring (general purpose application)	Rod/Piston	AS568A
	S11859	RD240B	Turcon® Cap Seal	Piston	Trelleborg Standard
	S11860	N/A	Turcon® Cap Seal	Rod	Trelleborg Standard
	S11940	RP40_M	Turcon® Plus Seal® (S30775 is preferred design)	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S11943	N/A	Turcon® Plus Seal® (S34750 is preferred design)	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S12066	RG66_B	Turcon® Glyd Ring® Series B	Rod	Trelleborg Standard MIL-P-5514; Revisions A, B, C, D, E
	S12068	PG68_B	Turcon® Glyd Ring® Series B	Piston	Trelleborg Standard MIL-P-5514; Revisions A, B, C, D, E
	S12083	PF02_B	Turcon® Dual Piston Ring (S30071 is preferred design)	Piston	Trelleborg Standard MIL-P-5514; Revisions A, B, C, D, E
	S12095	RF95_B	Turcon® Footseal (S33121 is preferred design)	Rod	Boeing Standard BAS: BACS11AA
	S12223	RD03_M	Turcon® Double Delta®	Rod	MIL-P-5514; Revisions A, B Two Back-up Rings

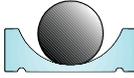
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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S12230	PF03_B	Turcon® Dual Piston Ring (S30071 is preferred design)	Piston	Trelleborg Standard MIL-P-5514; Revisions A, B, C, D, E
	S12257	N/A	Turcon® Dual Piston Ring (S13126 is preferred design)	Piston	Trelleborg Standard Fractional
	S12508	PD03_M	Turcon® Double Delta® (S30642 is preferred design)	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S12517	BP170M	Turcon® Back-up Ring Spiral, Heavy Duty	Rod/Piston	MIL-P-5514; Revisions C, D, E Fractional One or Two Back-up Rings
	S12546	RG46_B	Turcon® Glyd Ring® Series C	Rod	Trelleborg Standard Fractional Rod
	S12547	PG47_B	Turcon® Glyd Ring® Series C	Piston	Trelleborg Standard Fractional Bore
	S12560	RD040M	Turcon® Channel Seal	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S12561	RD05_M	Turcon® Double Delta® (S30632 is preferred design)	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S12562	RD06_M	Turcon® Double Delta® (S30630 is preferred design)	Rod	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S12563	PD04_M	Turcon® Double Delta® (S30640 is preferred design)	Piston	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S12587	BU870M	Turcon® Back-up Ring Solid	Rod/Piston	MIL-P-5514; Revisions A, B, C, D, E One or Two Back-up Rings
	S12599	PG990B	Turcon® Channel Seal	Piston	Trelleborg Standard
	S12603	PD05_M	Turcon® Double Delta® (S30641 is preferred design)	Piston	MIL-P-5514; Revisions C, D, E One Back-up Ring

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	S12604	RD07_M	Turcon® Double Delta® (S30631 is preferred design)	Rod	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S12714	PD00_M	Turcon® Double Delta®	Piston	MIL-P-5514; Revisions A, B One Back-up Ring
	S12715	RD08_M	Turcon® Double Delta® (S30611 is preferred design)	Rod	MIL-P-5514; Revisions A, B One Back-up Ring
	S12716	PD06_M	Turcon® Double Delta® (S30622 is preferred design)	Rod	MIL-P-5514; Revisions A, B Two Back-up Rings
	S12735	RP35_M	Turcon® Grooved Plus Seal® (S30855 is preferred design)	Rod	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S12737	PP37_M	Turcon® Grooved Plus Seal® (S34760 is preferred design)	Piston	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S12766	BG660M	Turcon® Back-up Ring	Rod/Piston	MIL-P-5514; Revisions D, E One or Two Back-up Rings
	S12794	RG94_B	Turcon® Glyd Ring®	Rod	Trelleborg Standard MIL-P-5514; Revisions A, B
	S12795	PG95_B	Turcon® Glyd Ring®	Piston	Trelleborg Standard Metric
	S12956	RD090M	Turcon® Cap Seal	Rod	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S12957	PD070M	Turcon® Cap Seal	Piston	MIL-P-5514; Revisions A, B, C, D, E Zero Back-up Rings
	S13050	BUS00M	Turcon® Back-up Ring, Heavy Duty	Rod/Piston	MIL-P-5514; Revisions C, D, E One or Two Back-up Rings
	S13068	RD100M	Turcon® Camseal®	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings

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	S13069	BG690M	Turcon® Camseal®	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S13076	N/A	Grooved Turcon® Double Delta®	Piston	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S13077	N/A	Grooved Turcon® Double Delta®	Rod	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S13095	PF04_B	Turcon® Piston Ring	Piston	Trelleborg Standard Fractional
	S13122	BGS20M	Turcon® Back-up Ring Single Turn, Heavy Duty, Scarf-cut	Rod/Piston	MIL-P-5514 thru MIL-G-5514 All Revisions One or Two Back-up Rings
	S13126	PF05_B	Turcon® Dual Piston Ring	Piston	Trelleborg Standard Fractional
	S13135	PF06_B	Turcon® Dual Piston Ring	Piston	Trelleborg Standard MIL-G-5514
	S13180	N/A	Grooved Turcon® Double Delta®	Piston	MIL-P-5514; Revisions A, B One Back-up Ring
	S13181	N/A	Grooved Turcon® Double Delta®	Rod	MIL-P-5514; Revisions A, B One Back-up Ring
	S13200	RD12_M	Grooved Turcon® Double Delta®	Rod	MIL-P-5514; Revisions A, B Two Back-up Rings
	S13201	N/A	Grooved Turcon® Double Delta®	Piston	MIL-P-5514; Revisions A, B Two Back-up Rings
	S13206	N/A	Grooved Turcon® Double Delta®	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S13207	N/A	Grooved Turcon® Double Delta®	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings

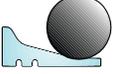
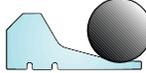
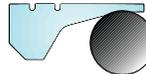
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	S30010	RD140M	Turcon® Channel Seal	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30050	RD160M	Turcon® Delta Seal®	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30058	RG58N	Turcon® Glyd Ring®	Rod	Trelleborg Standard Metric
	S30059	PG59N	Turcon® Glyd Ring®	Piston	Trelleborg Standard Metric
	S30071	PF07_B	Turcon® Dual Piston Ring	Piston	Trelleborg Standard MIL-P-5514; Revisions C, D, E
	S30213	N/A	Turcon® Cap Seal	Rod	Trelleborg Standard MIL-P-5514; Revisions C, D, E
	S30289	PD080M	Turcon® Channel Seal	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30294	BG940M	Turcon® Back-up Ring Cut	Rod/Piston	Boeing Standard BACR12BM
	S30310	BU100M	Turcon® Back-up Ring Solid	Rod/Piston	Boeing Standard BACR12BP
	S30388	WM880S	Turcon® Scraper Ring (S34382 is preferred design)	Rod	Boeing Standard BACS34A
	S30395	WE95_B	Turcon® Excluder® (S32925 is preferred design)	Rod	Trelleborg Standard MIL-P-5514 thru MIL-G-5514 All Revisions
	S30471	N/A	Turcon® Footseal (S33121 is preferred design)	Rod	Boeing Standard BACS11AA
	S30611	N/A	Turcon® Double Delta®II	Rod	MIL-P-5514; Revisions A, B One Back-up Ring

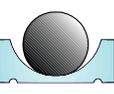
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	S30622	N/A	Turcon® Double Delta®II	Piston	MIL-P-5514; Revisions A, B Two Back-up Rings
	S30630	RD17_M	Turcon® Double Delta®II	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S30631	RD18_M	Turcon® Double Delta®II	Rod	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S30632	RD19_M	Turcon® Double Delta®II	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30640	PD09_M	Turcon® Double Delta®II	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S30641	PD10_M	Turcon® Double Delta®II	Piston	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S30642	PD11_M	Turcon® Double Delta®II	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30650	RD50_M	Turcon® Double Delta®II	Rod	MIL-G-5514; Revision F Zero Back-up Rings
	S30651	RD51_M	Turcon® Double Delta®II	Rod	MIL-G-5514; Revision F One Back-up Ring
	S30652	RD52_M	Turcon® Double Delta®II	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S30660	PD60_M	Turcon® Double Delta®II	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S30661	PD61_M	Turcon® Double Delta®II	Piston	MIL-G-5514; Revision F One Back-up Ring
	S30662	PD62_M	Turcon® Double Delta®II	Piston	MIL-G-5514; Revision F Two Back-up Rings

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S30669	WE69_S	Turcon® Scraper, Series E (S33865 is preferred design)	Rod	MS33675 MIL-P-5514 thru MIL-G-5514 All Revisions
	S30675	RD200M	Turcon® Delta Seal®	Rod	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S30676	N/A	Turcon® Delta Seal®	Piston	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S30677	RD210M	Turcon® Delta Seal®	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30678	PD780M	Turcon® Delta Seal®	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S30681	N/A	Turcon® Delta Seal®	Rod	MIL-G-5514; Revision F One Back-up Ring
	S30682	N/A	Turcon® Delta Seal®	Piston	MIL-G-5514; Revision F One Back-up Ring
	S30683	N/A	Turcon® Delta Seal®	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S30684	N/A	Turcon® Delta Seal®	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S30772	PP72_M	Turcon® Plus Seal® II (S34750 is preferred design)	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S30775	RP75_M	Turcon® Plus Seal® II	Rod	MIL-G-5514; Revision F Zero Back-up Rings
	S30852	PP52_M	Grooved Turcon® Plus Seal® II (S34760 is preferred design)	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S30855	RP55_M	Grooved Turcon® Plus Seal® II	Rod	MIL-G-5514; Revision F Zero Back-up Rings

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	S30989	BU890M	Turcon® Back-up Ring, Solid	Rod/Piston	AS568 One or Two Back-up Rings
	S32152	PF52_B	Turcon® Dual Piston Ring	Piston	Trelleborg Standard MIL-G-5514; Revision F
	S32240	PV920M	Turcon® Variseal® M	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S32240	RV920M	Turcon® Variseal® M	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S32265	PV930M	Turcon® Variseal® M	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S32265	RV930M	Turcon® Variseal® M	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S32571	RS570B	Turcon® Stepseal®	Rod	Trelleborg Standard MIL-P-5514; Revision E
	S32572	PS720B	Turcon® Stepseal®	Piston	Trelleborg Standard MIL-P-5514; Revision E
	S32573	RS730B	Turcon® Stepseal®	Rod	Trelleborg Standard MIL-P-5514; Revision E
	S32574	PS740B	Turcon® Stepseal®	Piston	Trelleborg Standard MIL-P-5514; Revision E
	S32830	RD22_M	Turcon® Grooved Double Delta®II	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S32831	N/A	Turcon® Grooved Double Delta®II	Rod	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S32832	N/A	Turcon® Grooved Double Delta®II	Rod	MIL-P-5514; Revisions C, D, E Two Back-up Rings

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	S32840	N/A	Turcon® Grooved Double Delta®II	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings
	S32841	N/A	Turcon® Grooved Double Delta®II	Piston	MIL-P-5514; Revisions C, D, E One Back-up Ring
	S32842	N/A	Turcon® Grooved Double Delta®II	Piston	MIL-P-5514; Revisions C, D, E Two Back-up Rings
	S32850	RD80_M	Turcon® Grooved Double Delta®II	Rod	MIL-G-5514; Revision F Zero Back-up Rings
	S32851	RD81_M	Turcon® Grooved Double Delta®II	Rod	MIL-G-5514; Revision F One Back-up Ring
	S32852	RD82_M	Turcon® Grooved Double Delta®II	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S32860	PD80_M	Turcon® Grooved Double Delta®II	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S32861	PD81_M	Grooved Turcon® Double Delta®II	Piston	MIL-G-5514; Revision F One Back-up Ring
	S32862	PD82_M	Grooved Turcon® Double Delta®II	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S32891	N/A	Turcon® Glyd Ring® DC Series C	Rod	Trelleborg Standard Fractional Rod
	S32892	N/A	Turcon® Glyd Ring® DC Series C	Piston	Trelleborg Standard Fractional Bore
	S32893	N/A	Turcon® Glyd Ring® DC Series B	Rod	Trelleborg Standard MIL-P-5514; Revisions C, D, E
	S32894	N/A	Turcon® Glyd Ring® DC Series B	Piston	Trelleborg Standard MIL-P-5514; Revisions C, D, E

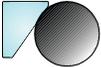
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	S32909	N/A	Turcon® Glyd Ring® Series J	Rod	Trelleborg Standard Fractional Rod
	S32910	PG02_B	Turcon® Glyd Ring® Series J	Piston	Trelleborg Standard Fractional Bore
	S32913	N/A	Turcon® Glyd Ring® DC Series J	Rod	Trelleborg Standard Fractional Rod
	S32914	N/A	Turcon® Glyd Ring® DC Series J	Piston	Trelleborg Standard Fractional Bore
	S32925	WE25_B	Turcon® Excluder® DC	Rod	Trelleborg Standard MIL-P-5514 thru MIL-G-5514 All Revisions
	S32927	RG27_B	Turcon® Glyd Ring® Series J	Rod	Trelleborg Standard MIL-P-5514 Revision F
	S32928	PG28_B	Turcon® Glyd Ring® Series J	Piston	Trelleborg Standard MIL-P-5514 Revision F
	S32933	RGE3_B	Turcon® Glyd Ring® DC Series J	Rod	Trelleborg Standard Rod MIL-P-5514; Revision F
	S32934	PGE4_B	Turcon® Glyd Ring® DC Series J	Piston	Trelleborg Standard MIL-P-5514; Revision F
	S32979	RH790M	Turcon® Hatseal® II Two-Piece (S34852 is preferred design)	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S32985	N/A	Turcon® Hatseal® II Two-Piece (S34851 is preferred design)	Rod	MIL-G-5514; Revision F One Back-up Ring
	S32991	RH910M	Turcon® Hatseal® II Two-Piece (S34853 is preferred design)	Rod	Boeing Standard
	S33081	N/A	Turcon® Plus Seal® II (S34571 is preferred design)	Rod	MIL-G-5514; Revision F One Back-up Ring

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S33084	N/A	Turcon® Plus Seal® II (S34581 is preferred design)	Piston	MIL-G-5514; Revision F One Back-up Ring
	S33087	N/A	Turcon® Plus Seal® II (S34711 is preferred design)	Rod	MIL-G-5514; Revision F One Back-up Ring
	S33090	N/A	Grooved Turcon® Plus Seal® II (S34721 is preferred design)	Piston	MIL-G-5514; Revision F One Back-up Ring
	S33121	RF210B	Turcon® Foot Seal II	Rod	Boeing Standard
	S33157	BUS70M (Solid) BGS70M (Scarf-cut)	Turcon® Back-up Ring Solid or Scarf-cut, two required	Rod/Piston	MIL-G-5514; Revisions C, D, E Two Back-up Rings
	S33277	N/A	Turcon® Delta Back-up Ring, Solid	Rod	MIL-P-5514; Revisions C, D, E One or Two Back-up Rings
	S33278	N/A	Turcon® Delta Back-up Ring, Solid	Piston	MIL-P-5514; Revisions C, D, E One or Two Back-up Rings
	S33317	RH170M	Turcon® Hatseal® II Three-Piece (S34831 is preferred design)	Rod	MIL-G-5514; Revision F One Back-up Ring
	S33353	N/A	Turcon® Hatseal® II Three-Piece (S34832 is preferred design)	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S33528	N/A	Turcon® Hatseal® II Three-Piece (S34842 is preferred design)	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S33555	RD550M	Turcon® Hatseal® II Two-Piece (S34842 is preferred design)	Rod	Boeing Standard
	S33557	N/A	Turcon® Plus Seal® II (S34572 is preferred design)	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S33565	N/A	Turcon® Hatseal® II Three-Piece (S34841 is preferred design)	Piston	MIL-G-5514; Revision F One Back-up Ring

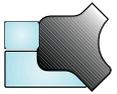
Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S33709	PP09_M	Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S33823	BU230M	Turcon® Delta Back-up Ring, Solid	Rod	MIL-G-5514; Revision F One or Two Back-up Rings
	S33824	BU440M	Turcon® Delta Back-up Ring, Solid	Piston	MIL-G-5514; Revision F One or Two Back-up Rings
	S33861	BGS10M (solid) BUS10M (Scarf-cut)	Turcon® Back-up Ring Solid or Scarf-cut, one required	Rod/Piston	MIL-G-5514; Revision F One Back-up Ring
	S33865	WE65_S	Turcon® Excluder® DC, Series E	Rod	MS33675 MIL-P-5514 thru MIL-G-5514F All Revisions
	S34382	WM820S	Turcon® DC Scraper Ring	Rod	MS33675 MIL-P-5514 thru MIL-G-5514F All Revisions
	S34435	RP01_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S34545	GP_XB	Turcon® Slydring® (1/32 thick)	Piston	Trelleborg Standard MIL-G-5514F
	S34546	GP_WB	Turcon® Slydring® (1/16 thick)	Piston	Trelleborg Standard MIL-G-5514F
	S34547	GP_YB	Turcon® Slydring® (3/32 thick)	Piston	Trelleborg Standard MIL-G-5514F
	S34548	GR_XB	Turcon® Slydring® (1/32 thick)	Rod	Trelleborg Standard MIL-G-5514F
	S34549	GR_WB	Turcon® Slydring® (1/16 thick)	Rod	Trelleborg Standard MIL-G-5514F
	S34550	GR_YB	Turcon® Slydring® (3/32 thick)	Rod	Trelleborg Standard MIL-G-5514F

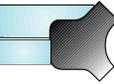
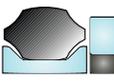
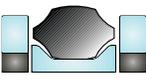
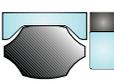
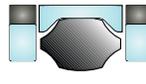
Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S34571	RP71_M	Turcon® Plus Seal® II	Rod	MIL-G-5514; Revision F One Back-up Ring
	S34572	RP72_M	Turcon® Plus Seal® II	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S34581	PP81_M	Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F One Back-up Ring
	S34582	PP82_M	Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S34690	RB90_M	Turcon® T-Seal	Rod	MIL-G-5514; Revision F Zero Back-up Rings
	S34691	RB91_M	Turcon® T-Seal	Rod	MIL-G-5514; Revision F One Back-up Ring
	S34692	RB92_M	Turcon® T-Seal	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S34700	PB00_M	Turcon® T-Seal	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S34701	PB01_M	Turcon® T-Seal	Piston	MIL-G-5514; Revision F One Back-up Ring
	S34702	PB02_M	Turcon® T-Seal	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S34711	RP11_M	Grooved Turcon® Plus Seal® II	Rod	MIL-G-5514; Revision F One Back-up Ring
	S34712	RP12_M	Grooved Turcon® Plus Seal® II	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S34721	PP21_M	Grooved Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F One Back-up Ring

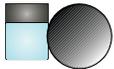
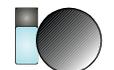
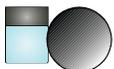
Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S34722	PP22_M	Grooved Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S34750	PP50_M	Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S34760	PP60_M	Grooved Turcon® Plus Seal® II	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S34767	RSA70B	Turcon® Stepseal®	Rod	Trelleborg Standard MIL-G-5514; Revision F
	S34768	PSA80B	Turcon® Stepseal®	Piston	Trelleborg Standard MIL-G-5514; Revision F
	S34770	RA70_M	Turcon® Wedgpak®	Rod	MIL-G-5514; Revision F Zero Back-up Rings
	S34771	RA71_M	Turcon® Wedgpak®	Rod	MIL-G-5514; Revision F One Back-up Ring
	S34772	RA72_M	Turcon® Wedgpak®	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S34780	PA80_M	Turcon® Wedgpak®	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S34781	PA81_M	Turcon® Wedgpak®	Piston	MIL-G-5514; Revision F One Back-up Ring
	S34782	PA82_M	Turcon® Wedgpak®	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S34831	RH310M	Turcon® Hatseal® II Three-Piece	Rod	MIL-G-5514; Revision F One Back-up Ring
	S34832	RH320M	Turcon® Hatseal® II Three-Piece	Rod	MIL-G-5514; Revision F Two Back-up Rings

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S34841	N/A	Turcon® Hatseal® II Three-Piece	Piston	MIL-G-5514; Revision F One Back-up Ring
	S34842	N/A	Turcon® Hatseal® II Three-Piece	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S34851	RH510M	Turcon® Hatseal® II Two-Piece	Rod	MIL-G-5514; Revision F One Back-up Ring
	S34852	RH520M	Turcon® Hatseal® II Two-Piece	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S34853	RH530M	Turcon® Hatseal® II Two-Piece	Rod	Boeing Standard BACS11AA
	S35961	RA610M	Turcon® Wedgpak®	Rod Static	MIL-G-5514; Revision F Zero Back-up Rings
	S35964	PA640M	Turcon® Wedgpak®	Piston Static	MIL-G-5514; Revision F Zero Back-up Rings
	S36611	RP00_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S36612	RP99_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S36621	PP01_M	Turcon® Plus Seal® II Set	Piston	MIL-G-5514; Revision F One Back-up Ring
	S36622	PP03_M	Turcon® Plus Seal® II Set	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S36991	BG990M	Turcon® Stakbak®, Scarf-cut	Rod	MIL-G-5514; Revision F One Back-up Ring
	S36992	BG920M	Turcon® Stakbak®, Scarf-cut	Rod	MIL-G-5514; Revision F Two Back-up Rings

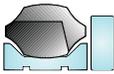
Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S37001	BG010M	Turcon® Stakbak®, Scarf-cut	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37002	BG020M	Turcon® Stakbak®, Scarf-cut	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S37011	BG110M	Turcon® Stakbak®, Scarf-cut	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37021	BG210M	Turcon® Stakbak®, Scarf-cut	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37051	RP51_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37052	RP52_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S37055	BG550M	Turcon® Stakbak®, Scarf-cut	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S37060	BG600M	Turcon® Stakbak®, Scarf-cut	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37061	PP61_M	Turcon® Plus Seal® II Set	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37062	PP62_M	Turcon® Plus Seal® II Set	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S37076	BG760M	Turcon® Stakbak®, Scarf-cut	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37083	BG830M	Turcon® Stakbak®, Scarf-cut	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37241	BG410M	Turcon® Stakbak®, Scarf-cut, Static Seal Set	Piston	MIL-G-5514; Revision F One Back-up Ring

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S37242	BG420M	Turcon® Stakbak®, Scarf-cut, Static Seal Set	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S37251	BG510M	Turcon® Stakbak®, Scarf-cut, Static Seal Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37252	BG520M	Turcon® Stakbak®, Scarf-cut, Static Seal Set	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S37261	BG610M	Turcon® Stakbak®, Scarf-cut, Static Seal Set	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37271	BG710M	Turcon® Stakbak®, Scarf-cut, Static Seal Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37401	PP02_M	Turcon® Plus Seal® II Set	Piston	MIL-G-5514; Revision F One Back-up Ring
	S37411	RP02_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37431	RP03_M	Turcon® Plus Seal® II Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S37804	PP040M	Turcon® Plus Seal® AQ	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S37967	WE670B	Turcon® Excluder® AS	Rod	AS4088
	S37971	WE710B	Turcon® Excluder® AS	Rod	AS4052 Type I
	S37972	WE720B	Turcon® Excluder® AS	Rod	AS4052 Type II
	S38000	DW000B	Turcon® Wedgpak®	Face (Internal)	Trelleborg Face Seal Gland Standard

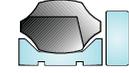
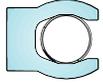
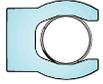
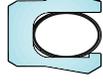
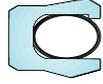
Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S38001	DW010B	Turcon® Wedgpak®	Face (External)	Trelleborg Face Seal Gland Standard
	S38002	PF09_B	Turcon® Single Piston Ring	Piston	Trelleborg Standard MIL-G-5514; Revision F
	S38003	PF08_B	Turcon® Single Piston Ring	Piston	Trelleborg Standard MIL-G-5514; Revision F
	S38362	PP00_M	Turcon® Plus Seal® PR	Piston	Two Back-up Rings MIL-G-5514; Revision F
	S38371	RP31_M	Turcon® Plus Seal® PR	Rod	One Back-up Ring MIL-G-5514; Revision F
	S38372	RP32_M	Turcon® Plus Seal® PR	Rod	Two Back-up Rings MIL-G-5514; Revision F
	S38410	RB10_M	Turcon® T-Seal	Rod	MIL-G-5514; Revision F Zero Back-up Rings
	S38411	RB11_M	Turcon® T-Seal	Rod	MIL-G-5514; Revision F One Back-up Ring
	S38412	RB12_M	Turcon® T-Seal	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S38420	PB20_M	Turcon® T-Seal	Piston	MIL-G-5514; Revision F Zero Back-up Rings
	S38421	PB21_M	Turcon® T-Seal	Piston	MIL-G-5514; Revision F One Back-up Ring
	S38422	PB22_M	Turcon® T-Seal	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S38544	BG440G	Turcon® Back-up Ring Scarf-cut	Rod	AS4716 One or Two Back-up Rings

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S38545	BG450G	Turcon® Back-up Ring Scarf-cut	Piston	AS4716 One or Two Back-up Rings
	S38587	BG870G	Turcon® Back-up Ring, Scarf-cut (1/2 Width)	Rod	AS4716 Two Back-up Rings in One Back-up Ring Width Gland
	S38588	BG880G	Turcon® Back-up Ring, Scarf-cut (1/2 Width)	Piston	AS4716 Two Back-up Rings in One Back-up Ring Width Gland
	S38611	RA1_OM	Turcon® Wedgpak® EP	Rod	MIL-G-5514; Revision F One Back-up Ring
	S38612	RA2_OM	Turcon® Wedgpak® EP	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S38618	BU180G	Turcon® Back-up Ring Solid	Piston	AS4716 One or Two Back-up Rings
	S38619	BU190G	Turcon® Back-up Ring Solid	Rod	AS4716 One or Two Back-up Rings
	S38620	PQ200M	Turcon® AQ-Seal® 5	Piston	Trelleborg Standard MIL-G-5514; Revision F
	S38621	PA1_OM	Turcon® Wedgpak® EP	Piston	MIL-G-5514; Revision F One Back-up Ring
	S38622	PA2_OM	Turcon® Wedgpak® EP	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S38647	RP470B	Grooved Turcon® Plus Seal® PR	Rod	Boeing Standard BACS11AA
	S38649	RA490B	Turcon® Wedgpak®	Rod	Boeing Standard BACS11AA
	S38661	PP68_M	Grooved Turcon® Plus Seal® PR	Piston	One Back-up Ring MIL-G-5514; Revision F

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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	S38662	PP66_M	Grooved Turcon® Plus Seal® PR	Piston	MIL-G-5514; Revision F Two Back-up Rings
	S38671	RP81_M	Turcon® Plus Seal® PR Set	Rod	MIL-G-5514; Revision F One Back-up Ring
	S38672	RP82_M	Turcon® Plus Seal® PR Set	Rod	MIL-G-5514; Revision F Two Back-up Rings
	S62600	PV910M	Turcon® Variseal® H	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings, MIL-G-5514F and AS4716
	S62600	RV910M	Turcon® Variseal® H	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings, MIL-G-5514F and AS4716
	S910	PV950M	Turcon® Variseal® W	Piston	MIL-P-5514; Revisions C, D, E Zero Back-up Rings, MIL-G-5514F and AS4716
	S910	RV950M	Turcon® Variseal® W	Rod	MIL-P-5514; Revisions C, D, E Zero Back-up Rings, MIL-G-5514F and AS4716
	N/A	DVA	Turcon® Variseal® M	Face, Internal	Trelleborg Face Seal Gland Standard
	N/A	DVC	Turcon® Variseal® M	Face, External	Trelleborg Face Seal Gland Standard
	N/A	DVE	Turcon® Variseal® H	Face, Internal	Trelleborg Face Seal Gland Standard
	N/A	DVL	Turcon® Variseal® H	Face, External	Trelleborg Face Seal Gland Standard
	N/A	DW00	Turcon® Wedgpak®	Face, External	Trelleborg Face Seal Gland Standard
	N/A	DW01	Turcon® Wedgpak®	Face, External	Trelleborg Face Seal Gland Standard

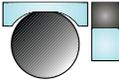
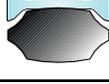
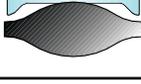
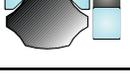
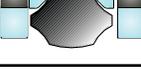
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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	DXA	Turcon® HST Seal	Face, External	Trelleborg Face Seal Gland Standard
	N/A	DXB	Turcon® HST Seal	Face, Internal	Trelleborg Face Seal Gland Standard
	N/A	PA00_G	Turcon® Wedgpak®II	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PAA1_G	Turcon® Wedgpak®II	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PAA2_G	Turcon® Wedgpak®II	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PAB1_G	Turcon® Wedgpak®EP	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PAB2_G	Turcon® Wedgpak®EP	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PAU0_G	Turcon® Unidirectional Wedgpak®II	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PAU1_G	Turcon® Unidirectional Wedgpak®II	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PAU2_G	Turcon® Unidirectional Wedgpak®II	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PBA0_G	Turcon® T-Seal	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PBA1_G	Turcon® T-Seal	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PBA2_G	Turcon® T-Seal	Piston	AS4716 Rev. A Two Back-up Rings

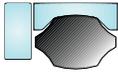
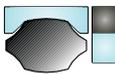
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Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	PBB1_G	Turcon® T-Seal Staged	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PBB2_G	Turcon® T-Seal Staged	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PDA0_G	Grooved Turcon® Double Delta® II	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PDA1_G	Grooved Turcon® Double Delta® II	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PDA2_G	Grooved Turcon® Double Delta® II	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PDA1AG	Grooved Turcon® Double Delta® II w/ one Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PDA2AG	Grooved Turcon® Double Delta® II w/ two Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PDA18G	Grooved Turcon® Double Delta® II w/ one Stakbak® Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PDA28G	Grooved Turcon® Double Delta® II w/ two Stakbak® Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PDB0_G	Turcon® Double Delta® II	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PDB1_G	Turcon® Double Delta® II	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PDB2_G	Turcon® Double Delta® II	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PDB1AG	Turcon® Double Delta® II w/ one Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring

Aerospace Part Number Guide

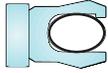
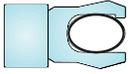
Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	PDB2AG	Turcon® Double Delta® II w/ two Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PDB18G	Turcon® Double Delta® II w/ one Stakbak® Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PDB28G	Turcon® Double Delta® II w/ two Stakbak® Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PPA0	Grooved Turcon® Plus Seal® II	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PPA1	Grooved Turcon® Plus Seal® II	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PPA2	Grooved Turcon® Plus Seal® II	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PPA1A	Grooved Turcon® Plus Seal® II w/ one Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PPA2A	Grooved Turcon® Plus Seal® II w/ two Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PPA18G	Grooved Turcon® Plus Seal® II w/ one Stakbak® Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PPA28G	Grooved Turcon® Plus Seal® w/ two Stakbak® Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PPB0	Turcon® Plus Seal® II	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PPB1	Turcon® Plus Seal® II	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PPB2	Turcon® Plus Seal® II	Piston	AS4716 Rev. A Two Back-up Rings

Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	PPB1A	Turcon® Plus Seal® II w/ one Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PPB2A	Turcon® Plus Seal® II w/ two Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PPB18G	Turcon® Plus Seal® II w/ one Stakbak® Back-up Ring	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PPB28G	Turcon® Plus Seal® II w/ two Stakbak® Back-up Rings	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PSF00B	Turcon® Stepseal®	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PVA_0	Turcon® Variseal® M2	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PVA_B	Turcon® Variseal® M2	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PVA_E	Turcon® Variseal® M2	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PVC	Turcon® Variseal® M2S	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PVE_0	Turcon® Variseal® H	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PVE_B	Turcon® Variseal® H	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PVE_E	Turcon® Variseal® H	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PVJ_0	Turcon® Variseal® W2	Piston	AS4716 Rev. A Zero Back-up Rings



Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	PVJ_B	Turcon® Variseal® W2	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PVJ_E	Turcon® Variseal® W2	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	PVP_O	Turcon® Variseal® SA	Piston	AS4716 Rev. A Zero Back-up Rings
	N/A	PVP_B	Turcon® Variseal® SA	Piston	AS4716 Rev. A One Back-up Ring
	N/A	PVP_E	Turcon® Variseal® SA	Piston	AS4716 Rev. A Two Back-up Rings
	N/A	RBB1_G	Turcon® T-Seal Staged	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RBB2_G	Turcon® T-Seal Staged	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RDA0_G	Grooved Turcon® Double Delta® II	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RDA1_G	Grooved Turcon® Double Delta® II w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RDA2_G	Grooved Turcon® Double Delta® II w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RDA1AG	Grooved Turcon® Double Delta® II w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RDA2AG	Grooved Turcon® Double Delta® II w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RDA18G	Grooved Turcon® Double Delta® II w/ one Stakbak® Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring

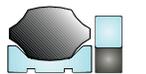
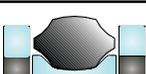
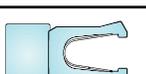
Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	RDA28G	Grooved Turcon® Double Delta® II w/ two Stakbak® Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RDB0_G	Turcon® Double Delta® II	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RDB1_G	Turcon® Double Delta® II	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RDB2_G	Turcon® Double Delta® II	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RAA0_G	Turcon® Unidirectional Wedgpak® II	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RAA1_G	Turcon® Wedgpak® II	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RAA2_G	Turcon® Wedgpak® II	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RAB1_G	Turcon® Wedgpak® EP	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RAB2_G	Turcon® Wedgpak® EP	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RAU0_G	Turcon® Unidirectional Wedgpak® II	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RAU1_G	Turcon® Unidirectional Wedgpak® II	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RAU2_G	Turcon® Unidirectional Wedgpak® II	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RBA0_G	Turcon® T-Seal	Rod	AS4716 Rev. A Zero Back-up Rings

Aerospace Part Number Guide

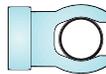
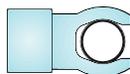
Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	RBA1_G	Turcon® T-Seal	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RBA2_G	Turcon® T-Seal	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RDB1AG	Turcon® Double Delta® II w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RDB2AG	Turcon® Double Delta® II w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RDB18G	Turcon® Double Delta® II w/ one Stakbak® Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RDB28G	Turcon® Double Delta® II w/ two Stakbak® Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	REL2	Turcon® VL seal	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	REL2B	Turcon® VL seal w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	REL2E	Turcon® VL seal w/ one Back-up Ring	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RPA0	Grooved Turcon® Plus Seal® II	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RPA1	Grooved Turcon® Plus Seal® II	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RPA2	Grooved Turcon® Plus Seal® II	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RPA1A	Grooved Turcon® Plus Seal® II w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring

Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	RPA2A	Grooved Turcon® Plus Seal® II w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RPA18G	Grooved Turcon® Plus Seal® II w/ one Stakbak® Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RPA28G	Grooved Turcon® Plus Seal® II w/ two Stakbak® Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RPB0	Turcon® Plus Seal® II	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RPB1	Turcon® Plus Seal® II	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RPB2	Turcon® Plus Seal® II	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RPB1A	Turcon® Plus Seal® II w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RPB2A	Turcon® Plus Seal® II w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RPB18G	Turcon® Plus Seal® II w/ one Stakbak® Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RPB28G	Turcon® Plus Seal® II w/ two Stakbak® Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RSF00B	Turcon® Stepseal® 2K	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RVA_0	Turcon® Variseal® M2	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RVA_B	Turcon® Variseal® M2 w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RVA_E	Turcon® Variseal® M2 w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings



Aerospace Part Number Guide

Cross Section	Old Part No.	New Part No.	Description	Seal Type	Gland Standard
	N/A	RVC	Turcon® Variseal® M2S	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RVE_0	Turcon® Variseal® H	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RVE_B	Turcon® Variseal® H w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RVE_E	Turcon® Variseal® H w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RVJ_0	Turcon® Variseal® W2	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RVJ_B	Turcon® Variseal® W2 w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RVJ_E	Turcon® Variseal® W2 w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings
	N/A	RVP_0	Turcon® Variseal® SA	Rod	AS4716 Rev. A Zero Back-up Rings
	N/A	RVP_B	Turcon® Variseal® SA w/ one Back-up Ring	Rod	AS4716 Rev. A One Back-up Ring
	N/A	RVP_E	Turcon® Variseal® SA w/ two Back-up Rings	Rod	AS4716 Rev. A Two Back-up Rings

Aerospace Part Number Guide

Aerospace Part Number Reference Guide - (By New Part Number)

New P/N	Old P/N
BG010M	S37001
BG020M	S37002
BG110M	S37011
BG210M	S37021
BG410M	S37241
BG420M	S37242
BG440G	S38544
BG450G	S38545
BG480M	S11248
BG510M	S37251
BG520M	S37252
BG550M	S37055
BG600M	S37060
BG610M	S37261
BG660M	S12766
BG690M	S13069
BG710M	S37271
BG760M	S37076
BG830M	S37083
BG870G	S38587
BG880G	S38588
BG920M	S36992
BG940M	S30294
BG990M	S36991
BGS10M	S33861
BGS20M	S13122
BP090A	S11109
BP170M	S12517
BU100M	S30310
BU180G	S38618
BU190G	S38619
BU230M	S33823

New P/N	Old P/N
BU440M	S33824
BU870M	S12587
BU890M	S30989
BUS00M	S13050
BUS70M	S33157
DW000B	S38000
DW010B	S38001
GP__WB	S34546
GP__XB	S34545
GP__YB	S34547
GR__WB	S34549
GR__XB	S34548
GR__YB	S34550
N/A	S11242
N/A	S11243
N/A	S11370
N/A	S11943
N/A	S12257
N/A	S13076
N/A	S13077
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N/A	S13206
N/A	S13207
N/A	S30471
N/A	S30611
N/A	S30622
N/A	S30676
N/A	S30681
N/A	S30682
N/A	S30683

Aerospace Part Number Guide

Aerospace Part Number Reference Guide - (By New Part Number)

New P/N	Old P/N
N/A	S30684
N/A	S32831
N/A	S32832
N/A	S32840
N/A	S32841
N/A	S32842
N/A	S32891
N/A	S32892
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N/A	S33084
N/A	S33087
N/A	S33090
N/A	S33277
N/A	S33278
N/A	S33353
N/A	S33528
N/A	S33557
N/A	S33565
N/A	S34841
N/A	S34842
OC140M	S11214
OC320M	S11732
PA1_M	S38621
PA2_M	S38622
PA640M	S35964
PA80_M	S34780

New P/N	Old P/N
PA81_M	S34781
PA82_M	S34782
PB00_M	S34700
PB01_M	S34701
PB02_M	S34702
PB20_M	S38420
PB21_M	S38421
PB22_M	S38422
PD00_M	S12714
PD03_M	S12508
PD04_M	S12563
PD05_M	S12603
PD06_M	S12716
PD070M	S12957
PD080M	S30289
PD10_M	S30641
PD11_M	S30642
PD130M	S11338
PD19_M	S30640
PD60_M	S30660
PD61_M	S30661
PD62_M	S30662
PD780M	S30678
PD80_M	S32860
PD81_M	S32861
PD82_M	S32862
PF00_B	S11052
PF01_B	S11114
PF02_B	S12083
PF03_B	S12230
PF04_B	S13095
PF05_B	S13126

Aerospace Part Number Guide

Aerospace Part Number Reference Guide - (By New Part Number)

New P/N	Old P/N
PF06_B	S13135
PF07_B	S30071
PF08_B	S38003
PF09_B	S38002
PF52_B	S32152
PG00_B	S11718
PG02_B	S32910
PG28_B	S32928
PG47_B	S12547
PG59N	S30059
PG68_B	S12068
PG95_B	S12795
PG990B	S12599
PGE4_B	S32934
PP00_M	S38362
PP01_M	S36621
PP02_M	S37401
PP03_M	S36622
PP040M	S37804
PP09_M	S33709
PP21_M	S34721
PP22_M	S34722
PP37_M	S12737
PP50_M	S34750
PP52_M	S30852
PP60_M	S34760
PP61_M	S37061
PP62_M	S37062
PP66_M	S38662
PP68_M	S38661
PP72_M	S30772
PP81_M	S34581

New P/N	Old P/N
PP82_M	S34582
PQ200M	S38620
PS720B	S32572
PS740B	S32574
PSA80B	S34768
PV920M	S32240
PV930M	S32265
RA1_M	S38611
RA2_M	S38612
RA490G	S38649
RA610M	S35961
RA70_M	S34770
RA71_M	S34771
RA72_M	S34772
RB10_M	S38410
RB11_M	S38411
RB12_M	S38412
RB90_M	S34690
RB91_M	S34691
RB92_M	S34692
RD03_M	S12223
RD040M	S12560
RD05_M	S12561
RD06_M	S12562
RD07_M	S12604
RD08_M	S12715
RD090M	S12956
RD100M	S13068
RD12_M	S13200
RD140M	S30010
RD160M	S30050
RD17_M	S30630

Aerospace Part Number Guide

Aerospace Part Number Reference Guide - (By New Part Number)

New P/N	Old P/N
RD18_M	S30631
RD19_M	S30632
RD200M	S30675
RD210M	S30677
RD22_M	S32830
RD240B	S11859
RD50_M	S30650
RD51_M	S30651
RD52_M	S30652
RD550M	S33555
RD80_M	S32850
RD81_M	S32851
RD82_M	S32852
RD890M	S11589
RF210B	S33121
RF95_B	S12095
RG00_B	S11717
RG27_B	S32927
RG46_B	S12546
RG58N	S30058
RG66_B	S12066
RG94_B	S12794
RGE3_B	S32933
RH170M	S33317
RH310M	S34831
RH320M	S34832
RH510M	S34851
RH520M	S34852
RH530B	S34853
RH790M	S32979
RH910M	S32991
RP00_M	S36611

New P/N	Old P/N
RP01_M	S34435
RP02_M	S37411
RP03_M	S37431
RP11_M	S34711
RP12_M	S34712
RP31_M	S38371
RP32_M	S38372
RP35_M	S12735
RP40_M	S11940
RP470G	S38647
RP51_M	S37051
RP52_M	S37052
RP55_M	S30855
RP71_M	S34571
RP72_M	S34572
RP75_M	S30775
RP81_M	S38671
RP82_M	S38672
RP99_M	S36612
RS570B	S32571
RS730B	S32573
RSA70B	S34767
WE25_B	S32925
WE65_S	S33865
WE670B	S37967
WE69_S	S30669
WE710B	S37971
WE720B	S37972
WE95_B	S30395
WM650S	S11065
WM820S	S34382
WM880S	S30388

Aerospace Part Number Guide

Contact your local marketing company for further information:

Europe

AUSTRIA - Vienna
(ALBANIA, BOSNIA AND HERZEGOVINA,
MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)

+43 (0) 1 406 47 33

BELGIUM - Dion-Valmont
(LUXEMBOURG)

+32 (0) 10 22 57 50

BULGARIA - Sofia
(ROMANIA)

+359 (0)2 969 95 99

CROATIA - Zagreb

+385 (0) 1 24 56 387

CZECH REPUBLIC - Rakovník
(SLOVAKIA)

+420 313 529 111

DENMARK - Hillerød

+45 48 22 80 80

FINLAND - Vantaa
(ESTONIA, LATVIA)

+358 (0) 207 12 13 50

FRANCE - Maisons-Laffitte

+33 (0) 1 30 86 56 00

GERMANY - Stuttgart

+49 (0) 711 7864 0

GREECE

+41 (0) 21 631 41 11

HUNGARY - Budaörs

+36 (06) 23 50 21 21

ITALY - Livorno

+39 0586 22 6111

THE NETHERLANDS - Barendrecht

+31 (0) 10 29 22 111

NORWAY - Oslo

+47 22 64 60 80

POLAND - Warsaw
(LITHUANIA, UKRAINE, BELARUS)

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RUSSIA - Moscow

+7 495 982 39 21

SPAIN - Madrid
(PORTUGAL)

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SWEDEN - Jönköping

+46 (0) 36 34 15 00

SWITZERLAND - Crissier

+41 (0) 21 631 41 11

TURKEY

+41 (0) 21 631 41 11

UNITED KINGDOM - Solihull
(EIRE)

+44 (0) 121 744 1221

AFRICA REGIONAL

+41 (0) 21 631 41 11

MIDDLE EAST REGIONAL

+41 (0) 21 631 41 11

Americas

AMERICAS - REGIONAL

+1 260 749 9631

BRAZIL - São Paulo

+55 11 3372 4500

CANADA - Etobicoke, ON

+1 416 213 9444

MEXICO - Mexico City

+52 55 57 19 50 05

USA, East - Conshohocken, PA

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USA, Great Lakes - Fort Wayne, IN

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USA, Northern California - Fresno, CA

+1 559 449 6070

USA, Northwest - Portland, OR

+1 503 595 6565

USA, South - N. Charleston, SC

+1 843 747 7656

USA, Southwest - Houston, TX

+1 713 461 3495

USA, West - Torrance, CA

+1 310 371 1025

Asia Pacific

Telephone

ASIA PACIFIC REGIONAL

+65 6 577 1778

CHINA - Hong Kong

+852 2366 9165

CHINA - Shanghai

+86 (0) 21 6145 1830

INDIA - Bangalore

+91 (0) 80 2245 5157

JAPAN - Tokyo

+81 (0) 3 5633 8008

KOREA - Anyang

+82 (0) 31 386 3283

MALAYSIA - Kuala Lumpur

+60 (0) 3 9059 6388

TAIWAN - Taichung

+886 4 2382 8886

THAILAND - Bangkok

+66 (0) 2732-2861

SINGAPORE

+65 6 577 1778

and all other countries in Asia

+65 6 577 1778

www.tss.trelleborg.com





Aero engine & airframe sealing solutions



Your Partner for Sealing Technology

Safety critical sealing solutions



Demanding aeroengine requirements

The aeroengine designer cannot risk component failure and major manufacturers rely on the experience of Trelleborg Sealing Solutions to ensure sealing integrity over extended aircraft service life.



Specialist airframe products

Airframe seals are not only used within the engine compartment but throughout the aircraft body, on wings, windows and doors, where they contribute to aerodynamic efficiency.



Aircraft engines represent the most demanding of all sealing environments, with the ultimate in safety-critical requirements. Seals must withstand extremes of temperature and pressure in areas where they are often exposed to high humidity, intense friction, powerful high frequency vibration and exceptionally destructive chemicals, lubricants and media. The aeroengine designer cannot risk component failure and for sealing parts, being vital elements in such systems, a partnership with a proven supplier of experience and excellence, is of paramount importance.

Trelleborg Sealing Solutions has been involved in aircraft engine development for over 50 years and is recognized as pioneering in aerospace sealing. As the leading supplier in our field, we offer a unique range that utilizes our proprietary materials, innovative manufacturing methods and patented products.

Whether a seal solution involves a custom design or a standard O-Ring, we are able to work with our customers to offer the optimum configuration. Our solutions, featuring on all major platforms including the Joint Strike Fighter and Airbus A380, demonstrate outstanding sealing integrity, over necessarily extended service lives, while meeting rigorous performance demands.

Continuously developing our proven technologies, within the engine and engine compartment, innovative airframe seals provide enhanced fuel efficiency, fire safety and reliability.

They also successfully contribute to aerodynamic performance on all parts of the airframe, on wing movable surfaces, windows, doors and hatches. A further refinement of this technology is inflatable seals, each individually designed and manufactured to complex 3-dimensional geometries.

The range of products offer:

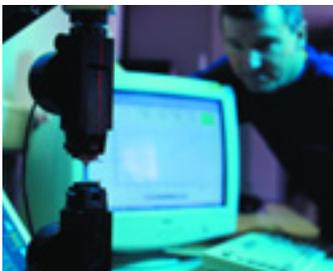
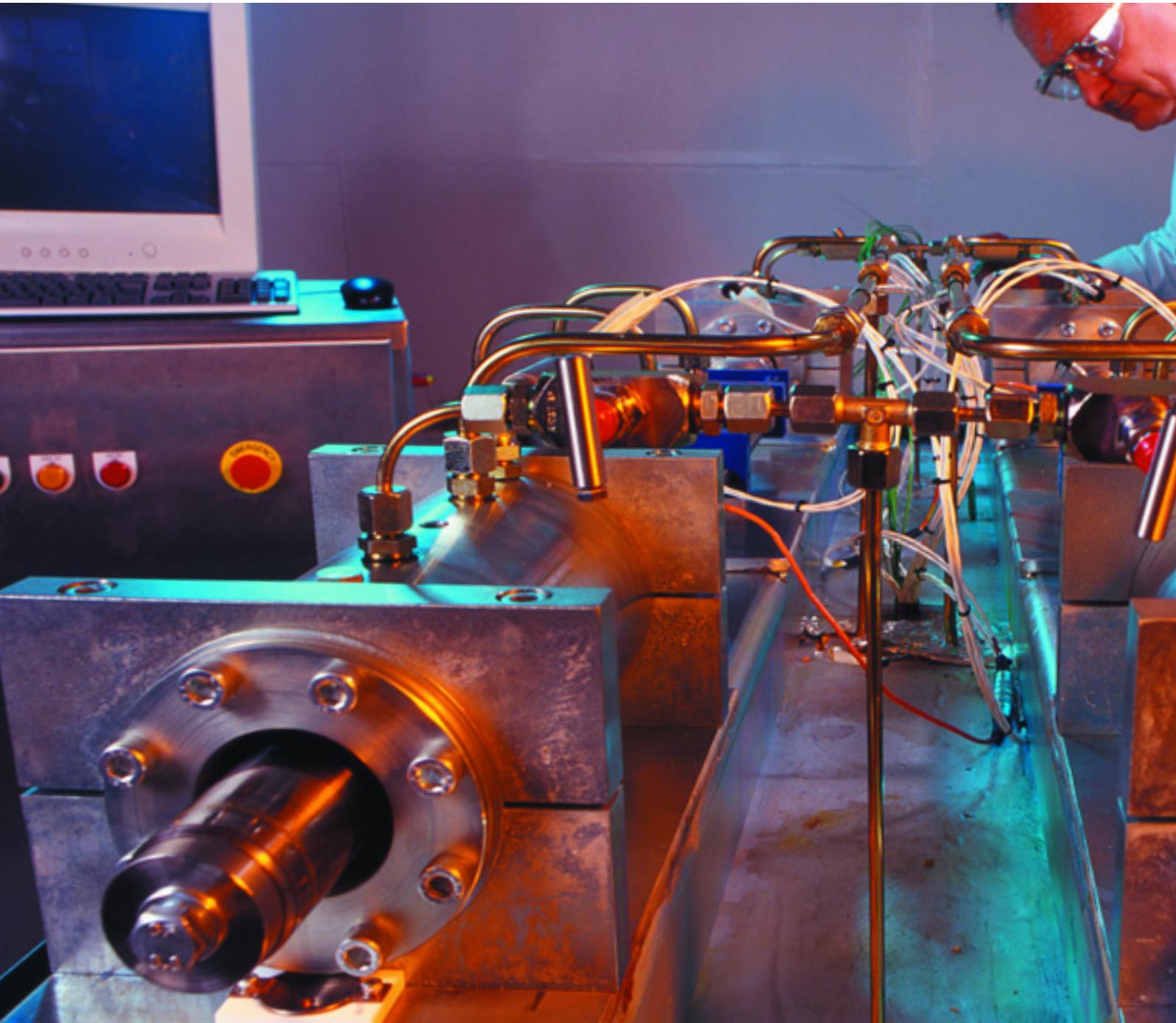
- Temperature resistance from cryogenic up to 850°C (1560°F) and fire seals withstanding flame temperatures up to 1100°C (2012°F)
- Compounds with almost universal chemical compatibility and superior contaminant resistance to aggressive phosphate ester fluid and synthetic hydrocarbon based oils.
- Excellent thermal stability
- Good mechanical strengths
- Low long-term compression set
- Aerospace approved materials, products and manufacturing



Innovative inflatable sealing

Trelleborg Sealing Solutions inflatable seals are proven to successfully perform in challenging safety-critical cockpit applications, individually designed and manufactured for numerous models of fighter jets.

Service from concept to delivery



Products tested to destruction

To ensure Trelleborg Sealing Solutions products meet and exceed operational requirements, significant investment is made in research and development, including destruction testing.



Innovative manufacturing methods

The success of TSS is founded on pioneering manufacturing methods such as proprietary glass braided sleeving technology, a development demonstrating a comprehensive understanding of market needs.



Only through research and development specifically linked to the exacting requirements of the aerospace industry, has Trelleborg Sealing Solutions managed to develop solutions that match the performance and safety-critical standards specified by our customers. Where every component within a system must exceed maximum operational limits, rigorous tests are undertaken to ensure long service life.

Our committed research and development facilities worldwide, seamlessly combine their knowledge with our manufacturing units, whose expertise is enhanced by focus on a specific material or product type. Within this global network we continuously develop new materials and products to meet ever more stringent standards, constantly challenging ourselves to achieve results previously thought to be impossible.

Dedicated aerospace production takes place in America, Denmark, France, Sweden and the United Kingdom, where our success has been founded on groundbreaking manufacturing methods and a comprehensive understanding of market needs. Unrivalled PTFE expertise and pioneering products, such as Wills Rings[®], supplement our leading edge elastomer capabilities. In addition to this, the Trelleborg Sealing Solutions service reflects and surpasses industry requirements from concept to delivery.

As the foremost seal supplier to aerospace, we contribute our outstanding expertise from the initial stages of aircraft development through to final build and on-going aftermarket support. In collaboration with major producers worldwide, we use state of the art design tools, including customer compatible CAD systems and rapid prototyping, to develop sealing configurations, which we prove in a virtual environment, using techniques such as Finite Element Analysis (FEA).

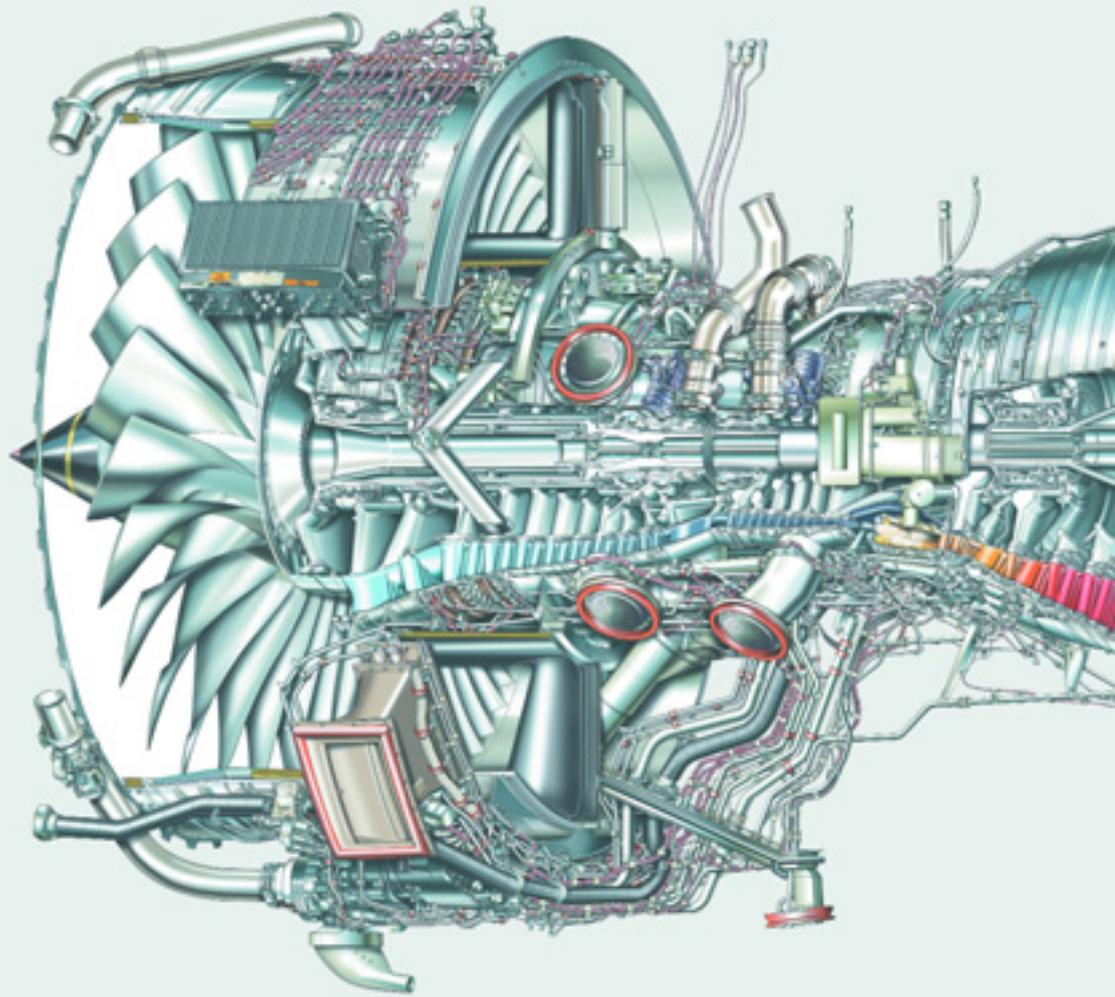
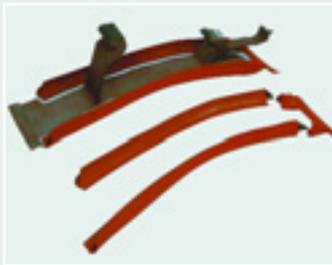
We combine effective supply from our European logistics center with sub-assembly, Direct Line Feed and kitting at our manufacturing units, often in special packaging, to meet strict aerospace and military criteria; all backed by round-the-clock product assistance.



Total service capabilities

Trelleborg Sealing Solutions service reflects and surpasses industry requirements with facilities such as Direct Line Feed and kitting aiding our customers in efficient aircraft build and maintenance.

High performance sealing technology



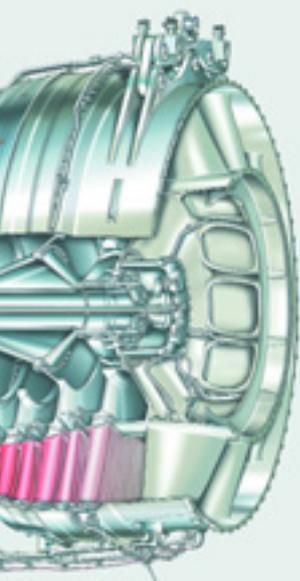
Advanced elastomers

Ideal for applications with temperatures up to 260 °C (500 °F), the Turel® range of aerospace elastomers are engineered for maximum temperature performance and chemical resistance.



Isolast® Perfluoroelastomer

The ultimate in elastomer sealing, these almost universally chemically compatible materials operate effectively in aggressive aerospace applications in extreme temperatures up to 325 °C (617 °F).



Breadth of range

Due to the breadth of range offered by Trelleborg Sealing Solutions, designers can specify seals that meet the challenge of balancing cost effectiveness with performance on all aeroengine applications, including fan blade annulus fillers, fan cowl and thrust reverser doors, heat exchangers, drive shafts, air intakes, fairings and coupling systems.

Turel® elastomer range

For static applications, O-Rings are available to meet all internationally recognized size standards, custom dimensions and moulded designs, in our Turel® range of high specification compounds, specifically developed for the aerospace industry, which includes Nitriles, EPDMs, Fluorosilicones and Fluorocarbons. These innovative compounds help meet our aims of offering extended service life and exceptional sealing integrity, demonstrating outstanding chemical resistance and operating from an extreme low temperature of -54 °C (-65 °F), up to 260 °C (500 °F).

Isolast® Perfluoroelastomer

Isolast® offers the ultimate in elastomer sealing, whether supplied as O-Rings, custom moulded parts or bonded to metal. Advanced Perfluoroelastomers (FFKM), Isolast® compounds are virtually inert and demonstrate almost universal chemical compatibility. Specialist grades, which operate at continuous temperatures up to 325 °C (617 °F), are ideal for situations when seals encounter elevated temperatures in conjunction with aggressive media, having proven superior capabilities in comparative testing within high temperature lubrication systems in aeroengines.

Inventive Turcon® Designs

Trelleborg Sealing Solutions was the first company to realise the huge potential of PTFE in aerospace sealing applications and pioneered most of the PTFE sealing technology commonly used today. Our proprietary Turcon® material offers incomparable performance characteristics including friction reduction, abrasion resistance, exceptional chemical compatibility and the power to withstand high pressures and temperature extremes in rotary and linear movement, as well as, static situations. Unique product types specified by the aeroengine designers include AQ Seal®, CX(S) and (D) Seals, Double Delta®, Excluder®, Glyd Ring®, Hatseal®, Kantseal, Plus Seal, Roto Glyd Ring®, Stepseal®, T-Seal, VL-Seal™ and Wedgpak®.



Unique Turcon® products

Trelleborg Sealing Solutions was the first company to realise the huge potential of PTFE in aerospace sealing applications and pioneered most of the PTFE sealing technology commonly used today.

Innovative engineered sealing options



Variseal® extreme sealing

Field-proven in extreme applications, whether the Variseal® is only 3 mm or 2.5 m (1/8th inch or 8 feet) in diameter, it is capable of providing the same level of system integrity.



Wills Rings® for the optimum solution
Wills Rings® in O or C cross sections can operate within continuous temperatures from cryogenic up to 850 °C (1560 °F) and are ideal for fire safe sealing.



Unique products and materials

Utilizing the latest technologies in metal and Turcon® PTFE sealing, inventive products and materials allow Trelleborg Sealing Solutions to fulfill the specific performance requirements of the aeroengine designer with cost efficient options.

Variseal®

An extremely important product to the aerospace industry, Variseal® spring energized Turcon® PTFE seals are field-proven in extreme aircraft operating conditions, having been used in the most demanding of aeroengine applications. Designed to fit in existing O-Ring grooves, with the correct selection of Turcon® compound, appropriate spring material and profile, Variseal® can provide the highest level of system integrity, even in the most aggressive and corrosive of chemical media at high temperatures up to 300°C (570°F) and pressures of 30,000 psi (2,000 bar). For static and dynamic applications at high speeds, they demonstrate low friction, leading to extended service life.

Wills Rings®

Wills Rings® are the original metal seals, providing the most effective option for static sealing on connectors, flanges and plates for gases and liquids. They exhibit the ultimate in reliability under extremes of temperature, ranging from cryogenic to 850°C (1560°F) and severe pressures up to 150,000 psi (10,000 bar), often being utilized when fire safe sealing is required. Wills Rings® are available in a variety of metals, O or C cross section with either pressure filled or system pressure activation.

Varilip® PDR

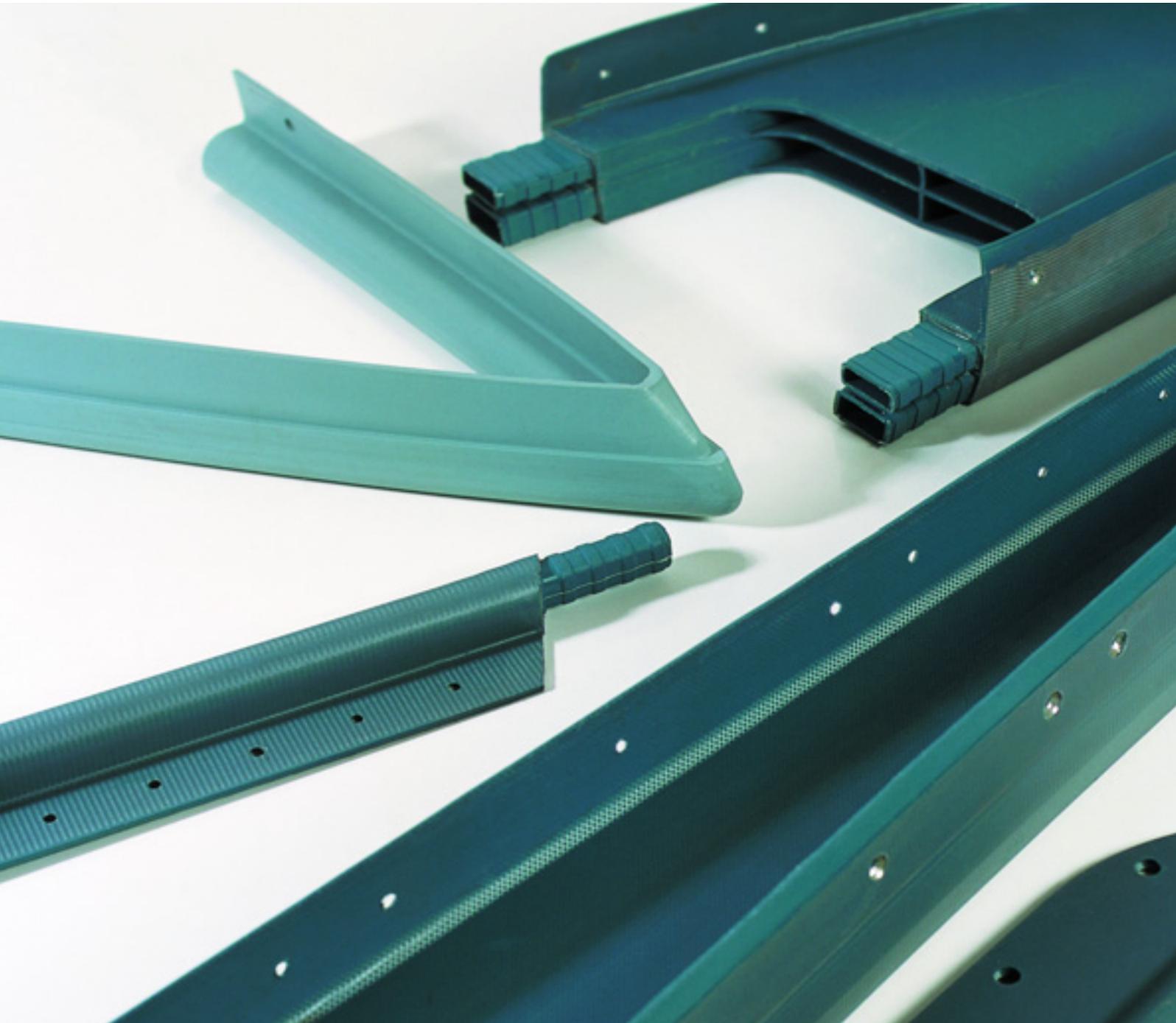
At the leading edge of sealing developments, Trelleborg Sealing Solutions provides a broad range of custom and standard options based on engineered plastic and metal technologies. Outstanding, high performance Varilip® PDR rotary shaft seals, comprise a Turcon® PTFE sealing lip retained in a crimped or clamped metal case. These single or multi-lip seals are ideal for use in aeroengine applications where, custom designed for each application, they demonstrate low friction and wear characteristics and offer almost universal chemical compatibility over an extremely wide temperature range.



Varilip® PDR rotary shaft seal

At the leading edge of sealing developments, TSS provides rotary shaft seals in custom and standard options based on engineered plastic and metal technologies.

Technologies matching customer needs



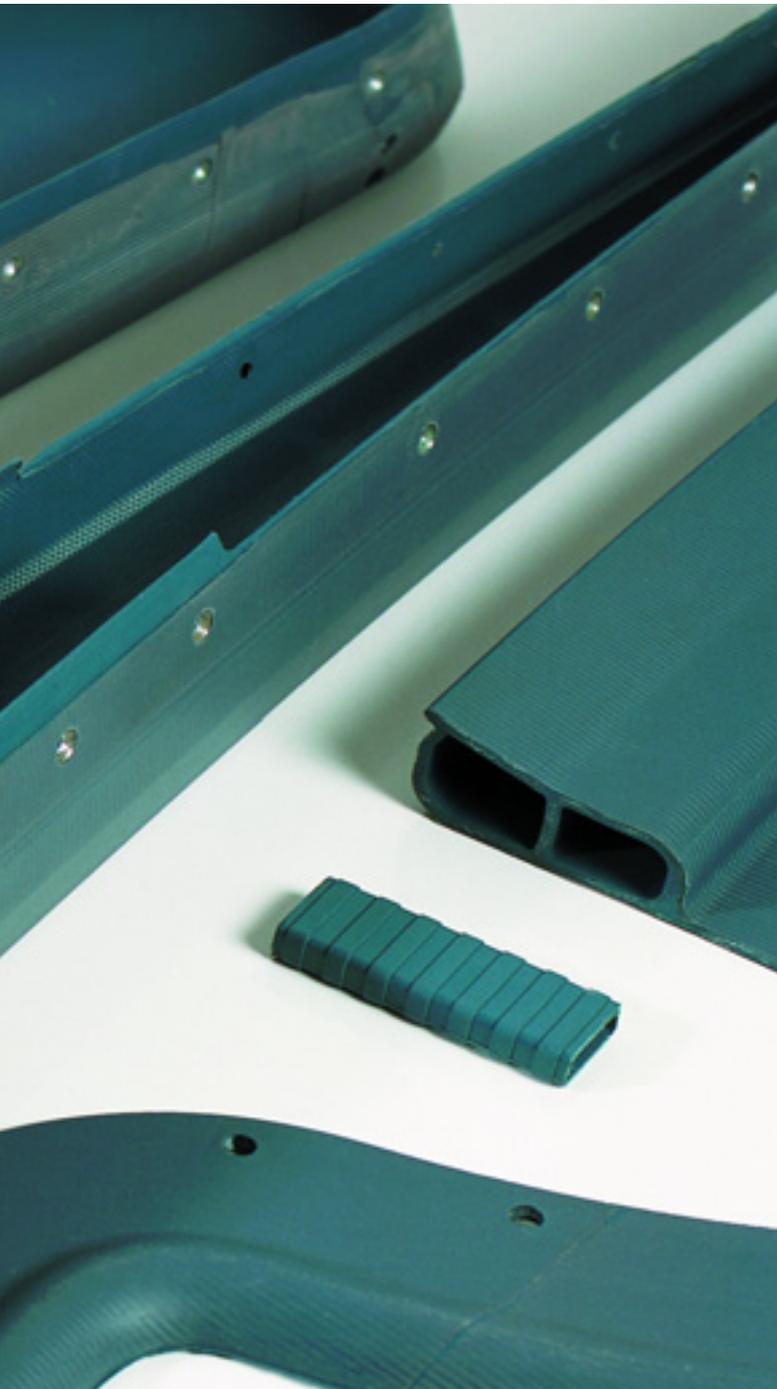
Airframes to exacting standards

Manufactured to standard or custom profiles, each airframe seal is hand-fabricated with absolute attention to detail, ensuring high quality supply whatever their application.



Unique inflatable technology

Inflatable seals, built up layer by layer in individual 3-dimensional tools, the full size of the sealing profile, are bonded by heating the complete tool and testing at line-side.



Airframe solutions

Manufactured to standard or custom profiles, each airframe seal is hand-fabricated, with absolute attention to detail and quality assured through 100% inspection. Focusing on aerodynamic efficiency, they offer reliability in service, along with efficiency in assembly and maintenance. The use of advanced FEA combined with product qualification programs, including extensive testing and verification, leads to maximum service life. Trelleborg Sealing Solutions airframe seals, often from existing tooling are used within the engine, structural gaps, wings, doors, hatches and windows, to meet customer needs throughout the aircraft.

Complex geometries

Trelleborg Sealing Solutions works with major airframe manufacturers to produce advanced inflatable seals from 3-D models, which are translated into tooling the full size of the sealing profile, replicating the increasingly complex geometries of airframe sections of, for instance, cockpits or doors. Such tools incorporate heating and pressurisation systems for precise manufacturing control and with testing at line-side, zero defect quality is the objective.

Effective fire barrier seals

Through material research, Trelleborg Sealing Solutions has developed an advanced composite fire seal, compliant with international standard ISO 2685. This specifies that fire barrier seals must withstand flame temperatures of 1100°C (2012°F) for 15 minutes. In fact, tests have shown that these seals are capable of exceeding this requirement, some withstanding the temperature for 30 minutes. A patented 'split-seal' option facilitates retrofitting without the need for dismantling other parts of the system.

Developments meeting industry requirements

Trelleborg Sealing Solutions has unrivalled experience within the aerospace industry and this leads to development of innovative products to meet specific requirements. Two examples are rotor blade filler seals, which are sub-assembled to the metal rotor blade and our unique method of coating glass fiber sleeving with PTFE. This provides products to reduce friction on metal clips and cable carriers for critical areas where sheering may occur, such as near to helicopter rotor blades and other areas subject to high vibration.



Superior fire sealing

Trelleborg Sealing Solutions advanced fire seals are proven to exceed international standard ISO 2685, which specifies seals must withstand flame temperatures of 1100°C (2012°F) for 15 minutes.

Development partnerships optimise applications



Miniature Turcon® Variseal®
Whatever their size, Turcon® Variseal® demonstrate the same performance characteristics; superior miniature sealing aiding design of smaller and lighter aerospace components.



Turcon® Varilip® PDR
Examination for leaked media between the two lips of Turcon® Varilip® PDR rotary shaft seal, is a failsafe device to highlight any seal deterioration in a critical application.



Trelleborg Sealing Solutions works with aerospace customers in development partnerships, identifying the best sealing option for specific applications from a broad choice of materials and seal profiles.

Superior miniature sealing

To maximise aeroengine fuel efficiency, components are becoming smaller and lighter and therefore the requirement for miniature sealing is increasing. At only 12 millimeters (1/2 inch), a tiny Turcon® Variseal® proposed for an electrical connection on an engine, demonstrates all the same performance characteristics of larger designs and meeting strict delivery and quality criteria, are supplied in individual blister packs.

Inventive failsafe leak detection

As it offered required resistance to extreme temperatures and chemical media at high speeds, Turcon® Varilip® PDR rotary shaft seal was chosen for a critical aeroengine application. For absolute sealing integrity, a second lip excluded media from the system in the unlikely event of seal leakage passed the first and as a failsafe, examination for leaked media between the two lips highlights any seal deterioration.

Expert solution maximizes fuel efficiency

Through partnerships with aeroengine manufacturers, Trelleborg Sealing Solutions has developed an expertise in the manufacture of annulus filler seals. Custom designed, they incorporate silicone elastomers in conjunction with fabrics and either metallic or carbon composites. The use of these has resulted in competitive advantage, through improved engine efficiency and lower operating costs.

Innovative manufacturing reduces friction

Fuel pipes, helically wrapped around aircraft engines, are subjected to significant friction. Wear was found on these copper fuel pipes caused by the harder metal of the stainless steel clips that held them in place; a potential fire hazard. The solution, to house the clips in Trelleborg Sealing Solutions PTFE glass braided sleeving, effectively reduced friction and wear, extending the life of the fuel pipes.



Annulus filler seals
 Constructed from silicone elastomer with fabric reinforcement, annulus filler seals improve aeroengine fuel efficiency, an important element in reducing overall operating costs.



PTFE coated glass braided sleeving
 A proprietary method of manufacture, PTFE coated glass braided sleeving effectively reduced wear caused by friction of stainless steel clips on the fuel pipes of aircraft engines.

Total - Sealing technology



Extensive test facilities
Strategically positioned materials development laboratories and fully resourced design and application centres, continuously deliver innovative sealing solutions.



Innovative material development
Developing and formulating materials in-house and engaging in on-going programs of development, we are also skilled in the field of applied materials technology.



Total - Sealing technology

Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer a dedicated design and development service for sealing arrangements, from our market leading product and material portfolio; one which has provided solutions that feature in virtually every application conceivable within the aerospace, industrial, and automotive industries.

Global - A worldwide presence

Globally servicing, supporting and supplying our customers, Trelleborg Sealing Solutions has an international network of over 70 facilities worldwide including more than 20 manufacturing sites, 8 strategically positioned materials and development laboratories and fully resourced design and application centers. Facilities are certified to ISO 9001:2000, with many manufacturing sites also working to QS9000 and VDA 6.1.

Expertise - Our proven capabilities

With over 50-years experience in development and application of sealing systems, Trelleborg Sealing Solutions engineering personnel contribute their knowledge of this specialized technology directly to customers. This includes project management of design, prototyping, production, test and installation using state-of-the-art design tools, fully customer-compatible CAD systems and leading edge Finite Element Analysis (FEA).

Innovation - In materials and supply

Developing and formulating our materials in-house, Trelleborg Sealing Solutions has acquired significant skills in the field of applied materials technology. Working in close cooperation with worldwide partners, we are engaged in on-going programs of material and product development, utilizing latest technologies and the resource of our material database, which includes over 2,000 proprietary compounds.

Commitment - To customers' needs long-term

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions. Trelleborg Sealing Solutions develops, manufactures and markets safety-critical polymer-based precision seals and associated systems. We are one of the world's foremost experts in polymer sealing technology.



Superior logistics support

We invested in an advanced logistical support system, which effectively delivers products to our customers worldwide from central warehouses in Europe and the Americas.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
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		and all other countries in Asia	+65 6 577 1778

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Aflas® XploR WTT80

Explosive Decompression Resistant Materials



An ideal EDR choice



Your Partner for Sealing Technology

Explosive Decompression is a major concern to the oil and gas industry. It occurs when applied system pressure is released, causing absorbed gas to expand, potentially damaging elastomer seals.

Trelleborg Sealing Solutions has focused on this issue and presents the XploR range, an entire family of advanced elastomers especially developed for oil and gas applications. The portfolio includes compounds in HNBR, FKM, Aflas® and Isolast® Perfluoroelastomer, each of which demonstrates best-in-class Explosive Decompression Resistance (EDR) for its material type.

In independent tests Aflas® XploR WTT80 was able to satisfy the requirements of Norsok M-710 Annex B, Rapid Gas Decompression, when tested with a back-up ring.

If the composition of the well or conditions of the application are known, Aflas® XploR WTT80 may prove the optimum and most cost-effective material for your application. For further information on selecting the right compound and advice on seal specification for your individual application, consult your local Trelleborg Sealing Solutions marketing company. Find contact details at www.tss.trelleborg.com.

Features & benefits:

- Unrivalled Explosive Decompression Resistance (EDR) within its material type
- Operating temperature from -10°C/14°F to 200°C/392°F
- Good steam resistance
- Exceptional mechanical performance
- Low long-term compression set
- Good chemical compatibility
- Long life in aggressive, including hydrocarbon and aqueous media, common within oil & gas applications
- High modulus, high strength
- Material compliant to Norsok M-710 Annex B

Applications:

- Gas lift equipment
- Tubing hangers
- Valves
- Wellhead equipment
- Riser equipment
- Downhole drilling equipment

XploR is available in all standard international O-Ring sizes and cross-sections along with custom-engineered solutions and specially designed seal profiles.

Explosive Decompression Facts

Inherently, elastomer seals contain voids. Gas or gas mixtures in contact with elastomer surfaces are absorbed and will saturate elastomer seals. At high-pressure this absorbed gas is in a compressed state. When external pressure is reduced, either rapidly or over a relatively short period of time, the compressed gas nucleates at the voids, expanding within the elastomer. The voids inflate leading to high tensile stresses or strains in the void walls. Depending on the strength and hardness of the elastomer, this can cause the elastomer to break or crack.

No elastomer can be completely explosive decompression resistant; however, the XploR range demonstrates unrivalled EDR inline with limits set by NORSOK M-CR-710 Rev. 2 2001 "Qualification of Non-metallic Sealing Materials and Manufacturers."

Compound No.:		WTT80		
Elastomer base:	DIN ISO 1629	FEPM		
Hardness:	DIN 53 505	92 +/- 5 IRHD		
Color:		black		
Specific gravity:		DIN EN ISO 1183-1	g/cm ³	1.58 ± 0.02
Tensile strength:		DIN 53 504	MPa N/mm ² psi	22.1 3,200
Elongation at break:		DIN 53 504	%	201
Modulus 100%:		DIN 53 504	MPa N/mm ² psi	10.9 1,580
TR point:		DIN 53 545	°C °F	+1 +34
Service temperature:			°C °F	-10 to 200 14 to 392
Specification:				Norsok M-710 Annex B

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

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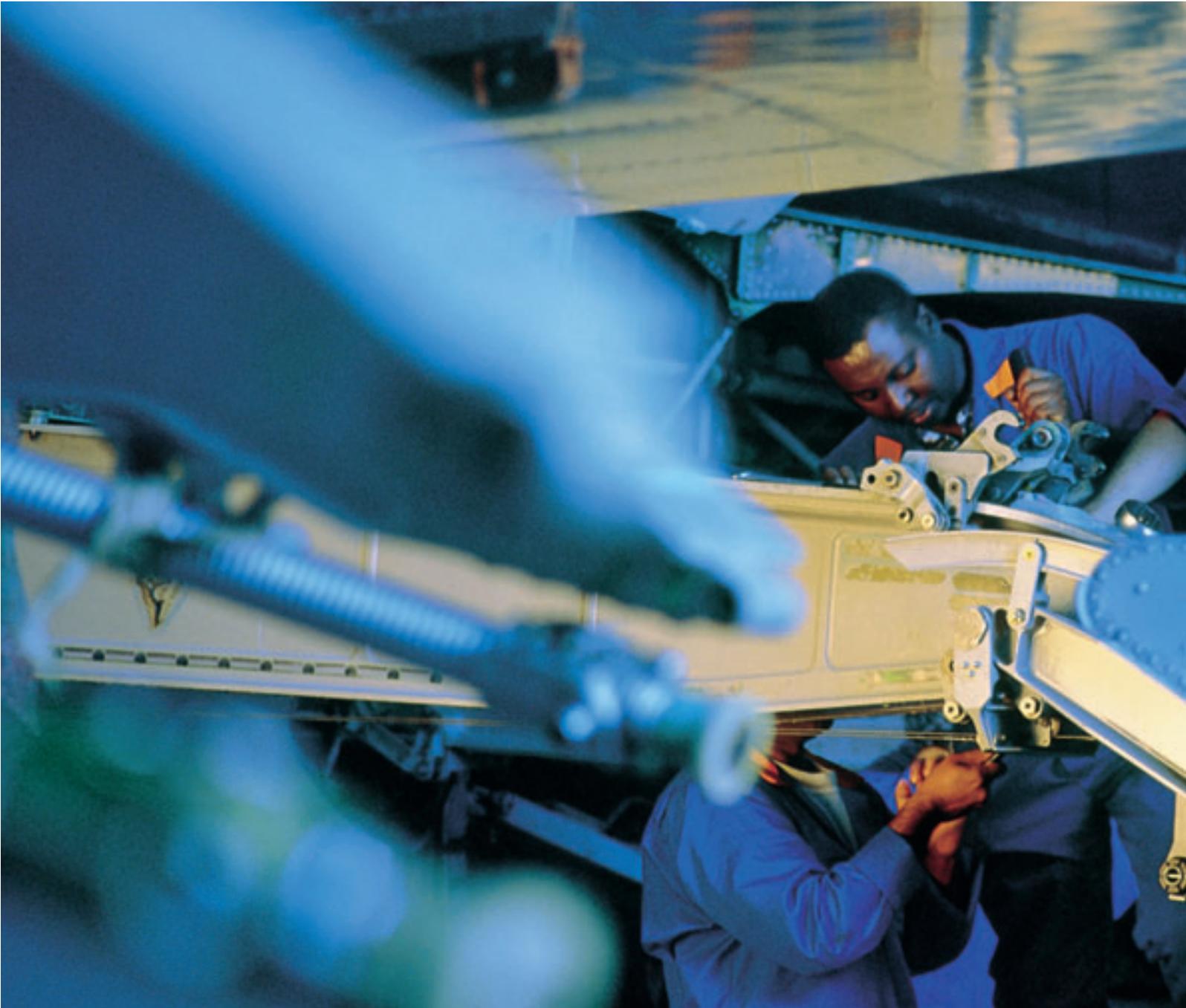


Airframe sealing profiles



Your Partner for Sealing Technology

Airframe sealing profiles



Demanding aeroengine requirements
The aeroengine designer cannot risk component failure and major manufacturers rely on the experience of Trelleborg Sealing Solutions to ensure sealing integrity over extended aircraft service life.



Specialized airframe products
Airframe seals are not only used within the engine compartment but throughout the aircraft body, on wings, windows and doors, where they contribute to aerodynamic efficiency.



Trelleborg Sealing Solutions is proud to bring together the unique capabilities of three world-leading brands with over 50 years of experience in aircraft sealing - Woodville Polymers, Specialized Elastomers, and Chase-Walton Elastomers.

Manufactured to standard or custom profiles, each airframe seal is hand-fabricated with absolute attention to detail and quality assured through 100% inspection. Focusing on aerodynamic efficiency, they offer reliability in service, along with efficiency in assembly and maintenance. The use of advanced FEA combined with product qualification programs, including extensive testing and verification, leads to maximum service life.

Trelleborg Sealing Solutions airframe seals, from existing tooling where possible, are used within the engine, structural gaps, wings, doors, hatches, and windows to meet customer needs throughout the aircraft. Trelleborg Sealing Solutions design capabilities can also address applications for wing and moving surfaces including complex aerodynamic shrouds for hydraulic jacks, extrusions and fabricated seals for doors and hatches, and interior couplings. Complex and even inflatable geometries can be developed for specific applications.

Developing and formulating our materials in house, Trelleborg Sealing Solutions has acquired significant skills in the field of applied materials technology. Through materials research, Trelleborg Sealing Solutions has developed an advanced composite fire seal that is compliant with international standard ISO 2685, withstanding flame temperatures of +2012 °F / +1100 °C for 15 minutes. With over 2,000 proprietary compounds, our Turel elastomers for aerospace applications are currently available in nitrile, silicone, and fluorosilicone grades. Parts are available as either homogenous or fabric-reinforced. Trelleborg Sealing Solutions always recommends specific customer testing in order to verify performance of any sealing configuration or material.

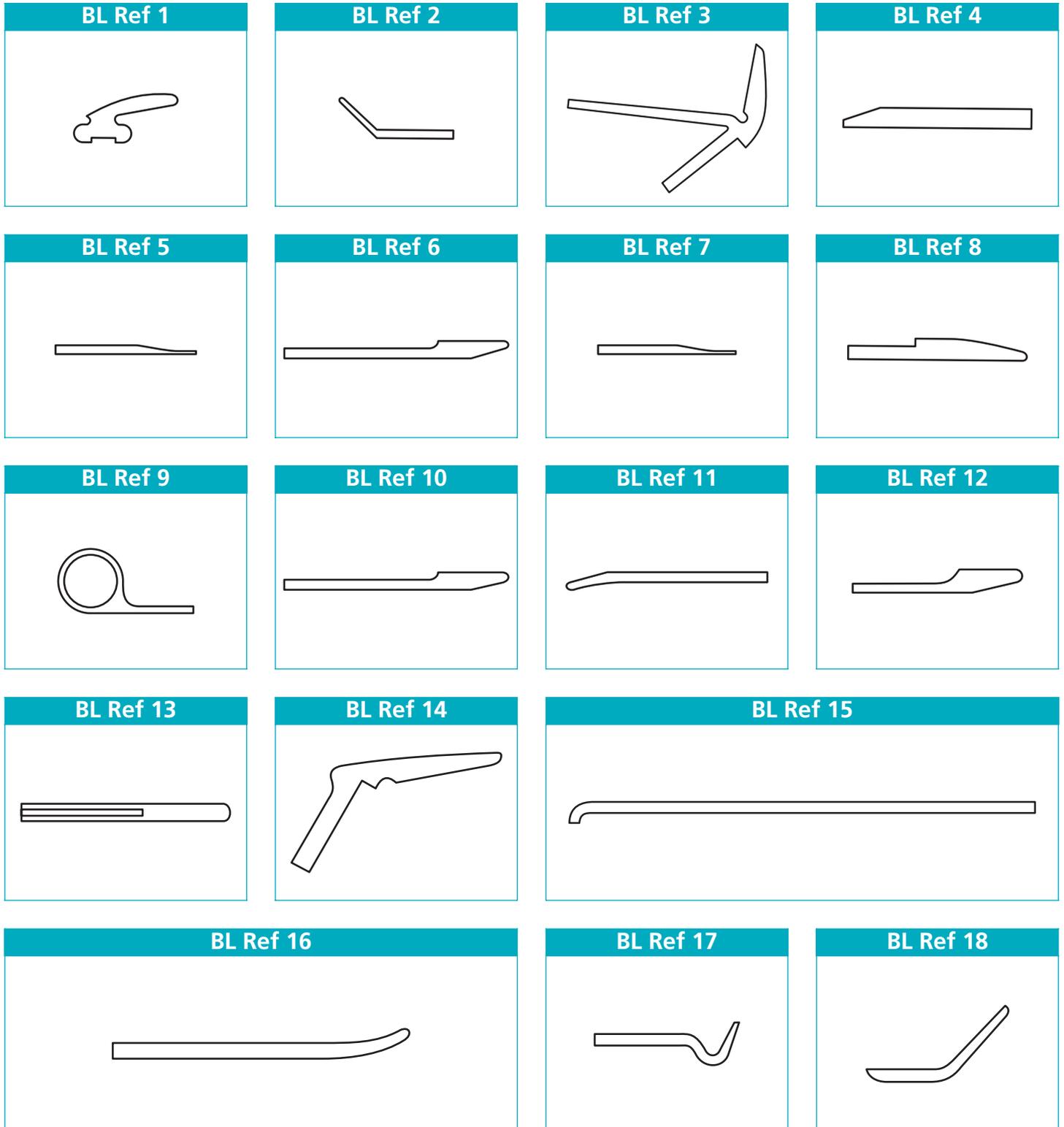
Trelleborg Sealing Solutions manufacturing sites are strategically located to provide global coverage while delivering cost effective sealing solutions and maintaining the highest standards of international airworthiness, quality control, and meeting the latest environmental legislation. Manufacturing at the following four locations:

- Trelleborg Sealing Solutions Cadley Hill, United Kingdom
- Trelleborg Sealing Solutions Condé, France
- Trelleborg Sealing Solutions Hudson, United States
- Trelleborg Sealing Solutions Shanghai, China



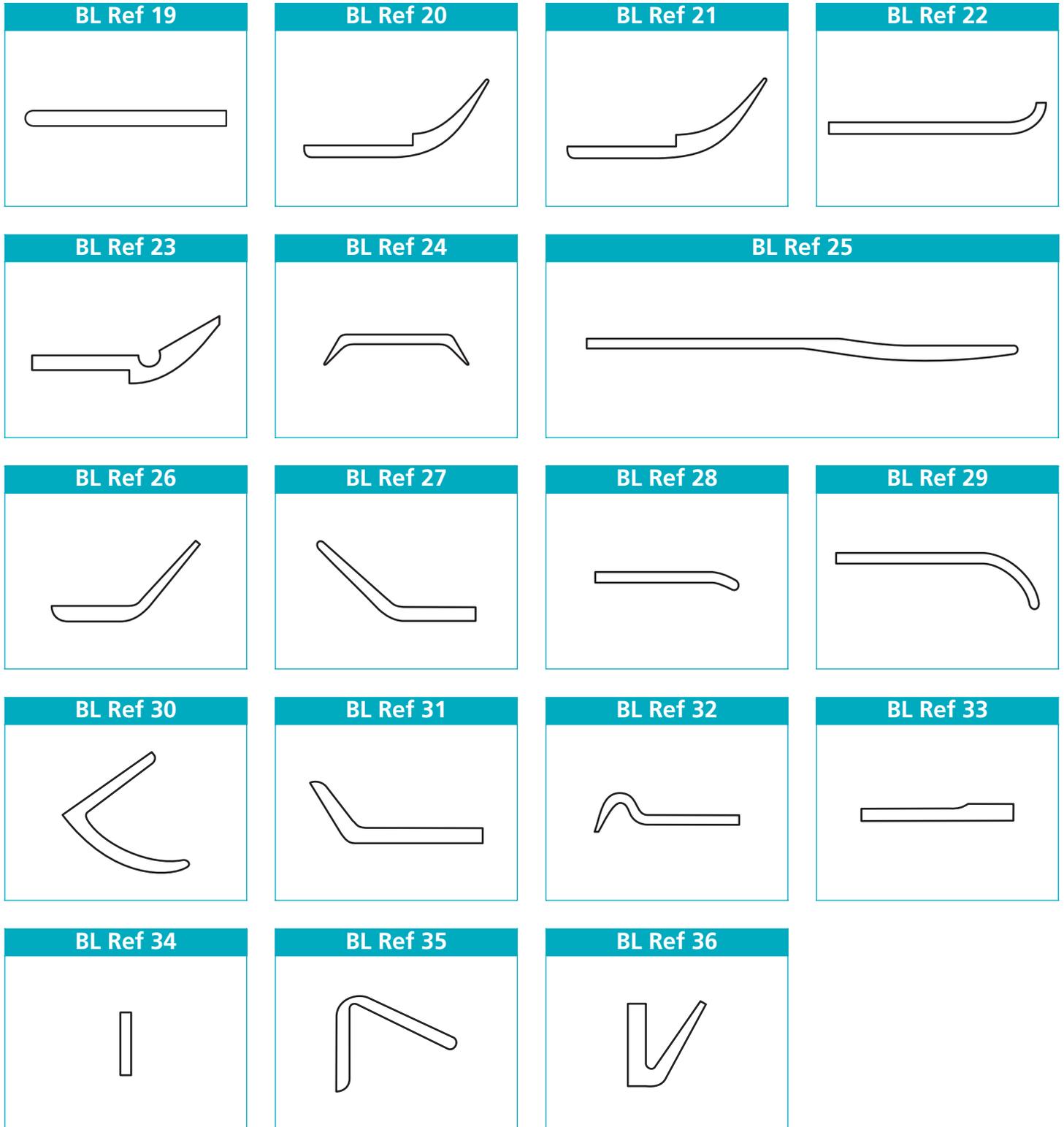
Innovative inflatable sealing
Trelleborg Sealing Solutions inflatable seals are proven to successfully perform in challenging safety-critical cockpit applications, individually designed and manufactured for numerous models of fighter jets.

Blade / Leaf Seals



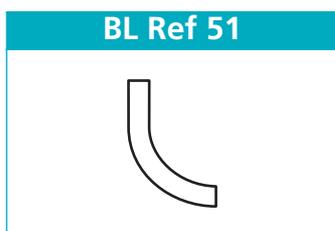
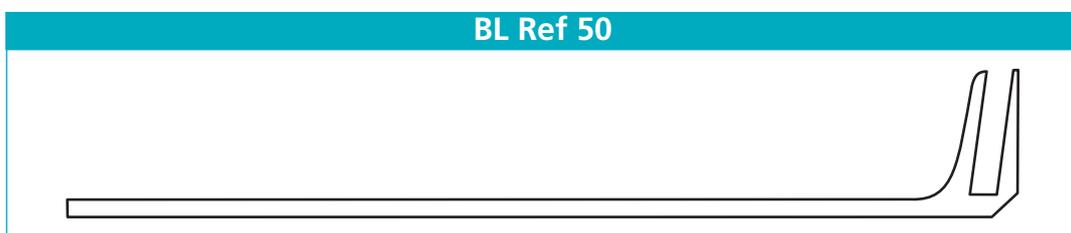
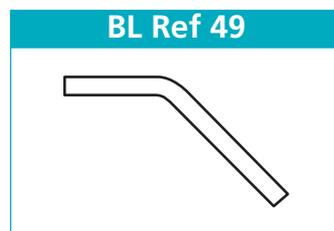
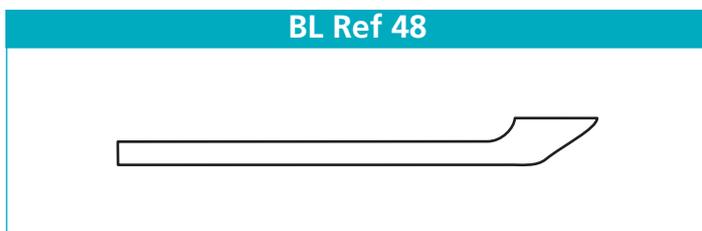
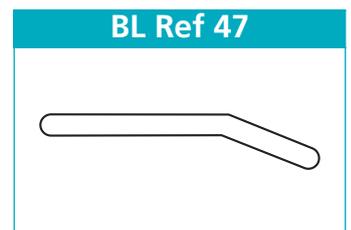
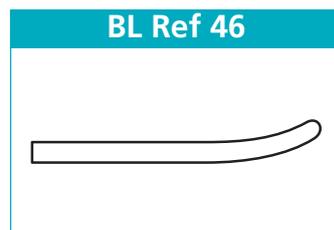
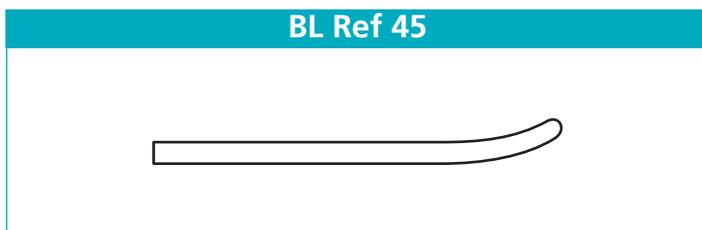
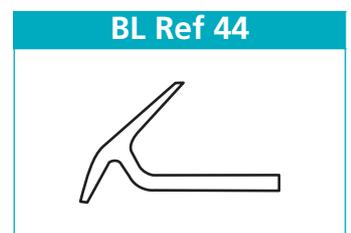
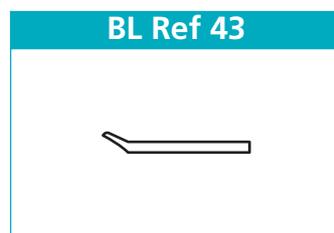
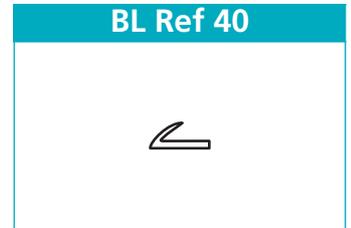
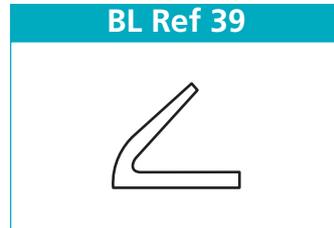
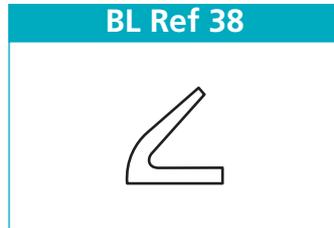
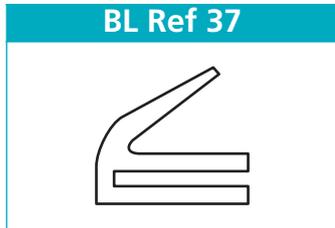
This brochure is intended to show the Trelleborg Sealing Solutions range of airframe seals. This material should not be used as a design guide. For specific information about the right seal for your application, please contact your local Trelleborg Sealing Solutions representative.

Blade / Leaf Seals



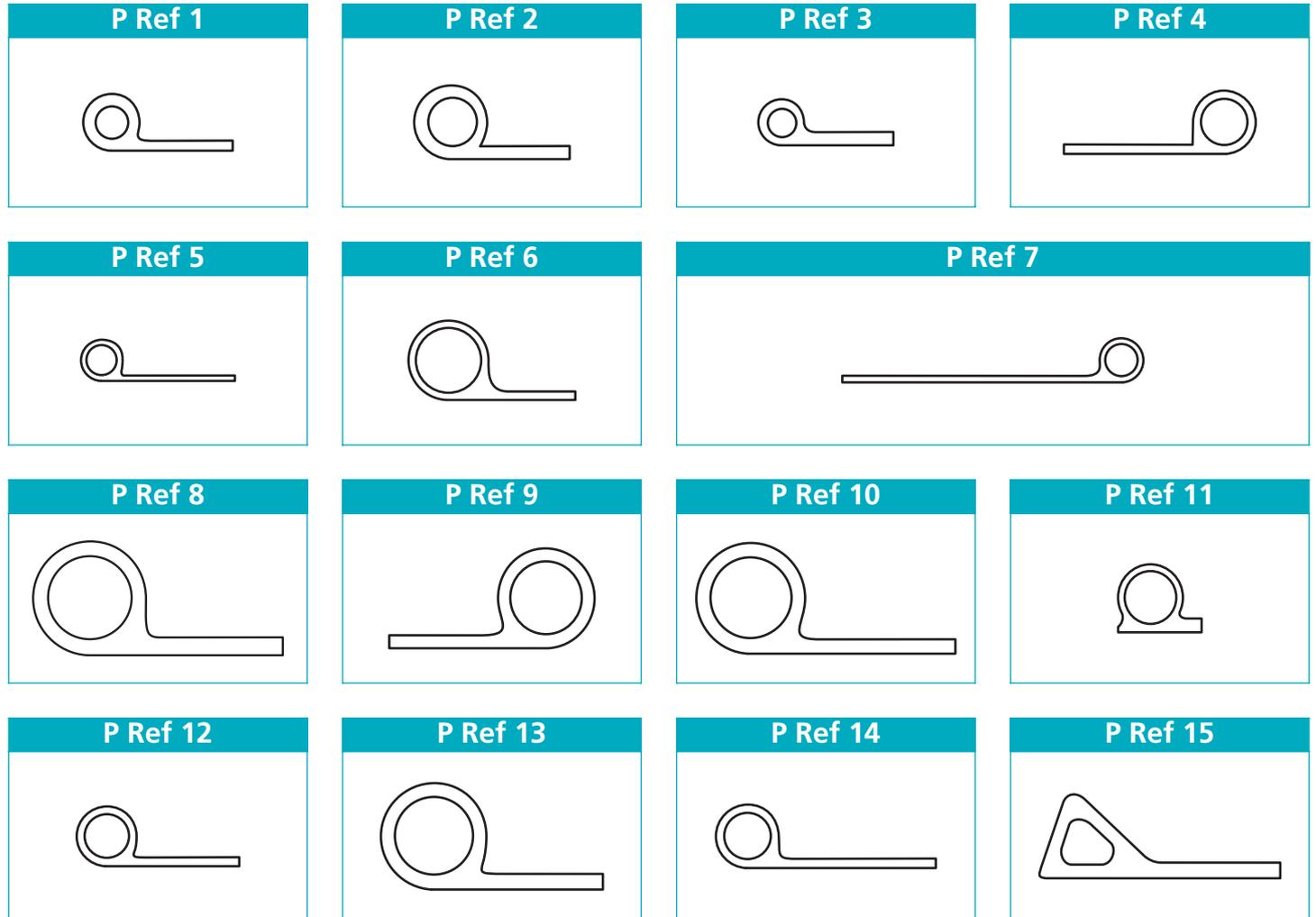
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Blade / Leaf Seals



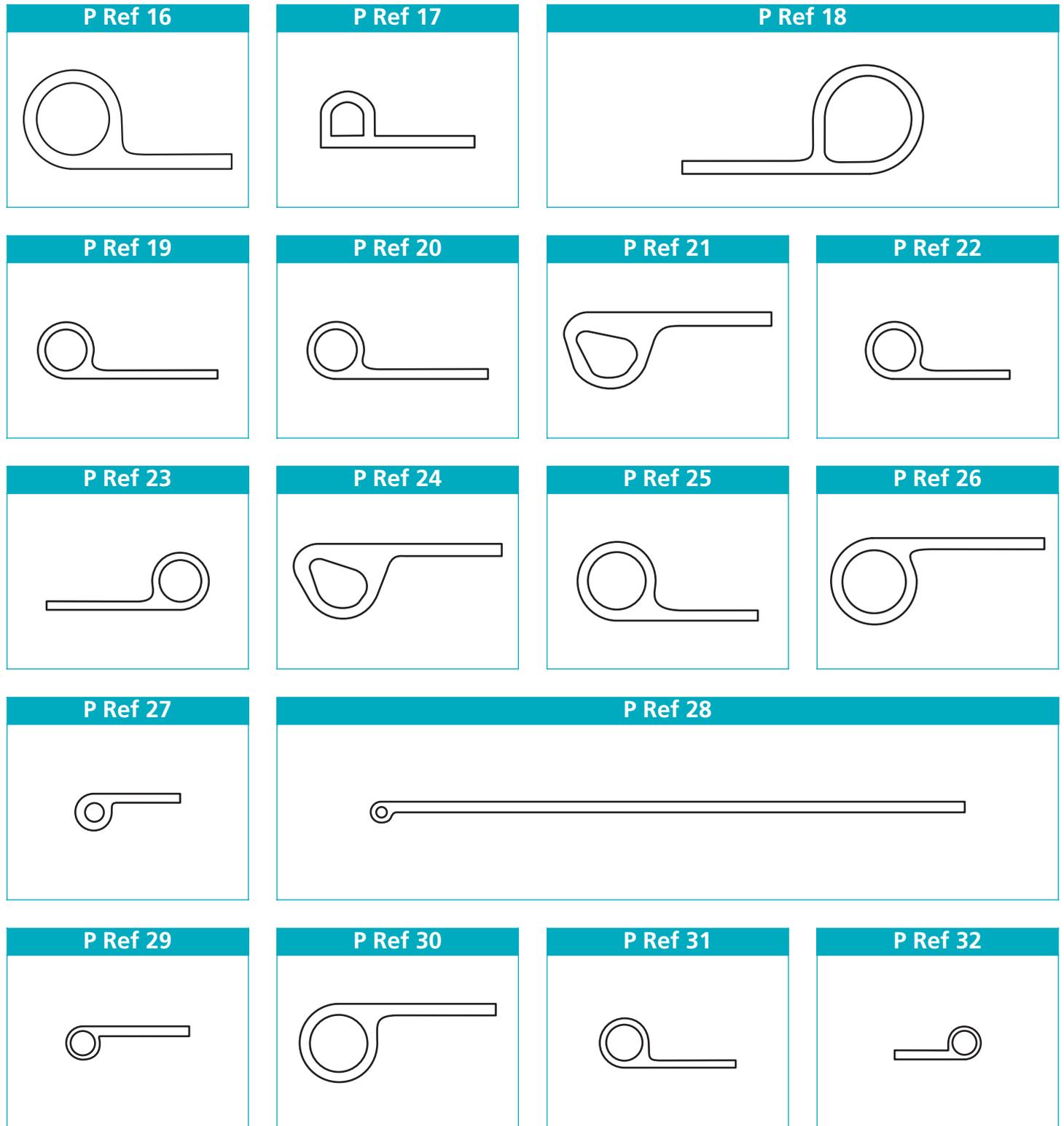
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P-Seals



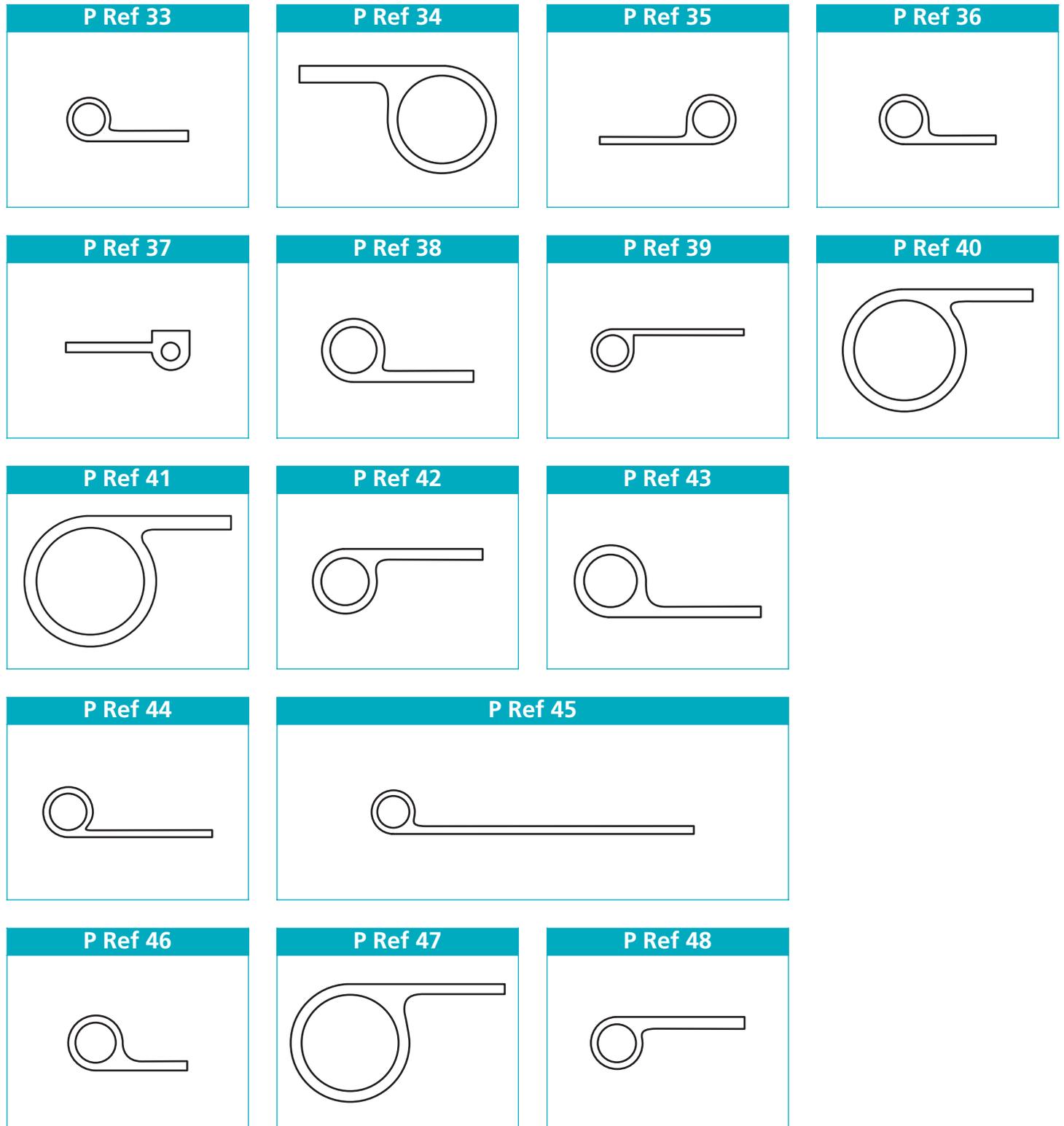
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P-Seals



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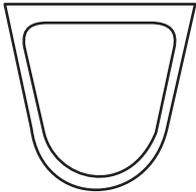
P-Seals



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D-Seals

D Ref 1



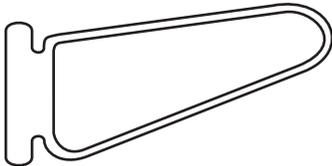
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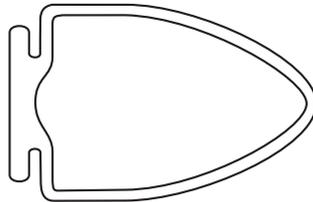
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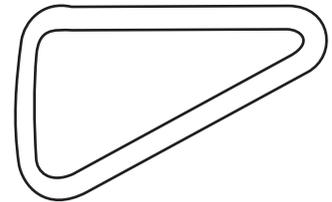
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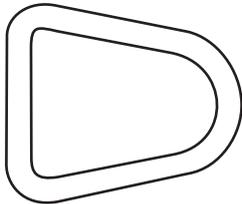
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D Ref 6



D Ref 7



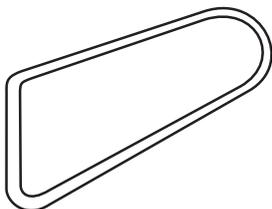
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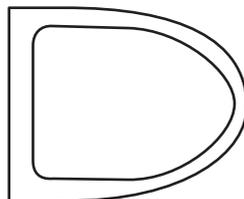
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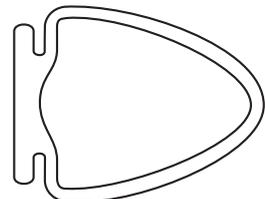
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D Ref 11



D Ref 12



D Ref 13



D Ref 14



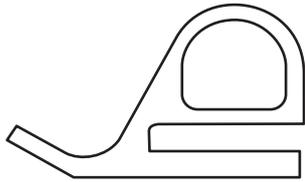
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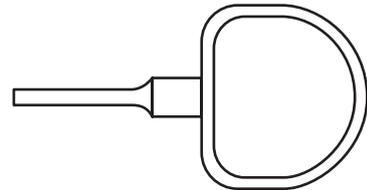
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D-Seals

D Ref 16



D Ref 17



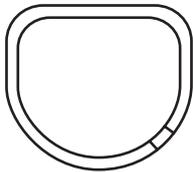
D Ref 18



D Ref 19



D Ref 20



D Ref 21



D Ref 22



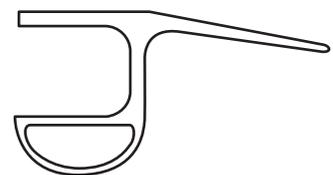
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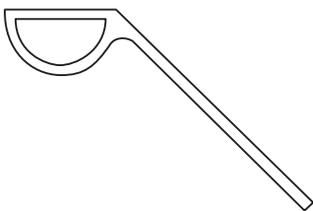
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D Ref 26



D Ref 27

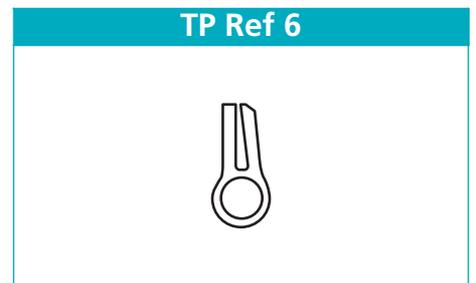
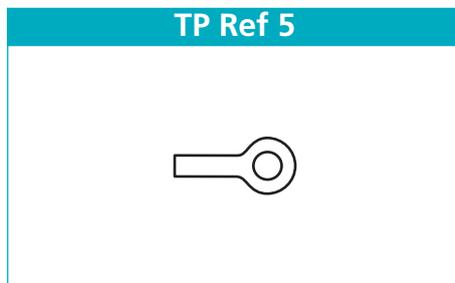
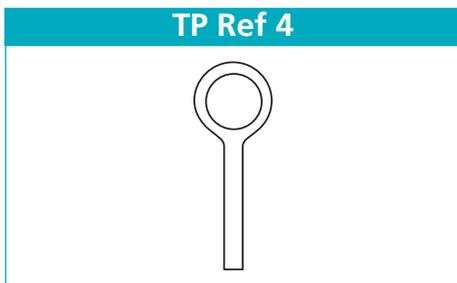
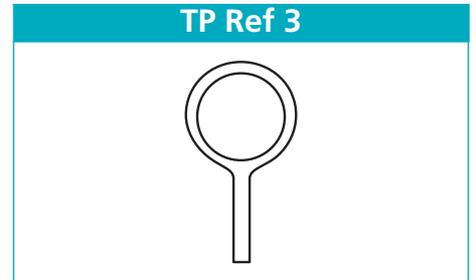
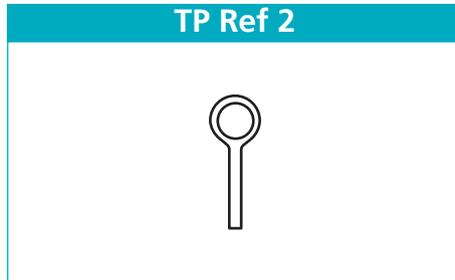
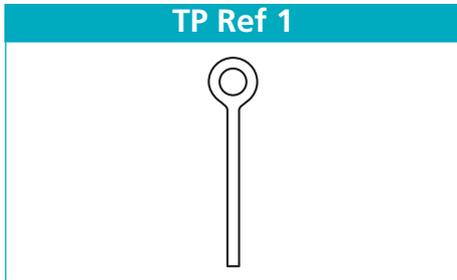


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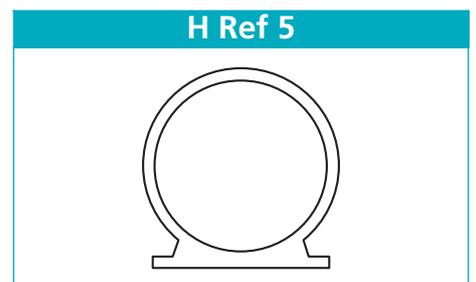
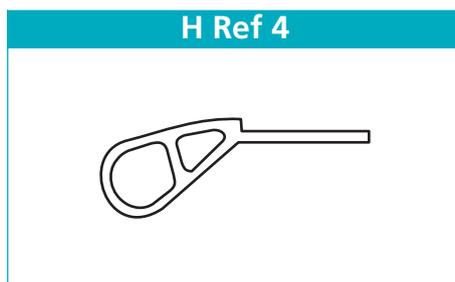
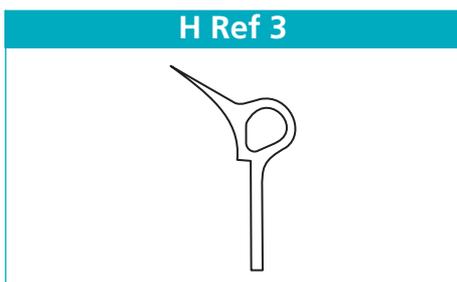
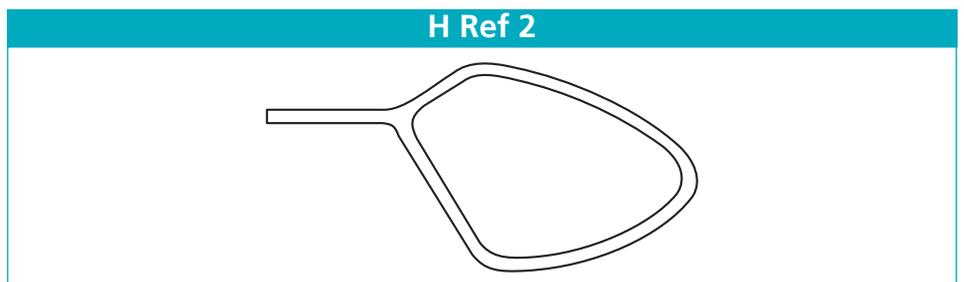
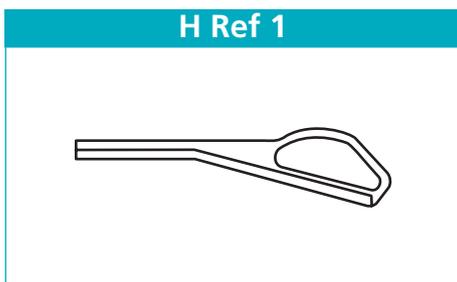


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Tadpole Seals



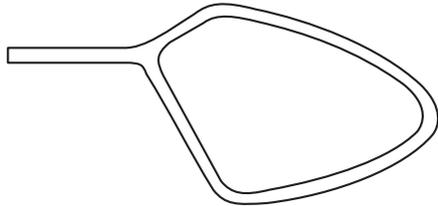
Miscellaneous Hollow Seals



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Miscellaneous Hollow Seals

H Ref 6



H Ref 7



H Ref 8



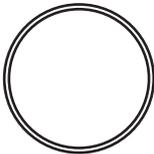
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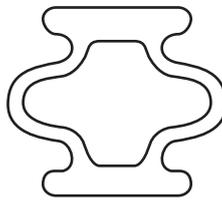
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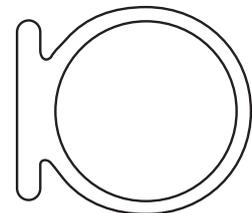
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H Ref 12



H Ref 13



H Ref 14



H Ref 15



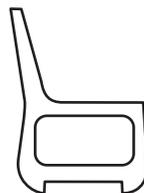
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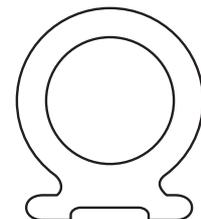
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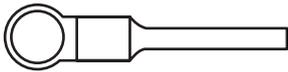
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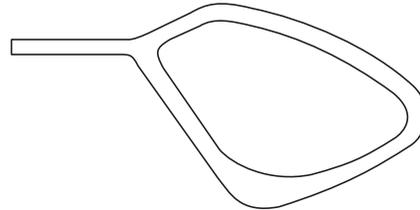
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Miscellaneous Hollow Seals

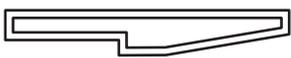
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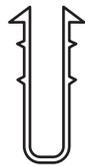
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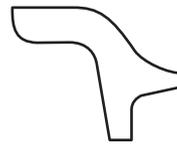
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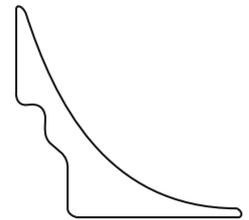
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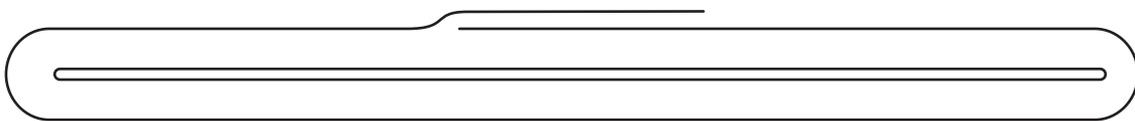
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H Ref 27



H Ref 28



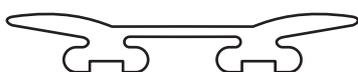
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H Ref 30



H Ref 31



H Ref 32

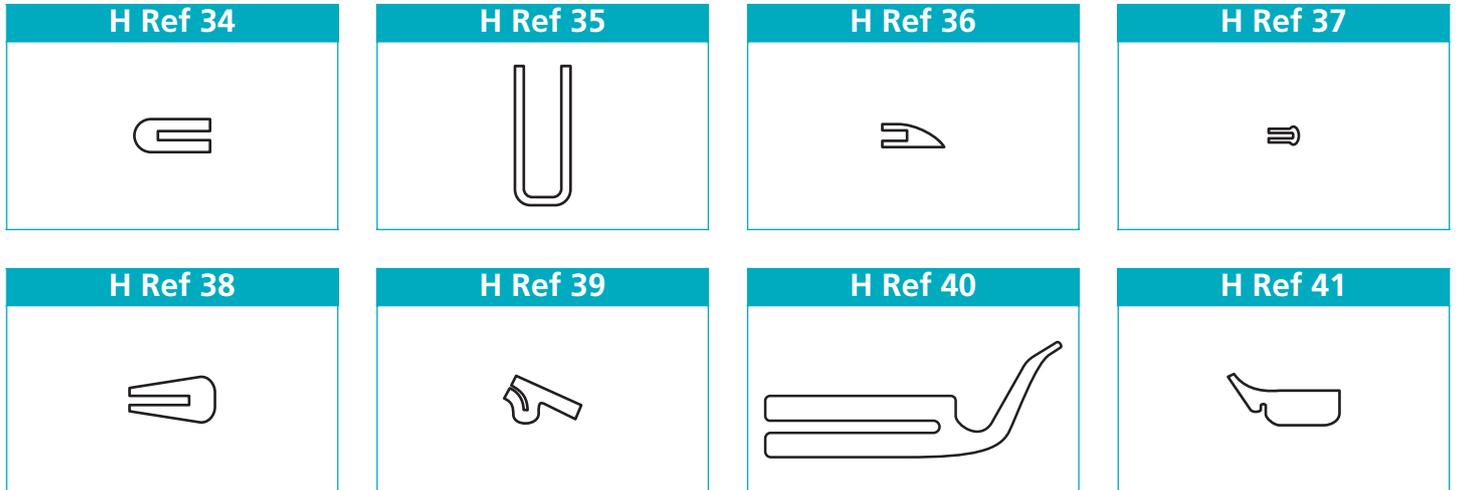


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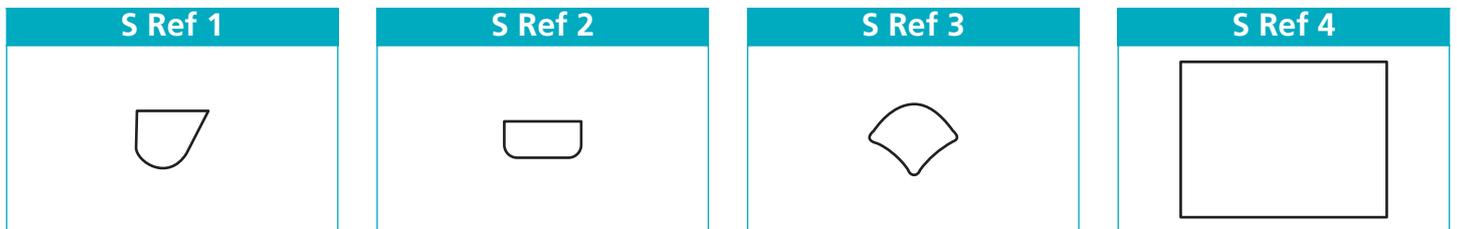


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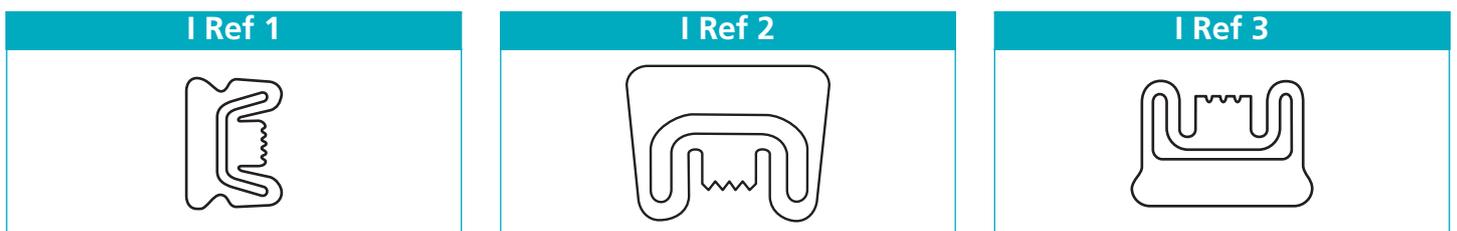
Miscellaneous Hollow Seals



Miscellaneous Solid Seals



Inflatable Seals



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Contact your local marketing company for further information:

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BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
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CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
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FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
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		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

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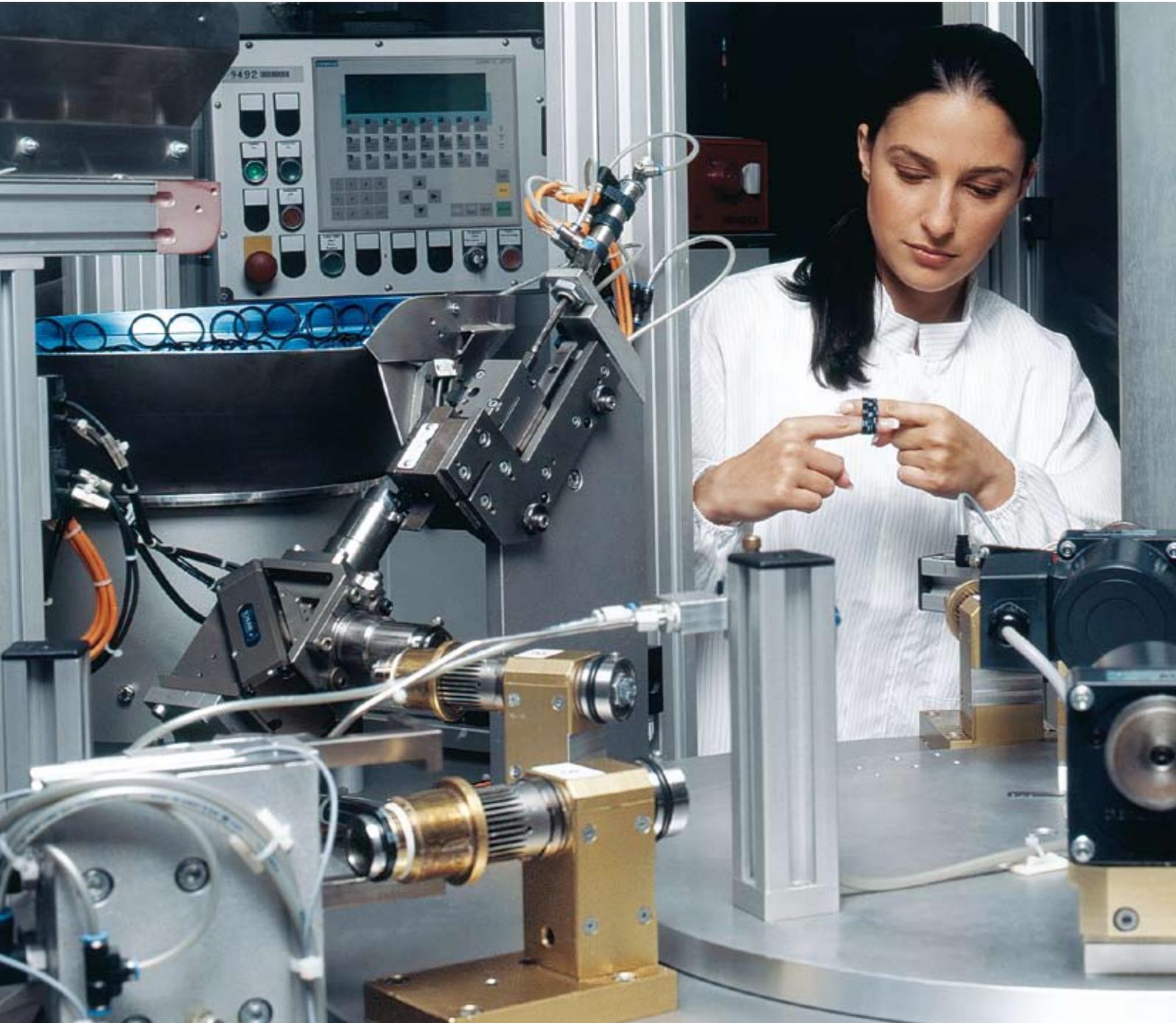


Automotive sealing systems



Your Partner for Sealing Technology

Optimum automotive sealing solutions



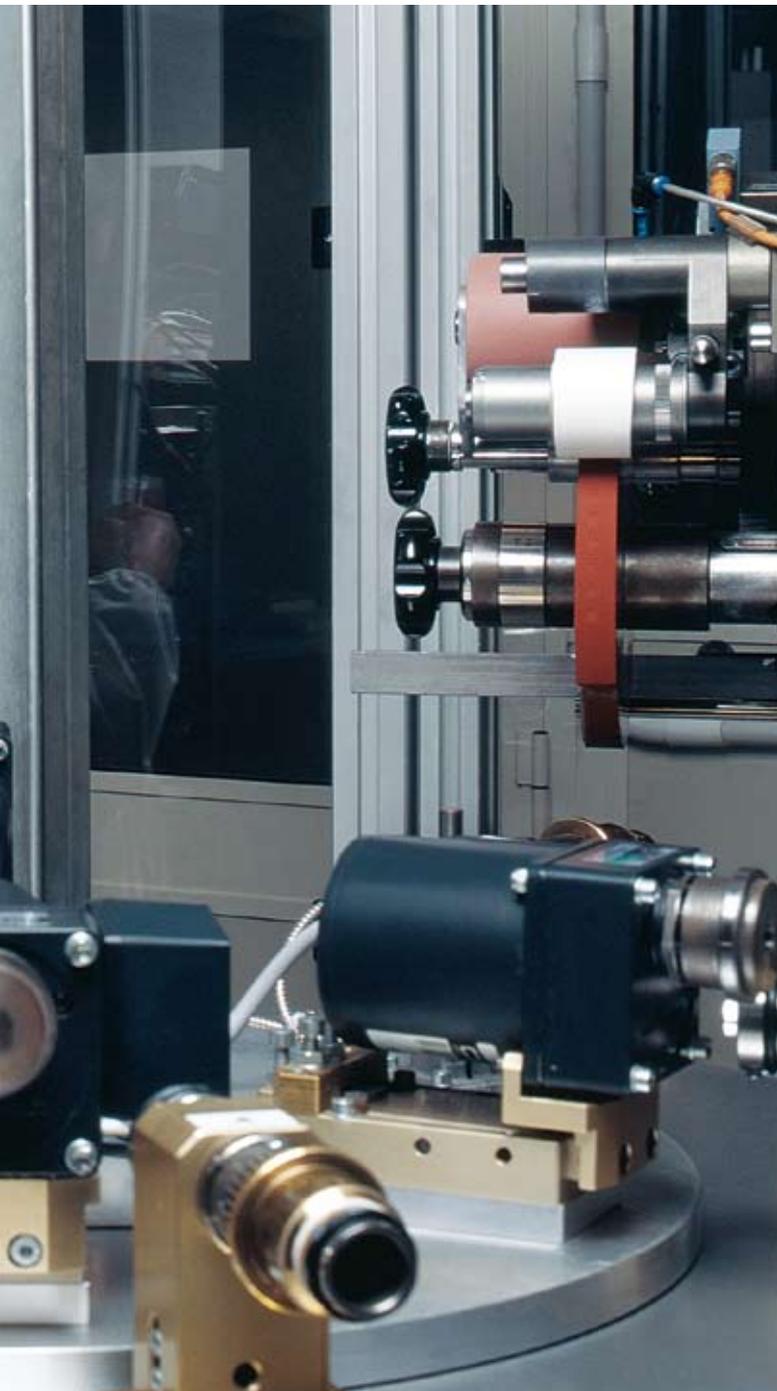
Engineering partnerships

Safety critical vehicle systems, such as fuelling, braking and steering rely upon sealing solutions of the highest integrity, engineered in partnership with Trelleborg Sealing Solutions.



Offering long service life

Involved in car and truck seal development for over 50 years, sealing configurations from Trelleborg Sealing Solutions are maximizing service life on most vehicle models on the road.



Reliable sealing integrity

Whatever the application, whether involving a custom design or a standard O-Ring, Trelleborg Sealing Solutions works with customers to offer the optimum seal arrangement.

Trelleborg Sealing Solutions works with automotive customers in development partnerships to satisfy the needs of today while contributing to the development of vehicles for the future. Our sealing solutions are featured on every major system, including fuel systems, emission controls, air induction systems, ride control, air conditioning, engine cooling, steering and braking systems.

Our mission

Trelleborg Sealing Solutions will be the leading global partner for our customers in selected automotive applications by providing high-performance sealing solutions with excellent quality and service.

An automotive sealing pioneer

Trelleborg Sealing Solutions has been involved in car and truck seal development for over 50 years and is a major sealing supplier to automotive manufacturers. Trelleborg Sealing Solutions can meet the needs of this growing and changing industry by efficiently supplying cost-effective, innovative solutions that give the highest sealing integrity.

Meeting the demanding sealing challenge

Seals must stand up to extremes of temperature and pressure, sometimes operate in partial vacuum conditions and withstand possible exposure to the elements. Not only static but moving parts must be sealed, often at high rotational speeds, requiring low friction options. Chemical compatibility of seal materials is a key issue, as components are in contact with a wide range of media that can deteriorate seals, reducing service life.

Specifying the best sealing configuration

Whether a seal solution involves a custom design or a standard O-Ring, as a principal supplier to most major tier-1 and 2 manufacturers, we are able to work with our customers to offer the best sealing arrangement. These are designed to give excellent sealing integrity, over a long service life, while meeting performance demands. We can select from a unique range that uses our proprietary materials, leading-edge manufacturing methods and patented products.

Products for all market requirements

The range of products offers:

- Temperature resistance from cryogenic up to 850 °C (1560 °F)
- Compounds with almost universal chemical compatibility and superior resistance to lubricants, fuels, refrigerants and engine coolants
- Excellent thermal stability
- Good mechanical strength
- Low long-term compression set and hysteresis
- Automotive approved materials, products and manufacturing

Service from concept to delivery



Products tested to destruction

Significant investment in research and development means products within the unique range from Trelleborg Sealing Solutions, which are often tested to destruction, can go beyond operational requirements.



Innovative total solutions

Trelleborg Sealing Solutions develops total solutions. This has led to our industry-leading knowledge of coatings technology, focusing on reducing friction both in application and automated assembly.



Global research and development network

The Trelleborg Sealing Solutions worldwide research and development facilities continuously focus on solutions to match our customers' current and emerging performance standards. They combine their knowledge with that of our manufacturing units, who have experience based on their specialized material or product type. We work with customers on their individual applications, testing solutions on their behalf and if necessary formulating materials or designing products to meet specific needs.

Leading-edge manufacturing capability

Dedicated automotive production takes place in world-class facilities in Brazil, Denmark, Italy, North America, Malta, Sweden, Poland, United Kingdom, and our growing presence in Asia. We have unrivalled PTFE expertise along with pioneering products and innovative elastomer capabilities and are industry leading in our knowledge of coatings technology.

Sealing expertise throughout the product development process

The Trelleborg Sealing Solutions service meets and goes beyond industry requirements from product concept to delivery. Customers can benefit from our sealing expertise from initial stages of vehicle engineering through to final build and ongoing aftermarket support. We use state-of-the-art design tools, including customer compatible CAD systems and rapid prototyping, often proving sealing designs in a virtual environment, using techniques such as Finite Element Analysis (FEA).

Servicing and supporting our customers worldwide

Our international locations allow us to work with design centers in several countries on product specification, then collaborate with manufacturing plants which may be located elsewhere in the world. Effective supply from our regional logistics centers is combined with sub-assembly and Direct Line Feed. Quality is a given and all production sites operate to TS 16949 with a zero defect philosophy.

Environmental Awareness

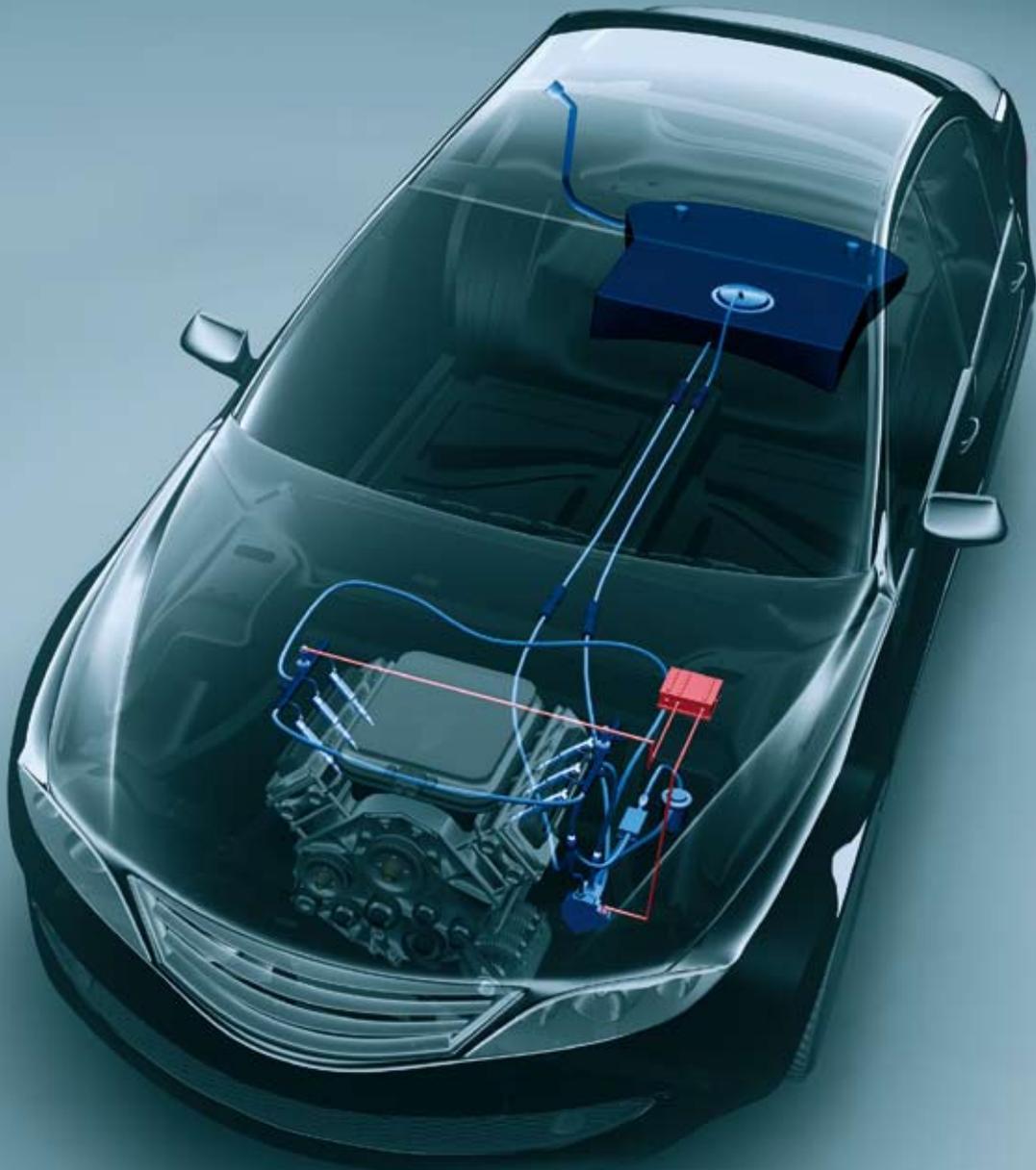
Trelleborg Sealing Solutions does its very best in searching for materials and technologies with improved environmental compatibility and in integrating these into production whenever possible. The use of recyclable materials in all of our activities is promoted in the same way, and also the development of procedures that altogether reduce the consumption of material and energy.



Total service capabilities

Trelleborg Sealing Solutions service reflects and surpasses industry requirements with specialized capabilities exactly matched to the demanding requirements of our customers.

Technologies matching customer needs



O-Rings

For static applications, any size of O-Ring (standard or custom) is available, in materials ranging from basic elastomer grades to leading-edge, high specification compounds.



Advanced elastomers

Materials used in O-Rings have been specifically developed for the automotive industry. These include conductive elastomers to eliminate static electricity buildup in fuel systems.

In fuel systems, there are seals at every connection point from the tank, through the pump, on pipes and connectors, to the injectors.

Constant operation in severe conditions

Fuel or unit injectors ensure that the engine receives the right amount of fuel. These work constantly when the vehicle is running, so seals that can withstand aggressive environments over the long term are vital.

Solutions to withstand extreme pressures

To improve performance, pressures in the fuel system are continuously increasing. Seals must operate at extremes, with pressures reaching up to 220 Mpa (2200 bar, 31908 psi) in the latest diesel pumps.

Sealing plastic connections effectively

Changes in composition of components make sealing more challenging. The use of plastics for fuel rails means seal configurations now need to compensate for greater potential misalignment.

Seals are important in meeting stringent regulations

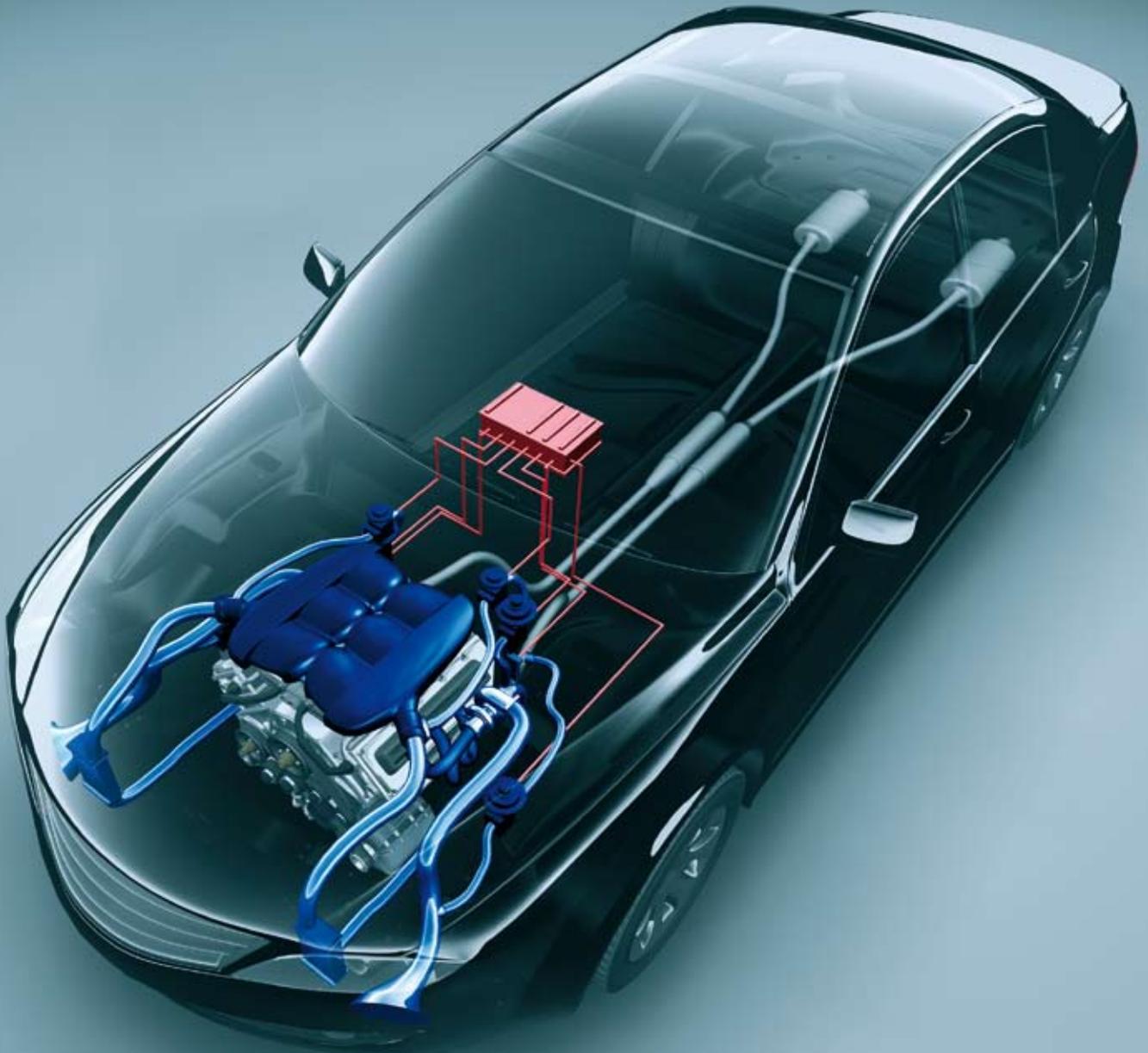
On fuel tanks, regulations have influenced the number of inlet and outlet connections, and as each one potentially increases emissions, seals must minimize fuel permeation.



Materials technology

To maximize service life, materials are engineered to withstand a wide range of aggressive fuels and additives and to be capable of sealing at low and high operating temperatures.

Innovative custom molded designs



Custom designed solutions

Most seals supplied to the automotive industry are custom designed. Advanced gaskets are produced in a variety of standard or automotive-specific elastomer materials.



Tailored Geometries

Unique custom seal designs meeting extreme high temperature and challenging fluid requirements.

Seals within emission control and air induction systems must give the maximum integrity over a long service life.

Minimizing leakage is a priority achieved

Stringent regulations on vehicle emissions require leakage of vapors to be at an absolute minimum. A variety of sealing combinations including glyd rings, vari seals, lip seals, and o-rings help achieve this in Exhaust Gas Recirculation valves.

Sealing from vacuum to backfire pressure

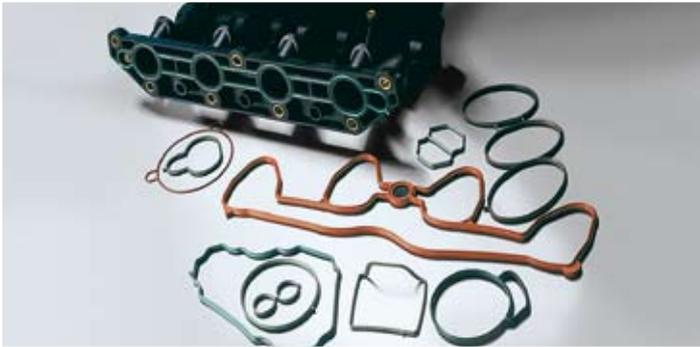
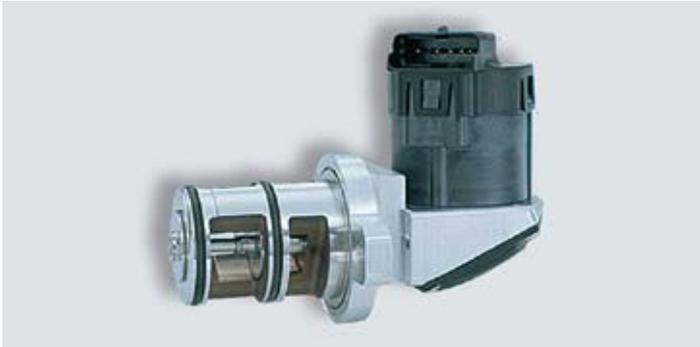
Air induction systems require sealing solutions engineered to withstand pressures ranging from 85kPa (0.85 bar, 12 psi) running vacuum to 800kPa (8 bar, 116 psi) backfire pressure.

Compensating for variations in composite components

Mounting a composite valve to a composite manifold is a sealing challenge. It requires a gasket that compensates for wide tolerances on the faces of both components.

Excellent solutions for rotary applications

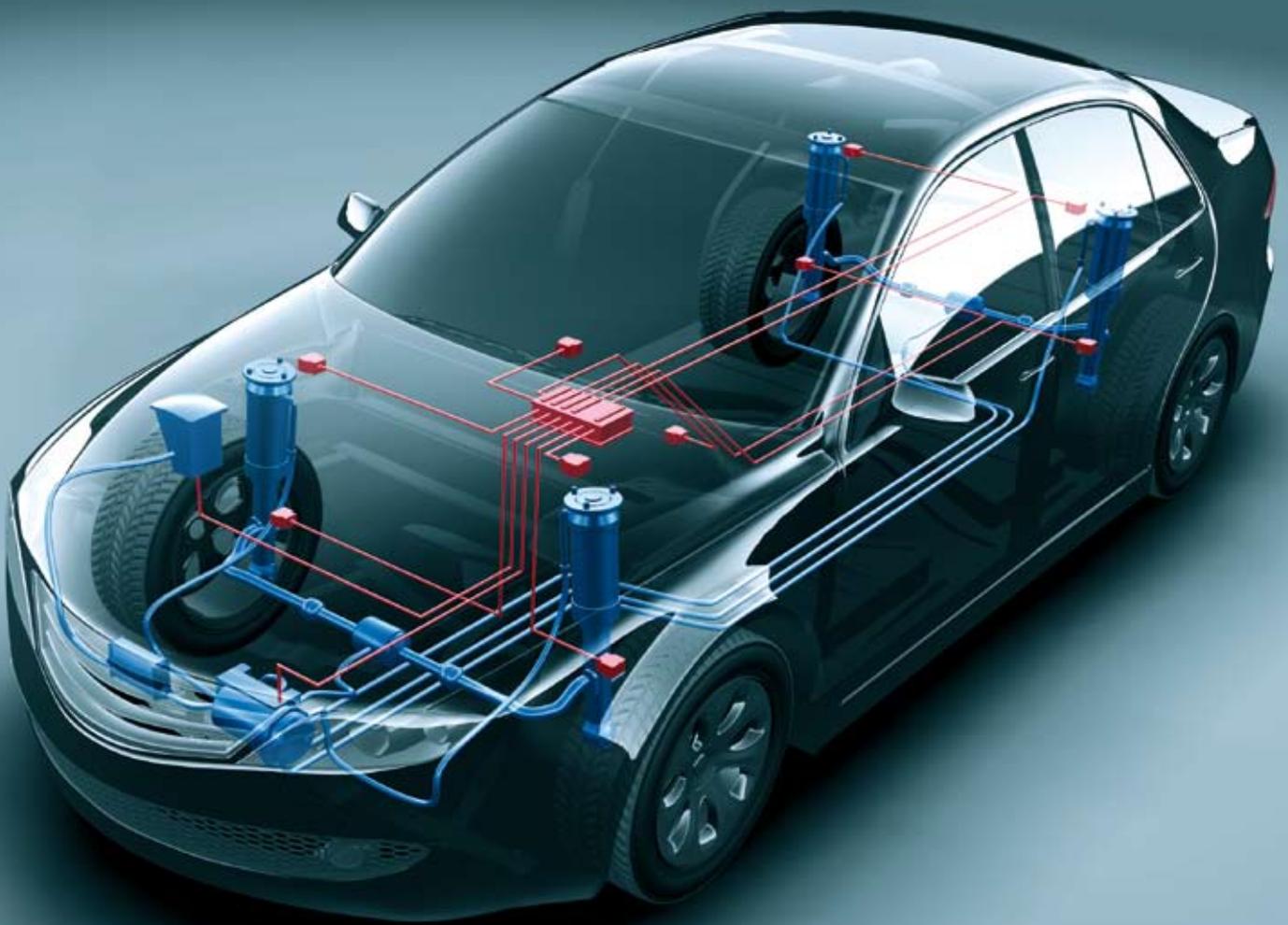
Superchargers and turbochargers provide the ultimate engine performance. In these, seals must operate at high rotational speeds, where shaft surface speeds can reach 21 m/s (69 ft/s).



Rotary sealing

Varilip® PDR rotary shaft seals, comprised of a Turcon® PTFE sealing lip retained in a crimped or clamped metal case, meet the demands of rotary sealing, especially at high surface speeds.

Advanced sealing products and materials



Unique products

Our proprietary products such as Variseal, spring-energized Turcon PTFE based seals, and Wills Rings, the original metal seal, provide innovative solutions to sealing challenges.



Stepseal®

Ideal for hydraulic applications is the Stepseal®. It optimizes seal integrity, minimizing the possibility of leakage, and demonstrates excellent friction and anti-extrusion characteristics.

Trelleborg Sealing Solutions has the superior sealing capabilities required to meet today's ride control and drivetrain needs.

Operating in high frequency linear applications

In ride control systems seals must operate in wide pressure and temperature ranges while demonstrating high chemical resistance. This can be where there is relatively high frequency and surface velocity.

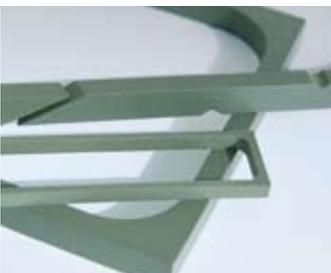
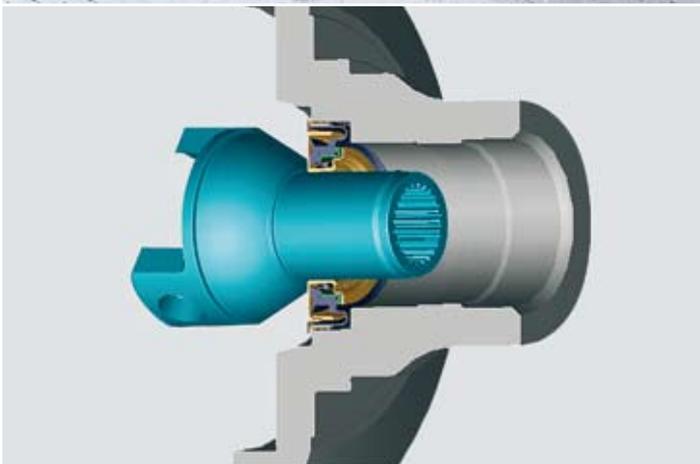
Exceptional friction characteristics

Expertise in hydraulic systems allows us to be a major solution provider for 'Active Body Control'. Specially engineered seals give exceptional friction characteristics, optimizing performance.

Anti-Roll system seals increase driver safety and comfort. The special requirements of this application are met with unique products and materials.

Dynamic durability performance

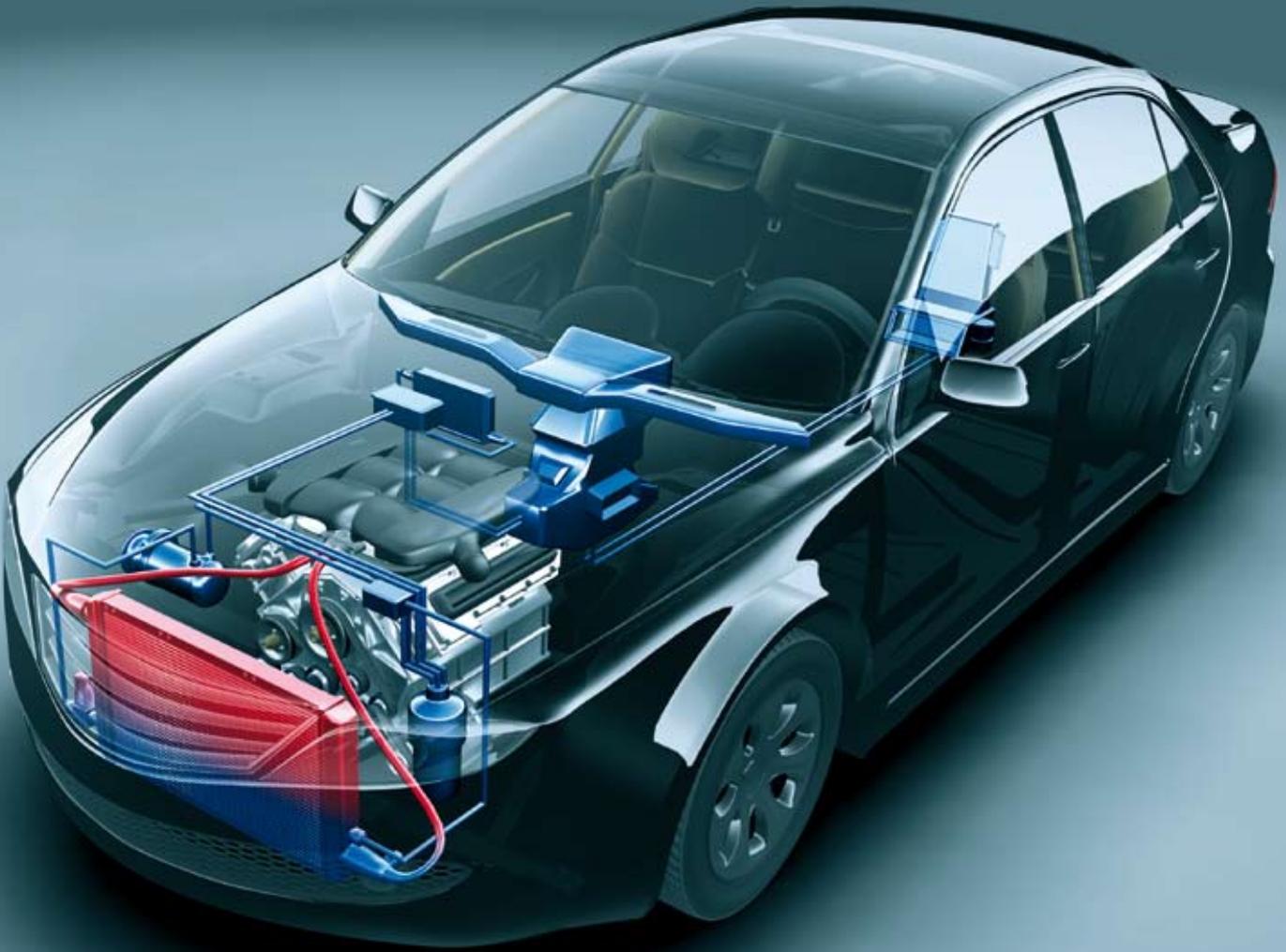
Trelleborg Sealing Solutions provides a total sealing portfolio for the most rigorous applications, from 4WD axle seals to hub seals. We help our customers seal, dampen, isolate, and protect their products. Our ability to utilize elastomers, polymers and metal components makes us the supplier of choice to numerous vehicle manufacturers and tier suppliers.



Vaneseal

Specifically designed for sealing the vanes in rotary actuators, vaneseals are used in anti-roll systems. Trelleborg Sealing Solutions successfully produces razor sharp corner profiles to ensure effective sealing.

Expertise to offer unique solutions



Bonded seals

Trelleborg Sealing Solutions is the original manufacturer of the Dowty bonded seal. These seals are supplied competitively, in high volume, from our low-cost manufacturing bases worldwide for a wide variety of applications.



Advanced technology

The expertise of Trelleborg Sealing Solutions in the technology of bonding seals, allows us to offer advanced custom manufactured solutions where elastomers are bonded to both metal and plastics.

The market for air conditioning, improving driver comfort, is a dynamic and growing sector where new technology means sealing is more complex.

Excellent temperature resistance

Seals must operate at ever more elevated temperatures in cooling systems. Here engine water temperatures are being increased to produce greater oil fluidity, leading to better fuel economy.

Materials with superior mechanical properties

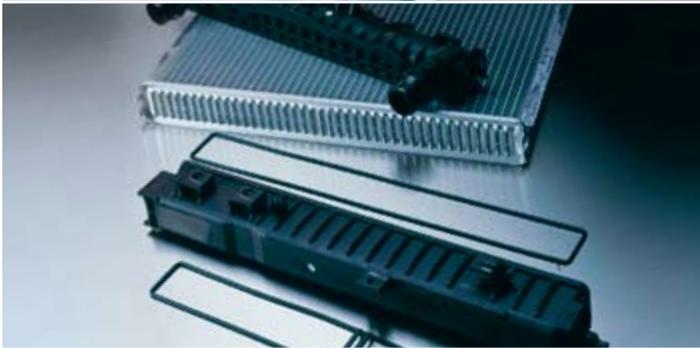
The growing use of components manufactured from thermoplastics makes sealing more challenging. For these, high performance materials with good compression stress relaxation characteristics are ideal.

Fluid sealing

The fluid transport system is an essential part of an air conditioning system. Making sure that leakage is prevented at every connection point is a design priority. Seals match specific compatibility and operating criteria.

Exceptional chemical compatibility

In air conditioning systems, seals need to have good pressure and temperature characteristics and be chemically resistant to refrigerants. For the next generation, they will also be required to perform in CO₂.



Optimum sealing choice

Due to the breadth of range offered by Trelleborg Sealing Solutions, designers can specify seals that meet the challenge of balancing cost effectiveness with performance for all automotive sealing applications.

Total - Sealing technology



Extensive test facilities

Strategically-positioned materials and development laboratories and fully resourced design and application centers, continuously deliver innovative sealing solutions.



Innovative material development

Developing and formulating materials in-house and engaging in ongoing programs of development, Trelleborg Sealing Solutions is also skilled in the field of applied materials technology.



Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer a dedicated design and development service for sealing arrangements, from our market leading product and material portfolio; one which has provided solutions that feature in virtually every application conceivable within the aerospace, industrial and automotive industries.

Global - A worldwide presence

Globally servicing, supporting and supplying our customers, Trelleborg Sealing Solutions has an international network of over 60 facilities worldwide including more than 20 manufacturing sites, strategically positioned materials and development laboratories and fully resourced design and application centers. Facilities are certified to ISO 9001:2000, with many manufacturing sites also working to TS 16949 and VDA 6.1.

Expertise - Our proven capabilities

With over 50-years experience in developing and applying of sealing systems, Trelleborg Sealing Solutions engineering personnel contribute their knowledge of this specialized technology directly to customers. This includes project management of design, prototyping, production, test and installation using state-of-the-art design tools, fully customer-compatible CAD systems and leading edge Finite Element Analysis (FEA).

Innovation - In materials and supply

Developing and formulating our materials in-house, Trelleborg Sealing Solutions has acquired significant skills in the field of applied materials technology. Working in close cooperation with worldwide partners, we are engaged in ongoing programs of material and product development, utilizing latest technologies and the resource of our material database, which includes over 2,000 proprietary compounds.

Commitment - To customers' needs long-term

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions. We are one of the world's foremost experts in polymer sealing technology. We develop and manufacture safety-critical, polymer-based, precision seals and associated systems.



Superior logistics support

Trelleborg Sealing Solutions invested in an advanced logistical support system, which effectively delivers products to our customers worldwide from regional warehouses.

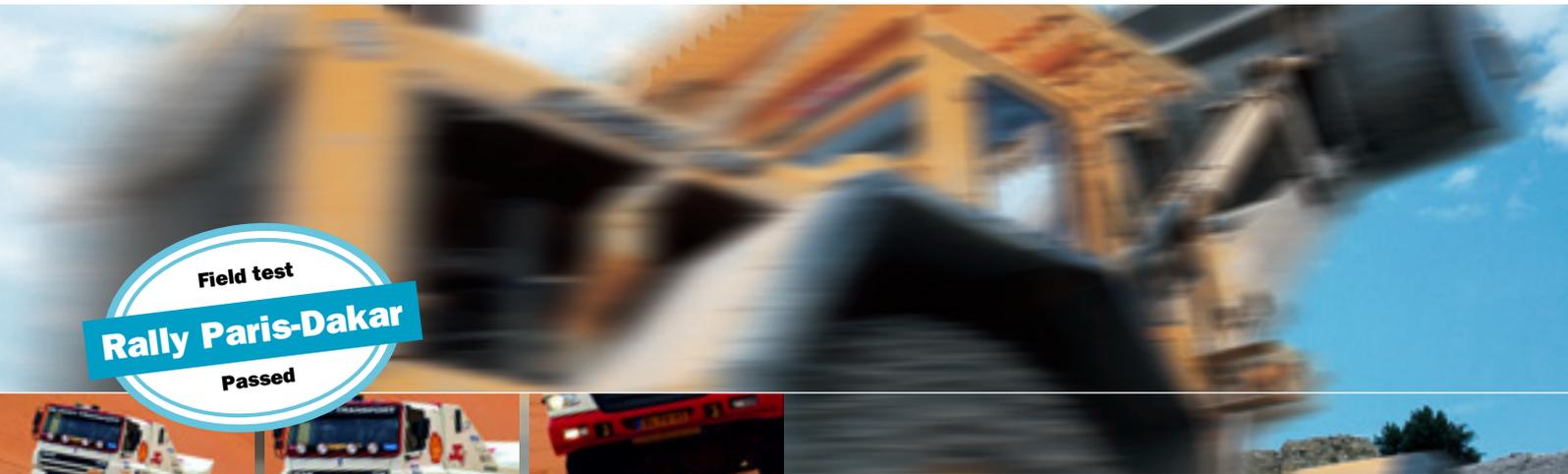
Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
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CZECH REPUBLIC - Rakovník <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
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		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

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Cassette seal System 3000



Field test
Rally Paris-Dakar
Passed



Your Partner for Sealing Technology

The System 3000 Cassette seal is designed especially for use with vehicles working in arduous conditions, such as heavy trucks, forestry machinery, agricultural equipment and general off-road vehicles. In addition to the sealing function performed by the spring-activated sealing lip, there are several dust and exclusion lips that form effective barriers against water, sand and dust. System 3000 is optimized for use in rotating hub applications. When optimized, the press-fit of the outside metal casing within the wheel hub ensures an efficient transfer of frictional heat from the seal. The inside elastomeric portion is fitted on the shaft and remains static when the equipment is in use, ensuring constant sealing force, independent of the vehicle speed. This, and the totally enclosed nature of System 3000, means service life is considerably longer than other current designs.

The System 3000 HS (High Speed) seal is based on the well proven System 3000, and as the name implies, is developed for equipment running at higher speeds. A part of our product development testing for System 3000 HS included field-testing with axles installed on the "de-Rooy Transport" team's heavy trucks, which successfully completed the Paris-Dakar Rally 2001.

During the race the seal performed perfectly even when exposed to speeds up to 95 mph under severe road and weather conditions. Subsequent inspection revealed there to be no signs of excessive wear nor deterioration of the sealing lips and the mating metal surfaces.

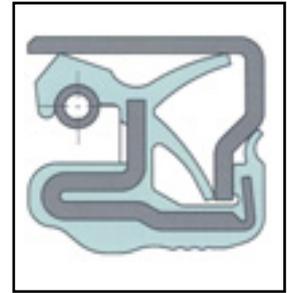
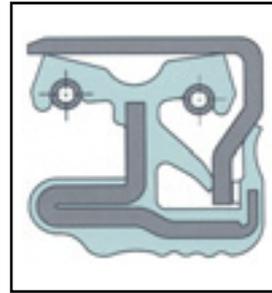
Cassette seal System 3000

Special Features:

- Positioning and design of the sealing lip optimized for low-friction
- Efficient transfer of frictional heat from the seal due to metallic contact between casing and hub
- Enclosed design protects the sealing lips
- The seal is press fitted into the housing and requires no further means of retention
- Spring-energized sealing lip towards the oil side
- Sealing force is not influenced by the wheel rotation, as the lips are stationary
- Built-in distance lugs ensure correct positioning of sealing element
- The seal has built-in grease reservoirs and is delivered grease-filled for ideal start up conditions and long life
- System 3000 has a spring-energized sealing lip towards the external side, ensuring efficient exclusion of dust and water

The **Off-Road** version has two spring-energized sealing lips and two excluder lips, for excellent performance in dirt and water.

The **On-Road** version has one spring-energized sealing lip and three excluder lips, resulting in lower seal torque and higher allowable speed.



Operational advantages:

- Long service life
- Best possible sealing and protection of the bearing
- High reliability in service
- Protects the environment, by eliminating unnecessary leakage
- Easy installation
- Up to 1200 ft/m rotational speed allowed for System 3000 HS
- Savings on machining and hardening of hub and shaft
- Reduction in number of parts in the hub assembly
- Change of seal at overhaul does not require rework of hardware

Material	NBR (75 Shore A)	HNBR (75 Shore A)	FKM (75 Shore A)
Reference number	4N063	4H063	4V063
Metal casing	Carbon steel	Carbon steel	Carbon steel
Spring	Stainless steel	Stainless steel	Stainless steel

These indications are based on laboratory values. The application limits for pressure, temperature, speed and media are maximum values determined in the laboratory. During practical applications it should be remembered that due to the interaction of the operating parameters the maximum values must be set correspondingly lower. It is vital that customers satisfy themselves as to the suitability of individual products through adequate testing. For exceptional operating conditions please contact your Trelleborg Sealing Solutions representative. The data sheet is not subject to an updating service.

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FKM XploR V9T20

Explosive Decompression Resistant Materials



Superior over-all performance



Your Partner for Sealing Technology

Explosive Decompression is a major concern to the oil and gas industry. It occurs when applied system pressure is released, causing absorbed gas to expand, potentially damaging elastomer seals.

Trelleborg Sealing Solutions has focused on this issue and presents the XploR range, an entire family of advanced elastomers especially developed for oil and gas applications. The portfolio includes compounds in HNBR, FKM, Aflas® and Isolast® Perfluoroelastomer, each of which demonstrates best-in-class Explosive Decompression Resistance (EDR) for its material type.

In independent tests FKM XploR V9T20 was able to satisfy the requirements of Norsok M-710 Annex B, Rapid Gas Decompression.

If the composition of the well or conditions of the application are known, FKM XploR V9T20 may prove the optimum and most cost-effective material for your application. For further information on selecting the right compound and advice on seal specification for your individual application, consult your local Trelleborg Sealing Solutions marketing company. Find contact details at www.tss.trelleborg.com.

Features & benefits:

- Unrivalled Explosive Decompression Resistance (EDR) within its material type
- Temperature resistance from -20°C/-4°F to 200°C/392°F
- Exceptional mechanical performance
- Low long-term compression set
- Very good chemical compatibility
- Long life in aggressive, including hydrocarbon and aqueous media, common within oil & gas applications
- High modulus, high strength
- Material compliant to Norsok M-710 Annex B

Applications:

- Separation equipment
- Connectors systems
- Valves
- Wellhead control equipment
- Tubing hangers
- Blowout Preventers (BOPs)
- Swivel stacks on Floating Production Storage and Offloading (FPSO) vessels
- Perforating equipment

XploR is available in all standard international O-Ring sizes and cross-sections along with custom-engineered solutions and specially designed seal profiles.

Explosive Decompression Facts

Inherently, elastomer seals contain voids. Gas or gas mixtures in contact with elastomer surfaces are absorbed and will saturate elastomer seals. At high-pressure this absorbed gas is in a compressed state. When external pressure is reduced, either rapidly or over a relatively short period of time, the compressed gas nucleates at the voids, expanding within the elastomer. The voids inflate leading to high tensile stresses or strains in the void walls. Depending on the strength and hardness of the elastomer, this can cause the elastomer to break or crack.

No elastomer can be completely explosive decompression resistant; however, the XploR range demonstrates unrivalled EDR inline with limits set by NORSOK M-CR-710 Rev. 2 2001 "Qualification of Non-metallic Sealing Materials and Manufacturers."

Compound No.:		V9T20		
Elastomer base:	DIN ISO 1629	FKM		
Hardness:	DIN 53 505	90 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN EN ISO 1183-1	g/cm ³	1.84 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ² psi	25.5 3,700
Elongation at break:		DIN 53 504	%	186
Modulus 100%:		DIN 53 504	MPa N/mm ² psi	13.2 1,915
TR10 point:		TBS 00036	°C °F	-15 +5
Service temperature:			°C °F	-20 to 200 -4 to 392
Specification:				Norsok M-710 Annex B

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

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FlexiMold™



Your Partner for Sealing Technology

FlexiMold™

Trelleborg Sealing Solutions has developed a new proprietary manufacturing technology, FlexiMold™, that allows the manufacture of large, high quality O-Rings without the leadtime and cost associated with dedicated tooling. Compared to conventional techniques such as the splicing of extruded cord, the FlexiMold™ process ensures full visual and dimensional integrity. It also gives the circular form stability of a molded O-Ring, along with its intended thermal and chemical resistance capability. Large O-Rings are used across all process industries including Chemical and Hydrocarbon, Pharmaceutical, Food & Beverage, the Electronics industry, in particular the production of flat panel displays applications.

Features:

- Infinite diameter capability
- No tooling charges for standard cross sections
- Full visual and dimensional product integrity
- High quality, tight tolerances
- Full performance integrity of an O-Ring
- Available in any elastomer
- Elimination of risks associated with spliced O-Rings

Applications:

- Flat Panel Display
- Large Cover Seals
- Vessels
- Electrolyzers
- Filters
- Power Generation
- Other large processing equipment

International Standard	Cross Section, inches	Cross Selection, mm
Metric	0.118	3.00
JIS B 2401	0.122	3.10
Metric / JIS	0.138	3.50
AS-568	0.139	3.53
JIS B 2401	0.140	3.55
Metric	0.157	4.00
Metric	0.197	5.00
JIS B 2401	0.209	5.30
AS-568	0.210	5.34
Metric / JIS	0.224	5.70
AS-568	0.275	6.99
JIS B 2401	0.275	7.00
Metric	0.315	8.00
JIS B 2401	0.330	8.40
Metric	0.394	10.00

Product of Availability:

Sizes:

- Recommended for diameters > 500 mm / 20 inches

Cross sections:

- Available for all standard cross sections
- Inquire about larger and special size cross sections
- Other seal profiles may be requested

Materials:

- Isolast® FFKM
- Resifluor™ High Performance Fluoroelastomers
- FKM
- EPDM, HNBR
- Many other elastomers
- FDA, USP Class VI, EDR type compounds available

Service:

- O-Rings supplied to standards ISO 3601-1, AS568, and JIS B 2401
- 'Zero' Defect quality policy
- Parts packaged and labeled individually
- Class 100 Cleanroom washing and packing available
- Express delivery service may be requested

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Food, Beverage and Pharmaceutical Sealing Solutions



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 of 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

The information in this brochure is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this brochure. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

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

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Sealing solutions for demanding processing environments

If you are an engineer specifying seals in equipment for use in bioprocessing, food, beverage, or pharmaceutical production, then this brochure is for you. Your processing environment is probably the most challenging of all and Trelleborg Sealing Solutions has engineered one of the widest ranges of products and materials specific to your

sector. In this publication, we present a wealth of material and product information to help you choose the right seal for your specific applications. With over 50 years of experience, we aim to offer you the optimum solution, however difficult your processing needs.

Content

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Material Overview

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An overview of the key issues involved in specifying materials for bioprocessing, food, beverage and pharmaceutical equipment.

Approvals

6

The industry is increasingly driven by regulations and approvals. This section details the most important ones and reviews which of our materials are compliant with them.

CIP and SIP

7

CIP (Cleaning In Place) and SIP (Sterilization In Place) cleaning regimes represent the most challenging of sealing environments. This section outlines the sealing issues connected to these regimes and gives recommended solutions.

Materials

10

Find out about our advanced solutions by material type and the optimum compounds for each application.

EPDM sealing materials engineered for aseptic technology

Excellent performance from **FKM** and the **Resifluor™ 500** range of materials

Isolast® Perfluoroelastomer: The ultimate in elastomer sealing

Turcon®: Unrivalled PTFE based sealing capabilities

Silicone, NBR and Zurcon® Z80 & Z2221 solutions

Coating

20

Surface treatments improve the friction characteristics of elastomer seals. This section details the most common surface treatments available for elastomer seals.

Products

21

We have the largest sealing product portfolio in the industry. With this and our engineered solutions, we can solve almost any sealing challenge.

Standard Elastomers Seals

O-Rings, FEP encapsulated O-Rings, FlexiMold™, QUAD-RINGS®, Kantseals and Gaskets

Dynamic Linear Seals

Proprietary fluid sealing: Stepseal® 2K, Glyd Ring® T and Variseal® in Turcon® MF and Zurcon®

Dynamic Rotary Seals

Unique products for rotary sealing: Varilip®, Varilip® PDR, Roto Variseal® and Roto Glyd Ring® in Turcon® MF

Engineered Seals

Custom components broaden application coverage

Applications

28

Overview of common food, beverage, and pharmaceutical applications

To find out more about sealing solutions for the Food, Beverage, Pharmaceutical and Medical industries, visit the Industries section „Food and Pharmaceutical“ on our website.

 www.tss.trelleborg.com



Material Overview

Standards and cleanliness are paramount

The sealing environment within food, beverage and pharmaceutical processing is perhaps the most demanding of all. Seal failure can lead to potential contamination or line stoppages. Materials, whether elastomer or plastics, have to cope with a broad variety of process media along with CIP (Cleaning In Place) and SIP (Sterilization In Place). They must also comply with an increasing number of national and international regulations such as FDA, 3-A, NSF and USP standards.

Materials developed for demanding applications

Based on decades of experience, working with leading equipment manufacturers and end users around the globe, we have developed a tailor-made portfolio of materials for this sector. To ensure extended sealing performance, Trelleborg Sealing Solutions has invested heavily in research to identify the optimum compound for each application. The resulting materials range from standard elastomers to the proprietary FFKM Isolast® and Turcon®, our range of PTFE based compounds. These are discussed in detail in the following section.

Compliance to all major standards

Most importantly, materials from Trelleborg Sealing Solutions are available across each compound type, which comply with all major standards including FDA 21 CFR 177.1550 for fluorocarbon plastics, FDA 21 CFR 177.2600 for elastomers, 3-A, USP Class VI, NSF, and Cytotoxicity (USP 87). On page 6 we give details of these standards.

Animal Derived Ingredients Free

Animal Derived Ingredients (ADI) can cause the disease BSE and should therefore be avoided in products that may come into contact with products that are intended for human consumption. Sealing material ingredients and process aids can contain ADI. Trelleborg Sealing Solutions has therefore checked the compound portfolio and can now offer a broad selection of ADI free materials.

Elastomers

Material	TSS Compound	Shore A	Type	Colour
EPDM	E7502	70	Elastomer	Black
EPDM	E7518	70	Elastomer	Black
EPDM	E8502	80	Elastomer	Black
FKM	V8605	80	Elastomer	Black
FKM	V8T41	80	Elastomer	Black
Resifluor™ 500	VCT90	75	Elastomer	Black
Isolast®	J9515	75	Elastomer	Black
Isolast®	J9516	75	Elastomer	White
Isolast®	J9503	75	Elastomer	Black
Isolast®	J9509	90	Elastomer	Black
Isolast®	J9505	70	Elastomer	White
Isolast®	J9501	80	Elastomer	White
Isolast®	J8325	75	Elastomer	Black
Isolast®	J9512	75	Elastomer	Black
Silicon	SC6L1	75	Elastomer	Blue
Silicon	S70R8	70	Elastomer	Red
NBR	N7027	70	Elastomer	Black
NBR	N7007	70	Elastomer	Black
NBR	N8604	80	Elastomer	Black

Plastic

Material	TSS Compound	Specific Gravity	Type	Colour
Turcon®	MF1	2.16 g/cm ³	Plastic	Off White
Turcon®	MF2	2.17 g/cm ³	Plastic	Off White
Turcon®	MF3	2.17 g/cm ³	Plastic	Off White
Turcon®	MF4	2.06 g/cm ³	Plastic	Grey
Turcon®	MF5	2.19 g/cm ³	Plastic	Off White
Turcon®	MF6	1.93 g/cm ³	Plastic	Brown
Turcon®	T05	2.17 g/cm ³	Plastic	Turquoise
Turcon®	T46	3.07 g/cm ³	Plastic	Brown
Turcon®	T19	2.31 g/cm ³	Plastic	Grey
Zurcon®	Z80	0.93 g/cm ³	Plastic	Translucent
Zurcon®	Z2221	1.16 g/cm ³	PUR	White

The indicated material properties are average values determined with standard test finished parts. The end user is responsible for ensuring that the selected material is



Min. Temp °C/°F	Max. Temp °C/°F Air	Max. H ₂ O °C/°F Steam	Tensile Strength MPa	Elongation at break %	Compression Set % °C/°F	FDA	USP	3-A
-45°C/49°F	160°C/320°F	160°C/320°F	16,4	216	18% at 72h/150°C/302°F	•	•	•
-45°C/49°F	150°C/302°F	150°C/302°F	15,9	171	10% at 24h/150°C/302°F	•	•	•
-45°C/49°F	160°C/320°F	160°C/320°F	15,9	125	11% at 24h/150°C/302°F	•	•	•
-18°C/0°F	200°C/392°F	130°C/266°F	14,2	197	13% at 24h/175°C/347°F	•	•	•
-20°C/-4°F	200°C/392°F	170°C/338°F	12	340	14% at 24h/175°C/347°F	•	•	•
-20°C/-4°F	220°C/338°F	170°C/338°F	15,2	210	18% at 70h/150 C/302°F	•	•	•
-10°C/14°F	250°C/482°F	250°C/482°F	11,7	182	16% at 72h/200°C/392°F	•	•	•
-10°C/14°F	250°C/482°F	250°C/482°F	11,9	228	35% at 72h/200°C/392°F	•	•	
-25°C/-13°F	240°C/464°F	240°C/464°F	12,6	124	16% at 72h/200°C/392°F			
-25°C/-13°F	240°C/464°F	240°C/464°F	12,1	70	48% at 72h/200°C/392°F			
-20°C/-4°F	240°C/464°F	240°C/464°F	8,6	172	23% at 72h/200°C/392°F			
-20°C/-4°F	240°C/464°F	240°C/464°F	10,8	147	27% at 72h/200°C/392°F			
-15°C/5°F	325°C/617°F	-	16,9	205	19% at 72h/200°C/392°F			
-5°C/23°F	260°C/500°F	260°C/500°F	13,1	191	14% at 72h/200°C/392°F			
-60°C/-76°F	200°C/392°F	100°C/212°F	9,9	400	20% at 72h/175°C/347°F	•		
-60°C/-76°F	200°C/392°F	100°C/212°F	8,1	234	24% at 24h/175°C/347°F	•		
-30°C/-22°F	100°C/212°F	100°C/212°F	17,9	330	9% at 24h/100°C/212°F	•		•
-30°C/-22°F	100°C/212°F	100°C/212°F	19,8	225	15% at 24h/100°C/212°F	•		•
-30°C/-22°F	100°C/212°F	100°C/212°F	18,3	128	14% at 24h/100°C/212°F	•		•

Min. Temp °C/°F	Max. Temp °C/°F	Max. H ₂ O °C/°F	Tensile Strength MPa	Tensile Elongation at break %	Creep %	FDA	USP	3-A
-253°C/-423°F	260°C/500°F	260°C/500°F	36 MPa	330	5,5	•	•	•
-200°C/-328°F	260°C/500°F	260°C/500°F	35 MPa	506	2,2	•		
-200°C/-328°F	260°C/500°F	260°C/500°F	29 MPa	320		•		
-200°C/-328°F	260°C/500°F	260°C/500°F	26 MPa	280	3,3	•	•	
-200°C/-328°F	260°C/500°F	260°C/500°F	28 MPa	311	6,4	•		
-200°C/-328°F	260°C/500°F	260°C/500°F	22 MPa	235		•	•	•
-200°C/-328°F	260°C/500°F	260°C/500°F	40 MPa	430	5,6			
-200°C/-328°F	260°C/500°F	260°C/500°F	29 MPa	280	3,7			
-200°C/-328°F	260°C/500°F	260°C/500°F	23 MPa	230	2,7			
-200°C/-328°F	125°C/257°F	100°C/212°F	51 MPa	260	5,5	•		
-45°C/49°F	110°C/230°F	60°C/140°F	57 Mpa	560		•		

slabs according to the corresponding specification. These values cannot be used as specification values and may be different from the material properties of suited to their specific application.



Compliance with strict standards

The pharmaceutical, food and beverage industries as well as the biotech and life science sectors provide a multitude of sealing challenges for critical processes and components. These processes and applications require the sealing

materials to be manufactured from a variety of materials compliant to various national and international approvals and standards listed in the table below.

Standard authority	Regulations applicable to seals
<p>FDA</p> <p>The Food and Drug Administration (FDA) is a government agency within the US Department of Health and Human Services and is responsible for enforcing the Federal Food, Drug, and Cosmetic Act to ensure consumers' health and safety. It is mandatory that seals conform to this standard when in contact with food or pharmaceuticals in processing systems.</p>	<p>Elastomer seals must comply with standards detailed in paragraph 21 CFR177.2600 'Rubber articles intended for repeated use' and FFKM elastomers with 21 CFR 177.2400. Polyurethane based elastomers must conform to FDA 21 CFR 177.1680.</p> <p>Perfluorocarbons (PTFE products and compounds, FEP and PFA resins) must comply with 21 CFR177.1550, olefin based resins must conform to FDA 21 CFR 177.1520.</p>
<p>3-A</p> <p>3-A Sanitary Standards, Inc. (3-A SSI) is an American organization that formulates sanitary standards and accepted practices for design, fabrication, installation and cleanability of dairy and food equipment or systems used to handle, process and package consumable products. Its goal is to protect consumable products from contamination and ensure that all product surfaces can be cleaned. A prerequisite for 3-A approval is that the seal material already fulfills the FDA requirements.</p>	<p>Elastomer seals must comply with standard number 18-03, which covers Multiple-Use Rubber and Rubber-Like Materials that come into contact with production media.</p> <p>Perfluorocarbons (PTFE products and compounds, FEP and PFA resins) must comply with standard 20-25, which covers Multiple-Use Plastic Materials Used as Product Contact Surfaces.</p>
<p>USP</p> <p>The United States Pharmacopoeia (USP) is an independent, science-based public health organization. It is the official public standards-setting authority for all prescription and over-the-counter medicines, dietary supplements and other healthcare products manufactured and sold in the United States. The USP is considered one of the most technologically advanced and respected pharmacopoeias in the world.</p>	<p>USP Class VI testing Part 88 is referenced for sealing products and components, designed to evaluate plastics and elastomeric materials for use in drug processing equipment. It consists of a four-part evaluation involving animal testing, to test the biological reactivity in vivo.</p> <p>USP testing according to Part 87, also called cytotoxicity, is a complimentary in vitro test that measures the quality of the test substrate to be toxic to cells.</p>
<p>NSF</p> <p>NSF is a non-profit organization known worldwide for providing certification services in the areas of health and safety. NSF registration assures inspection officials, consumers and end users that products are safe to use in and around food processing and storage. The evaluation process includes a toxicological review of the ingredients, accuracy of labelling and material safety data sheet. In some cases, toxicology testing may be required.</p>	<p>NSF/ANSI Standard 51 "Food equipment materials". This standard provides minimum food protection and sanitation requirements for the materials used in the construction of commercial food equipment. No physical testing is required but a formulation review is performed.</p> <p>NSF/ANSI Standard 61 "Drinking water systems components Health effects." In order to comply to this standard, sealing materials have to undergo a third-party certification process which requires the recipe to be fully disclosed and toxicology tested and reviewed by the NSF organization.</p>
<p>KTW</p> <p>The Deutsche Vereinigung des Gas und Wasserfaches (DVGW) is an independent organization sharing expertise for self-regulation in the gas and water supply industry in Germany and Europe.</p>	<p>The KTW certificate is applied to polymers exposed to cold, warm and hot drinking water. The approval contains an extraction test and taste test, as well as a register of permitted ingredients.</p>
<p>WRAS</p> <p>The Water Regulations Advisory Scheme (WRAS) is the UK Water Industry's approval scheme. Products are approved by the scheme with tests for compliance carried out in accredited laboratories.</p>	<p>Suitability of non-metallic products for use in contact with water intended for human consumption with regards to their effect on the quality of the water is specified in BS6920:2000. It requires a formula review, microbial test, extraction test and test in hot water.</p>
<p>ACS</p> <p>Accreditation de Conformité Sanitaire (ACS) is a French sanitary standard relevant for potable water systems.</p>	<p>The standard is used for rubber and plastic materials in contact with potable water systems. The applicable criteria are laid down in the French Standard AFNOR XP P41-250, Part 1-3.</p>
<p>BfR</p> <p>The German organisation Bundesamt für Risikobewertung (BfR) is employed to evaluate plastics material used in the food and beverage industry.</p>	<p>In section XXI, the recommendations for rubber based articles for daily use are specified. Depending on the type of application, contact media and contact time, different test are required.</p>



CIP & SIP

Withstanding severe cleaning regimes

Aggressive chemicals shorten seal life

Automated CIP (Cleaning In Place) and SIP (Sterilization In Place) are currently the best methods for cleaning processing systems. They ensure safety and efficiency, prevent toxic contamination of products and minimize recontamination of the process. Their complex formulations of chemicals can rapidly cause severe damage to elastomeric seals, especially in applications with load and pressures. With high temperatures and steam sterilization, which is now commonly up to 150°C/302°F, this deterioration is intensified.



Cost-effective solutions compliant to standards

Intervals between planned maintenance and production yield can be maximized by matching the seal material to the system media and the cleaning chemicals. With details of your specific requirements, we can propose cost-effective solutions that are compliant to all major standards and are proven to stand up to almost all known cleaning regimes, however stringent.

Choose from the following material types:

- EPDM based cost-effective sealing materials engineered for aseptic technology → Go to page 10
- Excellent performance from a variety of FKM materials and our proprietary Fluoroelastomer Resifluor™ 500 range → Go to page 12
- Isolast® Perfluoroelastomer materials combining the elasticity of an elastomer with almost universal chemical compatibility → Go to page 14
- Turcon® PTFE based sealing giving almost total chemical compatibility with unrivalled friction characteristics → Go to page 16
- Other materials → Go to page 18

CIP (Cleaning In Place) facts

Commercially available CIP cleaning media come from within the following categories:

- Alkaline CIP mixtures based on sodium hydroxide, potassium hydroxide and tensides
- Acidic CIP mixtures based on mineral acids and tensides
- Alkaline CIP disinfecting mixtures based on sodium hypochlorite, active chlorine and tenside
- Acidic CIP disinfecting mixture based on peracetic acid, hydrogen peroxide and tenside
- Solvents, both polar and unpolar

Making sure the following factors are considered is important to ensure maximum sealing integrity and prevent premature seal failure during the CIP process:

- Exposure time to cleaning and rinsing solutions
- Temperature of CIP fluids
- Concentration of CIP chemicals
- CIP solution flow rates
- Hygienic design of the equipment or system

Tests prove that matching seal material to an application can extend seal life

Specifying the right seal material when CIP and SIP is used is not a simple matter and standards do not really help. They only offer general information and refer just to groups of elastomeric materials and their compliance with standards. This is why Trelleborg Sealing Solutions has undertaken their own tests to support customers in recommending the optimum sealing material for specific applications.



Material Compatibility tests in CIP and SIP media

Comprehensive studies undertaken by Trelleborg Sealing Solutions have evaluated the performance of materials in a wide range of commercially available and commonly used CIP fluids and solvents. As the CIP process is now usually followed by sterilization in superheated steam up to 150°C/302°F, tests were also carried out in these conditions.

The most important properties, such as:

- Volume Change
- Weight Change
- Change of Elongation at break
- Change of Tensile Strength
- Hardness Change

The most important physical properties of elastomers have been determined after the exposure to the CIP fluids.

As expected, the intensive CIP fluids and high temperatures brought some elastomers tested to their performance limits. Importantly though, results from different materials, even within the same family of basic polymers, were vastly different. This has allowed Trelleborg Sealing Solutions to engineer materials that give maximized performance in CIP and SIP regimes.

Overall conclusions:

- EPDM materials E7502, E7518 and E8502 displayed excellent results in most CIP fluids and superheated steam. Tests proved that these grades can be used with aggressive polar solvents such as Acetone and Methyl-Ethyl-Ketone (MEK). Due to the unpolar nature of EPDM, they are not recommended for extremely fatty foods and some food grade lubricants.

→ **For more information on these materials go to page 10**

- Whereas the standard V8605 shows good performance in acidic fluids with active oxygen and unpolar solvents, its exposure time to steam should be limited. The premium FKM V8T41 can be exposed to steam up to 170°C/338°F and is also more resistant to all types of cleaning fluids. Seals of this material provide longer life than standard FKM seals. Both are high polar compounds and can be used in fatty foods, cosmetics, oils and lubricants.

→ **For more information on these materials go to page 12**

- Resifluor™ 500 has a unique polymer architecture, which means that it can be used with both polar and unpolar fluids, all CIP media and in superheated steam. It also displayed excellent properties in solvents such as MEK, Toluene and Acetone. The fact that Resifluor™ 500 has the combined characteristics of an EPDM and high fluorinated FKM makes it ideal for mixed process streams.

→ **For more information on these materials go to page 12**

- Isolast® FFKM gave the best performance in all test situations. In addition, it has been proved in steam at temperatures up to 240°C/464°F. This means that Isolast® should be selected for the most critical applications where line stops can not be tolerated.

→ **For more information on these materials go to page 14**

- Turcon® PTFE based sealing materials have almost universal chemical compatibility and are capable of operating at high temperatures and in steam. This makes them ideal for use in CIP and SIP regimes. The Turcon® MF range of materials has been specially developed for aseptic applications, with compliance to most major standards.

→ **For more information on these materials go to page 16**



CIP and SIP test results

The table below provides an easy overview of the performance of the Trelleborg Sealing Solutions material portfolio in test conditions.

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

CIP Category	Typical Media	EPDM	FKM			FFKM	PTFE
		E7502 E7518 E8502	V8605	V8T41	Resifluor™ 500 VCT90	Isolast® J9515 & J9516	Turcon® MF1 to MF6
Alkaline	NaOH	+	○	+/○	+	+	+
Acidic	HNO ₃ , H ₃ PO ₄	+	○	+	+	+	+
Acidic + Active Oxygen		+	+	+	+	+	+
Polar solvents	Acetone, MEK	+	-	-	○	+	+
Unpolar solvents	Toluene	-	+	+	+	+	+
Steam	150°C/302°F	+	-	+	+	+	+

+ Excellent ○ Adequate - Unsuitable

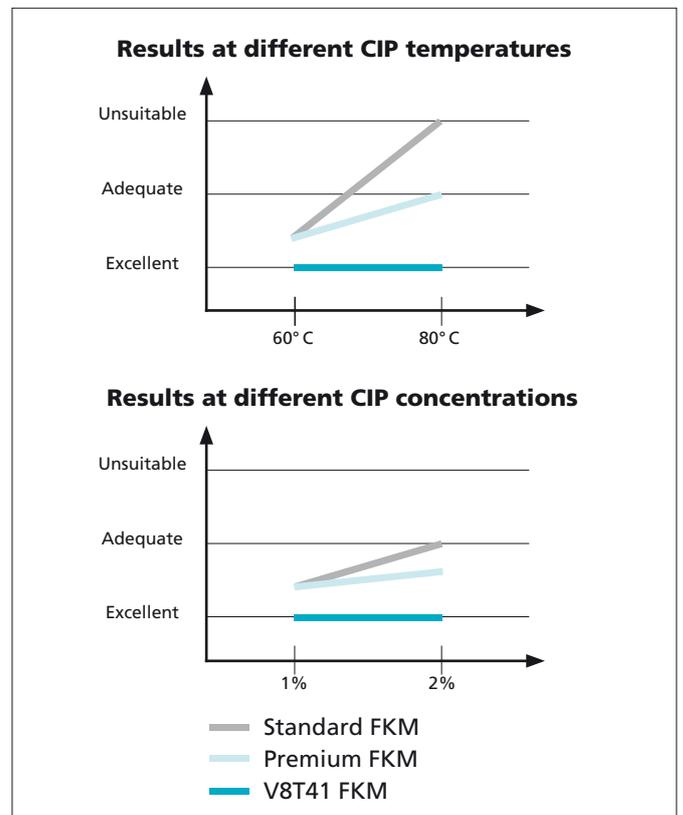
Choosing the right material to extend life

Although standard immersion tests provide detailed information about the suitability of materials in certain fluids, they are not very helpful in predicting length of life of sealing materials. This is why Trelleborg Sealing Solutions has extended our testing over a wider range of temperatures, high concentrations of chemicals and longer immersion times.

In the first test, a variety of FKM materials was tested at two different temperatures. At the lower one, all compounds showed good results. However, it was not until the test was repeated at a higher temperature that the differences between the material characteristics became clear. In the second test, the concentration of CIP medias was changed from 1% to 2%. Again, the differences only became apparent in the more demanding conditions.

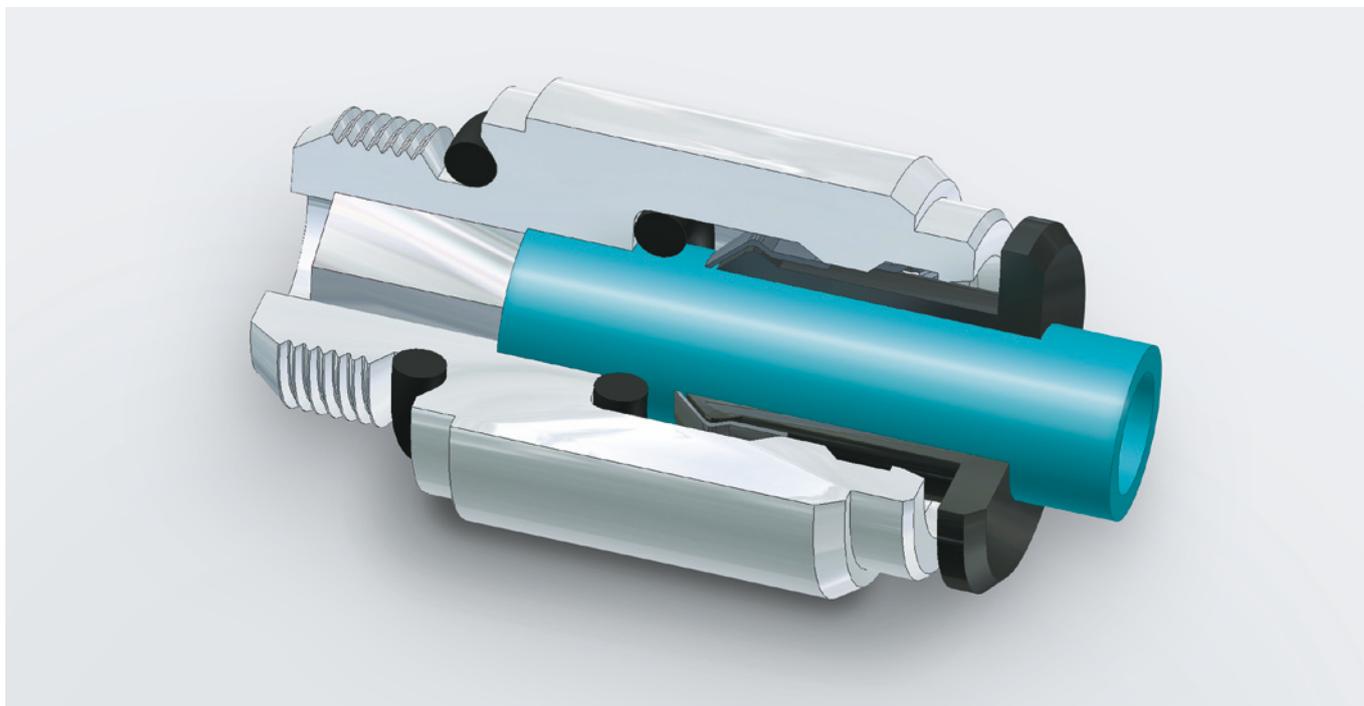
By undertaking these more extensive tests, Trelleborg Sealing Solutions can recommend seals that:

- Provide extended life
- Minimize maintenance cost
- Reduce life time cycle costs





EPDM sealing materials engineered for aseptic technology



Industry specific materials improve integrity

Ethylene Propylene Diene Rubber (EPDM) polymers are fully saturated, unpolar hydrocarbon based elastomers. Their polymer geometry gives them superior compatibility with polar fluids and polar solvents at elevated temperatures. The materials have high chemical resistance, giving long life in polar solvents, hot water and steam. In addition, they are suitable for contact with alkaline cleaning fluids. They have also proved to be excellent in most dairy applications and with WFI (Water For Injection) at high temperatures.

Materials technology enhances capabilities

All recommended EPDM grades are peroxide cured and contain a very low amount of softeners and process aids. This reduces potential leach out to a minimum, lowering the risk of contamination. They have also been engineered to achieve enhanced chemical and thermal stability along with compliance to FDA 21 CFR177.2600, 3-A, USP Class VI, Cytotoxicity (USP 87), NSF51 and several water approvals.

Our range of EPDM materials offers:

- Temperature resistance of standard range from -45°C/-49°F to 160°C/320°F
- Specially engineered grades operate in temperatures between 175°C/347°F and 200°C/392°F
- Exceptional mechanical performance
- Special designed formulations with low long-term compression set
- Minimal risk of contamination from leach out of softeners and process aids
- Long life in polar solvents, hot water and steam
- Suitable for contact with alkaline cleaning fluids
- Ideal in most dairy applications and with WFI (Water For Injection)
- Material compliant to:
 - FDA 21 CFR177.2600
 - 3-A
 - USP Class VI
 - Cytotoxicity (USP 87)
 - NSF
 - KTW, WRAS etc



Areas of use:

EPDM is used in almost all types of applications as a universal material, suitable both in cleaning and sterilization processes. Typical applications are filling, dispensing, pumps, pipe and flange gaskets, valves, quick connectors, tanks, separators, homogenizers, decanters and heat exchangers.

Products:

O-Ring, Square Seal, Kantseal, Flat Seal, Gaskets, Diaphragms, also reinforced. EPDM can also be bonded to other materials and delivered as engineered parts in almost any design.

EPDM Grades

E7502 70 Shore	<ul style="list-style-type: none"> • Recommended for use in aseptic technology • Excellent surface finish • Outstanding chemical stability in polar fluids and steam • Ideal for custom designed parts
E7518 70 Shore	<ul style="list-style-type: none"> • Outstanding chemical stability in polar fluids and steam • Ideal for high volume applications
E8502 80 Shore	<ul style="list-style-type: none"> • The same properties as E7502 but with a hardness of 80 shore A providing higher extrusion resistance



FDA and 3-A compliant EPDM E7502 was the ideal choice for secondary sealing, when an industry leading quick coupling manufacturer decided to develop a product for the chemical and beverage industry.

➔ **For more information on this application go to** page **29**

Property	Test Condition	Standard	Unit	E7502	E7518	E8502
Hardness			Shore A	70	70	80
Compression Set	24 hrs @ 150°C/302°F	DIN ISO 815 (B)	%	12	10	11
Tensile Strength		DIN 53 504	MPa	16.4	15.9	15.9
Elongation at Break		DIN 53 504	%	216	171	125
Min. Service Temperature			°C °F	-45°C -49°F	-45°C -49°F	-45°C -49°F
Max. Service Temperature	Water		°C °F	160°C 320°F	150°C 302°F	160°C 320°F
Color				Black	Black	Black
FDA				Yes	Yes	Yes
USP Class VI				Yes	Yes	Yes
3-A				Yes	Yes	Yes
NSF 51					Yes	
NSF 61					Yes	
KTW				Yes	Yes	Yes
WRAS				Yes	Yes	Yes

Note: Please see statement on material properties at the beginning of the catalog.



Excellent performance from FKM materials



Standard FKM optimized for steam environments

Trelleborg Sealing Solutions has optimized the performance of our Fluoroelastomer (FKM) material range, engineering it to meet the specific criteria of the processing industry. Materials demonstrate good elevated temperature characteristics and compatibility to acidic CIP fluid, fatty food products, food grade lubricants and oils. The specialized V8T41 gives increased chemical compatibility with the capability to operate in steam environments up to 170°C/338°F.

Increased flexibility from Resifluor™ 500 range

The Resifluor™ 500 range is a highly fluorinated speciality FKM with a modified polymer architecture, specifically developed for critical bioprocessing, food, beverage and pharmaceutical applications. It is engineered to combine the chemical resistance of an EPDM towards polar fluids, alkalis and acids, with the performance characteristics of FKM materials in a variety of aggressive fluids.

Resifluor™ 500 shows excellent resistance to attack by a variety of chemicals and fluids, including aliphatic and aromatic hydrocarbons, acids and bases, all types of alcohols and even low molecular ketones, esters and aldehydes. Compared to conventional FKM materials, it has better resistance to steam and caustic cleaning regimes.

Resifluor™ 500 also has low total organic carbon and metal extractables similar to PTFE, which gives the ultimate in cleanliness. This makes it suitable for pharmaceutical applications and bioprocessing in particular, where any extractables may interfere with bio organisms and related products such as proteins and enzymes.

In addition to the black compound a white version is under development to meet the needs of clean processing environments.

Our range of FKM and Resifluor™ 500 materials offers:

- Temperature resistance from -20°C/-4°F to 220°C/428°F
- Steamable FKM to 170°C/338°F
- Very good chemical compatibility
- Low long-term compression set characteristics
- Good compatibility to acidic fluids, fatty food products, food grade lubricants and oils
- Resifluor™ 500 is resistant to a variety of chemicals and fluids, including aliphatic and aromatic hydrocarbons, acids and bases, all types of alcohols and even low molecular ketones, esters and aldehydes
- Material compliant to:
 - FDA 21 CFR177.2600
 - 3-A
 - USP Class VI
 - Cytotoxicity (USP 87)



Areas of use:

FKM is especially suited to processes where there is contact with high fat media such as grease and oils or at high temperature.

Typical applications include Mechanical Seals, Decanters, Separators, Pumps, Tanks, Valves, Heat Exchangers and equipment cleaned using CIP and SIP regimes.

Products:

O-Ring, Square Seal, Kantseal, Flat Seal, Gaskets, Diaphragms, also reinforced.

FKM can also be bonded to other materials and delivered as engineered parts in almost any design.

FKM and Resifluor™ 500 Grades

V8605 80 Shore	<ul style="list-style-type: none"> • Very good operating characteristics • FDA and 3-A compliance
V8T41 80 Shore	<ul style="list-style-type: none"> • Excellent long term sealing resistance • Proven in water steam tests up to 170°C/338°F • Provides improved chemical resistance and extended life
Resifluor™ 500 VCT90 75 Shore	<ul style="list-style-type: none"> • Broadest chemical resistance of all FKM materials • Suitable for long term service in hostile environments where exposed to elevated temperatures and aggressive fluids, such as caustic solutions or polar solvents simultaneously



An engineered part produced in FKM V8605 was the best solution when an industry-leading valve manufacturer wanted to develop a new aseptic mix proof valve. The seal prevents premature failure while precluding mixing of production media and CIP fluids.

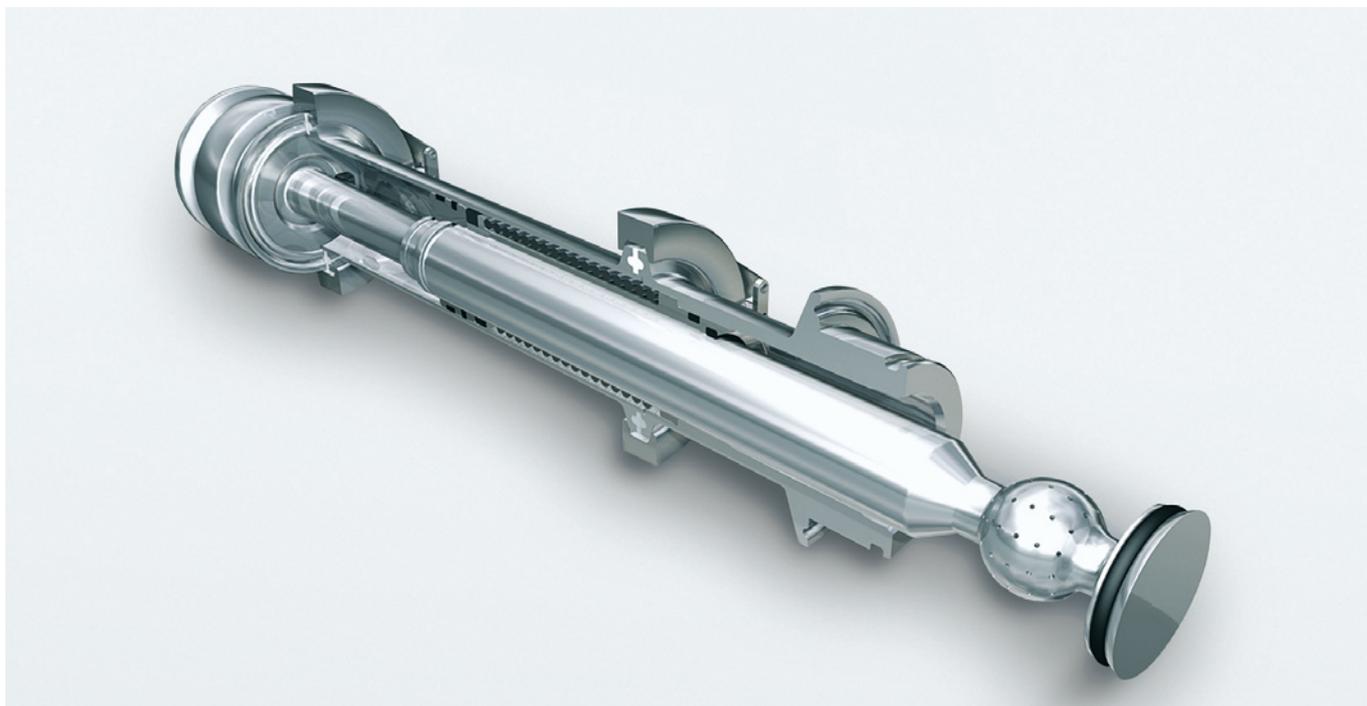
➔ For more information on this application go to **page 28**

Property	Standard	Unit	V8605	V8T41	Resifluor™ 500 Black VCT90
Hardness		Shore A	80	80	75
Compression Set	DIN ISO 815 (B)	%	13% 24h/175°C/347°F	14% 24h/175°C/347°F	18% 70h/150°C/302°F
Tensile Strength	DIN 53 504	MPa	15.9	15.9	15.2
Elongation at Break	DIN 53 504	%	171	125	210
Min. Service Temperature		°C °F	-18°C 0°F	-20°C -4°F	-20°C -4°F
Max. Service Temperature	Air	°C °F	200°C 392°F	200°C 392°F	220°C 392°F
Max. Service Temperature	H ₂ O	°C °F	130 C 266°F	170°C 338°F	170°C 338°F
Color			Black	Black	Black
FDA			Yes	Yes	Yes
USP			Yes	Yes	Yes
3-A			Yes	Yes	Yes

Note: Please see statement on material properties at the beginning of the catalog.



Isolast® FFKM: The ultimate in elastomer sealing



Outstanding resistance to chemicals

Perfluoroelastomer (FFKM) materials are terpolymers of monomers in which all hydrogen atoms have been replaced by fluorine. The absence of hydrogen in the molecular chain dramatically increases both their chemical and thermal resistance. The cross-linked molecular chains enable them to combine the resilience and sealing force of an elastomer with the chemical inertness and thermal stability of PTFE.

Unrivalled operating characteristics

Isolast® is the Trelleborg Sealing Solutions range of high specification perfluoroelastomer compounds. It offers the widest portfolio on the market engineered to meet specific processing demands. Virtually inert, the materials perform well in a broad range of chemical media including organic and inorganic oxides, acids, alkalis, amines, esters and steam at continuous operating temperatures from -25°C/-13°F to 325°C/617°F.

Improving production efficiency

In tests Isolast® is proven to have better operating characteristics than other elastomer types as well as competitive perfluoroelastomers. The two grades J9515 and J9516 have been developed to meet the most stringent standards and are ideal for sealing in aggressive solvent-based cleaning fluids in these applications. They help reduce downtime and improve production efficiency by extending seal life.

Our range of Isolast® FFKM materials offers:

- Temperature resistance from -30°C/-22°F to 325°C/617°F
- Almost universal chemical compatibility
- Exceptional hysteresis properties
- Outstanding low long-term compression set characteristics
- Materials perform well in a broad range of chemical media including ethylene oxides, acids, alkalis, amines, esters and steam
- Material compliant to:
 - FDA 21 CFR177.2400 (d)
 - 3-A
 - USP Class VI
 - Cytotoxicity (USP 87)



Areas of use:

Isolast® provides the ultimate solution for elastomer sealing in aggressive chemicals and at extreme temperatures. It is recommended for similar areas of use to those of EPDM or FKM materials but where extremely aggressive media is present.

Products:

Isolast® can be manufactured in a variety of standard and custom designs. In addition, we have developed many innovative cost-effective solutions that minimize FFKM content.



Isolast® Perfluoroelastomer Grades

J9515 and J9516	<ul style="list-style-type: none"> • Broadest chemical resistance of all elastomers, similar to PTFE • Black and white grades compliant to relevant approvals • Suitable for long term service in hostile environments where exposed to elevated temperatures and aggressive fluids, such as caustic solutions or polar solvents simultaneously
J9503	<ul style="list-style-type: none"> • Provides unrivalled chemical resistance
J9505 and J9501	<ul style="list-style-type: none"> • White grades ideal for use in strong oxidizing material • J9501 is slightly harder than J9505
J8325	<ul style="list-style-type: none"> • Excellent material for use in high temperature applications up to 325°C/617°F
J9512	<ul style="list-style-type: none"> • Ideal in high temperature steam applications and concentrated acids

In a retractable spray ball system for CIP, Isolast® parts compliant to FDA were used to seal between the spray head and process media. To meet the requirement of an absolute mix proof seal, in tests the sealing configuration withstood cycles of a 1,000 operations with no leakage and pressure held.

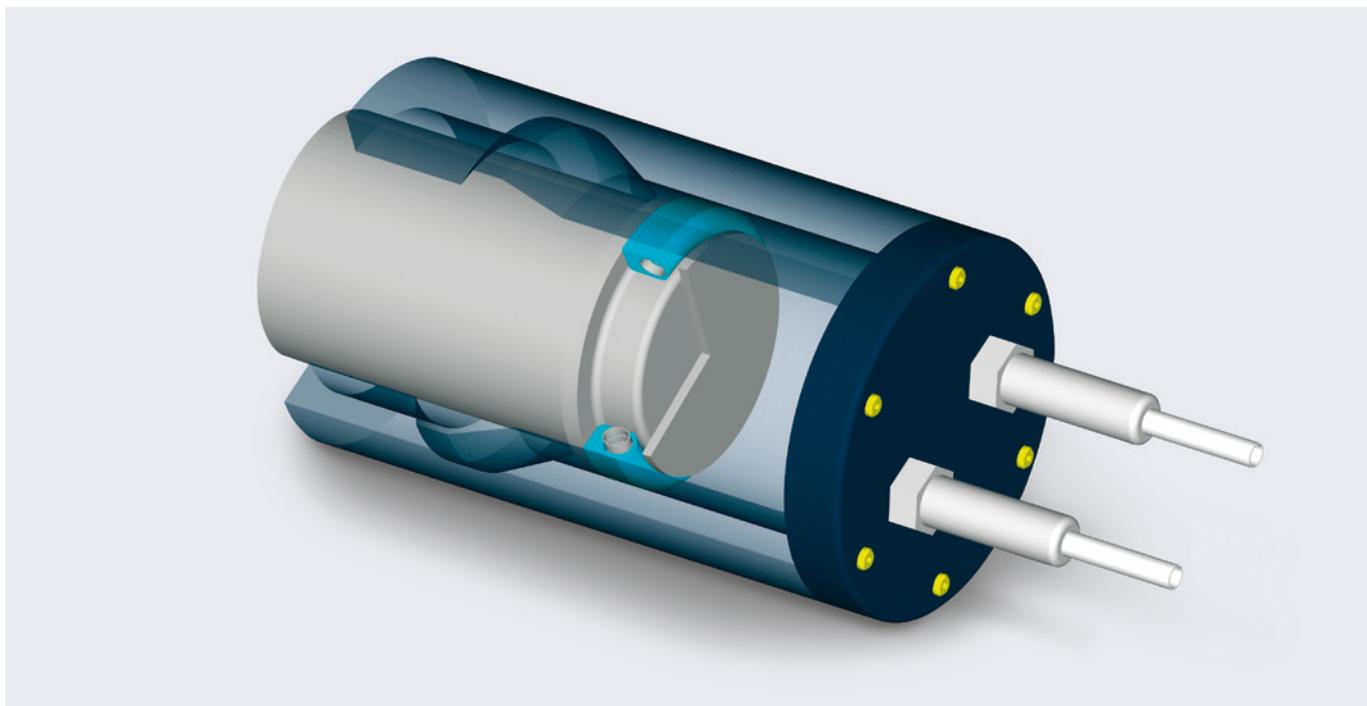
➔ For more information on this application go to **page 30**

Property	Test Condition	Unit	J9515	J9516	J9503	J9509	J9505	J9501	J8325	J9512
Hardness		Shore A	75	75	75	90	70	80	75	75
Compression Set	72 hrs @ 200°C/392°F	%	16	30	25	38	20	25	19	15
Tensile Strength		MPa	11	11	12.5	12.5	6.5	6.5	20	12
Elongation at Break		%	160	200	120	100	200	150	190	163
Min. Service Temperature		°C °F	-10°C 14°F	-15°C 5°F	-15°C 5°F	-25°C -13°F	-20°C -4°F	-20°C -4°F	-15°C 5°F	-5°C 23°F
Max. Service Temperature		°C °F	250°C 482°F	250°C 482°F	240°C 464°F	240°C 464°F	240°C 464°F	240°C 464°F	325°C 617°F	260°C 500°F
Color			Black	White	Black	Black	White	White	Black	Black
FDA			Yes	Yes						
USP Class VI			Yes	Yes						
3-A			Yes	Yes						

Note: Please see statement on material properties at the beginning of the catalog.



Turcon®: Unrivalled PTFE sealing capabilities



Dynamic and rotating sealing elements

Inherently, Polytetrafluoroethylene (PTFE) is compatible with almost all chemicals, making it ideal for use in equipment where seals are likely to be exposed to aggressive media, including CIP and SIP regimes. With excellent friction and self-lubricating characteristics, these materials are suited to dynamic and rotating applications. Specific operating properties are achieved by the addition of fillers and special processing technologies.

The world's largest manufacturer of PTFE based seals

Trelleborg Sealing Solutions is the world's largest manufacturer of seals in this type of material, and no other sealing supplier can offer such a wide range of grades. All of these are produced at our own facilities in Europe, US, South America and Asia. Turcon® is the Trelleborg Sealing Solutions brand of proprietary PTFE based compounds.

Engineered for demanding environments

With so many options, a cost-effective choice is available whatever the application. For environments where seals are not exposed to process media, compliance to approvals is not necessary. In these cases T05, T19, or T46 are the standard choice. Where compliant materials are needed, the Turcon® MF range has been formulated to meet bioprocessing, food, beverage and pharmaceutical production demands.

Turcon® MF designed for processing needs

Based on ultra-clean technology, these compounds are manufactured from high-purity PTFE grades and additives. Their smooth finish, with high gloss and low porosity, avoids the risk of contamination buildup and reduces particle shedding. Each batch of Turcon® MF material is manufactured using high-grade material only. Before delivery, all products are visually inspected and can be issued with a certificate of conformity.

Our range of Turcon® PTFE materials offers:

- Temperature resistance from -253°C/-423°F to 260°C/500°F
- Almost universal chemical compatibility
- High wear resistance
- Minimal creep and permeation
- Surface finish minimizes contamination risk
- Materials perform well in a broad range of chemical media including organic and inorganic oxides, acids, alkalis, amines, esters and steam
- Materials compliant to FDA 21 CFR 177.1550, 3-A, USP Class VI, 2002/72/EC and sanitary standards



Areas of use:

- For static, reciprocating and rotary applications
- To prevent downtime in pharmaceutical and serum production
- Mixed process streams in multipurpose equipment where seals are exposed to a variety of extremely aggressive cleaning solvents and CIP fluids
- Low and High temperature environments

A manufacturer of filling equipment for fruit juices identified that particles were being trapped within elastomer seals, leading to contamination of the process stream. This problem was solved by fitting a Turcon® Variseal® in a FDA compliant MF grade.

➔ For more information on this application go to **page 30**



When developing a new piston filler, a filling company selected the new Variseal® Ultra-Clean™ since it offers the ultimate in cleanliness for a spring energized MF PTFE based seal.

➔ For more information on the Turcon® Variseal® Ultra-Clean™ go to **page 23**

Turcon® Grades

Turcon® MF1	<ul style="list-style-type: none"> • Exceptional friction characteristics • Unrivalled low temperature capabilities • Suitable for use with soft mating surfaces
Turcon® MF2	<ul style="list-style-type: none"> • Good surface quality • Low gas permeability
Turcon® MF3	<ul style="list-style-type: none"> • Good wear resistance • Suitable for use with soft mating surfaces
Turcon® MF4	<ul style="list-style-type: none"> • Unique lubricating properties • Withstands higher pressures • Suitable for use with medium to hard mating surfaces • Very good wear resistance
Turcon® MF5	<ul style="list-style-type: none"> • High wear resistance • Good friction and sliding properties • Specially suitable for rotary applications
Turcon® MF6	<ul style="list-style-type: none"> • Superior pressure and wear performance • Suitable for gas, high and low viscosity fluids
Turcon® T05	<ul style="list-style-type: none"> • Static and light dynamic use • Good sealing performance in fluids and gases
Turcon® T19	<ul style="list-style-type: none"> • Good wear resistance in linear and rotary use • Can run with poor lubrication
Turcon® T46	<ul style="list-style-type: none"> • Standard grade for lubricated hydraulic applications • Excellent wear and extrusion resistance

Property	Test Condition	Standard	Unit	MF1	MF2	MF3	MF4	MF5	MF6	T05	T46	T19
Conditions of use												
Min. Service Temperature			°C °F	-253°C -423°F	-200°C -328°F	-200°C -328°F	-200°C -328°F	-200°C -328°F	-200°C -328°F	-200°C -328°F	-200°C -328°F	-200°C -328°F
Max. Service Temperature			°C °F	260°C 500°F	260°C 500°F	260°C 500°F	260°C 500°F	260°C 500°F	260°C 500°F	260°C 500°F	260°C 500°F	260°C 500°F
Tensile Strength @ Break	23°C/73°F	ASTM D 4894	MPa	36	35	29	26	28	22	40	29	23
Tensile Elongation @ Break	23°C/73°F	ASTM D 4894	%	330	506	320	280	311	235	430	280	230
Deformation under Load	23C/73F – 24 h 13.8 MPa	ASTM D 621	%	8.9	-	-	5.1	8.8	-	8.7	5.9	4.1
Creep	23C/73F – 24 h 13.8 MPa – 1.5 h	ASTM D 621	%	5.6	-	-	3.3	6.4	-	5.6	3.7	2.7
Color				White to off-white	White to off-white	White to off-white	Grey	White to off-white	Tan to dark brown	Turquoise	Greyish to dark brown	Greyish to dark grey
FDA				Yes	Yes	Yes	Yes	Yes	Yes			
USP Class VI				Yes			Yes		Yes			
3-A				Yes					Yes			

Note: Please see statement on material properties at the beginning of the catalog.



Solutions from a broad material range



With their compliance to industry approvals and broad compatibility to CIP and SIP processes, EPDM, FKM, FFKM and PTFE materials are the usual choice for sealing products in aseptic technology. However, Trelleborg Sealing Solutions offers a number of other compounds which can be used in peripheral applications.

Silicone inherently inert to bacteria, mold and fungi

Silicone materials are ideal for use in bioprocessing, food, beverage and pharmaceutical production due to their inherent inertness to bacteria, mold and fungi. Trelleborg Sealing Solutions provide materials that give excellent heat resistance, cold flexibility and dielectric properties. They are especially good where exposure to ozone and oxygen is likely and have operating temperatures from -60°C/-76°F to 200°C/392°F. Also, their exceptional low surface energy means they will not adhere to counterparts.

Demonstrating low long-term compression set, silicone materials are suitable for use in hot water, animal and plant fat, some lubricants and glycerin. However, care should be taken if specifying in acids, alkalis, ketones, esters and steam above 100°C/212°F, where chemical degradation can occur.

Silicone Compounds

SC6L1	Inherently inert to bacteria, mold and fungi
S7OR8	

Good mechanical performance from NBR

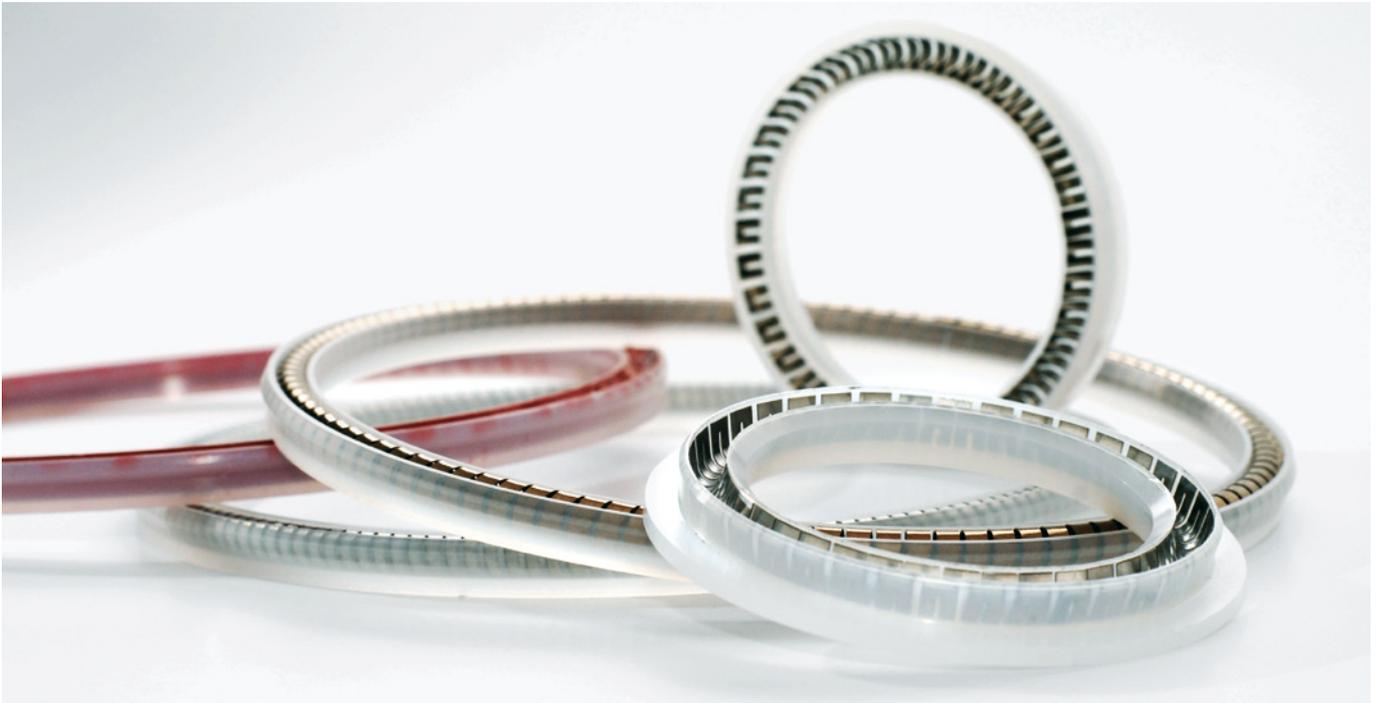
Acrylonitrile-Butadiene Rubber (NBR) is a good choice for applications where seals will not be exposed to harsh cleaning regimes, ozone or superheated steam. These materials are copolymers of butadiene and acrylonitrile. The percentage of these in the NBR formulation determines their performance characteristics.

With good mechanical properties, they have long-term operating temperatures from -30°C/-22°F to 100°C/212°F and up to 120°C/248°F for short periods. Special formulations give good resistance to hydrocarbons of high aromatic content and water. Ideal for meat and poultry processing they have excellent performance in animal and vegetable fats.

Grades are available that are compliant to FDA 21 CFR177.2600 and 3-A standards.

NBR Compounds

N7027	70 Shore A FDA, NSF51, NSF61, KTW, W270, ACS
N7007	70 Shore A FDA, 3-A, KTW
N8604	80 Shore A FDA, 3-A, WRAS



Zurcon® for reciprocating and oscillating situations

Zurcon® Z80

Zurcon® is the brand name for the Trelleborg Sealing Solutions range of engineered plastic based materials. Its friction characteristics mean it is ideal for reciprocating, very slow rotating and oscillating situations where high wear resistance is required. With an operating temperature from -196°C/-321°F to 80°C/176°F continuous use up to 125°C/257°F for short periods it is compatible with all water based and alkaline cleaning agents with steam cycles below 115°C/239°F.

Compliant to FDA 21 CFR 177.1520, Zurcon® Z80 is suitable for use in food processing applications.

Zurcon® Compounds

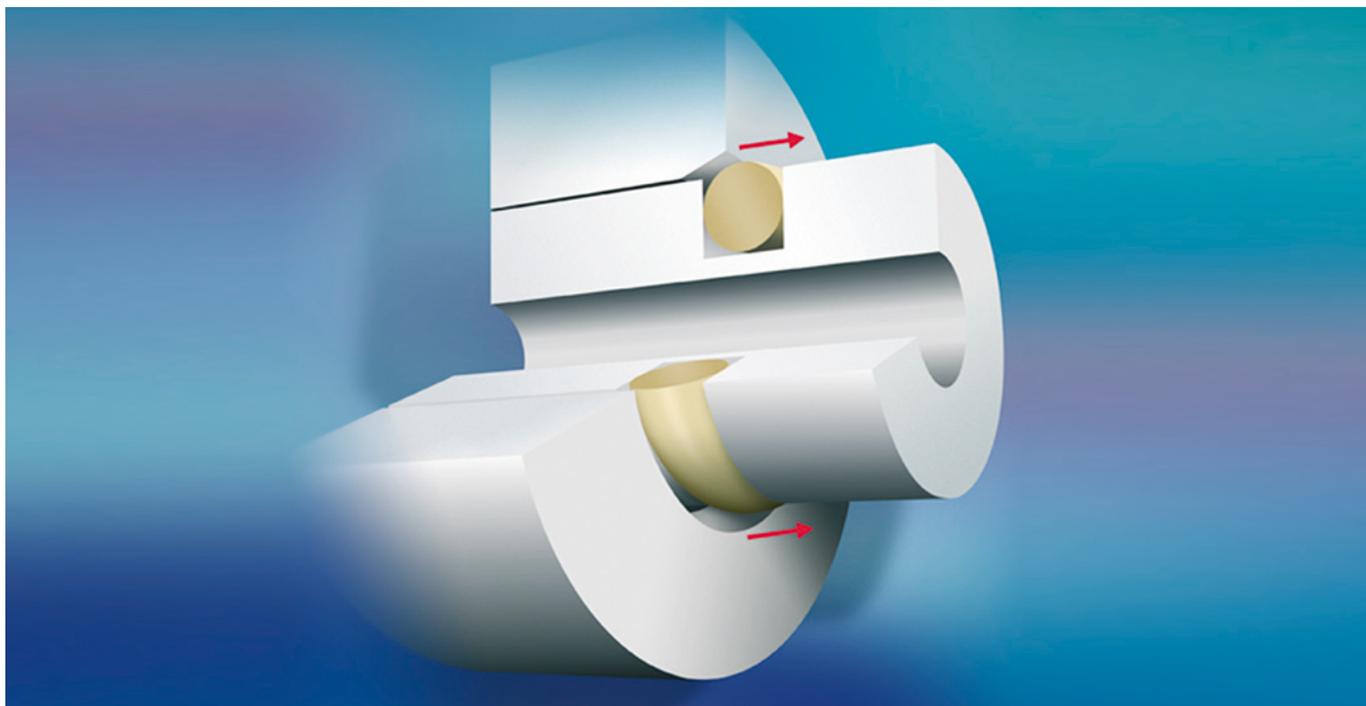
Z80	For abrasive conditions and poor lubrication FDA
Z2221	Good for standard applications FDA

Zurcon® Z2221

Zurcon® Z2221 is a proprietary polyurethane material specially developed for the manufacture of sealing elements. The material displays high wear resistance, low compression set and a wide operating temperature range from -30°C/-22°F to 110°C/230°F. Compliant to 21 CFR 177.1680, it is suitable for use in various food applications where resistance is required. It is compatible with many water based and alkaline cleaning agents and with steam cycles below 115°C/239°F.



Coatings



Surface treatments to improve friction characteristics

Inherently, elastomers have a high coefficient of friction. This means they tend to stick, either to each other during automated assembly, or to mating surfaces when inserted into a housing. Trelleborg Sealing Solutions offers a number of surface treatments that improve the friction characteristics of elastomer seals. Enhancing wear resistance, they lower insertion forces and allow sealing in some dynamic applications.

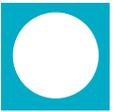
FF coating is the ideal surface treatment for food, beverage and pharmaceutical processing. This is compliant to FDA and other standards pertaining to the handling of food and potable water. It is water based, solvent-free and transparent with an operating temperature of -40°C/-40°F to 150°C/302°F.

The coating is suited for all kinds of elastomer seals, depending on their shape and size, and does not affect the seal's natural elasticity. Its reduced friction makes it ideal in automated assembly processes. Suited for both static and low-level dynamic applications, with infrequent movement and short stroke rate, it retains its properties in repeated insertion and dismantling processes.

Areas of use:

- Plug-in couplings or quick-release couplings
- Seals inside valves
- Any kind of automated or manual assembly

	FF
Type	coating, PTFE
Color	transparent (milky)
Quality control	reference sample
Coating thickness (guidance)	2 - 10 µm (deviations possible, dependant on the parts geometry)
Temperature range	-40°C/-40°F up to 150°C/302°F
Approvals / guidelines	FDA HHS 21 CFR Ch. I §§175.300/177.1520 approved according to the Foodstuffs and Commodities Act (LMBG, § 5, paragraph 1, § 31, paragraph 1) complies with the standards of the German Federal Environmental Agency (FEA), valid for the area D2 (seals)
Hardness of the coated part	increase in the hardness of the sealing surface of up to +4 IRHD possible (measured on the finished part)
Characteristics	<ul style="list-style-type: none"> • Solvent free • Water-based dry coating • Contains no materials requiring declaration to VDA 232-101
Area of application	for all types of elastomer (dependant on formulation)



Products designed for optimized performance

Trelleborg Sealing Solutions offers one of the widest product portfolios of any seal supplier including many proprietary designs. They extend from the multifunctional O-Ring to more complex Turcon® Variseal®, through

to custom molded geometries and bonded products. Innovative engineered products in high technology materials help reduce downtime and improve production efficiency by extending seal life.

Standard Elastomer Seals

Standard O-Rings



For static and slow dynamic situations, the O-Ring is the most commonly used seal, and Trelleborg Sealing Solutions can supply virtually any size. They are available to meet all international standards such as AS568B, DIN3771, BS 1806/ BS 4518, JIS B2401, NFT47-501, SMS 1586 and ISO 3601 alongside seals

produced in custom dimensions. Cost-effective, our wide range of specialized elastomers means O-Ring material can be matched to the specific needs of an application.

FEP encapsulated O-Rings



FEP O-Rings are an option when a seal with a high level of chemical compatibility is required. These consist of an elastomer inner ring encapsulated within a seamless Tetrafluoroethylene-Hexafluoropropylene (FEP) sheath. The FEP outer layer gives chemical resistance similar to PTFE, while a core

of either FKM or silicone provides elasticity. Compliant with FDA 21 CFR 177.1550 and 3-A standards, they are used in static, slow switching and rotary applications.

FlexiMold™ giant seals



With FlexiMold™ proprietary technology, Trelleborg Sealing Solutions manufactures giant high quality seals. Of superior quality to those fabricated as spliced seals or from extruded cord, they demonstrate the full visual and dimensional integrity of a molded product. Produced

without the need of a dedicated tool, a flexible tool setup minimizes leadtimes and costs. Available in a wide range of elastomers, FlexiMold™ is recommended for O-Rings and other seal profiles over 500 mm/20 inches. They are supplied to standards ISO 3601-1, AS568 and JIS B 2401 and can be produced in almost infinite diameters.

QUAD-RING®



Trelleborg Sealing Solutions is the supplier of the original QUAD-RING®. This is a four lipped seal with a specially developed sealing profile. In contrast to the O-Ring, the QUAD-RING® avoids twisting in the groove, has improved friction characteristics and gives higher sealing efficiency in some applications.

Kantseal



The Kantseal is a static seal with a square cross section. The Kantseal offers high extrusion resistance, minimal deformation and a good compression set.

Flange gaskets for pipe couplings

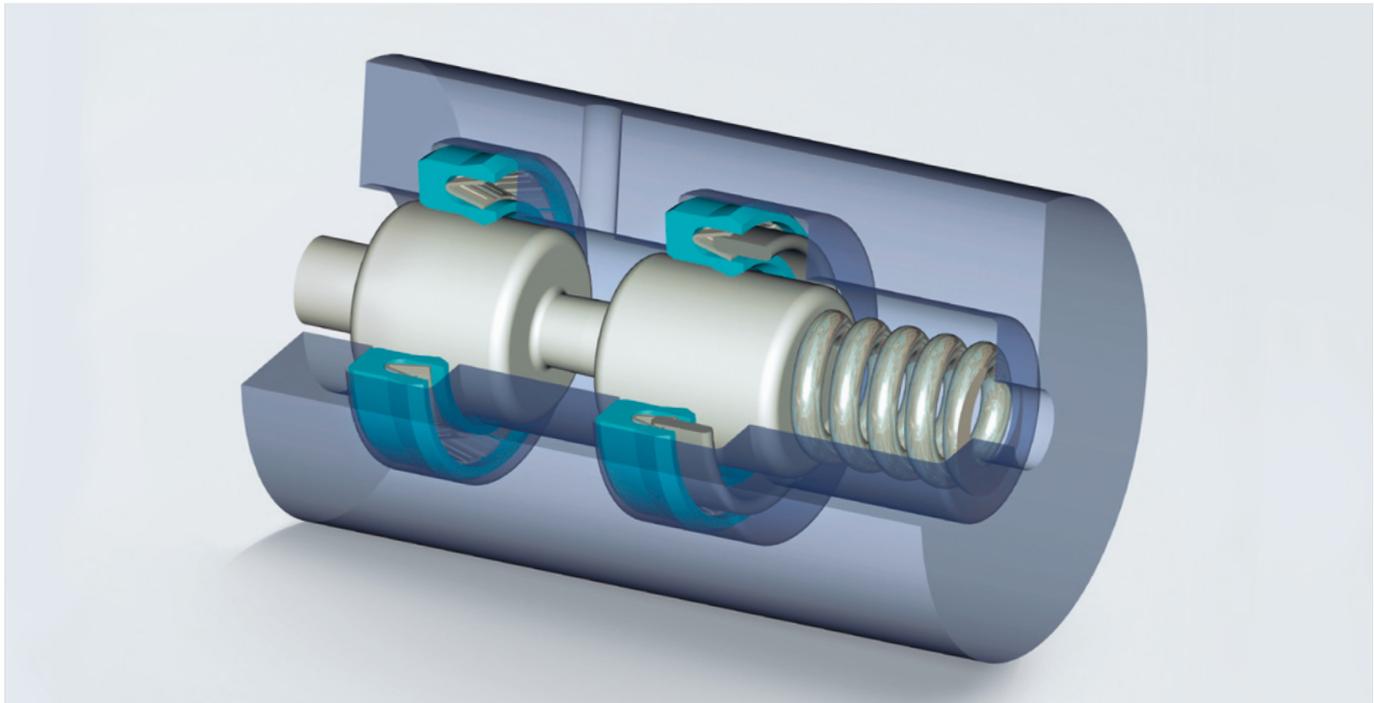


Trelleborg Sealing Solutions has a range of standard flange gaskets specifically designed for hygienic pipe couplings in process systems.

The gaskets are available in premium materials, and their excellent chemical resistance helps reduce downtime, improving production efficiency by extending seal life. They also minimize the risk of contamination and bacterial ingress, ensuring product purity. Parts are available in both inch sizes according to ISO 2852 and metric sizes to DIN 32676.



Dynamic Linear Fluid Seals



At the forefront of product design for fluid sealing situations, Trelleborg Sealing Solutions provides an unrivalled range of proprietary seals for these applications.

Glyd Ring® with improved leakage control



Turcon® Glyd Ring® and Turcon® Glyd Ring® T give excellent leakage control in piston and rod applications along with resistance to extrusion. These double acting O-Ring energized seals are primarily for dynamic applications where they give high wear resistance. Their low friction characteristics give

long life and prevent sticking even after extended periods of rest. Typical applications are high performance piston fillers and metering pumps for very viscous fluids.

Stepseal® 2K enhances performance in cylinder applications



Achieving new levels in piston and rod sealing, the Turcon® Stepseal® 2K enhances efficiency in these applications. With excellent extrusion resistance, it gives superior leakage control. It also has uniform, low friction characteristics throughout an extended life, and sticking is prevented, even

after long periods of rest. With very good abrasion resistance, this seal is a good choice for sticky fluids such as syrups and in glues.

Broad Range of Fluid Seals

In addition to these seals the fluid sealing range includes the following products:

Rimseal, L-Cup®, U-Cup, VL-Seal, Double Delta®, AQ Seal®, Wynseal® and many custom designs.

All fluid seals can be manufactured in Turcon® MF materials which are specially engineered for aseptic applications. These compounds, with their compliance to all major approvals and almost total chemical compatibility, allow these geometries to be fully utilized in bioprocessing, food, beverage and pharmaceutical applications.

→ For further information on Turcon® MF go to page 16



Variseal® provides optimum aseptic sealing

Turcon® Variseal® is an extremely important product within bioprocessing, food, beverage and pharmaceutical production. Commonly installed in filling plants, where demands are high on cleanability, sterilization and hygienic design, it is field proven in such operating conditions. Designed to fit in existing O-Ring grooves,

it can provide a very high level of integrity, even in aggressive system media and within cleaning regimes. For static and dynamic applications, these seals demonstrate low-friction characteristics, leading to extended service life.

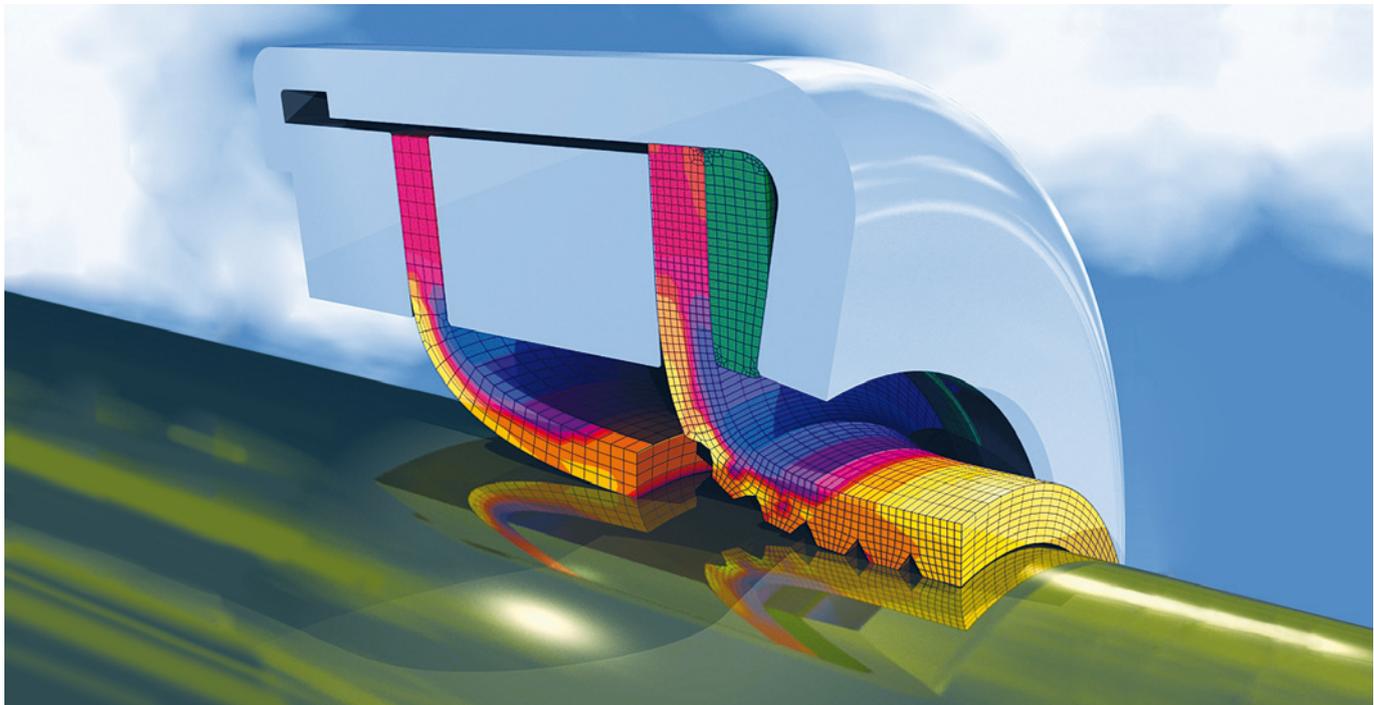
A wide variety of Turcon® Variseal® products

Choose from:

Standard	Designed for dynamic leakage control and long term wear resistance. Fitted with a medium spring load, it gives good flexibility. The Standard Variseal® is available in a Hi-Clean option.	
Scraper	Similar to the standard design but with optimized scraping ability. The Scraper Variseal® is available in a Hi-Clean option.	
Helical	With a rounded surface and high spring force, the design is ideal for sealing gases at zero or low pressure and for low viscosity fluids. Suitable for static sealing and demanding low speed applications.	
Slantcoil®	This seal's low spring force makes it ideal for low-friction and low-pressure applications. The Slantcoil® design gives almost constant load over the life of the seal.	
Face Seal	Similar to the Helical seal but with an axial design, this is the best choice for vacuum, gas and low temperature flange applications.	
Hi-Clean	In this seal the spring groove is filled with high temperature silicone. Preventing any trapping of contaminants within the seal, the filling ensures that it is easily cleaned.	
Ultra-Clean™	In this unique design, the spring is fully enclosed within a Turcon® case. This prevents contamination from media trapped in dead space around the spring. Additionally, the seal can be thoroughly cleaned and sterilized from all directions using any CIP media. Variseal® Ultra-Clean™ is available as a special engineered product.	



Dynamic Rotary Seals



When it comes to successfully sealing in rotary applications, specialized products are required. Trelleborg Sealing Solutions offers a range of unique options, both standard and custom, that give exceptional performance characteristics in demanding rotary situations. Seals in Turcon® MF compounds offer the best resistance in aggressive cleaning fluids and steam at extreme temperatures. Ideal in aseptic environments, they are compliant to all major approvals and can meet dead space free requirements.

→ For full details of the Turcon® MF range go to page 16

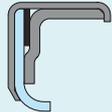
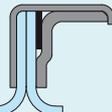
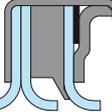
Turcon® Rotary Shaft Seals provide superior sealing

Utilizing advanced design techniques, Turcon® Rotary Shaft Seals, Turcon® Varilip® and Turcon® Varilip® PDR provide a superior sealing solutions within compact product dimensions. Consisting of a Turcon® sealing lip retained within a metal casing, they have the structural rigidity to function effectively in rotating actions. With low friction characteristics, sticking is prevented even after extended periods of rest.

Turcon® Varilip®: an exceptional standard solution

Several different types of Turcon® Varilip® are available in a range of sizes suitable for standard DIN and ISO housing and groove sizes. With its plain lip, it can be used on shafts that rotate in either direction.

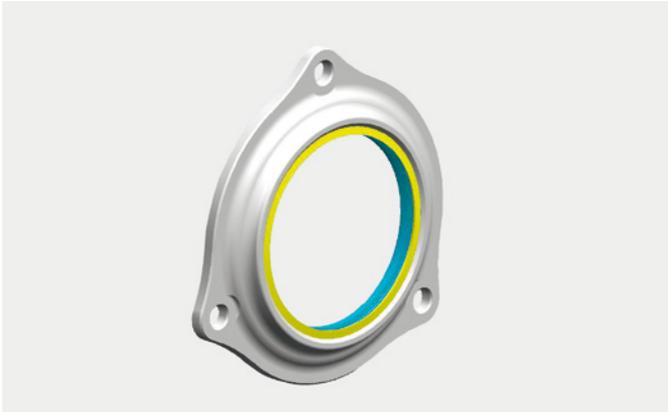
These standard Turcon® Varilip® types are recommended for high speed applications.

<p>Type A</p> 	<p>Suitable for use in applications with pressures to 0.5 MPa/72.5 psi in medium or poor lubrication. Operates at surface speeds up to 30 m/s/98 ft/s, depending on the cooling and lubrication of sealing lip.</p>
<p>Type B</p> 	<p>With its second lip it gives greater security especially where external media must be sealed from the process.</p>
<p>Type D</p> 	<p>This seal's double lip can be subjected to pressure from both sides with a differential of up to 0.1 MPa/14.5 psi. The second lip can function as a wiper, dust lip or to separate two different media.</p>
<p>Type E</p> 	<p>Similar to Type B, this seal's additional lip gives even higher security when external media must be sealed from the process and is ideal where abrasive particles are present.</p>



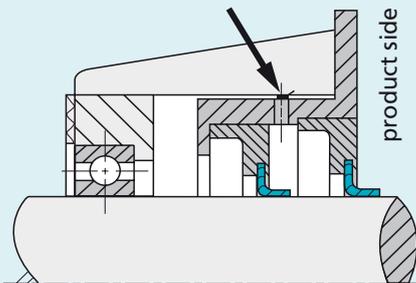
Custom-designed Turcon® Varilip® PDR

If you are developing equipment for bioprocessing, food, beverage or pharmaceutical production, Turcon® Varilip® PDR may be an option. These seals are custom-designed for non-standard housings and any shaft size. The sealing lip can even be integrated into the metal body of equipment housings. This can reduce your component assembly, give maximum integrity and eliminates dead space. With the inclusion of a hydrodynamic feature, positive displacement of fluid improves sealing function and lengthens seal life. It also increases lip flexibility, widening the contact band on the shaft, lowering shaft load and associated wear.



Turcon® Varilip® PDR

Purge bore for CIP/SIP fluids



Important in rotating applications, product designs in Turcon® MF such as Varilip® PDR, have the advantage of meeting the dead space requirements for aseptic environments.

Additionally a purge bore has been added to the hardware to enable for extra cleaning. The crimped design also eliminates the use of elastomers, giving it almost universal media resistance.

Seal and housing as one

Turcon® Varilip® PDR seal can be designed to be integral within the equipment housing. This gives maximum integrity and reduces assembly.

Turcon® Variseal® and Turcon® Glyd Ring® for rotary situations

In addition to Turcon® Rotary Shaft Seals, the Turcon® Roto Variseal® and Turcon® Roto Glyd Ring® have been specially adapted for rotary situations. The Turcon® Roto Variseal®, with its V shaped ring, has a flanged heel which prevents the seal rotating in the groove. Turcon® Roto Glyd Ring® is double acting and suitable for rotating, oscillating and helically moving pistons, rods and shafts.





Engineered seals broaden application coverage



Custom designs provide the optimum solution

For some critical applications, the best solution is a custom designed component, where material knowledge and a high level of technical design are united. The Trelleborg Sealing Solutions portfolio of engineered products is almost unlimited. This allows us to meet our aim of developing the optimum solution for each application, in terms of both value and functionality.

The product offering includes anything from relatively simple variations on a standard seal designs to diaphragms, with or without fiber reinforcement and complex gaskets. Sealing elements can also be bonded to housing substrates such as plastics or metal. These give almost total integrity, minimizing assembly, reducing overall production costs.



Working with customers to prove seals in application in our global research and development centers and test facilities, numerous tests can be carried out to make sure compounds perform to specific requirements. Additionally, using tools such as Finite Element Analysis (FEA), we can prove seal behavior in application in a virtual environment. While leading-edge test facilities, mean we can validate designs in a laboratory situation before the customer performs their field tests.



The application expert



The strength of Trelleborg Sealing Solutions has always been our deep application knowledge of the food, beverage and pharmaceutical industry. Many thousands of successful customer projects, using both standard products and engineered solutions, has made us to the technology leading company in these sectors.

Products from Trelleborg Sealing Solutions are found in all types of applications, including:

- Valves
- Pumps
- Separators and decanters
- Homogenizers
- Filling, dispensing and packaging machines
- Flange sealing
- Tanks
- CIP and SIP equipment
- Heat Exchangers
- Food handling equipment
- Mechanical Seals

On the following pages an overview of some recent applications:



Mix Proof Valves



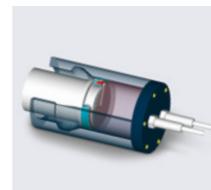
Hygienic Flange Gaskets



High End Quick Coupling



Safety valves with bonded Isolast®



Easy-to-Clean Fillers



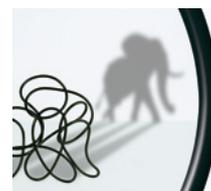
CIP/SIP Cleaning Equipment

To read about more applications and products, take a look at the in the groove customer magazine on our website.

www.tss.trelleborg.com/groove



Coffee Machines



Centrifuges sealed with giant seals



Optimizing seal life in application

Helping maximize production in systems fitted with mix proof valves

Mix proof valves are key components in automated matrix-piped processing plants. The plants can be used for the production of all sorts of products, ranging from food and beverage to pharmaceuticals and cosmetics. The mix proof valves allow for concurrent processing and cleaning of the system, while at the same time prevent mixing of media.

Sealing issue:

Trelleborg Sealing Solutions was contacted by a leading international valve manufacturer to help develop the sealing configuration for the new generation of valves. Since the valves were required to be in operation 24 hours per day, the seals come under attack both from high concentration CIP media and super heated steam. Additionally, several of the seals were used dynamically.

Sealing requirements:

- All sealing materials need to comply with FDA standards
- Have good chemical resistance to oil and fat, ozone and aging
- Allow for a thermal range up to 200°C/392°F
- Withstand cleaning fluids at a concentration up to 5% acids at 100°C/212°F and 5% bases at 40°C/104°F
- Withstand sterilization in steam

Solution:



Trelleborg Sealing Solutions worked with the valve manufacturer from initial development of the product. By using FEA (Finite Element Analysis) and 3D modeling we identified the best geometry for an engineered seal to maximize sealing integrity. FKM V8605 was selected due to its chemical compatibility to production media as well as cleaning regimes and steam.

Result:

The recommended sealing configuration has been fitted in volume to valves in a variety of liquid handling situations. They are proving to withstand CIP and SIP regimes, lengthening intervals between planned maintenance and maximizing production yield.

- **For more information on V8605 materials go to page 12**
- **O-Rings are featured on page 21**
- **Our engineered parts capabilities are shown on page 26**

Optimum sealing material for flange gaskets

In today's processing plants, there are thousands of lengths of piping and at each juncture, a coupling. These are sealed with clamp gaskets and O-Rings. Though the individual cost of these may be relatively insignificant, their cost in terms of maintenance can be extremely high.

Sealing issue:

Constantly in contact with system media and subject to aggressive cleaning regimes, flange gaskets used to seal pipework connections within a processing system of a global pharmaceutical company deteriorated quickly. Our customer wanted to reduce maintenance costs by extending intervals between planned maintenance cost-effectively. However, sealing integrity could not be compromised, as any contamination involved a major cost in scrapping production batches.

Sealing requirements:

- Withstand mixture of alkaline and acidic CIP medias
- Compliant with FDA, USP Class VI and 3-A standards
- Long seal life to extend intervals between planned maintenance

Solution:



Trelleborg Sealing Solutions has undertaken a number of tests to determine the optimum material for use in CIP chemicals. Based upon these results, it was recommended that the flange gaskets were replaced by ones manufactured in EPDM E7502.

Result:

The change in material for the flange gaskets proved to extend seal life and achieved the objective of increased productivity, extending meantime between planned maintenance. In addition, as E7502 was specifically engineered for aseptic applications, contamination was reduced.

- **For more information on EPDM E7502 go to page 10**
- **Flange gaskets are featured on page 21**



Superior chemical resistance in quick couplings

Quick couplings are now extensively used in process lines to allow for a flexible production system and to make maintenance and repair quicker and easier.

Sealing issue:

A leading quick coupling manufacturer wanted to develop a coupling for use in the chemical and beverage industry. The elastomer seals that they usually fitted in their product would not stand up to the harsh conditions of these processing lines. They approached Trelleborg Sealing Solutions for a solution that would be chemical and steam resistant while complying with relevant industry standards.

Sealing requirements:

- High chemical resistance
- Withstand CIP chemicals and operate in superheated steam.
- Compliant with FDA and USP Class VI standards
- Tight tolerances

Solution:



Depending on cleaning regimes and process media, Trelleborg Sealing Solutions recommended O-Rings in either EPDM E7502 or Isolast®.

Result:

By using seals in these materials, quick couplings could be effectively cleaned and sterilized without causing deterioration of the O-Rings. This meant that the customers of the coupling manufacturer benefited from long component life.

- For more information on EPDM E7502 go to page 10
- For more information on Isolast® go to page 14
- O-Rings are featured on page 21

Bonded part gives advantages in safety valves

Safety valves are installed to protect critical equipment.

Sealing issue:

A major medical equipment manufacturer had an existing design of safety valve. The seal was contained within a three piece assembly. The manufacturer wanted to increase the chemical resistance of the sealing element by specifying a FFKM material. Trelleborg Sealing Solutions believed by value engineering the complete assembly they could offer the customer a cost-effective sealing component that would improve integrity.

Sealing requirements:

- High chemical resistance
- Withstand CIP chemicals and operate in steam up to 150°C/302°F
- Compliant with FDA and USP Class VI standards

Solution:



With unique bonding technology, we were able to bond our Isolast® material to metal. This allowed the three separate components of the assembly to be produced as one item.

Result:

The resulting design of sealing element proved to be highly cost effective. Total cost was reduced by extending replacement intervals, a reduction in the amount of sealing material required and lower assembly costs. The component proved highly effective and the same concept is being used across their product range.

- For more information on Isolast® go to page 14
- For more information on engineered parts go to page 26



Optimizing seal life in application

Turcon® Variseal® Hi-Clean eliminates contamination in filling machines

Filling machines have numerous filling heads activated by pistons.

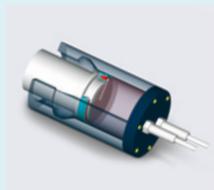
Sealing issue:

A filling machine manufacturer discovered fruit particles were being trapped in elastomer seals used within their filling heads. This led to contamination which was difficult to clean out due to seal design. In addition, the elastomers were sticking to the piston shaft, impeding piston motion and making filling erratic.

Sealing requirements:

- High chemical resistance
- Withstand CIP chemicals and operate in steam up to 150°C/302°F
- Compliant with FDA

Solution:



Trelleborg Sealing Solutions recommended replacing the elastomer seal with a Turcon® Variseal® Hi-Clean. As it fitted into the existing O-Ring groove, no equipment redesign was necessary. The stainless steel spring that

energizes the seal is encased in silicone. This means that it is easily cleaned and sterilized with no risk of contamination. The low friction characteristics of the Turcon® PTFE based material prevents sticking, even after extended periods of rest. The grade of Turcon® MF material chosen was also compliant to all relevant approvals.

Result:

In application, the Turcon® Variseal® Hi-Clean eliminated all risk of contamination. In addition filling action was improved due to the low friction characteristics of the seal.

- Find out about Turcon® PTFE based material on page 16
- For more information on Turcon® Variseal® Hi-Clean go to page 23

Seal configuration used in unique retractable tank spray system

Spraying systems are incorporated into tanks to clean them. Generally the spray head is now retracted automatically from the tank.

Sealing issue:

Trelleborg Sealing Solutions worked with a manufacturer who was developing a unique retractable spray ball system. It operates pneumatically which allows it to have the major benefit of being self-draining. A complete sealing configuration was required which could operate with liquid on the one side and air on the other. Under pressure from both sides and at high temperature, seals in contact with cleaning media had to withstand the harsh chemicals used in these regimes.

Sealing requirements:

- High chemical resistance
- Chemically resistant to all types of CIP media
- Compliant with FDA

Solution:



Trelleborg Sealing Solutions recommended a configuration of seals including a Turcon® Variseal®, along with O-Rings in EPDM and Isolast® options depending on chemical resistance requirement. The surface of the elastomer

O-Ring at the neck of the spray ball was treated with FDA compliant FF coating. This gave the seal the necessary friction characteristics to allow smooth dynamic operation of the spray head.

Result:

The seal configuration withstood extensive tests. After cycles of 1,000 operations, there was no leakage and pressure was held. The seals also continued to perform after a temperature test where the units were heated up to 140°C/284°F for 24 hours.

- Find out about EPDM materials on page 10
- For more information on Isolast® go to page 14
- For more information on coatings go to page 20
- For more information on Variseal® go to page 23



Optimizing seal life in application

Modified Stepseal® in Turcon® MF helps coffee machine maker

Professional coffee machines need to brew up to 300 cups of coffee per hour. This puts high demands on all components, especially their seals.

Sealing issue:

In professional coffee machines, components are metal, as opposed to the plastic of the domestic models. Harder surfaces combined with abrasive coffee beans mean that seals tend to wear quickly. A leading professional coffee machine producer worked with Trelleborg Sealing Solutions to maximize seal life with a target of 100,000 cycles before maintenance.

Sealing requirements:

- Cope with wear from abrasive coffee beans
- Compatible with fat and acids in process media
- Operate at a pressure of 16 bar/2320 psi in hot water
- Withstand CIP media
- FDA compliant

Solution:



To achieve the abrasion resistance the customer requested, the Turcon® Stepseal® surface was modified. Additionally a FDA compliant MF grade material was selected which was compatible with process the media, could withstand cleaning regimes and operate at high pressure.

Result:

In tests, the modified Turcon® Stepseal® design achieved the required cycles and is now fitted in a number of coffee machine models.

→ **Find out about Turcon® MF Materials on page 16**

→ **For more information on Stepseal® products, go to page 22**

FlexiMold™ O-Ring seals centrifuge housing

A centrifuge manufacturer specializing in the pharmaceutical industry needed large size O-Rings for the housing of one of their products.

Sealing issue:

The seals are exposed to high centrifugal forces, which put extreme demand on the physical properties of the seals. Additionally the seals needed to fit in the seal groove without creating dead space, so the centrifuge could be cleaned easily.

Sealing requirements:

- Compatible with harsh cleaning medias such as a variety of solvents
- Compliant with FDA and USP Class VI standards

Solution:



Due to the low volume requirement, the cost for a tool was prohibitive. An O-Ring using the FlexiMold™ process was therefore selected. By this proprietary production method, an O-Ring can be fabricated that has the same characteristics, including

integrity at the join, as a molded O-Ring without the need for a dedicated tool. To ensure compatibility with process media, Isolast® J9515 was specified.

Result:

The giant O-Rings were delivered in record time providing the same integrity as compression molded O-Rings without the tooling cost.

→ **Find out about Isolast® on page 14**

→ **For more information on FlexiMold™ go to page 21**

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

www.tss.trelleborg.com



Sanitary gasket

product range



Your Partner for Sealing Technology

Serving the world's processing industries



Extensive test facilities
Strategically positioned materials and development laboratories and fully resourced design and application centers deliver the latest product innovations and customer-focused seal, bearing and custom solutions.



Innovative material development
Developing and formulating materials in-house and engaging in ongoing programs of development, Trelleborg Sealing Solutions is also skilled in the field of applied materials technology.



Total - Sealing technology

Trelleborg Sealing Solutions is a major international sealing force uniquely positioned to offer a dedicated design and development service for sealing arrangements from our market-leading product portfolio. Our direct experience with unique and challenging applications positions us well to offer custom design and industry-specific development services for sealing components.

Expertise - Our proven capabilities

With over 50 years of experience developing and applying sealing systems, Trelleborg Sealing Solutions engineering personnel contribute their knowledge of this specialized technology directly to customers. This includes project management of design, prototyping, production, test and installation using state-of-the-art design tools, fully customer compatible CAD systems and leading-edge Finite Element Analysis (FEA).

Purity - In materials and supply

The state-of-the-art facility that manufactures our sanitary gasket products maintains superior quality control and purity of materials with rigorous standards during each critical step of production. After production, the sanitary gaskets are inspected and packaged in our cosmetic particulate-free box. A step beyond standard packaging, our box is made with cosmetic quality material that gives you a product free of particulates. Each box is clearly labeled with product information for clean inventory control. Lot and batch numbers provide traceability.

Commitment - To our customers' long-term needs

We help our customers achieve cost-effective, durable solutions that are precisely matched to their specific system requirements and business needs. This includes our logistical support which effectively delivers over 40,000 different sealing and bearing systems to our customers worldwide. We are one of the world's foremost experts in polymer sealing technology. We develop, manufacture and market safety-critical polymer-based precision seals and bearings and associated systems.

Trelleborg Sealing Solutions sanitary gaskets meet these stringent standards for purity:

- FDA Title 21 CFR 177.2600, 177.1550
- USP; U.S. Pharmacopeia Class VI certification*
- USP Cytotoxicity criteria*
- 3-A and P3-A Sanitary standards
- ASME-BPE standards
- NSF
- Current Good Manufacturing Practices (CGMP)
- ISO 9001:2000 and QS9000:1998
- European Pharmacopeia 3.1.9*
- Animal-derived ingredient-free*

Superior logistics support

Trelleborg Sealing Solutions operates an advanced logistical support system that delivers products to our customers worldwide from central warehouses in the United States, Europe and Asia/Pacific.



* Buna does not pass U.S. Pharmacopeia Class VI certification and Cytotoxicity and is not ADI-free.

Sanitary gasket capabilities

Standard Gaskets



All Trelleborg Sealing Solutions standard sanitary gaskets are molded from FDA-compliant compounds. Our clamp gaskets have all passed 3-A testing. Our EPDM, FKM Fluoroelastomer, Silicone and PTFE clamp gaskets have all passed USP Class VI testing. These gaskets are molded in the United States and are available in Flanged (Type A) and Non-Flanged (Type B) styles.

AVAILABLE Materials:

NBR, EPDM, FKM Fluoroelastomer, PTFE, Platinum & peroxide-cured Silicone, Tuf-Flex®(PTFE/EPDM), Tuf-Steel®(PTFE/and Stainless Steel)

AVAILABLE SIZES:

1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4", 6", 8", 10", 12"

Trelleborg Sealing Solutions offers metric sanitary gaskets according to ISO 2852 and DIN 32676.

Please contact your local Trelleborg Sealing Solutions sales office for available materials and specific sizes and types.

Bonded Envelope Gaskets



Tuf-Flex® (bonded envelope gaskets) are unitized gaskets - setting new standards for purity, performance and flexibility. The bonding surface is a layer of PTFE unitized to an EPDM rubber inner core. This totally bonded construction provides a PTFE gasket with the mechanical characteristics, including memory, of an elastomer gasket. Designed to meet critical requirements in biopharmaceutical, ultra-pure water, WFI (water-for-injection) and difficult food and beverage processing, this gasket outperforms other gaskets while eliminating costly process interruptions. Achieve higher performance under SIP/CIP conditions.

AVAILABLE Materials:

Tuf-Flex®(PTFE/EPDM), Food-Flex®(PTFE/NBR)

AVAILABLE SIZES:

1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4", 6"

PTFE/Stainless Steel Standard Gaskets



Tuf-Steel® (PTFE and Stainless Steel) delivers leak-proof performance and is composed of a unique 50/50 blend of non-pigmented PTFE and 316L passivated and atomized stainless steel. This gasket is the choice for leak-proof, perfect surface performance and outstanding durability in SIP (steam-in-place) and WFI (water-for-injection) applications. It is ideal for sanitary steam pipe connections in extreme temperatures ranging from -20 °F to 500 °F. Its superior strength eliminates cold flow and creep to prevent maintenance problems and system downtime.

AVAILABLE SIZES:

1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4", 6", 8", 10", 12"

Controlled Compression Gaskets



The Controlled Compression Gasket (CCG) cannot be over-tightened. The CCG is composed of the elastomer of your choice with a ring of Ultem® vulcanized inside the gasket from the ring O.D. to the locating ring of the gasket. This non-compressible ring controls clamp compression to exactly the correct amount, allowing the properly positioned gasket to make a perfect surface I.D. seal with the ferrules. No torque restrictions are necessary. CCG is also available in a tabbed gasket making it more user-friendly while isolating it from unnecessary human contact. CCG helps with position control and speeds up the installation process.

AVAILABLE ELASTOMERS:

EPDM, FKM Fluoroelastomer, Silicone

AVAILABLE SIZES:

1", 1-1/2", 2", 3"

CCGs meet ASME BPE specifications

patent number 6,857,638

Note: Food-Flex®, Tuf-Flex® and Tuf-Steel® are trademarks of RubberFab Technologies Group.
Ultem® is a trademark of SABIC Innovative Plastics.

Validation Gasket



The value of a Smart Gasket® (validation gasket) is proven when validating sterility in a high-purity processing system. A standard sanitary flange utilizing the validation gasket provides the processor the option to capture real - time validation data:

- thermal mapping
- meter fluids in your processing system
- withdraw fluid samples
- facilitate validation using sporetrap challenge test strips

AVAILABLE SIZES:
1/2", 3/4", 1", 1-1/2", 2", 3", 4"

AVAILABLE PORTS:
1 to 4 ports

Special clamps are specifically designed for use with with validation gaskets.

Biological Gasket



The Biological Indicator® gasket (biological gasket) enables the use of a self-contained biological indicator in sanitary process lines. This unique gasket permits either top loading or inline positioning of a self-contained biological indicator and/or a temperature probe. The great advantage of a self-contained biological indicator over the traditional spore strip in glassine is the time saved when confirming spore kill. Results are easily obtained in only 48 hours (versus the five to seven days required with a spore strip) and without problematic laboratory transfer. You can feel secure in knowing that the biological gasket will not be lost downstream in the process. The fail-safe validation gasket holds the indicator in place for easy retrieval.

AVAILABLE SIZES:
3/4", 1", 1-1/2", 2"

AVAILABLE PORTS:
1 port in sizes 1", 1-1/2", 2" (not available in 3/4")

patented

Gauge Safeguard



The Gauge Guard® Isolator (gauge safeguard) seal protects expensive diaphragms and instruments from damage without affecting instrument performance. By combining a quality Trelleborg Sealing Solutions hygienic seal with a membrane, the gauge safeguard isolates hot or caustic saline solution from instrumentation, a necessary and cost-effective step in assuring long life and accurate results from your instruments and gauges. As some gauge manufacturers will suggest the use of a gauge safeguard seal, others note that the failure to use a gauge safeguard seal can void most instrument and gauge warranties.

AVAILABLE Materials:
FKM Fluoroelastomer, Platinum Silicone, EPDM, PTFE, Tuf-Steel®

AVAILABLE SIZES:
1/2", 3/4", 1", 1-1/2", 2"

Gauge Guard Protectors



The Trelleborg Sealing Solutions gauge guard protector protects expensive, fragile gauge diaphragms and other similar instruments from damage during recalibration, maintenance and autoclave procedures.

By using a quality gauge guard protector during maintenance with a gauge safeguard during processing, you have complete gauge diaphragm protection! A necessary and cost-effective step in assuring maximum service life and accurate results from your instruments and gauges!

AVAILABLE Materials:
Platinum-Cured Silicone, 316 Stainless Steel

AVAILABLE SIZES:
Size 3/4", 1.5" (fits both 1" and 1.5"), 2"

Screen Gaskets



Fluid conditioning screen gaskets in 10 micron through four mesh are available from Trelleborg Sealing Solutions. Screen gaskets provide prefiltration for critical membrane filters, coalescence of water vapor from process exhaust lines and particulate removal before fill and finish. Also available in a complete elastomer selection are perforated plate fluid conditioning gaskets, removable sanitary gasket holders for all discs, screen disc inserts, perforated plate disc inserts and orifice plate disc inserts.

AVAILABLE MATERIALS AND SIZES:

- NBR - 1", 1-1/2", 2", 2-1/2", 3", 4"
- EPDM - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"
- FKM (Black) - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"
- PTFE (White) - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"
- SILICONE - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"
- TUF-STEEL® - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"

Please consult your local Trelleborg Sealing Solutions sales office for available micron retention meshes.

Sock Screen Gaskets



Sock Screen Gaskets are inserted into the I.D. of your stainless steel tubing and provide filtration for a greater soil burden.

Orifice Plate Gaskets



Our innovative orifice plate gasket line includes a complete selection of solid 316L Stainless Steel that can be custom drilled with an eccentric or concentric bore. T abbed orifice plates and slotted clamps are also available. Tabs help to acknowledge that an orifice plate is in the line and can be laser engraved to indicate the hole diameter, gasket size or with user specified information. A major safety consideration! Orifice plates can advance your system's performance, adjust flow rates, balance backflow and equalize back pressure during SIP procedures: achievable benefits while maintaining sanitary conditions.

AVAILABLE ELASTOMERS:

- NBR, EPDM, FKM Fluoroelastomer, PTFE, Silicone, Tuf-Steel®

AVAILABLE SIZES:

1/2" to 4", consult your local Trelleborg Sealing Solutions sales office for sizes over 6".

ALSO AVAILABLE:

- Slotted clamps

Perforated Metal Gaskets

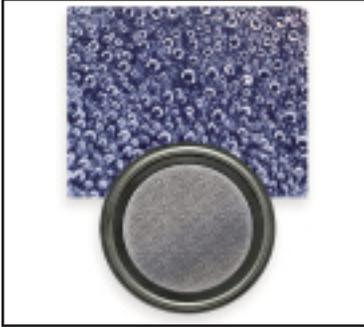


The perforated metal gasket is used for flow control and media filtration.

AVAILABLE MATERIALS AND SIZES:

- NBR - 1", 1-1/2", 2", 2-1/2", 3", 4"
- EPDM - 1", 1-1/2", 2", 2-1/2", 3", 4"
- FKM - 1", 1-1/2", 2", 2-1/2", 3", 4"
- PTFE (White) - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"
- SILICONE - 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"
- TUF-STEEL® - 1", 1-1/2", 2", 2-1/2", 3", 4"

Sanitary Diffuser Gaskets



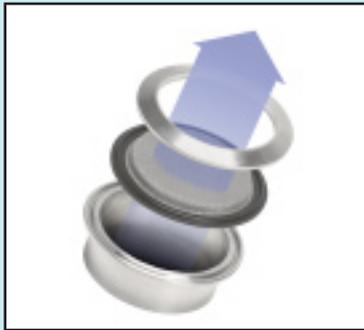
Diffuser aeration systems provide increased oxygen content to high-purity water systems. Diffusers can also be used to diffuse digester gases such as hydrogen sulfide and sulphur dioxide, to introduce ozone for oxidizing and destroying bacterial and organic chemical contaminants, as well as for carbon dioxide injection for carbonization and ph adjustment.

AVAILABLE MATERIALS:
EPDM, FKM Fluoroelastomer, Silicone

AVAILABLE SIZES:
1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3"

AVAILABLE MICRON:
1/2 to 2 micron
2 micron is standard stock, all other micron is custom.

V²B Vent Gaskets



The V²B vent gasket offers an additional answer for vacuum and pressure relief for pharmaceutical and food/beverage processing tank venting when airborne particulate removal is required. Using a 200 mesh screen combined with a 14 mesh screen of sintered construction, the V²B vent gasket is a cost-effective alternative to expensive vacuum breakers and venting systems.

AVAILABLE MATERIALS:
EPDM, FKM, Silicone

AVAILABLE SIZES:
1", 1-1/2", 2", 2-1/2", 3", 4", 6"

ANSI Flange 150#



An Ansi Flex® (ANSI Flange 150#) gasket's contact surface is PTFE unitized to an EPDM rubber inner core. This totally bonded construction provides a PTFE gasket with the mechanical characteristics, including memory, of an elastomer gasket with exceptional steam resistance. An ANSI Flange 150# gasket is ideal for applications, such as PVC piping and glass lining pipings, where low seating stress is required.

AVAILABLE SIZES:
Sizes available up to & including 12"

Bevel Seat



Bevel seat fittings provide a precision metal-to-metal tight connection. We offer a complete selection of bevel seat gaskets.

AVAILABLE MATERIALS:
PTFE (White), PTFE (Blue), NBR (Black), EPDM, FKM, Silicone

AVAILABLE SIZES:
1", 1-1/2", 2", 2-1/2", 3", 4"

patented

Note: Ansi Flex® is a trademark of Rubberfab Technologies Group.

Sanitary gasket capabilities

Smart Tracker



The Smart Trakr™ -T (Smart Tracker) is a miniature, battery-powered stand-alone precision temperature recorder. The all-in-one compact, portable, easy-to-use device will measure and record up to 21,845 measurements per channel. The storage medium is non-volatile solid state memory, providing maximum data security even if the battery becomes discharged. The RTD sensor does not suffer from the cold-junction issues of the thermocouple nor the errors at high and low temperatures of the thermistor. The device can be started and stopped directly from your computer and its small size allows it to fit almost anywhere. The Smart Tracker makes data retrieval quick and easy. Simply plug it into an empty COM or USB port and our user-friendly software does the rest.

I-Line & Q-Line



I-Line is an interlocking design which creates a self-aligning right union. I-Line unions feature an interlocking, metal-to-metal design that ensures gasket control, minimizing gasket extrusion, thus preventing liquid traps. Perfect for in-place cleaning, a favorite for use in the beverage industry.

AVAILABLE MATERIALS: NBR, FKM, EPDM, Silicone, PTFE (blue and white), Tuf-Steel®

AVAILABLE SIZES: 1", 1 1/2", 2", 2 1/2", 3", & 4"

Q-Line components are ideal for use in processing pipeline systems for dairy, beverage, food, pharmaceutical and bio-tech industries. All compounds meet the criteria of the FDA, some have been certified and accepted by the USDA, 3-A Sanitary Standard and USP Class VI certifications.

AVAILABLE MATERIALS: NBR, EPDM, FKM, PTFE, Silicone

AVAILABLE SIZES: 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3", 4"

Schedule 5 (Flanged/Non-Flanged)



Components are used in processing pipeline systems for the food, dairy, beverage, pharmaceutical and biotech industries. The products are manufactured from EPDM, FKM, NBR and Silicone, as well as gaskets made with fluoropolymer. All compounds meet the criteria of the FDA, and some compound formulations have also been certified and accepted by the USDA, 3-A Sanitary Standards and USP Class VI certifications.

AVAILABLE MATERIALS:

NBR (Black), EPDM, FKM (Black), Silicone (Clear), PTFE (White)

AVAILABLE SIZES: Trelleborg Sealing Solutions offers Schedule 5 gaskets. Note: Sizes 1", 1.5", 2", 2.5", 3" are Non-Flanged; Sizes 4", 6", 8", 10", 12" are Flanged except PTFE where all sizes are Non-Flanged.

APC



Gaskets for A.P.C. (Alloy Products) fittings.

AVAILABLE MATERIALS:

NBR (Gray), NBR (Black)

AVAILABLE SIZES:

1", 1-1/2", 2", 2-1/2", 3", 4"

Note: The Smart Trakr™ -T is a registered trademark of RubberFab Technologies Group.

John Perry



Components are used in processing pipeline systems for the food, dairy, beverage, pharmaceutical and biotech industries. The products are manufactured from EPDM, FKM, NBR and Silicone, as well as gaskets made with PTFE. All compounds meet the criteria of the FDA, and some compound formulations have also been certified and accepted by the USDA, 3-A Sanitary Standard and USP Class VI certifications.

AVAILABLE MATERIALS:
NBR, EPDM, FKM (Black), PTFE (White)

AVAILABLE SIZES:
1", 1 1/2", 2", 2 1/2", 3", & 4"

Torque Nuts



Torque-Rite® Nuts (torque nuts) allow you to control clamp compression and expansion while maintaining constant inch/pounds force. Torque nuts eliminate the problems associated with over- or under-tightening a gasket which can lead to an unsanitary system. Compression control is easy! When tightened, the torque nut's self-limiting internal mechanism will make an audible click, signaling the user they have reached proper inch/pounds force. If further tightening is attempted, there will be more clicks, but no additional force will be applied on the gasket. If emergency conditions arise, torque nuts have a built-in manual override feature. To use, simply unscrew/remove the clamp wing-nut and install the torque nut.

AVAILABLE:
30 in-lbs for all elastomers and Tuf-Flex®
40 in-lbs on a custom basis for rupture disc applications
50 in-lbs for Tuf-Steel® and PTFE envelope gaskets
60 in-lbs available on a custom basis

patent number 6,082,941

Clamps



Trelleborg Sealing Solutions offers a wide variety of sanitary gasket clamps. Clamps can be Hinged 1-pin, Hinged 2-pin, 2-bolt high pressure or special hinged clamps with custom ports for both validation access and/or spore trap access and/or compression controlled tabbed gaskets. Most clamps are stainless steel. We also offer Nylon Hinge clamps. Also available are gold clamps and/or wing nuts for line identification.

Note: Consult your local Trelleborg Sealing Solutions sales office for more information.

Engraved Gaskets



Laser Engraved® Gaskets (engraved gaskets), screen gaskets and orifice plate gaskets ensure permanent batch and lot traceability. Engraving remains readable throughout the service life of the gasket. Compound type and/or special application markings can also be laser engraved on gaskets at the customer's request.

AVAILABLE MATERIALS:
Available on all gaskets and fittings, adaptors and crimp collars.

NOTE:
Consult your local Trelleborg Sealing Solutions sales office for spacing and size limitations.

Validation Gasket Accessories

Thermometers

This versatile instrument measures temperature in both °C and °F. The internal memory of the micro-computer stores the minimum and maximum measured temperature for instant recall via the LCD display.

Temperature Range:

-90°C to +400°C
-130°F to +752°F

Resolution Accuracy:

0.1°C, 0.2°F +/-0.05%
READING +/-0.7°C or 1.3°F

Accuracy is specified for operating ambient temperature of 23°C/ 73°F +/-5°C

Cold junction error for thermocouples:

For operating ambient temperature for 0°C to +18°C / +32°F to +64°F and +28°C to +50°C / +82°F to 122°F, and an additional error of +/- 0.03°C or 0.03°F

Model ACC-7001H is a high-performance, precision hand-held instrument for the measurement of temperature using type T or K thermocouple probes.



Extension Leads

Male to male (sub-miniature type T connectors) 26 gauge. Stranded type to thermocouple wire with blue PVC insulation



Hole Plug

Chrome-plated brass head with stainless steel shaft 1-1/2" long, .095 diameter



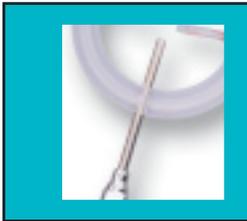
Temperature Probes

Short and long temperature probe for thermocouple gasket. Copper Constantan female socket and bootie



Stopcock

To fit sampling/injection tube; chrome-plated brass construction female luer fitting to male luer lock



Sampling/Injection Tube

Chrome-plated brass female luer head with 1-1/2" long stainless hypodermic tube, .095 OD, .071 ID



Thermocouple Wire Probes

Coated thermocouple wire probe x 10' long with male mini quick disconnect connector for use with thermometer. Specify Kaptan or FEP when ordering.

Sanitary gasket materials

Bonded Envelope: is the world's only unitized gasket, setting new standards for purity, performance and flexibility. A bonded envelope gasket's contact surface is a layer of PTFE unitized to an EPDM rubber inner core. This totally bonded construction provides a PTFE gasket with the mechanical characteristics, including memory, of an elastomer gasket. Designed to meet critical requirements in biopharmaceutical, ultra-pure water, WFI (water-for-injection) and difficult food and beverage processing, bonded envelope outperforms other gaskets while eliminating costly process interruptions. Achieve higher performance under SIP/CIP conditions.

PTFE/Stainless Steel: is a unique 50/50 blend of non-pigmented PTFE and 316L water-atomized and passivated stainless steel, PTFE/stainless steel delivers leak-proof performance. PTFE/stainless steel is the choice for leak-proof, perfect surface performance and outstanding durability in SIP (steam-in-place) and WFI (water-for-injection) applications. PTFE/stainless steel is ideal for sanitary steam pipe connections in extreme temperatures ranging from -20 °F to 500 °F. The superior strength of PTFE/stainless steel eliminates cold flow and creep to prevent maintenance problems and system downtime.

FKM Fluoroelastomer and EPDM: is specified by many process equipment manufacturers, these materials are generally suitable for a variety of applications. Service life must be considered and a preventative maintenance program be implemented to mitigate degradation. These materials are acceptable, but not recommended for continuous use in SIP procedures.

PTFE: is the material of choice whenever low temperature flexibility or gasket memory is not required (not recommended where large temperature variations occur frequently as leakage can occur). PTFE has almost no extractables, has a low absorption rate and excellent resistance to process fluids. It can remain in service for longer periods of time in both water and steam for continuous use. High-pressure clamps are recommended to prevent leakage resulting from temperature variations. PTFE envelope gaskets with an FKM Fluoroelastomer inner core should be used if slight misalignment is observed.

Platinum-Cured Silicone: is the material of choice in sanitary water systems when PTFE is not feasible due to severely misaligned fittings, or if the cost of high-pressure clamps does not outweigh the benefits of PTFE (extended service life).

Our Commitment is Certified: Trelleborg Sealing Solutions successfully meets the goals and standards set forth by the U.S. Pharmacopeia Class VI certification, passes cytotoxicity criteria and complies with FDA Title 21 CFR 177.2600 and 177.1550 standards.

1 = Excellent 2 = Good 3 = Acceptable 4 = Marginal 5 = Poor X = Do Not Use								
Gasket	Temperature Continuous Range	Continuous Steam	Pure Intermittent Steam	Pure Water Ambient	Process Water Hot	Process Fluids Ambient	Process Fluids Hot	Process Fluids (32 °F to >212 °F)
Bonded Envelope Maintains seal with wide temperature variations. Has extended service life*	-100 °F to 350 °F	1	1	1	1	1	1	1
PTFE/Stainless Steel Maintains seal with wide temperature variations. Has extended service life*	-100 °F to 500 °F	1	1	1	1	1	1	1
PTFE Wide temperature variations and may cause leakage at T	-100 °F to 500 °F	1	1	1	1	1	1	3
Silicone (platinum) Very flexible low temperature	-40 °F to 450 °F	2	2	2	2	2	2	1
FKM Fluoroelastomer Acceptable for steam applications	-30 °F to 392 °F	3	2	2	2	2	2	2
EPDM (peroxide) Low pressure steam only	-30 °F to 300 °F	3	3	2	3	2	3	3

* Applications dependent
This table is a general guide to material selection.
Please consult your local Trelleborg Sealing Solutions sales office for more information.
Gasket life dependent upon time and temperature exposure.

For further information:

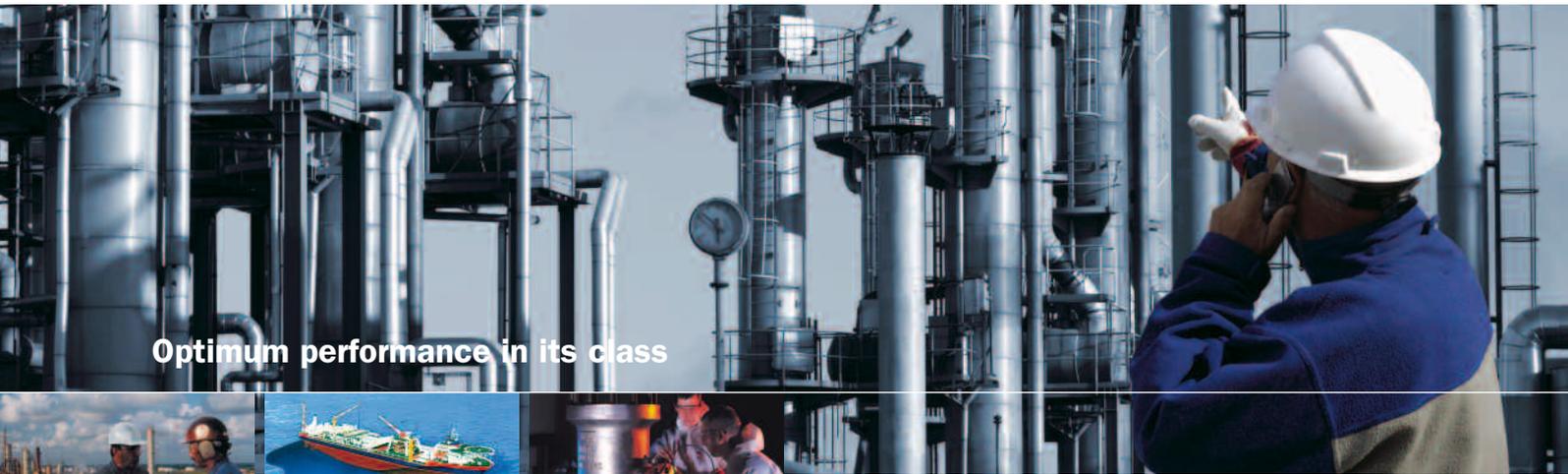
Europe	Telephone	America	Telephone
AUSTRIA - Vienna (ALBANIA, BOSNIA AND HERZEGOVINA, CROATIA, HUNGARY, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)	+43 (1) 406 47 33	AMERICAS - Fort Wayne, IN	+1 (260) 749 9631
BELGIUM - Dion-Valmont (LUXEMBOURG)	+32 (10) 22 57 50	BRAZIL - Sao Paulo	+55 (11) 3372 4500
BULGARIA - Sofia (ROMANIA, RUSSIA)	+359 2 96 99 510	CANADA - Ontario	+1 (416) 213 9444
CZECH REPUBLIC - Rakovnik (SLOVAKIA)	+420 313 529 111	MEXICO - Mexico D.F.	+52 55 57 19 50 05
DENMARK - Hillerød	+45 4822 8080	USA, East - Philadelphia, PA	+1 (610) 828 3209
FINLAND - Vantaa (ESTONIA, LATVIA)	+358 (0)207 12 13 50	USA, Great Lakes - Fort Wayne, IN	+1 (260) 482 4050
FRANCE - Maisons-Laffitte	+33 (0)1 30 86 56 00	USA, Midwest - Lombard, IL	+1 (630) 268 9915
GERMANY - Stuttgart	+49 (711) 7 86 40	USA, Mountain - Broomfield, CO	+1 (303) 469 1357
GREECE	+41 (21) 631 41 11	USA, Northern California - Fresno, CA	+1 (559) 449 6070
ITALY - Livorno	+39 (0586) 22 61 11	USA, Northwest - Portland, OR	+1 (503) 595 6565
THE NETHERLANDS - Barendrecht	+31 (10) 29 22 111	USA, South - N. Charleston, SC	+1 (843) 747 7656
NORWAY - Oslo	+47 22 64 60 80	USA, Southwest - Houston, TX	+1 (713) 461 3495
POLAND - Warsaw (BELARUS, LITHUANIA, UKRAINE)	+48 (22) 8 63 30 11	USA, West - Torrance, CA	+1 (310) 371 1025
RUSSIA - Moscow	+7 495 982 39 21		
SPAIN - Madrid (PORTUGAL)	+34 91 710 5730	Asia	Telephone
SWEDEN - Jönköping	+46 (36) 34 15 00	ASIA PACIFIC REGIONAL	+65 (6)265 6883
SWITZERLAND - Crissier	+41 (21) 631 41 11	CHINA - Hong Kong	+852 (2)366 9165
TURKEY	+41 (21) 631 41 11	INDIA - Bangalore	+91 (80) 2655 5157
UNITED KINGDOM - Solihull (EIRE)	+44 (0)121 744 1221	JAPAN - Tokyo	+81 (3) 5633 8008
		KOREA - Gyunggi-Do	+82 (31) 386 3283
		MALAYSIA - Kuala Lumpur	+66 (0) 2732 2861
		TAIWAN - Taichung	+886 (4) 23 58 00 82
		THAILAND - Bangkok	+60 (0) 3 9059 6388
		SINGAPORE	
		and all other countries in Asia	+65 (6)293 2500
AFRICA REGIONAL	+41 (21) 631 41 11		
MIDDLE EAST REGIONAL	+41 (21) 631 41 11		

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HNBR XploR H9T20

Explosive Decompression Resistant Materials



Optimum performance in its class



Your Partner for Sealing Technology

Explosive Decompression is a major concern to the oil and gas industry. It occurs when applied system pressure is released, causing absorbed gas to expand, potentially damaging elastomer seals.

Trelleborg Sealing Solutions has focused on this issue and presents the XploR range, an entire family of advanced elastomers especially developed for oil and gas applications. The portfolio includes compounds in HNBR, FKM, Aflas® and Isolast® Perfluoroelastomer, each of which demonstrates best-in-class Explosive Decompression Resistance (EDR) for its material type.

In independent tests HNBR XploR H9T20 was able to satisfy the requirements of Norsok M-710 Annex B, Rapid Gas Decompression, when tested with a back-up ring.

If the composition of the well or conditions of the application are known, HNBR XploR H9T20 may prove the optimum and most cost-effective material for your application. For further information on selecting the right compound and advice on seal specification for your individual application, consult your local Trelleborg Sealing Solutions marketing company. Find contact details at www.tss.trelleborg.com.

Features & benefits:

- Unrivalled Explosive Decompression Resistance (EDR) within its material type
- Temperature resistance from -25°C/-13°F to 160°C/320°F
- Exceptional mechanical performance
- Low long-term compression set
- Good chemical compatibility
- Long life in aggressive, including hydrocarbon and aqueous media, common within oil & gas applications
- High modulus, high strength
- Material compliant to Norsok M-710 Annex B

Applications:

- Riser connectors
- Tubing hangers
- Packers
- Perforating equipment
- Flowline equipment
- Blowout Preventers (BOPs)

XploR is available in all standard international O-Ring sizes and cross-sections along with custom-engineered solutions and specially designed seal profiles.

Explosive Decompression Facts

Inherently, elastomer seals contain voids. Gas or gas mixtures in contact with elastomer surfaces are absorbed and will saturate elastomer seals. At high-pressure this absorbed gas is in a compressed state. When external pressure is reduced, either rapidly or over a relatively short period of time, the compressed gas nucleates at the voids, expanding within the elastomer. The voids inflate leading to high tensile stresses or strains in the void walls. Depending on the strength and hardness of the elastomer, this can cause the elastomer to break or crack.

No elastomer can be completely explosive decompression resistant; however, the XploR range demonstrates unrivalled EDR inline with limits set by NORSOK M-CR-710 Rev. 2 2001 "Qualification of Non-metallic Sealing Materials and Manufacturers."

Compound No.:		H9T20		
Elastomer base:	DIN ISO 1629	HNBR		
Hardness:	DIN 53 505	90 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN EN ISO 1183-1	g/cm ³	1.25 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ² psi	34.8 5,000
Elongation at break:		DIN 53 504	%	204
Modulus 100%:		DIN 53 504	MPa N/mm ² psi	16.6 2,400
TR10 point:		TBS 00036	°C °F	-23 -9
Service temperature:			°C °F	-25 to 160 -13 to 320
Specification:				Norsok M-710 Annex B

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

www.tss.trelleborg.com

Aerospace sealing capabilities



Your Partner for Sealing Technology

Total Aircraft Sealing Technology Capabilities

Trelleborg Sealing Solutions offers its customers a wide range of aircraft sealing capabilities along with an extensive product portfolio for both military and civil programmes. This includes:

- aerodynamic wing sealing components
- window seals
- fire sealing technology
- inflatable canopy seals
- door seals
- hydraulic sealing systems
- gas sealing

Due to the increasingly stringent requirements of the aerospace market, Trelleborg Sealing Solutions places strong emphasis on its ability to globally service, support and supply its customers through their international network of manufacturing facilities and support teams.

Technical and Engineering Expertise

Trelleborg Sealing Solutions is uniquely placed to offer a dedicated seal design and development service to the Aerospace market. With years of experience in sealing all areas of aircraft systems, their engineering personnel are able to contribute their knowledge of this specialised technology directly to customers; from the efficient handling of enquiries to complete project management of design, prototyping, production, test and installation of sealing systems.

To compliment their expertise, Trelleborg Sealing Solutions employs state-of-the-art design tools, fully customer-compatible CAD systems and leading edge Finite Element Analysis (FEA).

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions that match their specific business requirements and needs.

Specialists in Polymer Technology

For decades, Trelleborg Sealing Solutions has been a world-leader in the development of new polymeric compounds for use in Aerospace applications.

Not only does Trelleborg Sealing Solutions develop and formulate its Aerospace materials in-house, it has also acquired significant skills in the field of applied materials technology. Seals can be individually hand fabricated, automatically moulded, fabric-reinforced or bonded to metallic components.

A full range of Aerospace grade Turel® elastomers is available, specifically engineered to withstand the extremes of temperature and aggressive chemicals encountered in today's aircraft. To complement these materials, many proprietary blends of premium-grade Turcon® Fluoropolymer resins and high-performance, high-modulus Zurcon® thermoplastics are available to provide a one-stop-shop of engineered solutions for aerospace sealing challenges.

Quality and Manufacturing Capability

Trelleborg Sealing Solutions manufacturing sites are strategically located to provide global coverage and have succeeded in delivering cost effective sealing solutions, whilst maintaining the highest standards of international airworthiness, quality control and meeting the latest environmental legislation.

Both the FAA, EASA and leading aerospace manufacturers are regular visitors to Trelleborg Sealing Solutions facilities worldwide and they continue to work with them to enhance their reputation for quality and to maintain their key position in the Aerospace supply chain.



Serving the world's commercial and military aerospace industries

The extensive product portfolio, service capability, materials development and engineering expertise of Trelleborg Sealing Solutions, confirms their position as a leading sealing force in the aerospace market, bringing together the best of foremost global specialist aerospace sealing brands; Shamban, Dowty Seals, Dowty Woodville Polymer, Impervia and Palmer-Chenard.

Trelleborg Sealing Solutions products are used in virtually every major commercial and military aircraft programme and are commonly specified by leading aircraft manufacturers and OEM customers as sealing solutions on a wide range of critical applications, such as:

- airframes
- engines
- flight controls and actuation
- landing gears
- wheel and brakes

With a strong commitment to excellent customer service, Trelleborg Sealing Solutions offers round-the-clock product assistance, combined with direct line feed, kitting and subassembly capabilities.

World leading reputation

Trelleborg Sealing Solutions uses its 50-year experience as the basis for development and application of engineered dynamic sealing systems and world class customer support. As a principal manufacturer of airframe, hydraulic, fuel systems and engine seals, Trelleborg Sealing Solutions provides innovative and functional solutions for complex applications.

Specialist in the design, development and manufacture of reinforced elastomer components, Trelleborg Sealing Solutions is the sole source supplier of inflatable fuselage fairings to B1-B, Tornado and F-111.

Trelleborg Sealing Solutions are experts in elastomer materials, high performance O-Rings, gaskets and custom designed sealing solutions, as well as fabric reinforced elastomeric diaphragms for environmental control in valves and pumps.

The first company to realise the huge potential of PTFE in aerospace sealing applications, Trelleborg Sealing Solutions remains at the forefront of this technology with its unique Turcon® material range.



The competitive edge

- A complete polymer sealing range for the aerospace industry
- Full service provision – design concept to aftermarket support
- 24-hour worldwide support
- Industry-leading design and materials expertise
- Best practice manufacturing
- Customised distribution capabilities – direct line feed, subassembly and kitting
- Aftermarket expertise
- Proven-engineering excellence – servicing all major aerospace programmes

Global manufacturing and customer support

Trelleborg Sealing Solutions is the global sales organisation of Trelleborg Sealing Solutions, one of the world's leading experts in polymer sealing technology for the aerospace, industrial, and automotive industries. Its worldwide resources include:

- Over 80 facilities in Europe, Asia, North America and Latin America
- More than 30 manufacturing sites - ISO 9000, AS 9100, QS9000, ISO 14001, EASA 21 subpart G
- 11 materials and development laboratories
- 17 design and application facilities



Complete aerospace sealing capabilities



Actuation

High integrity piston and gland seals are specified to meet the high usage, long-life demands of aircraft actuators. These can be designed for a variety of configurations up to 55 MPa (8000 psi). With its vast experience in this field, Trelleborg Sealing Solutions can also assist with actuator design by recommending component tolerances, surface finishes and coatings and seal groove geometries.



Flight controls

A wide range of both elastomer and spring energised PTFE solutions, offer zero leakage and long life performance, in an environment characterised by high frequency oscillation. For rotary shaft seal applications, Trelleborg Sealing Solutions provides conventional radial oil seals through to high performance PTFE lip seals.





Airframe

With a focus on aerodynamic efficiency, Busak+Shamban offers a range of standard and customised designs, developed for reliability in service and efficiency in assembly and maintenance. The Trelleborg Sealing Solutions range includes seals for wing and moving surfaces such as complex aerodynamic shrouds for hydraulic jacks, extrusions and fabricated seals for doors and hatches, interior couplings, inflatable cockpit canopy seals and fabricated swing-wing fuselage fairings.



Engine systems

A wide range of sealing systems for engine and engine management applications including fan blade annulus fillers, fan cowl and thrust reverser doors, heat exchangers, drive shafts, air intakes, fairings and coupling systems. Materials are selected for high temperature performance and include silicones up to +270°C and Isolast[®], the high performance perfluoroelastomer specially developed by Trelleborg Sealing Solutions, which will operate at up to +320°C. Reinforced engine seals and ducts are available that can provide fire control at tested temperatures of +1100°C.



Landing gear

A complete sealing system for all landing gear applications, ranging from light aircraft to long-range commercial airliners. Trelleborg Sealing Solutions has the expertise and resources to offer the most advanced elastomeric and PTFE technologies, ensuring ultimate reliability in high pressure and side load applications.



Wheel and brake

Designed for superior performance in harsh environments, the Trelleborg Sealing Solutions portfolio provides a complete range of static and dynamic sealing systems including steel reinforced bearing grease retainers, large O-Ring wheel hub seals and high temperature brake seals.



Contact your local marketing company for further information:

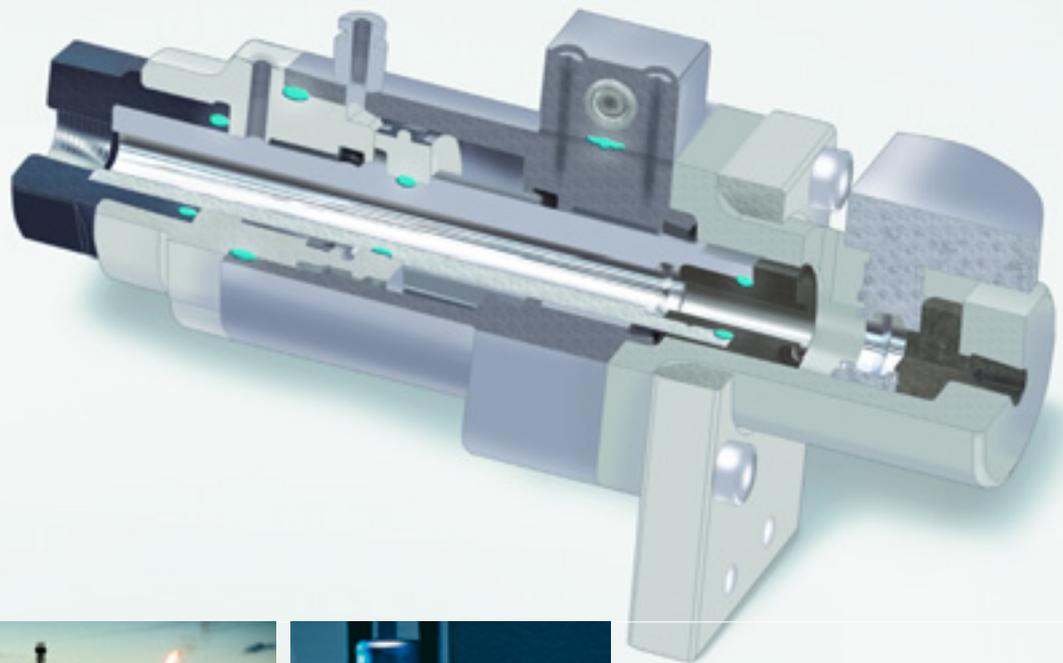
Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
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GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
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MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

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Isolast[®]

perfluoroelastomer seals



Your Partner for Sealing Technology



Introduction

Material performance and seal design are both critical to effective sealing. Equipment manufacturers and end users expect a sealing system to operate leak-free and maintain long service life. Reliability is crucial to effective low maintenance cost operations.

Isolast® is used in process industries such as chemical, semiconductor, pharmaceutical and hydrocarbon and is offered in a full range of products including O-Rings, gaskets and custom parts.

General perfluoroelastomer properties

Isolast® is a member of the perfluoroelastomer family (ASTM D1418: FFKM). Perfluoroelastomers are terpolymers of monomers in which all hydrogen atoms have been replaced by fluorine. The absence of hydrogen in the molecular chain dramatically increases both the chemical and thermal resistance of perfluoroelastomers. The cross-linked molecular chains enable perfluoroelastomers to combine the resilience and sealing force of an elastomer with the chemical inertness and thermal stability of PTFE.

The range of **Isolast®** perfluoroelastomer compounds developed by our specialists offers exceptional chemical resistance over a wide range of temperatures from -25 °C / -13 °F up to +325 °C / +617 °F.



Benefits

The **Isolast®** combination of high performance and quality with state-of-the-art sealing design provides a wide range of customer advantages:

- Superior reliability, cutting planned and unplanned maintenance costs
- Longer service life, reducing costs and driving up productivity
- Greater safety and reliability, reducing waste and contamination
- More opportunities for standardization and inventory reduction
- Optimized seal solutions cutting the risk of failure

To meet these demands in extremely hostile environments, with temperatures often in excess of 300 °C / 572 °F, **Isolast®** perfluoroelastomers offer exceptional chemical and thermal resistance without sacrificing the essential performance of elastomeric seals.



Applications

Isolast® perfluoroelastomer sealing products bring all these benefits to a wide range of applications for equipment manufacturers and end users in many industries:

- Chemical processing
- Pharmaceutical and food industries
- Oil & gas
- Hydrocarbon processing
- Semiconductor and nanotechnology
- Lacquer, print and coatings
- Aerospace
- Power generation

The Isolast® product range

O-Rings

O-Rings offer engineers a high-performance sealing element in a wide range of static and dynamic applications.

- AS 568A American standard
- DIN 3701 German standard
- BS 1806 / BS 4518 British standard
- JIS B2401 Japanese standard
- NFT47-501 French standard
- SMS 1586 Swedish standard
- ISO 3601 International standard
- Molded O-Rings to non-standard sizes – available to customer specification



Custom parts

Specific parts can be designed, developed and produced in conjunction with customers to ensure that all requirements are satisfied. The physical characteristics of perfluoroelastomers require careful design input from Trelleborg Sealing Solutions engineers. Inflatable seals, diaphragms and composite material products are typical areas of proven success in even the most hostile environments.

Gaskets: Molded, punched or laser-cut to intricate patterns to suit customers' specific requirements

Bonded Gaskets: For leak-proof flange gaskets with stainless steel or alternative metal compression retainer

Bonded Products: In a variety of geometries, material grades and metals

V Rings: For effective axial dirt sealing in static and dynamic environments, particularly for additional protection in hostile environments

Molded Parts: Custom-molded parts in virtually any shape

Specialty Seals: Homogeneous and layered diaphragms, inflatable seals, bellows, T-Seals and valve seals

Specialty Seals

FlexiMold™: Developed to produce large diameter seals without dedicated tooling

General advice on issues concerning specifications, applications, installations or developments is available through our global organization.

For personal service, consult your local Trelleborg Sealing Solutions Marketing Company (see back cover).



The Isolast® material range

Compound	Hardness	Color	
Grade J8325	75 IRHD	Black	This high-temperature material operates in applications up to +325 °C/+617 °F while maintaining broad chemical resistance and excellent retained sealing force.
Grade J9501	80 IRHD	White	This special material is designed for applications in strong oxidizing media such as halogens, ozone or hot oxidizing acids. Also suitable for applications where cleanliness is required.
Grade J9503	75 IRHD	Black	This classic material offers the most comprehensive chemical resistance including organic and inorganic oxides, amines and steam with an operating temperature range of -25 °C/-13 °F to +240 °C/+464 °F.
Grade J9505	70 IRHD	White	This general purpose, low compression set material is designed for clean applications. Also suitable for strong oxidizing mediums.
Grade J9509	90 IRHD	Black	A material developed from J9503 but with increased hardness for use in high-pressure applications.
Grade J9510	95 IRHD	Black	An approved explosive decompression resistant (EDR) (Shell Test) grade specifically developed for the oil & gas industry, compatible with, oils, steam, sour gas and amine-based corrosion protection chemicals, etc.
Grade J9512	75 IRHD	Black	Heavy duty material suitable for extremely strong acids and bases (e.g. caustic soda) and steam applications while maintaining good compression set characteristics.
Grade J9513	90 IRHD	Black	An explosive decompression resistant (EDR) grade compliant with NORSOK M-710 standard, this material is suited to hostile downhole environments and is resistant to service conditions including sour gas, bases, acids, hot water and steam.

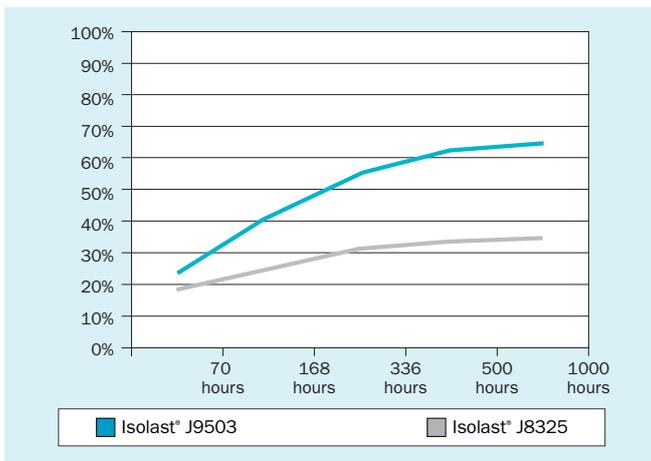
Compound	Hardness	Color	
Grade J9515 plus	75 IRHD	Black	A material compliant with US Food and Drug Administration (FDA) requirements that meets the high cleanliness standards typical in the pharmaceutical, food and bio-technology industries.
Grade J9516 plus	75 IRHD	White	A white material meeting the same qualifications as J9515 plus, including FDA requirements.
Grade J9610 Fab Range™	75 IRHD	Black	A universal compound developed for wet and dry semiconductor processes including wet cleaning, etching, Chemical Mechanical Polishing (CMP) and stripping.
Grade J9630 Fab Range™	85 IRHD	White	A white semiconductor grade developed for dry processes including etching, oxidation, diffusion and metallization.
Grade J9650 Fab Range™	75 IRHD	Black	A high-temperature semiconductor compound for use in Rapid Thermal Processing (RTP), Chemical Vapor Deposition (CVD) and diffusion applications up to +320 °C/+608 °F.
Grade J9670 Fab Range™	75 IRHD	Beige	A high-temperature non-black semiconductor compound for processes including Physical Vapor Deposition (PVD), CVD and etching, with a temperature range from -15 °C/+5 °F to +315 °C/+599 °F.
Grade J9675 Fab Range™	75 IRHD	Cream	Our latest universal semiconductor grade for both wet and dry processes, including fluorine and oxygen-based plasmas.
Grade J9680 Fab Range™	75 IRHD	Translucent	An ultra-clean translucent semiconductor compound for processes including oxidation, CVD, diffusion and etching, with a temperature range from -10 °C/+14 °F to +230 °C/+446 °F.

Standard grades with exceptional performance

The **Isolast®** range consists of two standard grades and a number of specialized grades engineered to meet the demands of specific applications. The standard grades, J9503 *Classic* and J8325 *High-Temperature* have been developed to ensure optimal performance and maximum meantime between failure through:

- Outstanding chemical resistance
- A wide temperature range from -25 °C/-13 °F up to +325 °C/+617 °F
- Very low outgassing at high temperatures and in vacuum applications
- Exceptional hysteresis properties ensuring high elasticity and dynamic recovery
- High quality surface finish further enhancing sealing performance
- Excellent compression set characteristics giving the best possible leak-proof seals (see figure 1)

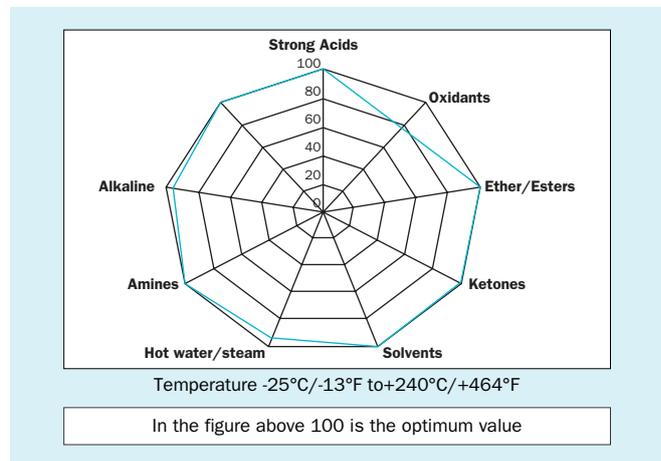
Figure 1: Long term compression set at +204 °C/+399 °F



Aggressive Chemical Environments

In hazardous applications involving aggressive chemicals, high temperatures and long service life, **Isolast® classic** material J9503 covers the widest range of chemicals from acids to alkalis and amines to esters.

Figure 2: Isolast® J9503 radar chart for chemical resistance



In tests, **Isolast®** J9503 has shown considerably better compatibility over comparable competitor products, as seen in figures 3 to 5. All tests were carried out on standard O-Rings size 214 (24.99 x 3.53 mm/.984 x .139 inches) and in accordance with test procedure DIN 53521.

Figure 3: Immersion in nitric acid at +98 °C/+208 °F

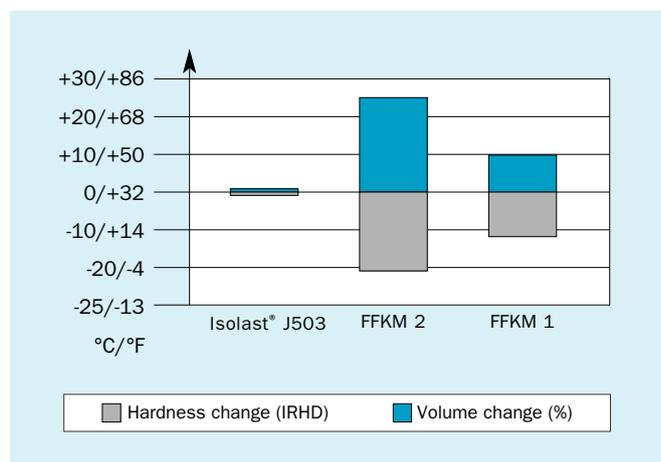


Figure 4: Immersion in acetic acid at +98 °C/+208 °F

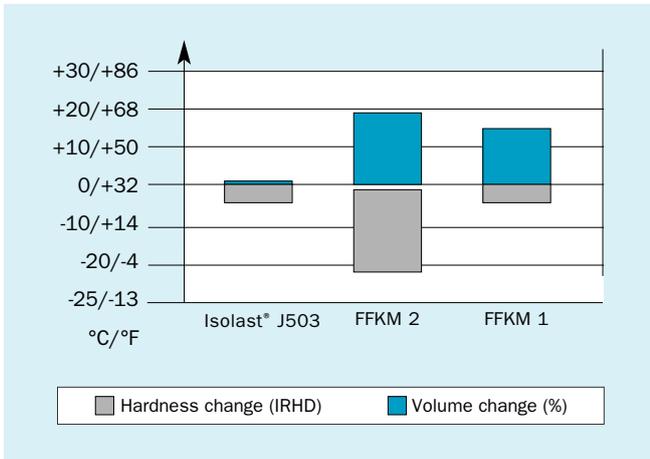
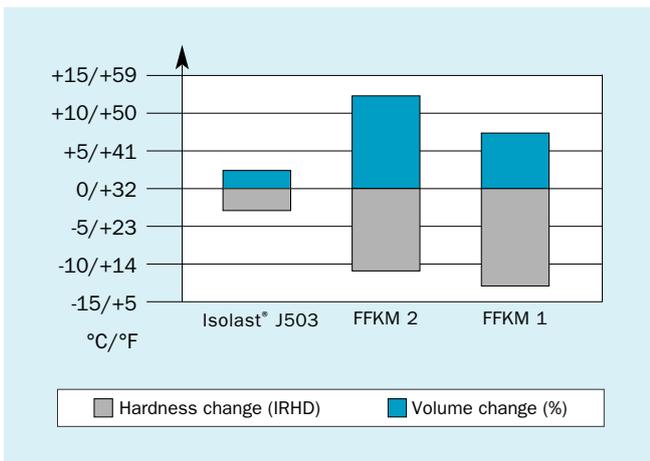


Figure 5: Immersion in pressurized steam at +200 °C/+392 °F

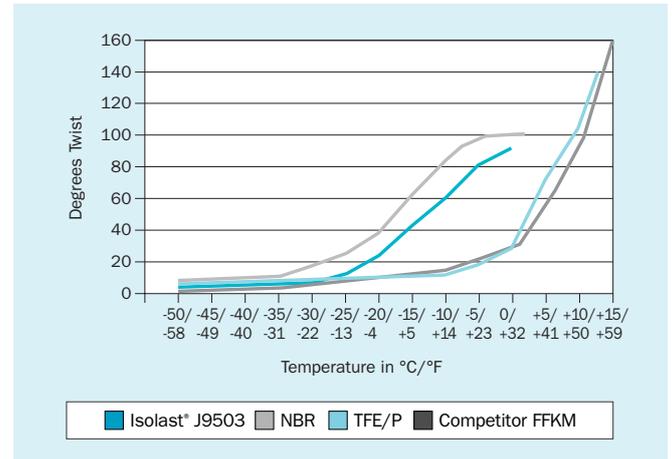


Low-Temperature Applications

At lower temperatures, below -20 °C/-4 °F for example, retained flexibility to maintain sealing force is critical. The glass transition temperature (T_g) of **Isolast®** J9503 is -19 °C/-2 °F, which is key to excellent low-temperature capability as the molecular backbone remains flexible.

Figure 6 reflects the results of a Gehman test conducted with **Isolast®** and three other elastomers. As expected, NBR rubber shows the best low-temperature capabilities, but it is followed by **Isolast®** J9503 which is effective down to -25 °C/-13 °F. Tetrafluoroethylene propylene (TFE/P) and a competitive perfluoroelastomer illustrate the exceptional performance of **Isolast®** J9503.

Figure 6: Low-temperature properties measured using a Gehman torsional test (BS 903: Part A 13, DIN 53548 and ASTM D 1053)

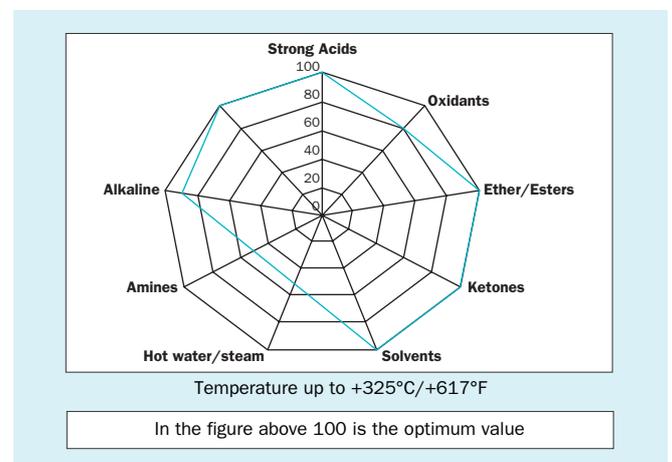


High-Temperature Applications

To meet high temperature requirements in aggressive chemical environments, **Isolast®** J8325 has been designed to run at continuous operating temperatures up to +325 °C/+617 °F. Even at these elevated temperatures, **Isolast®** maintains outstanding chemical resistance, as seen in figure 7.

Additionally, **Isolast®** J8325 high-temperature material has excellent retained sealing force which makes it suitable for applications with high-temperature cycles.

Figure 7: **Isolast®** J8325 radar chart for chemical resistance

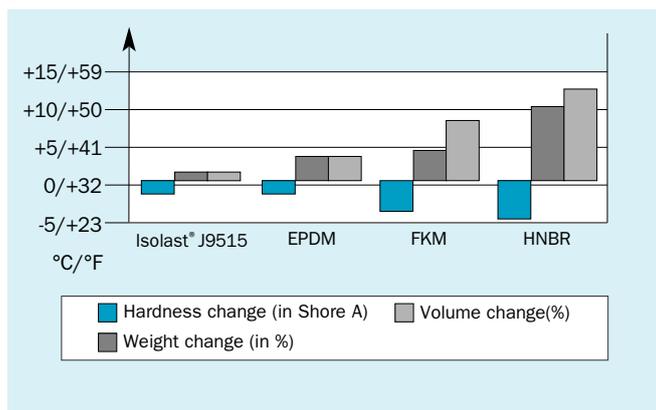


Industry specific grades

Pharmaceutical, Food and Beverage Applications

Sealing solutions in the pharmaceutical industry and also the food, beverage and biotechnology industries require cleanliness and high quality. To meet these special requirements a range of materials has been developed: **Isolast® J9515 plus** and the white **Isolast® J9516 plus**, both conform to the Food and Drug Administration (FDA) regulations set out in references 21 CFR 177.2600 (e,f) and 21 CFR 177.2400 (d) for perfluoroelastomers. **Isolast® J9515** and **Isolast® J9516** are suitable for a wide range of pharmaceutical and food applications. Extensive tests demonstrated that the **Isolast® plus** range has excellent compatibility in the most widely used Clean-in-Place (CIP) cleaning mediums and can also be applied in Water-for-Injection (WFI) and Sterilize-in-Place (SIP).

Figure 8: **Compatibility of Isolast® J9515 plus in a standard CIP medium at +80 °C/+176 °F**



Lacquer and Paint Applications

Meeting the aggressive nature of cleaning solvents and the requirement to be totally silicone-free, **Isolast®** materials are ideally suited for paint, print and lacquer applications.

For example, in automotive paint lines, **Isolast®** has proven compatibility with the new cleaning solvents for hydro-lacquer and maintains the highest quality surface finish from the initial filler coating to the final clear coat.



Oil & Gas Extraction and Processing

(High-Pressure and Explosive Decompression Resistant Applications)

In oil & gas applications, traditional sealing solutions are limited due to extreme environments. Seals are not only in contact with aggressive mediums such as crude oil, natural gas, sour gases, carbon dioxide, acids, seawater, hydrogen sulfide and anti-corrosion chemicals but are also subject to damage caused through explosive decompression.

Isolast® J9510 and **J9513** have been developed specifically to operate in the harsh environment of oil & gas processing. The base polymer provides excellent chemical resistance and the specially developed density of the materials make them ideal in explosive decompression environments. An independent testing institute has certified **Isolast® J9510** against the Shell Test and **Isolast® J9513** to NORSOK M-710 standard.

Explosive decompression: an elastomer under high gas pressure absorbs gas which creates bubbles within the material. By controlled release of pressure, the elastomer expands and then contracts back to its original size as the gas permeates out. A sudden pressure drop within the system can lead to explosive decompression as high-pressure gas expands within the elastomer before escaping, so destroying the surface and potentially the whole seal.

Semiconductor Applications

The semiconductor manufacturing process is extremely aggressive and seals are invariably housed in areas where they need to withstand highly corrosive liquids, gases and plasmas, often at elevated temperatures or in vacuum conditions. The ultimate in elastomer sealing is the ultra-pure **Isolast® Fab Range™**.

These high-performance perfluoroelastomers are virtually inert and demonstrate almost universal chemical compatibility. Suitable for wet processing systems and in aggressive plasma applications at elevated temperatures, they are ideal sealing solutions. For thermal applications,



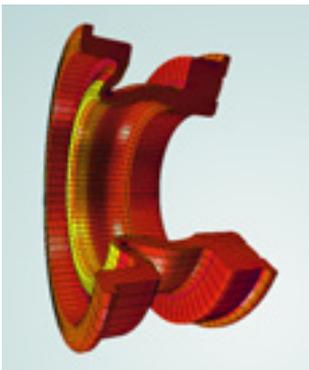
specialized grades have been developed to operate at continuous temperatures up to +325 °C/+617 °F.

This results in increased service life and extended meantime between planned maintenance (MTBM), thereby reducing downtime and maximizing production efficiency, yield and process reliability and minimizing overall cost of ownership.

In-House Testing and Laboratory Capabilities

Material development and analysis in our modern elastomer laboratories, located in the United States and Europe, ensure that the **Isolast®** range meets current and future customer requirements. Tests carried out to DIN, ASTM or other industry standards include:

- Chemical compatibility testing
- High-pressure and high-temperature testing
- Dynamical mechanical analysis (*DMA*) – TR / TR10
- Thermogravimetric analysis (*TGA*)
- Modulus curve
- Low temperature flexibility testing
- Rheometer data



Non-linear finite element analysis (NLFEA) is used to predict and optimize product performance. Taking comprehensive material test data from the material laboratories, accurate coefficients can be fed into the models. The availability of extensive test facilities permits validation of the models and benefits customers.

Design Capability

For over 50 years, our design engineers have been producing sealing solutions for industries worldwide. The integration of **Isolast®** materials into the Trelleborg Sealing Solutions product range provides unrivalled capabilities in material performance and seal design.

Our Technology

We can offer the widest product range to meet both standard and specialty requirements with assurance by:

- State-of-the-art Finite Element Analysis (*FEA*) and Non-Linear FEA computer modeling
- Extensive test facilities
- Dedicated in-house tooling facilities
- Manufacturing to zero defect standards in ISO 9001:2000 and ISO/TS 16949:2002 approved factories

Using a team approach, our applications engineers, product designers and material technologists work with the customer to achieve optimum sealing performance with cost-effective solutions.

Our international team of applications engineers and product designers are supported by 30 years experience with computer modeling. The benefits they offer, combined with data from our extensive test facilities, include:

- Opportunity to optimize designs prior to prototyping and reduce lead times
- Indication of potential assembly problems and assessment of seal performance under complex loading profiles
- Assessment of seal performance over time
- Highlighting of tolerance problems
- Insight into operational effects of elastomeric seals

Technical data - Compound overview for Isolast®

Isolast®	Grade	Hardness ± 5 Shore A	Color	Maximum service temperature °C/°F	Minimum service temperature °C/°F
Standard	J9503 – Classic	75	Black	+240/+464	-25/-13
	J8325 – High-Temperature	75	Black	+325/+617	-15/+5
Special	J9501 – Oxidizing media	80	White	+240/+464	-20/-4
	J9505 – Processing	70	White	+240/+464	-20/-4
	J9509 – High-Pressure	90	Black	+240/+464	-25/-13
	J9512 – Processing	75	Black	+260/+500	-15/+5
	J9515 Plus – FDA	75	Black	+250/+482	-15/+5
	J9516 Plus – FDA	75	White	+250/+482	-15/+5
	J9510 – EDR	95	Black	+250/+482	-15/+5
	J9513 – EDR	90	Black	+240/+464	-15/+5
	J9610 – Fab Range™	75	Black	+235/+455	-25/-13
	J9630 – Fab Range™	85	White	+260/+500	-15/+5
	J9650 – Fab Range™	75	Black	+320/+608	-15/+5
	J9670 – Fab Range™	75	Beige	+315/+599	-15/+5
	J9675 – Fab Range™	75	Cream	+300/+572	-15/+5
	J9680 – Fab Range™	75	Translucent	+230/+446	+10/+14

Notes ¹ BS 903 Part A2 ² ASTM D1414 O-Rings

For our range of semiconductor products, please refer to Isolast® semiconductor literature or contact your local Trelleborg Sealing Solutions Marketing Company.

Tensile strength ¹ MPa/psi	Elongation at break %	Compression set ² 70 h at 204 °C/399 °F %	Average linear coefficient of thermal expansion (-25 °C/-13 °F to 200 °C/392 °F)	TR-10 values of Isolast® material °C/°F
12.5/1,813	120	25	$3.31 \times 10^{-4} / ^\circ\text{C}$	-18/-0.4
20/2,900	190	19	$2.82 \times 10^{-4} / ^\circ\text{C}$	-5/+23
6.5/943	150	25	$3.64 \times 10^{-4} / ^\circ\text{C}$	-18/-0.4
6.5/943	200	20	$3.52 \times 10^{-4} / ^\circ\text{C}$	-19/-2.2
12.5/1,813	100	38	$3.04 \times 10^{-4} / ^\circ\text{C}$	-8/+17.6
10/1,450	150	15	$3.38 \times 10^{-4} / ^\circ\text{C}$	-5/+23
11.7/1,697	182	16	$3.48 \times 10^{-4} / ^\circ\text{C}$	-2/+28.4
10/1,450	200	30	$3.31 \times 10^{-4} / ^\circ\text{C}$	-2/+28.4
22/3,190	80	30	$3.01 \times 10^{-4} / ^\circ\text{C}$	-5/+23
18/2,610	65	35	$2.75 \times 10^{-4} / ^\circ\text{C}$	-3/+26.6
12.5/1,813	120	25	$3.31 \times 10^{-4} / ^\circ\text{C}$	-18/+0.4
12/1,740	223	30	$3.00 \times 10^{-4} / ^\circ\text{C}$	-7/+19.4
18.3/2,654	119	14	$2.80 \times 10^{-4} / ^\circ\text{C}$	-5/+23
13.5/1,958	185	30	$2.70 \times 10^{-4} / ^\circ\text{C}$	-6/+21.2
10/1,450	200	20	$3.50 \times 10^{-4} / ^\circ\text{C}$	-5/+23
16/2,320	215	30	$4.50 \times 10^{-4} / ^\circ\text{C}$	-1/+30.2

Key Chemical Resistance:

Isolast® is resistant to the following chemical groups. For more detailed information refer to our Chemical Compatibility Guide which is available from your local Trelleborg Sealing Solutions technical Marketing Company (see back cover) or online at www.tss.trelleborg.com.



- Concentrated organic and inorganic acids
- Strong alkalis and bases
- Alcohols, aldehydes
- Ketones, esters, ethers
- Halogens and strong oxidizing media
- Hydraulic and fuel oils, fuels (e.g. Skydrol®, Pydraul®)
- Most organic solvents
- Hot water/steam*
- CIP/SIP cleaning media
- Aliphatic and aromatic amines
- Ethylene oxide and propylene oxide

Storage conditions for Isolast® perfluoroelastomer seals

Isolast® materials have a minimum 18 year storage life provided the products are sealed in the original packaging.

For further information regarding seal storage, please refer to the **Isolast®** Chemical Compatibility Guide.

General design considerations

Some important considerations when designing sealing systems with **Isolast®**:

1. Perfluoroelastomers have a higher volumetric coefficient of expansion than fluoroelastomers or other sealing materials. The volumetric expansion when warming the material from +20 °C/+68 °F to +240 °C/+464 °F is circa 25 percent. At room temperature the groove should be only 75 percent filled to avoid extrusion of the seal at higher temperatures.
2. For static applications the installation pressure should be between 12 – 18 percent. Larger pressures will, over time, increase the compression set and could lead to premature failure of the seal. When the operating temperature is under 0 °C/+32 °F an installation pressure of 15 – 21 percent is recommended.
3. Elastomers will tend to act as a highly viscous fluid under pressure and require support or anti-extrusion devices where high pressures and/or temperatures are experienced. **Isolast®** perfluoroelastomer seals used in pressure applications exceeding 150 MPa/21,755 psi require PTFE back-up rings.
4. When operating at or below TR-10 values, shock loads should be avoided to maintain sealing integrity.
5. Care should be taken during installation of **Isolast®** materials to avoid over-stretching the seal (*max. 50 percent*).

*For further **Isolast®** details or general inquiries concerning the full range of Trelleborg Sealing Solutions products, please refer to your local Trelleborg Sealing Solutions Marketing Company (see back cover).*

Online services

Trelleborg Sealing Solutions is making it easy to design and specify seals, online. Our simple O-Ring calculator, with unique functions, allows you to easily specify the correct O-Ring for your application. With the CAD Online service, at the click of a mouse, you can download seal profiles to use in component designs. These free-of-charge programs are compatible with all commonly-used CAD systems and save users design time.

From the Isolast® Chemical Compatibility Guide

On this page you will find the introductory portion of our **Isolast®** Chemical Compatibility Guide. To download the complete Chemical Compatibility Guide, visit www.tss.trelleborg.com. Please contact your local Trelleborg Sealing Solutions Marketing Company for more information.

Isolast® perfluoroelastomer seals are available in a range of compounds to suit the most demanding applications in the chemical processing industries, food, beverage and pharmaceutical production, semiconductor manufacturing and oil & gas exploration.

The standard **Isolast®** J9503 material is manufactured from a general purpose compound suitable for most chemical processing applications ranging from -25 °C/-13 °F to +240 °C/+464 °F.

Isolast® J9503 seals offer outstanding resistance to most acids, ketones, esters, solvents, amines, hot water/steam, ethylene and propylene oxide.

For temperatures in excess of +240 °C/+464 °F and up to +325 °C/+617 °F, **Isolast®** J8325 is the preferred standard grade. **Isolast®** J8325 shows excellent general chemical resistance and low swelling properties in organic and inorganic acids, aldehydes and ketones. It has outstanding hot air aging properties. This grade is not recommended in hot water/steam or aliphatic amines applications at higher temperatures. It should never be used in applications involving ethylene and propylene oxide.

Specialized materials are available for specific applications. Please refer to the Chemical Compatibility Guide carefully or contact your local marketing company for selection of the preferred grade.

Using this Guide

All elastomer products are made from a basic elastomeric polymer compounded with fillers, additives and curing agents.

The formulation is chosen to provide the best balance of properties for each application. We have developed thousands of compounds to provide our customers with sealing solutions across a broad range of industries. Our world-leading expertise has been applied to the compounds used for **Isolast®** seals.

The effect of immersion in a fluid on an elastomer largely depends on the base polymer. Reaction with the fillers, additives and curing agents is normally of lower significance. However, in certain media the possibility of a reaction has to be considered.

Isolast® perfluoroelastomer parts should always be tested for suitability when used in fluids containing high concentrations of some diamines, nitric acid and basic phenols at temperatures in excess of +100 °C/+212 °F.

It is important to recognize when using this guide that 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. However, **Isolast®** perfluoroelastomer parts, with their outstanding chemical resistance, are most likely to provide excellent service life.

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 greater 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 **Isolast®** perfluoroelastomer seals for each application. Our experienced technical staff can be consulted for further information on specific applications.

Ratings are shown for four other commonly used elastomers: Ethylene-Propylene-Dien (EPDM), silicone (VMQ), fluorosilicone (FVMQ) and fluorocarbon (FKM). These have been included primarily for comparison and reflect the performance of typical compounds. In practice the performance of actual compounds may differ substantially from what is shown here. Ratings published here for these elastomers should not be used as the basis for choice in any application.

If an elastomer is to be used in contact with foodstuffs or beverages, users should confirm that the elastomer complies with any statutory regulations that might apply. For medical and pharmaceutical applications it is also important that direct advice is gained from the manufacturer.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (0) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

www.tss.trelleborg.com



Isolast® HT J8325

**Superior high temperature sealing
over a broad range of chemicals**



Your Partner for Sealing Technology

The Isolast® HT J8325

The Isolast® range of high specification perfluoroelastomer compounds has been developed to provide equipment manufacturers and end users with sealing solutions compatible with virtually all chemical media, over the widest temperature range possible. Unique Isolast® formulations give real benefits and cost advantages by providing optimum seal reliability and extending service life. Seal performance is further enhanced by superior hysteresis and compression set characteristics, which ensure high elasticity and dynamic recovery, minimizing risk of seal failure.

Isolast® J8325 material grade is an advanced perfluoroelastomer compound with a continuous upper operating temperature of 325°C / 617°F. It is formulated to offer unrivalled thermal stability across a broad range of chemical media, while

retaining its superior physical properties.

Features:

- Thermal stability from -15°C to +325°C / +5°F to +617°F
- Compatibility across a broad range of chemical media
- Unrivalled long-term compression set performance
- Exceptional hysteresis properties
- Available as standard and non-standard O-Rings and custom-molded designs

Applications:

- Chemical processing
- Hydrocarbon processing
- Oil and Gas industry, offshore and onshore
- Aerospace industry
- Semiconductor fabrication
- Diesel engines
- Power generation

Isolast® HT

J8325 Compound Data

Compound No.:		J8325		
Elastomer base:	DIN ISO 1629	FFKM		
Hardness:	DIN 53 505	75 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	2.01 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ²⁰ / psi	20 / 2,900
Elongation at break:		DIN 53 504	%	190
Compression set:	72 h / 200 °C / 392 °F	DIN ISO 815 Typ B	%	19
Service temperature:			°C / °F	-15 / +325 +5 / +617

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

www.tss.trelleborg.com



Isolast® General Purpose J9440



Improved value with excellent chemical resistance over a broad range of applications



Your Partner for Sealing Technology

Isolast® J9440

The Isolast® range of high specification perfluoroelastomer compounds has been developed to provide equipment manufacturers and end users with sealing solutions compatible with virtually all chemical media, over the widest temperature range possible. Unique Isolast® formulations give real benefits and cost advantages by providing optimum seal reliability and extending service life. Seal performance is further enhanced by superior hysteresis and compression set characteristics, which ensure high elasticity and dynamic recovery, minimizing risk of seal failure.

Isolast® J9440 is an improved value material grade, an advanced perfluoroelastomer compound developed to give excellent chemical resistance in a broad range of chemical media at continuous operating temperatures from -7°C to $+230^{\circ}\text{C}$ / $+19^{\circ}\text{F}$ to $+446^{\circ}\text{F}$. It is particularly suitable for use in mechanical seals, lacquer and paint applications, pumps, valves and power generation equipment.

Features:

- Excellent chemical compatibility
- Thermal stability from -7°C to $+230^{\circ}\text{C}$ / $+19^{\circ}\text{F}$ to $+446^{\circ}\text{F}$
- Excellent long-term compression set characteristics
- Exceptional hysteresis properties
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

- Chemical processing
- Hydrocarbon processing
- Diesel engines
- Power generation
- Lacquer, print and coatings
- Semiconductor fabrication
- Mechanical seals
- Pumps and valves
- Filters, flanges and couplings

Isolast® J9440 Compound Data

Compound Number:		J9440		
Elastomer base:	DIN ISO 1629	FFKM		
Hardness:	DIN 53 505	75 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	2.03 ± -0.03
Tensile strength:		DIN 53 504	MPa N/mm ² / psi	17.4 / 3,191
Elongation at break:		DIN 53 504	%	161
Compression set:	72 h / 200 °C / 392 °F	DIN ISO 815 Type B	%	30
Service temperature:			°C/°F	-7 to +230 / +19 to +446

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application.

Trelleborg Sealing Solutions offers:

- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

www.tss.trelleborg.com



Isolast® Universal J9503



**Superior sealing
resistant to virtually all chemicals**



Your Partner for Sealing Technology

Isolast® Universal J9503

The Isolast® range of high specification perfluoroelastomer compounds has been developed to provide equipment manufacturers and end users with sealing solutions compatible with virtually all chemical media, over the widest temperature range possible. Unique Isolast® formulations give real benefits and cost advantages by providing optimum seal reliability and extending service life. Seal performance is further enhanced by superior hysteresis and compression set characteristics, which ensure high elasticity and dynamic recovery, minimizing risk of seal failure.

Isolast® J9503 material grade is an advanced perfluoroelastomer compound developed to give unrivalled chemical resistance in the broadest range of

chemical media, including organic and inorganic oxides, acids, alkalis, amines, esters and steam, at continuous operating temperatures from -25°C to +240°C / -13°F to +464°F .

Isolast® J9509 material grade, a development of Isolast® J9503, has an increased hardness of 90 Shore A offering improved extrusion resistance in high-pressure applications typically encountered in the oil & gas and hydrocarbon processing industries.

Isolast® J9501 (80 Shore A) and 9505 (70 Shore A) white material grades have been developed for use in strong oxidizing media such as halogens, ozone or hot oxidizing acids.

Isolast® Universal J9503 Compound Data

Features:

- Almost universal chemical compatibility
- Thermal stability from -25°C to +240°C / -13°C to +464°F
- Excellent long-term compression set characteristics
- Exceptional hysteresis properties
- Isolast® J9503 offers superior extrusion resistance
- Available as standard and non-standard O Rings, custom-molded designs and bonded products

Applications:

- Chemical processing
- Hydrocarbon processing
- Oil and Gas industry, offshore and onshore
- Pharmaceutical and food processing
- Aerospace industry
- Diesel engines
- Power generation
- Lacquer, print and coatings industry
- Semiconductor fabrication

Compound No.:		J9503		
Elastomer base:	DIN ISO 1629	FFKM		
Hardness:	DIN 53 505	75 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	1.94 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ² / psi	12.5 / 1,813
Elongation at break:		DIN 53 504	%	120
Compression set:	72 h / 200 °C / 392° F	DIN ISO 815 Typ B	%	25
Service temperature:			°C / °F	-25 / +240 -13 / +464

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

www.tss.trelleborg.com



Isolast® J9510



**Explosive decompression resistance
with superior high pressure performance**



Your Partner for Sealing Technology

Isolast® J9510

The Isolast® range of high specification perfluoroelastomer compounds has been developed to provide equipment manufacturers and end users with sealing solutions compatible with virtually all chemical media, over the widest temperature range possible. Unique Isolast® formulations give real benefits and cost advantages by providing optimum seal reliability and extending service life. Seal performance is further enhanced by superior hysteresis and compression set characteristics, which ensure high elasticity and dynamic recovery, minimizing risk of seal failure.

Isolast® J9510 material grade is a high-performance perfluoroelastomer formulated for chemical compatibility in the widest range of media, including amines, steam, oils, sour gases, completion and drilling fluids, bacteriacides, corrosion and scale inhibitors, offering a continuous operating temperature range of -10°C to +250°C/+14°F to 482°F.

Specifically developed for the oil and gas processing industries, Isolast® J9510 exhibits superior high-pressure sealing and unrivalled perfluoroelastomer performance for explosive decompression resistance (EDR), which is supported by independent institute approval to industry standard test protocols.

Features:

- Almost universal chemical compatibility
- Thermal stability from -10°C to +250°C / +14°F to 482°F
- Unrivalled perfluoroelastomer performance for explosion decompression resistance (EDR)
- Independent approval to Shell test protocol for EDR
- Superior high-pressure performance
- Excellent long-term compression set characteristics
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

- Oil and Gas industry, offshore and onshore
- Chemical processing
- Hydrocarbon processing
- Refining
- Downhole production
- Logging equipment
- Chemical injection

Isolast®

J9510 Compound Data

Compound No.:		J9510		
Elastomer base:	DIN ISO 1629	FFKM		
Hardness:	DIN 53 505	95 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	2.01 ± -0.03
Tensile strength:		DIN 53 504	MPa N/mm ² / psi	22 / 3,191
Elongation at break:		DIN 53 504	%	80
Compression set:	72 h / 200°C / 392°F	DIN ISO 815 Typ B	%	30
Service temperature:			°C/°F	-10 / +250 +14/ +482

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

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- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
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- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

www.tss.trelleborg.com



Isolast® J9512

Superior sealing with resistance to high temperature steam



Your Partner for Sealing Technology

Isolast® J9512

The Isolast® range of high specification perfluoroelastomer compounds has been developed to provide equipment manufacturers and end users with sealing solutions compatible with virtually all chemical media, over the widest temperature range possible. Unique Isolast® formulations give real benefits and cost advantages by providing optimum seal reliability and extending service life. Seal performance is further enhanced by superior hysteresis and compression set characteristics, which ensure high elasticity and dynamic recovery, minimizing risk of seal failure.

Isolast® J9512 material grade is a high-performance perfluoroelastomer formulated for chemical compatibility in the widest range of media, including highly concentrated acids and bases, organic and inorganic oxides, amines and esters, offering a continuous operating temperature range of -5°C to +260°C / +23°F to +500°F.

Specifically developed for aggressive chemical processing applications, Isolast® J9512 exhibits excellent resistance to high-temperature steam and concentrated acids, achieving unrivalled results in comparative laboratory and field tests.

Features:

- Almost universal chemical compatibility
- Thermal stability from -5°C to +260°C / +23°F to +500°F
- Unrivalled high-temperature steam resistance
- Resistant to concentrated acids at elevated temperatures
- Excellent long-term compression set characteristics
- Exceptional hysteresis properties
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

- Chemical processing
- Hydrocarbon processing
- Oil and Gas industry, offshore and onshore
- Diesel engines
- Power generation
- Metals extraction

Isolast®

J9512 Compound Data

Compound No.:		J9512		
Elastomer base:	DIN ISO 1629	FFKM		
Hardness:	DIN 53 505	75 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	2.01 ± -0.03
Tensile strength:		DIN 53 504	MPa N/mm ² / psi	12 / 1,741
Elongation at break:		DIN 53 504	%	163
Compression set:	72 h / 200 °C / 392 °F	DIN ISO 815 Typ B	%	15
Service temperature:			°C / °F	-5 / +260 +23 / +500

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

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Isolast® *plus* sanitary ferrule gaskets J9515 and J9516



Your Partner for Sealing Technology

The Isolast® plus Sanitary Ferrule Gasket

The Isolast® plus Sanitary Ferrule Gasket offers a superior sealing solution, exclusively designed and formulated for pipe work within processing systems, specifically in the food, pharmaceutical, cosmetic, medical and biotechnology industries. Their special material formulations help reduce downtime and improve production efficiency by extending seal life, while minimizing risk of contamination and bacterial ingress, ensuring product purity. These high-performance perfluoroelastomer gaskets demonstrate almost universal chemical compatibility, giving real benefits and cost advantages in aggressive processing environments.



Isolast® plus sanitary ferrule gasket J9515 and J9516 Compound Data

Features and benefits:

- Exceptional thermal resistance, withstanding temperatures up to 250°C/+482°F and down to -15°C/+5°F
- Excellent performance characteristics in CIP and SIP media with almost universal chemical resistance
- Ultra-high purity material
- Long-term low compression set
- Manufactured in black (J9515) or white (J9516) compounds
- Materials totally FDA-compliant
- USP class VI for pharmaceutical applications
- Corresponds to the biotechnology draft DIN EN 12462
- Option of manufacturing and packaging according to class 100 cleanroom conditions
- Available as standard product with outer ring diameter from 34mm/1.3in to 119mm / 4.7in

Compound No.:			J9515	J9516
Elastomer base:	DIN ISO 1629		FFKM	FFKM
Hardness:	DIN 53 505		73 +/- 3 Shore A	70 +/- 5 Shore A
Color:			black	white
Specific gravity:	DIN 53 479	g/cm ³	2.03 ± -0.03	2.43 ± -0.03
Tensile strength:	DIN 53 504	MPa N/mm ² / psi	11.7 / 1,697	11.9 / 1,726
Elongation at break:	DIN 53 504	%	182	228
Compression set:	72 h / 200 °C / 392 °F DIN ISO 815 Typ B	%	16	30
Service temperature:		°C / °F	-15 / +250 +5 / +482	-15 / +250 +5 / +482

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

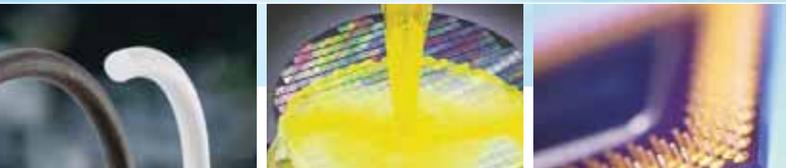
- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

www.tss.trelleborg.com



Isolast® Fab Range™ J9610

**Superior sealing
for wet process applications**



Your Partner for Sealing Technology

Isolast® Fab Range™ J9610

The Isolast® Fab Range™ offers high specification sealing compounds, exclusively formulated for the semiconductor industry. The special formulations help reduce downtime and improve production efficiency by extending seal life. These high-performance perfluoroelastomers are virtually inert and demonstrate almost universal chemical compatibility, giving real benefits and cost advantages in semiconductor applications.

Isolast® J9610 material grade is a high-performance perfluoroelastomer designed specifically for a wide range of wet processing applications in semiconductor environments with a continuous operating temperature up to 235 °C/455°F.

Features:

- Extremely low metal cation extractables
- Minimal anion impurities
- Low levels of extractable total organic carbon
- Highest levels of chemical resistance to acids, solvents and UPDI water
- Clean and contaminant-free sealing surfaces
- Superior long-term low compression set
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

Isolast® J9610 is recommended for use at continuous operating temperatures up to 235 °C/455°F in:

- Wet etch
- Wet stripping
- Wet cleaning
- Plating
- Chemical mechanical planarization

Isolast® Fab Range™

J9610 Compound Data

Compound No.:		J9610		
Elastomer base:	DIN ISO 1629	FFKM Ultra Pure		
Hardness:	DIN 53 505	75 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	1.94 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ² /psi	13.8 / 2,002
Elongation at break:		DIN 53 504	%	128
Compression set:	72 h / 200 °C / 392 °F	DIN ISO 815 Typ B	%	17
Service temperature:		DIN ISO 1629	°C/°F	-25 / +235 73 / +455

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

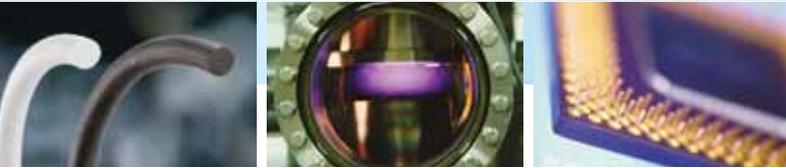
- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

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Isolast® Fab Range™ J9630

**Superior sealing
for aggressive plasma applications**



Your Partner for Sealing Technology

Isolast® Fab Range™ J9630

The Isolast® Fab Range™ offers high specification sealing compounds, exclusively formulated for the semiconductor industry. The special formulations help reduce downtime and improve production efficiency by extending seal life. These high-performance perfluoro-elastomers are virtually inert and demonstrate almost universal chemical compatibility, giving real benefits and cost advantages in semiconductor applications.

Isolast® J9630 is capable of operating at continuous temperatures up to 260°C / 500°F, and has been specifically compounded for mid-temperature plasma applications in wafer processing. Minimal particulation and extremely low outgassing means that industry requirements for seals needing to exhibit ultra-high purity, cleanliness, reliability and long life can be met.

Features:

- Resistance to aggressive plasmas and particulation
- Resistance to semiconductor dry process gasses
- Minimal outgassing and weight loss
- Continuous service temperatures up to 260°C / 500°F
- Clean and contaminant-free sealing surfaces
- Manufactured and packaged in Class 100 cleanroom conditions
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

Isolast® J9630 is recommended for use at continuous operating temperatures up to 260°C / 500 deg F in:

- Dry plasma etch
- Oxidation
- Chemical Vapor Deposition (CVD)
- Plasma ashing
- Diffusion
- Metalization

Isolast® Fab Range™

J9630 Compound Data

Compound No.:		J9630		
Elastomer base:	DIN ISO 1629	FFKM Ultra Pure		
Hardness:	DIN 53 505	85 +/- 5 Shore A		
Color:		white		
Specific gravity:		DIN 53 479	g/cm ³	2.57 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ² / psi	12 / 1,741
Elongation at break:		DIN 53 504	%	223
Compression set:	72 h / 200 °C / 392 °F	DIN ISO 815 Typ B	%	30
Service temperature:		DIN ISO 1629	°C / °F	-15 / +260 +5° / +500°

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

www.tss.trelleborg.com



Isolast® Fab Range™ J9650



**Superior sealing
for high temperature applications**



Your Partner for Sealing Technology

Isolast® Fab Range™ J9650

The Isolast® Fab Range™ offers high specification sealing compounds, exclusively formulated for the semiconductor industry. The special formulations help reduce downtime and improve production efficiency by extending seal life. These high-performance perfluoroelastomers are virtually inert and demonstrate almost universal chemical compatibility, giving real benefits and cost advantages in semiconductor applications.

Isolast® J9650 has been specifically developed for high-temperature wafer processing applications and exhibits minimal outgassing at continuous operating temperatures up to 320°C / 608°F.

Features:

- Ultra-high purity
- Superior resistance to thermal degradation
- Extremely low metal cation extractables
- Minimal anion impurities
- Long-term low compression set
- Almost universal chemical resistance
- Clean and contaminant-free sealing surfaces
- Minimal outgassing at elevated temperatures
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

Isolast® J9650 is recommended for use at continuous operating temperatures up to 320°C / 608 °F in:

- Rapid thermal processing
- Chemical Vapor Deposition (CVD)
- Diffusion processing
- Dry plasma etching
- Dry ashing
- Metalization
- Annealing

Isolast® Fab Range™

J9650 Compound Data

Compound No.:		J9650		
Elastomer base:	DIN ISO 1629	FFKM Ultra Pure		
Hardness:	DIN 53 505	75 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN 53 479	g/cm ³	2.01 ± 0.03
Tensile strength:		DIN 53 504	MPa N/mm ² /psi	18.3/2,654
Elongation at break:		DIN 53 504	%	119
Compression set:	72 h / 200 °C / 392 °F	DIN ISO 815 Typ B	%	14
Service temperature:		DIN ISO 1629	°C / °F	-15 / +320 +5 / +608

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

Trelleborg Sealing Solutions offers to the semiconductor industry:

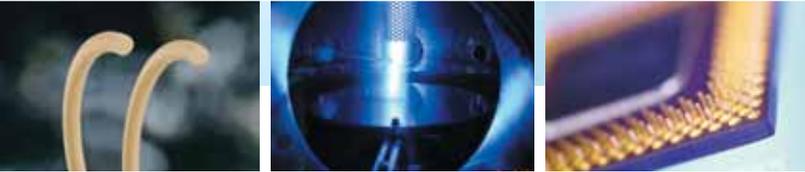
- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

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Isolast® Fab Range™ J9670

**Superior sealing for
high temperature plasma applications**



Sealing Solutions for the Semiconductor Industry

Isolast® Fab Range™ J9670

Isolast® J9670 is capable of operating at continuous temperatures up to +315 °C / +600 °F, and has been specifically formulated for high-temperature plasma applications in wafer processing. Superior resistance to aggressive, high-temperature plasma erosion combined with minimal particle generation and extremely low outgassing means that industry requirements for seals exhibiting ultra-high purity, cleanliness, reliability and long life can be met.

The Isolast® Fab Range™ offers high specification sealing compounds, exclusively formulated for the semiconductor industry. The special formulations help reduce downtime and improve production efficiency by extending seal life. These high-performance perfluoroelastomers are virtually inert and demonstrate almost universal chemical compatibility, giving real benefits and cost advantages in semiconductor applications.



Applications

Isolast® J9670 is recommended for use at continuous operating temperatures up to +315 °C / +600 °F in:

- Dry plasma etch
- Oxidation
- Chemical Vapor Deposition (CVD)
- Plasma ashing
- Diffusion
- Metallization

Isolast® Fab Range™ J9670 Compound Data

Compound No.	J9670			
Elastomer Type	FFKM Ultra Pure			
Color	Beige			
Hardness	ASTM D 2240 DIN 53505	75 (+/-5) Shore A		
Tensile Strength	ASTM D 412	1960 psi	DIN 53504	13.5 MPa N/mm ²
Elongation at break	ASTM D 412	185%	DIN 53504	185%
Modulus @ 100%	ASTM D 412	900 psi	DIN 53504	6.2 MPa
Compression set	ASTM D 395 B 72h / +392 °F	30	DIN ISO 815 Type B 72h / +200 °C	30
Service temperature	ASTM D 1418	+5 °F to +600 °F	DIN ISO 1629	-15 °C to +315 °C

Features

- Resistance to high-temperature plasmas and particulation
- Continuous service temperatures up to +315°C/+600°F
- Superior physical properties at elevated temperatures
- Resistance to aggressive semiconductor dry process gases
- Minimal outgassing
- Resistance to aggressive, high-temperature plasma erosion
- Clean and contaminant-free sealing surfaces
- Manufactured and packaged in Class 100 cleanroom conditions
- Available as standard and non-standard O-Rings and custom-molded designs

Trelleborg Sealing Solutions offers to the semiconductor industry:

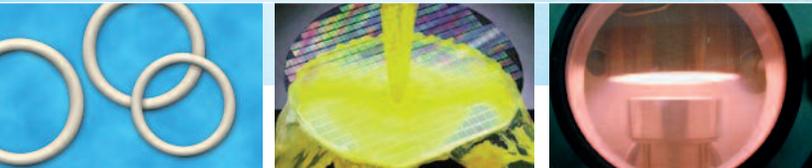
- Quality levels to ISO 9001:2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

The indicated material properties are average values determined with the use of standard test labs according to the corresponding specification. These values cannot be used as specification values and may be different from the material properties of finished parts. This is to emphasize that the end user is requested to test the material with regard to its suitability in the application. This information is not subject to an automatic update.

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Isolast® Fab Range™ J9675

Universal Sealing in
Dry / Plasma Wafer Processes



Your Partner for Sealing Technology

Isolast® Fab Range™ J9675

Isolast® J9675 is a new cream-colored perfluoroelastomer compound, developed to offer excellent chemical resistance and minimal particulation across a wide range of wafer processes and all fluorine- and oxygen-based plasma environments. Unique curing and filler systems ensure excellent long-term properties retention in continuous service temperatures to +300 °C / +572 °F. Isolast® J9675 is the ideal candidate to be used in multiple seal geometries across a wide range of static and dynamic applications in all wafer processing tools.

Typical Physical Properties:

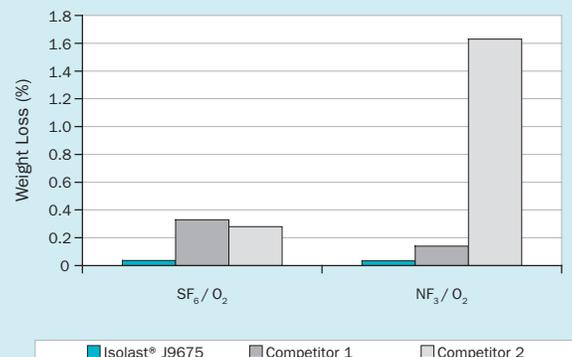
Elastomer Type		FFKM
Color		Cream
Hardness, Shore A	Pts.	75
Tensile Strength	MPa N/mm ² psi	10.0 1400
Elongation at Break	%	200
Modulus 100 %	MPa N/mm ² psi	3.5 500
Compression Set, max.		
72h @ +204 °C / +400 °F	%	20
72h @ +275 °C / +527 °F		28
Continuous Service Temperature	-15 °C to +300 °C +5 °F to +572 °F	

Note: unless otherwise noted, all tests are performed on standard test sheets. Compression set tested on AS-568A-214 O-Rings.

Applications:

- Deposition (CVD, PECVD, HDPCVD, RPCVD, APCVD, SACVD, DCVD)
- Oxidation
- Diffusion
- Etching
- Ashing
- Metallization
- RTP

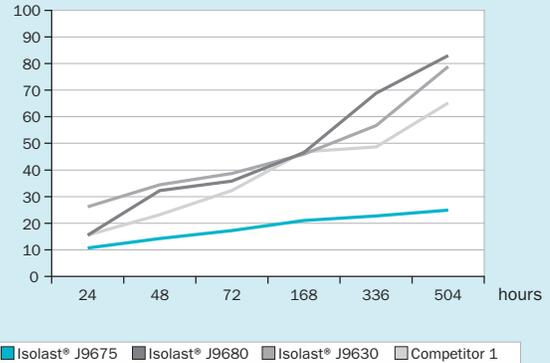
Plasma Resistance in NF₃ / O₂ and SF₆ / O₂
(90 min plasma immersion)



Features:

- High purity
- Extremely low cationic and TOC leach out in various wet fluids (UPDI, strippers etc.)
- Excellent resistance to all dry and plasma-based wafer processing chemistries
- Continuous service temperatures to +300 °C / +572 °F
- Outstanding long-term properties retention
- Available in O-Rings, square and special section seals, V-Rings®, as well as custom molded seals and engineered solutions
- Standard product finishing in Class 100 Cleanroom

Compression Set Results @ +250°C / +482°F



Field experiences with Isolast® Fab Range™ J9675

- ➔ Wafer Seal – Electrochemical Plating (ECP) process
 - Lower particulation and increased wafer count with Isolast® J9675 over competitive FFKM
- ➔ Slit Door – 300 mm Dry Etch Process Chamber
 - Solve sticking problem and lower particle generation with Isolast® J9675 over competitive FFKM
- ➔ O-Ring – PC manifold in 300 mm Etcher
 - Isolast® J9675 solved seal cracking problem and surpassed service life with existing FKM seal

Isolast® Fab Range™ Seals are part of the Trelleborg Sealing Solutions product portfolio developed for the Semiconductor industry. Trelleborg Sealing Solutions is a full service supplier to the Semiconductor and other industries encompassing:

- Wide range of sealing materials and products
- Engineered Sealing Solutions
- Technical, logistics, and sales support through the global Trelleborg Sealing Solutions network
- Material development to meet tomorrow's market requirements
- Vast Application Engineering Experience
- Innovation in Product Design including NLFEA modeling
- ISO 9001 Quality Standards

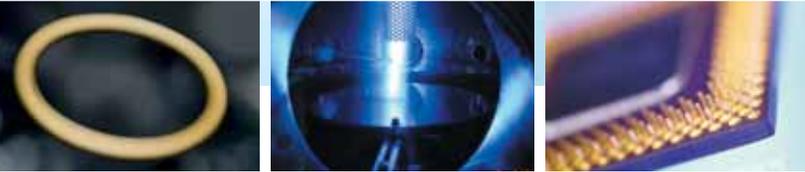
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Isolast® Fab Range™ J9680

Superior sealing for aggressive plasma applications



Sealing Solutions for the Semiconductor Industry

Isolast® Fab Range™ J9680

Isolast® J9680 is a translucent, modern architecture perfluoroelastomer compound, formulated for select plasma and gas deposition processes, where the ultimate in low-particle generation and low outgassing are key performance criteria. Isolast® J9680 exhibits outstanding chemical resistance in oxygen and fluorine-based plasmas, has excellent long-term mechanical properties and is suited for static and low sealing force applications in moderate temperatures to +230°C / +450°F.

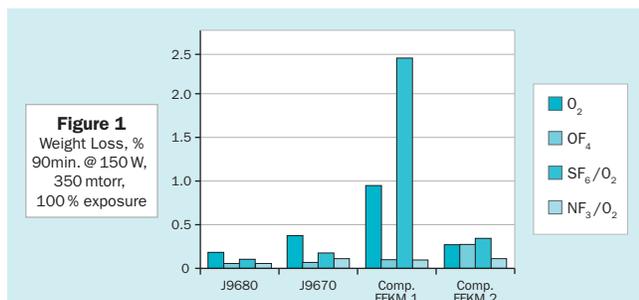
The Isolast® Fab Range™ offers high specification sealing compounds, exclusively formulated for the semiconductor industry. The special formulations help reduce downtime and improve production efficiency by extending seal life. These high-performance perfluoroelastomers are virtually inert and demonstrate almost universal chemical compatibility, giving real benefits and cost advantages in semiconductor applications.



Applications

Isolast® J9680 is recommended for use in select dry process applications in moderate operating temperatures up to +230°C / +450°F where minimal outgassing and particle generation are required in static and low sealing force applications to maximize wafer counts:

- Deposition
- Dry Plasma Etch
- Dry Ashing
- Oxidation
- Metallization
- Diffusion



Isolast® Fab Range™ J9680 Compound Data

Compound No.	J9680			
Elastomer Type	FFKM Ultra Pure			
Color	Translucent			
Hardness	ASTM D 2240 DIN 53505	75 (+/-5) Shore A		
Tensile Strength	ASTM D 412	2300 psi	DIN 53 504	16.0 MPa N/mm ²
Elongation at break	ASTM D 412	215%	DIN 53 504	215%
Modulus @ 100%	ASTM D 412	800 psi	DIN 53 504	5.5 MPa
Compression set	ASTM D 395 B 72h / +392 °F 500h / +392 °F	30 42	DIN ISO 815 Type B 72h / +200 °C 500h / +200 °C	30 42
Service temperature	ASTM D 1418	+14 °F to +450 °F	DIN ISO 1629	-10 °C to +230 °C

Features

- High-purity, very low metallic ion content
- Exceptional chemical resistance in all oxygen and fluorine-based plasma environments
- Ultra-low particle generation
- Continuous service temperature to +230 °C / +450 °F
- Very good long-term compression set
- Available in O-Rings and other standard seals, custom-molded and rubber-metal bonded designs
- Standard product finishing in Class 100 Cleanroom

Trelleborg Sealing Solutions offers to the semiconductor industry:

- Quality levels to ISO 9001:2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

The indicated material properties are average values determined with the use of standard test labs according to the corresponding specification. These values cannot be used as specification values and may be different from the material properties of finished parts. This is to emphasize that the end user is requested to test the material with regard to its suitability in the application. This information is not subject to an automatic update.

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For further information:

Europe	Telephone	America	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, CROATIA, HUNGARY, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (1) 406 47 33	AMERICAS - Fort Wayne, IN	+1 (260) 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (10) 22 57 50	BRAZIL - Sao Paulo	+55 (11) 3372 4500
BULGARIA - Sofia <small>(ROMANIA, RUSSIA)</small>	+359 2 96 99 510	CANADA - Ontario	+1 (416) 213 9444
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	MEXICO - Mexico D.F.	+52 55 57 19 50 05
DENMARK - Hillerød	+45 4822 8080	USA, East - Philadelphia, PA	+1 (610) 828 3209
FINLAND - Vantaa <small>(ESTONIA, LATVIA, LITHUANIA)</small>	+358 (0)9 8256 110	USA, Great Lakes - Fort Wayne, IN	+1 (260) 749 6781
FRANCE - Maisons-Laffitte	+33 (0)1 30 86 56 00	USA, Midwest - Lombard, IL	+1 (630) 268 9915
GERMANY - Stuttgart	+49 (711) 7 86 40	USA, Mountain - Broomfield, CO	+1 (303) 469 1357
GREECE	+41 (21) 63141111	USA, Northern California - Fresno, CA	+1 (559) 449 6070
ITALY - Livorno	+39 (0586) 22 61 11	USA, Northwest - Portland, OR	+1 (503) 595 6565
THE NETHERLANDS - Barendrecht	+31 (10) 29 22 111	USA, South - N. Charleston, SC	+1 (843) 747 7656
NORWAY - Oslo	+47 22 64 60 80	USA, Southwest - Houston, TX	+1 (713) 461 3495
POLAND - Warsaw <small>(BELARUS, LITHUANIA, UKRAINE)</small>	+48 (22) 8 63 30 11	USA, West - Torrance, CA	+1 (310) 371 1025
RUSSIA - Moscow	+7 495 982 39 21		
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 91 710 5730	Asia	Telephone
SWEDEN - Jönköping	+46 (36) 34 15 00	ASIA PACIFIC REGIONAL	+65 (6)265 6883
SWITZERLAND - Crissier	+41 (21) 631 41 11	CHINA - Hong Kong	+852 (2)366 9165
TURKEY	+41 (21) 631 41 11	INDIA - Bangalore	+91 (80) 2655 5157
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0)121 744 1221	JAPAN - Tokyo	+81 (3) 5633 8008
AFRICA REGIONAL	+41 (21) 631 41 11	KOREA - Gyunggi-Do	+82 (31) 386 3283
MIDDLE EAST REGIONAL	+41 (21) 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
		TAIWAN - Taichung	+886 (4) 23 58 00 82
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	+65 (6)293 2500
		and all other countries in Asia	

Semicon Segment Contacts:
Americas + 925 858 1394
Asia + 886 930982646
Europe +49 1727446176

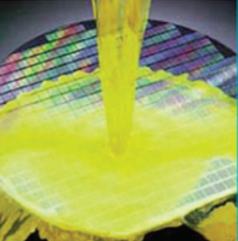
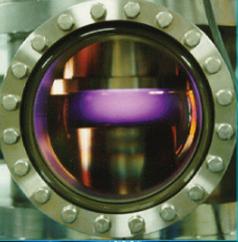
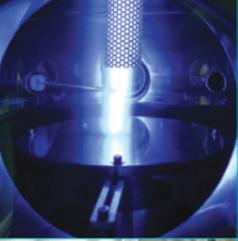
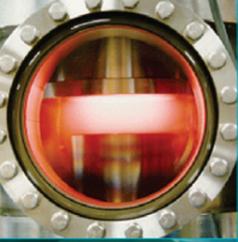
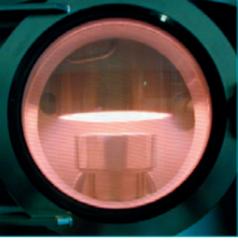
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Isolast® Fab Range™ Selection Guide

Your Partner for Sealing Technology

Range of ultra pure sealing perfluorelastomers specifically for semiconductor and nanotechnology industries

Application	Compound	Processes	Typical Chemicals/Gases	Operating Temperature	Hardness shore A, IRHD +/- 5	Color	Compression Set in % ASTM D 395B 72 h/204 °C/400 °F
	J9610	wet cleaning etching stripping plating CMP	TMAH, Stoddard Solvent, HF, H ₃ PO ₄ , nMP, CuSO ₄ , UPDI, CMP slurries	-25 °C /235°C -13 °F/455 °F	75	black	17
	J9650	RTP, CVD diffusion dry plasma etch, dry ashing metallization deposition annealing	Resistance to IR absorption, SF ₆ , CF ₄ /O ₂ , NF ₃ , O ₂ , CHF ₃ , TMS, TEOS, SiH ₄ , High Vacuum	-15 °C /320°C 5 °F/608 °F	75	black	14
	J9630	dry plasma etch oxidation CVD plasma ashing diffusion metallization	SF ₆ , CF ₄ /O ₂ , NF ₃ , O ₂ , NH ₃ , CHF ₃ , TMS, TEOS, SiH ₄	-15 °C /260 °C 5 °F/500 °F	85	white	30
	J9670	high temperature plasma processes dry plasma etch PVD, CVD	SF ₆ , BCl ₃ /O ₂ , NF ₃ , CHF ₃ , O ₂ , HCl, High Vacuum, Al, Cu, Ta, Ti, TEP, TEOS, SiH ₄	-15 °C /315 °C 5 °F/599 °F	75	beige	30
	J9680	dry plasma etch oxidation CVD plasma ashing diffusion metallization	SF ₆ , BCl ₃ /O ₂ , CHF ₃ , O ₂ , HCl, Al, Cu, Ta, Ti, TEP, TEOS, SiH ₄	-10 °C /230 °C 14 °F/446 °F	75	translucent	30
	J9675	ECP wet stripping fluorine + oxygen based plasma processes	ArF ₂ , NF ₃ , CuSO ₄ , H ₂ SO ₄ , nMP, Hydroxylamine, O ₂ , CF ₄ , SF ₆ , CCl ₄ , Cl ₂	-15 °C /300 °C 5 °F/572 °F	75	cream	20

Available on O-rings, square and special section seals, V-rings®, as well as custom molded seals and engineered solutions.

Isolast® XploR J9513

Explosive Decompression Resistant Materials



The ultimate in chemical and temperature resistance



Your Partner for Sealing Technology

Explosive Decompression is a major concern to the oil and gas industry. It occurs when applied system pressure is released, causing absorbed gas to expand, potentially damaging elastomer seals.

Trelleborg Sealing Solutions has focused on this issue and presents the XploR range, an entire family of advanced elastomers especially developed for oil and gas applications. The portfolio includes compounds in HNBR, FKM, Aflas® and Isolast® Perfluoroelastomer, each of which demonstrates best-in-class Explosive Decompression Resistance (EDR) for its material type.

Isolast® XploR J9513 offers the ultimate sealing solution for oil and gas applications where there is a risk of explosive decomposition. It is resistant to virtually all media even in a cocktail of various hydrocarbons mixed with brines, rust inhibitors, and chemical injection. It will withstand high pressures up to 100 Bar/1,450 psi, even higher when used in conjunction with anti-extrusion devices and is capable of operating in extreme temperatures.

In independent tests Isolast® XploR J9513 was able to satisfy the requirements of Norsok M-710 Annex B, Rapid Gas Decompression. It is the first perfluoroelastomer to meet the requirements of this stringent test.

Features & benefits:

- Unrivalled Explosive Decompression Resistance (EDR) within its material type
- Temperature resistance from -20°C/-4°F to 240°C/464°F
- Exceptional mechanical performance
- Outstanding low long-term compression set
- Almost universal chemical compatibility
- Long life in the most aggressive, including hydrocarbon and aqueous media, common within oil & gas applications
- High modulus, high strength
- Material compliant to Norsok M-710 Annex B

Applications:

- Logging tools
- Wireline tools
- Drilling motors
- Swivel stacks on Floating Production Storage and Offloading (FPSO) vessels
- Flowline equipment
- Packers
- Chemical injection equipment

XploR is available in all standard international O-Ring sizes and cross-sections along with custom-engineered solutions and specially designed seal profiles.

Isolast® XploR

J9513 Compound Data

Explosive Decompression Facts

Inherently, elastomer seals contain voids. Gas or gas mixtures in contact with elastomer surfaces are absorbed and will saturate elastomer seals. At high-pressure this absorbed gas is in a compressed state. When external pressure is reduced, either rapidly or over a relatively short period of time, the compressed gas nucleates at the voids, expanding within the elastomer. The voids inflate leading to high tensile stresses or strains in the void walls. Depending on the strength and hardness of the elastomer, this can cause the elastomer to break or crack.

No elastomer can be completely explosive decompression resistant; however, the XploR range demonstrates unrivalled EDR inline with limits set by NORSOK M-CR-710 Rev. 2 2001 "Qualification of Non-metallic Sealing Materials and Manufacturers."

Compound No.:		J9513		
Elastomer base:	DIN ISO 1629	FFKM		
Hardness:	DIN 53 505	95 +/- 5 Shore A		
Color:		black		
Specific gravity:		DIN EN ISO 1183-1	g/cm ³	1,92 +/- 0,03
Tensile strength:		DIN 53 504	MPa N/mm ² psi	18.6 2,700
Elongation at break:		DIN 53 504	%	68
Modulus 100%:		DIN 53 504	MPa N/mm ² psi	N/A
Compression Set:	72h / 200°C 72h / 392°F	DIN ISO 815 Typ B	%	35
TR10 point:		ASTM D 1329	°C °F	-3 +27
Service temperature:			°C °F	-20 to 240 -4 to 464
Specification:				Norsok M-710 Annex B

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

For further information on selecting the right compound and advice on seal specification for your individual application, consult your local Trelleborg Sealing Solutions marketing company. Find contact details at www.tss.trelleborg.com.

www.tss.trelleborg.com

Isolast® Plus J9515 & J9516

**Superior sealing with
FDA, USP class VI and SP 3-A compliance**



Your Partner for Sealing Technology

The Isolast® Plus J9515 & J9516

The Isolast® range of high specification perfluoroelastomer compounds has been developed to provide equipment manufacturers and end users with sealing solutions compatible with virtually all chemical media, over the widest temperature range possible. Unique Isolast® formulations give real benefits and cost advantages by providing optimum seal reliability and extending service life. Seal performance is further enhanced by superior hysteresis and compression set characteristics, which ensure high elasticity and dynamic recovery, minimizing risk of seal failure.

Isolast® Plus J9515 (black) and J9516 (white) material grades are high-performance perfluoroelastomers formulated for chemical compatibility in the widest range

of media, including CIP and SIP media, acids and alkalis, organic and inorganic oxides, offering a continuous operating temperature range of -10°C to +250°C / -14°F to +482°F.

Specifically developed for food, pharmaceutical and biotechnology applications, Isolast® Plus J9515 & J9516 are totally compliant to:

- Food and Drug (FDA) administration regulations set out in references 21 CFR 177.2600 (e.f) and 21 CFR 177.2400 (d)
- United States Pharmacopoeia (USP) class VI
- SP 3-A Sanitary Standards for Multiple-Use Rubber Dairy Equipment, Number 18-03

Isolast® Plus

J9515 & J9516 Compound Data

Features:

- Almost universal chemical compatibility
- Thermal stability from -10°C to +250°C / +14°F to +482°F
- Excellent long-term compression set characteristics
- Exceptional hysteresis properties
- Compliant to FDA, USP Class VI and SP 3-A sanitary standards
- Corresponds to biotechnology draft DIN EN 12462
- Available washed and packed to class 100 standards
- Available as standard and non-standard O-Rings, custom-molded designs and bonded products

Applications:

- Pharmaceutical manufacturing
- Food and beverage production
- Biotechnology industries
- Medical equipment
- Cosmetics manufacturing

Compound No.:			J9515	J9516
Elastomer base:	DIN ISO 1629		FFKM	FFKM
Hardness:	DIN 53 505		75 +/- 3 Shore A	75 +/- 5 Shore A
Color:			black	white
Specific gravity:	DIN 53 479	g/cm ³	2.03 ± -0.03	2.43 ± -0.03
Tensile strength:	DIN 53 504	MPa N/mm ² /psi	11.7 / 1,697	11.9/1,726
Elongation at break:	DIN 53 504	%	182	228
Compression set:	72 h / 200 °C / 392°F DIN ISO 815 Typ B	%	16	30
Service temperature:		°C / °F	-10 / +250 +14 / +482	-10 / +250 +14 / +482

Material properties are average values resulting from tests, as specified, on standard test samples. The values are for guidance only. It is the responsibility of the user to test material for suitability within a specific application. Information is correct at time of publication.

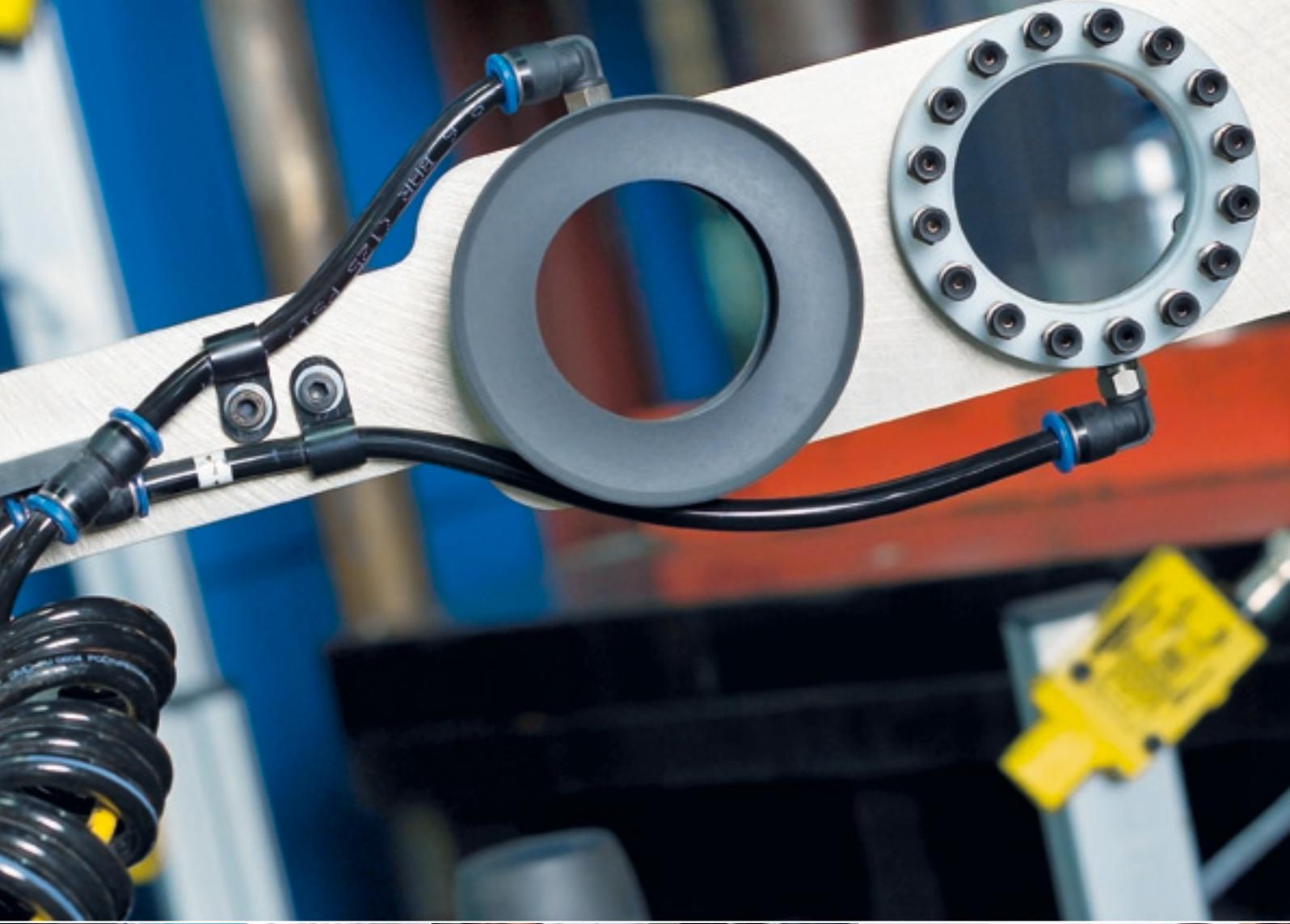
Trelleborg Sealing Solutions offers to the semiconductor industry:

- Quality levels to ISO 9001-2000 including 100% inspection and zero defects
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development test capability
- Sealing solutions using our extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

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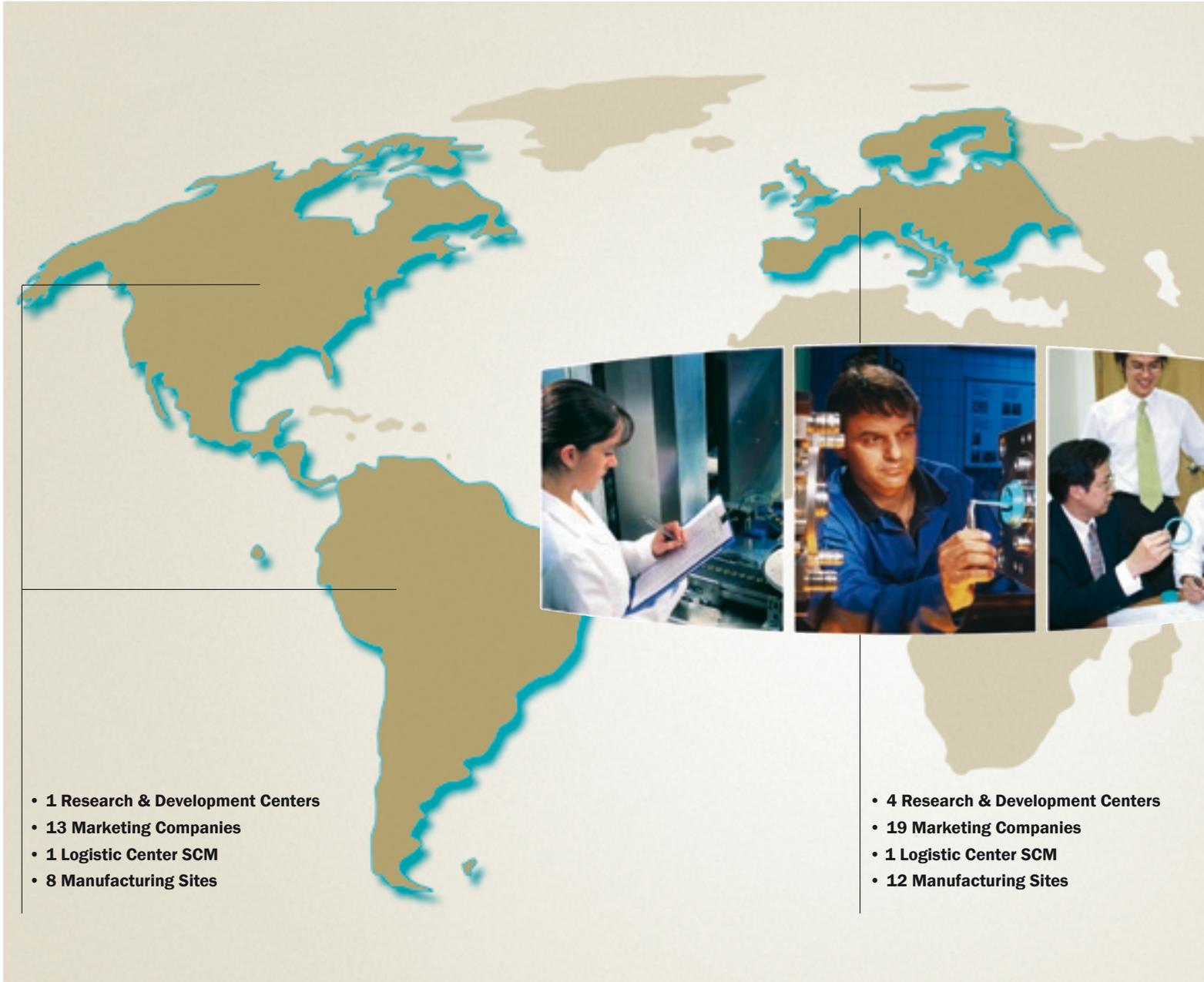


Global Manufacturing Capabilities



TRELLEBORG
SEALING SOLUTIONS

Trelleborg Sealing Solutions Global Resources



International excellence in production

Trelleborg Sealing Solutions is one of the largest seal producers in the world, with over 20 strategically located manufacturing facilities on four continents. Continuous investment ensures that we maintain and improve production efficiency, fulfilling our aim of offering customers the most cost effective sealing solutions possible. Manufacturing locations

specialize in a single product group or type, whether it be seals in proprietary Turcon® or Zurcon® materials, exclusive product designs in our unique range of elastomers, including the groundbreaking Isolast® perfluoroelastomer, or bearings in market leading Orkot®, HiMod® or Turcite®. On the basis of its extensive material expertise and

product development capabilities, Trelleborg Sealing Solutions is the partner of first choice for challenging developments in areas such as the Automotive, Aerospace, Medical, Pharmaceutical, Food or Semiconductor industries.

We master the production of both standard parts in high quantities up

to several millions as well as tailor-made customized products, using state-of-the-art equipment and the latest in best practice techniques. We provide our customers with best-in-class on time delivery while maintaining the highest quality standards. Lean manufacturing was successfully implemented several years ago to secure constant quality and the most cost effective production to satisfy our customers.



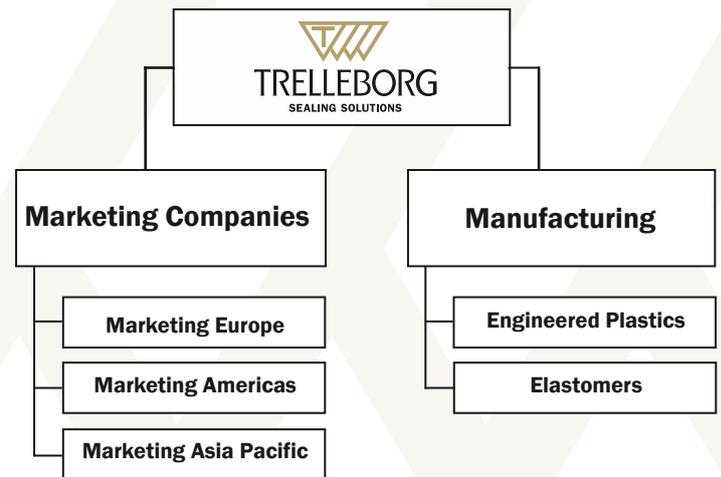
- **2 Research & Development Centers**
- **11 Marketing Companies**
- **2 Logistic Center SCM**
- **2 Manufacturing Sites**

Flexible capabilities globally

- Experts at development of tailor-made solutions for the most demanding applications
- Size range from 0.5 mm inside diameter to 15 meters (49 feet)
- Equally capable of supplying standard parts in very high volumes or a single specialized custom-manufactured component
- Production methods matched to the specific needs of each industry served including just-in-time delivery, cell manufacture, direct line feed and kitting
- Cleanroom production with wash and pack to class 100 standards
- Rapid ramp-up from concept to mass production

Trelleborg Sealing Solutions

Trelleborg Sealing Solutions is exclusively responsible for the global sales and marketing of sealing and bearing products manufactured by Trelleborg Sealing Solutions.



Our world renowned manufacturing names

We own many of the longest established and leading names within the seal industry. These include:

- **Variseal:** spring energized and radial lip Turcon® seals
- **Dowty Seals:** high-performance elastomer based sealing products
- **Forsheda:** rotary sealing systems including V-Rings® and Cassette Seals
- **Impervia:** specialized aerospace sealing systems
- **Orkot:** advanced composite bearing materials
- **Palmer Chenard:** diaphragms
- reinforced with engineered textiles
- **Polypac:** sealing systems for heavy-duty hydraulic applications
- **Nordex:** innovative compact hydraulic and pneumatic seals in polyurethane
- **Shamban:** Shamban: advanced sealing systems in Turcon® (PTFE based materials) and other engineered plastics
- **Silcofab:** gaskets and moldings from heat-cured silicone rubber
- **Skega:** premium O-Rings, sealing plates and custom-designed seals
- **Stefa:** radial shaft seals for demanding environments
- **Wills:** Wills Rings®, Turcon® Variseal® and PDR rotary shaft seals

- Minimal lead times exploiting centralized logistical operations
- In-house elastomer mixing and molding facilities
- Quality certification to a variety of international standards including ISO 9001:2000, QS 9000, AS 9100, VDA 6.1 and TS 16949
- Environmental approval to ISO 14001
- Health & Safety approval to OHSAS 18001

Products & Materials

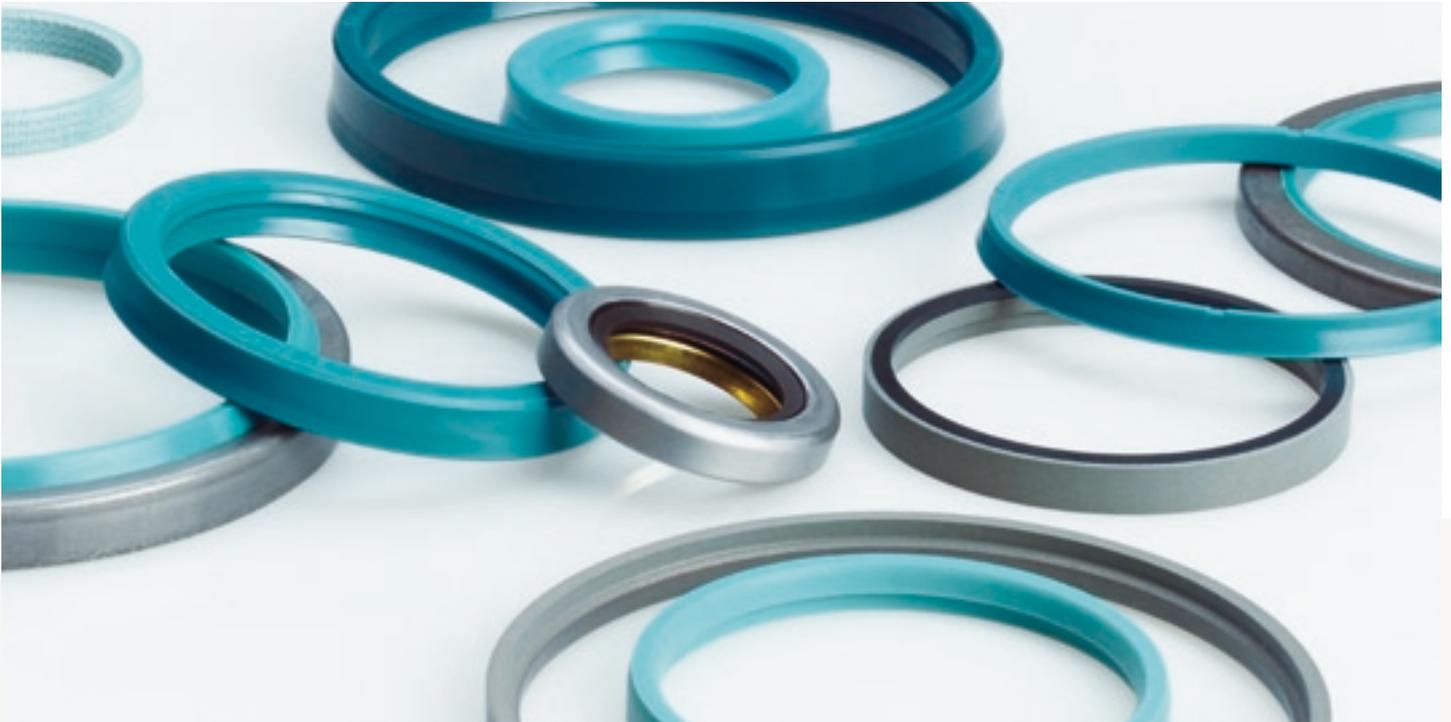


Proprietary materials

Trelleborg Sealing Solutions is involved in the constant development of materials that meet specific application needs including the requirements of standards and approvals, specified typically in water handling applications, pharmaceutical manufacturing and food processing. Expertise in elastomeric compounds allow us to offer formulations that can operate in temperatures from cryogenic up to +325 °C (617 °F) and provide almost universal chemical resistance. Ongoing developments in engineered thermoplastics and polyurethane have yielded some of the most successful materials available of these types for sealing.

- HiMod®: engineered thermoplastic material
- Isolast®: leading edge perfluoroelastomer
- Orkot®: High Performance Composite Bearing Material
- Turcite®: engineered thermoplastic bearing materials
- Turcon®: high performance engineered thermoplastic (seal material)
- Zurcon®: enhanced polyurethane and other engineered plastics





Product development

Trelleborg Sealing Solutions is pioneering within the sealing industry and continuously developing innovative products.

- Turcon® AQ Seal®: QUAD-RING®* Seal inset into a Turcon® sealing element
- D-A-S Compact Seal: Combination of piston seal, back-up and wear rings
- Turcon® Double Delta®: Turcon® sealing element energized by an elastomer O-Ring
- Turcon® Excluder®: O-Ring energized scraper that excludes media ingress
- Turcon® Glyd Ring® T: O-Ring energized rod or piston seal for dynamic applications
- Turcon® Hatseal®: Aerospace seal combining elastomer and Turcon® contact seals
- Zurcon® L-Cup®: Zurcon® rod seal with back pumping ability
- Turcite® Slydring®: Wear ring that prevents metal to metal contact
- Turcite® B-Slydway®: Linear bearing used primarily on machine tools
- Turcon® Stepseal® 2K: O-Ring energized piston or rod seal in Turcon® or Zurcon®
- V-Ring®: Flexible elastomeric axial lip seal that prevents media ingress
- Varilip®: Metal cased PTFE high performance rotary shaft seal
- Turcon® Variseal®: U-shaped Turcon® ring with a metal spring energizer
- Turcon® VL-Seal™: Unidirectional rod and piston seal designed for aerospace
- Turcon® Wedgpak®: triangular elastomer sealing element with two Back-up Rings
- Wills Rings®: Metal O and C Rings for use in severe operating conditions
- Zurcon® Wynseal®: O-Ring energized Zurcon® piston seal for dynamic applications



* QUAD-RING® is a Trademark of Quadion Corporation.

Trelleborg Sealing Solutions Helsingør (Denmark)



Company Profile



Trelleborg Sealing Solutions Helsingør is a world leader in the manufacturing of PTFE based seals and bearings for the most demanding applications in aerospace, oil and gas, automotive, fluid power and many other industries. Our Turcon® and Zurcon® seals are used in equipment around the world where there is demand for dynamic sealing.

We established our factory as W.S. Shamban Europa at Helsingør in Denmark in 1965 and now have around 350 employees. Our modern production equipment enables us to meet the most challenging demands of our customers.

Service

We are determined to be best-in-class in all aspects. Our engineering support and design of customer specific solutions enables our customers to meet the toughest requirements. Our R & D provides development of a wide range of standard and special materials

meeting practically any demand, and our laboratory is equipped with state-of-the-art facilities in order to test, analyze, and document material and sealing performance. And when speed is essential, our emergency and Turcon® Express service ensures delivery in only 24 hrs.



Products and Materials



The company is dedicated to the manufacture of sealing and bearing solutions where low friction, high temperature and long service life are important.

Our highly skilled engineers and chemists, and years of experience in design and production of sealing



solutions, guarantee the successful function of our customers' equipment.

We can provide the majority of sealing solutions from our wide range of standard proprietary materials, including Turcon®, Turcite® and Zurcon®. Our standard proprietary designs (for example



Stepseal® 2K, Glyd Ring® T, Roto Glyd Ring® and Excluder®) have provided years of top performance in all kinds of applications. If necessary, we can also develop special materials and products for specific applications or customers.

Quality, Environment and Health & Safety

We are living up to the highest quality standards and we are certified in accordance with

- ISO 9001
- QS-9000
- ISO/TS 16949
- ISO 14001 and
- OHSAS 18001.

Facilities



Our facilities are equipped with the latest technology to produce advanced high quality designs, quickly, efficiently and with a high degree of flexibility. The focus on quality and efficiency when compounding PTFE and fillers, producing Turcon® materials or machining numerous designs is a top priority for us. We have state-of-the-art equipment throughout the process - from CAD and 3D

modeling for design work, through PLC controlled processes in molding, sintering and CNC machining, to fully automatic equipment for assembly and optical quality controls. Our machines are set up for quick change of designs and materials.

Applications	Products	Materials
<ul style="list-style-type: none"> • Hydraulic applications: such as hydraulic cylinders, presses, injection moulding machines, fork lifts, excavators • Automotive: such as fuel injection, brakes, ride control, suspension, steering • Aerospace: such as landing gear, flight controls 	<p>Piston seals, rod seals, seals for rotary applications, scrapers, bearings etc:</p> <ul style="list-style-type: none"> • Stepseal® 2K • Stepseal® V • Glyd Ring® T • Roto Glyd Ring® • Excluder® • AQ Seal® • VL Seal® • Double Delta® • VL Seal® • Slydring® • Slydway® 	<ul style="list-style-type: none"> • Turcon® • Turcite® • Zurcon®

Trelleborg Sealing Solutions Skelleftea (Sweden)



Company Profile

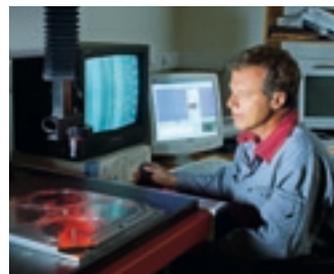


The company started in 1932 by manufacturing shoes and gloves protected with rubber. These products became popular among farmers and woodsmen and in the mines that had recently been established in the area. Contact with the mining industry was significant and Skega AB became a global supplier of heavy wear-resistant components.

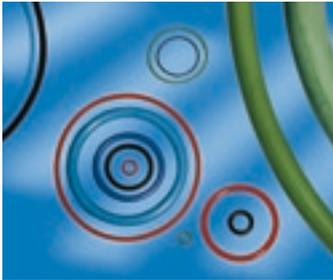
The company introduced its first range of high quality O-Ring products in 1948, used since then by the Swedish Air Force. Skega AB soon became the only significant O-Ring manufacturer in Scandinavia. Today Trelleborg Sealing Solutions Skelleftea is recognised as a world-class supplier of O-Rings and static seals in rubber and polyurethane, along with bonded seals. These are supplied for a wide variety of demanding applications worldwide. The key to our success is our skilled and committed personnel, 230 employees working in the northernmost rubber manufacturing facility in the world.

Service

- Our mission is to supply customers with high quality products, which add value in terms of performance, life-cycle cost, quality and environmental aspects.
 - Extensive technical support, test and laboratory capabilities.
 - We use 3D modelling and finite element analysis to develop and optimize a sealing function.
- This helps us deliver design reliability, uniform product quality and shorter lead times for new product development.
- Key account support, priority- and early warning systems provide rapid response and flexible delivery.
 - Full quality assurance capabilities using core tools as required in ISO/TS 16949 and ISO 14001.



Products and Materials



Our high quality O-Rings can be supplied from moulds up to 1300 mm (51") diameter as well as joint-vulcanised for larger applications. Products include bonded seals along with O-Rings and customer specific static seals. Seals are



available in a wide variety of materials formulated to offer solutions for the most demanding sealing requirements. Materials and their properties are important in our daily work. Trelleborg Sealing Solutions



Skelleftea is recognised as a supplier of world-class elastomer materials, providing compounds to suit our customers' applications. Since 2003 we have extended our product and material portfolio with



Polyurethane O-Rings and special seals in Zurcon® materials Z20, Z22, Z24 and Z30, produced with a high grade of automation and without any second operation needed.

Facilities

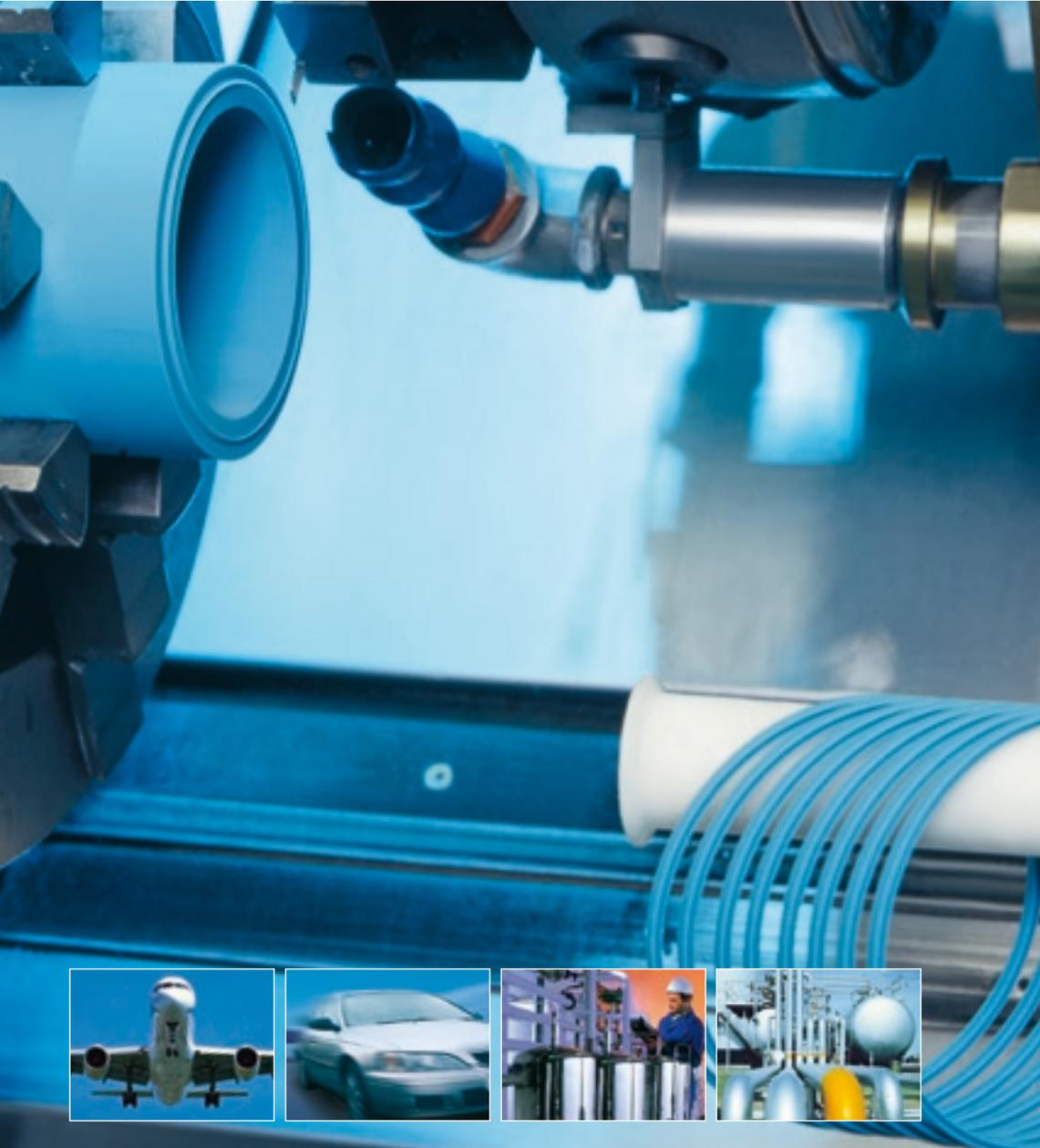


Today Trelleborg Sealing Solutions Skelleftea has a reputation for excellent delivery performance utilizing our modern production machinery equipped with advanced control systems, which results in high uniform product quality. Other contributory factors are our extensive technical expertise and efficient production planning.

The facilities are industry leading in process, as well as environmental friendly solutions. Major investments have been made in state-of-the-art equipment. Production equipment available includes injection moulding machines (ranging from 60 to 600 tonnes), compression presses (80 to 640 tonnes) and automatic visual inspection systems.

Applications	Products	Materials
<ul style="list-style-type: none"> • Diesel & Truck • Energy • Automation • CPI 	<ul style="list-style-type: none"> • O-Rings • Bonded Seals • Static and linear seals • Cylinder Seals • D-Seal® • X-Rings 	<ul style="list-style-type: none"> • FKM (GFLT, GLT), Resifluor™ 400 • EPDM • NBR (including "Polar") • HNBR • Q • VMQ • CR • Zurcon® (Z20, Z22, Z24, Z30)

Trelleborg Sealing Solutions Bridgwater (UK)



Company Profile



Trelleborg Sealing Solutions Bridgwater is part of the Global Operations Engineered Plastics division of Trelleborg Sealing Solutions. The company - originally named Wills Pressure Filled Joint Company - was founded by Percy Wills in 1935 following his invention of a gas-filled metal O-Ring. Today Trelleborg Sealing Solutions Bridgwater operates at a modern 4166 square meter site and employs 150 people.

We have been producing high-performance sealing solutions for over seventy years. Wills Rings® is our most well known product worldwide.

We also offer Variseal® and Varilip® PDR product ranges, which allow us to find effective solutions for the most demanding applications.

Service

We provide a combination of design flexibility, experience and customer service. This results in a superior sealing solution that meets the customers' needs and performs well during its long working life.

Our highly qualified and experienced employees are focused on designing

and manufacturing effective sealing solutions with attention on customer service and ability to respond promptly and efficiently.

We use modern 2-D and 3-D drawing software and high technology analysis and testing facilities to ensure the right outcome.

Finite Element Analysis (FEA) provides structural and design feedback for specified operating parameters and significantly reduces development lead times and prototype costs.

Comprehensive test work can be carried out to develop and prove designs for customer verification.



Products and Materials



Trelleborg Sealing Solutions Bridgwater is a global supplier of Wills Rings®, and a joint global supplier Variseal® and Turcon® Varilip® PDR. Varilip® products are standard rotary shaft seals made from high-performance metallic materials with proprietary Turcon® polymer dynamic sealing elements. The Turcon® Varilip® PDR (Performance, Durability, Reliability)



product range is a range of standard and custom-designed shaft seals. The products are designed for demanding applications that are too harsh for standard elastomeric rotary shaft seals. Turcon® Varilip® PDR seals are made from high-performance metallic casing materials with a range of specialist and proprietary blended polymer sealing lips.



Wills Rings® are superior controlled-compression seals used for static applications. They are designed for extreme conditions, exceeding the capabilities of elastomer and polymer seals. Wills Rings® are made from high performance metallic materials such as stainless steel, copper, Inconel® or Monel® and coated with a softer metal or polymer.

Our Variseal® products are spring-energized seals in high performance Turcon® PTFE-based and metallic spring materials. They are used for dynamic and static applications often under extreme conditions.

Facilities



Trelleborg Sealing Solutions Bridgwater has on-site facilities that allow us to find effective solutions for the most complex applications:

- Highly specialized material compounding and molding.
- High-performance machining: \varnothing 3.0mm to \varnothing 2.5m available as standard parts.
- Cleaning, packing and inspection including advanced ultrasonic washing and optical measuring.

- Secondary and assembly operations.
- Leading industry certification of Health and Safety, Quality and Environmental management.

Applications	Products	Materials
<ul style="list-style-type: none"> • Aerospace • Automotive • Motorsport • Vacuum • Oil and Gas • Chemical and Processing 	<ul style="list-style-type: none"> • Variseal® • Wills Rings® • Turcon® Varilip® PDR (Catalogue and customer specific non-standard rotary shaft seals) 	<ul style="list-style-type: none"> • Variseal: Turcon® PTFE-based proprietary materials, high-performance metallic spring materials. • Wills Rings®: high performance metallic materials with softer metal or polymer coating. • Turcon® Varilip® PDR: high - performance metallic casing materials with a range of specialized and proprietary blended polymer sealing lips.

Trelleborg Sealing Solutions Tewkesbury (UK)



Company Profile



Trelleborg Sealing Solutions Tewkesbury is one of the prime European production and development facilities within the Global Operations Elastomers division of Trelleborg Sealing Solutions. Becoming fully operational in 2008, Trelleborg Sealing Solutions Tewkesbury is a world-class facility, strategically placed to take global customer and supply partnerships well into the twenty first century.

The company was formed locally in 1945 as Dowty Seals Ltd and was originally a stand-alone business within the Dowty engineering empire, where it supported the highly innovative aircraft equipment companies.

Over the years, Dowty Seals became the industry leader for the supply of technical solutions for arduous sealing applications. The foundations of the business were firmly established in its ability to offer the highest quality standard and custom products in the widest possible range of elastomer materials. Today Trelleborg Sealing Solutions Tewkesbury continues that tradition in providing class-leading innovation at all levels.

Service

The extensive range of materials and manufacturing processes enable our experienced product engineers to offer elastomer-based sealing solutions for every customer requirement.

Our technical support services offer customers the following genuine advantages:

- Superior reliability - cutting planned and unplanned maintenance costs
- Longer service life - driving up efficiency and productivity
- Greater safety and reliability – protecting people and equipment
- More opportunities for standardization and inventory reduction
- Optimized seal solutions - cutting risk, reducing waste and contamination



Products and Materials



The company is a global supplier of standard and custom elastomer products into the aerospace and niche industrial market segments. We are specialists in high quality



mouldings and offer the full range of seals for static and dynamic applications. Areas of particular expertise include piston and rod type seals, radial oil seals and

grease seals as well as O-Rings, gaskets and diaphragms. We also have a unique ability to machine elastomeric parts to very tight tolerances. Bonding rubber to metallic and plastic elements is also a core competence which allows a number of sealing components to be integrated into one part.

TSS Tewkesbury is the global home of the highly specialised Perfluoroelastomer range of materials known as Isolast® as well as the specialty fluoroelastomer

Resifluor™ and XploR™ grades. These materials are offered predominantly to the Oil & Gas, Chemical Processing and Semiconductor industries for sealing applications where chemical and thermal resistance is paramount. Isolast® products can be offered on a same day service and produced in the dedicated Class 100 cleanroom facility. Also, any size of o-ring above 500 mm diameter can be produced without the need for expensive tooling by our proprietary Fleximold process.

Facilities



Trelleborg Sealing Solutions Tewkesbury employs over 130 people in its new manufacturing facility. The company is accredited to design and manufacture seals to numerous International, National and Customer specific standards. These include EN/ISO 9001 and AS/EN 9100. In line with the Trelleborg Group's Environmental policy, Trelleborg Sealing Solutions in Tewkesbury has held the ISO 14001 approval for over a decade.

Applications	Products	Materials
<ul style="list-style-type: none"> • Aerospace <ul style="list-style-type: none"> Military and Civilian aircraft Fixed and Rotary Wing Hydraulic Systems Fuel Systems Environmental Protection • Industrial <ul style="list-style-type: none"> Semiconductor Chemical Processing Oil & Gas 	<ul style="list-style-type: none"> • Bonded Plates • Capped Seal Assemblies • Radial Oil Seals • Grease Seals • Machined Dynamic Seals • O-Rings • Gaskets • Diaphragms • Excluder Seals • Complex Mouldings 	<p>Elastomers</p> <ul style="list-style-type: none"> • Chloroprenes (CR) • Ethylene Propylenes (EPDM) • Fluoroelastomers (FKM) • Fluorosilicones (FVMQ) • Hydrogenated Nitriles (HNBR) • Nitriles (NBR) • Perfluoroelastomers (FFKM) - Isolast® • Silicones (VMQ) <p>PTFE, PEEK and metallic based materials</p>

Trelleborg Sealing Solutions Cadley Hill (UK)



Company Profile



Trelleborg Sealing Solutions Cadley Hill is the principal manufacturer of airframe seals and reinforced elastomeric components for the aerospace industry with leading design and materials expertise, best practice manufacturing and customized distribution capabilities. The company is a division of Trelleborg Sealing Solutions and is based on a modern 5000 square meter site at Cadley, Swadlincote Derbyshire. There are 150 employees. Our manufacturing capability extends to over 9000 different seals.

Airframe seals are used in the engine compartment and throughout the aircraft body on wings, windows and doors, where they contribute to aerodynamic efficiency. Our inflatable seals, individually designed and manufactured for many models of fighter jet, have performed successfully in challenging safety-critical cockpit applications.

Service

We have developed and evolved expertise in the manufacture of annulus filler seals through partnerships with leading aero engine customers. These are custom designed to incorporate

silicone elastomers in conjunction with fabrics and metallic or carbon composites. The use of these has resulted in competitive advantage through improved engine efficiency and lower operating costs.

Our proven capabilities include project management of design, prototyping, production, test and installation using state-of-the-art design, development and manufacturing tools.



Products and Materials



Manufactured to standard or custom profiles, each airframe seal is handfabricated, with absolute attention to detail and quality assured through 100% inspection. Focusing on aerodynamic efficiency, they offer reliability in service, along with efficiency in assembly and maintenance.



The use of advanced FEA combined with product qualification programs, including extensive testing and verification, leads to maximum service life. Airframe seals, often produced from existing tooling are used within the engine, structural gaps, wings, doors, hatches and

windows, to meet customer needs throughout the aircraft.

Inflatable seals from 3-D models, which are translated into tooling the full size of the sealing profile, replicate the increasingly complex geometries of airframe sections of, for instance, cockpits or doors. Such tools incorporate heating and pressurization systems for precise manufacturing control and with testing at line-side; zero defect quality is the objective.

Also manufactured is an advanced composite fire seal, compliant with international standard ISO 2685,

which withstands flame temperatures in excess of the required 15 minutes at 1100°C (2012°F).

Facilities



The dedicated aerospace facility at Trelleborg Sealing Solutions Cadley Hill allows us to manufacture the most complex products. Our solutions are used on all major platforms including the Airbus A380 and the Joint Strike Fighter. This demonstrates our full range of capabilities including:

- Design
- Development
- Technical innovation and solution
- Cellular manufacture
- Self contained logistics and despatching
- Kitting
- Direct line feed

Applications

- Aerospace

- Airframe Seals
- Reinforced elastomeric components

Materials

- Nitriles, EPDM,
- Fluorosilicone, Fluorocarbon

Trelleborg Sealing Solutions Rotherham (UK)



Company Profile



Trelleborg Sealing Solutions Rotherham manufactures Orkot® fabric-reinforced composites used in the production of wear rings for the hydraulics industry and bearings for the industrial, marine and hydro-electric power sectors.

The company is part of the Engineered Plastics section of Trelleborg Sealing Solutions and is based in a modern purpose-built factory in Rotherham, UK. The original Orkot® business began in 1952 as part of the world renowned Sheffield steel industry. Resin was taken and applied to a cloth reinforcing matrix to make the first composite bearings. This product was developed using cutting edge materials technology to produce the range of composite materials known as Orkot®.

The current factory, the third in the company's history, was purpose-built in 1998 to manufacture and showcase our products. The 5000 square meter facility employs 110 people.

Service

Our team of experienced customer service staff is able to help develop the correct bearing solution for your application. With a library of materials and a vast knowledge of the application of these materials, we can quickly recommend the right product. Our engineers are able to design the bearing and provide information

on operating parameters such as loads, lubrication, wear life and fitting techniques.

We are equipped with a materials testing laboratory that is able to carry out mechanical tests. We also have several test rigs to permit real

life testing of bearing materials and counter faces in a variety of operating conditions. These rigs perform rotary, reciprocating and linear testing in flat and circular conditions to determine the wear properties of the bearing material under dynamic conditions.



Products and Materials



Trelleborg Sealing Solutions Rotherham is a global supplier of advanced bearing materials with key brand supporting industries around the world. Orkot® is a well known brand in the hydraulics industry where Orkot® C380 wear rings are chosen for their ability to withstand high loads and keep working over many years to provide a "fit-and-forget" solution for hydraulic cylinder users. Orkot® Marine is recognized in



commercial and naval shipbuilding for rudder bearings, water lubricated stern tube bearings, stabilizers and stern rollers. Orkot® TLMM is the normal choice of material for these applications. We also offer a premium grade of material, Orkot® TXMM, which can be used if lower friction and wear properties are required, particularly where there is little or no lubrication. In the offshore industry Orkot® is chosen for its ability to perform



under the extreme conditions i.e. for mooring systems, cranes and FPSO turret bearings.

Orkot® Hydro is becoming known throughout the hydropower industry where there is a requirement to replace oil lubricated bronze bearings with unlubricated bearings. In these applications we normally offer our Orkot® TXMM material because it has been shown to outperform other materials in many applications. Used as



mainshaft bearings or wicket gate bearings, Orkot® TXMM chosen time and again to replace traditional bearings in hydro and river applications.

The industrial applications of Orkot® are numerous with a wide range of materials developed to suit each situation. Five materials - C320, C321, C361, C324 and C369 - cover most applications and product engineers are available to help you in your material selection.

Facilities



Our manufacturing facility includes equipment for manufacturing sheets and tubes in a wide range of sizes up to 2 meters diameter (6.5 feet) and 100mm thickness (3.9"). These materials can be machined in our modern machine shop employing the latest generation of CNC lathes and machining centres with 3, 4 and 5 axes. There are many special-purpose machines for the fast and accurate production of

flat products. These include sanding machines capable of achieving 50 micron tolerances and CNC routers for producing complex shapes.

This is backed up by an extensive materials testing capability and an experienced development team. Our factory holds ISO 9001:2000 quality certification and over 30 specialized marine approvals.

We also have ISO 14001:2004 environmental certification and OHSAS 18001 approval for Health & Safety management systems.

Applications	Products	Materials
<ul style="list-style-type: none"> • Hydraulics • Industrial • Marine • Hydropower • Offshore • Civil engineering 	<ul style="list-style-type: none"> • Orkot® • Orkot® Marine • Orkot® Hydro 	<ul style="list-style-type: none"> • C380 • C320 • C321 • C324 • C361 • C369 • TLMM • TXMM

Trelleborg Sealing Solutions Condé (France)



Company Profile



Trelleborg Sealing Solutions Condé was formed in 1934 and has a long history and experience in aerospace. The company was the first manufacturer of elastomeric and plastic seals in France for the aerospace industry and is now the leading company in this sector in the country. It is a division of Trelleborg Sealing Solutions based at Condé-sur-Noireau in Normandy.



Service

Our services include Direct Line Feed (DLF) and kitting. In addition, we offer customer specific product and material development, including testing.



Products and Materials



Trelleborg Sealing Solutions Condé specializes in molded elastomer, bonded seals, O-Rings, elastomer and elastomer precision seals. We are able to manufacture a wide range of special seals and sealing systems in elastomer and plastics

for aerospace applications. Our wide range of materials can satisfy the requirements of standard and customized products and includes 350 compounds and 620 grades. 25 of these are certified by French approval authorities.

Facilities



Trelleborg Sealing Solutions Condé employs 110 people. Approximately 80 percent of production is supplied to the aerospace sector.

- Flexible mixing unit dedicated to aerospace products
- 80 compression and injection presses dedicated to small quantities and a wide range of molded parts and O-Rings

- Flexible precision seals workshop with CNC machines
- Laboratory for material development
- Engineering office for process and product development

Applications	Products	Materials
<ul style="list-style-type: none"> • Military • Aerospace • Rail • Industrial 	<ul style="list-style-type: none"> • Molded and Extruded Parts • Bonded Seals • O-Rings • Kantseals 	<ul style="list-style-type: none"> • NBR • HNBR • EPDM • BR • Silicone • FPM

Trelleborg Sealing Solutions Czechowice (Poland)



Company Profile



Trelleborg Sealing Solutions Czechowice was founded in 2002 as a low cost, high quality automotive compression and injection molding facility producing a wide range of elastomeric radiator and manifold gaskets. The company is part of the Global Operations Elastomers business unit of Trelleborg Sealing Solutions. It employs 280 people on a 5300 square meter site at Czechowice-Dziedzice, Poland which is approved to ISO/TS 16949 and ISO 14001. The company has an extensive Tier-1 customer base through Trelleborg Sealing Solutions.

Service

Trelleborg Sealing Solutions Czechowice provides high quality expertise in the molding and finishing of automotive and industrial gaskets. We focus on customer service and offer a complete package to our customers which includes:

- Product design
- Finite Element Analysis (FEA)
- Materials
- Tooling
- Process development
- Testing
- Logistics support



Products and Materials



The company molds gaskets and seals in a wide range of materials including:

- Silicones
- EPDM
- HNBR
- NBR
- AEM
- and others as required.

A number of product variations are manufactured including:

- Radiator and manifold gaskets
- Engine seals
- Rubber-to-plastic bonded engine covers
- Machine cut square gaskets
- Insert moldings
- Edge bonded metal to rubber gaskets

Facilities



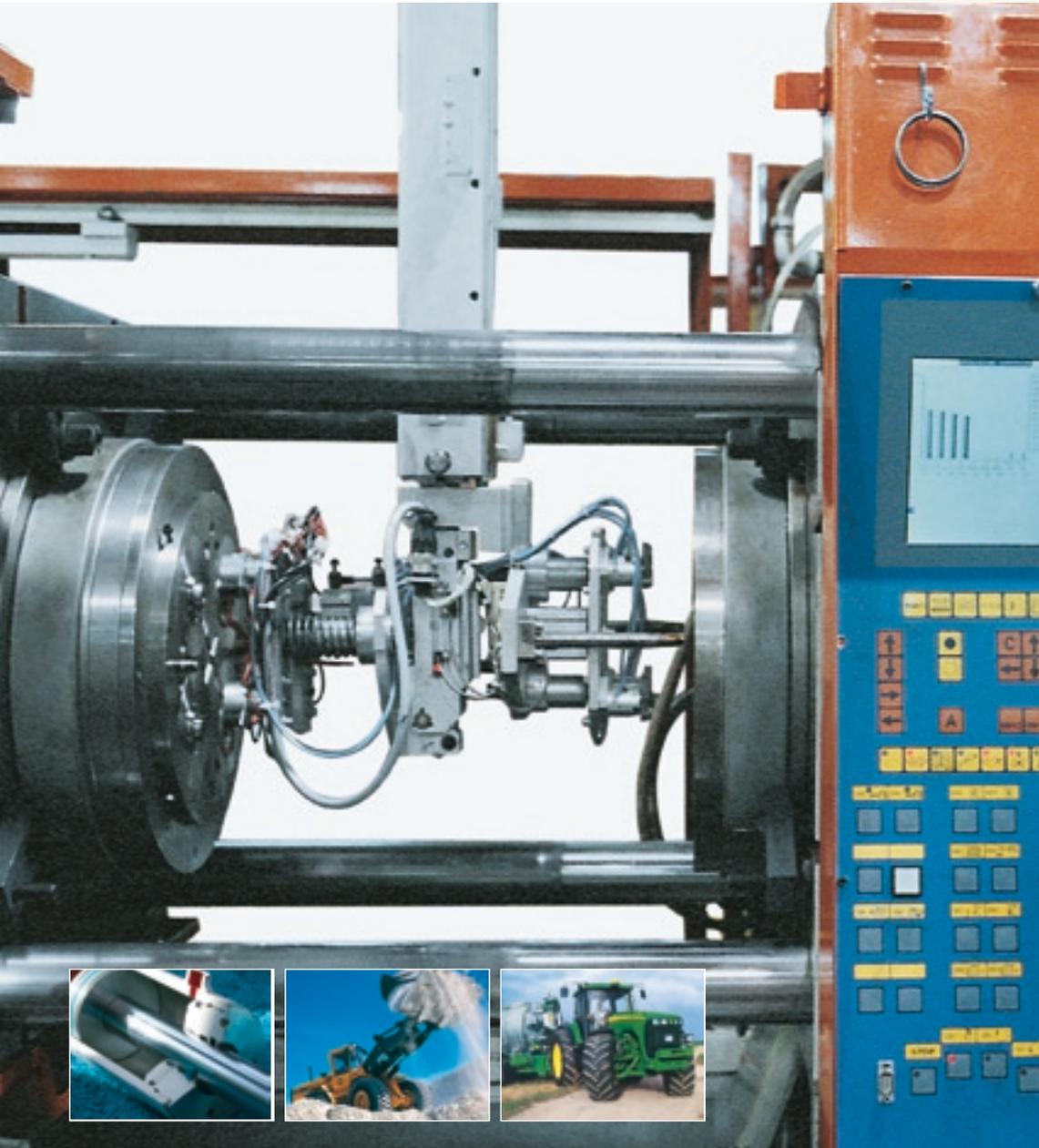
Trelleborg Sealing Solutions Czechowice is developing its facilities to provide comprehensive manufacturing capacity for its products and enhanced customer support:

- Horizontal injection molding
- Vertical injection molding
- Compression shuttle presses
- Cryogenic de-flashing
- Ultrasonic and dry-blast mold cleaning

- Metal insert and gasket preparation facilities
- Unigraphics and AutoCad on site, with a trained design and production engineering resource
- Extensive laboratory testing facilities
- Comprehensive group support on new materials, product development and FEA

Applications	Products	Materials
<ul style="list-style-type: none"> • Automotive • Industrial 	<ul style="list-style-type: none"> • Inlet manifold gaskets • Radiator gaskets • Engine seals • Plate heat exchanger (PHE) gaskets 	<ul style="list-style-type: none"> • Fluorocarbon (FKM) • Fluorosilicone (FMVQ) • Silicone (VMQ) • HNBR • NBR • EPDM

Trelleborg Sealing Solutions Livorno (Italy)



Company Profile



Trelleborg Sealing Solutions Livorno has been producing high quality hydraulic seals in rubber fabric, polyurethane and thermoplastic resins for the last 35 years and sells more than 25 million parts each year.

Trelleborg Sealing Solutions Livorno is the preferred partner of major European manufacturers of earth moving equipment, agricultural machinery, cranes, and hydraulic cylinders. We have a mission to be the preferred partner of our customers all over the world by developing and manufacturing sealing systems of the highest quality, at competitive prices, with benchmark customer service.

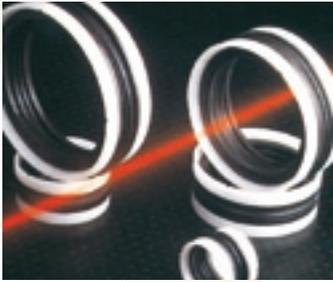
Service

The company has a wide range of products and materials. We are able to optimize the seal design for a particular set of operating conditions and produce special items at our customers' request.

We also have access to a vast range of test rigs and other facilities to guarantee efficient and professional technical support for our customers. We work to a zero defect philosophy and are certified to ISO 9001.



Products and Materials



Our ability to supply a complete range of hydraulic seals comes from close co-operation with major European customers. Combined with a wide range of materials,



this means we can provide a sealing solution for a wide variety of applications. Materials can be optimized to give the best performance, whether they are



traditional elastomers or materials specially developed for high temperatures and compatibility with aggressive fluid, different polyurethane grades or vast rubber



compounds. We can also supply a wide range of complementary elements such as guide rings and wipers which allow us to provide a complete sealing package.

Facilities



Trelleborg Sealing Solutions Livorno has a wide range of traditional and innovative equipment for each stage of production:

- Molding units with compression transfer and injection technology for rubber components
- Efficient and completely automated area for polyurethane and plastic products
- Well equipped laboratory and test facilities for internal control

and new materials development

- Fully automatic machines for finishing, assembling and optical quality controls
- New facility for synthesis of polyurethane Zurcon® materials to meet market demand from hydraulic and pneumatic industries
- New prototyping service for Zurcon products made by a dedicated lathing machine



Applications

- Hydraulic cylinders
- Earth moving machines
- Tractors
- Industrial presses
- Cranes
- Forklift trucks
- Gate openers
- High pressure volumetric water pumps
- High pressure process pumps

Products

- Piston seals, rod seals, scrapers, guide rings and special engineering products:
- Polypac Balmaster®
 - Polypac Balsele®
 - Polypac Selemaster®
 - Polypac Duopac®
 - Polypac Veepac®
 - Polypac SWP and UWR/PC
 - Zurcon® U-Cup RU9
 - Zurcon® Glyd Ring® P
 - Zurcon® Buffer seal
 - Zurcon® Roto Glyd® Ring S

Materials

- **Rubber:**
NBR, HNBR, XNBR, EPDM, FKM, VMQ
- **Fabric:**
Cotton and aramid fibre
- **Thermoplastic:**
HiMod®, POM*, PA*, UP,
- **Polyurethane:**
Zurcon® Z20, Z22, Z23, Z24, Z30

*filled and not filled in different grades

Trelleborg Sealing Solutions Modena (Italy)



Company Profile



Since 1960 GNL duo cone & square bore seal groups have been manufacturing in Modena, Italy, according to precise engineering standards. GNL has been recently purchased by Trelleborg Sealing Solutions.

Trelleborg Sealing Solutions Modena seal groups consist of two forged alloy steel rings and two rubber rings, their aim is to guarantee a suitable protection inside the application, to bearings and used lubricant, by the external agents as all undercarriage applications, reduction gear boxes, bitumen conglomerate and /or cement mixers, mining & earthmoving equipment must endure a wearing effect due to abrasive materials they come into contact with.

Thanks to the close tolerances they are made, Trelleborg Sealing Solutions Modena seal groups are interchangeable with other similar designs.

Special purpose rubber rings for either very low or very high temperatures can be supplied. The purpose of this brochure is to show technical features, applications and dimensions of our seal groups.

Service

Trelleborg Sealing Solutions Modena offers its customers a broad range of services including application engineering, co-design, compatibility and function tests, 100 % visual inspection of incoming and outgoing materials and products.



Products and Materials



Trelleborg Sealing Solutions Modena manufactures more than 300 different part numbers with outside diameters from 45 mm up



to 886 mm that can be perfectly used in a wide variety of applications as you can see into below framework.



Special Mechanical Face Seals on Customer's demand can be developed and manufactured. Trelleborg Sealing Solutions Modena



has been working since many years either with the most important O.E.M. or After Market international companies.

Facilities



Facilities include CNC lathe machines lapping and grinding machines, testing, fully integrated supply chain management and quality management certified to ISO 9001:2000.

Applications	Products	Materials
<ul style="list-style-type: none"> • rollers – reduction gears – front idlers and final drives of tracked crawler vehicles • wheeled tractors – graders – shovels – ploughs – ditchers and scrapers • off-highway trucks – drilling machines – hydraulic excavators – conveyors – concrete mixers • asphalt plants – mining equipment – crushing equipment – grass mowers and hay balers 	<p>Mechanical Face Seals:</p> <ul style="list-style-type: none"> • Duo cone seals • L-shaped Seals <p>*All our parts must be used in a peripheral speed range up to 3 meter/sec</p>	<p>Forged alloy steel ring: Material: 100Cr6 according to: UNI 3097; DIN 100Cr6-W3; EURONORM 100Cr6; AISI 52100 Hardness: HRc: 63+/-3 according to: UNI EN 10003-1</p> <p>Rubber Rings:</p> <ul style="list-style-type: none"> • NBR • NBR 2 (Low temperatures) • HNBR • Silicone • FPM

Trelleborg Sealing Solutions Turin (Italy)



Company Profile



Originally called Stensholms Fabriks and renamed in 1967, Stefa Industri AB, now named Trelleborg Sealing Solutions Turin, it is world leading specialist in development, design and manufacturing of Rotary Shaft Seals for engineered applications like automotive, truck, off-road vehicles and specialty gear boxes.

The company consists of two plants in Turin, Italy, with 145 employees. The main plant in Turin specializes in lower volume, high service compression molded seals, whereas the second plant in Leini is highly automated and specializes in high volume seals. The business offers specialized product design and technical support for a wide range of customized sealing solutions for rotary applications.

Trelleborg Sealing Solutions Turin manufactures its products with ZERO DEFECTS, according to ISO/TS 16949 and ISO 14001, with state-of-the-art machinery for injection and compression moulding, using unique cut-lip technology.

Service

TSS Turin it is the competence center for Rotary Shaft Seals: it's mission is to develop innovative and reliable sealing solutions for the most engineered applications, by providing services of codesign,

engineering, testing and validation. It can rely on fully equipped polymer laboratories, on CAD and FEA stations, and on advanced test rigs reproducing field conditions.



Products and Materials



Rotary shaft seals are developed and manufactured to work in the most different environments, thanks to a deep knowhow and availability of tailored compounds like FPM, HNBR, NBR, VMQ in different grades.



More than 300 standard rotary seals following DIN 3760/1 are manufactured, using the Trelleborg proprietary compounds, state of the art manufacturing technology and ZERO DEFECT quality philosophy



Customized and tailored rotary seals are developed and manufactured in codesign with application engineering, following all APQP steps, in order to effectively work in demanding applications like high speed shafts, dual fluid pumps, underwater propellers, robots, etc.



Tailored rotary shaft seals integrated with metal grinded sleeves, dust protecting labirinths, additional high-tech plastic washers are developed, tested and manufactured in order to provide effective and reliable sealing solution in the most various and severe environments

Facilities



Trelleborg Sealing Solutions Turin has a wide and flexible range of equipment dedicated to rotary shaft seal production:

- CAD/CNC tool design and manufacturing
- rubber compression molding presses up to 550mm seal diameter
- rubber injection molding presses up to 520tons
- fully automated production cells for automotive seals
- state of the art CNC trimming process
- 100% quality inspection of finished products
- laboratory and test facilities for internal control and new product development

Applications	Products	Materials
<ul style="list-style-type: none"> • truck and off road axles • fuel and dual fluid pumps • washing machines • robots and gearboxes • underwater propellers 	<ul style="list-style-type: none"> • RSS following DIN3760/3761 • RSS with TURBO profile • RSS with patented TANDEM assembly • RSS combined with engineered washers • RSS integrated with sleeve and labirinths 	<ul style="list-style-type: none"> • NBR • HNBR • FPM • FPM low temperature • VMQ • steel AISI304

Trelleborg Sealing Solutions Malta



Company Profile



Trelleborg Sealing Solutions Malta was established in 1961 as part of Dowty Seals UK and joined Trelleborg Sealing Solutions in October 2003. The company has over 40 years of experience in producing premium quality elastomeric O-Rings with an emphasis on technical capability and quality assurance. The company produces 25 million O-Rings each week for a global customer base, which includes Bosch, Ford, Visteon, Denso, VW, Continental Teves, Honeywell and Magneti Marelli.

Trelleborg Sealing Solutions Malta is QS 9000, TS 16949 and ISO 14001 certified. With a strong reputation built on proven performance, reliability and value, the company is committed to continuous improvement and exceeding customer expectations.

Service

Trelleborg Sealing Solutions Malta provides a totally integrated service that includes product design, material formulation, product development and testing, manufacturing and aftermarket support. A fully equipped testing laboratory can provide data on

materials and finished components. Our materials research and development department works in close relationship with customers to improve O-Ring performance. We have invested heavily in dedicated mixing lines and fully automated batch-off equipment.

This resource not only provides superior quality materials and service to the production facility in Malta but also to other Trelleborg group facilities and customers worldwide. The company provides full support including in-house tool design and manufacture.



Products and Materials



Trelleborg Sealing Solutions Malta manufactures elastomeric O-Rings for a wide range of automotive and industrial applications in a variety of standard and specially formulated materials including:



- FKM
- FVMQ
- HNBR
- EPDM
- NBR
- VMQ
- PTFE-coated O-Rings
- O-Rings with printed ink markings

So far, we have produced over 300 compounds approved by our customers.

The company's expertise lies in providing customized solutions for an extensive range of automotive and industrial applications including:

- Fuel injectors
- Fuel connectors
- Brakes
- Air conditioning
- Diesel, steering and transmission systems
- Hydraulics and pneumatics
- Water and gas supply systems
- Compressors and vacuum system

Facilities



We provide engineering support at all stages of the manufacturing process. We have the latest in CAD/CAM programming software and FEA capabilities that support seal design. Our application support and technical capabilities extend through to our in-house tool design and manufacture and we are leaders in machine vision inspection technology.

We have relocated operations to brand new premises in Hal Far and there is also a specialized mixing facility in Marsa. In addition to investing in the new factory, we have focused on equipment and technology that will help us retain our competitive position. We consider ourselves to be a leader in machine vision technology and our auto inspection machines have been developed to our specific requirements in-house.

Applications	Products	Materials
<ul style="list-style-type: none"> • Automotive • Industrial 	<ul style="list-style-type: none"> • O-Rings and mouldings • Moulded parts 	<ul style="list-style-type: none"> • FKM • FVMQ • HNBR • EPDM • NBR • VMQ

Trelleborg Sealing Solutions Broomfield (USA)



Company Profile



Trelleborg Sealing Solutions Broomfield designs and manufactures engineered PTFE seals and polymer bearings. These products are suitable for extreme sealing and bearing applications in a variety of industries. Since its incorporation in 1978 in Denver, Colorado our business has been recognized as a world leader in providing advanced polymer sealing and bearing solutions for the oil and gas, industrial, medical, automotive and aerospace markets.

Our quality management system is fully certified to both ISO 9001 and AS 9100. In addition to customer approvals from many leading world-wide companies, we have achieved FAA - TSO C150 registration of many of our seal products for the commercial aircraft market. We maintain an ISO 14001-certified environmental management system as well, which ensures that we constantly strive to lessen the impact on the environment.

Service

We provide product engineering for customer specific solutions and application engineering support and troubleshooting. To underline our world-class customer service, we offer fast prototyping, emergency and

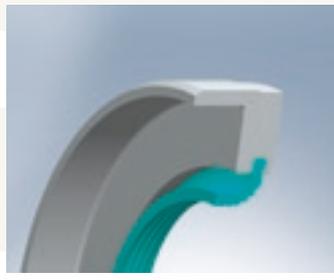
express delivery service for urgent requirements. Technical training of Trelleborg Sealing Solutions marketing company personnel is supported by our comprehensive application knowledge including an extensive database of case histories.



Products and Materials



We produce a full range of engineered spring-energized PTFE seals (Variseal®) and rotary PTFE shaft seals (Varilip®) capable of handling extreme operating



conditions and the most aggressive media. We also design and produce a wide variety of polymer bearings for applications that require low noise, high corrosion resistance



and design flexibility. Rolling-element, sleeve, flange and thrust bearings, as well as integrated seal and bearing solutions, are also produced.



Facilities



We employ the most advanced equipment and process techniques in the design and manufacture of all our products to provide consistent high quality levels and efficient production methods:

- CAD design system with solid modeling capability
- In-house compounding of PTFE and thermoplastic materials
- Extensive spring manufacturing and metal-forming capabilities
- CNC machining of seal and bearing geometries
- PLC-controlled molding and sintering of PTFE materials
- PLC-controlled injection molding and extrusion of thermoplastic bearing materials
- Automated assembly equipment for both seal and bearing products

Applications	Products	Materials
<ul style="list-style-type: none"> • Aerospace: actuators, gearboxes, pumps, valves, ram air turbines • Automotive: AC compressors, EGR valves, transmissions • Oil & Gas: downhole tools, swivels, control valves, safety valves • Semiconductor: wafer processing/transport equipment, direct-drive motors, CVD tools • Medical: oxygen pumps, ultrasound and anaesthesia equipment, precision motors, blood separation devices • Food, Beverage & Pharmaceutical: filling/dispensing equipment, dry blenders, homogenisers 	<ul style="list-style-type: none"> • Seals: rod, piston, face, scraper, rotary • Bearings: rolling element, sleeve, flange and thrust • Variseal™ spring energised seals • Varilip® rotary shaft seals • Durobal® roller element bearings • HiMod® moulded shapes • Turcite® rod 	<ul style="list-style-type: none"> • Turcon® • Zurcon® • Himod® • Turcite® • PEEK • PPS • PFA • Other Thermoplastics

Trelleborg Sealing Solutions Northborough (USA)



Company Profile



Trelleborg Sealing Solutions Northborough was privately started in 1955 as Chase-Walton Elastomers. Bought in 2005, the plant has since moved locally to a more modern facility and has invested extensively into new tooling and equipment. The company has an international reputation, built on a successful track record of meeting the customer's needs in the demanding area of aerospace. We have supplier approvals from the world's leading aircraft and jet engine manufacturers such as Boeing, Airbus, Spirit Aerosystems, GEAE, Bombardier, Honeywell, United Technologies and Goodrich. The facility has earned the internationally recognized quality standard AS9100 and ISO 9001-2000.

Service

Trelleborg Sealing Solutions Northborough specializes in the design and manufacture of reinforced elastomer products for the aerospace industry. Our team of design engineers is constantly researching and coming up with innovative seal designs or materials. We have broad

experience in fire testing and developing methods to prove quality assurance, reliability and durability of our products. We have invested in the latest analytical and development tools such as 3D scanning and modeling, finite element analysis and rapid prototyping abilities.



Products and Materials



Northborough makes aircraft door seals, hatch seals, flap seals, thrust reverser seals, ducts, hoses and other various molded profiles to seal gaps between static and dynamic surfaces. Although many of our



products are handmade using compression molding techniques, we also can produce complex extrusions, hose, and rubber sheeting. We can produce seals from a wide range of silicone



elastomer materials developed to meet industry standards, low temperature flexibility, high temperature resistance, flame retardance or other demanding application requirements.

Most of the products we produce are reinforced with fabrics, metals or composites. By adding various fabrics we can offer added strength and abrasion resistance or reduce surface friction to ensure easier operation over moving surfaces that can further lessen seal wear. In addition we have the latest in fabric and elastomer technology to provide fire protection against flame penetration of the ducts and fire seals we produce.

Facilities



The 29,000 square foot facility is located in Northborough Massachusetts, which is 30 miles West of Boston. There are 107 employees. Our full range of capabilities include Product Development & Design, Elastomer Compounding, Calendaring, Kitting, Compression Molding, Transfer Molding, Extruding, Die Cutting, Splicing, Hose Braiding, Metal to Elastomer Bonding and Product Testing.

Applications	Products	Materials
<ul style="list-style-type: none"> • Aerospace – Environmental Control Systems, Power Plant, Airframes, Wings, Doors Windows, Nacelles 	<ul style="list-style-type: none"> • Fireproof Seals • Aerodynamic Seals • Inflatable Seals • Gaskets • Ducts • Hoses • Sheets 	<ul style="list-style-type: none"> • Silicone • Fluorosilicone • Polyurethane • Ceramics • Nomex • Polyester • Fiberglass • Prepreg • Metal Inserts • Carbon Composite

Trelleborg Sealing Solutions Fort Wayne (USA)



Company Profile



Trelleborg Sealing Solutions Fort Wayne manufactures hydraulic and pneumatic static seals, bearings and rotary seal products for the industrial, aerospace and automotive markets. The facility also has the ability to manufacture sheet PTFE, which is particularly important to the machine tool industry. Our precision-machined PTFE and molded perfluoro-elastomers, polyurethane and elastomer products are marketed worldwide under the Trelleborg Sealing Solutions name. We are now expanding our markets to include the medical, pharmaceutical, food, beverage and semiconductor sectors.

The company was originally founded in 1950 and our 10,000 square meter (108,000 square foot) facility is located in Fort Wayne, Indiana, USA. We have approximately 300 full-time employees. We use the most advanced manufacturing equipment and processes to produce our products.

Service

Our goal is to meet or exceed customer expectations in quality, cost, and delivery of products and services. In order to achieve this goal, our employees are empowered to support the company's quality objectives. The manufacturing facility is supported by the Fort Wayne research and development laboratory to help ensure

the highest quality products. This laboratory provides materials development, material testing, product development, product testing, and HVOEM design engineering.

One of the most significant service opportunities this facility offers is known as ProtoXpress. This provides

customers with standard components and assemblies within 48 hours. Engineered products will be shipped in 72 hours where tooling exists. All products manufactured through ProtoXpress are made from the same high-quality materials and use the same proven manufacturing techniques. Each part is supplied with a certificate of conformance.



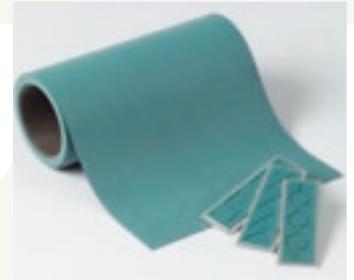
Products and Materials

We are considered a market leader in seal material, design, quality and performance. We specialize in engineered solutions where product performance is paramount and system downtime must be minimized. A broad range of engineered polymers, including Turcite®, Turcon®

and Zurcon® are available to provide solutions that meet the specific customer demands.

We have several site certificates and approvals including ISO 9001, ISO 14001, AS 9000 and QS 9000 and are currently working towards TS 16949.

Our site operates as the North American research and development facility. Through extensive materials development activities, we are able to offer next-generation formulations that fulfill high-end and unique sealing applications.



Facilities



Trelleborg Sealing Solutions Fort Wayne is an outstanding example of cellular manufacturing. The plant has three business units utilizing dedicated manufacturing cells, each differentiated by diameter and product type.

We support all of the other Trelleborg Sealing Solutions facilities in North America with materials development and testing, product development and product testing services.

The Fort Wayne facility is dedicated to ensuring the highest quality products for its customers. The plant achieved its first ISO 9001 certification over a decade ago and AS 9100 certification in 2004. It has also received certification by a number of United States agencies including FAA, TSO-C150, Airworthiness Approval Tags (8130-3), and has numerous customer approvals from leading companies around the world.

Applications	Products	Materials
<ul style="list-style-type: none"> • Industrial: Machine tool, construction equipment • Automotive: suspension systems, EGR valves, transmissions, fuel injectors • Aerospace: flight controls, landing gear, wheel and brake systems 	<ul style="list-style-type: none"> • Piston Seals: dynamic and static • Rod Seals: dynamic and static • Exclusion Devices • Buffer seal • Glydring® II • Roto Glydring® HT • Turcon® J Style • Backup Ring • Turcon® CST™ Seal • Turcon® Wedgpak® II • Turcon® Excluder®2 • Zurcon® Hatseal®II • Turcon® VL Seal • Turcon® Stepseal® 2k • Turcite® Slydring® • Turcite® Slydway® 	<ul style="list-style-type: none"> • HiMod® • Turcite® • Turcon® • Zurcon®

Trelleborg Sealing Solutions Hudson (USA)



Company Profile



Trelleborg Sealing Solutions Hudson is a leading manufacturer of tubing, hoses, sheeting and specialty components for the Life Science Industry. TSS Hudson's unique and diverse capabilities include: extrusion, calendering and liquid injection molding to provide customers with a complete and comprehensive sealing solution.

Trelleborg Sealing Solutions Hudson has gained a vast amount of experience within the Pharmaceutical, Biotechnology, Medical Equipment and Healthcare segments of the Life Science Industry. They are also a key supplier within the Food & Beverage Marketplace.

Service

Trelleborg Sealing Solutions Hudson recognizes that responsiveness and flexibility is the key to success within the Life Science Market. TSS Hudson has an extensive track record of providing customers with both standard products as well as custom design sealing solutions for this highly regulated market. TSS Hudson has also established

itself as an industry leader by providing world class on-time delivery to all parts of the globe. Adding value for the customer is also important to Trelleborg Sealing Solutions Hudson staff. A key differentiator for this facility is the ability to custom blend "Medical Grades" of silicone to respond to the diverse needs of the Life



Science Field. It has one of the most innovative and experienced design teams in the industry and leverages



this strength by providing engineered solutions as well as innovative ideas.

Products and Materials

Since the facility first opened in 1982, Trelleborg Sealing Solutions Hudson has manufactured a broad line of products. These range from silicone tubing to extruded profiles and over-molded assemblies. The SF Medical product line ranges from premium grade silicone tubing, sanitary reinforced hose, silicone sheeting, extruded profiles and liquid injection molded silicone components and over-molding. All products are manufactured from virgin silicone. Customers may choose between peroxide and platinum cured silicone. Trelleborg Sealing Solutions Hudson has an extensive line of "Medical Grade" silicones as well as capabilities for custom blending to meet specific customer needs.

Trelleborg Sealing Solutions Hudson extrudes, liquid injection molds and over-molds products using specialized silicone materials to provide custom-engineered solutions for a variety of medical, device, healthcare, biotechnology and pharmaceutical applications. Our silicone products maintain high pressure ratings, have excellent flexibility, are sterilizable and autoclavable, impart no taste or odor, are available in bulk assemblies and operate under a wide temperature range. Silicone materials are ideal for use in bioprocessing, medical and pharmaceutical production due to their inherent inertness to bacteria, mold and fungi. Trelleborg Sealing



Solutions Hudson provides materials that give excellent heat resistance, cold flexibility and dielectric properties. Trelleborg Sealing Solutions Hudson, though it's capability to custom blend materials, is able to provide customers with both standard "Medical Grade" silicone as well as compounds to meet the specific needs of customers. Customer

needs for color matching, product labeling and special packaging are standard practices for Trelleborg. The company has earned numerous certifications and approvals from its customer base and industry regulatory institutions. TSS Hudson is ISO 9001-2000 registered as well as being an FDA registered facility for the production of Class II Medical Devices.

Facilities



Trelleborg Sealing Solutions Hudson's primary focus is the manufacturing of precision products for the Life Science Market. It operates in a controlled environment equivalent to class 100,000 conditions, with ambient temperature, humidity, and particulate count monitored regularly. This facility follows strict "Good Manufacturing Practices"

as defined by the FDA and in accordance with their quality standards ISO 9001-2000. Trelleborg Sealing Solutions Hudson is a 60,000 sq. ft. facility comprised of 5,000 sq. ft. of clean manufacturing and 700 sq. ft. of HEPA Filtered Clean packaging area. Industry standard gowning procedures are closely followed in all manufacturing areas. The facility

is registered with the FDA and undergoes regular audits by key customers to maintain approvals.

Applications	Products	Materials
<ul style="list-style-type: none"> • Orthopedic Products • Peristaltic Pumps • Intravenous Lines • Catheters • Medical Equipment Components • Feeding tubes • TPN Tubing • TFF Filtering • IV Infusion • Dialysis Equipment • Fluid Transfer 	<ul style="list-style-type: none"> • Pharmatube™ - Silicon Tubing • PharmaSil™ - Silicone Hose – Platinum Cured • NutraSil™ - Silicone Hose – Peroxide Cured • PharmElast™ - Silicone Sheeting • PharmaLim™ - Liquid Injection Molded Products • Pharmed™ - Encapsulated Silicone Labeling • SilFit™ - Permanent & Reusable Fittings 	<p>Silicone:</p> <ul style="list-style-type: none"> • Peroxide Cured • Platinum Cured • Medical Grade • Multi-Color • Multi-Durometer • Liquid Injection Molded Silicone • Gum Stock

Trelleborg Sealing Solutions Somersworth (USA)



Company Profile



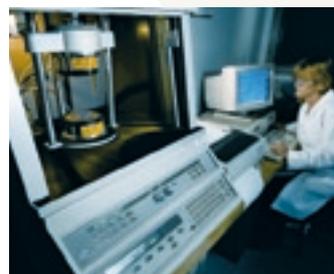
Trelleborg Sealing Solutions Somersworth is a world leader in fabric-reinforced diaphragms and high performance radial oil lip seals.

With the broadest selection of elastomer formulations and our ability to irreversibly bond elastomers to plastic and metal inserts, high performance fabrics, and PTFE barrier films, Trelleborg Sealing Solutions Somersworth is able to design and manufacture fabric reinforced diaphragms and radial oil lip seals for the world's most demanding applications.

The company was established in 1963 as Palmer Chenard and we operate a 6510 square meter (70,000 square foot) facility. Since being founded in 1963, the company has continuously expanded its product line, offering diaphragm assemblies and custom molded parts. Trelleborg Sealing Solutions Somersworth has proprietary, high flow elastomers that can achieve tight tolerances through formulation modification and advanced tool design.

Service

Our internal staff and customers' engineers are trained to provide engineering support for design of customer-specific solutions, testing, analysis and selection of materials and design.



Products and Materials



Trelleborg Sealing Solutions Somersworth has a line of patented radial oil lip seals that have the industry's highest pressure ratings and are able to withstand pressure



exceeding 4500psi (310 bar). The HP series is able to withstand elevated temperature and pressure through proper material selection and design and is perfect for the



hydraulic motor market. Our innovative diaphragm designs and extensive material selection have allowed our customers to



improve product performance, and value, by increasing stroke length, pressure, and sensitivity of actuators, regulators, pumps and valves.

Facilities



Trelleborg Sealing Solutions Somersworth has the latest technology available to design and manufacture fabric reinforced diaphragms, lip seals and associated tooling for low and high volume production.

We use state-of-the-art equipment throughout the process, including compound mixing, fabric cutting, PLC controlled molding processes, CNC machining, CAD/CAM tool design and manufacture, all supported by optical measuring equipment.

Applications

- Flow Control Valves & Hygienic Valves
- Pneumatic Actuators
- Diaphragm Pumps
- Pressure Regulators
- Turbo Wastegate Actuators
- High Pressure Hydraulic Motor Seals
- Heavy Duty Seals
- Gearbox Seals
- Chemical Dosage Pumps
- Fuel Delivery/Vapor Recovery Systems
- Compressor Seals

Products

- Diaphragms:**
- Fabric reinforced diaphragms for high temperature and pressure applications
 - Diaphragm assemblies for Aerospace actuators, regulators, valves and pumps
 - Large diameter, deep draw, fabric reinforced diaphragms
 - PTFE bonded diaphragms
 - Thin, ultrasensitive, fabric reinforced diaphragms
- Radial Lip Seals:**
- High pressure, balanced seal designs
 - Increased sideload capability
 - Spring loaded and nonspring loaded designs
 - Fractional horse power, low friction seal designs
- Custom Molded Parts:**
- Belleville Washers for Heavy Duty Seals
 - Custom gaskets and other elastomeric seals

Materials

- Elastomers:**
- Ethylene Propylenes (EPDM)
 - Epichlorohydrins (CO)
 - Nitriles (NBR)
 - Hydrogenated Nitriles (HNBR)
 - Chloroprenes (CR)
 - Fluorocarbons (FKM)
 - Fluorosilicones (FVMQ)
 - Silicones (VMQ)
 - Perfluoroelastomers (FFKM)-Isolast
- High Performance fabrics:**
- Nylons
 - Polyesters
 - Meta-polyaramides (Conex/Nomex)

Trelleborg Sealing Solutions Streamwood (USA)



Company Profile



For more than forty years, Trelleborg Sealing Solutions Streamwood, formerly Hydro-Components Research & Development, has been setting the pace in sealing and wear technology for hydraulic and engineered components. Our reputation was built on two founding principles: tight tolerances and superior materials. This dedication to precision and quality has only strengthened over the years. Today, this productive tandem remains the cornerstone of all our efforts to deliver maximum value to customers. Creating value is a matter of solving customer problems by maintaining the tightest tolerances, incorporating the latest statistical process control methods and consistently improving material specifications. By combining our design expertise and ingenuity in tooling development, we have earned a reputation for making things work. Our greatest source of pride comes from doing things others can't... or won't. This is made possible by unique blends of nylons and other engineered plastics fabricated into components designed to take on the toughest hydraulic and structural applications. These days, some judge success based on the ability to do it faster or cheaper. Trelleborg Sealing Solutions Streamwood remains committed to doing things better.

Service

Our internal staff and customers' engineers are trained to provide engineering support for design of customer-specific solutions, testing, analysis and selection of materials and design.



Products and Materials



Our HM803 (formerly Hydro-Components 1903) material is a recognized industry standard for use in hydraulic systems. This special glass-filled, heat-stabilized material is a fundamental building block for



wear rings and bearings specified throughout North America and around the world. Originally developed as a replacement for bronze and phenolic components, HM803 offers across-the-board



improvements in strength, imbeddability and tribological properties. With the addition of a lubricant, our HM852 (formerly Hydro-Components 1952) material has



long been the cylinder designer's choice for marginally lubricated applications. A variety of other proprietary compounds including Acetal, PEEK and other high temperature materials are used for specialty applications.

Facilities



Trelleborg Sealing Solutions Streamwood has always made research and development our first priority. Armed with a strong understanding of mechanics, particularly in hydraulic systems, we promote the use of nylon and other engineered plastics as the most cost-effective solution to reduce friction and improve

component life in cylinder applications. Today, customers can choose from engineered materials precisely suited to their specific applications. Focusing on high-grade nylon-based materials, we also offer features such as internal lubricants and high temperature grades.

Applications	Products	Materials
<ul style="list-style-type: none"> • Hydraulic cylinders • Elevators • Injection molding machines • High pressure water forming equipment • Mining trucks • Excavators • Shears • Mining shovels • Forestry equipment • Wheel loaders and backhoe loaders • Thrust Washers • Agricultural equipment • Cranes • Rock crushers 	<ul style="list-style-type: none"> • Back-up rings • Bearings - solid and split • Guidelock assemblies • Piston assemblies • Piston rings • Piston seals • Rod seal sets • Rod wipers • Structural components • Thrust washers • U-cups • Vee rings • Wear pads • Wear rings 	<ul style="list-style-type: none"> • Engineered plastics

Trelleborg Sealing Solutions Tijuana (Mexico)



Company Profile



Trelleborg Sealing Solutions Tijuana manufactures Rubber gaskets, Orings and extruded pipe for the automotive and industrial markets. The company was formed as a joint venture between the Dowty Group and a California-based customer in 1990 and now supplies markets throughout the Americas. It has a modern 6,500 square meter facility on the edge of Tijuana with 250 employees.

A warehouse in San Diego, California and the Trelleborg Sealing Solutions marketing office in Mexico City ensure that Trelleborg Sealing Solutions Tijuana is able to meet the requirements of the most demanding customers.

Service

From a strong background in automotive O-Rings, we have expanded to become a natural partner for all customers who require high quality rubber gaskets in volume. We can manufacture gaskets ranging from three

millimeters in diameter to three meters (9.8 feet) in length. Our modern joining facilities enable us to make even larger gaskets for the fast-growing plate heat exchanger (PHE) and other industrial markets.



Products and Materials



Trelleborg Sealing Solutions Tijuana has most forms of elastomer including EPDM, NBR, HNBR, FKM and silicone.

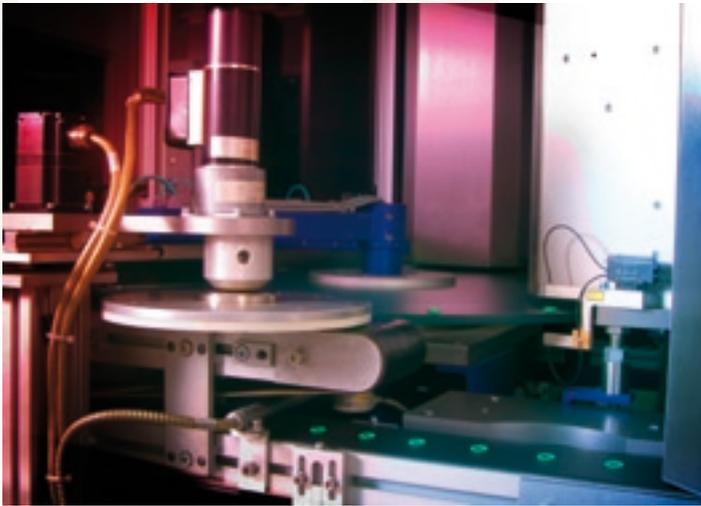


Our materials include fluorocarbons, silicones, and fluorosilicones. All our material requirements are produced in LA, this insures that TSS Tijuana can offer short lead times and quick response to even the most demanding of customers.



Whilst being an established plant for many years TSS Tijuana still has excellent opportunity for growth with approximately 19,000 square feet of available manufacturing space and 40% spare capacity on both our compression presses and our extrusion lines.

Facilities



Our facilities include compression and injection molding capabilities ranging from 150 to 1000 tonne (150 to 1000 tons) and platen sizes from 250cm to 3m (10 inches to 10 feet). Our new extrusion machines have a wide range of capabilities ranging from extruded appliance gaskets to various tubing. The modern laboratory and inspection equipment maintain the quality levels our customers deserve. Our certification to TS 16949 and ISO 14001, ensure we operate to the highest standards in the industries we serve.

Applications	Products	Materials
<ul style="list-style-type: none"> • Automotive • Industrial 	<ul style="list-style-type: none"> • Plate Heat Exchanger (PHE) gaskets • Radiator Gaskets • Extruded Industrial gaskets • Extruded Tubing • Extruded appliance gaskets • Toric ORings • Electrical Grommets and seals • Bonded valve seals • Specialty moldings 	<ul style="list-style-type: none"> • FKM fluorocarbon • FMVQ flourosilicone • VMQ silicone • HNBR • NBR • EPDM • CR • BUTYL

Trelleborg Sealing Solutions São Paulo (Brazil)



Company Profile



Trelleborg Sealing Solutions São Paulo manufactures seals for industrial, aerospace and automotive segments for all markets in the Americas. The manufacturing site was established in São Jose dos Campos in 1999 and is now a low cost, high quality 1000 square meter facility with over 50 employees. Modern production equipment, high quality raw material suppliers and a lean manufacturing philosophy are our main drivers, assuring competitiveness and recognized quality in the market.

We produce O-Rings, custom rubber molded parts, Turcon® seals, thermoplastic seals and rotary shaft seals for a global customers base which includes Bosch, Visteon, Magneti Marelli, Modine, John Crane, Valtra, Rexroth, TI Auto, Festo, Hyco Hidrover, Embraer and Eleb.

Service

We offer the best sealing solution to our customers utilizing all TSS Group expertise. We also provide technical training for customers' engineers and technicians.



Products and Materials



We supply Turcon® seals for rotary and reciprocating applications, thermoplastic seals for hydraulic applications (Zurcon® and HiMod® materials), PTFE rotary shaft seals and automotive custom-molded rubber products.

Proprietary materials

Turcon®: a range of high performance polymers developed for specific duties and service within sealing applications. HiMod®: a range of high modulus, high

performance thermoplastics. Zurcon®: a full range of high performance engineered thermoplastic compounds developed for use in sealing elements.

Facilities



We are certified ISO 9001, ISO TS 16949, NBR 15100 (AS 9100) and ISO 14001 (under TI's umbrella). The facility incorporates five production cells:

- Rubber - Compression Cell: produces more than 1.2 million O-Rings each month in FKM,

FVQM and NBR for the automotive sector

- Rubber - Injection Cell: producing EPDM and NBR customized parts for radiators and mechanical seals applications
- PTFE Cell: producing Turcon® seals and Varilip® and PDR® lips with external diameter up to

400mm (15.7") using CNC machines

- TPU Cell: dedicated to production of polyurethane and polyacetal gaskets and wear rings
- PDR® Cell: dedicated to production of rotary shaft seals and Varilip®

Applications	Products	Materials
<ul style="list-style-type: none"> • Automotive Segment: Fuel injection nozzle, quick connectors, radiators, intake manifold, supercharges, mechanical seal • Hydraulic and Pneumatic Segment: Cylinders, pumps, compressors and machine tools • Agricultural Segment: Engine • Home Appliance Segment: Mechanical Seal • Aerospace Segment: Landing gear, hydraulic cylinders 	<ul style="list-style-type: none"> • O-Rings • Rubber gaskets • Molded parts • PDR® • U-Cups • WAE scrapers • Wear rings • Glyd Ring® T • Stepseal® K • Excluder® • Roto Glyd Ring® • AQ Seal® • Backup ring CST seal • PTFE rotary shaft seals • Custom rubber molded products 	<ul style="list-style-type: none"> • FKM • FVQM • NBR • EPDM • HNBR • Silicon • Turcon® • Zurcon®

Trelleborg Sealing Solutions Bangalore (India)



Company Profile



Trelleborg Sealing Solutions Bangalore began as a joint venture of Busak+Shamban in the year 1998. In the year 2003, taken over by Trelleborg Sealing Solutions and moved over to a new premise in the year 2006.

Presently employed about eighty five people in the work force. Quality system certified to ISO9001 and Environment Management System to ISO14001. Certification target for TS16949 is November 2008.

Service

We are in the production of high-quality precision seals. Seal materials includes PTFE and polyurethane. Our production system is based on MTO/MTS and quick response.

Our product design and engineering is supported by Trelleborg Sealing Solutions Helsingor,

Trelleborg Sealing Solutions Fortwayne, Trelleborg Sealing Solutions Broomfield and Trelleborg Sealing Solutions Bridgewater.

We facilitate Indian, LCE, LCA and Group company requirements.



Products and Materials



Raw material for producing seals is imported from Trelleborg Sealing Solutions facilities in Fort Wayne and Helsingør. We have recently installed PDR® seal manufacturing equipment.



- Turcon® and Zurcon® Seals: 3mm to 450mm (0.12" to 17.7") diameter
- Varilip® PDR Rotary Shaft seals: 20mm to 250mm (0.78" to 9.8") diameter



Present Turcon® raw material production capability: Up to 300mm diameter tubes. Turcon tubes above 300mm diameter and Zurcon are imported from group companies.

Facilities



Our facility includes Turcon® Tube manufacturing, Seal Machining Cell, Varilip® PDR cell and Inspection and Material Test laboratory to take care of the manufacturing needs.

Process improvements through Six Sigma and SPC.

Applications	Products	Materials
<ul style="list-style-type: none"> • Construction • Automotive • Farm Equipments • Railways • Defense • Power • Industrial • Chemical, Oil & Gas • Life Sciences 	<ul style="list-style-type: none"> • Step seal® 2K • Glyd Ring® • Roto Glyd Ring® T • Roto Glyd Ring® • Excluder® • AQ seal® • Double delta • Varilip® PDR seal • Variseal® • Rim seal® • Roto glyd ring® S • Vector seal® • Spiral Back-up ring 	<ul style="list-style-type: none"> • Turcon® (T01, T03, T05, T06, T08, T10, T24, T29, T40, T42, T46, T99) • Zurcon® (Z51, Z52, Z80)

Trelleborg Sealing Solutions Shanghai (China)



Company Profile



Production of high-quality precision seals in materials including elastomers, PTFE and polyurethane is the focus of the new plant in Shanghai, China. Also housing a technical center and a sales office approximately 200 people will be employed there.

The plant strengthens Trelleborg Sealing Solutions' presence in this important growth region and facilitates further expansion through increased service to new and existing customers in the area.

Service

The technical center encompasses 2-D and 3-D CAD design capabilities and product testing in order to provide customer-specific solutions. Our highly trained and certified staff provides qualified solutions and expertise for the growing demands in

Asia. Our Application Engineers and Sales Engineers have sufficient breadth and depth of knowledge about sealing technology, the related applications and all of our extensive range of sealing products.



Products and Materials



We can provide the majority of sealing solutions from our wide range of proprietary materials, including Turcon® and Zurcon®.



Our seals are used in equipment throughout Asia where there is demand for dynamic and static sealing under demanding conditions.



Our products and materials are developed in-house and controlled by our specialists.

Facilities



Trelleborg Sealing Solutions Shanghai has on-site facilities that allow for efficient design, production, testing, inspection and shipping of sealing solutions throughout Asia.

Applications	Products	Materials
<ul style="list-style-type: none"> • Industrial applications: such as hydraulic cylinders, presses, injection molding machines, forklifts or excavators • Automotive • Aerospace 	<p>Piston seals, rod seals, seals for rotary applications, scrapers, bearings etc:</p> <ul style="list-style-type: none"> • Stepseal® 2K • Glyd Ring® T • Roto Glyd Ring® • Excluder® • AQ Seal® • Double Delta® • Slydring® • Slydway® • O-Rings 	<ul style="list-style-type: none"> • Turcon® • Zurcon® • Orkot® • Isolast®

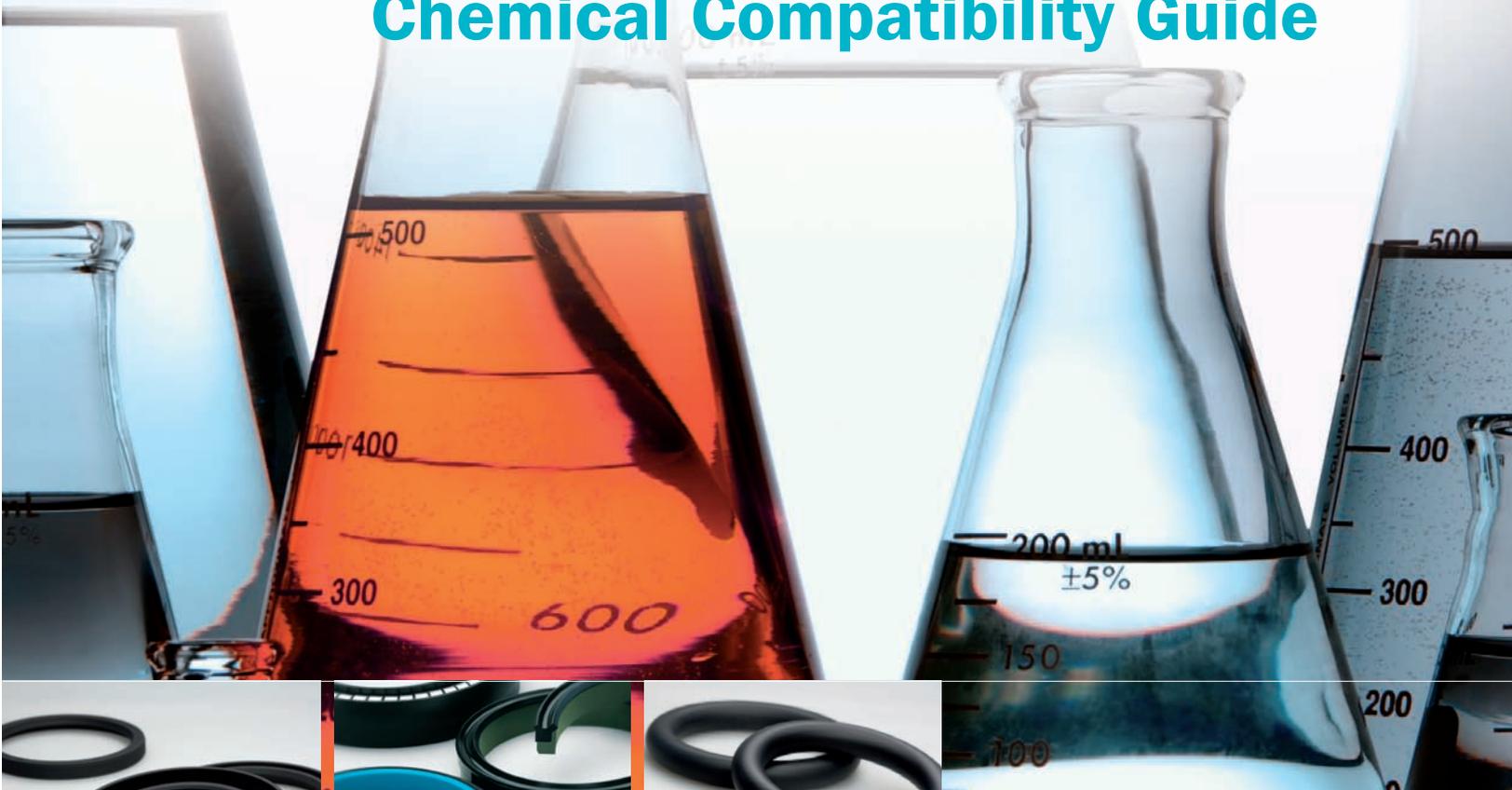
Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 2264 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 39059 6388
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Materials Chemical Compatibility Guide



Your Partner for Sealing Technology



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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 of 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, 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. Trelleborg Sealing Solutions is backed by the experiences and resources of one of the world's foremost experts in polymer technology: the Trelleborg Group.

ISO 9001:2000

ISO/TS 16949:2002

The information in this brochure is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this brochure. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

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

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Sealing materials - 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 material groups

for seals is 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.

Table I Elastomers

Designation	Trade Name*	Abbreviation		
		ISO 1629	ASTM D 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-EI® 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
Chlorosulfonated Polyethylene Rubber	Hypalon®	CSM	CSM	WM
Polysulfide Elastomer	Thiokol®	-	TWT	WY
Epichlorohydrin Elastomer	Hydrin®	CO/ECO	CO/ECO	WO

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

ASTM = American Society for Testing and Materials
ISO = International Organization for Standardization

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

Chemical name	Abbreviation	
	ISO 1629	ASTM D 1418
M - Group (saturated carbon molecules in main macro-molecule-chain) - Polyacrylate Rubber - Ethylene Acrylate Rubber - Chlorosulfonated Polyethylene Rubber - Ethylene Propylene Diene Rubber - Ethylene Propylene Rubber - Fluorocarbon Rubber - Perfluoro Rubber	ACM AEM CSM EPDM EPM FKM FFKM	ACM CSM EPDM EPM FKM FFKM
O - Group (with oxygen molecules in the main macro-molecule chain) - Epichlorohydrin Rubber - Epichlorohydrin Copolymer Rubber	CO ECO	CO ECO
R - Group (unsaturated hydrogen carbon chain) - Chloroprene Rubber - Butyl Rubber - Nitrile Butadiene Rubber - Natural Rubber - Styrene Butadiene Rubber - Hydrogenated Nitrile Butadiene Rubber	CR IIR NBR NR SBR HNBR	CR IIR NBR NR SBR HNBR
Q - Group (with Silicone in the main chain) - Fluorosilicone Rubber - Methyl Vinyl Silicone Rubber	FVMQ VMQ	FVMQ VMQ
U - Group (with carbon, oxygen and nitrogen in the main chain) - Polyester Urethane - Polyether Urethane	AU EU	AU EU



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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 swell, shrink or harden and develop cracks or even tears.

Elastomer heat resistance/swelling in oil

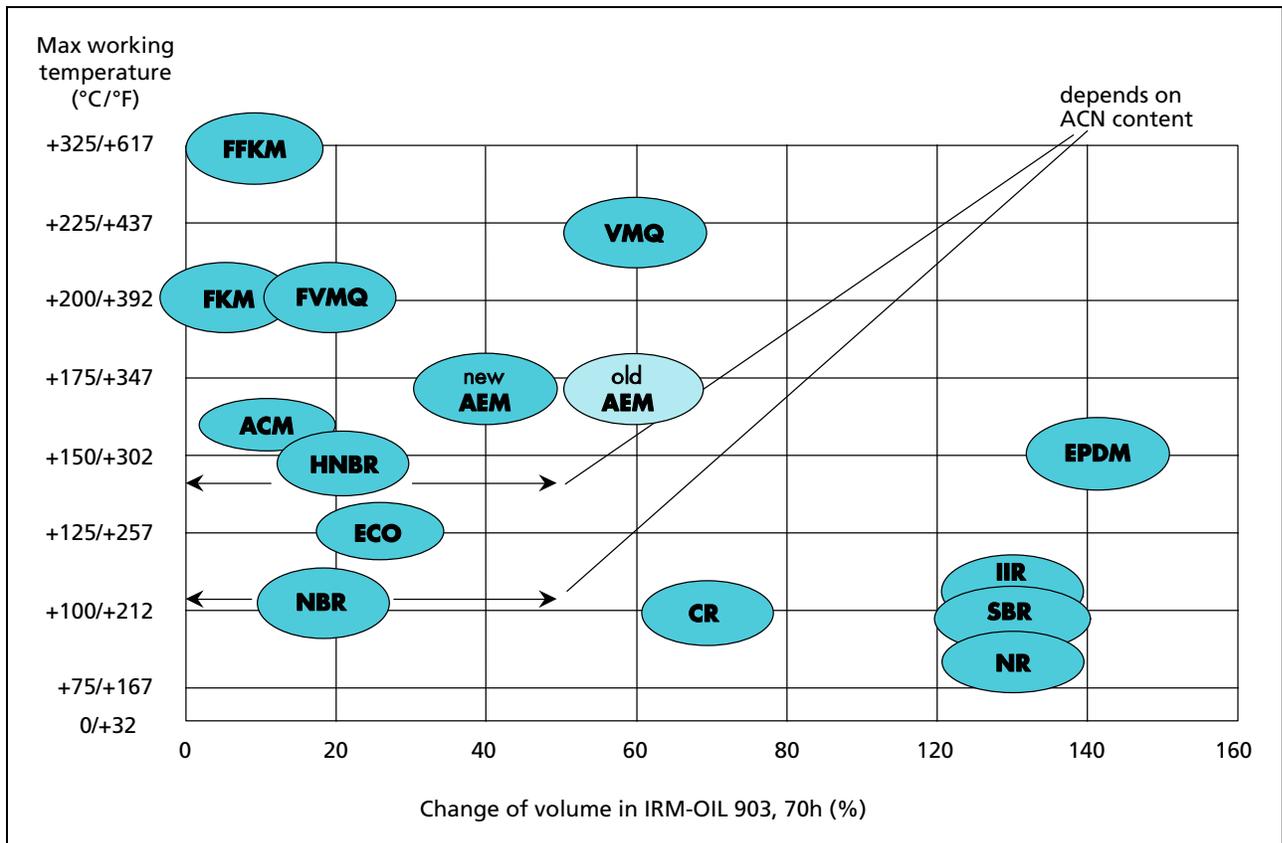


Figure 1 Change of volume in IRM-Oil 903 (old ASTM-Oil No 3)

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Temperature range

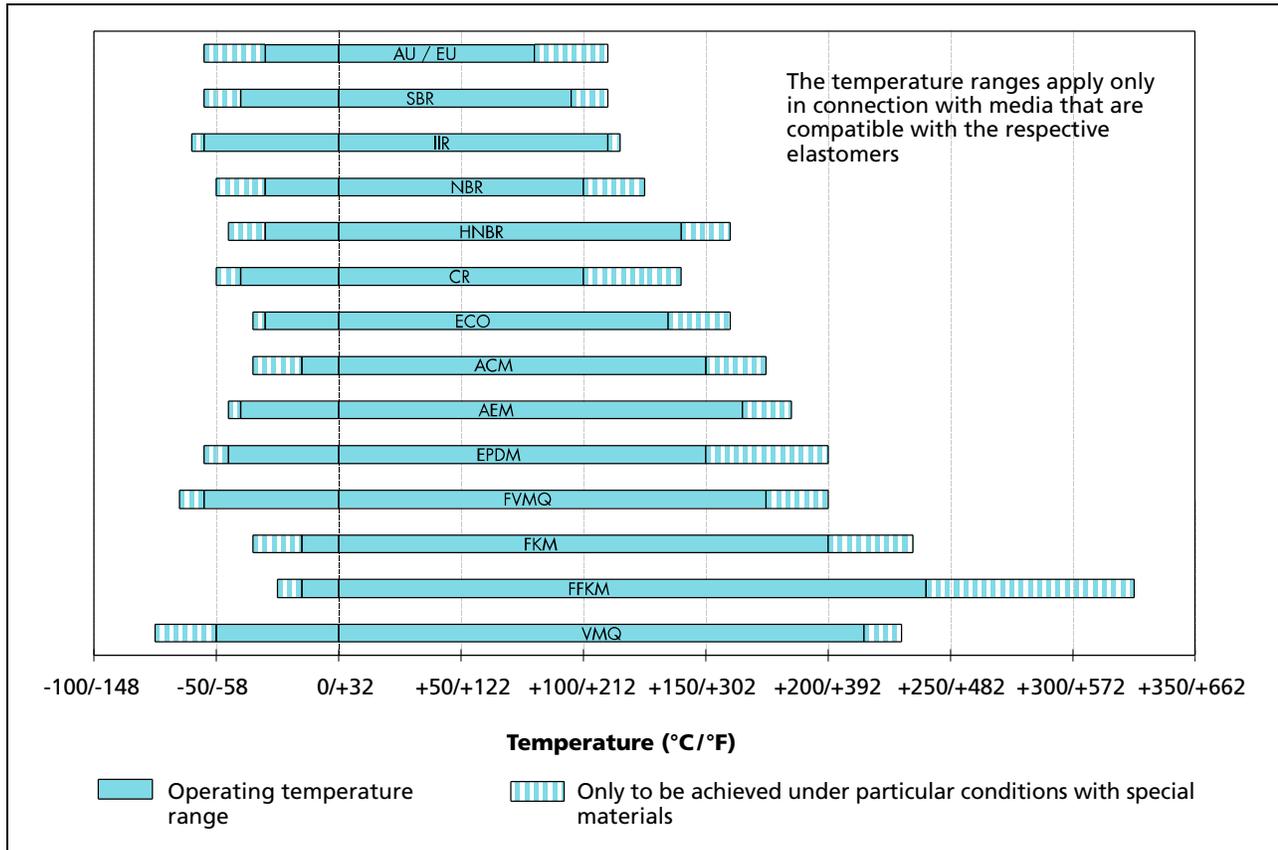


Figure 2 Temperature range of various elastomers

General fields of application

Elastomer materials are used to cover a large number of fields of application.

The various elastomers can be characterized 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 $-30^{\circ}\text{C}/-22^{\circ}\text{F}$ and $+100^{\circ}\text{C}/+212^{\circ}\text{F}$ (for a short period of time up to $+120^{\circ}\text{C}/+248^{\circ}\text{F}$). Suitable formulated NBR can be used down to $-60^{\circ}\text{C}/-76^{\circ}\text{F}$.

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 $-20^{\circ}\text{C}/-4^{\circ}\text{F}$ and $+200^{\circ}\text{C}/+392^{\circ}\text{F}$ (for a short period of time up to $+230^{\circ}\text{C}/+446^{\circ}\text{F}$). Suitable formulated FKM can be used down to $-35^{\circ}\text{C}/-31^{\circ}\text{F}$. 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 behavior as well as good insulating properties.

The operating temperatures of applications for EPDM range between $-45^{\circ}\text{C}/-49^{\circ}\text{F}$ and $+150^{\circ}\text{C}/+302^{\circ}\text{F}$ (for a short period of time up to $+175^{\circ}\text{C}/+347^{\circ}\text{F}$). With sulfur cured types the range is reduced to $-45^{\circ}\text{C}/-49^{\circ}\text{F}$ and $+120^{\circ}\text{C}/+248^{\circ}\text{F}$ (for short period of time up to $+150^{\circ}\text{C}/+302^{\circ}\text{F}$).

EPDM can often be found in applications with brake fluids (based on glycol) and hot water.

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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/-22°F and +140°C/+284°F (for a short period of time up to +160°C/+320°F) in contact with mineral oils and greases. Special types can be used down to -40°C/-40°F.

VMQ (Silicone Rubber)

VMQ shows excellent heat resistance, cold flexibility, dielectric properties and especially good resistance to weather, ozone and UV rays.

Specific VMQ formulations are resistant to aliphatic engine and gear oils, water up to +100°C/+212°F and high-molecular chlorinated hydrocarbons. The temperature range is between -60°C/-76°F and +200°C/+392°F (temporary up to +230°C/+446°F).

FVMQ (Fluorosilicone Rubber)

FVMQ has a good heat resistance, very good low temperature flexibility, good electrical properties and excellent resistance to weather, ozone and UV rays. FVMQ shows a significantly better chemical resistance than standard Silicone especially in hydrocarbons, aromatic mineral oils, fuel and low molecular aromatic hydrocarbons e.g. Benzene and Toluene. The temperature range is between -55°C/-67°F and +175°C/+347°F (temporary up to +200°C/+392°F).

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/-40°F and +100°C/+212°F (for a short period of time up to +120°C/+248°F). Special types can be used down to -55°C/-67°F. 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/-4°F and +150°C/+302°F (for a short period of time up to +175°C/+347°F). Special types can be used down to -35°C/-31°F.

ACM-materials are mainly used in automotive applications which require special resistance to lubricants containing many additives (incl. sulfur) 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/-13°F and +240°C/+464°F. Special types can be used up to +325°C/+617°F.

Applications for FFKM can be mostly found in the chemical and process industries and in all applications with either aggressive environments or high temperatures.

Polyurethane (Zurcon® Polyurethane)

Polyurethanes are an exceptionally complex material group. They are individually designed and fit various applications' needs. Therefore it is not possible to unify the materials' properties.

Zurcon® polyurethane materials from Trelleborg Sealing Solutions are customized to appropriate applications and stand out due to their excellent elastic properties and optimum abrasion resistance. Outstanding tensile strength, low compression set and good resistance to O₂ and O₃ are further significant characteristics. Depending on the individual Zurcon® polyurethane type the application temperature ranges from below -50°C/-58°F up to +110°C/+230°F, temporary even higher, is feasible.

Chemical compatibility

It is important to recognize that when using this guide, the ratings shown are based on published data and immersion tests. These tests are conducted under laboratory conditions predominantly at room temperature and may not adequately represent 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.

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Chemical Compatibility Guide for sealing materials

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 not suitable for application in this media.
- Insufficient information available for service in this media.

A

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Acetaldehyde	U	U	-	B	A	U	B/C	U	U	U	-
Acetamide	-	-	A	A	A	U	A	A	A	A	B
Acetic Acid	C	U	B	A	A	C	A	C	C	C	B
Acetic Acid Chloride	U	U	U	U	A	A	A	A	U	U	U
Acetic Acid Vapors	U	U	C	A	A	U	A	C	U	U	U
Acetic acid, 96-99.5% (Glacial)	U	U	U	B	A	U	B	U	U	U	B
Acetic Anhydride	U	U	C	B	A	U	A	C	U	U	B
Acetone	U	U	U	A	A	U	B	U	U	U	U
Acetophenone	U	U	U	A	A	U	A	U	U	U	U
Acetylacetone	U	U	U	A	A	U	B	U	U	U	U
Acetylchloride	U	U	U	U	A	A	A	A	U	U	U
Acetylene Gas	A	-	B	A	A	A	A	A	A	A	B
Acetylene Tetrabromide	-	U	B	A	A	A	A	-	U	U	-
Acrolein	U	U	C	A	A	U	A	-	C	C	-
Acrylonitrile	U	U	U	U	A	U	C	U	U	U	U
Adipic Acid	U	U	A	A	A	A	A	A	A	A	A
Adipic Acid Diethyl Ester	-	-	-	A	A	U	A	-	U	U	-
Aero Lubriplate	A	A	A	U	A	A	A	A	A	A	B
Aero safe 2300	U	U	U	A	A	U	A	U	U	U	U
Aero safe 2300 W	U	U	U	A	A	U	A	U	U	U	U
Aero Shell 1 AC Grease	A	A	B	U	A	A	A	A	A	A	B
Aero Shell 17 Grease	A	A	B	U	A	A	A	A	A	A	B
Aero Shell 7 A Grease	A	A	B	U	A	A	A	A	A	A	B
Aero Shell 750	B	U	U	U	A	A	A	B	B	B	U
Aero Shell Fluid 4	B	B	U	U	A	A	A	A	A	A	U



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Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Aerozine 50 (50%Hydrazine,50% UDMH)	-	U	U	A	B (J9505)	U	A	U	U	U	U
Air	A	A	A	A	A	A	A	A	A	A	A
Alcohol (Methanol)	U	U	A	A	A	U	A	A	A	A	A
Alkyl Arylsulfonic Acid	U	U	C	A	A	U	A	U	C	C	U
Alkyl Benzene	U	U	U	U	A	A	A	A	U	U	U
Allyl Alcohol (2-Propene-1-ol)	U	U	A	A	A	B	A	U	B	B	U
Allyl Chloride (3-Chloro-1-Propene)	-	U	U	U	A	-	A	-	U	U	A
Allyl Ketone	U	U	C	A	A	U	B	U	U	U	B
Aluminium Acetate	U	U	B	A	A	U	A	U	B	B	U
Aluminium Bromide	A	U	A	A	A	A	A	A	A	A	A
Aluminium Fluoride	-	U	A	A	A	A	A	A	A	A	B
Aluminium Nitrate	U	U	A	A	A	A	A	-	A	A	B
Aluminium Phosphate	A	U	A	A	A	A	A	A	A	A	A
Aluminium Sulfate	U	U	A	A	A	A	A	A	A	A	A
Aluminium-Potassium Sulfate Solution	-	-	-	A	A	-	A	-	-	-	-
Aluminum Chloride Solution	A	C	A	A	A	A	A	A	A	A	B
Aluminum Hydroxide Solution	U	U	A	A	A	A	A	A	A	A	A
Aluminum Sulfate Solution	U	-	A	A	A	A	A	A	A	A	A
Ambrex 33 (Mobile)	A	B	B	U	A	A	A	U	A	A	U
Ambrex 830 (Mobile)	A	A	B	U	A	A	A	A	A	A	B
Amines, primary (such as Methyl, Ethyl, Propyl, Allyl)	U	U	U	A	A	U	A	U	U	U	C
Aminoacetic Acid	U	U	A	A	A	A	A	U	B	B	U
Ammonia (gas)	U	U	A	A	A (J9503)	U	A	U	A	A	A
Ammonia (gas, hot)	U	U	B	B	A (J9503)	U	A	U	U	U	U
Ammonia (liquid)	U	U	-	A	A	U	A	-	B	B	-
Ammonia Solution	U	U	-	A	A	U	A	-	B	B	-
Ammonia, anhydrous	U	U	A	A	A (J9503)	U	A	U	A	A	B
Ammonia, aqueous Solution	U	U	A	A	A	U	A	U	C	C	C
Ammonia-Lithium	U	U	U	B	A	U	A	U	B	B	U
Ammonium Acetate	-	U	B	A	A	U	A	-	A	A	-
Ammonium Carbonate	-	U	B	A	A	U	A	-	A	A	-
Ammonium Carbonate Solution	-	-	B	A	A	-	A	-	U	U	-
Ammonium Chloride	B	U	A	A	A	A	A	A	A	A	A
Ammonium Chloride Solution	-	-	A	A	A	-	A	-	A	A	-
Ammonium Fluoride	U	U	B	A	A	B	A	B	A	A	A

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Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Ammonium Hydroxide	U	U	A	A	A	U	A	-	U	U	-
Ammonium Hydroxide Solution	U	U	A	A	A	U	A	-	U	U	-
Ammonium Nitrate Solution	U	-	A	A	A	-	A	-	A	A	-
Ammonium Nitrite	-	-	B	A	A	-	A	-	A	A	B
Ammonium Phosphate, Monobasic, Dibasic, Tribasic	-	-	A	A	A	-	A	-	A	A	A
Ammonium Sulfate Solution	U	U	A	A	A	U	A	B	A	A	B
Ammonium Sulfide	U	U	B	A	A	U	A	B	B	B	B
Ammonium Thiocyanate	-	B	-	A	A	-	A	-	A	A	A
Amyl Acetate	U	U	U	A	A	U	A	U	U	U	U
Amyl Alcohol	U	U	B	A	A	B	A	B	B	B	U
Amyl Borate	-	-	A	U	A	-	A	-	A	A	-
Amyl Chloride	U	U	U	U	A	A	A	B	U	U	U
Amyl Naphthalene	U	U	U	U	A	A	A	A	U	U	U
Anderol L-774	A	U	U	U	A	A	A	A	A	A	U
Aniline Chlorohydrate	U	U	B	B	A	B	A	B	B	B	U
Aniline Liquid	U	U	U	A	A	U	A	U	U	U	U
Animal Fats	A	A	B	B	A	A	A	A	A	A	B
Anisole	U	U	U	U	A	U	A	U	U	U	U
Antimony Chloride	B	U	B	A	A	A	A	A	A	A	B
Antimony Chloride, dry	B	B	A	A	A	A	A	A	A	A	A
Aqua Regia (Nitric Acid/Hydrochloric Acid)	U	U	U	U	B	U	U	U	U	U	U
Argon Gas	A	A	A	A	A	A	A	A	A	A	A
Aromatic Fuels (up to 50% Aromatic)	B	B	U	U	A	A	A	A	A	A	U
Aromatic Hydrocarbons (100% Aromatic)	U	U	U	U	A	A	A	A	U	U	U
Arsenic Acid	C	C	A	A	A	A	A	A	A	A	A
Arsenic Acid, Solution	C	C	A	A	A	A	A	A	A	A	A
Asphalt, Emulsion	B	B	B	U	A	A	A	B	B	B	U
ASTM Test Fuel A	B	A	B	U	A	A	A	A	A	A	U
ASTM Test Fuel B	U	U	U	U	A	A	A	A	A	A	U
ASTM Test Fuel C	U	U	U	U	A	A	A	B	B	B	U
ASTM-Oil IRM 902	A	B	B	U	A	A	A	A	A	A	B
ASTM-Oil IRM 903	A	B	U	U	A	A	A	A	A	A	B
ASTM-Oil No.1	A	B	B	U	A	A	A	A	A	A	A
ATM-Brake Fluid (Glycolbased)	U	U	B	A	A	U	A	A	U	U	A
Automatic-Transmission Fluid	U	A	B	U	A	A	A	A	A	A	B
Automotive Gasoline	C	B	U	U	A	A	A	A	A	A	U



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B

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Barium Carbonate	-	A	-	A	A	A	A	A	A	A	A
Barium Chloride Solution	U	A	A	A	A	A	A	A	A	A	A
Barium Hydroxide Solution	U	U	A	A	A	A	A	A	A	A	A
Barium Nitrate Solution	U	A	A	A	A	A	A	A	A	A	A
Barium Sulfate	A	A	A	A	A	A	A	A	A	A	A
Barium Sulfide Solution	U	A	A	A	A	A	A	A	A	A	A
Battery Acid (Sulfuric Acid diluted)	U	U	U	A	A	A	A	U	U	U	U
Beef Tallow	C	-	B	U	A	A	A	B	A	A	B
Beer	U	C	A	A	A	A	A	A	A	A	A
Beet Sugar Sap	U	-	B	A	A	A	A	A	A	A	A
Benzaldehyde	U	U	U	B	A	U	A	U	U	U	B
Benzenesulfonic Acid	U	U	B	-	A	A	A	B	U	U	U
Benzine (Gasoline)	C	B	U	U	A	A	A	A	A	A	U
Benzine 50/Benzene 30/Ethanol 20	U	U	U	U	A	B	A	B	U	U	U
Benzine 50/Benzene 50	U	U	U	U	A	B	A	B	U	U	U
Benzine 60/Benzene 40	U	U	U	U	A	B	A	B	U	U	U
Benzine 70/Benzene 30	U	U	U	U	A	A	A	A	B	B	U
Benzine 80/Benzene 20	U	U	U	U	A	A	A	A	B	B	U
Benzoic Acid, Solution	B	U	B	B	A	A	A	A	B	B	B
Benzol (Benzene)	U	U	U	U	A	A	A	B	U	U	U
Benzophenone	U	U	-	B	A	A	A	A	-	-	-
Benzyl Alcohol	U	U	B	B	A	A	A	B	U	U	B
Benzyl Chloride	U	U	U	U	A	A	A	A	U	U	U
Biphenyl	U	-	U	U	A	A	A	B	U	U	U
Bitumen	U	B	U	U	A	A	A	A	U	U	U
Black Liquor	U	U	B	B	A	B	A	-	B	B	-
Blast Furnace Gas	B	U	U	U	A	A	A	B	U	U	A
Bleach Solution	U	U	U	A	A	A	A	B	U	U	U
Bleaching Powder Solution	U	U	B	A	A	A	A	B	C	C	B
Boiler Feed Water	U	U	C	A	A	B	A	B	B	B	C
Bone Oil	A	A	U	U	A	A	A	A	A	A	U
Borax (Sodium Borate)	A	U	B	A	A	A	A	A	B	B	A
Borax Solutions	U	U	U	A	A	B	A	B	B	B	B
Boric Acid	U	B	B	A	A	A	A	A	A	A	A
Brake Fluids (based on glycol ether)	U	U	B	A	A	U	A	U	U	U	U
Brake Fluids (based on mineral oil)	-	A	B	-	A	A	A	-	A	A	-

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Bromine	U	U	U	U	A	B	B	B	U	U	U
Bromine Solution in Water	U	U	U	U	A	A	A	B	U	U	U
Bromine Vapor	U	U	U	U	A	B	B	B	U	U	U
Bromobenzene	U	U	U	U	A	A	A	B	U	U	U
Bromochlorotrifluoroethane	U	U	U	U	A	A	A	B	U	U	U
Bunker Oil	A	B	U	U	A	A	A	A	B	B	B
Butadiene	U	U	U	U	A	B	A	B	U	U	U
Butanediol	-	U	B	A	A	U	A	U	A	A	U
Butane	A	B	B	U	A	A	A	A	A	A	U
1-Butanethiol	U	-	U	U	A	A	A	U	U	U	U
Butanol	U	U	B	B	A	A	A	A	A	A	B
Butanetriol	A	B	B	A	A	A	A	A	A	A	A
Butene	-	B	C	U	A	A	A	B	B	B	U
Buthylphenol	U	U	U	U	A	B	A	-	U	U	U
Butter	B	B	B	B	A	A	A	A	A	A	B
Buttermilk	U	A	A	A	A	A	A	A	A	A	A
Butyl Acetate	U	U	U	B/C	A	U	B/C	U	U	U	U
Butyl Alcohol	U	U	B	A	A	A	A	A	A	A	B
Butylamine	U	U	U	-	A (19503)	U	A	U	U	U	C
Butyl Carbitol	U	-	C	A	A	C	A	U	U	U	U
Butyl Cellosolve	U	U	C	A	A	U	A	U	C	C	-
Butyl Diglycol	-	-	-	A	A	A	A	-	A	A	-
Butyl Phthalate	U	U	U	A	A	U	A	A	U	U	A
Butyl Pyrocatechol	U	-	-	B	A	A	A	B	U	U	-
Butyl Stearate	-	A	U	U	A	A	A	B	B	B	B
Butyl Benzoate	U	-	U	A	A	A	A	A	U	U	-
Butylene	-	B	C	U	A	A	A	B	B	B	U
Butyl Ether	U	U	U	U	A	U	A	U	U	U	U
Butyraldehyde	U	-	U	B	A	U	A	U	U	U	U
Butyric Acid	U	U	C	U	A	A	A	B	B	B	U
Butyric Acid Butyl Ester	U	-	U	B	A	B	A	B	U	U	-



Chemical Compatibility Guide

C

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Calcium Acetate	U	B	B	A	A	U	A	U	B	B	U
Calcium Bisulfate	-	A	-	A	A	A	A	A	A	A	A
Calcium Bisulfide Solution	C	C	B	A	A	B	A	C	B	B	C
Calcium Carbonate	-	A	A	A	A	A	A	-	A	A	A
Calcium Carbonate Slurry	U	U	A	A	A	A	A	A	A	A	A
Calcium Chloride	B	B	A	A	A	A	A	A	A	A	A
Calcium Chloride, brine	U	B	A	A	A	A	A	A	A	A	A
Calcium Cyanide	-	-	A	A	A	-	A	-	A	A	A
Calcium Hydroxide Solution	U	B	A	A	A	A	A	A	A	A	A
Calcium Hypochlorite Solution	U	U	B	A	A	A	A	A	C	C	B
Calcium Nitrate	B	B	A	A	A	A	A	A	A	A	B
Calcium Oxide	U	A	-	A	A	A	A	A	A	A	B
Calcium Phosphate Slurry	U	U	B	A	A	A	A	A	A	A	A
Calcium Silikate	-	-	A	A	A	A	A	-	A	A	-
Calcium Sulfate	-	A	-	A	A	A	A	A	A	A	A
Calcium Sulfide	U	A	A	A	A	A	A	A	A	A	B
Calcium Sulfite	U	A	A	A	A	A	A	A	A	A	A
Calcium Thiosulfate	U	A	A	A	A	A	A	A	B	B	A
Caliche Solution (Sodium Nitrate)	U	B	B	A	A	A	A	A	B	B	B
Camphor	U	U	B	U	A	B	A	U	A	A	U
Camphor Oil	-	-	U	U	A	B	A	-	A	A	-
Cane Sugar Sap	U	-	-	A	A	A	A	A	A	A	A
Carbitol	-	U	B	B	A	B	A	B	B	B	B
Carbolic Acid (Phenol)	U	C	U	B	A	A	A	A	U	U	U
Carbolineum	U	U	-	B	A	A	A	U	B	B	U
Carbon Dioxide, dry	B	U	B	B	A	A	A	B	A	A	B
Carbon Dioxide, wet	U	U	B	B	A	A	A	B	A	A	B
Carbon Disulfide	U	U	U	U	A	A	A	C	U	U	U
Carbon Monoxide	A	A	B	A	A	B	A	B	A	A	A
Carbonic Acid	U	B	B	A	A	A	A	B	A	A	B
Carboxylic Acids	-	A	A	A	A	A	A	A	A	A	A
Casein	-	-	A	B	A	A	A	A	A	A	A
Castor Oil	A	A	A	B	A	A	A	A	A	A	A
Cellosolve (2-Etho-yethanol)	U	U	U	B	A	U	A	U	U	U	U
Cellulose Acetate	-	A	U	B	A	U	A	-	A	A	A
Chile Saltpeter (Sodium Nitrate)	U	B	B	A	A	A	A	A	B	B	B

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Chinawood Oil	-	C	B	U	A	A	A	A	A	A	U
Chloracetic Acid	U	U	U	A	A	U	A	B	U	U	U
Chloracetic Acid Ethyl Ester	U	U	U	U	A	A	A	B	U	U	U
Chloric Acid	U	U	U	B	A	B	A	U	U	U	U
Chloride of Lime	U	U	U	A	A	A	A	A	U	U	B
Chlorine Dioxide	U	-	U	C	B	A	A	B	U	U	-
Chlorine gas, anhydrous	-	-	C	A	A	A	A	-	C	C	-
Chlorine Water	U	U	U	B	A	A	A	U	U	U	U
Chlorine, liquid	U	U	U	B	A	A	A	C	U	U	U
Chloroacetaldehyde	U	U	U	A	B	U	A	C	U	U	U
Chloroacetone	B	U	U	A	A	U	B	U	U	U	U
Chloroamine	U	U	A	A	A	U	A	U	A	A	U
Chlorobenzene	U	U	U	U	A	B	A	B	U	U	U
Chlorobromomethane	U	U	U	B	A	B	A	B	U	U	U
Chlorobutadiene	U	U	U	U	A	B	A	B	U	U	U
Chloroform	U	U	U	U	A	B	A	C	U	U	U
Chloromethyl Ether	U	U	U	C	A	U	A	U	U	U	U
Chloronaphthalene	U	U	U	U	A	A	A	B	U	U	U
(o)-Chlorophenol	U	U	U	U	A	A	A	U	U	U	U
Chlorosulfonic Acid	U	U	U	C	A	U	A	U	U	U	U
Chlorothene	U	U	U	U	A	B	B	B	U	U	U
Chlorotoluene	U	U	U	U	A	A	A	B	U	U	U
Chrome Alum	U	-	A	A	A	A	A	-	A	A	A
Chromic Acid	U	U	U	C	A	A	A	C	U	U	C
Chromosulfuric Acid	U	U	U	U	A	A	A	U	U	U	U
Cider	U	U	B	A	A	B	A	A	A	A	B
CIP fluids, acidic**	U	U	U	A	A	B	A	U	U	U	U
CIP fluids, alkaline	U	U	U	A	A	U	A	U	U	U	U
Citric Acid	U	U	A	A	A	A	A	A	A	A	A
Citrous Oils	-	U	B	U	A	A	A	-	B	B	B
Coal Tar	-	U	-	U	A	B	A	A	B	B	B
Cobalt Chlorite	B	B	A	A	A	A	A	A	A	A	B
Coca-Cola	U	B	B	A	A	B	A	A	A	A	A
Cocoa Butter	-	B	B	U	A	A	A	B	A	A	C
Coconut Grease	A	B	B	U	A	A	A	A	A	A	A
Coconut Oil	A	A	B	U	A	A	A	A	A	A	A
Coconut, Fatty Acid	A	A	B	U	A	A	A	A	A	A	A
Cod-liver Oil	A	A	B	B	A	A	A	A	A	A	B
Coffee	U	U	A	A	A	A	A	A	A	A	A



Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Coffee Extract	U	U	A	A	A	A	A	A	A	A	A
Coke Oven Gas	U	U	U	U	A	A	A	B	U	U	B
Copper Acetate Solution	U	U	C	B	A	U	A	U	U	U	U
Copper Ammonium Acetate	U	U	C	A	A	U	A	U	U	U	U
Copper Chloride, Solution	U	B	B	A	A	A	A	A	A	A	A
Copper Cyanide	A	B	A	A	A	A	A	A	A	A	A
Copper Fluoride	U	-	B	A	A	A	A	U	B	B	U
Copper Nitrate	U	U	B	A	A	A	A	U	B	B	U
Copper Sulfate (Blue Vitriol) Solution	U	U	A	A	A	A	A	A	A	A	A
Corn Oil	B	A	B	U	A	A	A	A	A	A	B
Cotton Oil	A	A	C	C	A	A	A	A	A	A	A
Cottonseed Oil	A	A	B	U	A	A	A	A	A	A	B
Cresol	U	U	U	U	A	A	A	C	U	U	U
Crotonaldehyde	U	U	U	A	A	U	A	U	U	U	U
Crude Oil	-	U	U	U	A	A	A	A	B	B	U
Cumene	U	U	U	U	A	A	A	U	U	U	U
Cuprous Ammonia Acetate Solution	U	U	U	A	A	U	A	U	U	U	U
Cyanic Acid	U	-	B	A	A	A	A	B	B	B	-
Cyanic Acid Solution	U	-	B	A	A	A	A	B	B	B	-
Cyclohexane	B	A	C	U	A	A	A	A	A	A	U
Cyclohexanol	-	-	U	U	A	A	A	A	B	B	-
Cyclohexanone	U	U	U	U	A	U	B	U	U	U	U
Cyclohexylamine	U	U	U	C	A (J9503)	U	A	U	U	U	U
(p)-Cymene	U	U	U	U	A	A	A	B	U	U	U

D

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
DDT Solutions (Kerosene Solvent)	B	B	C	U	A	A	A	A	A	A	U
DDT Solutions (Toluene Solvent)	U	U	U	U	A	A	A	A	U	U	U
Decalin (Decahydronaphthalene)	B	U	U	U	A	A	A	A	U	U	U
Decane	A	U	U	U	A	A	A	A	A	A	B
Dextrin	U	U	A	A	A	A	A	A	A	A	A
Dextrose	B	B	-	A	A	A	A	A	A	A	A

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Di-Isobutyl Ketone	U	U	U	A	A	U	A	U	U	U	U
Di-Isobutylene	U	U	U	U	A	A	A	C	B	B	U
Di-Isooctyl Sebacate	U	U	U	B	A	B	A	U	U	U	U
Di-Isopropyl Benzene	U	U	U	U	A	A	A	A	U	U	U
Di-Isopropyl Ketone	U	U	U	A	A	U	A	U	U	U	U
Diacetone	-	B	-	A	A	U	A	U	-	-	-
Diacetone Alcohol	U	U	B	A	A	U	A	U	U	U	U
1,2-Diaminoethane	U	U	B	A	A (J9503)	U	A	U	B	B	U
Diamylamine	U	U	U	A	A (J9503)	U	A	U	U	U	U
Diazinone	-	-	U	U	A	B	A	B	U	U	U
Dibenzyl Sebacate	U	B	U	B	A	B	A	U	U	U	U
Dibenzylether	C	B	-	B	A	C	A	-	U	U	B
Dibromodifluoromethane	U	U	U	B	A	-	A	U	U	U	U
Dibromomethylbenzene	U	U	U	U	A	A	A	B	U	U	U
Dibutyl Ether	U	U	U	U	A	U	A	U	U	U	U
Dibutyl Phthalate	U	-	U	B	A	C	A	B	U	U	C
Dibutyl Sebacate	U	U	U	B	A	B	A	B	U	U	B
Dibutylamine	U	U	U	U	A (J9503)	U	A	U	U	U	U
Dichloro Acetic Acid	U	U	U	U	A	U	A	-	U	U	U
Dichloro Acetic Acid Methylester	U	U	U	A	A	U	A	U	U	U	U
Dichloro-iso-propylene ether	U	B	U	U	A	U	A	U	U	U	U
Dichlorobutane	U	U	U	U	A	A	A	B	B	B	U
Dichlorobutylene	U	U	U	U	A	B	A	U	U	U	U
Dichloroethane	U	U	U	U	A	B	B	U	U	U	U
Dichloroethylene	-	U	U	U	A	B	B	-	U	U	U
Dichloromethane	U	U	U	U	A	B	A	B	U	U	U
Dichloropentane	U	U	U	U	A	A	A	C	U	U	U
3,1-Dichloropropene	-	U	U	U	A	-	A	-	U	U	A
Dichlorobenzene	U	U	U	U	A	A	A	B	U	U	U
Dicyclohexylamine	U	U	U	U	A (J9503)	U	A	U	U	U	U
Diesel Fuel	U	B	U	U	A	A	A	A	A	A	U
Diesel Oil	B	A	U	U	A	A	A	A	A	A	U
Diethanolamine	U	U	U	B	A	U	A	U	U	U	U
Diethylamine	U	U	U	B	A (J9503)	U	A	U	U	U	B
Diethyl Aniline	U	U	U	A	A	U	A	U	U	U	U



Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Diethyl Benzene	U	U	U	U	A	A	A	A	U	U	U
Diethyl Carbonate	U	U	U	U	A	A	A	B	U	U	U
Diethyl Ether	U	B	U	B/C	A	U	A/B	U	U	U	U
Diethyl Formaldehyde	U	U	U	A	A	U	A	U	U	U	U
Diethyl Hydrazine	U	U	C	A	A	U	A	U	C	C	U
Diethyl Maleate	U	U	C	A	A	U	A	U	C	C	U
Diethyl Sebacate	U	U	U	B	A	B	A	B	U	U	B
Diethyl Sulfate	-	U	-	-	A	U	A	-	U	U	U
Diethylene Glycol	U	U	A	A	A	A	A	A	A	A	B
Diethylene Triamine	U	U	U	A	A (J9503)	U	A	U	U	U	U
Diglycolic Acid	U	-	B	A	A	A	A	U	U	U	U
Dihexyl Phthalic Acid Ester	U	-	U	-	A	U	A	-	U	U	U
Dihydroxy Tartaric Acid (Tartaric Acid)	U	U	A	B	A	A	A	A	A	A	A
1,4-Dihydroxybenzene	B	-	U	B	A	U	A	B	U	U	U
Dimethyl Amine	U	U	U	B	A (J9503)	U	A	U	U	U	U
Dimethyl Aniline	U	U	U	B	A	U	A	U	U	U	U
Dimethyl Ether	U	B	U	A	A	U	B	U	U	U	U
Dimethyl Formamide	U	U	U	A/B	A/B	U	B	U	U	U	U
Dimethyl Hydrazine	-	-	B	A	A	U	A	U	B	B	U
Dimethyl Ketone	U	U	U	A	A	U	A	U	U	U	U
Dimethyl Phenol	-	-	U	U	A	U	A	U	U	U	U
Dimethyl Phthalate	U	U	U	B	A	B	A	B	U	U	-
Dimethylbutane	A	-	B	U	A	A	A	A	A	A	U
Dinitro Toluene	U	U	U	U	A	U	A	U	U	U	U
Dinitrogen Oxide	A	A	A	B	A	A	A	A	A	A	A
Diocetyl Amine	U	U	U	A	A (J9503)	U	A	U	U	U	U
Diocetyl Phthalate	U	B	U	B	A	B	A	B	U	U	B
Diocetyl Sebacate	U	B	U	B	A	B	A	U	U	U	U
Dioxane	U	U	U	B	A	U	B	U	U	U	U
Dioxolane	-	U	U	B	A	U	A	U	U	U	U
Dipentene	U	U	U	U	A	A	A	U	B	B	U
Diphenyl	U	U	U	U	A	A	A	B	U	U	U
Diphenyl Ether	U	U	U	U	A	B	A	B	U	U	U
Diphenyl Oxide	-	U	-	U	A	A	A	B	U	U	U
Dipropylene Glycol	B	B	B	B	A	B	A	B	B	B	B
Dithionite	-	-	B	A	A	A	A	U	B	B	U
Divinylbenzene	U	U	U	U	A	A	A	B	U	U	U

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
DMT (Dimethyl Terephthalate)	U	U	U	A	A	A	A	B	U	U	U
DNCB (Dinitrochlorobenzene)	U	U	U	U	A	A	A	B	U	U	U
Dodecanol	-	-	A	B	A	A	A	-	B	B	-
Domestic Fuel Oils	A	A	B	U	A	A	A	A	A	A	U
Dowtherm A	U	U	U	U	A	A	A	B	U	U	U
Dowtherm E	U	U	U	U	A	A	A	B	U	U	U
Dodecanol (Lauryl Alcohol)	B	U	A	B	A	A	A	U	B	B	A

E

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Epichlorhydrin	U	U	U	B	A (19503)	U	A	U	U	U	U
Essential Oils	U	B	U	U	A	B	A	B	U	U	U
Ethane	A	B	B	U	A	A	A	A	A	A	B
Ethanol Amine	U	U	C	B	A (19503)	U	A	U	C	C	C
Ether	U	U	U	C	A	U	A	U	U	U	U
Ethyl Acetate	U	U	U	B/C	A	U	C	U	U	U	U
Ethyl Alcohol, Ethanol	U	U	A	A	A	U	A	A	A	A	B
Ethyl Benzene	U	U	U	U	A	B	A	B	U	U	U
Ethyl Bromide	U	U	U	U	A	A	A	A	B	B	U
Ethyl Cellulose	U	U	B	B	A	U	A	U	B	B	U
Ethylhexanol	U	U	A	A	A	A	A	A	A	A	B
Ethyl Oxalate	U	A	U	A	A	A	A	B	U	U	U
Ethyl Pentachlorobenzene	U	U	U	U	A	A	A	B	U	U	U
Ethyl Pyridine	U	U	U	A	A	C	A	U	U	U	U
Ethyl Sulfate (Diethyl Sulfate)	U	U	A	A	A	U	A	C	U	U	A
Ethylacrylate	U	U	U	-	A	U	A	U	U	U	U
Ethylchloride	U	U	B	B	A	B	A	A	U	U	U
Ethylchloroacetate	-	U	B	B	A	A	A	U	B	B	U
Ethylene	B	B	C	U	A	A	A	A	A	A	U
Ethylene Bromide	U	U	U	C	A	A	A	C	U	U	U
Ethylene Chloride	-	-	B	B	A	B	A	-	-	-	U
Ethylene Chlorohydrin	U	U	B	B	A	U	A	B	U	U	U



Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Ethylene Diamine	U	U	U	A	A (J9503)	U	B	U	U	U	U
Ethylene Dibromide	U	U	U	U	A	A	A	C	U	U	U
Ethylene Dichloride	U	U	U	U	A	A	A	C	U	U	U
Ethylene Glycol	C	B	B	A	A	A	A	A	A	A	C
Ethylene Glycol Ethylether (Cellosolve)	U	U	U	B	A	U	A	U	U	U	U
Ethylene Oxide	U	U	U	B	A (J9503)	U	A	U	U	U	U
Ethylene Silicate	-	B	A	A	A	A	A	A	A	A	-
Ethylene Trichloride	U	U	U	C	A	B	A	B	U	U	U

F

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Fats (animal/vegetable)	A	A	A	U	A	A	A	A	A	A	B
Fatty Acids	A	A	B	U	A	A	A	A	B	B	A
Ferric Chloride Solution	-	A	B	A	A	A	A	A	A	A	B
Ferric Nitrates	B	B	A	A	A	A	A	A	A	A	B
Ferric Sulfate (Ferric Vitrinol)	B	B	A	A	A	A	A	A	A	A	B
Ferric Sulfate Solution	-	A	A	A	A	A	A	A	A	A	B
Fir Oil	U	B	U	U	A	A	A	A	B	B	U
Fish Oil	A	B	B	U	A	A	A	A	A	A	A
Fluorine	U	-	-	U	B	U	U	U	U	U	U
Fluorobenzene	U	-	U	U	A	B	A	B	U	U	U
Fluorosilicic Acid	-	-	B	A	A	A	A	U	B	B	U
Formaldehyde (Formalin-Solution)	U	U	U	A	A	U	A	U	C	C	C
Formaldehyde (Methanal)	U	U	U	A	A	B	A	U	B	B	B
Formamide	-	U	U	A	A (J9503)	B	B	-	B	B	-
Formic Acid	U	U	B	B	A	U	A	U	U	U	U
Freon 11	-	U	U	U	B	B	B	B	A	A	U
Freon 112	-	B	B	U	A	B	B	B	B	B	U
Freon 113	-	B	A	U	B	B	B	U	A	A	U
Freon 114	-	A	A	A	B	B	B	B	A	A	U
Freon 114 B2	-	B	B	U	B	B	B	B	B	B	U
Freon 115	-	B	A	A	B	B	B	B	A	A	U

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Freon 12	-	B	A	B	B	B	B	U	B	B	U
Freon 13	-	B	A	A	B	B	B	U	A	A	U
Freon 13 B1	-	B	A	A	B	B	B	U	A	A	U
Freon 134 a	-	-	-	A	B	-	-	-	A	-	-
Freon 14	-	A	A	A	B	B	B	B	A	A	U
Freon 142 b	-	-	A	A	B	U	U	-	A	A	U
Freon 152 a	-	-	A	A	B	U	U	-	A	A	-
Freon 21	U	B	B	U	A	U	U	B	U	U	U
Freon 218	-	-	A	A	B	A	A	-	A	A	-
Freon 22	B	U	A	A	B	U	U	U	U	U	U
Freon 31	-	B	A	A	B	U	U	B	U	U	U
Freon 32	-	B	A	A	B	U	U	B	A	A	U
Freon 502	-	-	A	A	B	B	B	-	B	B	A
Freon BF	-	U	B	U	B	A	A	-	B	B	U
Freon C316	-	-	A	A	B	-	-	-	A	A	U
Freon C318	-	-	A	A	B	B	B	B	A	A	U
Freon MF	-	B	U	U	B	B	B	-	B	B	U
Freon PCA	-	A	A	U	B	B	B	-	A	A	U
Freon T-P35	-	A	A	A	B	A	A	-	A	A	A
Freon TA	-	A	A	A	B	U	U	-	A	A	A
Freon TC	-	A	A	B	B	A	A	-	A	A	U
Freon TF	-	A	A	U	B	A	A	U	A	A	U
Freon TMC	-	B	B	B	B	A	A	-	B	B	U
Freon TWD602	-	A	B	A	B	A	A	U	B	B	-
Fruit Juices	U	U	B	A	B	B	B	A	B	B	A
Fumaric Acid	U	-	B	-	A	A	A	A	A	A	B
Furan	U	U	U	U	A	U	U	U	U	U	U
Furfural (Furfuryl Aldehyde)	-	C	-	-	A	-	A	-	C	C	-
Furfuryl Alcohol	-	C	-	-	A	-	A	-	-	-	-

Chemical Compatibility Guide

G

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Gallic Acid	U	U	B	B	A	A	A	A	A	A	A
Gas Oil	A	A	B	U	A	A	A	A	A	A	B
Gasoline/Alcohol Mix	U	U	U	U	A	B	A	U	B	B	U
Gasoline, 100 Octane	U	B	U	U	A	A	A	A	A	A	U
Gasoline, 130 Octane	U	B	U	U	A	A	A	A	A	A	U
Gasoline, aromatic	U	A	U	U	A	A	A	A	A	A	U
Gasoline, Ethyl and Regular	U	B	U	U	A	A	A	A	A	A	U
Gasoline, Refined	U	B	U	U	A	A	A	A	A	A	U
Gasoline, Sour	U	B	U	U	A	A	A	A	A	A	U
Gasoline, with Mercaptan	U	B	U	U	A	A	A	A	A	A	U
Gelatin	U	U	A	A	A	A	A	A	A	A	A
Generator Gas	B	A	B	U	A	A	A	B	A	A	B
Glauber's Salt	U	U	B	A	A	B	A	B	B	B	B
Glucose solution	U	U	A	A	A	A	A	A	A	A	A
Glucose, aqueous	C	A	A	A	A	A	A	A	A	A	A
Glycerin (Glycerol)	U	U	A	A	A	A	A	A	A	A	A
Glycerol	U	U	A	A	A	A	A	A	A	A	A
Glycerol Chlorohydrin	-	-	U	B	A	B	A	-	U	U	-
Glycerol Triacetate (Triacetin)	U	U	B	A	A	U	A	U	B	B	B
Glycerol Trinitrate (Nitroglycerin)	U	U	B	A	A	A	A	U	U	U	U
Glycine	U	U	A	A	A	A	A	U	B	B	U
Glycolic Acid	U	U	B	A	A	B	A	A	A	A	A

H

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
HEF-3	U	U	U	U	A	A	A	B	B	B	U
Helium Gas	A	A	A	A	A	A	A	A	A	A	A
Heptane	A	B	B	U	A	A	A	A	A	A	C
Hexachloro Acetone	U	U	U	A	A	U	A	U	U	U	U
Hexachloro Butadiene	U	B	U	U	A	A	A	U	U	U	U
Hexachloro Cyclohexane (Lindane)	U	B	U	U	A	A	A	U	-	-	U

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
1-Hexadecanol	-	-	A	A	A	-	A	-	A	A	-
Hexafluorosilicic Acid	U	U	B	B	A	A/B	A	-	B	B	U
Hexaldehyde	-	U	B	A	A	U	A	U	U	U	B
Hexalin (Cyclohexanol)	-	-	B	U	A	A	A	A	A	A	U
Hexamine	U	U	U	A	A	U	A	U	U	U	U
Hexanal (Caproaldehyde)	U	U	-	B	A	U	A	U	-	-	B
Hexane	A	B	B	U	A	A	A	A	A	A	C
Hexanetriol	B	U	B	A	A	A	A	A	A	A	A
Hexene	A	B	B	U	A	A	A	A	B	B	U
Hexyl Alcohol	U	U	B	B	A	A	A	B	A	A	B
Hydrazine	C	U	B	A	A (I9503)	C	A	B	B	B	U
Hydrazine Hydrate	C	U	B	A	A (I9503)	C	A	B	B	B	U
Hydrobromic Acid	U	U	U	A	A	A	A	C	U	U	U
Hydrochloric Acid (Muriatic Acid) 37%	U	U	U	B	A	A	A	U	U	U	U
Hydrocyanic Acid	U	-	B	A	A	A	A	B	B	B	-
Hydrofluoric Acid (cold)	U	U	U	B	A	B	A	U	U	U	U
Hydrofluoric Acid (hot)	U	U	-	U	A	U	B	U	U	U	U
Hydrogen Chloride Gas	-	-	C	A	A	A	A	U	U	U	U
Hydrogen Fluoride	U	U	U	A/B	A	-	A/B	U	U	U	U
Hydrogen Peroxide, concentrated	U	U	U	U	A	A - C	B	B	U	U	B
Hydrogen Sulfide	U	U	U	C	A	U	A	U	U	U	U
Hydrogen, Gas	B	A	A	A	A	A	A	C	A	A	C
Hydrogen Bromide, anhydrous	U	U	U	U	A	A	A	U	U	U	B
Hydrogensulfite Leach	B	U	B	A	A	A	A	-	U	U	-
Hydroquinone	B	-	U	B	A	U	A	B	U	U	U
Hydroxy Acetic Acid	U	U	U	A	A	U	A	U	U	U	B
Hydroxylamine	-	-	-	A	A	A	A	A	A	A	A
Hydroxylamine Sulfate	-	-	B	A	A	A	A	A	A	A	A
Hypochlorous Acid	U	-	U	B	A	A	A	-	U	U	-

Chemical Compatibility Guide

I

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Ink	A	A	A	A	A	B	A	A	A	A	A
Iodine	-	-	U	B	A	A	A	A	B	B	-
Iodine tincture	U	U	B	B	A	A	A	B	B	B	B
Iodoform	-	-	-	A	A	A	A	-	-	-	-
Iso-Butane	A	A	U	U	A	A	A	A	A	A	U
Iso-Butyl Alcohol	U	U	A	A	A	B	A	A	B	B	A
Iso-Butyl Methyl Ketone	U	U	U	A	A	U	B	U	U	U	U
Iso-Butylene	U	U	U	U	A	A	A	A	A	A	U
Iso-Butyraldehyde	U	U	U	A	A	U	A	U	U	U	U
Iso-Cyanate	-	-	-	A	A	-	A	-	-	-	-
Iso-Dodecane	U	U	B	U	A	A	A	A	A	A	U
Iso-Octane	A	B	B	U	A	A	A	A	A	A	U
Iso-Pentane	A	B	U	U	A	A	A	A	A	A	U
Iso-Propyl-Acetate	U	U	U	B	A	U	B	U	U	U	U
Iso-Propyl-Alcohol	U	U	B	A	A	A	A	A	B	B	A
Iso-Propyl-Benzene	U	U	U	U	A	A	A	B	U	U	U
Iso-Propyl-Chloride	U	U	U	U	A	A	A	B	U	U	U
Iso-Propyl-Ether	U	U	U	A	A	U	A/B	U	U	U	U

J

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Jet Fuel JP3	B	B	U	U	A	A	A	A	A	A	U
Jet Fuel JP4	B	B	U	U	A	A	A	B	A	A	U
Jet Fuel JP5	B	B	U	U	A	A	A	B	A	A	U
Jet Fuel JP6	B	B	U	U	A	A	A	B	A	A	U
JP3 (Fuel)	U	B	U	U	A	A	A	A	A	A	U
JP4 (Fuel)	U	B	U	U	A	A	A	B	A	A	U
JP5 (Fuel)	U	B	U	U	A	A	A	B	A	A	U
JP6 (Fuel)	B	B	U	U	A	A	A	B	A	A	U
JPX (Fuel)	-	-	B	U	A	U	A	U	A	A	U

Chemical Compatibility Guide

K

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Kerosene	C	B	U	U	A	A	A	B	A	A	U
Ketchup	U	B	A	A	A	A	A	A	A	A	A

L

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Lactams	U	U	C	U	A	U	A	U	U	U	U
Lactic Acid	U	B	A	B	A	A	A	A	B	B	B
Lanolin	A	A	B	U	A	A	A	A	A	A	B
Latex	U	U	A	A	A	A	A	A	A	A	A
Laughing Gas (N2O)	A	A	A	B	A	A	A	A	A	A	A
Lavender Oil	B	U	U	U	A	A	A	B	B	B	U
Lead Acetate Salt Solution	U	U	U	A	A	U	A	U	C	C	U
Lead Arsenate	-	A	-	A	A	-	A	-	A	A	A
Lead Nitrate	-	U	B	A	A	A	A	A	A	A	B
Lead Nitrate Solution	-	-	A	A	A	-	A	A	A	A	B
Lead Sulfate	U	A	A	A	A	A	A	A	B	B	B
Lemon Juice	U	-	B	A	A	A	A	-	A	A	A
Ligroin	-	B	B	U	A	A	A	A	A	A	U
Lindol	U	U	U	A	A	U	A	C	U	U	C
Linoleic Acid	-	B	-	U	A	A	A	-	B	B	B
Linseed Oil	B	B	B	C	A	A	A	B	A	A	B
Liqueurs	B	B	A	A	A	A	A	A	A	A	A
Lithium Bromide Brine	U	U	A	A	A	A	A	A	A	A	A
Lithium Chloride	U	U	A	A	A	A	A	A	A	A	A
Lithium Hydroxide	U	U	U	A	A	-	A/B	U	U	U	U



Chemical Compatibility Guide

M

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Machinery Oil (mineral)	A	A	B	U	A	A	A	A	A	A	B
Magnesium Acetate Solution	U	U	U	A	A	U	A	U	U	U	U
Magnesium Chloride Solution	-	U	A	A	A	A	A	A	A	A	A
Magnesium Hydroxide (Solution)	U	U	B	A	A	B	A	B	B	B	B
Magnesium Silicate (Talcum)	A	A	A	A	A	A	A	A	A	A	A
Magnesium Sulfate (Epson Salts)	U	U	A	A	A	A	A	A	A	A	A
Maleic Acid	C	C	B	A	A	A	A	B	B	B	C
Maleic Anhydride	U	-	U	U	A	B	A	-	U	U	-
Malic Acid	U	U	B	B	A	A	A	A	A	A	B
Manganese Chloride (Solution)	U	U	A	A	A	A	A	A	A	A	A
Margarine	A	B	B	U	A	A	A	A	A	A	B
Mayonnaise	-	U	U	U	A	U	A	U	A	A	A
Menthol	U	U	B	B	A	A	A	U	B	B	U
Mercaptans	U	U	U	A	A	U	A	U	U	U	U
Mercuric Chloride Solution	-	-	A	A	A	A	A	A	A	A	A
Mercury	A	A	A	A	A	A	A	A	A	A	A
Mercury Nitrate	-	-	A	A	A	-	A	-	A	A	A
Mesityl Oxide	U	U	U	A	A	U	A	U	U	U	U
Methacrylic Acid	U	U	U	B	A	U	A	U	U	U	U
Methanal	U	U	U	A	A	B	A	U	B	B	B
Methane	B	U	B	U	A	A	A	C	A	A	U
Methanol	U	U	B	A	A	U	A	A	B	B	A
Methoxy Benzene	U	U	U	U	A	U	A	U	U	U	U
Methoxy Butanol	-	-	B	B	A	A	A	-	A	A	-
Methyl Acetate	U	U	B/C	A	A	U	C	U	U	U	U
Methyl Acetoacetate	U	U	U	A	A	U	B	U	U	U	B
Methyl Acrylate	U	U	U	B	A	U	B	U	U	U	U
Methyl Alcohol	U	U	B	A	A	U	A	A	B	B	A
Methyl Amine	U	U	U	A	A (J9503)	U	A	U	U	U	U
Methyl Aniline	U	U	U	B	A	B	A	-	U	U	-
Methyl Bromide	U	U	U	U	A	A	A	A	U	U	U
Methyl Butyl Ketone	U	U	U	A	A	U	B	U	U	U	U
Methyl Carbonate	U	U	U	U	A	U	A	B	U	U	U
Methyl Cellosolve	U	U	U	B	A	U	A	U	U	U	U
Methyl Cellulose	U	B	B	B	A	B	A	U	B	B	B
Methyl Chloride	U	U	U	B	A	B	A	B	U	U	U

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Methyl Cyclopentane	U	U	U	U	A	B	A	B	U	U	U
Methyl Ethyl Ketone	U	U	U	B	A	U	B	U	U	U	U
Methyl Formate	-	-	U	B	A	U	B	-	U	U	-
Methyl Glycol	U	U	U	B	A	U	A	U	U	U	U
Methyl Glycol Acetate (Ethylene Glycol)	U	U	U	B	A	U	A	-	U	U	B
Methyl Iso-Butyl Ketone	U	U	U	B	A	U	A	U	U	U	U
Methyl Iso-Propyl Ketone	U	U	U	A	A	U	A	U	U	U	U
Methyl Methacrylate	U	U	U	U	A	U	A	U	U	U	U
Methyl Methacrylic Acid Ester	U	U	U	U	A	U	A	U	U	U	U
Methyl Oleate	-	-	-	B	A	A	A	B	U	U	-
Methyl Phenyl Ether (Anisole)	U	U	U	U	A	U	A	U	U	U	U
Methyl Pyrrolidone	-	U	-	A	A	U	A	-	U	U	B
Methyl Salicylate	-	-	U	B	A	-	A	-	U	U	-
Methylene Chloride	U	U	U	B	A	B	A	C	U	U	U
2-Methylpentane	A	U	-	U	A	A	A	U	A	A	U
3-Methylpentane	A	U	-	U	A	A	A	U	A	A	U
Milk	U	B	A	A	A	A	A	A	A	A	A
Milk of Lime	U	U	B	A	A	B	A	B	U	U	B
Mineral Oil	A	A	B	U	A	A	A	A	A/B	A/B	B
Mineral Spirits	C	B	C	U	A	A	A	A	A	A	U
Molasses	U	U	B	A	A	A	A	A	A	A	A
Monobromobenzene	U	U	U	U	A	B	A	U	U	U	U
Monochloroacetic Acid	U	U	U	A	A	U	A	U	U	U	U
Monochloroacetic Acid Ethyl Ester	U	U	U	B	A	U	A	U	U	U	U
Monochlorobenzene	U	U	U	U	A	B	A	B	U	U	U
Monoethanol Amine	U	U	U	B	A (19503)	U	A	U	U	U	U
Mononitrochlorobenzene	U	U	U	U	A	A	A	A	U	U	U
Morpholine	U	U	C	B	A	-	A	-	U	U	U
Muriatic Acid (HCl) (Hydrochloric Acid)	U	U	-	B	A	A	A	-	U	U	U
Muriatic Acid (HCl), diluted	U	U	B	A	A	A	A	-	B	B	B



Chemical Compatibility Guide

N

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Naphtha	B	B	U	U	A	A	A	B	U	U	U
Naphthalene	U	U	U	U	A	A	A	B	U	U	U
Naphthenic Acid	-	-	U	U	A	A	A	A	B	B	-
Naphtolen ZD	U	-	U	U	A	A	A	-	B	B	U
Natural Gas	A	B	B	U	A	A	A	A	A	A	A
Neats Foot Oil	A	A	U	B	A	A	A	A	A	A	B
Neon Gas	A	A	A	A	A	A	A	A	A	A	A
Nickel Acetate	U	U	B	A	A	U	A	U	B	B	U
Nickel Chloride	C	C	B	A	A	A	A	A	A	A	A
Nickel Nitrate	-	-	A	A	A	A	A	-	A	A	A
Nickel Sulfate	U	C	A	A	A	A	A	A	A	A	A
Nitrating Acids	U	U	U	A	A	U	A	U	U	U	U
Nitric Acid, concentrated	U	U	U	U	A	B	A	U	U	U	U
Nitric Acid, fuming	U	U	U	U	A	B	A	U	U	U	U
Nitro Benzene	U	U	U	U	A	U	A	U	U	U	U
Nitro Glycerin	U	U	C	A	A	A	A	U	U	U	U
Nitro Glycol	U	U	B	A	A	A	A	U	U	U	U
Nitro Methane	U	U	U	B	A	U	A	U	U	U	U
Nitro Propane	U	U	U	B	A	U	A	U	U	U	U
Nitro Toluene	U	U	U	U	A	U	A	U	U	U	U
Nitrogen Gas	A	A	A	A	A	A	A	A	A	A	A
Nitrogen Tetroxide	U	U	U	U	-	U	A	U	U	U	U
Nonanol	-	U	-	A	A	A	A	-	U	U	B
Nut Oil	A	B	B	U	A	A	A	A	A	A	B

O

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Octadecane	B	B	B	U	A	A	A	A	A	A	U
Octal	U	B	U	B	A	B	A	C	U	U	C
Octane	U	U	U	U	A	A	A	B	B	B	U
Octanol (Octyl Alcohol)	U	U	B	A	A	A	A	B	B	B	B

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Octyl Alcohol	U	U	B	B	A	A	A	B	B	B	B
Octyl Cresol	U	U	U	U	A	B	A	U	C	C	U
Oil of Turpentine	U	U	U	U	A	A	A	B	B	B	U
Olefin, crude	A	A	U	U	A	A	A	A	A	A	U
Oleic Acid	-	-	U	U	A	A	A	-	A	A	U
Oleic Alcohol	U	U	A	A	A	A	A	U	A	A	U
Oleum (Sulfuric Acid, 0 to 50%)	U	U	U	A	A	A	A	U	U	U	U
Olive Oil	A	U	B	U	A	A	A	B	A	A	B
Ortho Dichloro Benzene	U	U	U	U	A	A	A	B	U	U	U
Oxalic Acid	-	-	B	A	A	A	A	A	B	B	B
Ozone	B	A	B	A/B	A	A	A	A	B/C	U	A

P

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Palm Kernel Oil	A	-	A	U	A	A	A	-	A	A	-
Palm Oil	A	A	U	U	A	A	A	A	A	A	U
Palmitic Acid	U	B	B	C	A	A	A	A	B	B	U
Para Dichloro Benzene	U	U	-	U	A	A	A	B	U	U	U
Paraffin	A	B	A	U	A	A	A	A	A	A	B
Paraffin Oil	A	B	A	U	A	A	A	A	A	A	B
Peanut Oil	A	A	U	U	A	A	A	A	A	A	B
Pectin	A	A	A	A	A	A	A	A	A	A	A
Penta Chloro Diphenyl	U	U	U	U	A	C	A	U	U	U	U
Penta Chloro Phenol	-	U	-	B	A	-	A	-	U	U	U
Pentane	A	U	B	U	A	A	A	U	A	A	U
Pentanol	U	U	A	A	A	B	A	A	B	B	U
Perchloric Acid	U	U	B	B	A	A	A	C	U	U	U
Perchloro Ethylene	U	U	U	U	A	B	A	B	U	U	U
Petroleum	B	B	B	U	A	A	A	B	A	A	B
Petroleum Ether	A	B	B	U	A	A	A	B	A	A	U
Phenol	C	U	U	U	A	B	A	-	U	U	U
Phenyl Benzene	-	U	U	U	A	B	A	-	U	U	-
Phenyl Ether	U	U	U	U	A	U	A	U	U	U	U



Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Phenyl Hydrazine	U	U	U	U	A (J9503)	B	A	U	U	U	U
Phosphine	U	U	B	A	A	B	A	U	U	U	-
Phosphoric Acid	-	U	U	B	A	A	A	C	U	U	C
Phosphoric Acid 45%	C	U	B	A	A	A	A	A	B	B	B
Phosphorous Trichloride	U	U	U	A	A	A	A	-	U	U	U
Photographic Developing Bath	-	B	A	B	A	A	A	A	A	A	A
Phthalic Acid	-	-	B	A	A	B	A	-	B	B	A
Phthalic Anhydride	-	-	-	A	A	-	A	-	-	-	-
Picoline, alpha	-	-	-	A	A	U	A	-	-	-	-
Picric Acid, Aqueous Solution	-	B	A	B	A	A	A	B	B	B	-
Pine Oil	A	A	U	U	A	A	A	A	B	B	U
Pineapple Juice	U	U	A	A	A	A	A	A	A	A	A
Pinene	U	B	B	U	A	A	A	B	B	B	U
Piperidine	U	U	U	U	A	U	A	U	U	U	U
Polyvinyl Acetates	-	-	B	A	A	U	A	-	-	-	-
Potassium Acetate	U	B	B	A	A	B	A	U	B	B	U
Potassium Aluminium Sulfate	-	-	-	A	A	-	A	-	-	-	-
Potassium Bicarbonate	U	U	A	A	A	A	A	A	A	A	B
Potassium Bisulfate	U	U	B	A	A	A	A	B	A	A	B
Potassium Borate	C	U	B	A	A	A	A	B	A	A	B
Potassium Bromate	C	U	B	A	A	A	A	B	A	A	B
Potassium Bromide	U	U	B	A	A	A	A	A	A	A	A
Potassium Carbonate	C	U	B	A	A	A	A	A	A	A	A
Potassium Chlorate	U	U	B	A	A	A	A	-	U	U	-
Potassium Chloride	C	C	B	A	A	A	A	A	A	A	A
Potassium Chromate	U	U	B	A	A	A	A	-	B	B	-
Potassium Cyanide	U	U	B	A	A	A	A	A	A	A	A
Potassium Dichromate	U	C	B	A	A	A	A	U	A	A	B
Potassium Hydroxide (Solution 50%)	U	U	B	A	A	C	A	C	B	B	C
Potassium Hydroxide, Potassium Lye	U	U	B	A	A	U	A	U	B	B	U
Potassium Hypochlorite (Javelle water)	U	U	-	B	A	A	A	B	B	B	B
Potassium Iodide	U	U	B	A	A	A	A	A	A	A	A
Potassium Nitrate	C	C	B	A	A	A	A	A	B	B	A
Potassium Perchlorate	U	U	B	A	A	A	A	-	U	U	-
Potassium Perfluoroacetate	-	-	B	A	A	U	A	U	B	B	-
Potassium Permanganate	C	B	B	A	A	A	A	U	U	U	U
Potassium Persulfate	U	U	B	A	A	A	A	U	U	U	U
Potassium Phosphate	-	-	-	A	A	A	A	-	A	A	U

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Potassium Sulfate	U	C	B	A	A	A	A	B	A	A	B
Potassium Sulfite	U	C	A	A	A	A	A	A	A	A	A
Propane	B	B	B	U	A	A	A	B	A	A	U
Propanol	U	U	A	A	A	A	A	A	B	B	B
2-Propanone (Acetone)	U	U	U	A	A	U	B	U	U	U	U
2-Propene-1-ol	U	U	A	A	A	A	A	U	B	B	U
Propinyl Alcohol	U	-	A	A	A	A	A	-	A	A	-
Propion Aldehyde	U	U	U	A	A	U	A	U	U	U	U
Propionic Acid	C	U	B	B	A	A	A	U	A	A	U
Propyl Acetate	U	U	U	B	A	U	B	U	U	U	U
Propyl Acetone	U	U	U	A	A	U	A	U	U	U	U
Propyl Amine	U	U	U	U	A (J9503)	U	A	U	U	U	U
Propyl Nitrate	U	U	U	A	A	U	A	U	U	U	U
Propylene	U	U	U	U	A	A	A	B	U	U	U
Propylene Dichloride	-	-	-	U	A	-	A	-	U	U	U
Propylene Glycol	U	U	A	A	A	A	A	-	A	A	-
Propylene Oxide	U	U	U	B	A (J9503)	U	A	U	U	U	U
Pyridine	U	U	U	B	A	B	A	U	U	U	U
Pyrrrole	U	U	U	U	A	U	A	B	U	U	B

R

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Rapeseed Oil	B	B	B	U	A	A	A	B	B	B	U
Roast Gas (dry)	A	-	B	A	A	A	A	A	A	A	A
Rosin (Colophony)	U	U	A	A	A	A	A	A	A	A	A

Chemical Compatibility Guide

S

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Salicylic Acid	-	A	A	A	A	A	A	-	B	B	-
Sea Water	U	U	B	A	A	B	A	A	A	A	B
Sewage	-	-	B	A	A	A	A	A	A	A	A
Silicone grease	A	A	A	A	A	A	A	A	A	A	U
Silicic Acid	U	-	B	A	A	A	A	-	A	A	-
Silicon Dioxide	-	A	-	A	A	A	A	-	A	A	A
Silicone Oil	A	A	A	A	A	A	A	A	A	A	U
Silver Cyanide Solution	U	U	A	U	A	A	A	A	U	U	U
Silver Nitrate	B	-	B	A	A	A	A	A	B	B	A
Silver Salts	U	U	A	A	A	A	A	A	A	A	A
Skydrol 500	U	U	U	A	A	U	A	U	U	U	U
Skydrol 7000	U	U	U	A	A	B	A	U	U	U	U
Soap Solution	B	B	B	A	A	A	A	A	A	A	A
Soda (Natrium Carbonate)	U	U	A	A	A	A	A	A	A	A	A
Sodium Acetate	U	U	B	A	A	U	A	U	B	B	B
Sodium Benzoate	U	U	B	A	A	A	A	A	A	A	A
Sodium Bicarbonate Solution	U	U	A	A	A	A	A	A	A	A	A
Sodium Bisulfate Solution	U	U	A	A	A	A	A	A	A	A	A
Sodium Bisulfite Solution	U	U	A	A	A	A	A	A	A	A	A
Sodium Borate (Borax)	U	U	A	A	A	A	A	A	B	B	A
Sodium Carbonate (Soda Ash)	U	U	A	A	A	A	A	A	A	A	A
Sodium Carbonate Solution	-	-	A	A	A	A	A	A	A	A	A
Sodium Chlorate	U	B	B	A	A	A	A	U	B	B	U
Sodium Chloride (Common Salt)	U	U	A	A	A	A	A	A	A	A	A
Sodium Chloride Solution	-	-	A	A	A	A	A	-	A	A	-
Sodium Chlorite	-	-	U	A	A	A	A	-	U	U	-
Sodium Cyanide Solution	-	-	A	A	A	-	A	-	B	B	A
Sodium Dichromate	U	U	A	A	A	A	A	-	B	B	B
Sodium Fluoride	-	B	-	A	A	A	A	-	A	A	B
Sodium Hydroxide	C	C	B	A	A	C	A	C	B	B	C
Sodium Hydroxide, Caustic Soda	B	B	B	A	A	B	A	B	B	B	A
Sodium Hypochlorite Solution	U	U	B	A	A	A	A	B	B	B	B
Sodium Nitrate	U	U	B	A	A	A	A	A	B	B	B
Sodium Nitrite	U	U	B	A	A	A	A	U	U	U	U
Sodium Peroxide Solution	U	U	B	A	A	A	A	A	B	B	U
Sodium Phosphate	-	-	B	A	A	A	A	-	A	A	U

Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Sodium Silicate Solution	-	-	A	A	A	A	A	-	A	A	-
Sodium Sulfate (Glauber's Salt) Solution	U	U	B	A	A	B	A	B	B	B	B
Sodium Sulfhydrate Solution	U	-	A	A	A	A	A	A	A	A	A
Sodium Sulfide	U	U	B	A	A	A	A	A	B	B	B
Sodium Sulfite Solution	U	U	A	A	A	A	A	A	A	A	A
Sodium Tetraborate Solution	U	-	B	A	A	A	A	A	B	B	B
Sodium Thiosulfate (Antichlor)	-	-	A	A		A	A	-	B	B	-
Soy Bean Oil	B	B	B	U	A	A	A	A	A	A	B
Sperm Oil	-	-	-	B	A	A	A	-	A	A	-
Spermacetin	U	U	B	U	A	A	A	U	A	A	U
Spirits	B	B	A	A	A	A	A	B	A	A	A
Stannic Chloride Solution	-	-	U	A	A	A	A	A	A	A	B
Starch	B	B	A	A	A	A	A	A	A	A	A
Stearic Acid	A	A	B	B	A	A	A	A	B	B	B
Stoddard Solvent	A	A	B	U	A	A	A	A	A	A	U
Styrene	U	U	U	U	*	A	A	C	U	U	U
Succinic Acid	U	U	B	A	A	A	A	-	A	A	A
Sucrose Sap	U	U	B	A	A	A	A	A	A	A	A
Sugar Solutions	U	U	B	A	A	A	A	A	A	A	A
Sulfur	U	-	A	A	A	A	A	B	U	U	B
Sulfur Chloride	U	U	U	U	A	A	A	B	U	U	U
Sulfur Dioxide (SO2)	U	U	U	A	A	B	A	B	U	U	B
Sulfur Dioxide Liquid (anhydrous)	U	-	U	A	A	U	A	B	U	U	B
Sulfur Dioxide, gaseous	U	-	U	A	A	U	A	B	U	U	B
Sulfur Hexafluoride (SF6)	B	-	A	A	A	B	A	B	B	B	-
Sulfuric Acid (0 to 50%)	U	U	U	A/B	A	A/B	A	U	U	U	U
Sulfuric Acid, diluted	U	U	U	A	A	A	A	U	B	B	U
Sulfurous Acid	U	U	-	B	A	A	A	-	-	-	U

T

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Talcum	A	A	A	A	A	A	A	A	A	A	A
Tallow	U	B	B	B	A	A	A	U	A	A	B



Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Tannins	U	B	B	B	A	A	A	A	B	B	B
Tar	U	U	U	U	A	B	A	C	U	U	-
Tartaric Acid	U	U	B	B	A	A	A	A	A	A	A
Tetrachloroethane	U	U	U	U	A	B	A	C	U	U	U
Tetrachloromethane	-	U	U	U	A	A	A	B	U	U	U
Tetrachoroethylene	U	U	U	U	A	A	A	B	U	U	U
Tetraethyl Lead	-	U	U	U	A	A	A	B	B	B	U
Tetrahydrofuran	U	U	U	U	A	U	C	U	U	U	U
Thionyl Chloride	U	U	U	B	A	A	A	U	U	U	U
Thiophene	U	U	U	U	A	U	A	U	U	U	U
Titanium Tetrachloride	U	U	B	B	A	B	A	B	B	B	U
Toluene (Toluol)	U	U	U	U	A	B	A	B	U	U	U
Town Gas	U	U	U	U	A	A	A	B	B	B	B
Transformer Oil	B	A	U	U	A	A	A	A	B	B	B
Tri-Iso-Propyl Benzene	A	A	U	U	A	A	A	-	A	A	U
Triacetin (Glycerine Triacetate)	U	U	B	A	A	U	A	U	B	B	B
Triaryl Phosphate	U	U	U	A	A	A	A	B	U	U	U
Tributoxy Ethyl Phosphate	B	-	B	B	A	B	A	-	U	U	U
Tributyl Marcaptane	U	-	U	U	A	A	A	U	U	U	U
Tributyl Phosphate	U	U	U	B	A	U	A	U	U	U	U
Trichloro Benzene	U	U	U	U	A	A	A	U	-	-	U
Trichloro Ethane	U	U	U	B/C	A	A	A	B	U	U	U
Trichloro Ethyl Phosphate	-	-	U	-	A	U	A	-	U	U	-
Trichloro Ethylene	U	U	U	B/C	A	B	A	B	U	U	U
Trichloroacetic Acid	U	U	U	B	A (J8325)	U	A	U	B	B	B
Tricresyl Phosphate	U	U	U	B	A	B	A	B	U	U	U
Triethanolamine	U	U	-	A	A	-	A	-	-	-	U
Triethyl Borane	-	-	-	-	A	A	A	-	-	-	-
Triethyl Glycol	C	-	-	A	A	A	A	-	A	A	A
Triethylaluminium	-	-	-	U	A	B	A	-	-	-	-
Trifluoro Ethane	U	U	U	U	A	A	A	B	U	U	U
Trinitrotoluene (TNT)	U	B	B	U	A	B	A	B	U	U	-
Trioctyl Phosphate	U	U	U	A	A	B	A	B	U	U	U
Trisodium Phosphate Solution	C	B	B	A	A	A	A	A	A	A	A
Turpentine	B	C	U	U	A	A	A	A	A	A	U

Chemical Compatibility Guide

U

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Urea	B	U	B	A	A	A	A	A	A	A	A

V

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Vaseline	B	B	B	U	A	A	A	A	A	A	B
Vaseline Oil	U	U	B	U	A	A	A	B	A	A	B
Vegetable Juices	U	U	B	A	A	A	A	A	A	A	A
Vegetable Oils	B	-	B	U	A	A	A	A	A	A	B
Vinegar	U	U	B	A	A	B	A	B	B	B	A
Vinyl Acetate	-	-	-	-	A	-	A	-	-	-	-
Vinyl Chloride, liquid	-	-	-	-	A	-	A	-	-	-	-
Vinylidene Chloride	U	U	U	U	A	B	A	U	U	U	U

W

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Waste Gas (cont. Carbon Dioxide)	A	-	A	A	A	A	A	A	A	A	A
Waste Gas (cont. Carbon Monoxide)	A	A	A	A	A	A	A	A	A	A	A
Waste Gas (cont. Hydrogen Chloride)	-	-	A	A	A	A	A	-	B	B	-
Waste Gas (cont. Hydrogen Fluoride)	-	-	A	A	A	A	A	-	A	A	A
Waste Gas (cont. Nitrous Fumes)	U	-	A	A	A	A	A	B	-	-	U
Waste Gas (cont. Sulfur Dioxide)	-	-	A	A	A	A	A	-	B	B	-
Waste Gas (cont. Sulfuric Acid)	-	-	B	A	A	A	A	-	U	U	-
Water steam < +150 °C/+302 °F	U	U	U	A	A	U	A	B	U	U	B
Water steam > +150 °C/+302 °F	U	U	U	B	A	U	B	U	U	U	U
Water to +80 °C/+176 °F	U	U	B	A	A	B	A	A	A	B	B
Water to +135 °C/+275 °F	U	U	C	A	A	C	A	A	C	U	U



Chemical Compatibility Guide

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Water vapor < +140 °C/+284 °F	U	U	U	A	A	U	A	B	C	U	B
Water vapor > +140 °C/+284 °F	U	U	U	B	A	U	A	B	U	U	B
Wax Alcohols	A	-	B	U	A	A	A	-	A	A	A
Wine + Whiskey	U	U	A	A	A	A	A	A	A	A	A
Wood Spirit	U	U	U	B	A	U	A	U	U	U	-

X

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Xenon	A	A	A	A	A	A	A	A	A	A	A
Xylene (Xylol)	U	U	U	U	A	B	A	U	U	U	U
Xylidines (aromatic Amines)	U	U	U	B	A	U	A	U	U	U	U

Y

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Yeast	B	U	A	A	A	A	A	A	A	A	A

Z

Chemical	ACM	AU	CR	EPDM	FFKM (Isolast®)	FKM	FKM Resifluor™ 500	FVMQ	HNBR	NBR	VMQ
Zeolites	-	-	A	A	A	A	A	-	A	A	-
Zinc Acetate	U	U	B	A	A	B	A	U	B	B	U
Zinc Chloride Solutions	U	U	A	A	A	A	A	A	A	A	-
Zinc Sulfate	U	U	A	A	A	A	A	A	A	A	A

Chemical Compatibility Guide

Chemical Compatibility Guide for sealing materials and media used in semiconductor manufacturing processes

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 not suitable for application in this media.
– Insufficient information available for service in this media.

Plasma Processes +180°C/+356°F

Chemical	FFKM				FKM
	Isolast® Fab Range™				Resifluor™ 800
	J9610	J9650	J9670	J9675	VCT1S
Ammonium Fluoride	U	U	A	A	A
Argon	U	U	A	A	A
Boron Trichloride	U	U	A	A	A
Carbon Tetrachloride	U	U	A	A	A
Chlorine	U	U	A	A	A
Dichlorodifluoromethane (F-12)	U	U	A	A	A
Fluoroform (F-23)	U	U	A	A	A
Freon 152 a	U	U	A	A	A
Helium	U	U	A	A	A
Hexafluoroethane (F-116)	U	U	A	A	A
Hydrogen	U	U	A	A	A
Hydrogen Bromide	U	U	A	A	A
Hydrogen Chloride	U	U	A	A	A
Nitrogen Trifluoride	U	U	A	A	A
Oxygen	U	U	A	A	A
Perfluoropropane	U	U	A	A	A
Silicon Tetrachloride	U	U	A	A	A
Silicon Tetrafluoride	U	U	A	A	A
Sulfur Hexafluoride	U	U	A	A	A
Tetrafluoromethane (F-14)	U	U	A	A	A
Trifluoromethane (F-23)	U	U	A	A	A
Tungsten Hexafluoride	U	U	A	A	A



Chemical Compatibility Guide

Wet Processes

Chemical	FFKM				FFKM
	Isolast [®] Fab Range [™]				Resifluor [™] 800
	J9610	J9650	J9670	J9675	VCT15
Acetic Acid (30%)	A	A	U	U	A
Acetic Acid, glacial	A	A	U	U	A
Acetone	A	A	U	U	A
Acetophenone, 4-Hydroxy	A	A	U	U	A
ACT 690C	A	A	U	U	A
ACT 935	A	A	U	U	A
ACT 970	A	A	U	U	A
ACT CMI	A	A	U	U	A
ACT K-101	A	A	U	U	A
ACT K-117	A	A	U	U	A
ACT NE-14	A	A	U	U	A
ALEG 310	A	A	U	U	A
Amino Diglycol	A	A	U	U	A
Aminoethoxyethanol	A	A	U	U	-
Ammonia	A	A	U	U	A
Ammonium Fluoride	A	A	U	U	A
Ammonium Hydroxide, conc.	A	A	U	U	A
Aqua Regia	A	A	U	U	A
Boron Tribromide	A	A	U	U	A
Buffered Oxide Etchants (BOE)	A	A	U	U	A
Butyl Acetate	A	A	U	U	A
Butyl diglycol	A	A	U	U	A
Cellosolve	A	A	U	U	A
Chromic Acid	A	A	U	U	A
Citric Acid	A	A	U	U	A
CKI-888	A	A	U	U	A
Copper Sulfate (Blue Vitriol) Solution	A	A	U	U	A
Cyclohexane	A	A	U	U	A
Deionized Water (UPDI)	A	A	U	U	A
Dichlorofluoroethane (F-114b)	A	A	U	U	A
Dichlorotrifluoroethane (F-123)	A	A	U	U	A
Dimethylacetamide	A	A	U	U	A
EKC 265	A	A	U	U	A
EKC 4000PCT	A	A	U	U	A
EKC 830	A	A	U	U	A
Ethanolamine	A	A	U	U	-
Ethoxyethyl Acetate (EGMEEA)	A	A	U	U	A

Chemical Compatibility Guide

Chemical	FFKM				FKM
	Isolast® Fab Range™				Resifluor™ 800
	J9610	J9650	J9670	J9675	VCT15
Ethyl Acetate	A	A	U	U	A
Ethyl Lactate	A	A	U	U	A
Gamma-Butyrolactone	A	A	U	U	A
Hexamethyldisilazane (HMDS)	A	A	U	U	A
Hydrochloric Acid	A	A	U	U	A
Hydrofluoric Acid	A	A	U	U	A
Hydrogen Peroxide	A	A	U	U	A
Hydroxyethylpyrrolidone	A	A	U	U	A
Hydroxylamine	A	A	U	U	-
Isopropyl Alcohol (IPA)	A	A	U	U	A
Methanol	A	A	U	U	A
Methoxy Propyl Acetate	A	A	U	U	A
Methoxydipropanol	A	A	U	U	A
Methoxyethanol (DGMMA)	A	A	U	U	A
Methoxypropanol	A	A	U	U	A
Methyl (n-) Pyrrolidone (nMP)	A	A	U	U	-
Methyl Ethyl Ketone (MEK)	A	A	U	U	A
Methyl Isobutyl Ketone (MIBK)	A	A	U	U	A
MICROPUR	A	A	U	U	A
Monoethanolamine (MEA)	A	A	U	U	-
N-Cyclohexylpyrrolidone	A	A	U	U	-
Nitric Acid	A	A	U	U	A
Ozonated Deionized Water	A	A	U	U	A
Pentamethyldiethylenetriamine (PMDETA)	A	A	U	U	A
Phosphoric Acid	A	A	U	U	A
Phosphorus Oxychloride	A	A	U	U	A
Piranha	A	A	U	U	A
Potassium Hydroxide	A	A	U	U	A
PRS-1000	A	A	U	U	A
PRS-3000	A	A	U	U	A
QZ 3501 Polyimide Developer	A	A	U	U	A
RER 500	A	A	U	U	A
RER 652	A	A	U	U	A
REZI 28	A	A	U	U	A
SC-1 (Standard Clean-1)	A	A	U	U	A
SC-2 (Standard Clean-2)	A	A	U	U	A
Sodium Hydroxide	A	A	U	U	A
Stoddard Solvent	A	A	U	U	A
Sulfuric Acid	A	A	U	U	A
Tetramethyl Ammonium Hydroxide	A	A	U	U	A



Chemical Compatibility Guide

Chemical	FFKM				FKM
	Isolast® Fab Range™				Resifluor™ 800
	J9610	J9650	J9670	J9675	VCT1S
Tetramethylcyclotetrasiloxane (TMCTS)	A	A	U	U	A
TMAH 25%	A	A	U	U	A
TOK 105 Stripper	A	A	U	U	A
TOK 106 Stripper	A	A	U	U	A
Toluene	A	A	U	U	A
Trichloroethylene (TCE)	A	A	U	U	A
Trichlorofluoromethane (F-11)	A	A	U	U	A
Trichlorophenylsilane	A	A	U	U	A
Trichlorosilane	A	A	U	U	A
Trichlorotrifluoroethane	A	A	U	U	A
Trimethyl Borate (TMB)	A	A	U	U	A
Trimethyl Phosphite (TMP)	A	A	U	U	A
Xylene (Xylol)	A	A	U	U	A

Thermal Processes

Chemical	FFKM				FKM
	Isolast® Fab Range™				Resifluor™ 800
	J9610	J9650	J9670	J9675	VCT1S
Ammonia	U	A	A	U	A
Dichlorosilane	U	A	A	U	A
Hydrogen Chloride	U	A	A	U	A
Nitrogen	U	A	A	U	A
Oxygen	U	A	A	U	A

Chemical Compatibility Guide

Gas Deposition +180°C/+356°F

Chemical	FFKM				FKM
	Isolast® Fab Range™				Resifluor™ 800
	J9610	J9650	J9670	J9675	VCT15
Ammonia	U	U	A	A	A
Ammonium Fluoride	U	U	A	A	A
Ammonium Persulfate	U	U	A	A	A
Antimony Trioxide	U	U	A	A	A
Argon	U	U	A	A	A
Arsenic Trioxide	U	U	A	A	A
Arsine	U	U	A	A	A
Boron Tribromide	U	U	A	A	A
Boron Trichloride	U	U	A	A	A
Boron Trioxide	U	U	A	A	A
Bromide Anhydrous	U	U	A	A	A
Bromide Pentafluoride	U	U	A	A	A
Bromide Trifluoride	U	U	A	A	A
Bromotrifluoroethylene	U	U	A	A	A
Carbon Dioxide	U	U	A	A	A
Chlorine Trifluoride	U	U	A	A	A
Chlorodifluoromethane (F-22)	U	U	A	A	A
Chloropentafluoroethane (F-115)	U	U	A	A	A
Chlorotrifluoromethane (F-13)	U	U	A	A	A
Diborane	U	U	A	A	A
Dichlorodifluoromethane (F-12)	U	U	A	A	A
Dichlorofluoromethane (F-21)	U	U	A	A	A
Dichlorosilane	U	U	A	A	A
Dichlorotetrafluoroethane (F-114)	U	U	A	A	A
Dimethyl Amine (DMA)	U	U	A	A	A
Dimethyl Ether	U	U	A	A	A
Disilane	U	U	A	A	A
Ethylene	U	U	A	A	A
Fluorine	U	U	A	B	A
Fluoroform (F-23)	U	U	A	A	A
Freon 114 (Dichlorotetrafluoroethane)	U	U	B	B	B
Freon 115 (Chloropentafluoroethane)	U	U	B	B	B
Freon 116 (Hexafluoroethane)	U	U	B	B	B
Freon 12 (Dichlorodifluoromethane)	U	U	B	B	B
Freon 124 (Chlorotetrafluoroethane)	U	U	B	B	B
Freon 125 (Pentafluoroethane)	U	U	B	B	B
Freon 13 (Chlorotrifluoromethane)	U	U	B	B	B



Chemical Compatibility Guide

Chemical	FFKM				FKM
	Isolast [®] Fab Range [™]				Resifluor [™] 800
	J9610	J9650	J9670	J9675	VCT1S
Freon 134a (Tetrafluoroethane)	U	U	B	B	B
Freon 13b1 (Bromotrifluoromethane)	U	U	B	B	B
Freon 142b (Difluorochloroethane)	U	U	B	B	B
Freon 21 (Dichlorofluoromethane)	U	U	B	B	B
Freon 22 (Chlorofluoromethane)	U	U	B	B	B
Freon 23 (Fluoroform)	U	U	B	B	B
Germane (Germanium Tetrahydride)	U	U	A	A	A
Helium	U	U	A	A	A
Hexafluoroethane (F116)	U	U	A	A	A
Hydrogen	U	U	A	A	A
Hydrogen Bromide	U	U	A	A	A
Hydrogen Chloride	U	U	A	A	A
Hydrogen Fluoride	U	U	A	A	A
Hydrogen Iodide	U	U	A	A	A
Hydrogen Selenide	U	U	A	A	A
Hydrogen Sulfide	U	U	A	A	A
Iodine Pentafluoride	U	U	A	A	A
Isobutane	U	U	A	A	A
Methane	U	U	A	A	A
Methane Thiol	U	U	A	A	A
Methyl Bromide	U	U	A	A	A
Methyl Chloride	U	U	A	A	A
Monoethanolamine	U	U	A	A	A
Nitrogen	U	U	A	A	A
Nitrogen Trifluoride	U	U	A	A	A
Nitrous oxide	U	U	A	A	A
Oxygen	U	U	A	A	A
Ozone	U	U	A	A	A
Perfluoropropane	U	U	A	A	A
Phosgene	U	U	A	A	A
Phosphine	U	U	A	A	A
Potassium Hydroxide	U	U	A	A	A
Silane	U	U	A	A	A
Silicone Tetrabromide	U	U	A	A	A
Silicone Tetrachloride	U	U	A	A	A
Silicone Tetrafluoride	U	U	A	A	A
Sodium Hydroxide	U	U	A	A	A
Sulfur Hexafluoride	U	U	A	A	A
Sulfur Tetrafluoride	U	U	A	A	A
TEOS	U	U	A	A	A

Chemical Compatibility Guide

Chemical	FFKM				FKM
	Isolast® Fab Range™				Resifluor™ 800
	J9610	J9650	J9670	J9675	VCT1S
Tetrafluoromethane (F-14)	U	U	A	A	A
Titanium Tetrachloride	U	U	A	A	A
Trichloroethane	U	U	A	A	A
Trichloromethane	U	U	A	A	A
Trifluoromethane (F-23)	U	U	A	A	A
Trimethyl Amine	U	U	A	A	A
Trimethyl Borate	U	U	A	A	A
Trimethyl Phosphite	U	U	A	A	A
Tungsten Hexafluoride	U	U	A	A	A
Vinyl Chloride	U	U	A	A	A
Vinyl Fluoride	U	U	A	A	A
Xenon	U	U	A	A	A



General quality criteria and storage guidelines

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 ISO 2859-1:2004-01 AQL 1,0 general inspection level II.

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.

Storage and shelf life of polymer sealing material

Seals and bearings are often stored for longer time periods. Due to wrong storage conditions the physical properties of elastomers may change during storage. Because of hardening, softening, crack initiation, breakage or other degradation they can become unusable. These types of material deterioration are the result of particular factors or a combination of factors such as deformation, high temperatures, contact with oxygen, ozone, light, humidity or other media.

A few simple precautions can help to extend shelf life of seals considerably. Basic instructions for the storage, cleaning and maintenance of elastomer sealing elements are described in international standards, such as: DIN 7716/BS 3F68, ISO 2230 or DIN 9088

These standards provide several recommendations for the storage and the shelf life of elastomers, depending on the type of material.

The following requirements for storage of elastomers and other polymers, based on the recommendations of these standards, need to be followed to preserve the physical and chemical properties of such seals.

Heat

The storage temperature should preferably be between +5°C/+41°F and +25°C/+77°F. Direct contact with heat sources such as boilers, radiators or direct sunlight should be avoided. During storage at low temperatures, elastomers can stiffen. Therefore the handling of seals at low temperatures must be done very carefully in order to avoid deformation or damage.

Humidity

The relative humidity in the storage area should be below 70 percent. Extremely humid or extremely dry conditions should be avoided. Condensation must not develop.

Light

Elastomer seals must be protected from light sources during storage. In particular direct sunlight and strong artificial light with an ultraviolet content should be avoided. The original storage bags, especially plastic bags, should be used if they provide UV protection.

In case of strong external light exposure it is recommended to mask the windows of the storage rooms with red or orange covers or screens.

Radiation

Elastomer seals should be stored protected from all sources of ionizing radiation likely to cause damage to the stored parts.

Oxygen and ozone

If possible elastomers should be stored in the original packaging or in airtight containers in order to protect them from circulating air.

Ozone is harmful to many sealing materials. Therefore no equipment producing ozone (i.e. mercury vapor lamps, high voltage electrical equipment, electric motors or other producers of electric sparks or electric discharges) should be kept in the storage areas. Also combustion emissions and organic vapors should be avoided as they may produce ozone via photochemical processes.

Deformation

If possible elastomer materials should be stored free from tension, compression or other deformation. Parts delivered in tension-free condition should remain in their original packaging.

Chemical Compatibility Guide

Contact with liquids and lubricants

Elastomer seals should not come in contact with solvents, oils greases or any other media at any time during storage unless so packed by the manufacturer.

Contact with metal and non-metals

Direct contact with certain metals such as manganese, iron and particularly copper and its alloys, e.g. brass, are known to have damaging effects on some rubbers. Elastomer seals should not be stored in contact with such metals.

Because of possible transfer of plasticizers or other ingredients, rubbers should not be stored in contact with PVC. To avoid a mix-up, different rubbers should preferably be stored separately from each other.

Cleaning

If necessary, cleaning should be carried out using soap and water (demineralized water to avoid lime stains) or denatured alcohol. However, water should not come into contact with fabric-reinforced components, polyurethane rubbers or metal components without anti-corrosive protection. Disinfectants or other organic solvents, as well as sharp-edged objects, should not be used. The cleaned parts should be dried at room temperature and should not be placed near heat sources.

Shelf life and shelf life control

The shelf life of seals depends to a large extent on the polymer type. When stored under the above recommended conditions the below listed shelf life for the different materials can be considered.

NR, SBR	2 years
AU, TFE/P, Thermoplastics	4 years
CR, CSM, ECO, HNBR, IIR, NBR	6 years
ACM, AEM, EPDM	8 years
FKM, FMQ, FVMQ, VMQ	10 years
FFKM, Isolast®	18 years
PTFE	unlimited

Elastomer seals need to be checked after the above periods. If the seals are okay an extension of the shelf life is possible.

Elastomer parts and components with less than 1.5 mm /0.059 in thickness are more strongly affected by oxidation degradation even if stored under ideal conditions according to the above described. Therefore they need to be checked and tested more frequently than mentioned above.

Pre-assembled elastomer parts and seals

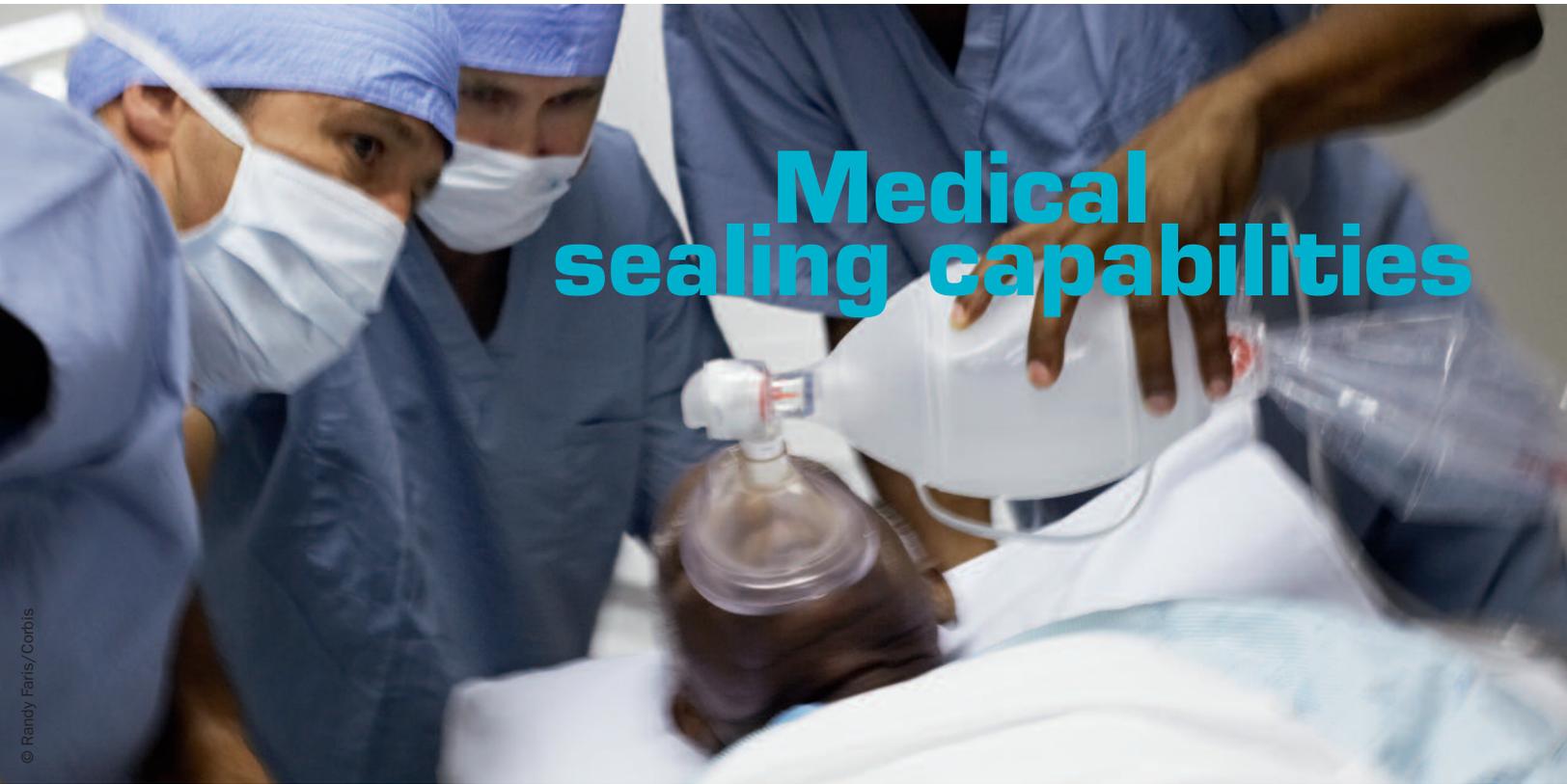
Generally it is not recommended to store elastomer seals in assembled condition. If it is necessary to do so, it is recommended that the units should be checked at least every six months. The maximum shelf life period a rubber component is allowed to remain assembled within a stored unit is a total of the initial period stated above and the extension period. The inspection interval will depend on the design and geometry of the unit.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna (ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont (LUXEMBOURG)	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia (ROMANIA)	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik (SLOVAKIA)	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa (ESTONIA, LATVIA)	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw (LITHUANIA, UKRAINE, BELARUS)	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
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		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

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Medical sealing capabilities

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Your Partner for Sealing Technology

Serving the world's medical device industry

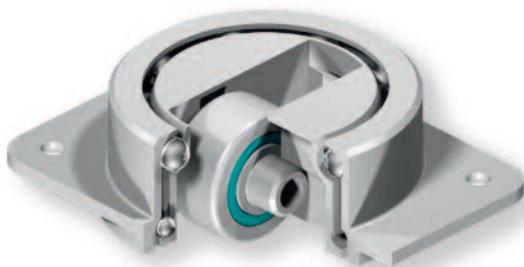
Trelleborg Sealing Solutions has been solving the world's most demanding sealing and bearing applications for over 50 years. We proudly offer a broad line of polymer products providing exceptional chemical and thermal resistance. Our product offering is extensive, and we have more than 2,000 material compounds available to produce seals, bearings, hoses, tubing and custom shapes for static, dynamic, reciprocating or rotary applications.

Sealing and bearing solutions must cope with the extremes of aggressive media, temperature, pressure and motion found in today's medical devices. In addition, chemical cleaning agent and steam sterilization resistance are often key requirements as more and more medical devices are designed for reuse.

We work closely with our customers to find the seal and bearing materials and designs that will provide unfailing performance of their equipment. Working together at the early stages of design provides our customers with shorter product launch times and improved quality and manufacturability.

Trelleborg Sealing Solutions proudly provides sealing solutions to all original equipment manufacturers and processors in the medical, pharmaceutical and biotechnology industries for applications including:

- Catheters
- Centrifuges, blood separators
- Diagnostic equipment
- Dialysis equipment
- Drug delivery systems
- Enteral feeding pumps
- Fiber optic sets
- Fluids transfer
- Home care oxygen compressors
- Orthopedic products
- Processing equipment
- Pumps (blood, infusion, HPLC)
- Respirators
- Sanitary fluid transfer
- Surgical saws and drills
- Surgical trays
- MRI machines



MRI tables

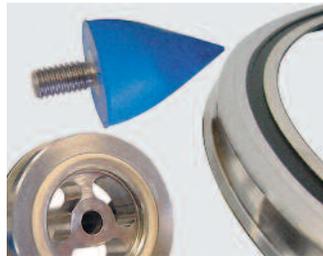
This bearing assembly is specifically designed without metal components so it will not interfere with the MRI imaging process.



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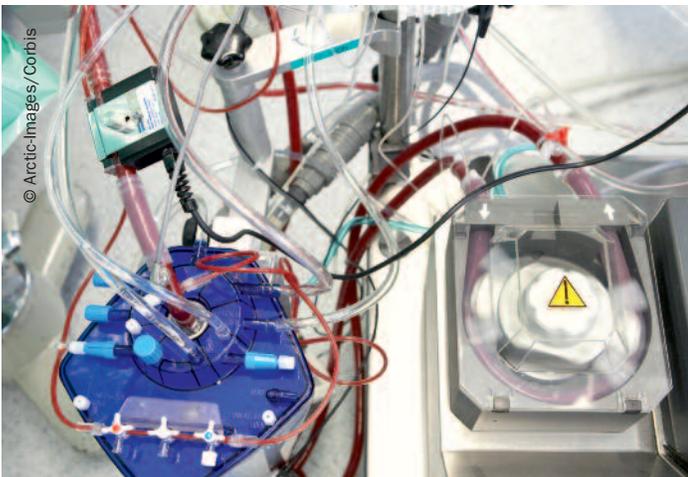
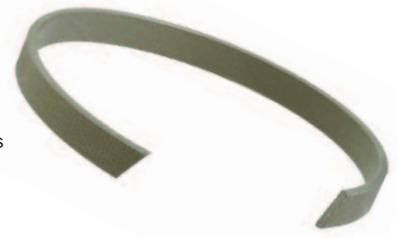
Engineered solutions

Trelleborg Sealing Solutions has the capability to bond elastomers and Turcon® to plastics and metals to create unique solutions such as these specialty valve components.



Hospital beds

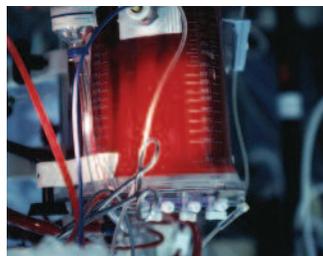
Patient comfort is of extreme importance in the design of hospital beds. Seals and bearings from Trelleborg Sealing Solutions offer quiet, smooth operation with minimal friction and stick-slip.



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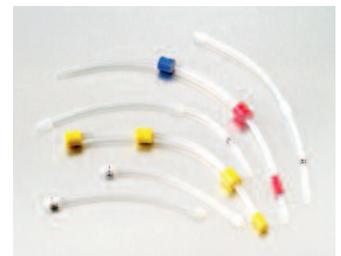
Medical pumps

Trelleborg Sealing Solutions offers a variety of high-performance products, for oxygen pumps to HPLC pumps to peristaltic pumps, to ensure leak-free sealing, long-lasting performance and solvent resistance.



Peristaltic pump tubing

Peristaltic pumps are widely used in medical applications because the pump never comes in contact with the fluid. Custom durometers and wall thicknesses can be developed for specific applications.



Innovative material formulations

Material compliance

Trelleborg Sealing Solutions develops and formulates materials in-house and engages in ongoing development of applied material technology. We offer over 90 materials that are fully compliant with the FDA CFR 21. Since the FDA only approves systems and units, our compliance with this norm ensures that our seals will not be the limiting factor for our customers to receive FDA approval for their systems. In addition, we offer compounded materials compliant to USP Class VI and ISO 10993 Cytotoxicity. Certificates on material conformance to these standards are available upon request.

Turcon® – a PTFE-based material

Our Turcon® PTFE products have very good slide properties with low friction and no stick-slip, provide high sealing efficiency and a long service life, meet demanding service conditions and provide high flexibility for easy installation. Our wide variety of Turcon® formulations ensures that we will have just the right material to meet the specific needs of our customers' applications.

Isolast® – a perfluoroelastomer material

Seals made of our Isolast® material operate in temperatures ranging from cryogenic up to +325 °C / +617 °F and seal effectively under pressure or in a vacuum. They provide nearly universal chemical resistance to withstand aggressive fluids such as acids, bases, solvents, gases and autoclaving solutions. Their FDA- and USP Class VI-compliant material formulations help reduce downtime and improve production efficiency by extending seal life, while minimizing the risk of contamination and bacterial ingress, which ensures product purity. Isolast® seals are available in black, white and clear.

Silicone material

We extrude, liquid injection mold and overmold products using specialized silicone materials to provide custom-engineered solutions for a variety of medical device, healthcare, biotechnology and pharmaceutical applications. Our silicone products maintain high pressure ratings, have excellent flexibility, are sterilizable and autoclavable, impart no taste or odor, are available in bulk or assemblies and operate under a wide temperature range.

Silicone inherently inert to bacteria, mold and fungi

Silicone materials are ideal for use in bioprocessing, medical and pharmaceutical production due to their inherent inertness to bacteria, mold and fungi. Trelleborg Sealing Solutions provides materials that give excellent heat resistance, cold flexibility and dielectric properties. They are especially good where exposure to ozone and oxygen is likely and have operating temperatures from -60 °C / -76 °F to +200 °C / +392 °F. Also, their exceptionally low surface energy means they will not adhere to counterparts. Demonstrating low long-term compression set, silicone materials are suitable for use in hot water, animal and plant fat, some lubricants and glycerin. However, care should be taken if specifying in acids, alkalis, ketones, esters and steam.



Engineered thermoplastics

Ideal for applications where wear resistance and low friction is required, a variety of high-performance PEEK and polyimide materials are offered which withstand high temperatures, have excellent chemical resistance and low out-gassing.

Industry Material Standards

Compliance with strict standards

The Life Sciences and Biotechnology industries, as well as the Pharmaceutical and Food and Beverage industries, provide a multitude of sealing challenges for critical processing components. These processes and applications require that sealing materials be manufactured from a variety of materials compliant with various national and international approvals and standards listed in the table below.

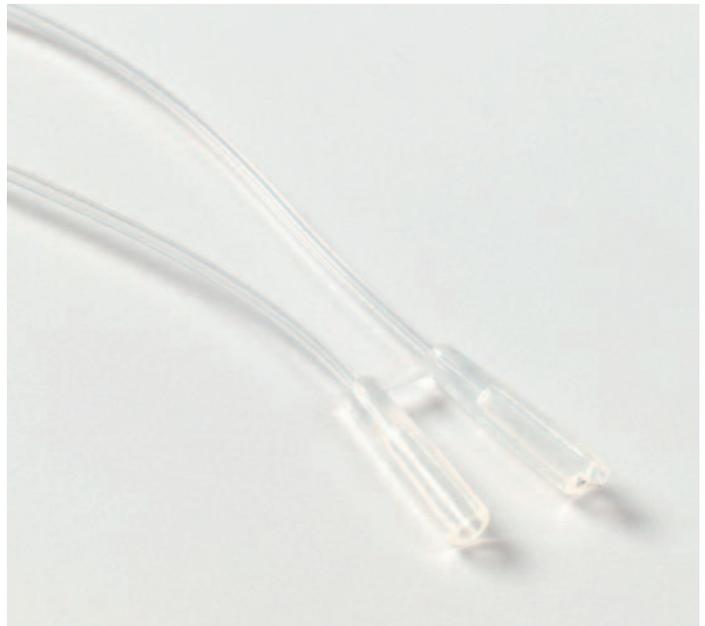
Standard authority	Regulations applicable to seals
FDA <p>The Food and Drug Administration (FDA) is a government agency within the US Department of Health and Human Services and is responsible for enforcing the Federal Food, Drug, and Cosmetic Act to ensure consumers' health and safety. It is mandatory that seals conform to this standard when in contact with food or pharmaceuticals in processing systems.</p>	<p>Elastomer seals must comply with standards detailed in paragraph 21 CFR 177.2600 "Rubber articles intended for repeated use" and FFKM elastomers with 21 CFR 177.2400. Polyurethane based elastomers must conform to FDA 21 CFR 177.1680.</p> <p>Perfluorocarbons (PTFE products and compounds, FEP and PFA resins) must comply with 21 CFR 77.1550, olefin based resins must conform to FDA 21 CFR 177.1520.</p>
3-A <p>3-A Sanitary Standards, Inc. (3-A SSI) is an American organization that formulates sanitary standards and accepted practices for design, fabrication, installation and cleanability of dairy and food equipment or systems used to handle, process and package consumable products. Its goal is to protect consumable products from contamination and ensure that all product surfaces can be cleaned. A prerequisite for 3-A approval is that the seal material already fulfills the FDA requirements.</p>	<p>Elastomer seals must comply with standard number 18-03, which covers Multiple-Use Rubber and Rubber-Like Materials that come into contact with production media.</p> <p>Perfluorocarbons (PTFE products and compounds, FEP and PFA resins) must comply with standard 20-25, which covers Multiple-Use Plastic Materials Used as Product Contact Surfaces.</p>
USP <p>The United States Pharmacopoeia (USP) is an independent, science-based public health organization. It is the official public standards-setting authority for all prescription and over-the-counter medicines, dietary supplements and other healthcare products manufactured and sold in the United States. The USP is considered one of the most technologically advanced and respected pharmacopoeias in the world.</p>	<p>USP Class VI testing Part 88 is referenced for sealing products and components, designed to evaluate plastics and elastomeric materials for use in drug processing equipment. It consists of a four-part evaluation involving animal testing, to test the biological reactivity in vivo.</p> <p>USP testing according to Part 87, also called cytotoxicity, is a complimentary in vitro test that measures the quality of the test substrate to be toxic to cells.</p>
NSF <p>NSF is a non-profit organization known worldwide for providing certification services in the areas of health and safety.</p> <p>NSF registration assures inspection officials, consumers and end users that products are safe to use in and around food processing and storage. The evaluation process includes a toxicological review of the ingredients, accuracy of labelling and material safety data sheet. In some cases, toxicology testing may be required.</p>	<p>NSF/ANSI Standard 51 "Food equipment materials". This standard provides minimum food protection and sanitation requirements for the materials used in the construction of commercial food equipment. No physical testing is required but a formulation review is performed.</p> <p>NSF/ANSI Standard 61 "Drinking water systems components Health effects." In order to comply to this standard, sealing materials have to undergo a third-party certification process which requires the recipe to be fully disclosed and toxicology tested and reviewed by the NSF organization.</p>
KTW <p>The Deutsche Vereinigung des Gas und Wasserfaches (DVGW) is an independent organization sharing expertise for self-regulation in the gas and water supply industry in Germany and Europe.</p>	<p>The KTW certificate is applied to polymers exposed to cold, warm and hot drinking water. The approval contains an extraction test and taste test, as well as a register of permitted ingredients.</p>
WRAS <p>The Water Regulations Advisory Scheme (WRAS) is the UK Water Industry's approval scheme. Products are approved by the scheme with tests for compliance carried out in accredited laboratories.</p>	<p>Suitability of non-metallic products for use in contact with water intended for human consumption with regards to their effect on the quality of the water is specified in BS6920:2000. It requires a formula review, microbial test, extraction test and test in hot water.</p>
ACS <p>Accréditation de Conformité Sanitaire (ACS) is a French sanitary standard relevant for potable water systems.</p>	<p>The standard is used for rubber and plastic materials in contact with potable water systems. The applicable criteria are layed down in the French Standard AFNOR XP P41-250, Part 1-3.</p>
BfR <p>The German organisation Bundesamt für Risikobewertung (BfR) is employed to evaluate plastics material used in the food and beverage industry.</p>	<p>In section XXI, the recommendations for rubber based articles for daily use are specified. Depending on the type of application, contact media and contact time, different test are required.</p>

Single-Use Product Capabilities

Trelleborg Sealing Solutions single-use products serve the Life Sciences industry in healthcare, bioprocessing and pharmaceutical applications.

Trelleborg Sealing Solutions offers a complete line of disposable products for the Life Sciences industry. Applications ranging from patient care, bioprocessing and pharmaceutical processing require systems that will provide first-time, one-time quality results. Researchers and healthcare providers are assured the highest quality of single-use products through our SF Medical product line. Trelleborg Sealing Solutions has long been known for their PharmaSil® premium medical-grade silicone tubing. The PharmaLim® liquid injection molded (LIM) products also offer a wide range of stoppers and bottle top assemblies. By combining these two market-leading products, Trelleborg Sealing Solutions is able to provide the Life Sciences industry with a complete line of premium first-time, one-time quality products such as:

- Tubing
- Stoppers
- Bottle Top Assemblies
- Unions such as Y and T connectors
- Custom Gaskets & Molded Components
- Custom-Designed Manifold Systems



PharmElast™ sheeting

Trelleborg Sealing Solutions also provides a complete line of silicone sheeting. PharmElast™ Sheeting is a translucent or radiopaque silicone elastomer material designed for applications demanding the ultimate compatibility in healthcare and other biological-related applications. PharmElast™ is available as a solid silicone sheet or with polyester tricot reinforcement. A complete line of color tinting is available, as well as clear.

Multi-lumen and custom design capability

Trelleborg Sealing Solutions can work with your engineers to develop custom tubing sub-assemblies such as these tubing sets designed for use in vascular & cardiac surgery. Our tubing is used in a variety of catheter designs for various medical specialties.

Innovative engineered product solutions

Our leading-edge sealing solutions for the medical device industry include a broad range of custom and standard seal options based on engineered plastic and metal technologies. Some of our solutions include:

- Variseal® spring-energized PTFE seals – providing the highest level of system integrity in extreme gas, fluid and pasty media handling applications.
- Varilip® PDR rotary shaft seals – a hydrodynamic sealing lip in a specially formulated grade of Turcon® PTFE that provides high sealing integrity and a low level of power consumption. Varilip® low friction/low wear seals are designed to provide a good seal even when in contact with oils with low surface tension and are compatible with most chemicals over an extremely wide temperature range.
- Bearings – We manufacture two types of bearing designs – HiMod® / Turcite® bearings (generally known as journal, sleeve, flange and thrust bearings or bushings) and Durobal® bearings (generally known as polymeric rolling element bearings).
- Diaphragms – providing the world's most advanced diaphragm solutions, from homogeneous designs to highly-engineered, deep drawn, fabric-reinforced, coated and bonded diaphragms.
- Hose – providing sanitary hose for a variety of medical applications including pumps; pharmaceutical processing; chemical, acid, vessel, tank or bulk transfer; cell cultures and load cells.



Sealing product range

- O-Rings
- Diaphragms
- Cup seals
- Turcite® Slydrings
- Varilip® PDR
- Molded elastomer seals
- Variseal®
- Metal seals
- Gaskets



Bearing product range

- HiMod® Bearings
- Turcite® Bearings
- Durobal® Bearings
- Composite Bearings

Hose product range

- PharmaSil® Sanitary Hose
- PharmElast™ Silicone Sheeting
- PharmaLim® products

Product Design

Rapid Prototyping

Succeeding in today's extremely competitive Life Sciences and Biotechnology industries requires much more than creative concepts and the development of advanced sealing solutions. Winning in these markets with their continually reduced product development times demands the ability to design, communicate and deliver a cost-effective design in a fraction of the time of traditional design and production cycles. While many product development organizations gauge design cycles in months, today's competitive Life Sciences and Biotechnology industries are moving at such a rapid rate that potential suppliers are expected to complete concepts and samples for presentation to potential customers before even securing the business.

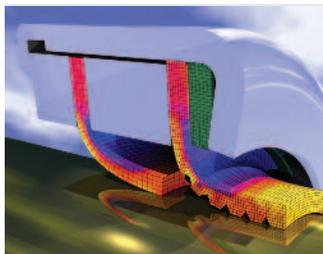
Trelleborg Sealing Solutions is a leading manufacturer of tubing, hoses and sealing solutions for the Life Sciences industry. To gain a competitive advantage, we utilize Liquid Injection Molding (LIM) technology within a clean room environment. However, the fast moving health care market is placing greater demands on suppliers within this industry to reduce lead times on not only delivery of manufactured products, but also delivery of quoting and samples of design. The time and cost to deliver such samples to secure new business is many times not possible due to the tooling utilized for LIM manufacturing.

Trelleborg Sealing Solutions has made a strategic investment in advanced design, prototyping and production technologies to gain a competitive edge. The company began investigating rapid prototyping technologies as part of an effort to shorten design cycle, reduce prototype development costs, streamline production, improve customer presentation and capture new business. Prototype samples which used to take weeks and months and cost thousands of dollars now can take hours and cost as little as \$10. Prototype samples produced are available in a number of different material systems to satisfy a variety of modeling needs. While some companies may use the more rigid snap-to-fit epoxy-based binder material, we incorporate the elastomeric material to create parts with rubber-like properties.

This technology has already found its way into the world's best-known R&D facilities. In a short lead-time competitive quoting situation, Trelleborg Sealing Solutions is able to provide potential customers with multi-colored samples to hold and touch instead of line drawings or CAD models.

Extensive test facilities

FEA modeling techniques are also used in conjunction with test rigs at our fully-resourced design and application centers to prove the effectiveness of our seal, bearing and custom solutions.



FDA-approved location

The manufacturing facility that produces our silicone tubing product line is registered with the FDA and undergoes regular audits by key customers to maintain approvals.

Bone Drill



This bone drill design uses an oiler cartridge to keep the drill tip cool during operation. A seal is needed to contain the oil and keep contamination out. This static application operates at 0.414 MPa/60 psi, +135°C/+275°F and is exposed to air, mineral oil and autoclave sterilization. The original design utilized an O-Ring that prematurely failed due to excessive wear and leakage.

Solution: Variseal® M with Turcon® T17 seal material with medium load V-spring

Result: The seal met all operating requirements and provided improved wear resistance, which resulted in extending the service life.

Blood Separator



This device separates platelets from blood, which can later be used to speed the healing process of wounds or supply hemophiliacs with clotting factor. A bearing is used to provide rotary fluid exchange between the collection tray and the separator unit. The bearing operates at room temperature and rotates at 1,680 rpm without coming into direct contact with the blood. The existing bearing was too costly and experienced unacceptable field failures.

Solution: A Durobal® bearing design consisting of PET inner and outer portions with a PET compounded cage and 302 stainless steel balls

Result: Significant cost savings were achieved by going to a near net molded part versus the fully machined original. The product has been in production since 2001 and has resulted in reduced service costs and field failures.

Oxygen Pump

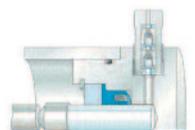


This 5-stage pump is the key component for the filling of oxygen tanks in the home in a safe, compact manner. Oxygen, created with an integrated oxygen concentrator, must be charged to approximately 15.17 MPa/2,200 psi in order to ensure adequate volume within the tank to last for many hours. To safely do this, the oxygen is fed through each of the five stages, with each stage yielding a higher pressure until it finally reaches the tank at 15.17 MPa/2,200 psi.

Solution: Each stage incorporates a piston with one Variseal® M, a V-spring-energized piston seal made from Turcon® T07 and two wear sleeves made from QD8. This combination allows for an efficient charging of the oxygen with low power consumption.

Result: The seals passed all testing and have provided excellent service life.

HPLC Pump



Plunger pumps used in analytical chemistry systems handle a wide range of solvents as well as abrasive saline solutions. The seal needed to be leak-free while sealing on a very smooth sapphire plunger, be compatible with numerous solvents and provide consistent friction and long life. The seal reciprocates with a 0.64 mm/0.25 inch stroke at 41.40 MPa/6,000 psi. Operating temperatures vary from +4°C/+40°F to +49°C/+120°F.

Solution: Custom Variseal® FW with extended heel, Zurcon® Z80 seal material and a heavy load slantcoil spring

Result: The specified seal, made from UHMWPE, provides excellent wear resistance and long life while the slantcoil spring imparts the force necessary to create a consistent, leak-free seal with consistent friction.

Bioprocessing Flow Tubing



Due to the volume of a large volume bottom outlet disposable biobag, a high flow rate discharge was required. A standard peristaltic pump would not achieve the desired flow rate, so a rotary lobe style pump was selected. Standard 0.32 mm/0.125 inch wall tubing was collapsing due to the large suction pressure caused by the rotary lobe style pump, and the desired flow rates were not being achieved.

Solution: The tubing wall was increased to 0.48 mm/0.1875 inch while maintaining the same ID. This improvement would prevent the tube from collapsing under the higher pump suction.

Result: The thicker wall tubing has proven to be a successful solution to the problem, and the specified flow rates are being met.

Medical device sealing and bearing capabilities

Quick Disconnect Coupling

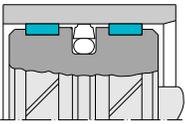


This coupling is used for portable oxygen units that convert liquid oxygen into a breathable form. The portable unit is recharged by a larger, home-based container. This seal must withstand cryogenic temperatures, be FDA-compliant, leak-free, durable and exhibit low friction while being engaged and disengaged repeatedly.

Solution: Standard Variseal® FM with a Turcon® T01 jacket and medium-load V-spring

Result: The specified seal meets all of the application requirements and has helped make portable oxygen units easier to use and operate. The seal's durability also provides an added measure of reliability.

Hospital Bed Cylinder



Today's powered hospital beds utilize electronically controlled hydraulic cylinders to move patients into different positions. The patients are often too weak or immobilized, but must be moved to conduct various procedures. Patient comfort is of extreme importance, and due to the side loads, minimal friction and stick-slip are required.

Solution: Turcite® Slydring

Result: The Slydring prevents metal-to-metal contact between the piston and bore. Turcite® is a reinforced PTFE capable of handling moderate side loads while providing good frictional properties. The new Slydring added damping to the system and removed the stick slip, which provided the important performance the customer was requesting.

MRI Machine



Comfortably moving patients in and out of the MRI machine is of utmost importance. The bearings used on the movable table must provide low friction and be non-metallic due to the strong magnetic field generated by the MRI process. The table bearings operate at room temperature and allow for 360 degrees of slow, smooth motion.

Solution: Custom Durobal® bearing assembly with quiet smooth operation

Result: Trouble-free operation and a long service life

Cryogenic Storage System



This new biological sample storage and retrieval system required a seal that could accommodate both rotary (5rpm) and reciprocating (102mm/40inch stroke) motion under a 5mm/2inch Hg vacuum. Since the motors and drives are external to the tank, the cryogenic seal seals the feed port through which the manipulator arm places and retrieves samples in the storage unit. The seal was exposed to liquid nitrogen and ice. In addition, the seal would operate infrequently, 2 to 3 times a day, for 1 to 2 minutes and required low friction and stick-slip.

Solution: Variseal® M seal with Zurcon® Z80 seal material with two nested load V-springs

Result: The seal met all performance requirements and provided long operating life.

Peristaltic Pump Tubing



Consistent, long-term flow rate through peristaltic pump tubing is vital for use in critical healthcare applications. The flow rate can be negatively affected by hysteresis (a lagging effect or loss in elastic energy when a silicone is dynamically deformed and returned to its original shape) and spallation (dislodged particles on the interior wall of the tubing). Silicone tubing must deliver consistent fluid flow rates.

Solution: Development of silicone grades to achieve the best formulation to achieve repeatable, consistent flow rates while reducing the effects of hysteresis and spallation

Result: Silicone tubing endurance testing shows Trelleborg Sealing Solutions pump tubing meets the demanding requirements of these critical applications.

Developing partnerships to optimize application solutions

Trelleborg Sealing Solutions works with our customers to develop partnerships that will ultimately identify the best sealing and bearing solution for specific applications from a broad range of materials and shapes. We also develop unique formulations and products to meet specific industry or functional requirements. Our highly-engineered solutions are verified at leading edge test facilities and backed by independent test results through internationally-recognized institutes.

Total Technology

From medical devices to applications in aerospace, automotive and general industry, Trelleborg Sealing Solutions is a major international seals and bearings provider. Our direct experience with unique and challenging applications positions us well to offer custom design and industry-specific development services for sealing components. Strategically located material development laboratories and fully resourced design and application centers continually deliver the latest product innovations and customer-focused sealing solutions.

Proven Expertise

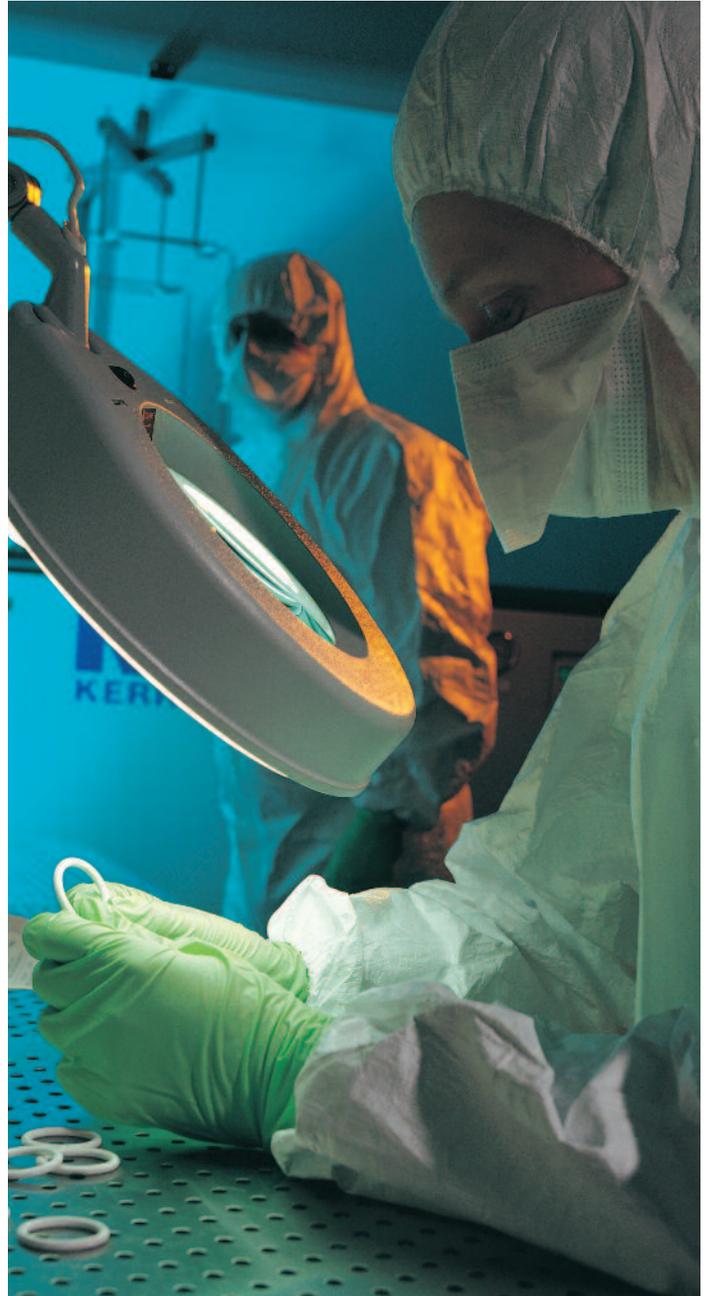
With over 50 years of experience in the design, development and application of sealing and bearing systems, Trelleborg Sealing Solutions engineering personnel bring their expertise directly to our customers. This includes project design management, prototyping, production, testing and installation. Our state-of-the-art design tools include customer-compatible CAD systems and leading edge Finite Element Analysis (FEA) systems.

Customer Commitment

We help our customers achieve cost-effective, durable solutions that are precisely matched to their specific system requirements and business needs. This includes our logistical support, which effectively delivers over 40,000 different sealing and bearing systems to our customers worldwide. Trelleborg Sealing Solutions is one of the world's foremost experts in polymer sealing and bearing technology. We develop, manufacture and market safety-critical polymer-based precision seals and bearings and associated systems.

Our Competitive Edge

- A complete polymer sealing range for the medical device industry
- 24-hour worldwide service and support
- Industry-leading design and materials expertise
- Best practice manufacturing
- Customized distribution capabilities
- Proven engineering excellence



Global manufacturing, customer support

Our worldwide resources include over 80 facilities in the Americas, Europe and Asia including manufacturing sites, materials and development laboratories and design and application centers.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovník <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

www.tss.trelleborg.com





Flexcoat™ Friction-free Running



Your Partner for Sealing Technology

Optimized solutions for individual requirements

30 years of coating expertise

Trelleborg Sealing Solutions offers a wide range of surface treatments. Their primary function is to improve the friction characteristics of elastomer seals within production processes or their application. By doing this, assembly forces are reduced, seals are prevented from sticking together and permanent friction reduction is provided without the use of lubricants. In addition, the treatments contribute to the efficiency of the total production process, with UV-indicators and colors that aid quality checks and avoid mix-up of similar components during storage or assembly.

Combining 30 years of experience in coating of elastomer seals with research studies and the latest technologies, our surface treatments are tailored to individual manufacturing requirements and the properties of the sealing materials. Taking into account the need to make manufacturing processes as green as possible, we support our customers with environmentally friendly products.



Improved capabilities, through technical innovations

Easy component assembly, low breakaway forces and longer service life cannot, in most cases, be achieved through the development of elastomer materials alone. Properties of the sealing elements, in particular their surface finish, need to be optimized to broaden their application range. This requirement is being driven by manufacturers' need to save time, for safe and secure assembly, cleanliness and the shift of manual processes to automation.

Three Levels of working

Providing the optimum solution for individual requirements, surface treatments from Trelleborg Sealing Solutions are the ideal choice; whether it is simply to improve handling, facilitate assembly or enhance overall performance.

Simple and economical handling aids meet requirements, such as easy separation of parts while more advanced coatings and surface treatments are for specific applications. Micro-thin high-performance coatings and surface modification provide the ultimate choice, maximizing friction characteristics during assembly and in dynamic applications.

With our three levels of surface treatment technology – handling aids, assembly professionals and application professionals – Trelleborg Sealing Solutions can offer individual solutions for a wide range of critical applications.

The Application Professionals combine their advanced benefits with those of the Assembly Professionals, while all surface treatments perform well as Handling Aids.

The Application Professionals

dry surface finishes
for permanent reduction
of friction and wear

The Assembly Professionals

dry coating solutions
for automated assembly
and reduced assembly forces

Handling Aids

low-cost powders, waxes and oils
for ease of separation
and simple handling

From the original seal to the coated solution

The Process flow

Depending on the coating or surface treatment, the seals will pass through different production steps. For Handling Aids these include control, packaging and labeling.

To ensure a high quality result, the micro-thin coatings of the Assembly and Application Professionals are applied in a numerically controlled process. This has two additional cleaning stages followed by plasma activation, which guarantees a firm and permanent surface bond for the elastic coating.

Series production and sampling

For the automated coating process a minimum quantity is required, dependent on the seal's size and material.

Small quantities of seals up to 100 pieces can be coated manually for samples. This excludes Flexcoat™ LF color and CF color. However to get a reliable comparison, it is recommended to test samples from an automated near-series production coating process.

Diagram shows the process flow for Handling Aids, Assembly Professionals and Application Professionals:

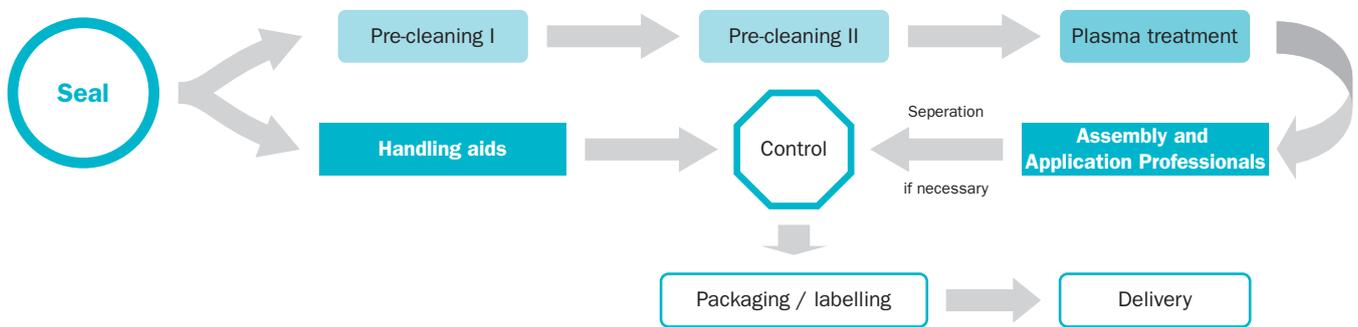
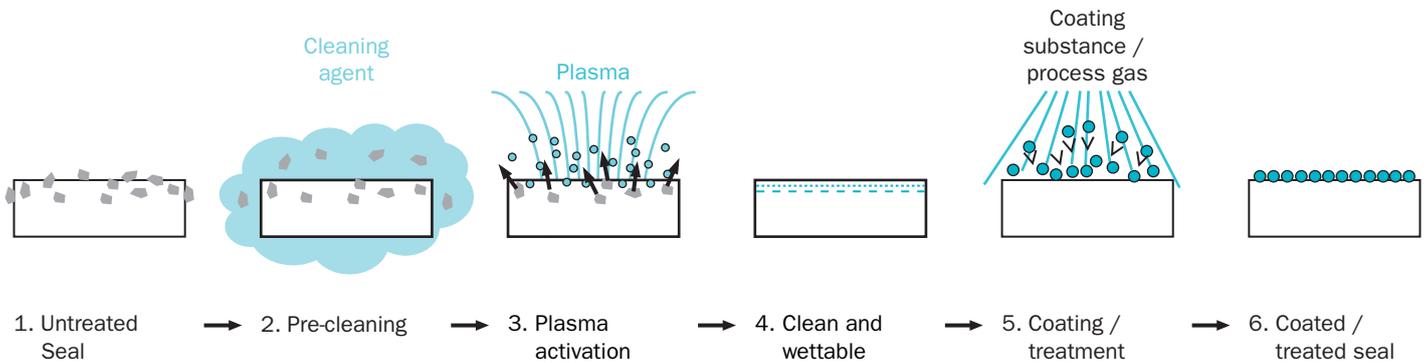


Diagram of the coating process for Assembly Professionals and Application Professionals



The Application Professionals

Micro-thin high-performance coatings and surface modification provide the ultimate choice, maximizing friction characteristics during assembly and in dynamic applications.

Flexcoat™ PF

– Friction reduction polysiloxane –

For the first time, this coating provides engineers with a true alternative to oil lubrication. Black pigment dots ensure that with non-black seal materials, the transparent coating can easily be seen. In addition our proven UV-indicator allows detection of the coating during the production process.

Flexcoat™ LF transparent

– Dynamic friction reduction –

The primary aim of using LF coating is to reduce friction in dynamic applications while assembly forces are significantly reduced. With the use of the transparent LF coating, the color of the sealing material is preserved.

Flexcoat™ LF color

With the same performance characteristics as the transparent version, colored LF coatings allow differentiation of similar seals, preventing mix-up during the production process. Colors available: yellow, orange, red, blue, white, brown and green.

Flexcoat™ SF

– High-performance friction reduction –

SF coating is characterized by its outstanding level of resistance to wear and excellent friction properties in dynamic applications.

Flexcoat™ DF

– Surface modification –

In this process, the surface of the elastomer seals is modified in the micrometer range. There is only a very slight effect on the physical properties of the elastomer.

Application examples

- Automated assembly
- Reduction of assembly forces particularly where there are frequent assembly and dismantling operations
- Seals in plug-fit or quick-release couplings
- Seals in valves
- Seals in push buttons
- Seals in dynamic applications at low speeds and with short stroke lengths.

Application Professionals	Type	Color	Detection	Coating thickness ¹	Temperature range ²	Approvals / Guidelines	Hardness (surface)	Appearance
Flexcoat™ PF	coating, Polysiloxane	transparent, with black pigments	UV-indicator, reference samples	2–10 µm 78.74–393.1 µin	-45°C to +175°C -49°F to +347°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ LF transparent	coating, PTFE	transparent	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ LF color ⁴	coating, PTFE	yellow, orange, red, blue, white, brown, green	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ SF	coating, PTFE	black	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ DF	chemical modification	—	reference samples	—	like NBR	KTW possible	up to +4 IRHD	dry

¹ Important: The coating thickness is not quoted as a capability criterion but is for guidance only, deviations are possible depending on part geometry

² Only valid for coating layer

³ Dependent on the part and the material, has to be requested specially

⁴ Available for special materials from Maltese production only



Advantages

- Prevent parts sticking together during packaging or handling
- Improve the automatic supply or separation of seals
- Simplify the assembly and dismantling of seals, in manual or automated assembly
- Reduce insertion forces
- Optimize the dynamic use of elastomer seals
- Decrease the tendency of elastomer seals to stick to mating surfaces even after extended periods of rest
- Reduce “stick-slip” effect
- Increase wear resistance of elastomer seals in dynamic applications

Benefits

- Save time and enhance safety and security of assembly
- Cleaner process reduces associated time and cost for maintenance
- Ensure shorter process-flow times
- Increase opportunities for the use of simple and cost-effective elastomer seals
- Extend service life due to better wear properties and increased assembly safety
- Improve safety and security of elastomer seals used in valves, as they are less likely to seize up

Characteristics	Base material types	Important notice	Available in Labs-free quality ³	Application area	Advantages	Supply / separation	Easier assembly / once-only assembly	Reduced insertion force / repeat assembly	Reduction of stick-slip effects	Low dynamic loadings	General dynamic use (without limit)
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	contains Silicone	yes	I + A		•	•	•	•	•	○
computer-controlled, secure process, water-based	all types of elastomers, PU, except Silicones / Fluorosilicones (depending on formulation)	—	yes	I + A		•	•	•	•	•	•
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	friction values may differ from LF transparent	no	A		•	•	•	•	•	•
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	—	yes	I + A		•	•	•	•	•	•
environmentally-friendly process	only NBR (black)	no coating layer	yes	I + A		•	•	•	•	•	•

I = Industrial applications
 A = Automotive applications, high volume

• = fully capable
 ○ = partly capable
 — = not applicable

The Assembly Professionals

The Assembly Professionals are suited to both manual and automated assembly, ensuring friction-free running of assembly processes.

Flexcoat™ FF

– FDA assembly aid –

Flexcoat™ FF is a coating that has been specifically developed for hygienic processing environments. As required for food and beverage processing, it is FDA compliant. In addition, it complies to the German Lebensmittel- und Bedarfsgegenständegesetzes (LMBG) §5 para. 1, §31 para. 1 and to the standards of the Umweltbundesamtes (UBA) (German Federal Environmental Agency (FEA)) for organic coatings used in potable water valid for the area D2 (seals).

Flexcoat™ CF color

– Colored assembly aid –

Flexcoat™ CF is a dry coating which is used to reduce assembly and plug-in forces. Available in pink and turquoise it is ideal for segregation of similar seals in production processes.

MaxWax®

MaxWax® is a waxy coating which can be used as a substitute for lubricants to ease assembly. Its use is dependent on the material.

Flexcoat™ MF

– For easier assembly –

Flexcoat™ MF is the alternative to lubrication, guaranteeing safety and security within automated assembly processes. Its dry surface improves handling without contaminating the system.

Flexcoat™ AMF

– Automotive assembly aid –

Flexcoat™ AMF is a semi-permanent coating that eases assembly primarily in automotive applications. It is modified dependent on materials.

Application examples

- Manual and automated assembly
- Once-only and repeated assembly processes
- Reduction of assembly and plug-in forces

Assembly Professionals	Type	Color	Detection	Coating thickness ¹	Temperature range ²	Approvals / guidelines	Hardness (surface)	Appearance
Flexcoat™ FF	coating, PTFE	transparent (milky)	reference samples	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	FDA compliant, conform to LMBG, §5 para. 1 and §31 para. 1 and to the standards of UBA	up to +4 IRHD	dry
Flexcoat™ CF color	coating, PTFE	pink, turquoise	reference samples	2–10 µm 78.74–393.1 µin	-30°C to +140°C -22°F to +284°F	—	up to +4 IRHD	dry
MaxWax® ⁵	wax	transparent	reference samples	n/a	-40°C to +150°C -40°F to +302°F	—	like the base material	dry, waxy
Flexcoat™ MF	coating, PTFE	transparent	UV-indicator	2–10 µm 78.74–393.1 µin	up to +175°C +347°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ AMF ⁵	coating, PTFE	transparent	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry

¹ Important: The coating thickness is not quoted as a capability criterion but is for guidance only, deviations are possible depending on part geometry

² Only valid for coating layer

³ Dependent on the part and the material, has to be requested specially

⁴ Available for special materials from Maltese production only

⁵ Available for special materials from Swedish production only

Advantages

- Prevent parts sticking together during packaging or handling
- Improve the automatic supply or separation of seals
- Simplify the assembly and dismantling of seals, in manual or automated assembly
- Reduce insertion forces



Benefits

- Save time and increase safety and security in assembly
- Cleaner process reduces associated time and cost for maintenance
- Ensure shorter process-flow times
- Extend service life due to enhanced assembly safety
- Improve friction properties
- Improve safety and security of elastomer seals used in valves, as they are less likely to seize up

Characteristics	Base material types	Important notice	Available in Labs-free quality ³	Application area	Advantages	Supply / separation	Easier assembly / once-only assembly	Reduced insertion force / repeat assembly	Reduction of stick-slip effects	Low dynamic loadings	General dynamic use (without limit)
computer-controlled, secure process, water-based	all types of elastomers (depending on formulation)	—	yes	I + A	●	●	●	●	○	—	
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	contains Polysiloxane	no	I + A	●	●	●	●	○	—	
mixture of paraffins and synthetic waxes	all types of elastomers	contains non migrating Silicone	no	I + A	○	●	●	—	○	—	
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	not permanent, storage not recommended	yes	I + A	●	●	—	—	—	—	
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	—	no	A	●	●	—	—	—	—	

I = Industrial applications
A = Automotive applications, high volume

● = fully capable
○ = partly capable
— = not applicable

The Handling Aids

The simple and economical handling aids facilitate basic requirements, such as easy separation of parts along with other assembly processes like feeding and insertion.

Talcum powder coating

Applied to the seal as a loose powder coating the talcum prevents parts sticking together during packaging and simplifies handling.

MoS₂ powder coating

A dry lubricating film, MoS₂ is applied by tumbling onto the seal surface. It is primarily used for separation of elastomer seals. Long-term friction reduction can be achieved by deposition of slide-promoting substances in the hollows of mating surfaces.

Graphite powder coating

Graphite powder forms a dry lubricating film and is primarily used to ease separation and assembly of parts.

Elastolub 013

Elastolub 013 is a silicone fluid-based lubricant. The substance is applied to seals in a drum and adheres very well to the elastomer surface. Forming a thin lubricating film it has a tendency to make seals stick together slightly so is not recommended for automated assembly.

Application examples

- To prevent parts sticking together
- Manual seal assembly
- Automated seal assembly

Handling Aids	Type	Color	Detection	Coating thickness ¹	Temperature range ²	Approvals / Guidelines	Hardness (surface)	Appearance
Talcum powder coating	powder coating	white	reference samples	n/a	like base material	—	like base material	dry, powder
MoS₂ powder coating	powder coating	anthracite	reference samples	n/a	like base material	—	like base material	dry, powder
Graphite powder coating	powder coating	grey / silvery	reference samples	n/a	like base material	—	like base material	dry, powder
Elastolub 013	lubrication based on oil	transparent	reference samples	n/a	like base material	—	like base material	oily

¹ Important: The coating thickness is not quoted as a capability criterion but is for guidance only, deviations are possible depending on part geometry

² Only valid for coating layer

³ Dependent on the part and the material, has to be requested specially



Benefits

- Provide time savings in assembly
- Ensure shorter process-flow times
- Cost-effective solutions with good performance

Advantages

- Prevent parts sticking together during packaging or handling
- Facilitate the separation of seals
- Improve the gliding properties of seals during manual assembly operations
- Rapid availability due to their simple production process

Characteristics	Base material types	Important notice	Available in Labs-free quality ³	Application area	Advantages	Supply / separation	Easier assembly / once-only assembly	Reduced insertion force / repeat assembly	Reduction of stick-slip effects	Low dynamic loadings	General dynamic use (without limit)
—	all types of elastomers	contamination possible due to wear	no	I + A	●	○	—	—	—	—	—
—	all types of elastomers	contamination possible due to wear, absorption of MoS ₂ through base material possible	no	I + A	●	○	○	○	○	○	—
—	all types of elastomers	contamination possible due to wear	no	I + A	●	○	○	—	—	—	—
Silicone oil with solid lubricants	all types of elastomers, except Silicones	contains Silicone, parts tend to stick, not for automated assembly, absorption through base material possible	no	I + A	○	●	○	—	—	—	—

I = Industrial applications
A = Automotive applications, high volume

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— = not applicable

Technical Information

Differentiation and detection options

Several options are available to provide evidence of coating or to differentiate between seals that appear to be almost identical.

The UV-indicator

Most of the Assembly and Application Professionals provide a UV-indicator.

This will be highlighted under ultraviolet lamps, the shade and brilliancy varying from white to violet, dependent on the coating and on seal material. This can be used for 100 percent detection of coating.

It is recommended to only use lamps with long wave ultraviolet light as this provides the best brilliancy and protects eyesight.



Uncoated and coated seal under UV-light

Colored coatings

The primary function of any coating is to improve the friction characteristics of an elastomer seal. In addition, colored coatings enable effective differentiation of seals and 100 percent detection in production and assembly process.

Color-coding allows segregation of seals that appear to be similar during assembling or storage. This prevents mix-ups, which can lead to leakage or seal failure. In addition, lighter colors can be more easily detected in a black or dark assembly during end of line quality checks.

Flexcoat™ CF color is available in pink and turquoise. Flexcoat™ LF for dynamic applications is available in yellow, orange, red, blue, white, brown and green. Detailed information regarding the coatings can be found on pages 4 to 7.



Colored coated O-Rings

Cleanliness and residue analysis

Modern sealing technology involves washing, Labs-free cleaning and residue analysis. With coated seals several important issues have to be considered.

Washing

Washing of seals after coating is not usually recommended as depending on the washing method and agent, the coating can be damaged. However, in some cases washing is possible.

Residue analysis

To determine residue on the seal surface we recommend the use of wdk (the trade association of the German rubber industries) guideline number 2111. For coated seals only the sputtering method is applicable. Using an ultrasonic bath may damage the coating.

Labs-free cleaning for automotive lacquering applications

Substances such as processing aids, softeners or similar ingredients within seals can potentially contaminate sensitive automotive lacquering process. Acting similarly to silicone oils, they can cause 'dimples' on the lacquer surface which are not allowed.

A high-tech 'Labs-free' cleaning regime is used to remove these substances from within or on the surface of the seal as specific by the Volkswagen test specification 'Colors and Lacquers' PV 3.10.7.

If seals have been cleaned using the 'Labs-free' method, once packaging has been opened, any unused seals remaining within it should be discarded. For information on suitable packaging, please contact your local Trelleborg Sealing Solutions Marketing Company.

Almost all coatings or treatments from the Assembly and Application Professionals can be delivered in Labs-free quality. Please find further information in the tables on pages four to seven.

Tests and analyses

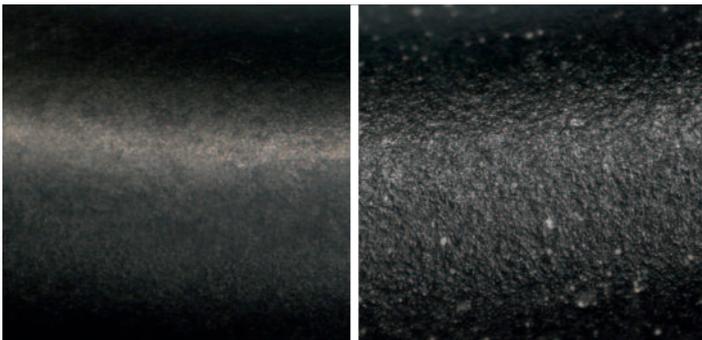
Test results exist on the friction properties of seals with and without surface treatments. Various movement types are simulated, forces measured and surfaces microscopically inspected. These results can only be used as a general guide.

Due to the interaction of parameters influencing friction, customers should preferably undertake their own tests within their specific application. Alternatively the seals should be tested within components that make up the final assembly.

Surface analyses

In general coatings improve the friction coefficient of elastomer seals. A major contribution to this improvement is the change in surface structure caused by coating.

The microscopic examination of the surface of coated and uncoated seals shows significant differences in the structure. In most cases the coated seal will have a rougher texture.



Surface of an uncoated seal (left) and of a seal coated with Flexcoat™ SF (right)

Standard analyses

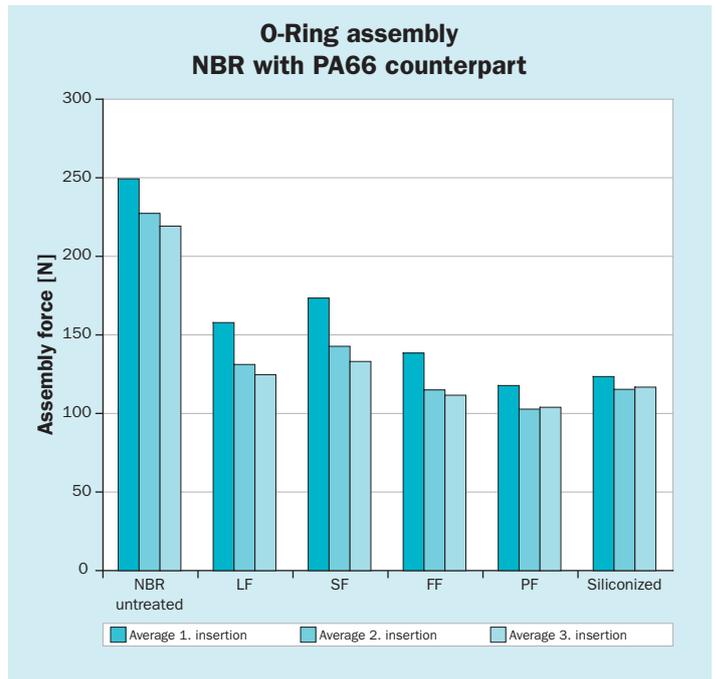
Various standard analyses, always done under the same conditions, allow the comparison of different methods of friction reduction.

Assembly force tests

The following graph shows the necessary plug-in forces for the multiple assembly of O-Rings in a standard application. Tests have been run comparing uncoated O-Rings to coated ones with silicone oil treated parts used as piston seals. The O-Ring size was 20.29 × 2.62 mm / 0.8 × 0.1 inches combined with a compression of approximately 20%.

Local marketing companies at your service

To identify the optimum seal for your application, contact your local marketing company. To locate this see the back cover of this brochure or go to www.tss.trelleborg.com.



Assembly forces of O-Rings

Disclaimer:

The given application limits for temperature are maximum values determined in laboratory conditions. In application, due to inappropriate interaction media the temperature resistance of a coating may be influenced negatively. The application temperature has to be adopted accordingly. Furthermore in all cases, reduction in friction is dependent on the application parameters. This should be tested in conjunction with the surface treatment before specification.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovník <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

www.tss.trelleborg.com



Oil & Gas sealing solutions



Your Partner for Sealing Technology

Ultimate sealing solutions for oil & gas



Exploration applications

In exploration wells, sealing systems must withstand the harshest of environments, with downhole temperatures in excess of +180 °C (+360 °F) and pressures possibly up to 155 MPa (22,500 psi).



Production offshore

Subsea production presents the ultimate challenge to sealing systems engineers, with deep-sea wells now reaching 6,000 metres (19,600 feet) in sea depths of 1,000 metres (3,300 feet).



Providing effective sealing solutions for the oil and gas industry is extremely challenging. Whether for use during exploration, offshore or onshore production, upstream, midstream or downstream, seals must withstand highly destructive and aggressive chemicals and gases, abrasive media, intense downhole temperatures and severe pressures. Further difficulties arise from supplying sealing systems to oilfields located in remote areas of operation, especially as most production now takes place in the harsh Subsea environments in which, to fully exploit diminishing reserves, wells are excavated to previously unbelievable depths.

The considerable practical experience of Trelleborg Sealing Solutions, along with ongoing product testing and qualification, mean we understand the needs of the industry. Whether operating in the Gulf of Mexico, the South China Seas or off the coast of Scotland, our global network can provide the same level of service and support; its primary aim is to minimise maintenance time and to maximise 'life of well' sealing integrity. Whether a seal is 1.2 millimetres (1/16th inch) or 3 metres (10 feet) in diameter, we are able to work with our customers to offer the optimum configuration, often participating in on-site development to meet individual requirements.

A single source for the majority of oil and gas sealing needs, we develop innovative solutions from our extensive range of seal materials and products, some of which are specifically engineered to meet particular industry requirements, ensuring the ultimate in reliability and safety.

The range of products offer:

- Temperature resistance from cryogenic up to +850 °C
- Almost universal chemical resistance; withstanding aggressive sour gas, corrosive fluids, hydrocarbons, carbon dioxide, acids, solvents and amine based corrosion inhibitors
- Excellent thermal stability
- Steam and explosive decompression resistant materials
- Good mechanical strengths
- Low long-term compression set
- NORSOK approved materials



Processing onshore

Seals that are virtually universally chemically compatible allow provision of innovative solutions for refining of hydrocarbons in pipelines, valves and flow meters.

High performance elastomer sealing technology



Advanced elastomers

Ideal for applications where temperatures do not exceed +180 °C (+356 °F), the TSS range of elastomers are engineered for maximum temperature performance and chemical resistance.



FEP encapsulated O-Rings

FEP encapsulated O-Rings consist of a Fluoroelastomer or Silicone elastomer O-Ring housed within a seamless FEP jacket, providing improved chemical compatibility with equivalent elasticity and low friction.



Breadth of range

Due to the breadth of range offered by Trelleborg Sealing Solutions, designers can specify seals that meet the challenge of balancing cost effectiveness with performance. For static applications, any size of O-Ring (standard or custom) is available alongside custom moulded designs and bonded products; in materials ranging from basic elastomer grades to leading edge, high specification compounds, particularly developed for the oil and gas industry. These innovative compounds help meet our aims of minimising maintenance time and improving production efficiency by extending seal life.

Advanced elastomer seals

As one of the leading developers of elastomer compounds for sealing applications, Trelleborg Sealing Solutions offers a range of HNBR and FKM materials engineered to maximise their effectiveness at high temperatures and when in contact with aggressive chemicals. Specification of these is supported by local experts who can recommend the optimum grade for every application.

Inventive designs

A development of the standard O-Ring, FEP encapsulated O-Rings, consist of a Fluoroelastomer or Silicone elastomer O-Ring housed within a seamless FEP jacket and are ideal when a cost effective solution is required that offers improved chemical compatibility, equivalent elasticity and low friction. Quad rings, manufactured from the same materials and to the same groove dimensions as standard O-Rings, can directly replace these when movements are found to cause twisting, reducing sealing integrity.

Isolast® Perfluoroelastomer

Trelleborg Sealing Solutions Isolast® presents the ultimate in elastomer sealing. These high performance Perfluoroelastomers (FFKM) are virtually inert and demonstrate almost universal chemical compatibility, making them ideal for hydrocarbon processing applications. Specialist grades can operate at continuous temperatures up to +325°C (+617°F) and specially formulated explosive decompression and steam resistant compounds are available. In addition, the resistance of Isolast® to amines extends the life of seals in contact with corrosion inhibitors, a known problem in environmentally friendly water based drilling equipment.



Isolast® Perfluoroelastomer

The ultimate in elastomer sealing, these virtually inert and almost universally chemical compatibility materials have been specifically designed to operate effectively in aggressive oil & gas processing systems.

Innovative engineered sealing options



Variseal® extreme sealing
Field-proven in extreme gas and liquid handling situations, Variseal® have been used in the most demanding of oil & gas sealing applications including high pressure and corrosive environments.



Wills Rings® for the optimum solution
Wills Rings® in O or C cross sections can operate within continuous temperatures from cryogenic up to +850°C (+1560°F) and are ideal for fire safe sealing.



Variseal®

An extremely important product to the oil and gas industry, Variseal® spring energised Turcon® PTFE seals are field-proven in extreme gas and liquid handling situations, having been used in the most demanding of production and refining applications. Designed to fit in existing O-Ring grooves, with the correct selection of PTFE, filled PTFE compounds and appropriate spring material and profile, Variseal® can provide the highest level of system integrity, even in the most aggressive and corrosive of chemical media; providing the ultimate explosive decompression resistance.

Wills Rings®

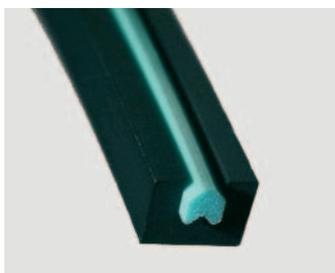
Wills Rings® are the original metal seals, providing the optimum solution in static sealing on connectors, flanges and plates for gases and liquids. They operate effectively under extremes of temperature, ranging from cryogenic to 850°C (1560°F) and severe pressures, often being utilised when fire safe sealing is required. Wills Rings® are available in a variety of metals, O or C cross section with either pressure filled or system pressure activation.

Turcon® PTFE

A range of Turcon® PTFE solutions offers advanced sealing for rotary applications. In Turcon® Glyd Ring, Turcon® Roto Glyd Ring and Turcon® AQ Seal an elastomer O-Ring or Quad Ring energises a PTFE sealing ring. Engineered to reduce friction with high wear and abrasion resistance, they are ideal for high-pressure situations. The Double Delta fits in an existing O-Ring groove and expands the parameters of the O-Ring used with it, improving wear and friction characteristics.

Bearing solutions

Bearings manufactured from Turcite®, an engineered PTFE based thermoplastic, prevent metal to metal contact between piston and rods, bores and glands, absorbing transverse load and with low friction, minimise stick-slip. Bearings from Orkot®, a non-asbestos synthetic, composite material incorporating solid lubricants, provide exceptional wear resistance and virtually no swell in water. Ideal for Subsea environments they offer effective and maintenance free solutions in seawater.

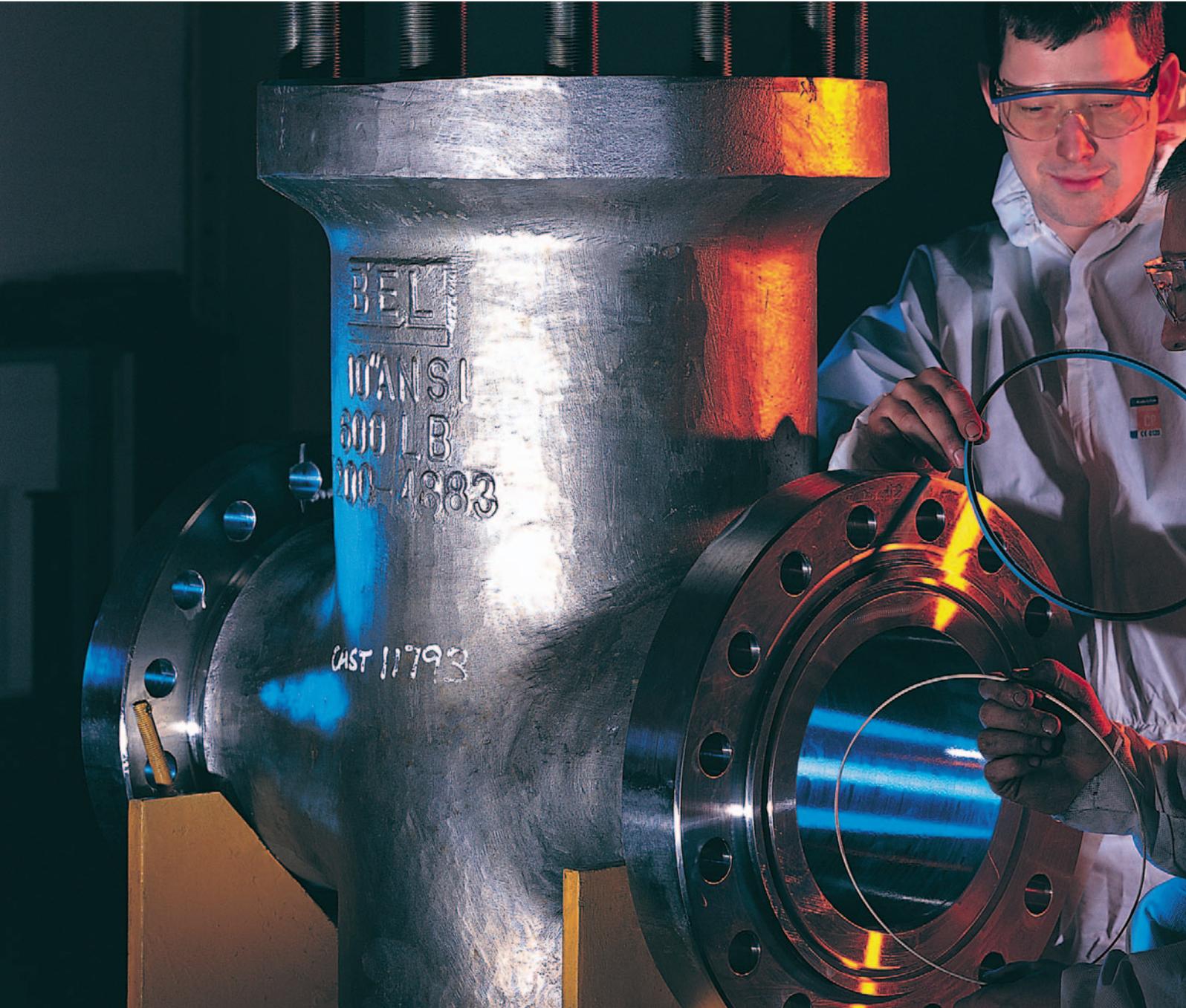


High performance Turcon®
Turcon® PTFE solutions offer advanced sealing for rotary applications, providing reduced friction, high wear and abrasion resistance in high pressure situations.



Advanced bearing options
Bearings manufactured from Turcite®, prevent metal-to-metal contact, while Orkot® with virtually no swell in water offers an effective and maintenance free solution Subsea.

Development partnerships optimise applications



Sealing on FPSO units
Specialist sealing and bearing solutions operating offshore on FPSO turrets and fairleads withstand ingress of seawater and chain breaking forces, typically up to 1,700 tons.



Valve and pump sealing
Within processing systems, seals must operate in harsh environments; facing extreme temperatures and pressures, contact with aggressive chemicals and the possibility of explosive decompression.



Trelleborg Sealing Solutions works with oil and gas customers in development partnerships, identifying the best sealing option for specific applications from a broad choice of materials and seal profiles.

Exceptional offshore performance

On FPSO (Floating Production Storage and Offloading) unit turrets a combination of Turcon® Roto Glyd Ring®, NBR O-Ring, Turcon® Variseal® and V-Seals, give exceptional sealing performance. They withstand rigorous ocean movements, allowing low friction turning when connected to subsea buoys. The fairleads to these resist extreme chain breaking forces with the help of high load bearings from Orkot® that exhibit excellent corrosion and wear properties.

Resisting harsh conditions

Valves and pumps within processing systems must operate in harsh environments, facing extreme temperatures ranging from -60°C to +300°C (-75°F to +575°F) in conjunction with high and low pressures. Seals within them may also have to withstand contact with aggressive chemical media and counter the possibility of explosive decompression. Helping to extend service life, Turcon® Variseal® and Isolast® O-Rings are performing excellently in such applications.

Safety critical sealing

The nozzle on gas flare lines, recovering hydrocarbon gas and routing this back to the main process, require a sealing system capable of withstanding intense temperatures reaching +400°C (+750°F) and severe pressures up to 200 MPa (30,000 psi). The best option for this application is Wills Rings® and these metal O-Rings have proved more than capable of withstanding these extremes whilst providing effective fire-safe sealing.

Ensuring downhole integrity

With the increasing depth of wells, the challenge of ensuring logging equipment retains sealing integrity during exploration is paramount. Sealing systems must withstand temperatures in excess of +180°C (+360°F) and pressures over 155 MPa (22,500 psi). In constant contact with destructive well fluids, innovative designs utilising Turcon® Variseal®, Isolast® O-Rings and AQ seals, must fit into compact housings, significantly restricted by tool diameter.



Extremes withstood in flares

The best option for withstanding intense temperatures and severe pressures is Wills Rings® which have proved themselves in extremes whilst providing effective fire-safe sealing.



Effective sealing in exploration

The challenge of ensuring logging equipment retains sealing integrity is paramount and sealing systems must withstand high temperatures and pressures along with destructive well fluids.

Market leading global sealing capabilities



Extensive test facilities
Strategically positioned materials and development laboratories and fully resourced design and application centres, continuously succeed in the delivery of sealing solutions.



Innovative material development
Developing and formulating materials in-house and engaging in on-going programmes of development, TSS is also skilled in the field of applied materials technology.



Total - Sealing technology

Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer a dedicated design and development service for sealing arrangements, from our market leading product and material portfolio; one which has provided solutions that feature in virtually every application conceivable within the aerospace, industrial, and automotive industries.

Global - A worldwide presence

Globally servicing, supporting and supplying our customers, Trelleborg Sealing Solutions has an international network of over 70 facilities worldwide including more than 20 manufacturing sites, strategically positioned materials and development laboratories and fully resourced design and application centres. Facilities are certified to ISO 9001:2000, with many manufacturing sites also working to QS9000 and VDA 6.1.

Expertise - Our proven capabilities

With over 50-years experience in development and application of sealing systems, Trelleborg Sealing Solutions engineering personnel contribute their knowledge of this specialised technology directly to customers. This includes project management of design, prototyping, production, test and installation using state-of-the-art design tools, fully customer-compatible CAD systems and leading edge Finite Element Analysis (FEA).

Innovation - In materials and supply

Developing and formulating our materials in-house, Trelleborg Sealing Solutions has acquired significant skills in the field of applied materials technology. Working in close cooperation with worldwide partners, we are engaged in on-going programmes of material and product development, utilising latest technologies and the resource of our material database, which includes over 2,000 proprietary compounds.

Commitment - To customers' needs long-term

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions. As the global sales and marketing organisation of Trelleborg Sealing Solutions, who develop, manufacture and market safety-critical polymer-based precision seals and associated systems, we have the backing of one of the world's foremost experts in polymer sealing technology.



Superior logistics support

TSS invested in an advanced logistical support system, which effectively delivers products to our customers worldwide from a central European warehouse.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
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GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
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Orkot[®] Bearings

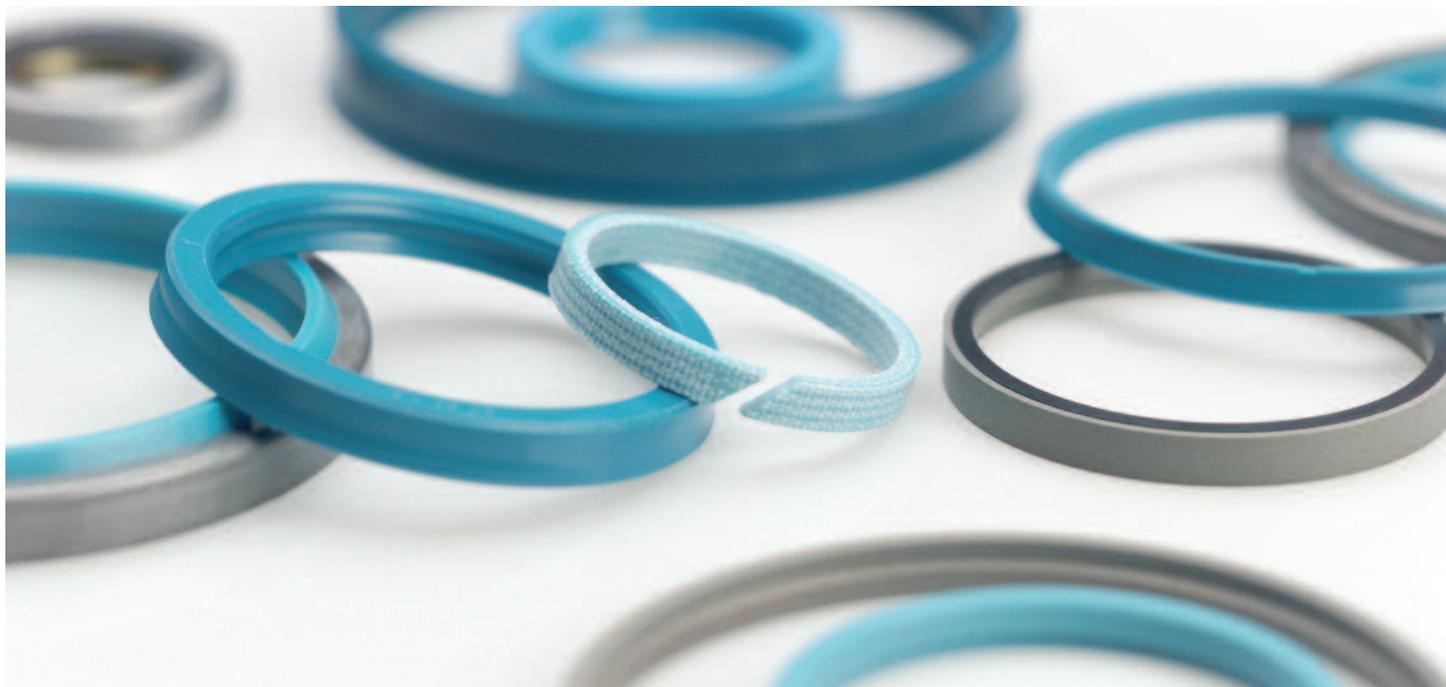
Engineering manual for industrial applications



Your Partner for Sealing Technology

Orkot® Bearings

Engineering manual for industrial applications



Trelleborg Sealing Solutions is an international group specialized in polymer technology, 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 sealing and bearing 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, 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. 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

The information in this manual is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this manual. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

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

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Orkot® Materials

Orkot® bearing materials are a range of thermoset composite bearing materials incorporating advanced polymer technologies. These consist of technical fabrics impregnated with thermosetting resins, evenly dispersed solid lubricants and further additives to ensure the optimum solution is reached to satisfy many engineering applications.

Orkot® materials have many advantages over more traditional metallic bearing materials and other polymeric bearings including:

- Low coefficient of friction
- High load capacity
- Good chemical resistance
- Operates in fresh or salt water without lubrication
- Damping of vibration
- Accommodation of shaft misalignment
- Ease of machining
- Fitting by pressing, freezing, adhesives and mechanical methods
- Dimensional stability
- Minimal thermal softening
- Does not encourage galvanic corrosion
- Orkot® contains no asbestos or environmentally hazardous/toxic substances

Quality

All Orkot® bearings manufactured are subject to strict quality controls and procedures, from raw material acquisition through manufacturing to delivery.

Certification of the production facility is in accordance with international standard BS EN ISO 9001:2000 and meets the specific requirements for quality control and management of purchasing, production and marketing functions.

Many successful applications for Orkot® involve highly loaded bearings or pads operating with intermittent or oscillating movements.

Manufacturing composite bearings since 1954, Orkot® bearings have been fitted and used by thousands of satisfied customers world-wide in a diverse range of applications, including:

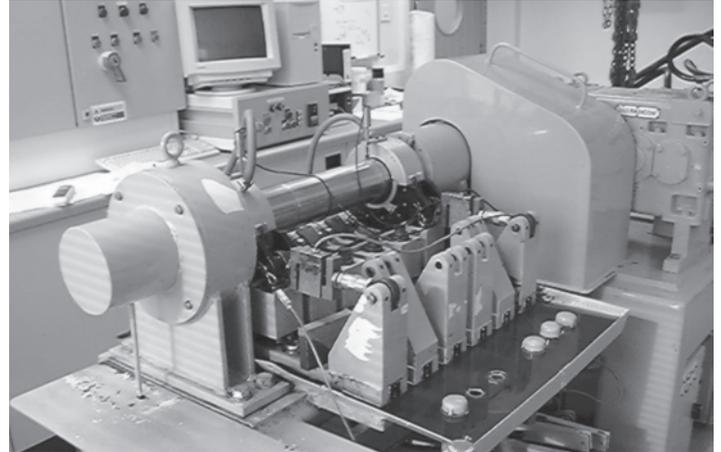
- Railways
- Off-road vehicles
- Process equipment
- Injection molding machines
- Pumps and Valves
- Lifting and handling equipment
- Hydropower
- Formula 1 racing cars
- Roll coverings
- Ports, harbors, sluices, sea defense barriers
- Merchant and Navy Shipbuilding (specialized engineering manual available on marine applications)

Accreditation is supported by procedures and processes to ensure full traceability of each component.

A continuous test program ensures the quality and performance of Orkot® bearing materials, and this can be further supported by specific testing and certification of products for customers if required.

R+D and Test Facilities

The testing laboratories at the factories are equipped to carry out tribological and mechanical tests. Tribological tests are conducted both in linear and rotary geometries, either dry or externally lubricated with fluids (oil, grease, water, etc). Wear and friction data are obtained against a range of counter faces, including those specific to a customer application. Mechanical tests include compressive, tensile, flexural, shear and hardness testing.



Oscillating test rig

Availability

Orkot® bearing materials are usually supplied as fully machined components to customers' own drawings. Alternatively, semi-finished materials are supplied in the form of tube or sheet. The following standard range of sizes is available with other sizes on request:

Tube		
	Minimum ID	8 mm
	Maximum OD	2,000 mm
	Standard lengths	340, 500 and 670 mm
Sheet		
	Minimum thickness	1 mm
	Maximum thickness	50 mm
	Maximum width	600 mm
	Maximum length	2,000 mm



Orkot® Bearings

Grades

Orkot® bearings are manufactured in a range of grades using different combinations of fabrics, resins and additives designed to satisfy many applications.

The commonly used grades have been designated as standard grades, these are shown in the table below.

Many other grades have been developed, even for unusual applications, employing different combinations of standard and specialized fabrics, additives and resin systems.

Please contact TSS Product Management to discuss any projects with unusual conditions for which a special grade may be required.

Grade	Properties	Typical Applications	Coefficient of Friction, typical dry *
C320	standard grade	used against carbon steel, treated surfaces, ceramic or chrome plated counter face	0.15 – 0.20
C321	high electrical resistance	electrical insulators, food applications and structural parts	0.15 – 0.20
C322	standard grade operating in water	used against stainless steel counter face, where water is present or electrical insulation required	0.15 – 0.20
C324	high temperature or chemical resistance	railway brake systems, withstanding high temperature and offering thermal insulation	0.20 – 0.35
C335 / C361	low swell rate and resistance to sea water with limited dry running capability	used against stainless steel counter face, with intermittent water contact or where electrical insulation is required	0.15 – 0.20
C338	high temperature or chemical resistance with added lubricants	guide bearings for high temperature applications	0.20 – 0.25
C369	dry running, low friction, reduced stick-slip and extended life	used against carbon steel, treated surfaces, ceramic or chrome plated counter face	0.05 – 0.10
C378	dry running, low friction, reduced stick-slip and extended life	used with stainless steel counter face, where water is present or electrical resistance required	0.05 – 0.10
C380	high wear resistance and good sliding properties	standard wear ring material for use in hydraulic cylinders, see separate specialized application catalog for more information	0.15 – 0.20
C410	silent operation, stick-slip minimized, dry running capability	materials handling equipment and industrial processing, off highway heavy lift and transport, fluid power when stick-slip or poor lubrication are issues	0.05 – 0.10

* The coefficient of friction values indicated are typical only and can vary with load, speed, counter face material and any contamination present.

Properties / Specifications

Orkot® Grade	C320 / C321 / C322 C335 / C361 / C380	C324 / C338	C369 / C378	C410
Ultimate Compressive Strength (N/mm ²)	300	350	280	280
Shear Strength (N/mm ²)	80	80	80	80
Tensile Strength (N/mm ²)	55	60	55	55
Compressive Modulus of Elasticity (N/mm ²)	2800	3400	2800	2800
Hardness (Rockwell M)	100	105	100	80
Density (g/cm ³)	1.25	1.25	1.25	1.25

Note, all data based on tests to BS EN ISO 604:1997, BS EN ISO 178:1997, BS 2782:1993 and Orkot® standard methods.

Mechanical Properties

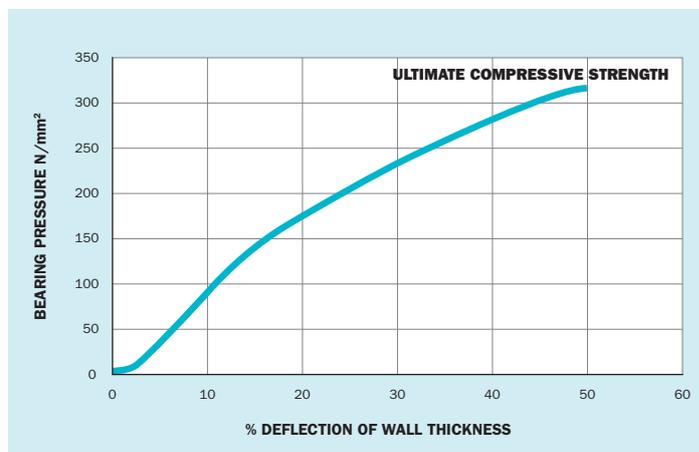
Under compressive load, standard Orkot® grades behave in an elastic manner up to a yield point. Beyond this, permanent deformation may occur. The yield point relates to the shape of the part and to some extent to the operating temperature.

To keep a safe distance from the yield point when designing a bearing, our general recommendation is for most static applications a maximum design load of 80 N/mm², with 40 N/mm² maximum for dynamic applications. However, dynamic application is also dependant on the PV (pressure × velocity) value (see page 12).

These values are with fully supported bearing surfaces and forces perpendicular to the laminations. For forces applied parallel to the laminations, such as on the end face of a flanged bush, only light loads should be used, typically to a maximum of 40 N/mm² for static loading and 20 N/mm² for dynamic. Higher loads may require the use of, for example, separate thrust washers made from a flat laminate sheet.

Higher load values than those indicated above have been used for specific applications.

Please contact TSS Product Management for assistance if your applications exceeds these values.



Typical deflection under load for a cylindrical bearing

As with all composite bearings, the effective Elastic Modulus in an application for Orkot® materials is very dependent upon the shape of the component and the support provided for it. Modulus values for Orkot® standard grades range from 800 N/mm² to 3000 N/mm². Thus, calculating the deformation of a pad or the degree by which a shaft moves off the center line when under load is complex and depends on the wall thickness, any shaft misalignment and the bearing clearance.

Please contact TSS Product Management for assistance if bearing deflection is important in your application.

Thermal Properties

Orkot® materials have low thermal conductivity and operate as thermal insulators. As with all polymer bearing materials, the thermal expansion of Orkot® must be taken into consideration during the design process, particularly when operating at higher temperatures or with components having thick sections. As a laminate material, the coefficient of thermal expansion is different perpendicular or parallel to the layers.

The wall thickness of a bush should be kept to a minimum to limit the effect of thermal expansion and to better control clearance levels.

Application at the extremes of temperature depends on the design of the component and the fixation method used. For example, an interference fit can be used from -30 °C to +60 °C whereas a split ring mounted in a groove housing can be used between -60 °C and +130 °C.

Grades C324 and C338 were specifically developed for high temperature applications.

Please contact TSS Product Management for advice on cryogenic or high temperature applications.

Property		Standard Grades	High Temperature Grades C324 / C338
Coefficient of thermal expansion perpendicular to laminations	10 ⁻⁵ /°C	9 – 10 (-40 °C to +130 °C)	4 – 5 (-40 °C to +250 °C)
Coefficient of thermal expansion parallel to laminations	10 ⁻⁵ /°C	5 – 6 (-40 °C to +130 °C)	2 – 3 (-40 °C to +250 °C)
Thermal Conductivity	W/m °K	0.293	0.169
Minimum and maximum operating temperatures*		Cryogenic to +130 °C	Cryogenic to +250 °C

* Correct operation at upper extremes of temperature depends upon application

Electrical Resistance

Orkot® materials are suitable for applications in which interference with magnetic or electric fields must be prevented. They also exhibit electrical insulation properties and have been used in many electrical applications in generators, motors, switches and transformers.

Orkot® is non-magnetic and does not build up static charges and can be used as a general construction material in the electrical engineering industry.

C321 should normally be used and the properties for this are indicated below:

Property	Value
Insulation resistance MOhm	2000
Dielectric strength at +90 °C, V/mm (perpendicular to the fabric laminations)	210
Dielectric constant up to 1 MHz (permittivity)	3.1

Radiation Resistance

Orkot® components have been successfully used in nuclear and irradiated environments. However, as with all polymer materials, the mechanical properties of Orkot® are effected by exposure.

While these changes may be very small, please contact TSS Product Management to discuss applications.

Chemical Resistance

Orkot® materials are resistant to many chemicals. They do not corrode and are unaffected by many solvents, inorganic solutions and weak acids. Water based chemicals can also act as lubricants. Standard grades are attacked by chemicals such as ketones, chlorinated solvents, strong alkalis and hot strong oxidizing agents. However, C324 and C338 grades provide additional chemical resistance.

Chemical resistance is affected by many issues such as temperature, concentration, etc. Over the years the manufacturer collected substantial application and laboratory testing information and will be pleased to review any application involving aggressive media. However, the following table provides some information regarding the chemical resistance of standard grades and C324 / C338:

	A	B
Acetaldehyde	N	N
Acetic Acid 75%	N	Y
Acetic Acid Glacial	N	N
Acetone	N	N
Alcohol, Amyl	Y	Y
Alcohol, Butyl	N	Y
Alcohol, Ethyl	N	N
Ammonia Liquified Gas	N	N
Ammonia Gas	N	N
Ammonium Hydroxide	N	N
Benzene	N	Y
Bleaches		
- Calcium Hyperchlorite	Y	Y
- Chlorine Dioxide Wet	Y	Y
- Hydrogen Peroxide	Y	Y
- Lithium Hyperchlorite	Y	Y
- Peroxides Dilute	Y	Y
- Sodium Hyperchlorite < 18%	Y	Y
Brine	Y	Y
Bromine Dry Gas	N	N
Bromine Liquid	N	N

	A	B
Carbon Dioxide Gas	Y	Y
Carbon Monoxide Gas	Y	Y
Carbon Tetrachloride	Y	Y
Carbon Tetrachloride Vapour	Y	Y
Chlorine Hydrochloric Acid Wet 10%	Y	Y
Chlorine Dry Gas	Y	Y
Chlorine Wet Gas	Y	Y
Chloroform	N	N
Chromic Acid	N	Y
Citric Acid	Y	Y
Copper Nitrate	Y	Y
Cumene	N	Y
Cyclohexane	N	Y
Deionized Water	Y	Y
Demineralized Water	Y	Y
Detergents Organic pH 9-12	Y	Y
Detergents Organic pH > 12	N	Y
Diesel Fuel	Y	Y
Diethyl Ether	N	N
Distilled Water	Y	Y
Ethanol	N	N

A = C320 / C321 / C322 / C335 / C361 / C369 / C378 / C410
B = C324 / C338

Y = Acceptable in application
N = Unsuitable for application

All data refers to temperatures up to +50°C, beyond this consult TSS Product Management

Properties / Specifications

	A	B
Ethyl Acetate	N	N
Ethylene Glycol	Y	Y
Fatty Acids	Y	Y
Fluorine Gas	N	N
Formaldehyde	N	Y
Formic Acid	N	N
Gasoline/Petroleum Leaded	Y	Y
Gasoline/Petroleum Aviation	Y	Y
Gasoline/Petroleum Unleaded	N	Y
Glucose	Y	Y
Glycerine	Y	Y
Glycol	Y	Y
n-Heptane	Y	Y
Hexane	Y	Y
Hydrobromic Acid < 25%	Y	Y
Hydrobromic Acid 50%	N	Y
Hydrobromic Acid 60%	N	N
Hydrochloric Acid < 25%	Y	Y
Hydrochloric Acid 40%	N	Y
Hydrochloric Acid + Organics	N	N
Hydrofluoric Acid 10%	N	Y
Hydrofluoric Acid 20%	N	N
Hydrogen Bromide Wet Gas	Y	Y
Hydrogen Chloride Dry Gas	Y	Y
Hydrogen Chloride Wet Gas	Y	Y
Hydrogen Fluoride Vapor	Y	Y
Hydrogen Peroxide 30%	Y	Y
Iodine Crystals	Y	Y
Iodine Vapor	N	Y
Isopropyl Alcohol	N	Y
Jet Fuel JP-4	Y	Y
Kerosene	Y	Y
Lactic Acid	Y	Y
Latex Solution	N	Y
Magnesium Hydroxide	Y	Y
Mercury	Y	Y
Methyl Alcohol (Methanol) 5%	Y	Y

	A	B
Methyl Alcohol (Methanol) 100%	N	N
Methyl Ethyl Ketone	N	N
Naphtha	Y	Y
Naphthalene	Y	Y
Nitric Acid 5%	Y	Y
Nitric Acid 10%	Y	Y
Nitric Acid 20%	N	Y
Nitric Acid 40%	N	N
Oil Crude Sour	N	Y
Oil Crude Sweet	N	Y
Oleum	N	N
Olive Oils	Y	Y
Peroxide Bleach	Y	Y
Phenol	N	N
Phosphoric Acid	Y	Y
Potassium Hydroxide 25%	Y	Y
Potassium Hydroxide 45%	N	Y
Propylene Glycol	Y	Y
Sodium Chloride	Y	Y
Sodium Hydroxide 10%	Y	Y
Sodium Hydroxide 25%	N	Y
Sodium Hydroxide 50%	N	Y
Soy Sauce	N	Y
Soya Oil	Y	Y
Stearic acid	Y	Y
Styrene	N	Y
Sugar Beet Liquor	Y	Y
Sugar Cane Liquor	Y	Y
Sugar/Sucrose	Y	Y
Sulphuric Acid 25%	Y	Y
Sulphuric Acid 70%	N	Y
Sulphuric Acid 80%	N	Y
Sulphuric Acid 90%	N	N
Tetrachloroethane	N	Y
Toluene	N	Y
Trichloroethane	N	Y
Xylene	N	Y

A = C320 / C321 / C322 / C335 / C361 / C369 / C378 / C410
 B = C324 / C338

Y = Acceptable in application
 N = Unsuitable for application

All data refers to temperatures up to +50 °C, beyond this consult TSS Product Management

Swell

In Orkot® material the swell in water, a common issue when using polymers, is only minimal. Taking normal running clearances into account it is so small that no extra allowances are required.

Swell rate for Orkot® standard grades; expressed in change of the wall thickness <0.1% and for C324 and C338 grades <1%.

Food and Potable Water Contact

Within the Orkot® range of materials there are designated grades which are safe for contact with food, with all constituents listed by the Food and Drug Administration (FDA). The materials available include compounds which, by use of special resin systems, offer improved temperature and cleaning chemical resistance compared with many traditional plastic materials. The dispersed PTFE lubricant used by Orkot® is also FDA listed.

C322 (TLM) has been approved for cold water applications following extensive testing to BS 6920 (2000) in accordance with the Water Regulations Advisory Scheme (WRAS).

Further information on these approvals is available on request.

PV and Coefficient of Friction

A major advantage of Orkot® materials is their ability to withstand high loads with intermittent / oscillating movement. However, as with many polymer bearing materials, consideration must be given to the sliding faces causing frictional heat if moving for long periods.

Additives included in Orkot® materials reduce the coefficient of friction and thus the heat generation. This can be further improved by use of external lubricants in the form of oil, grease, water or other process chemicals.

Many factors effect the coefficient of friction for a bearing, particularly the counter face surface finish, bearing pressure and contamination. The continuous operation of any plain bearing is limited by frictional heat generation.

Please contact TSS Product Management for assistance if the coefficient of friction is critical to an application.

For information, the following table indicates some typical values found in oscillating motion with bearing pressures between 10 N/mm² and 80 N/mm²:

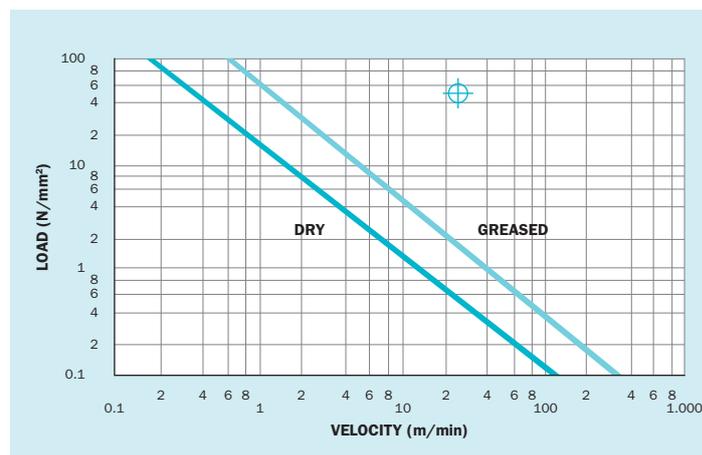
Orkot® Grade	C320	C322	C338	C369	C378	C410
Counter Face	Chrome Steel	316 S/Steel	316 S/Steel	34CrNiMo6 (EN24)	316 S/Steel	316 S/Steel
Lubrication	Hydraulic Oil	Water	Dry	Dry	Dry	Dry
Static Coefficient of Friction	0.13	0.28	0.25	0.10	0.10	0.10
Dynamic Coefficient of Friction	0.07	0.18	0.13	0.05	0.05	0.05

Un-lubricated or Boundary Lubrication Conditions

Tests have indicated a continuous running PV for C320 of $14 \text{ N/mm}^2 \cdot \text{m/min}$ when operating dry and $34 \text{ N/mm}^2 \cdot \text{m/min}$ when grease lubricated.

- Typical PV graph for C320 shows limits for continuous operation.
- Higher PV values are successfully used with intermittent movement. (Consult TSS Product Management).

The PV value in application is affected by many factors including counter face surface finish, bearing pressure and speed and the test values indicated above should be used as a design guide only. For intermittent movement, PV values higher than these can be used if the period of movement is short enough to prevent excessive frictional heat generation. An example of this is indicated on the graph (\oplus) for components in a lifeboat launching mechanism having a PV of $1250 \text{ N/mm}^2 \cdot \text{m/min}$.



Hydrodynamic Applications

In high-speed applications in the presence of water or water based liquids, such as pump bearings and hydropower turbine main shaft bearings, hydrodynamic running may be achieved and considerably higher PV values are possible.

The following criteria must be met for hydrodynamic running:

1. Velocity / pressure > 320 where,
 - velocity is the surface speed, m/min
 - pressure is the load/projected bearing area, N/mm^2 .
2. A positive flow of water is provided

The performance of a polymer bearing is affected by various parameters and any quoted values are relevant to the test conditions only. TSS have many years of experience of supplying Orkot® for a wide range of applications, supported by extensive laboratory testing results, and are able to offer advice for any situation.

Please contact TSS Product Management for assistance with any applications.

Grease Lubrication

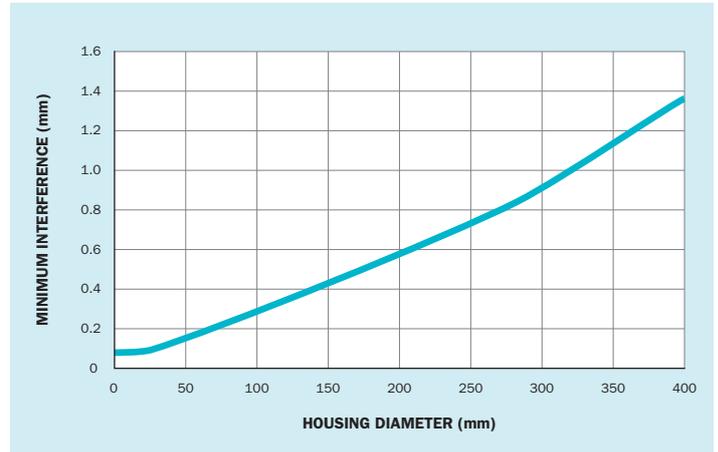
The majority of commercially available lubricants are acceptable for use with Orkot®. Grease may need to be refreshed at regular intervals to ensure it does not dry out. The use of heavily filled grades containing a high percentage of solid lubricants may interfere with the lubricants in the Orkot® material. Therefore, in general the use of such lubricants is not recommended. However it depends from the application, if required careful testing is suggested.

Interference Fit

Within the range -30 °C to +65 °C, bushes are preferably fitted with interference, and fully supported over the length of the bush. Because of the nature of polymer materials, the interference will necessarily be higher than for metallic bearings. Thus the machined dimensions will need to be modified when changing from metal to Orkot® .

The value of interference varies with the size of the bush and is a balance between the wall pressure and hoop stress. The interference between bush and housing creates a wall pressure between the two parts. This needs to be above a minimum value to ensure that the bush does not move in application. However, excessive interference will lead to hoop stresses in the bush above the design limit of the material, resulting in permanent material deformation.

The interference level also varies with wall thickness and minimum temperature expected during operation. A typical interference curve is indicated on the graph:



This interference is used with the housing and bush diameter machining tolerances to determine the bush outside diameter. The use of an interference fit to hold a bearing requires a reasonable machined tolerance on the housing bore, typically BS EN 20286-2:1993 H7.

Wall Thickness

To allow the correct balance of wall pressure and hoop stress with an interference fit, a minimum wall thickness is required for bushes. The minimum wall thickness indicated below should also be used where possible since excessive wall thickness can result in increased clearance requirements to accommodate thermal expansion and swell if used in water. Also, the lower wall thickness allows more accurate control of final fitted bush size.

Thinner wall sections can be used depending on the application details. Please inquire if a thinner wall thickness is required to fit existing hardware. Alternatively, thin walled bushes can be fitted using adhesive or designed as a split ring mounted in a closed groove.

Shaft Diameter (mm)	Minimum Wall Thickness (mm)
6 – 25	1.5
26 – 50	2.5
51 – 75	3.5
76 – 100	5.0
101 – 150	6.5
151 – 200	8.0
201 – 280	10.0
280 – 400	12.0
400 +	Consult TSS

Machining Tolerances

The following tolerances should be used for the diameters of the Orkot® bush:

Please note that for bearings with a length to diameter ratio over 1, a larger tolerance may be required.

Bearing Outside Diameter (mm)	Manufacturing Tolerance (mm)
10 – 200	0.05
201 – 400	0.10
> 400	Consult TSS

Clearance

All results are based on a standard temperature of +20 °C. The clearance values used for Orkot® bearings, with shaft diameter of "D", are:

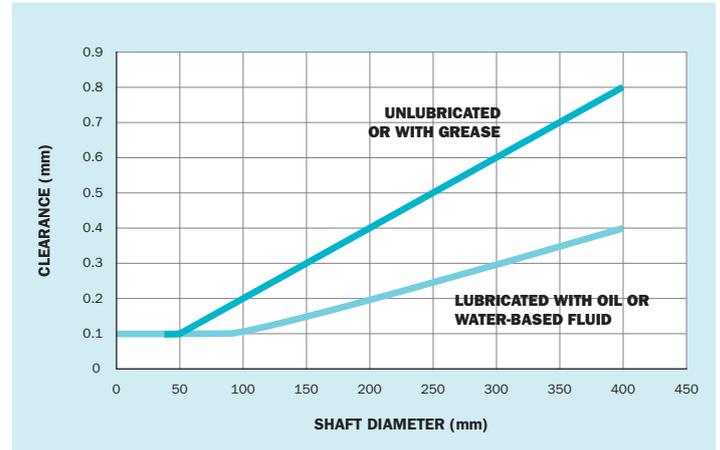
- $0.001 \times D$ for oil or water-based fluid lubricated.
- $0.002 \times D$ for dry running or grease lubricated.

With a minimum of 0.1 mm generally applied in both cases.

The graph indicates the minimum clearances that should generally be used. Certain applications may require reduced clearances. Please consult TSS Product Management if special clearances are required.

The clearance between shaft and a fitted bush depends on the combined dimensions and tolerances of the bush, housing and shaft. Greater control over the clearance can be achieved by fitting the bush with adhesive or machining the bore of the bush after assembly in the housing.

Shaft tolerances should be in line with BS EN 20286-2:1993 g6 or better to control clearance levels.

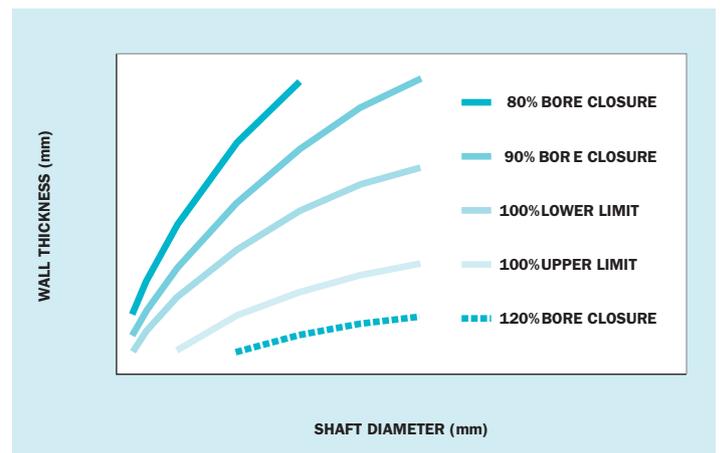


Bore Closure on Assembly

When a bush is assembled in a housing with an interference, the reduction in OD is transferred to a reduction in fitted ID.

When the recommended wall thickness and interference are followed, 100% of the interference is transferred as a reduction in the ID.

With a thick-walled bush, not all of the interference may be transferred to the ID. Conversely, for thin-walled bushes, a high level of interference may result in the wall thickness increasing, effectively resulting in more than 100% transfer. This effect is also governed by the interference between bush and housing. A typical Bore closure graph is indicated below:



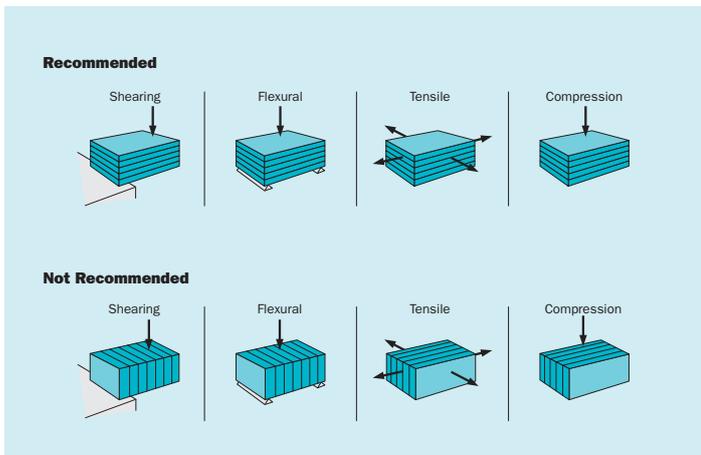
Design service

The correct design of a bush, including clearance on the shaft and interference in the housing, depends upon many factors.

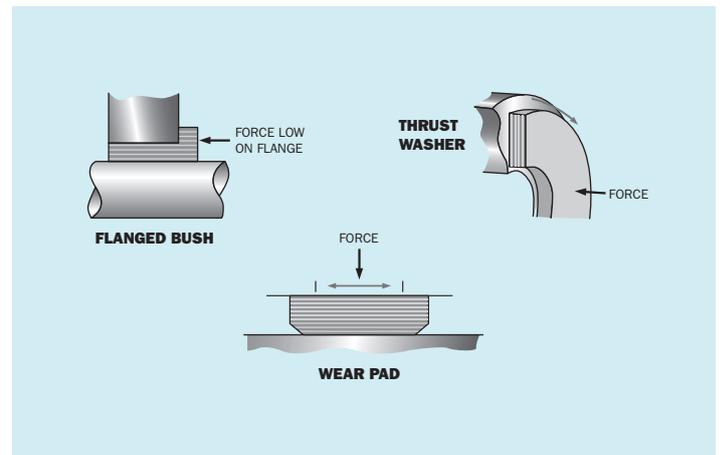
Trelleborg Sealing Solutions is prepared to review any application and provide technical recommendations including calculation of bush dimensions.

Lamination Direction

As with all laminated materials, the best results are obtained with the bearing surface parallel to, or concentric with, the layers of the fabric. For example, loads on the end of a flanged bush may require a separate thrust washer.



Care must be taken with the design of components subject to compression, bending or shear loads along the direction of lamination.



Counter Face

The counter face has a major effect on the performance of a polymer bearing. The surface finish should preferably be between $0.1\ \mu\text{m}$ and $0.8\ \mu\text{m}$ Ra, and between $0.4\ \mu\text{m}$ and $0.8\ \mu\text{m}$ Ra for grades C369 and C378. There should be no sharp edges and any grease paths or other surface discontinuities. Shafts can have drilled holes to feed grease to the sliding area.

Circular grooves should be machined in the bearing matching the grease feed line, to facilitate grease distribution as well as to prevent damage of the bearing surface at this location. Orkot® materials are successfully used against many different counter face materials, including hardened steel, stainless steel (i.e. 316 or Duplex), gunmetal, chrome plated steel, ceramic coated steel and nitrided surfaces.

Installation

Where possible, Orkot® bushes should be mounted with an interference fit, with the bearing fully supported over its full length. Suitable shallow chamfers should be used on the housing to prevent damage and bushes should be assembled with a press or drawing-in method. Sharp hammer blows directly onto the Orkot® should be avoided to reduce the possibility of damage to the bush. Correctly shaped drifts should be used. Alternatively, freeze fitting using liquid nitrogen or dry ice can be used without any danger of shattering.

If operating above $+65\ ^\circ\text{C}$ bonding with an adhesive is recommended. Use of an interference fit, combined with thermal expansion of the bush, can induce stresses in the bush above its elastic limit. The bush may then become loose at low temperatures.

Orkot® can be fitted using various readily available adhesives. Please consult TSS Product Management if any advice is required.

Please contact TSS Product Management for further details of this method if required.

Pads can be retained using counter-sunk bolts. For highly loaded parts, keeper plates or metal washers should be used to provide a more secure fixing method. Alternatively, pads can be recessed in pockets in the carrier.

Application Checklist

To ensure the correct grade of Orkot® is chosen, and the component design optimized, it is important that all application details are considered.

- Bearing load
- Speed
- Type of movement (rotation or sliding)
- Duty cycle
- Lubrication present

- Chemical or abrasive contamination
- Counter face material and surface finish
- Temperature range of operation
- Application details, what problems are occurring and need to be resolved by using Orkot® .
- Is electrical insulation important?

Machining Orkot®

General

Orkot® materials are readily machinable by conventional machine shop techniques. As a general guide, methods used for brass, aluminium or lignum vitae will apply for Orkot® materials. It is preferable to use tungsten carbide turning tools with cutting speeds of 5.5 meters per second. Orkot® materials must be machined dry without the use of coolant.

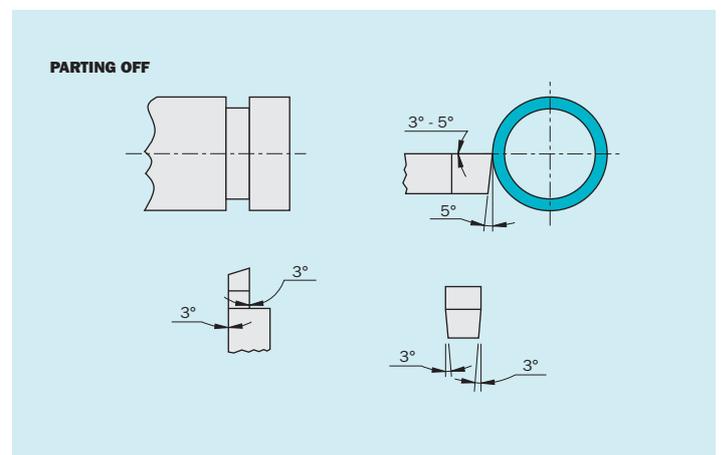
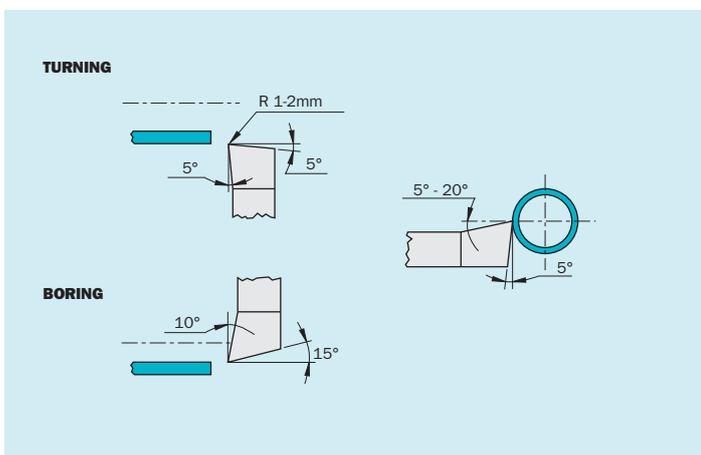
Turning

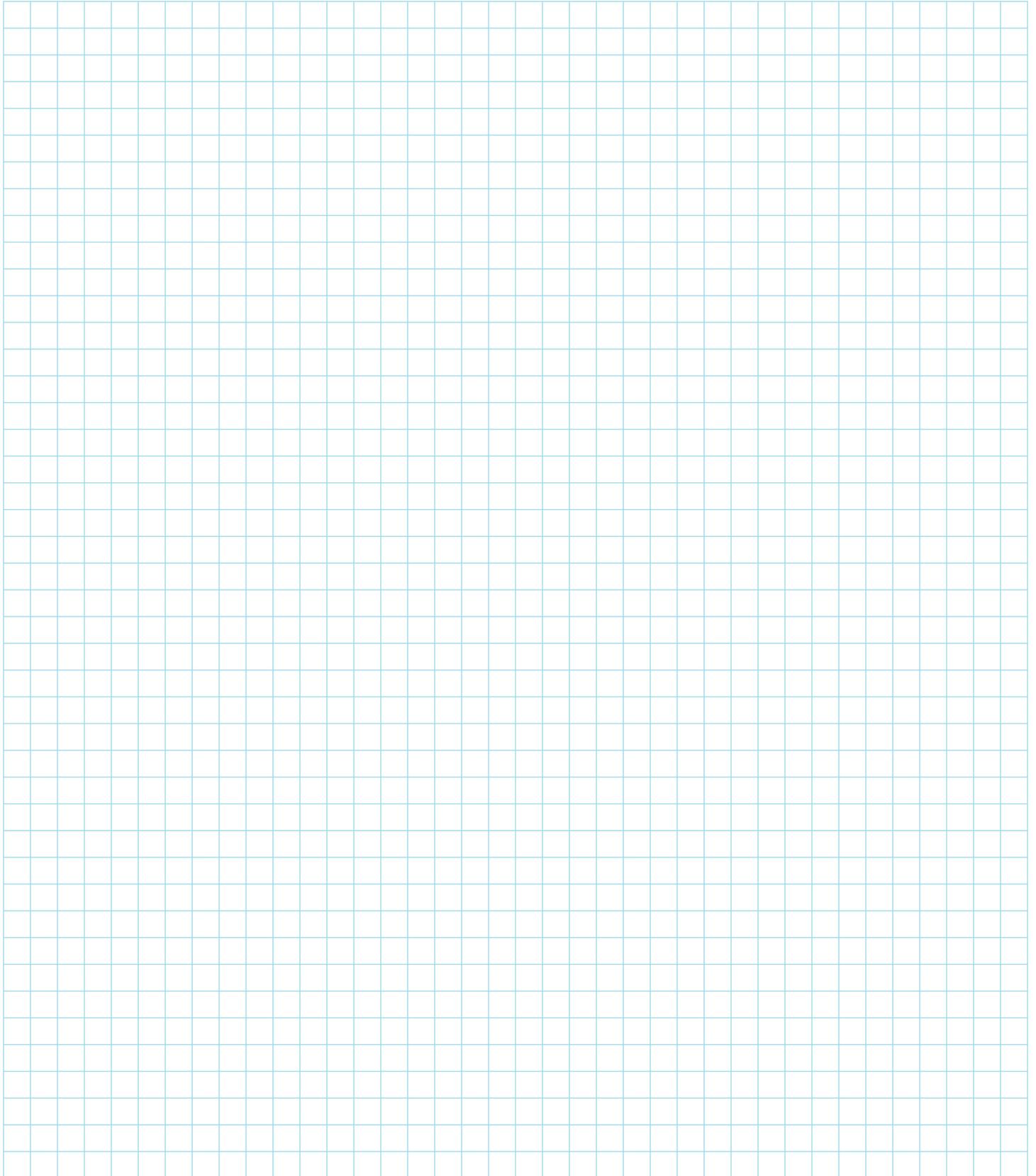
Tungsten carbide tooling of the butt-welded type using K20 grade carbide is suitable for most applications. If carbide inserts are used then aluminium grades with high positive rakes give best results e.g. Plansee grade H10T.

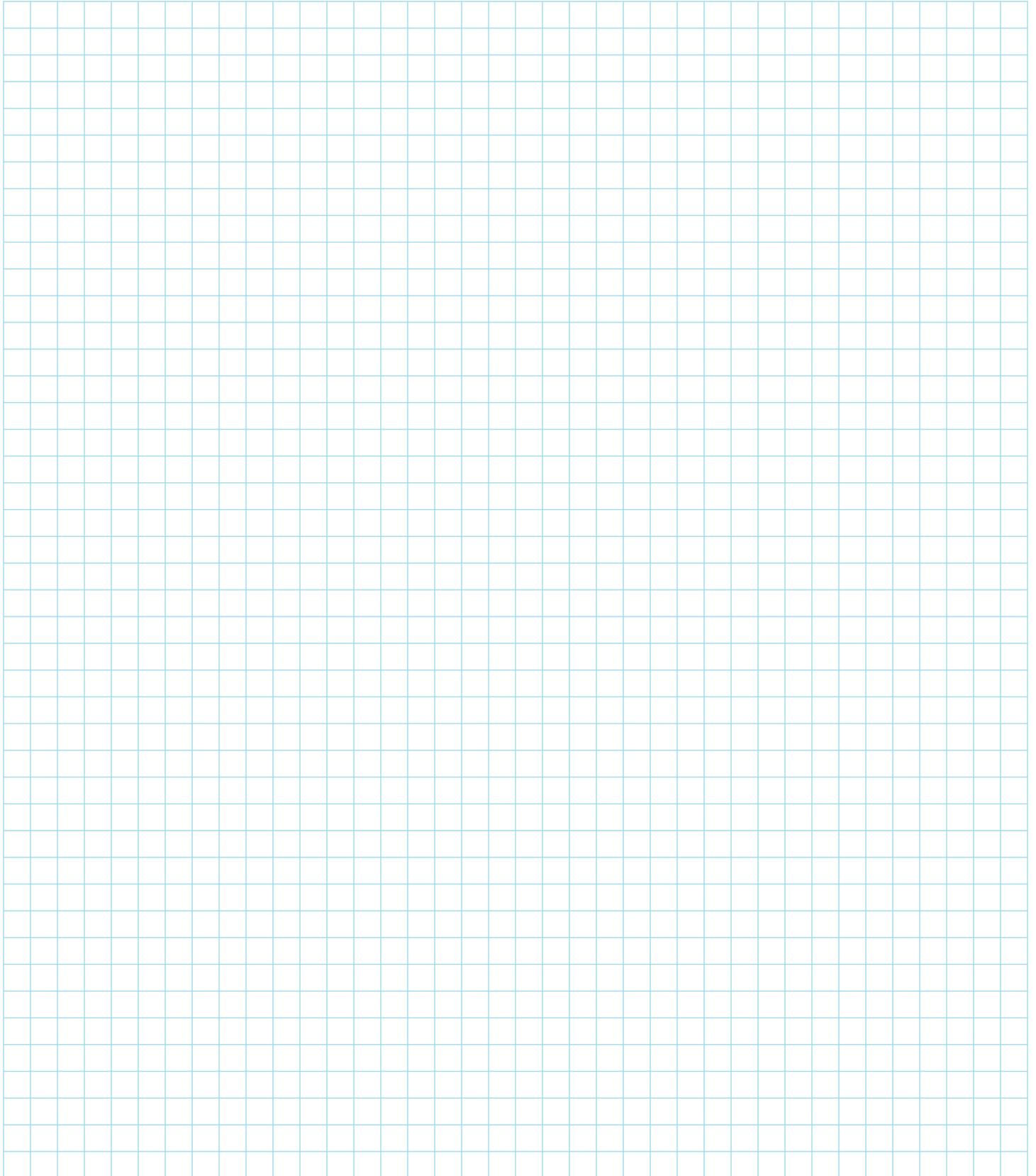
For heavy wall thickness, the internal and external diameters should be machined together to reduce vibration.

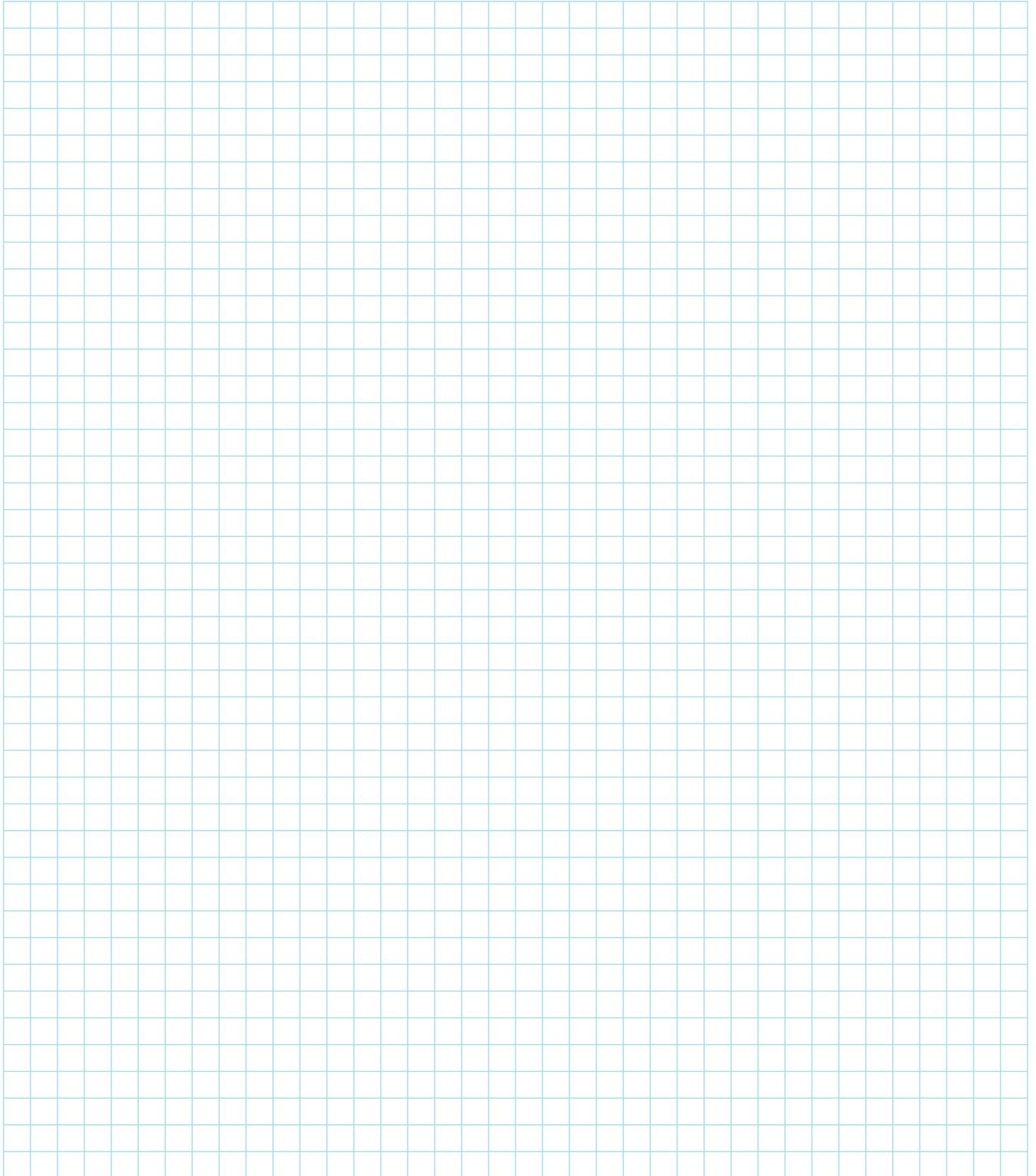
No asbestos is used in the manufacturing of Orkot® and the material is completely non toxic. It is however advisable to use adequate dust extraction when machining. If unavailable, operators should wear dust particle masks.

For small volume work and machining of chamfers, radii and other forms, then high-speed steel gives good results, but tool life is shorter than with tungsten carbide.









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Orkot[®] Hydro Bearings



Your Partner for Sealing Technology

A Global Approach

Orkot® is a world-leading brand of composite bearing material, with Orkot® hydro bearings being specified for the hydro industry. Orkot® is manufactured by three Trelleborg Sealing Solutions manufacturing plants in the Americas, Europe and Asia, and is sold through an extensive global network of regional marketing companies, agents and distributors. Orkot® hydro bearings are offered at the highest level of quality and service expected from a leading global company. Orkot® hydro bearings have been successfully installed in American, European and Asian hydro markets for the past 20 years.



Hydro bearing materials

Orkot® TXMM Bearings

Key Features

- **Low coefficient of friction** – Orkot® TXMM bearings exhibit a very low coefficient of friction whether operating in a wet or dry application. Another benefit of the Orkot® material is that the coefficient of friction is reduced as the load increases.

- **Self-lubrication** – The addition of solid lubricants during the manufacturing process enhances the bearings self-lubricating properties, thereby allowing the bearings to operate without the benefit of oil, grease or water lubrication, while at the same time demonstrating low coefficients of friction.
- **Excellent dimensional stability** – Orkot® TXMM has virtually no swell in water.
- **High load capabilities** – Orkot® TXMM bearing material has high ultimate compressive strength and yield strength. Generally, Orkot® TXMM bearing material fits within the same design envelope as traditional bronze bearings.
- **Proven wear resistance** – The excellent wear resistance of Orkot® TXMM material has been proven over many years of service in hydro, marine and civil engineering applications.
- **Environmentally-friendly** – Orkot® low-friction bearings require no lubrication, eliminating any pollution concerns associated with petroleum-based greases or lubricants.
- **Excellent shock capabilities** – Orkot® TXMM material has excellent shock load capabilities, making it ideal for use in hydropower applications where frequent high impact and low amplitude oscillation cause a pounding out that can shorten bearing life or lead to bearing failure.
- **Easily machined** – Orkot® TXMM material is easily machined using conventional machining techniques, and as a general guide may be treated as aluminum or bronze and must be machined dry. Its exceptional mechanical and physical properties lend it to the tight running clearances associated with the hydro industry.
- **Operates in wet and dry conditions** – The unique formulation is suitable for wet and dry operating conditions.
- **Outstanding edge loading capabilities** – The mechanical properties of Orkot® TXMM material allows the bearing to operate effectively under severe edge loading conditions.

Characteristics

Orkot® TXMM is an advanced, reinforced, medium-weave polymer material incorporating a unique low-friction bearing surface, and with the addition of solid lubricants greatly reduces the coefficient of friction.

Supplier of Composite Bearings

In areas without lubrication, such as upper wicket gate/guide vane bearings, Orkot® TXMM bearing material has been especially effective in eliminating stick-slip problems associated with dry running conditions, giving the material a broad range of hydro applications.

Qualifications & References

- Stringent quality procedures are maintained to ISO 9001 standards, allowing full traceability of product from raw materials to finished parts.
- Orkot® TXMM bearing material has been tested at Power Tech Laboratories at the specific request of the U.S. Army Corps of Engineers and is approved for use in hydro applications.
- In Europe, Orkot® materials have been exhaustively tested by technical institutions and end users, including Dinorwig Power Station in the UK. Dinorwig Power Station has performed extensive field testing of Orkot® TXMM bearing material with excellent results.

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- Technical assistance providing complete design recommendations and drawings for your specific application
- Extensive support service is complimented by a comprehensive range of technical documentation and the Orkot® hydro bearing calculation program.
- Calculation of bearing dimensions for internal or on-site machining is also available.
- On-site engineering and technical assistance is available upon request

Availability

Orkot® TXMM bearing products can be supplied fully machined to specifications and is also available in tube and sheet forms.



Applications

Orkot® TXMM bearing material has a wide range of proven applications, including:

- **Wicket gate/guide vane bearings**
- **Wicket gate linkage bearings**
- **Vertical/horizontal main guide bearings**
- **Trash rake bearings & wear pads**
- **Lock gate bearings**
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- **Segmented face seal rings**
- **Fish pump steady bearings**
- **Bulkhead wear pads**
- **Spillway gate trunnion bearings**
- **Spillway gate thrust washers**

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www.tss.trelleborg.com

Global Head Office

Trelleborg Sealing Solutions Rotherham
Bradmarsh Business Park
Rotherham S60 1BX United Kingdom

Tel: +44 (0) 1709 789 826
Fax: +44 (0) 1709 374 819

North & South America

Trelleborg Sealing Solutions Streamwood
901 Phoenix Lake Avenue
Streamwood, Illinois 60107 USA

Tel: +1 (630) 289 1500
Fax: +1 (630) 289 5434



Orkot[®] Hydro Bearings



Your Partner for Sealing Technology

A Global Approach

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Hydro bearing materials

Orkot® TXMM Bearings

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- **Excellent dimensional stability** – Orkot® TXMM has virtually no swell in water.
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www.tss.trelleborg.com/us

Global Head Office

Trelleborg Sealing Solutions Rotherham
Bradmarsh Business Park
Rotherham S60 1BX United Kingdom

Tel: +44 (0) 1709 789 826
Fax: +44 (0) 1709 374 819

North & South America

Trelleborg Sealing Solutions Streamwood
901 Phoenix Lake Avenue
Streamwood, Illinois 60107 USA

Tel: +1 (630) 289 1500
Fax: +1 (630) 289 5434



Orkot[®] TLM & TXM Marine Bearings



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A Global Approach

Trelleborg Sealing Solutions is a world-leading manufacturer and supplier of bearings and bearing materials to the shipping and marine industries.

Supported by an extensive global network of manufacturing plants, agents and distributors, we are able to offer the highest levels of quality and service associated with a leading global company.

Part of the Trelleborg group of companies, Orkot® Marine Bearings has been active within the marine and shipping industry for over 25 years.

Apart from Marine bearings, Trelleborg offers a broad variety of products for on-deck machinery and other equipment. The product range includes o-rings, static, linear and rotary seals, wear rings, scrapers, bearings and custom made elastomer and plastics parts.



TLM Marine Characteristics

Orkot® TLM Marine is an advanced, reinforced polymer (sometimes called synthetic polymer alloy) solid lubricants. The material has exceptional wear resistance and virtually no swell in water, providing dimensional stability.

Orkot® TLM Marine tolerates edge loading and misalignment even with the heaviest loads.

Orkot® Marine Bearings are installed with an interference fit. Bearings are normally freeze fitted using liquid nitrogen but can be press fitted or resin chocked as required.

Where there are extended periods without lubrication, such as upper pintle bearings under light ballast conditions, Orkot® TLM Marine proves especially effective.

TXM Marine Characteristics

Orkot® TXM Marine is an advanced reinforced medium weave polymer material (sometimes called synthetic polymer alloy) using a unique manufacturing process that provides a high concentration of PTFE in the sliding area while maintaining high compressive strength. The PTFE layer is several millimetres thick, making it tolerant to wear, while maintaining its low friction properties throughout the service life of the bearing. The PTFE layer is backed by our well known polymer, Orkot® TLM Marine giving a truly homogeneous bearing material without a metal backing layer.

In areas where the running conditions are dry, Orkot® TXM Marine has proved particularly effective in eliminating stick-slip problems normally associated with these operating parameters. The special PTFE layer provides for similar mechanical properties to Orkot® TLM Marine, but with substantially reduced friction and wear characteristics.

Service and Support

Orkot® Marine Bearings has a team of experienced and highly skilled engineers who offer a full and complete service tailored to your specific requirements. Some aspects of this service are:

- Recommendations on adapting our bearings to specific environmental and operational conditions
- Calculation of bearing dimensions for internal or on site machining
- Technical assistance with bearing installations
- Full technical backup and support throughout the service life of the bearing
- 24 hour emergency support

This extensive support service is complimented by a comprehensive range of technical documentation and the Orkot® Marine Bearing Calculation program.



World Wide Web

Visit our website for general and technical information on Orkot® marine products and applications. You will also be able to view and download certificates, literature and other documents.

www.orkotmarine.com

For information on Trelleborg's entire portfolio of sealing & bearing solutions please look under www.tss.trelleborg.com

World Wide Availability

Orkot® TLM & TXM Marine stock tubes can be shipped same day via our world wide distribution network. In addition we can manufacture specific sizes in both tube and sheet form within 24 hours and can supply a full range of finished-machined products quickly and economically.

Quality & Classification

ISO 9001 approval is held for all manufacturing operations and internal systems while in-house testing resources are used extensively to simulate the extreme operational environments where the material is used.

Orkot® TLM and TXM Marine is approved by all major marine classification societies including: Lloyds, DNV, ABS, GL, BV and NKK. Copies of our approval certificates can be viewed and downloaded from our websites.

Mechanical Properties

	TLM Marine metric	TLM Marine inch	TXM Marine metric	TXM Marine inch
Compressive Strength Normal to Laminate Parallel to Laminate	300 N/mm ² 90 N/mm ²	43,500 lbs/in ² 13,000 lbs/in ²	280 N/mm ² 90 N/mm ²	40600 lbs/in ² 13000 lbs/in ²
Tensile Strength	60 N/mm ²	8700 lbs/in ²	55 N/mm ²	8000 lbs/in ²
Flexural Strength	65 N/mm ²	9400 lbs/in ²	65 N/mm ²	9400 lbs/in ²
Shear Strength	80 N/mm ²	1600 lbs/in ²	80 N/mm ²	11600 lbs/in ²
Impact Strength Charpy Impact Unnotched Normal to Laminate	120 KJ/m ²	0.079 KJ/in ²	120 KJ/m ²	0.079 KJ/in ²



	TLM Marine metric	TLM Marine inch	TXM Marine metric	TXM Marine inch
Hardness - Rockwell M	90	90	90	90
Density	1.3 g/cm ³	0.047 lbs/in ³	1.3 g/cm ³	0.047 lbs/in ³
Swell in water, % of wall thickness	0.1%	0.1%	0.1%	0.1%
Thermal Expansion Coefficient 20 – 100 °C (per °C x 10⁻⁵) 68 – 212 °F (per °F x 10⁻⁵) Normal to Laminate Parallel to Laminate	9 - 10 5 - 6	5.0 - 5.5 2.7 - 3.3	9 - 10 5 - 6	5.0 - 5.5 2.7 - 3.3
Sliding Properties Typical coefficient of friction running dry against a corrosion resistant surface such as stainless steel. Bearing Pressure 15N/mm ² /2175 lbs/in ²	0.13	0.13	0.05	0.05

Orkot® TLM & TXM Marine Bearings – Proven Benefits:

- Extensive stock available
- Classification approval for up to 15N/mm²
- Virtually no swell in water
- Environmentally friendly
- 24 hour turnaround for non-stock sizes
- Approved dry running capability
- Low coefficient of friction
- Tolerant to edge loading



Applications

Orkot® TLM & TXM Marine is used in a wide range of proven applications, including:

- Rudder bearings
- Water lubricated propeller shaft bearings
- Stabilizer bearings
- Weapons handling bearings and guide strips
- Deck machinery bearings
- High strength synthetic rope termination bushings
- Offshore mooring system bearings
- Steering and diving system bearings
- Steering gear bearings
- Stern roller bearings
- Slipway pads
- Sonar bushings and guide strips
- Low magnetic permeability materials for mine counter measure vessels
- Door bushes
- Crane mast bearings

Contacts:

Trelleborg Sealing Solutions has two specialized business centers for Orkot® marine bearings.

Trelleborg Sealing Solutions Rotherham

Bradmarsh Business Park
Rotherham S60 1BX United Kingdom

24 Hour Emergency Line:

Email: enquiries@orkotmarine.com
www.orkotmarine.com

Tel: +44 (0)1709 789 828
Fax: +44 (0)1709 789 802

+44 (0)1709 789 840

Trelleborg Sealing Solutions Streamwood

901 Phoenix Lake Avenue
Streamwood, IL 60107 USA

24 Hour Emergency Line:

Email: tssusa@trelleborg.com
www.orkotmarine.com

Tel: +1 (630) 289 1500
Fax: +1 (630) 289 5434

+1 (800) 546 7568

www.orkotmarine.com

For information on Trelleborg's entire portfolio of sealing & bearing solutions please look under

www.tss.trelleborg.com



Zurcon[®] Roto Glyd Ring[®] S



Your Partner for Sealing Technology

Zurcon[®] Roto Glyd Ring[®] S

The new Zurcon[®] Roto Glyd Ring[®] S comprises a polyurethane profile ring and an elastomer energising ring. The seal is double-acting and can be exposed to pressure from one or both sides.

Application examples:

- for sealing shafts, rods and rotary transmission leadthroughs with slow rotary or oscillating movement
- can also be used to seal rotary joints at increased rotating speeds even when exposed to pressure, e.g. rotary indexing tables
- rotary connections with swivel movement, even when exposed to high pressure, e.g. clamping units

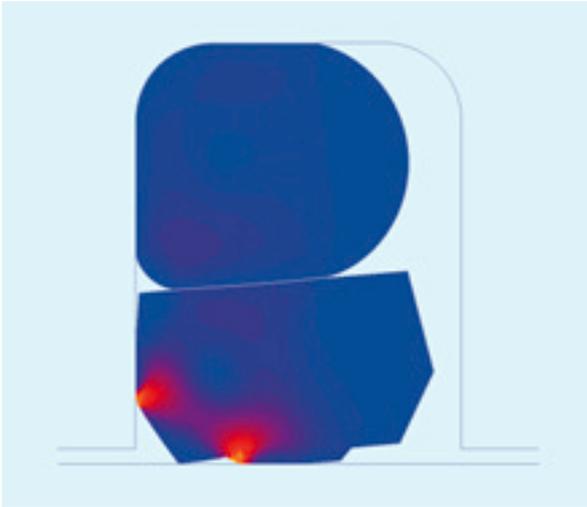
Advantages:

- available for inside and outside sealing
- low friction
- extremely wear-resistant
- high extrusion resistance
- simple groove design
- easy to assemble, no recalibration required
- the excellent lubrication conditions and hydraulic pressure balance can significantly improve friction and wear characteristics and therefore service life

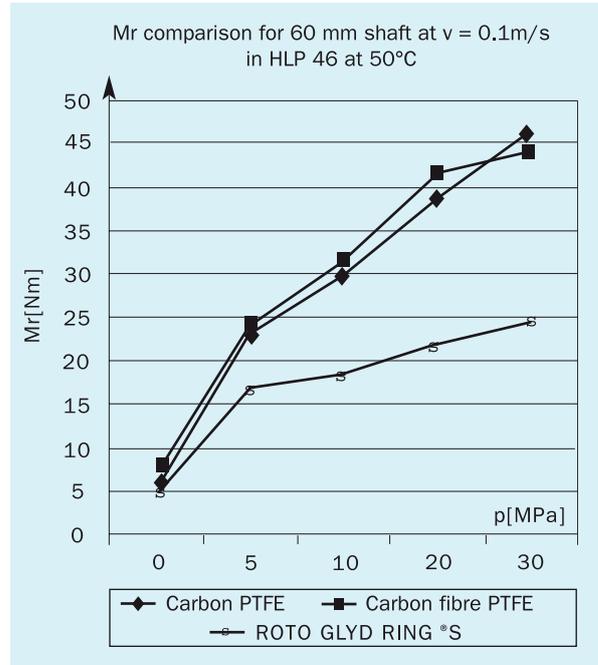
Zurcon® Roto Glyd Ring® S Compound Data

Reduced contact surfaces under all operating conditions significantly improve friction and wear characteristics. When exposed to low pressure, only the central section of the seal comes into contact with the mating surface.

As the system pressure increases, the sealing ring is tilted slightly generating the hydrostatic pressure balance in the sealing gap. Tilting the ring under pressure optimises the lubrication between the seal and the mating surface.



The fact that the profile is supported by a second edge restricts contact with the shaft, thereby significantly reducing friction and wear. The material used for the energising ring can be adapted to suit operating conditions. The angle on both sides of the polyurethane ring prevents extrusion into the extrusion gap.



	Z 52	Z 80
Material	Polyurethane (PUR)	Ultrahigh molecular weight PE
Material hardness, Shore D	58	52
Pressure	up to 30 MPa	up to 30 MPa
Speed/Pressure (below 360°)	up to $p \cdot v$ 6.5 MPa x m/s	up to $p \cdot v$ 6.5 MPa x m/s
Temperature	-30 to +100 °C	-30 to +80 °C
Media (hydraulic fluids)	- mineral oil base - synthetic and natural ester HEES, HETG up to +60 °C - flame-retardant hydraulic fluids HFA, HFC Z80 is recommended for sealing e.g. coolants or air	

These indications are based on laboratory values. The application limits for pressure, temperature, speed and media are maximum values determined in the laboratory. During practical applications it should be remembered that due to the interaction of the operating parameters the maximum values must be set correspondingly lower. It is vital that customers satisfy themselves as to the suitability of individual products through adequate testing. For exceptional operating conditions please contact your Trelleborg Sealing Solutions representative. The data sheet is not subject to an updating service.

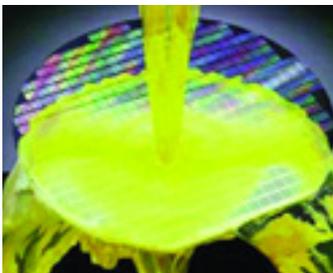
www.tss.trelleborg.com

Semiconductor sealing solutions



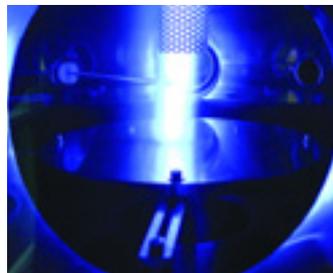
Your Partner for Sealing Technology

Optimum semiconductor sealing solutions



Wet process applications

Wet process sealing options combine continuous mid-range operating temperatures with excellent performance in ultra pure de-ionised water and a low level of extractable total organic carbon.



Aggressive plasma systems

Seals can meet the needs of aggressive plasma applications for ultra high purity, cleanliness, reliability and long life, demonstrating minimal particulation and extremely low outgassing.



The semiconductor manufacturing process is extremely aggressive and seals are invariably housed in areas of the processing system where they need to withstand highly corrosive liquids, gases and plasmas often at elevated temperatures or in vacuum conditions. Trelleborg Sealing Solutions are a leading developer and manufacturer of high performance sealing options and we work with our customers to help them establish the optimum seal material and design to maximise the performance of semiconductor manufacturing equipment. This can result in increased service life and extended mean time between planned maintenance (MTBM) thereby reducing downtime and maximising production efficiency and yields, process reliability and minimising overall cost of ownership.

The considerable practical experience of Trelleborg Sealing Solutions in solution provision allows us to recommend the best possible option from our extensive range of innovative seal materials and products, many specifically engineered to meet the increasingly demanding requirements of the industry and to provide exceptional sealing integrity. We provide a single source for the majority of semiconductor equipment sealing requirements including the most stringent within critical manufacturing processes.

The range of products offer:

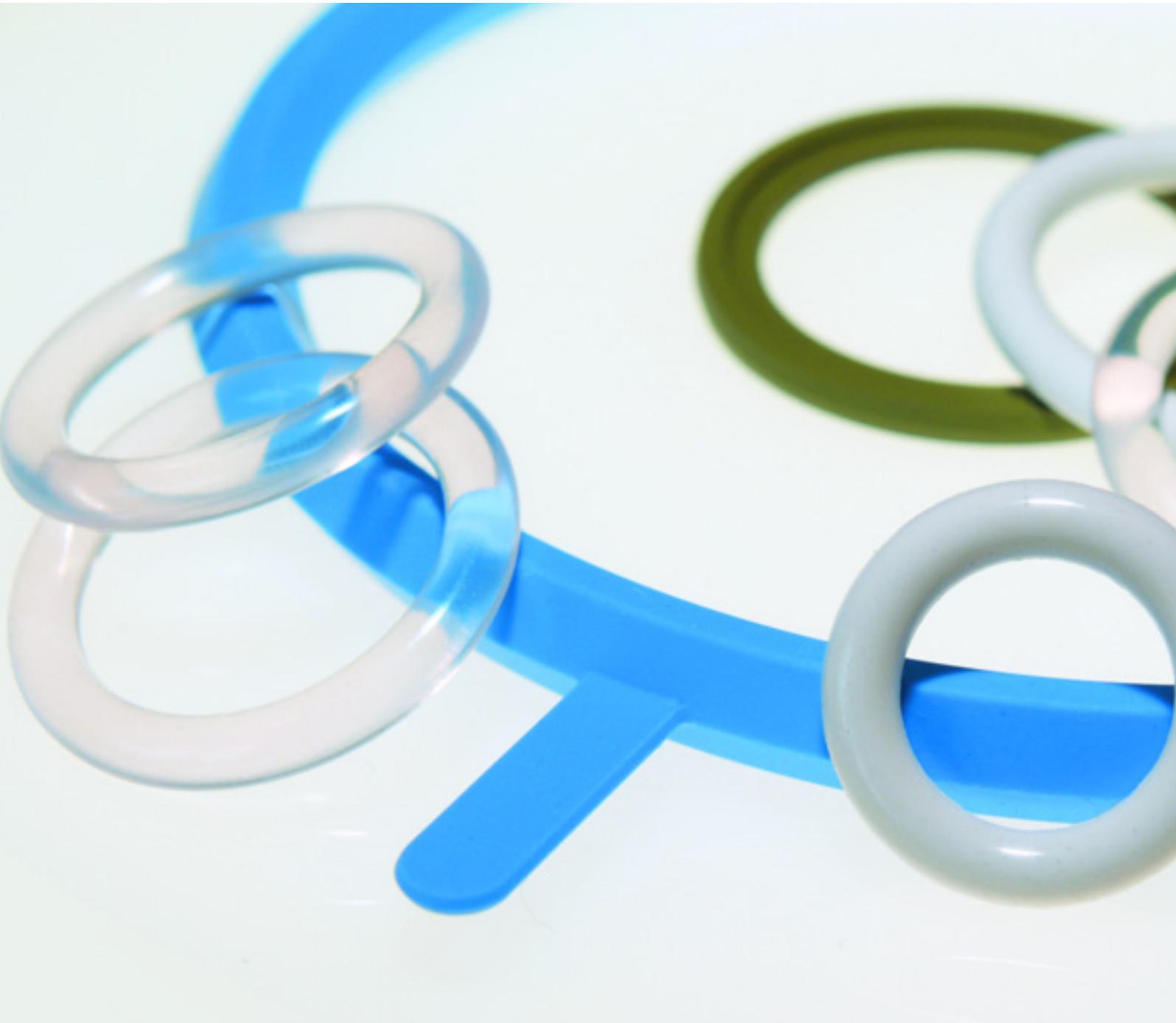
- Temperature resistance from cryogenic up to 850 °C
- Almost universal chemical resistance; withstanding aggressive fluids including acids, bases, solvents amine based strippers and gases, chlorinated cleaning gases, oxygen and fluorine plasmas
- Excellent stability both thermal and when operating within a vacuum or under pressure
- Extremely low levels of ionic impurities (anionic and cationic) and TOCs (Total Organic Carbon)
- Minimal particle generation and outgassing even at elevated temperatures
- Low permeation rates
- Reduced IR absorption and weight loss
- Good mechanical performance
- Low long-term compression set
- Resistance to dry and wet process chemistry



High temperature resistance

The challenge of continuous high temperature operation requires high performance materials, which minimise outgassing even when sealing aggressive chemicals and media.

High performance elastomer sealing technology



Crystal clear elastomer
A specially developed translucent elastomer offers a sealing solution with an extremely low level of ionic impurities.



Isolast® Fab Range™
The ultimate in elastomer sealing, these virtually inert and almost universally chemical compatibility materials have been specifically designed to operate effectively in aggressive semiconductor processing systems.



Breadth of range

Due to the breadth of range offered by Trelleborg Sealing Solutions, designers can specify seals that meet the challenge of balancing cost effectiveness with performance. Any size of O-Ring (standard or custom) is available alongside custom moulded designs and bonded products; in materials ranging from basic elastomer grades to leading edge, high specification compounds, specifically developed for semiconductor equipment applications. These innovative compounds help reduce downtime and improve production efficiency by extending seal life.

Advanced elastomer seals

Fluoroelastomer (FKM) seals are ideal for downstream applications such as vacuum pumps and wet process applications where temperatures do not exceed 180°C. These materials exhibit excellent resistance to a wide range of chemicals deployed in the semiconductor industry, whilst offering high purity with low permeation and outgassing levels for vacuum applications.

Isolast® Fab Range™

The ultimate in elastomer sealing is the Trelleborg Sealing Solutions Isolast® Fab Range™. These high performance Perfluoroelastomers (FFKM) are virtually inert and demonstrate almost universal chemical compatibility. Suitable for wet processing systems at elevated temperatures and in aggressive plasma applications, they are ideal as an upstream sealing solution. For thermal applications, specialist grades have been developed to operate at continuous temperatures up to 325°C.

Bonded to metal

Trelleborg Sealing Solutions can effectively bond FKM and Isolast® seals to a wide variety of surfaces including stainless and mild steel, aluminium, brass and various plastics. This gives the major advantages of maximising seal integrity, eliminating contamination associated with groove voids, providing ease of assembly, reduced inventory and cost effective seal solutions.



Seals bonded to metal

FKM and Isolast® seals are successfully bonded to metals and plastics, maximising seal integrity, eliminating contamination associated with groove voids and providing cost effective seal solutions.

Innovative engineered sealing options



Varilip® PDR in rotary applications

Outstanding, high performance rotary shaft seals effectively prevent gearbox oil entering the processing system and allow the introduction of an inert gas barrier system within semiconductor processing pumps.



Variseal® extreme sealing

Field-proven in extreme gas and liquid handling situations, Variseal® have been used in the most demanding of semiconductor sealing applications including high vacuum and corrosive environments.



Varilip® PDR

At the leading edge of sealing developments, Trelleborg Sealing Solutions provide a broad range of custom and standard options based on engineered plastic and metal technologies. Outstanding, high performance Varilip® PDR rotary shaft seals, comprise a Turcon® PTFE sealing lip retained in a crimped or clamped metal case. These multi-lip seals are ideal for use in semiconductor process pumps where they effectively prevent gearbox oil entering the processing system and allow the introduction of an inert gas barrier system. Custom designed for each application, they demonstrate low friction and wear characteristics and offer almost universal chemical compatibility over an extremely wide temperature range.

Variseal®

Field-proven in extreme gas and liquid handling situations, Variseal® spring energised Turcon® PTFE seals have been used in the most demanding of semiconductor sealing applications including high vacuum and corrosive environments. With the correct selection of PTFE, filled PTFE compounds and appropriate spring material and profile, Variseal® can provide the highest level of system integrity.

Engineered thermoplastics

High performance engineered thermoplastics offer novel sealing solutions in materials such as PEEK™ (Polyether Ether Ketone) and polyimide. This withstands high service temperatures, demonstrating good chemical and plasma resistance, electrostatic control and low outgassing. HiMod® wear rings and bearings for piston and rod applications have proved successful in a number of semiconductor applications which require outstanding dimensional stability and low particle shedding. Specialist Turcon® PTFE components include bellows offering a high purity and chemically compatible option to rubber joints.

Wills Rings®

Wills Rings® are metallic seals providing the optimum solution in static sealing on connectors, flanges and plates for gases and liquids under extremes of temperature and pressure, from cryogenic to 850°C and hard vacuum to 1000 MPa. Wills Rings® are available in a wide range of metals, O or C cross section with either pressure filled or system pressure activation.



High performance engineered thermoplastics

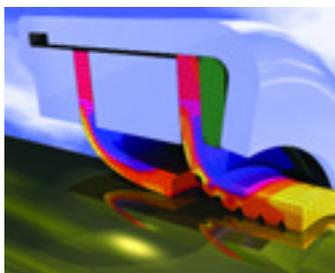
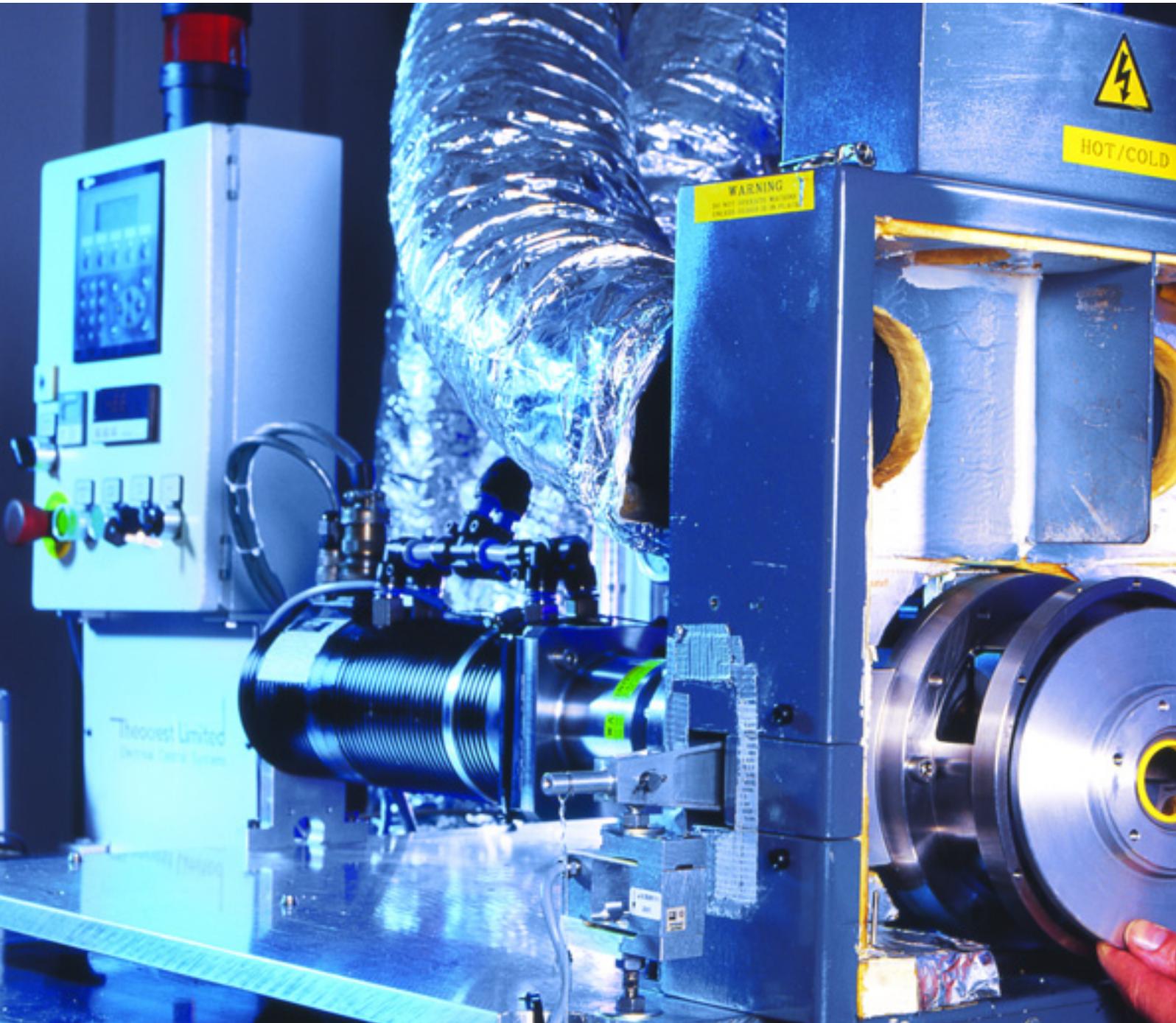
These offer novel sealing and bearing solutions in proprietary materials such as HiMod® (PEEK™ or polyimide based) and Turcon® (PTFE based).



Wills Rings® for the optimum solution

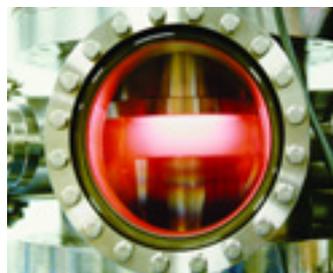
Wills Rings® in O or C cross sections can operate in high pressure and hard vacuum situations within continuous temperatures from cryogenic up to 850°C.

Development partnerships optimise applications



Advanced FEA methods

FEA modeling techniques were used in conjunction with test rigs to prove the Variip® PDR sealing solution developed for high-speed semiconductor pumps and boosters.



Excellent chemical resistance

Seals have to withstand some of the harshest of environments in plasma applications. The Isolast® Fab Range™ has been specially designed to offer materials resistant in this environment.



Trelleborg Sealing Solutions work with semiconductor customers in development partnerships, identifying the best sealing option for specific applications from a broad choice of materials and seal profiles. Trelleborg Sealing Solutions also develop unique formulations and products specifically to meet particular industry or functional requirements, with proposed solutions proven in leading edge test facilities and backed by independent tests through internationally recognised institutes.

High speed operation

The low surface tension of PFPE oil, typically used in semiconductor pumps and boosters, means it is difficult to maintain a meniscus of fluid, necessary for good sealing. For high speed rotary applications Trelleborg Sealing Solutions developed a Varilip® PDR with hydrodynamic sealing lip in a specially formulated grade of Turcon® PTFE, giving high integrity sealing and low level of power consumption.

Resisting harsh chemicals

In contact with harsh chemicals, gases and plasmas in semiconductor processing systems, seals suffer degradation. Aiming at developing resistant materials, the resultant Isolast® Fab Range™ offer perfluoroelastomer seals demonstrating market leading chemical resistance. These give extended seal life, increased MTBO and equipment reliability, leading to improved production yields.

Hard vacuum sealing

Vacuum sealing is a critical application within the semiconductor industry. In-house helium leak testing to 10^{-12} mbar/l/sec has been used to analyse the integrity of different sealing arrangements in vacuum conditions, enabling the development of solutions in elastomer, plastic and metal, proven to be capable of sealing extreme hard vacuums.

Ensuring consistent purity

Trelleborg Sealing Solutions invested in a cleanroom manufacturing facility for its high performance Isolast® Fab Range™ to meet the increasing demand from semiconductor manufacturers for cleanliness and purity. This is ensured with seal production of ultra-pure polymers with high purity fillers in the specialist cleanroom, which incorporates final wash and pack in class 100 conditions and double bag packaging.



Helium testing in vacuum

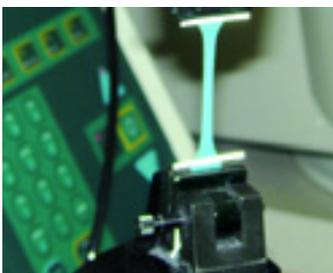
Analysis of sealing integrity in vacuum conditions is carried out on an in-house helium test rig. This has enabled development for effective solutions for hard vacuum applications.



Clean room production

To ensure purity in seal production, the Isolast® Fab Range™ are manufactured in clean room conditions, washed and packed to class 100 conditions and double bagged.

Market leading global sealing capabilities



Extensive test facilities

Strategically positioned materials and development laboratories and fully resourced design and application centres, continuously succeed in the delivery of sealing solutions.



Innovative material development

Developing and formulating materials in-house and engaging in on-going programmes of development, Trelleborg Sealing Solutions are also skilled in the field of applied materials technology.



Total – Sealing technology

Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer a dedicated design and development service for sealing arrangements, from our market leading product and material portfolio; one which has provided solutions that feature in virtually every application conceivable within the aerospace, industrial, and automotive industries.

Global – A worldwide presence

Globally servicing, supporting and supplying our customers, Trelleborg Sealing Solutions have an international network of over 80 facilities worldwide. They include more than 30 manufacturing sites, strategically positioned materials and development laboratories and fully resourced design and application centres, continuously succeeding in the delivery of sealing solutions to the highest standards. Facilities are certified to ISO 9001-2000, with many manufacturing sites also working to QS9000 and VDA 6.1.

Expertise – Our proven capabilities

With over 50-years experience in development and application of sealing systems, Trelleborg Sealing Solutions engineering personnel contribute their knowledge of this specialised technology directly to customers. This includes project management of design, prototyping, production, test and installation using state-of-the-art design tools, fully customer-compatible CAD systems and leading edge Finite Element Analysis (FEA).

Innovation – In materials and supply

Developing and formulating our materials in-house, Trelleborg Sealing Solutions have also acquired significant skills in the field of applied materials technology. Working in close cooperation with worldwide partners, we are engaged in on-going programmes of material and product development to provide customers with competitive advantage, utilising latest technologies and the resource of our material database, which includes over 2,000 proprietary compounds.

Commitment – To customers' needs long-term

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions that match their specific business requirements and needs. This includes our logistical support which effectively delivers over 40,000 different seals and sealing systems to our customers worldwide. As the global sales and marketing organisation of Trelleborg Sealing Solutions, who develop, manufacture and market safety-critical polymer-based precision seals and associated systems, we have the backing of one of the world's foremost experts in polymer sealing technology.



Superior logistics support

Trelleborg Sealing Solutions invested in an advanced logistical support system, which effectively delivers products to our customers worldwide.

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

www.tss.trelleborg.com





**Trelleborg
Sealing
Solutions**



**Your Partner for
Sealing Technology**

We build
long term partnerships
with customers and suppliers
by providing leading technology
and excellent service

The Trelleborg Group



Automotive

- Antivibration Systems
- Noise and Vibration Dampening
- Fluid Systems



Wheel Systems

- Agricultural and Forestry Tires
- Industrial Tires



Engineered Systems

- Engineering Solutions
- Marine Fenders
- Industrial Fluid Control
- Sealing Profiles for Buildings
- Water Proofing
- Offshore



Sealing Solutions

- Precision seals for the Industrial, Automotive and Aerospace markets

Welcome to Trelleborg Sealing Solutions

Our Mission

We will be the supply partner of first choice within our chosen markets, working globally through our local teams. We will build long-term partnerships with customers and suppliers by providing leading technology and excellent service.

We are determined to be different.

Sealing technology

Trelleborg Sealing Solutions offers an outstandingly comprehensive sealing portfolio – a one-stop shop providing the best in elastomer, thermoplastic, PTFE and composite technologies.

Industries

Our solutions have featured in virtually every application conceivable within the aerospace, automotive and industrial industries.

A worldwide presence

- Over 90 Facilities worldwide
- 27 Manufacturing sites
- Over 45 local Marketing Companies offering application engineering
- Strategically positioned materials and development laboratories

Commitment – To customers' needs long-term

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions that match their specific business requirements and needs.



Food and Pharmaceutical



Machine Tools

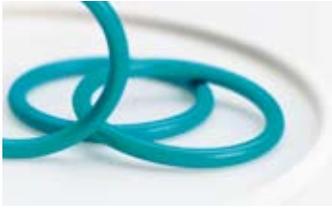


Oil and Gas



Power Transmission and Propulsion Technology

Our Global Resources



O-Rings



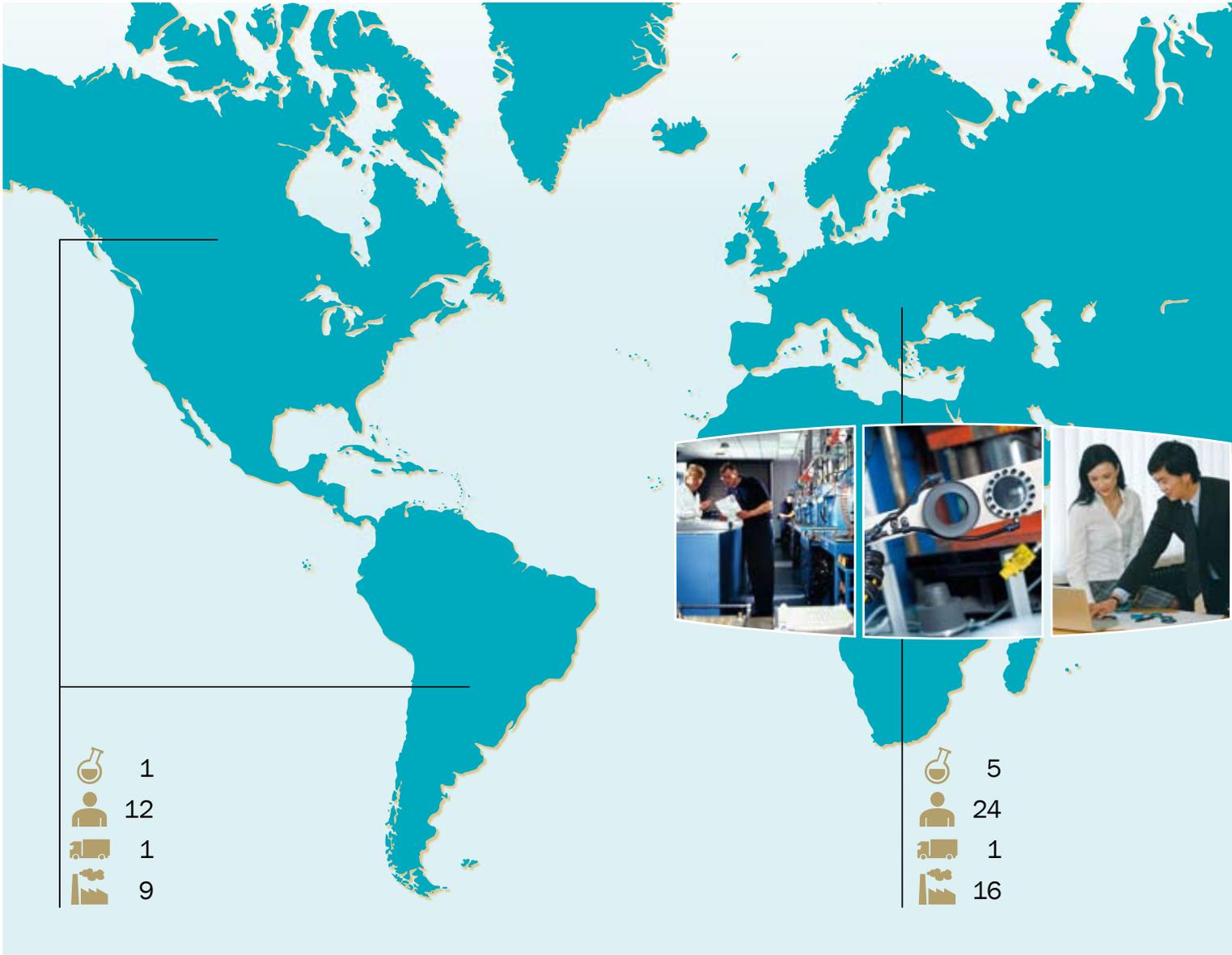
Static seals



Rotary seals



Bearings and bushings



Semiconductor



Automotive



Aerospace



Fluid power



Fluid sealing systems



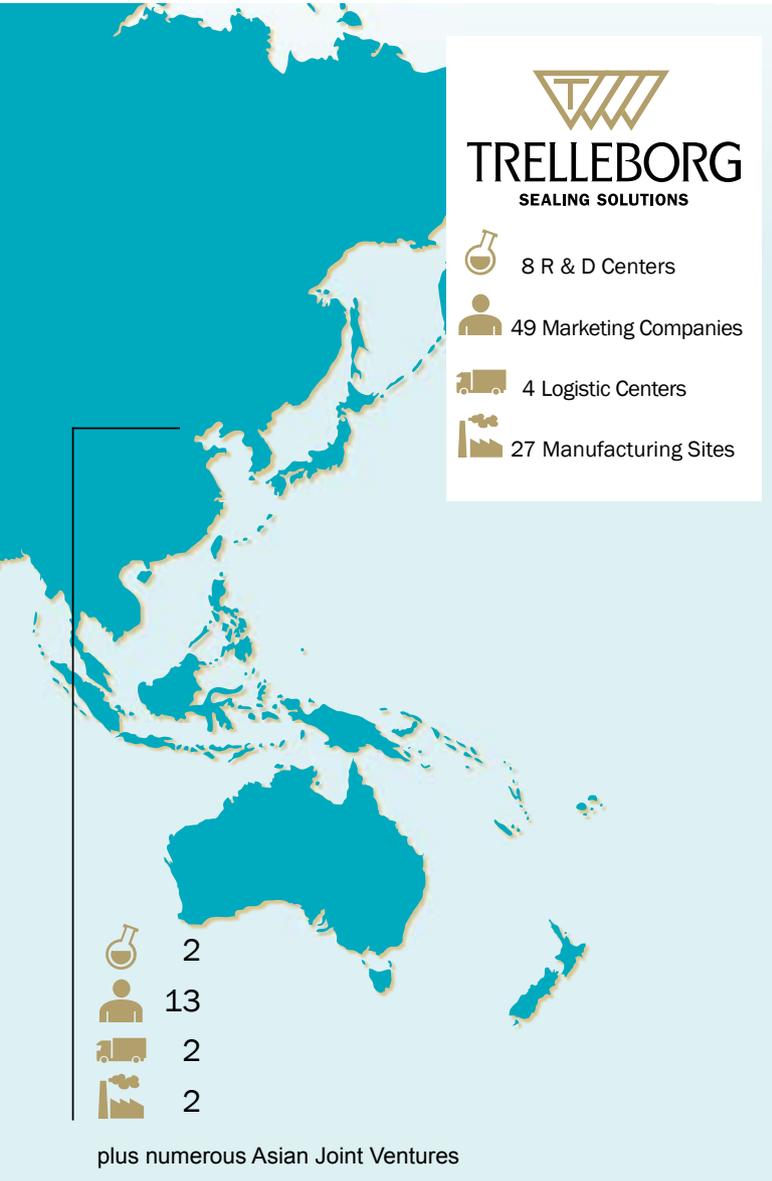
Pneumatic seals



Custom manufactured solutions



Customized aerospace sealing



Our pioneering products

Trelleborg Sealing Solutions is pioneering within the sealing industry and continuously developing innovative products.

- **Turcon® AQ Seal®**
- **D-A-S Compact Seal®**
- **Turcon® Double Delta®**
- **Turcon® Excluder®**
- **Turcon® Glyd Ring® T**
- **Turcon® Hatseal®**
- **Zurcon® L-Cup®**
- **Turcite® Slydring®**
- **Turcite® B-Slydway®**
- **Turcon® Stepseal® 2K**
- **V-Ring®**
- **Varilip®**
- **Turcon® Variseal®**
- **Turcon® VL-Seal™**
- **Turcon® Wedgpak®**
- **Wills Rings®**
- **Zurcon® Wynseal®**

World renowned names united

We own many of the longest established and leading names within the seal industry. These include:

- **American Variseal**
- **Busak+Shamban**
- **Dowty Seals**
- **Chase Walton**
- **Forsheda**
- **GNL**
- **Impervia**
- **Nordex**
- **Orkot**
- **Palmer Chenard**
- **Polypac**
- **SF Medical**
- **Shamban**
- **Silcofab**
- **Skega**
- **Stefa**
- **Wills**

Proprietary materials

Ongoing development has yielded some of the most successful sealing materials available for these types for sealing.

- **HiMod®**
- **Isolast®**
- **Luytex®**
- **Orkot®**
- **Turcite®**
- **Turcon®**
- **Turel®**
- **Zurcon®**



Off-Highway



Chemical and Processing Industries

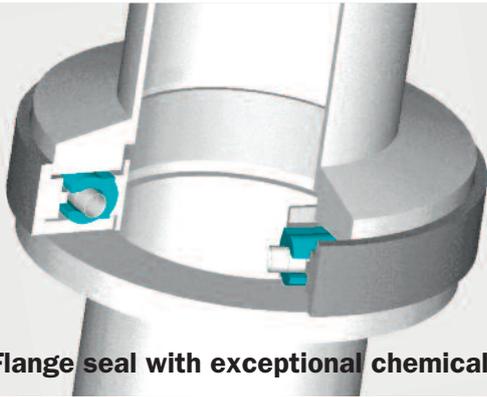
Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
BELGIUM - Dion-Valmont <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	BRAZIL - São Paulo	+55 11 3372 4500
BULGARIA - Sofia <small>(ROMANIA)</small>	+359 (0)2 969 95 99	CANADA - Etobicoke, ON	+1 416 213 9444
CROATIA - Zagreb	+385 (0) 1 24 56 387	MEXICO - Mexico City	+52 55 57 19 50 05
CZECH REPUBLIC - Rakovnik <small>(SLOVAKIA)</small>	+420 313 529 111	USA, East - Conshohocken, PA	+1 610 828 3209
DENMARK - Hillerød	+45 48 22 80 80	USA, Great Lakes - Fort Wayne, IN	+1 260 482 4050
FINLAND - Vantaa <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	USA, Midwest - Lombard, IL	+1 630 268 9915
FRANCE - Maisons-Laffitte	+33 (0) 1 30 86 56 00	USA, Mountain - Broomfield, CO	+1 303 469 1357
GERMANY - Stuttgart	+49 (0) 711 7864 0	USA, Northern California - Fresno, CA	+1 559 449 6070
GREECE	+41 (0) 21 631 41 11	USA, Northwest - Portland, OR	+1 503 595 6565
HUNGARY - Budaörs	+36 (06) 23 50 21 21	USA, South - N. Charleston, SC	+1 843 747 7656
ITALY - Livorno	+39 0586 22 6111	USA, Southwest - Houston, TX	+1 713 461 3495
THE NETHERLANDS - Barendrecht	+31 (0) 10 29 22 111	USA, West - Torrance, CA	+1 310 371 1025
NORWAY - Oslo	+47 22 64 60 80		
POLAND - Warsaw <small>(LITHUANIA, UKRAINE, BELARUS)</small>	+48 (0) 22 863 30 11	Asia Pacific	Telephone
RUSSIA - Moscow	+7 495 982 39 21	ASIA PACIFIC REGIONAL	+65 6 577 1778
SPAIN - Madrid <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	CHINA - Hong Kong	+852 2366 9165
SWEDEN - Jönköping	+46 (0) 36 34 15 00	CHINA - Shanghai	+86 (0) 21 6145 1830
SWITZERLAND - Crissier	+41 (0) 21 631 41 11	INDIA - Bangalore	+91 (0) 80 2245 5157
TURKEY	+41 (0) 21 631 41 11	JAPAN - Tokyo	+81 (0) 3 5633 8008
UNITED KINGDOM - Solihull <small>(EIRE)</small>	+44 (0) 121 744 1221	KOREA - Anyang	+82 (0) 31 386 3283
AFRICA REGIONAL	+41 (0) 21 631 41 11	MALAYSIA - Kuala Lumpur	+60 (0) 3 9059 6388
MIDDLE EAST REGIONAL	+41 (0) 21 631 41 11	TAIWAN - Taichung	+886 4 2382 8886
		THAILAND - Bangkok	+66 (0) 2732-2861
		SINGAPORE	
		and all other countries in Asia	+65 6 577 1778

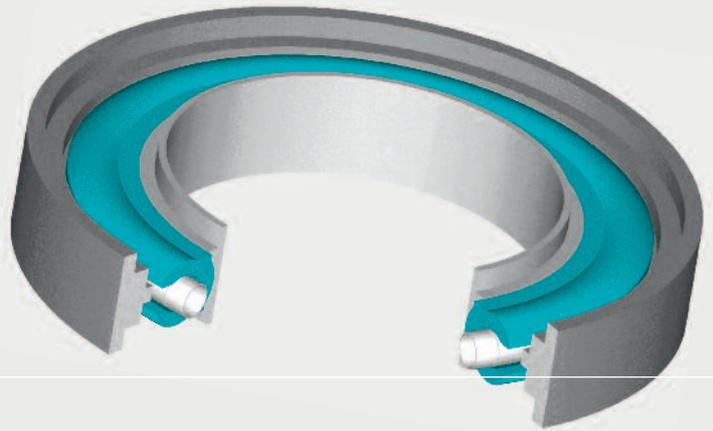
www.tss.trelleborg.com



Variseal® NW



Flange seal with exceptional chemical resistance



Your partner for sealing technology

Variseal® NW

Turcon® Variseal® NW is a flange seal that provides exceptional chemical resistance. In this unique design, a Turcon® PTFE based case encompasses its energizing spring in such a way that there can be no possible contact between the spring or spring cavity and system media.

Manufactured in our MF grade materials, specially developed for hygienic environments, the seals are compliant to all major approvals. The compounds combine superior wear resistance with compatibility to virtually all chemicals. They can withstand extremely aggressive media in the most extreme of operating temperatures across all processing sectors, including the CIP & SIP regimes faced in production of consumable products. Specifically to semiconductor manufacturing, the seal is proven in fluorine gas at high temperatures and is capable of operating in a vacuum.

In dynamic flange sealing applications, the unrivalled friction characteristics of Turcon® MF gives the benefit of stick-slip free starting, even after extended periods of rest. There is also no potential of sticking or welding of material to counter surfaces, a possibility with elastomer sealing elements. This cuts down the need for hardware cleaning and maximizes seal life.

Features:

- Operates in extreme temperatures from -253 °C / -423 °F to +260 °C / +500 °F
- Vacuum capability in air to 10⁻⁹ mbar/l/s²
- Excellent wear and friction characteristics
- Stick-slip free starting, even after extended periods of rest
- Alleviates potential sticking or welding of material to counter surfaces, a possibility with elastomer sealing elements
- Compatible with virtually all media and gases including fluorine gas at high temperature
- Low outgassing
- Unrivalled seal performance
- Materials available compliant to FDA 21 CFR 177.1550, 3-A, USP Class VI, Cytotoxicity <USP 87>, NSF, and the EU Machinery Directive
- Suitable for internal and external differential flange sealing
- Option of both internal or external support rings in stainless steel, aluminum or polymer to facilitate flange fitment
- Available in custom sizes or standard dimensions
- Easy retrofit for current NW elastomer seals

Materials:

Variseal® NW jacket is available in the premium grade Turcon® MF materials from Trelleborg Sealing Solutions. These high purity PTFE based compounds have been specially engineered for hygienic applications. They combine superior sealing capabilities and material purity, with minimal impurities that could potentially contaminate processing systems.

Spring can be supplied in stainless steel, Elgiloy or Hastelloy.

Test results:

Turcon® Variseal® NW has been successfully proven in tests. The seal was exposed to 20% Fluorine gas for a period of two weeks. At +140 °C / +284 °F weight loss was only 0.004% and at +250 °C / +482 °F it was 0.01%.

Industries:

- Food, beverage and pharmaceutical manufacturing processes
- Chemical processing
- Semiconductor fabrication

Trelleborg Sealing Solutions service:

- Quality levels to ISO 9001:2000 including 100% inspection and zero defect philosophy
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development and test capabilities
- Extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network

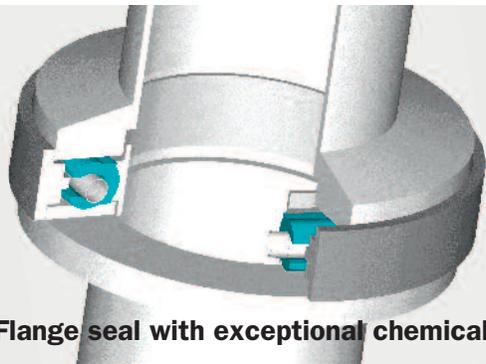
For further information:

Europe	Telephone
AUSTRIA - Vienna (ALBANIA, BOSNIA AND HERZEGOVINA, CROATIA, HUNGARY, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)	+43 (1) 4064733
BELGIUM - Dion-Valmont (Luxembourg)	+32 (10) 225750
BULGARIA - Sofia (ROMANIA, RUSSIA)	+359 2 9699510
CZECH REPUBLIC - Rakovnik (SLOVAKIA)	+420 313529111
DENMARK - Hillerød	+45 48228080
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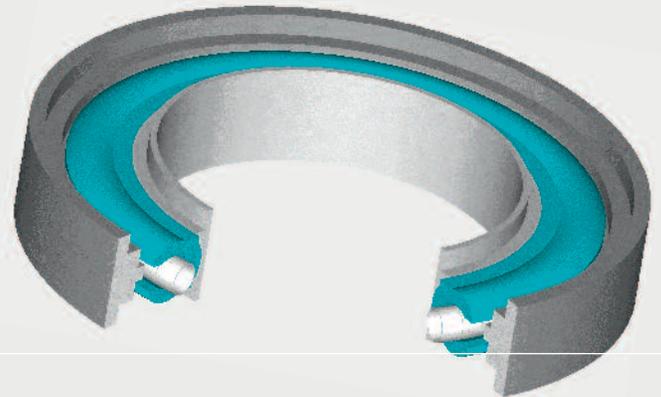
America	Telephone
AMERICAS - Fort Wayne, IN	+1 (260) 7499631
BRAZIL - Sao Paulo	+55 (11) 33724500
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SINGAPORE	
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Flange seal with exceptional chemical resistance



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Industries:

- Food, beverage and pharmaceutical manufacturing processes
- Chemical processing
- Semiconductor fabrication

Trelleborg Sealing Solutions service:

- Quality levels to ISO 9001:2000 including 100 % inspection and zero defect philosophy
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development and test capabilities
- Extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
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Variseal® PS™

Sealing Solutions for chemical processing applications



Your Partner for Sealing Technology

The Variseal® PS™

The Variseal® PS™ has been developed to provide equipment manufacturers and end users with a sealing solution compatible with virtually all chemical media. This high performing seal type has been designed with a Turcon® PTFE based sealing body, encompassing a polymeric spring which has been tailored to give precisely the correct seal energization at low pressures, while maintaining high pressure sealing integrity by assistance from the system media pressure. The polymer spring and Turcon® jacket both have unrivalled chemical compatibility performance – far superior to any existing FKM or FFKM O-Rings.

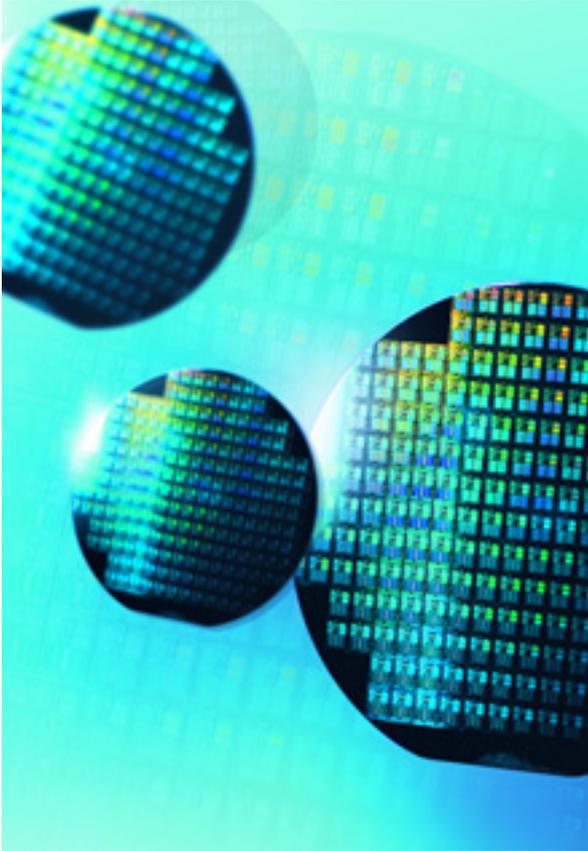
The Variseal® PS™ has ultra-low leach out impurities as per SEMI standard F57-0301 and no outgassing as seen with rubber O-Rings. Therefore this product is ideally suited for use in semiconductor wet processing where very low leach out impurities are required with chemically inert sealing materials that will not degrade over time.

The Variseal® range of sealing solutions is available in size ranges from 5mm/0.20in to 2.5m/100in in diameter from premium grade materials such as Turcon®, polyethylene and Zurcon® polyurethane. Standard spring materials consist of Stainless Steel, Elgiloy and Hastelloy.

Variseal® can be used for sealing rods, pistons and faces in static, reciprocating and rotary applications.

Features:

- Thermal stability from -253°C/-423°F to 80°C/176°F
- Vacuum sealing 5.3×10^{-8} mbar/l/s¹ (4.7×10^{-8} psi/in³/s¹) per mm length of seal circumference
- Withstands high pressures in excess of 40 MPa/5,800psi
- Excellent wear and friction characteristics
- Compatible with virtually all chemicals
- Can be supplied clean room washed and packed to class 100
- Suitable for dynamic and static applications
- Materials available compliant to USP Class VI, Cytotoxicity <USP 87>, NSF, EU Machinery Directive, FDA 21 CFR 177.1550 and 3-A
- Suitable for piston, rod, face, rotary, reciprocating and static situations
- Easily retrofitted into standard Variseal® and O-Ring grooves including to MIL-G-5514F, DIN 3771, ISO 6194 and AS-568
- Available in standard and custom seal designs
- Ultra-low leach out and no outgassing
- Patent pending



Materials:

- Variseal® jacket can be supplied in premium grade Turcon® MF PTFE based material, Zurcon® polyurethane or PEEK
- Spring can be supplied in PEEK, Stainless Steel, Elgiloy or Hastelloy

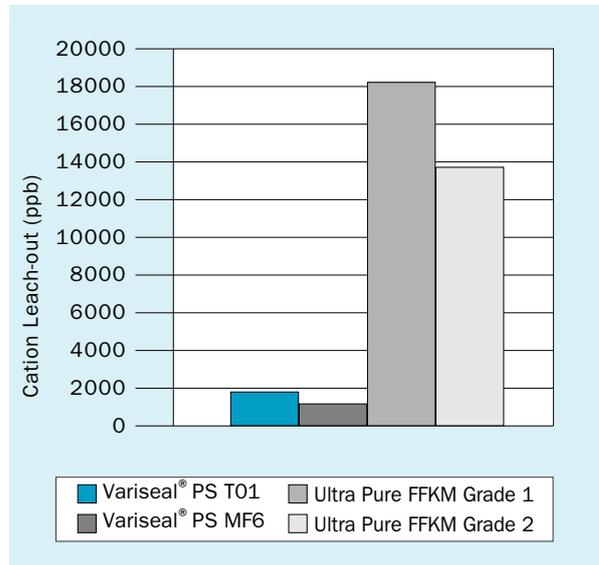
Industries:

- Food, beverage and pharmaceutical manufacturing
- Life science/Medical technology
- Chemical processing
- Semiconductor fabrication

Trelleborg Sealing Solutions service:

- Quality levels to ISO 9001:2000 including 100% inspection and zero defect philosophy
- Wash and pack to class 100 standards
- Leading-edge in-house polymer development and test capability
- Extensive design facilities, including material specific non-linear Finite Element Analysis (FEA)
- Comprehensive technical support and after-sales service through the global Trelleborg Sealing Solutions network
- SCM and logistics support

Turcon® MF Grades	
Turcon® MF1	• Exceptional friction characteristics • Unrivalled low temperature capabilities • Suitable for use with soft mating surfaces
Turcon® MF2	• Good wear resistance
Turcon® MF3	• Very good wear and abrasion resistance • Suitable for use with soft mating surfaces
Turcon® MF4	• Unique lubricating properties • Withstands higher pressures • Suitable for use with medium to hard mating surfaces
Turcon® MF5	• High wear resistance • Good friction and sliding properties
Turcon® MF6	• Superior pressure and wear performance • Suitable for gas, high and low viscosity fluids



Variseal® PS™ is available in the Trelleborg Sealing Solutions Turcon® MF range. These high purity PTFE based compounds have been specially engineered for hygienic applications. They combine superior sealing capabilities and material purity, with minimal impurities that could potentially contaminate processing systems.

www.tss.trelleborg.com



Perfect in a Tight Squeeze

Trelleborg Sealing Solutions has announced a new capability with the addition of the custom-designed Variseal® SEE to its product line. An extension of the Variseal® family of seals, the Variseal® SEE is a spring-energized elastomer seal specifically developed to add additional design flexibility and expand the material capabilities of Variseal® products. While traditional Variseals® are manufactured from PTFE, the Variseal® SEE features a fully-molded rubber jacket which encases a spring. Spring-energized to combat elastomer compression set, the Variseal® SEE is ideal for applications in which elastomeric sealing properties are desired along with the added assurance of a spring-energized seal. The Variseal® SEE is available in a broad range of materials, and is suitable for poor surface finish applications.



These seals can be used across many industries, including Food & Beverage, Semiconductor, Mobile Hydraulics, Medical and Aerospace.



Examples of Applications:

- Beverage machine mixing chambers
- Dispensing equipment
- Hydraulic cylinders
- Wafer handling equipment
- Commercial appliances
- Surgical tools
- Food processing and handling

Features and Benefits:

- Totally flexible/Easy to install
- Design flexibility
- Smooth surface finish
- No parting lines in critical sealing areas
- Possibility for complicated geometries
- Constant sealing force prolongs elasticity
- Long-term machine storage
- Springs available in stainless steel, hastelloy, elgiloy
- Extended life
- No measurable leakage
- Fast prototype delivery

Perfect in a Tight Squeeze

Product Availability:

Sizes:

- Recommended for diameters < 500 mm / 20 inches

Cross sections:

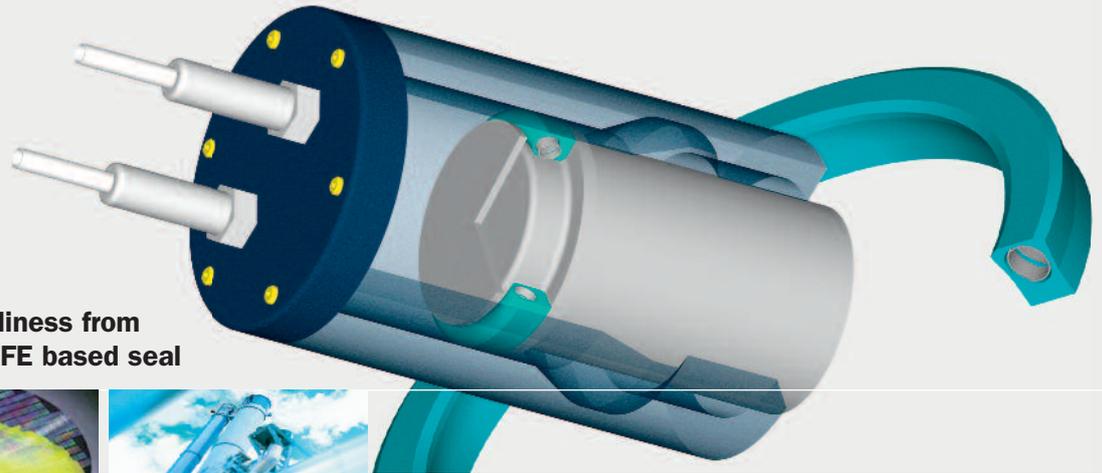
- .062" / 1.5 mm to .500" / 12.7 mm

Materials:

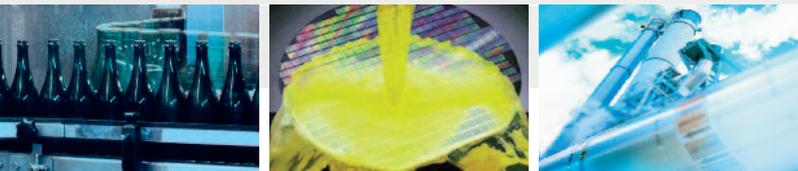
- NBR
- EPDM
- Fluoroelastomer
- Silicone
- Isolast®
- Other elastomer compounds
- TPE
- TPU

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Variseal® Ultra-Clean™



The ultimate in cleanliness from a spring-energized PTFE based seal



Your Partner for Sealing Technology

Turcon® Variseal® Ultra-Clean™ offers the ultimate in cleanliness, making it ideal for use in processing equipment where maintaining an ultra clean system is a priority. In this unique design, the spring required to activate the seal is fully enclosed within a Turcon® PTFE based case. In food, beverage and pharmaceutical production this ensures there is no dead space for bacteria to be caught. While in semiconductor fabrication, where the minutest contamination can destroy the effectiveness of wafers, metal extractables are totally excluded.

Manufactured in our MF grade of materials, specially developed for hygienic environments, the seals are compliant to all major approvals. They combine superior wear resistance and unrivalled friction characteristics with compatibility to virtually all chemicals even in the most extreme of operating temperatures. This provides long life in the CIP & SIP regimes faced in manufacture of consumable products. In addition, in semiconductor manufacturing, the purity and low particle shedding of Turcon® MF are a major advantage.

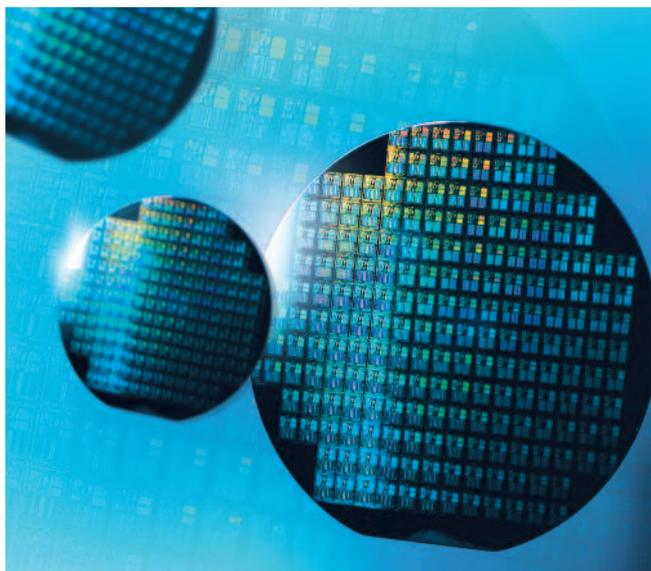
Footnote: Patent is pending on Variseal® Ultra-Clean™

Features and Benefits:

- Operates in extreme temperatures from -253 °C / -423 °F to +260 °C / +500 °F
- Withstands high pressures in excess of 100 bar / 1450 psi
- Excellent wear and friction characteristics
- Compatible with virtually all chemicals
- Unrivalled cleanability in food & beverage and pharmaceutical applications
- Materials available compliant to FDA 21 CFR 177.1550, 3-A, USP Class VI, Cytotoxicity <USP 87>, NSF, and the EU Machinery Directive
- Suitable for piston, rod, face, rotary, reciprocating and static situations
- Easy retrofit into standard AS-568 O-Ring and Variseal® grooves

Materials:

- Variseal® jacket can be supplied in premium grade Turcon® MF PTFE based material, Zurcon® polyurethane or PEEK
- Spring can be supplied in stainless steel, Elgiloy or Hastelloy



Industries:

- Food, beverage and pharmaceutical manufacturing
- Chemical processing
- Oil and gas, on and offshore
- Semiconductor fabrication

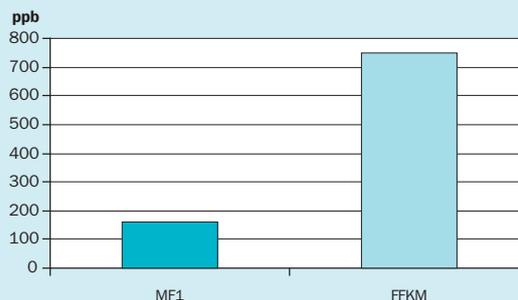
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Turcon® MF Grades

Turcon® MF1	<ul style="list-style-type: none"> • Exceptional friction characteristics • Unrivalled low temperature capabilities • Suitable for use with soft mating surfaces 	FDA
Turcon® MF2	<ul style="list-style-type: none"> • Good wear resistance 	FDA
Turcon® MF3	<ul style="list-style-type: none"> • Very good wear and abrasion resistance • Suitable for use with soft mating surfaces 	FDA
Turcon® MF4	<ul style="list-style-type: none"> • Unique lubricating properties • Withstands higher pressures • Suitable for use with medium to hard mating surfaces 	FDA, USP Class VI
Turcon® MF5	<ul style="list-style-type: none"> • High wear resistance • Good friction and sliding properties 	FDA

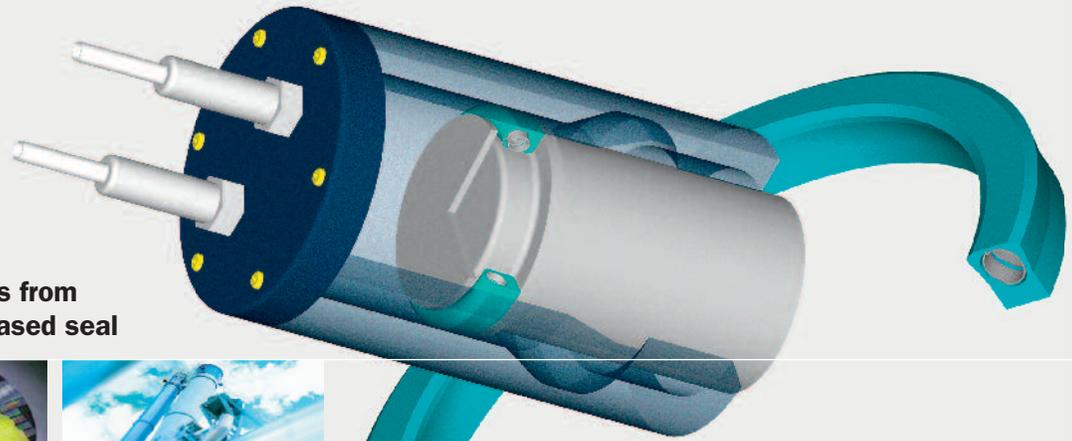
Result of a leach out test in UPDI, 85°C/1 week / 185°F/1 week according to SEMI Standard F57-0301 (20 cations)



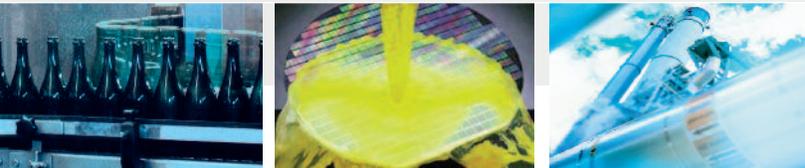
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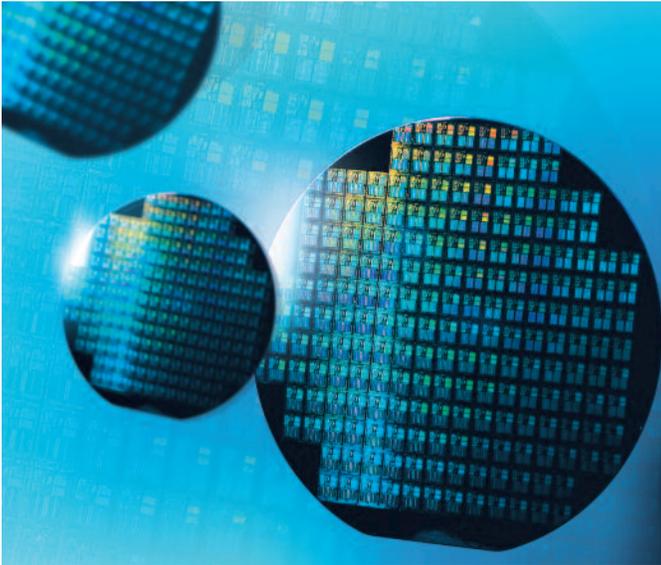
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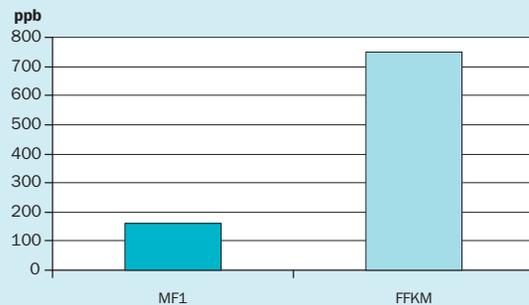
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Turcon® MF4	<ul style="list-style-type: none"> • Unique lubricating properties • Withstands higher pressures • Suitable for use with medium to hard mating surfaces 	FDA, USP Class VI
Turcon® MF5	<ul style="list-style-type: none"> • High wear resistance • Good friction and sliding properties 	FDA

Result of a leach out test in UPDI, 85°C/1 week / 185°F/1 week according to SEMI Standard F57-0301 (20 cations)



Variseal® Ultra-Clean™ is available in the Trelleborg Sealing Solutions Turcon® MF range. These high purity PTFE based compounds have been specially engineered for hygienic applications. They combine superior sealing capabilities and material purity, with minimal impurities that could potentially contaminate processing systems.

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Ventseal - Light



**NEW: the reliable
elastomeric venting valve**



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, 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. Trelleborg Sealing Solutions is backed by the experiences and resources of one of the world's foremost experts in polymer technology, Trelleborg Group.

ISO 9001:2000

ISO/TS 16949:2002

The information in this brochure is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this brochure. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

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

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Ventseal-Light

■ Ventseal-Light

General, Fields of Application

Ventseal-Light is designed for the venting of closed receptacles, in which a low pressure build-up causes malfunction. After the venting process, the pressure room shall be safely sealed against influences from outside.

Maintenance-free closed storage batteries need such venting valves to ensure their good function over longer periods of time.

Preferred cases of application are maintenance-free lead gel storage batteries, Ni-Cd batteries, Ni-MH batteries and VLRA batteries.

The requirements on such components are very demanding. If the valves do not close correctly the affected cell will dry out within a short period of time or be destroyed due to the ingress of atmospheric oxygen.

The function of the valve's opening mechanism therefore must be absolutely reliable. If the ultimate opening pressure is exceeded due to a jammed valve, the potential risks range from structure damages within the cell up to its entire destruction.

Due to the constantly rising demands on reliability, longevity and efficiency, present valves have come up against limiting factors. These demands have been considered in the development of the Ventseal-Light. This patented low-pressure valve (European Patent No. 989487087) combines an excellent impermeability with a secure opening and closing behaviour.

Apart from the aforementioned advantages, the Ventseal-Light is also suitable for all cases where the pressure in a closed receptacle must be kept below a certain limit, while at the same time any ingress from the outside has to be sealed off securely. The use of different elastomer materials grants a reliable sealing of various media.

Ventseal-Light is, with regard to function and cost, an optimized version of the well-known Ventseal series of Trelleborg Sealing Solutions.

It combines the characteristics of a seal and a pressure control valve in one single product.

This version allows adjustment to the opening pressure and adaption to the respective application.

Opening pressure ranges from 50 to 400 mbar.

Function

The following installation example demonstrates the function mode:

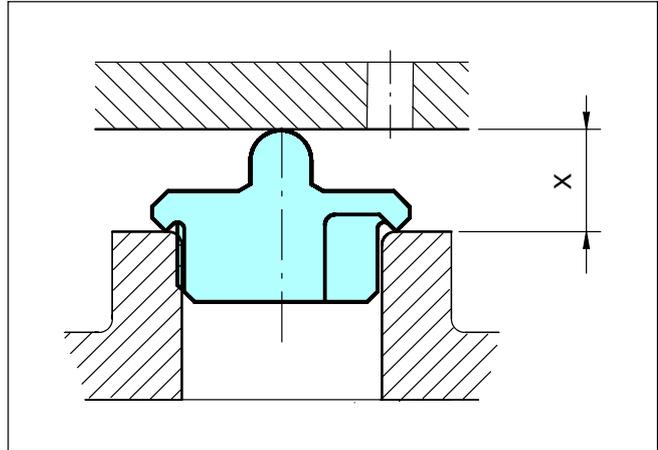


Figure 1 Ventseal-Light installed on a battery muff

In the present case the Ventseal-Light is mounted onto a battery muff. A simple bore is also possible. The sealing face located at the front of this muff (bore) has a certain surface quality. Here, the Ventseal-Light, energized with a cover, seals with its annular sealing edge. The cover is designed with a pre-defined distance X towards the muff. This dimension X allows adjustment to the opening pressure. A steering channel inside the Ventseal-Light allows the overpressure in the receptacle to escape towards the sealing edge where it lifts off the sealing edge at a certain pressure level. After a drop in pressure the sealing lip reseals the pressure room. Ventseal-Light thus reliably fulfils its sealing function. As soon as pressure comes from the outside resp. at low pressure within the battery Ventseal-Light acts as a safe seal.

Advantages

- Ventseal-Light supplies a very good price/performance relation
- Ventseal-Light provides a very good sealing ability. Additional advantage is the possibility of adapting the opening pressure to the respective application
- Tests have verified a very good ageing stability



Installation Recommendations

The level of the average opening and closing pressure can be freely chosen. It is determined by the prestress depending on dimension X - see figure 2.

The dimension X should be designed with the smallest possible tolerances admissible by manufacturing engineering in order to keep the variation of the opening pressure values at a minimum. A tolerance of ± 0.05 mm is recommended.

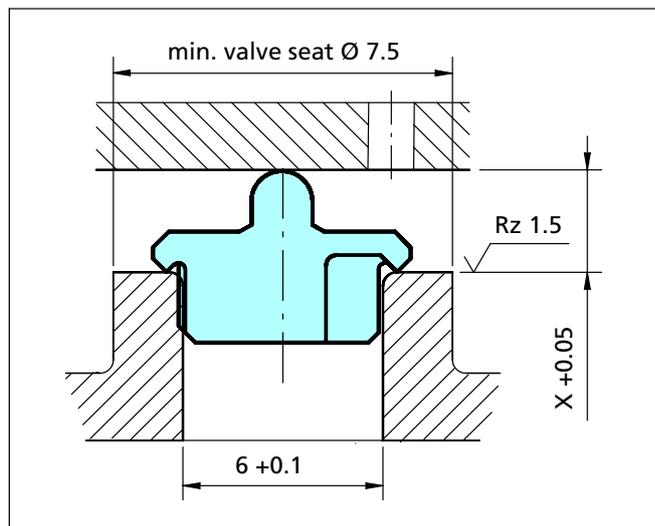


Figure 2 Ventseal-Light Installation

The sealing face of the muff should be polished. Surface quality Rz 1.5; defects, bell mouths and scratches are not admissible.

The transition between sealing face and bore of the muff should have a radius R 0.1 to 0.3 mm. Burrs are not allowed. The cover has to be installed in a vertical direction relative to the muff.

Technical Data

Sealability: up to 50 mbar due to adjustment (dim. X)

Pressure range: 50 - 200 mbar, up to 400 mbar with harder elastomer types

Temperature: -30°C up to +150°C (standard), up to 200°C with other suitable elastomer types

Media: Air, gases, battery acid, KOH and other media with suitable elastomer types

Materials

Function and media resistance depends on the material used. Two standard qualities are available. They are not resistant to mineral oil.

Table I Standard materials

Basic elastomer	Material No.	Hardness	Pressure Range	Temperature
EPDM	E5501	50 Shore A	up to 200 mbar	-50 to +150°C
EPDM	E6601	60 Shore A	> 200 mbar	-50 to +150°C



Ventseal-Light

Opening Pressure

The average opening and closing pressure is determined by the prestress given by dimension X. The diagram shows the value of the opening pressure as a function of the prestressing dimension X.

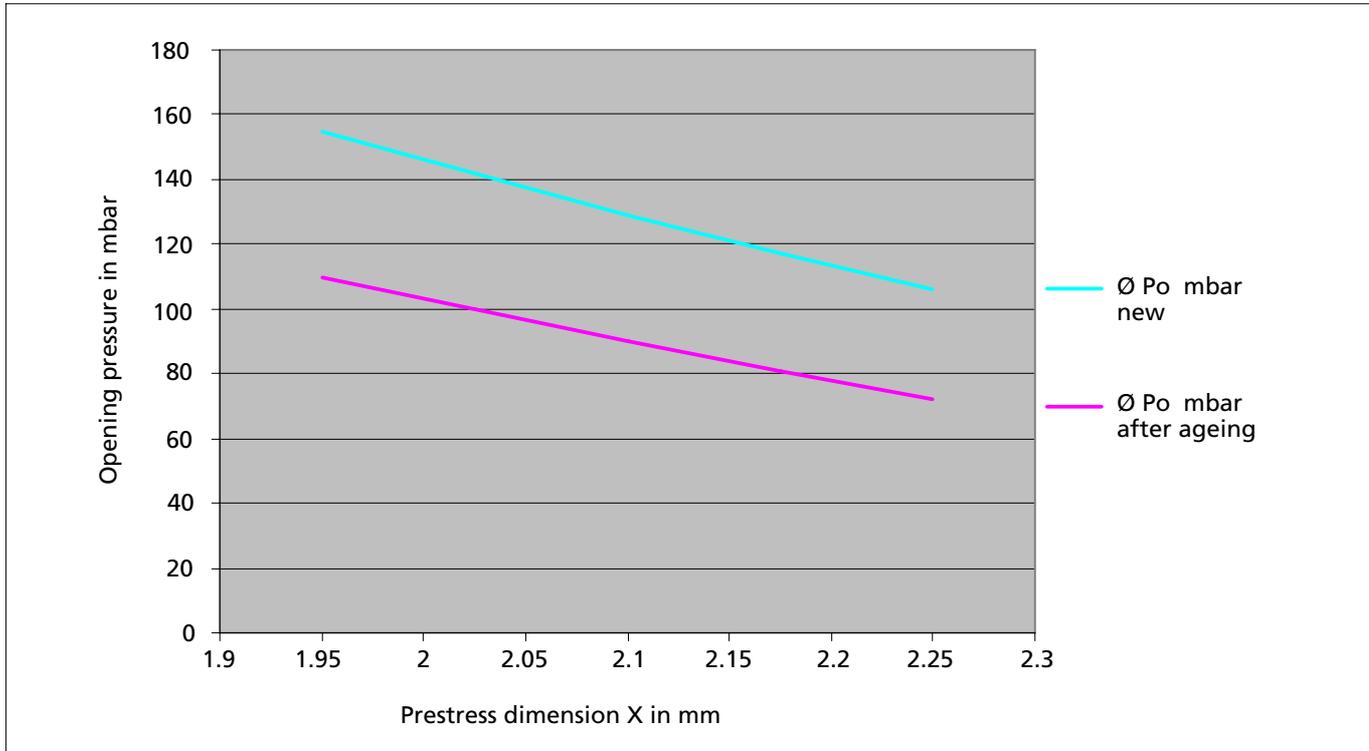


Figure 3 Opening pressure of Ventseal-Light manufactured in material E5501 depending on the prestress dimension X - new and after ageing

The values of the opening pressure are average values only. They have been determined by the rate of flow. In the present case the valve has been evaluated as open at a flow rate of 30 ml/min. Lower flow rates result in lower opening pressure values. Additionally, there are different methods to determine the opening pressure. Therefore we recommend to discuss these values with the user.

The closing pressure value is 10 mbar lower than the opening pressure value.

The lower curve in the above diagram shows the opening pressure value in aged valves.

This value which is determined by the ageing behaviour of the elastomer material is reached after 6 months at room temperature at the latest.

Thereafter, the opening pressure remains constant for the entire service life.

The values of the opening pressure are subject to a certain variation.



This variation is shown in the following diagram.

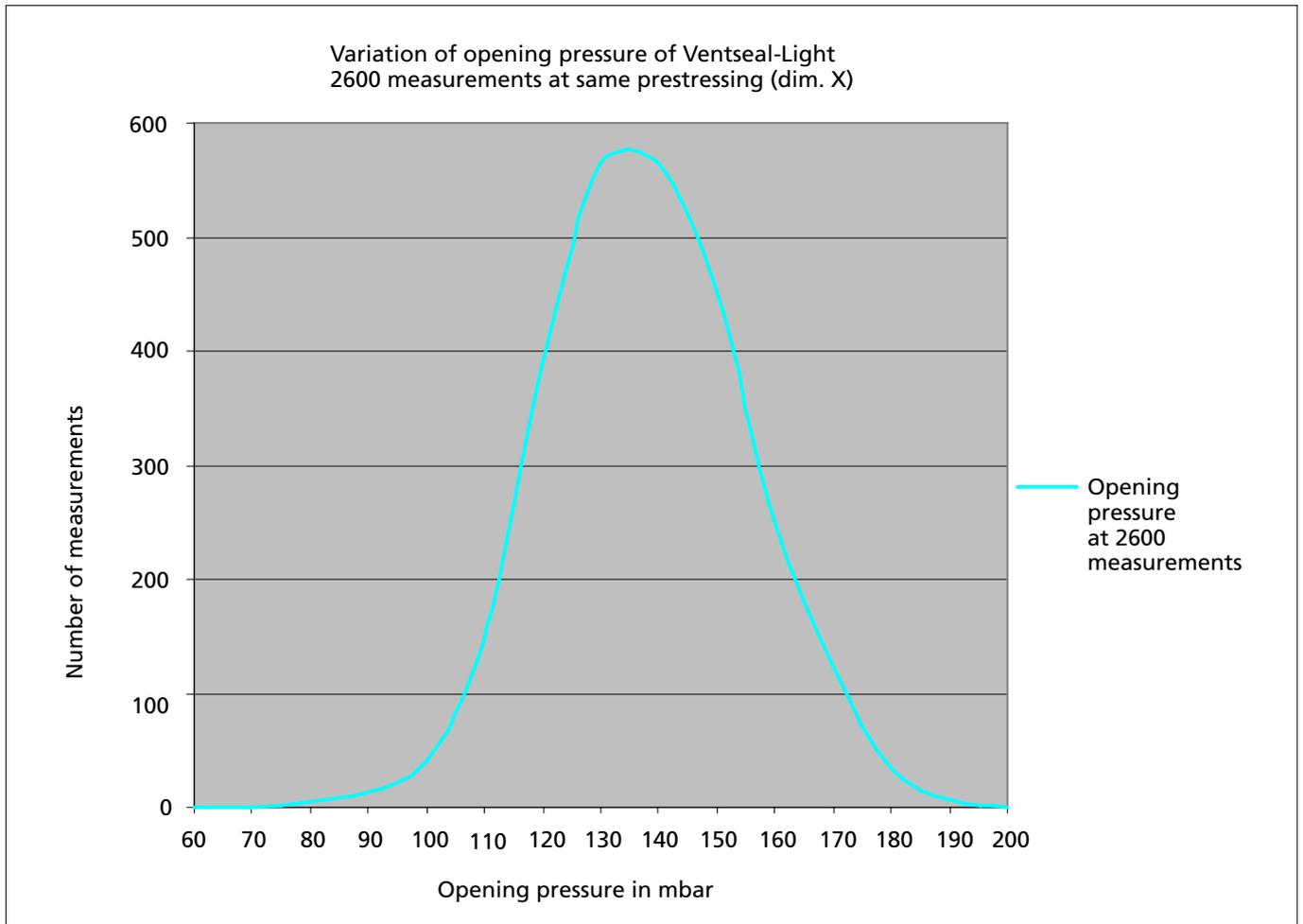


Figure 4 Distribution of the opening pressure values of the Ventseal-Light manufactured in the series tool

These values have been measured with one prestress dimension. To limit the variation it is possible to treat the surface with Krytox oil GLP 105 which is a PTFE solvent with high viscosity. This treatment reduces the variation range by up to 20 %.

At the same time this medium prevents the Ventseal's sealing lip from sticking to the muff surface.

In general, elastomer seals tend to stick to the sealing surface after longer periods of standstill.

Many factors such as surface quality, material combination, installation conditions and lubricant have an influence on the nominal opening pressure.

For this reason we recommend that the user conducts individual tests in order to determine the respective actual pressure and the variation.

Ordering Example

TSS Order No. YB2400060 - E5501

TSS Order No.	YB2400060	-E5501
Ventseal Type	2400	
Muff diameter	6 mm	
Material		

Contact your local marketing company for further information:

Europe	Telephone	Americas	Telephone
AUSTRIA - Vienna <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+43 (0) 1 406 47 33	AMERICAS - REGIONAL	+1 260 749 9631
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O-Rings Zurcon® Z20/Z22/Z24

**Polyurethane Materials
for O-Rings**



Your Partner for Sealing Technology

O-Rings Zurcon® Z20/Z22/Z24

Zurcon® O-Rings are the most suitable solution for high gas pressure with rapid pressure relief. Typical applications are pressure controls or sliding valves, control devices, couplings, screw-connections and cylinders. O-Rings produced in these high-performance materials Zurcon® Z20, Zurcon® Z22 and Zurcon® Z24 are suitable for use in hydraulic as well as pneumatic systems – and especially recommended for gas processing systems.

Special Material Properties:

- good cold flexibility
- high tensile and tear strength
- very low gas permeability
- very high extrusion resistance
- extremely good abrasion resistance
- low friction
- low compression set
- good resistance against hydrolysis

Advantages:

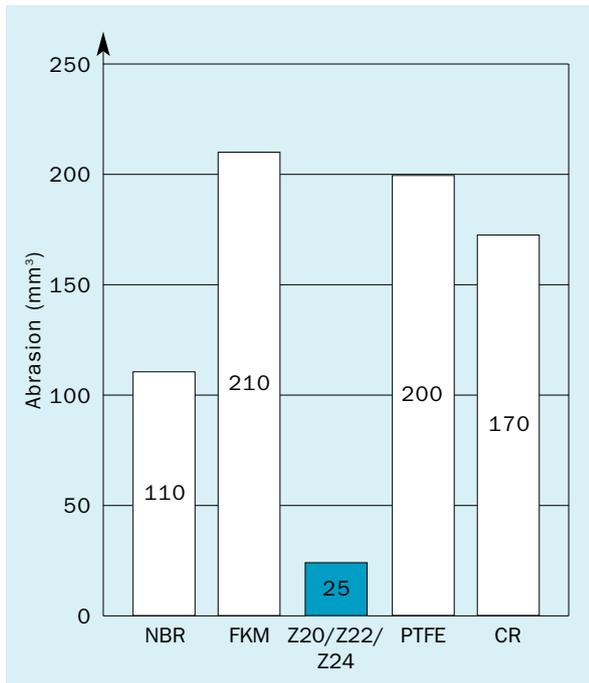
- reliable sealing for your products
- competitive advantages for your products due to long service life
- cost savings due to component reduction
- in static applications additional back-up rings are only necessary for pressures above 60 MPa – thus smaller grooves are possible
- safety for gas applications (no destruction of the O-Rings when exposed to high pressures and rapid pressure relief)
- enlarged field of dynamic applications

O-Rings Zurcon®

Z20/Z22/Z24 Compound Data

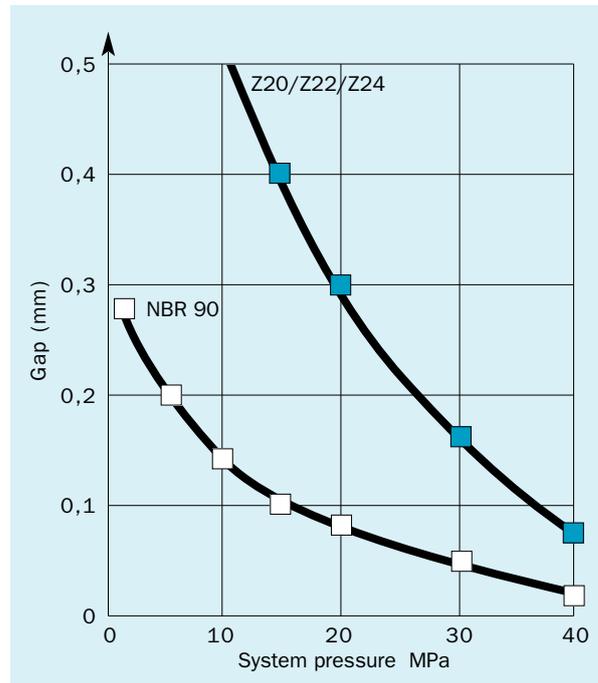
Abrasion (DIN 53516)

Extremely good abrasion resistance



Admissible radial gap (static load)

Very high extrusion resistance



Material*		Standard	Unit	Z20 Standard	Z22 Low Temperature	Z24 Good Hydrolysis Resistance
	Hardness	DIN 53 505	Shore A	94 +/-2	93 +/-2	94 +/-2
Operating Temperature:	Max.		°C (°F)	+110 (+230)	+110 (+230)	+110 (+230)
	Min.		°C (°F)	-35 (-31)	-45 (-49)	-30 (-22)
	TR10 Point	ASTM D 1329	°C (°F)	-34 (-29)	-50 (-58)	
Compression Set / Air	24h / -20°C (-4°F)	DIN ISO 815 (B)	%	46	25	
	72h / +70°C (158°F)	DIN ISO 815 (B)	%	23	20	26
	72h / +100°C (212°F)	DIN ISO 815 (B)	%	39	33	36
	3h / +130°C (266°F)	DIN ISO 815 (B)	%	28	25	
	Tensile Strength	DIN 53 504 (S2)	N/mm²	64	61	57
	Elongation at break	DIN 53 504 (S2)	%	550	560	550
	Rebound Resilience	DIN 53 512 (6 mm)	%	49	54	42
	100% Modulus	DIN 53 504 (S2)	MPa	14	14	13
	Colour			Turquoise	Dark Turquoise	Green

* Other Zurcon materials e.g. with a Operating Temperature < 50° (-58°F) or a Hardness of 83+/-2 Shore A on requests

These indications are based on laboratory values and reflect typical material properties. The application limits for pressure, temperature, speed and media are maximum values determined in the laboratory. During practical applications it should be remembered that due to the interaction of the operating parameters the maximum values must be set correspondingly lower. It is vital that customers satisfy themselves as to the suitability of individual products through adequate testing. For exceptional operating conditions please contact your Trelleborg Sealing Solutions representative. The data sheet is not subject to an updating service.

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Zurcon® U-Cup RU9



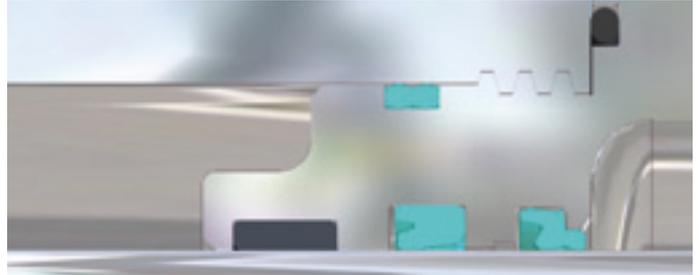
Innovation in design and material



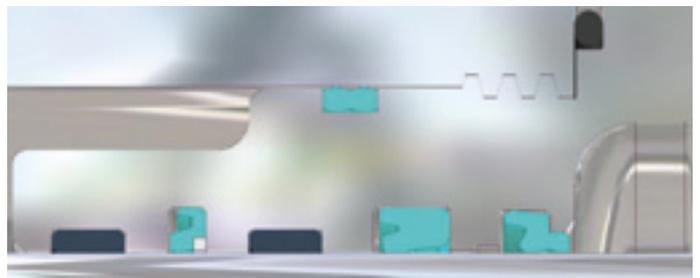
Your Partner for Sealing Technology

Advantages of Zurcon® U-Cup RU9

- Optimum solution for mobile and industrial hydraulic applications
- Long service life minimizes maintenance and downtime
- Unique patented construction gives excellent back-pumping ability
- Constant lubrication film minimizes break-away force
- Proven performance under high pressure for extended periods
- Superb friction characteristics
- Enhanced pressure distribution on rod
- Low heat generation
- Superior extrusion resistance
- Wide operating temperature range
- Almost universal media compatibility
- Compact installation dimensions
- Designed for easy assembly



Zurcon® U-Cup RU9 used as a single seal in a sealing system with a double-acting scraper.



Zurcon® U-Cup RU9 as a secondary seal in a "tandem design" sealing system with double-acting scrapers.

Features of Zurcon® U-Cup RU9

- Fits into standard groove sizes according to DIN/ISO 5597
- Capable of installation in closed grooves
- Increased hardware clearance
- Interference fit at external diameter
- Trimmed seal lip gives outstanding dynamic and static sealing effect
- Microstructure gives excellent tribological characteristics

Zurcon® Z20 and Z22 polyurethane:

Proprietary polyurethane material specially developed by Trelleborg Sealing Solutions for manufacture of sealing elements

- High wear resistance
- Low compression set
- Wide operating temperature range
- Almost universal media compatibility

Technical data	
Pressure	max. 40 MPa (5800 psi)
Velocity	max. 0.5 m/s (20 inch/sec)
Operating temperature	Zurcon® Z20 Standard: -35°C to +110°C (-31°F to +230°F) Zurcon® Z22 Premium: -45°C to +110°C (-49°F to +230°F)
Media/Operating temperature	
Hydraulic fluids	- Mineral oil base -35°C to +110°C (-31°F to +230°F) - Synthetic and natural ester HEES, HETG up to +60°C (+140°F) - Flame-retardant hydraulic fluids HFA and HFB up to +40°C (+104°F)
Material	- Zurcon® Z20 Standard polyurethane 93 Shore A - Zurcon® Z22 Premium polyurethane 93 Shore A
Color	Turquoise

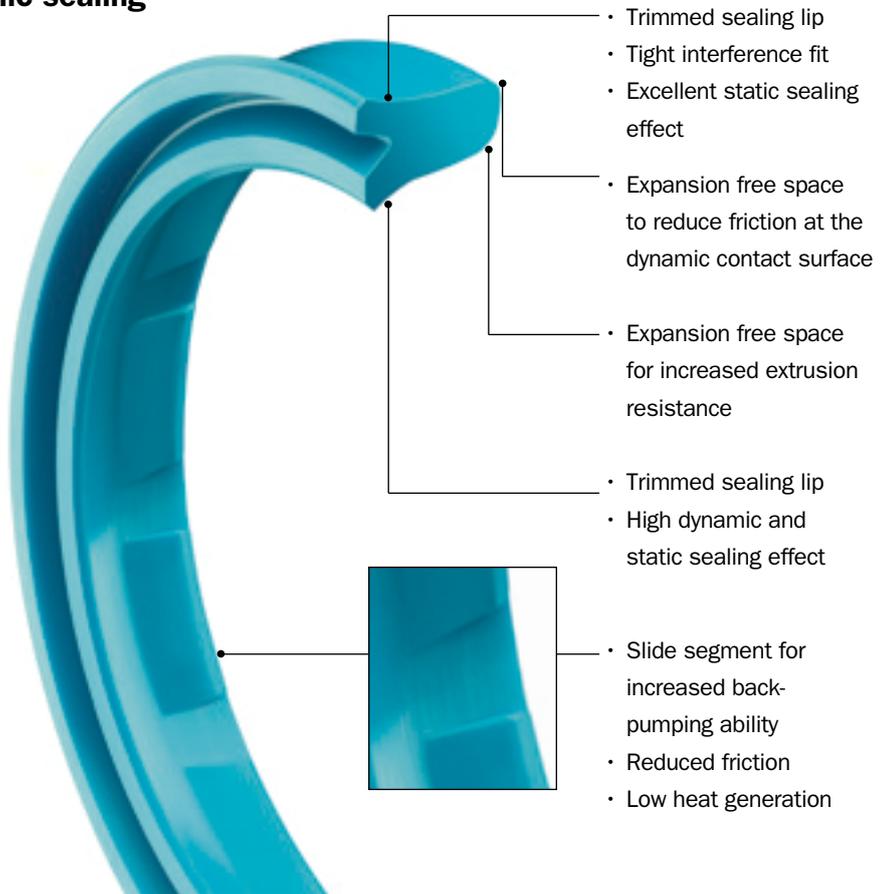
Zurcon® U-Cup RU9 - Exceptional hydraulic sealing

In mobile and hydraulic applications, a long service life is needed from piston rods. Important in achieving this, is the effectiveness of their sealing system.

Rod seals must operate for extended periods under high pressure and friction. To give long-term performance, wear and extrusion resistance are vital, as is compatibility to aggressive media and a wide temperature capability. While compact installation dimensions and ease of assembly are also essential.

Zurcon® U-Cup RU9, developed to meet these criteria, provides the optimum sealing solution for mobile and industrial hydraulic applications.

A key to the long service life of Zurcon® U-Cup RU9 is its special hydrodynamic and tribologic properties. These are the result of its unique patented microstructure, where sliding surfaces in the seal are combined with back-pumping channels. Giving excellent back-pumping across its entire pressure range, a constant lubrication film underneath the seal-sliding surface reduces dynamic friction and breakaway force, even after pro-longed periods of rest.



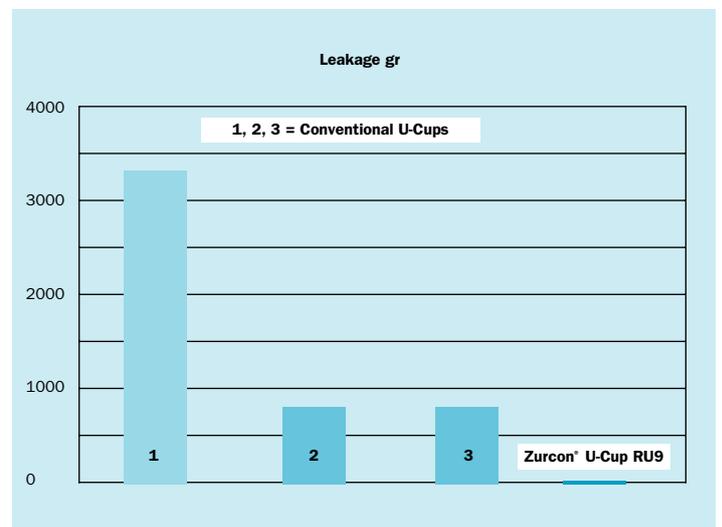
Sealing Performance with virtually zero leakage

Excellent sealing performance is achieved by:

- Interference fit at the external diameter
- Special shape of both trimmed seal lips
- Controlled pressure distribution and hydrodynamic back-pumping ability over a wide pressure range

Test Conditions

Groove	50/60/11
Velocity	0.05 to 0.4 m/s (2 inch/sec to 16 inch/sec)
Pressure	0 to 20 MPa (0 to 2900 psi, 200 bar)
Oil Temperature	50°C (122°F)
Oil Type	HLP46
Test Distance	40.5 km (25 miles)



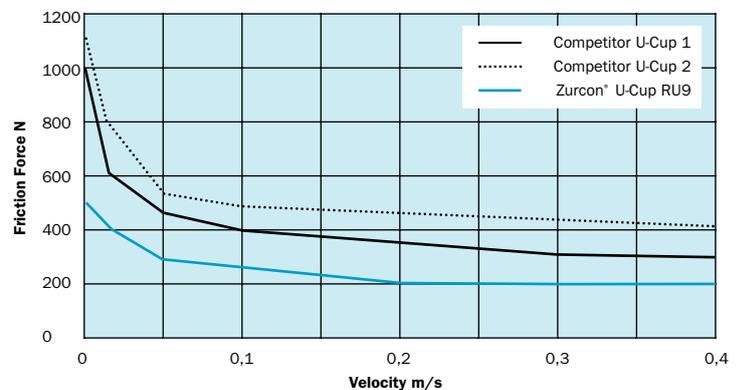
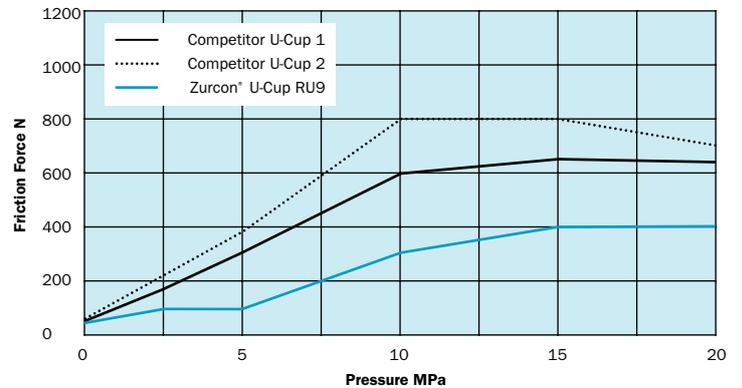
Superb friction characteristics

The friction force of U-Cups increases greatly between 2.5 and 10 MPa (362 and 1450 psi, 25 and 100 bar). The Zurcon® U-Cup RU9 has a unique feature. When the system pressure is higher, the contact surface between the Zurcon® U-Cup RU9 and the piston rod becomes larger. The seal deforms to such an extent that its entire friction generating inside surface is in contact with the piston rod.

Due to the special design of Zurcon® U-Cup RU9, the pressure distribution on the rod is improved. The resulting tribological benefits (the effect of friction, lubrication, and wear of interacting surfaces) enhance the friction characteristics of the seal. This is illustrated when the friction values of conventional U-Cups are compared to those of the Zurcon® U-Cup RU9.

Test Conditions

Groove	40/50/8
Oil Temperature	50°C (122°F)
Oil Type	HLP46



Back-pumping effect extends seal life

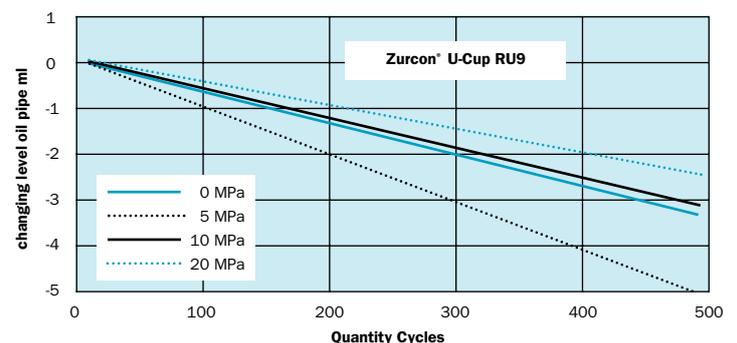
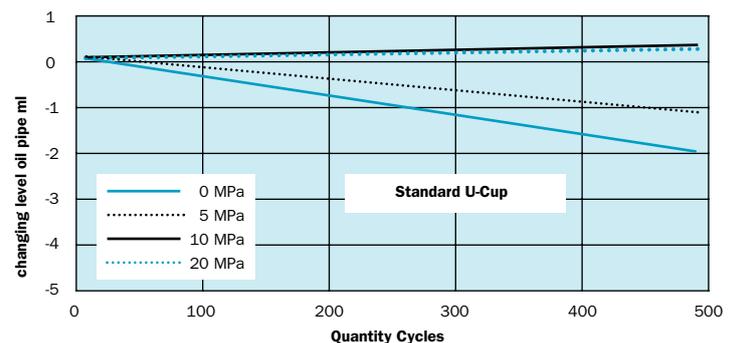
The unique patented microstructure of Zurcon® U-Cup RU9, where sliding surfaces in the seal are combined with back-pumping channels, gives excellent back-pumping across its entire pressure range.



In back-pumping technology, on the forward stroke of the shaft, an oil lubricating film is distributed under the seal. On the return stroke the oil is back-pumped into the system, preventing leakage. This extends seal life by reducing dynamic friction and breakaway force, even after pro-longed periods of rest.

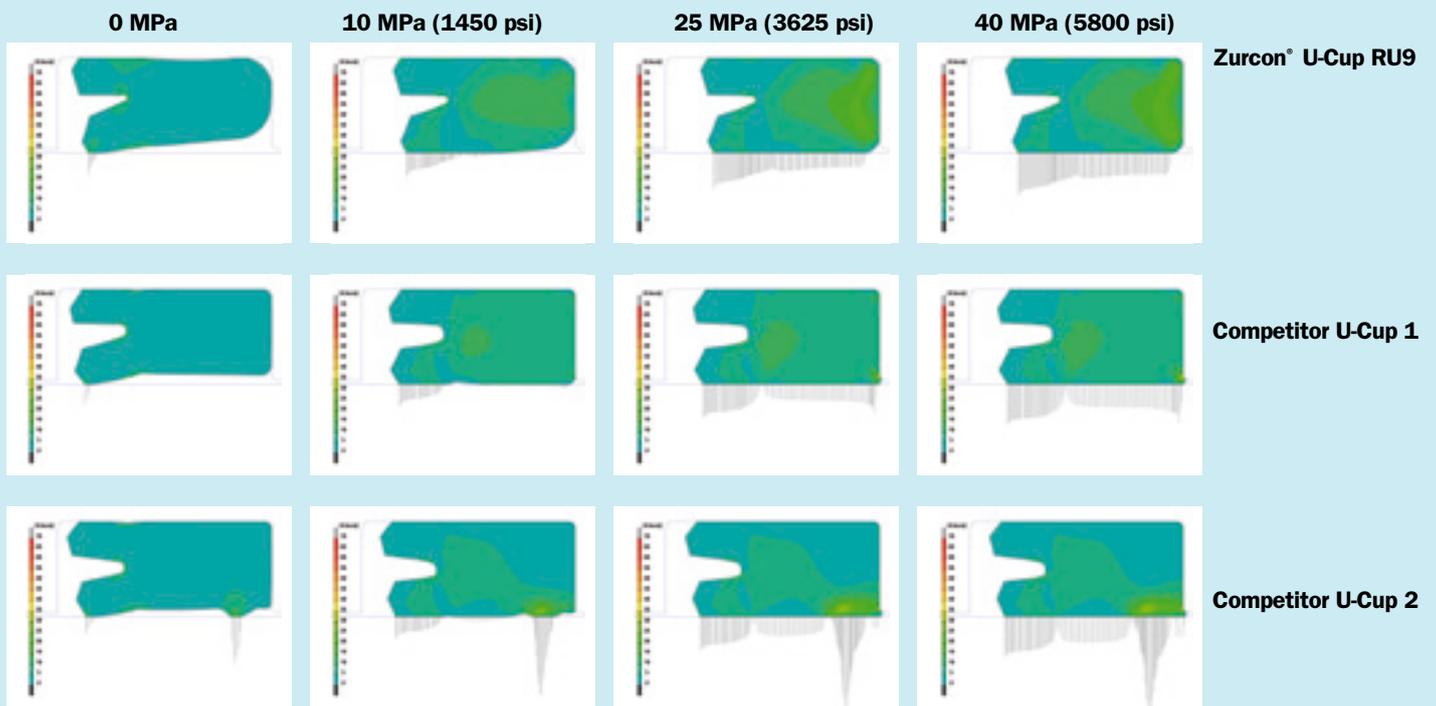
Test Conditions

Groove	40/50/8
Stroke length	250 mm (1 inch)
Velocity	0.4 m/s (16 inch/sec)
Velocity ratio	1:1
Oil Temperature	50°C (122°F)
Oil Type	HLP46



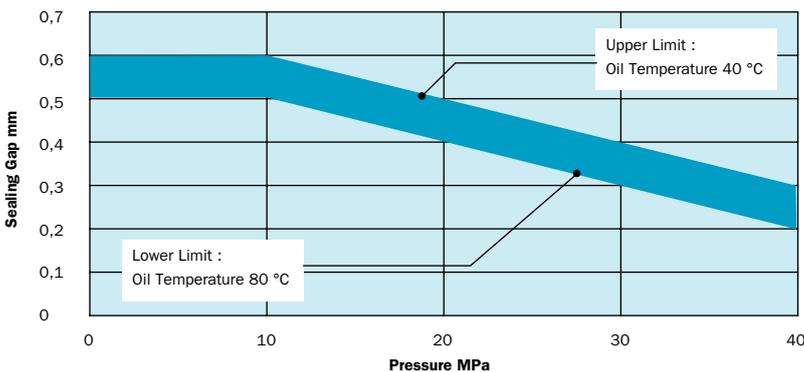
Zurcon® U-Cup RU9 gives superior performance under pressure compared with standard U-cups

The FEA (Finite Element Analysis) illustrations below clearly demonstrate the outstanding performance of Zurcon® U-Cup RU9 under pressure.



Hardware clearance can be increased

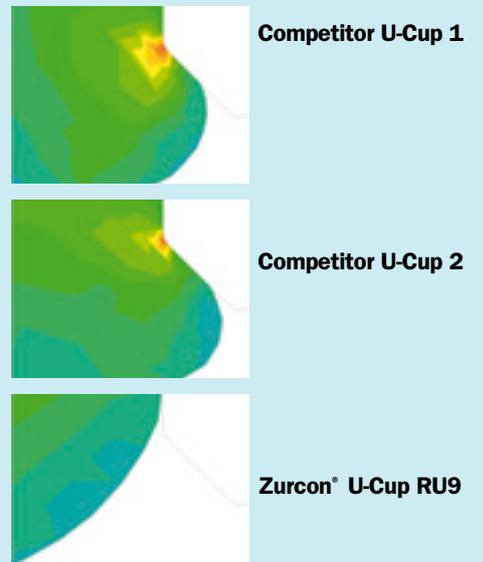
The new Zurcon® U-Cup RU9 design combined with special material properties gives a better extrusion resistance compared to standard U-Cups under all working conditions. This means the hardware clearance can be increased significantly.



All graphs are in metric measurements.

Better extrusion resistance

40MPa (5800 psi, 400 bar)



Zurcon® U-Cup RU9 shows better extrusion resistance than standard U-Cups in the same hardware and service conditions.

Contact your local marketing company for further information:

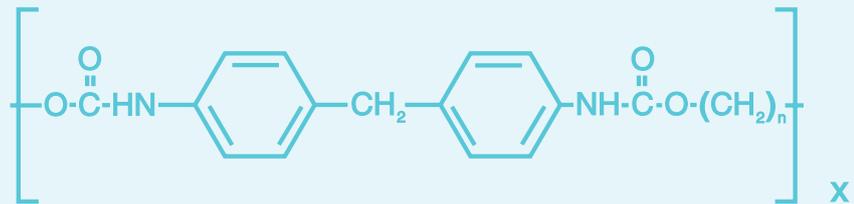
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The new Class

ZURCON® Z20 / Z22
New worldclass polyurethane materials



Your Partner for Sealing Technology

Introduction

Polyurethane seals based on old technology materials do not meet the high requirements of tomorrow's fluid power industry in many key areas:

- Leak free performance
- Life
- Life cycle cost
- Temperature range

Trelleborg Sealing Solutions has therefore invested in in-house laboratory and material production facilities to develop tailor made polyurethane materials with exceptional properties to meet the expectations of the fluid power industry.

The first of this new generation of materials are now approved and released by Trelleborg Sealing Solutions:

Zurcon® Z20

Standard material for hydraulic applications.

Zurcon® Z22

Premium material for hydraulic seals applications with a wide operating temperature range.

Zurcon® Z201

Standard material for hydraulic scrapers.

Zurcon® Z221

Premium material for hydraulic scrapers for low and high temperatures.

All Trelleborg Sealing Solutions standard hydraulic seals and scrapers will be offered in the new Zurcon® material Z20/Z201 or in the premium Zurcon® Z22/Z221.

Further Zurcon® materials for alternative application types are under development and will be released as they are approved by Trelleborg Sealing Solutions.

Positioning

For all hydraulics applications with normal operating conditions, the standard polyurethane materials are recommended; Zurcon® Z20 for seals and Zurcon® Z201 for scrapers. For applications where an excellent low temperature behaviour is necessary, the new premium polyurethane Zurcon® Z22 for seals and Zurcon® Z221 for scrapers are recommended for improvements in cold flexibility and compression set. Pricing of seals and scrapers in Zurcon® Z22/Z221 is higher than the standard Zurcon® Z20/Z201.

Extrusion resistance, wear resistance

Trelleborg Sealing Solutions seals (U-cup or L-cup) produced in the new Zurcon® polyurethane materials, have outstanding extrusion and wear resistance. Therefore life, life-cycle cost and leak free performance all meet the high expectations of the end user.

No additional back-up ring is necessary for applications up to 40 Mpa if Trelleborg Sealing Solutions installation recommendations are used.

Fluid compatibility

Zurcon® Z20 and Zurcon® Z22 have been developed for use in mineral oil based hydraulic fluids. They can also be used in synthetic ester fluids within the recommended temperature range. The swell of Zurcon® Z20 in mineral oil is very low (ASTM 3 approx. 6%).

Operating temperature

The new developed Zurcon® polyurethane materials have an extended temperature range compared to old technology polyester (AU) or polyether (EU) based materials. These excellent properties increase the life, extrusion resistance and leakage performance for seals and scrapers.

Figure 1: Operating temperature range for the new Zurcon® materials

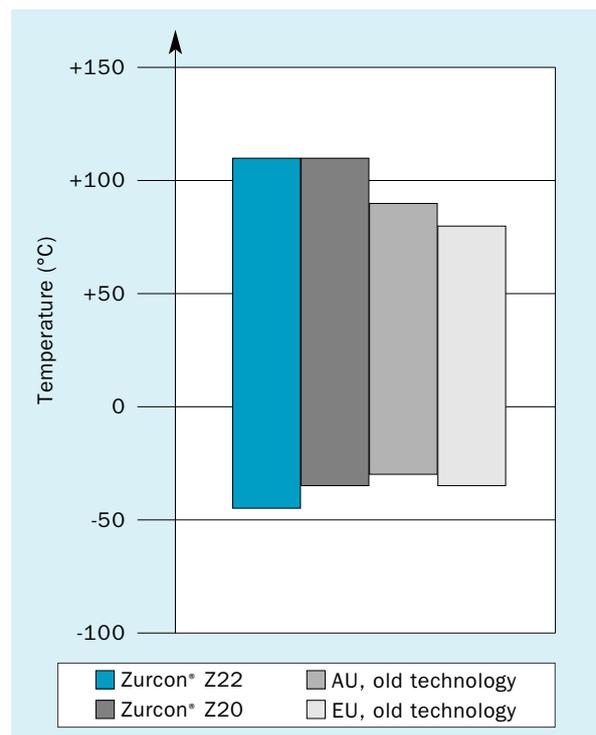


Table 1:

Typical material properties

Material	Units	Z20	Z22	TPU - old technology
Hardness	Shore A	93	93	93
100% modulus	MPa	12	13	10
Ultimate elongation	% (min.)	550	550	450
Tensile strength	MPa	57	55	45
Compression set				
24h / -20°C	%	46	25	65
72h / +70°C	%	23	21	35
72h / +100°C	%	39	36	55
3h / +130°C	%	28	25	35
Rebound resilience	%	41	44	30
TR10-point	°C	-34	-50	-27
Operating Temperature				
Max.	°C	+110	+110	+80
Min.	°C	-35	-45	-30
Colour	-	Turquoise	Dark turquoise	Turquoise

Compression set

Zurcon® Z22 and Zurcon® Z20 materials have been tailor made to have very low compression set values to meet applications under low or high temperature conditions as well as the paint drying process of hydraulic components with water based varnish paint coats.

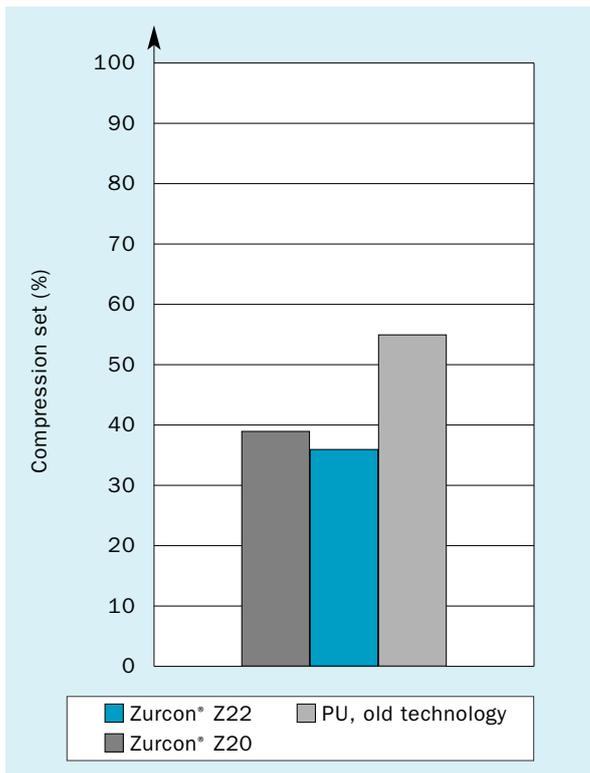


Figure 2: **Compression set 72 h / 100°C**

Figure 3: **Loss of contact stress 30min /130°C**

Short duration high temperature exposure creates severe loss of sealing stress in old technology materials.

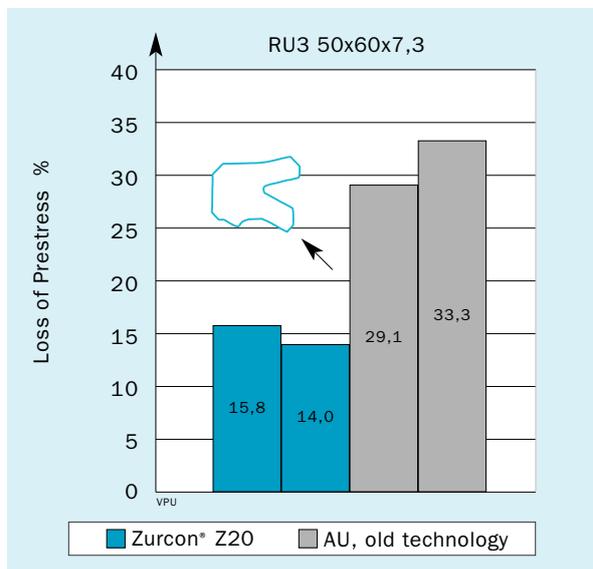


Figure 3: **Loss of contact stress 30min /130°C**

Wear and extrusion performance of U-Cups

U-Cup RU2100500, 50 x 60 x 11

Zurcon® Z20 (Figure 4)

versus

PU, old technology (Figure 5)

U-Cup RU3200500, 50 x 65 x 12,5

Zurcon® Z20 (Figure 6)

versus

U-Cup, old technology (Figure 7)

The performance of different U-cups in different materials has been tested under the following test conditions

(Figure 8):

Pressure (cycling)	0-30 MPa	Velocity	0.2 m/s
Cycles	200 000	Stroke	300 mm
Oil temperature	+80°C	Extrusion gap	0.2 mm

Figure 4-8:

Test results

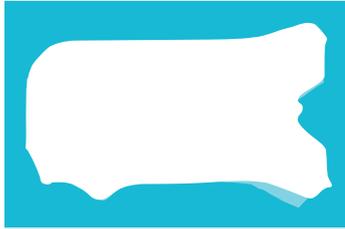


Figure 4: Zurcon® Z20

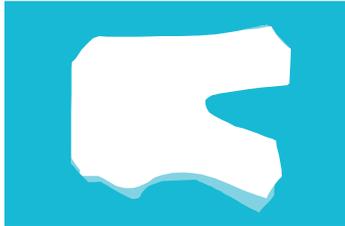


Figure 6: Zurcon® Z20



Figure 8: rod seal test rig

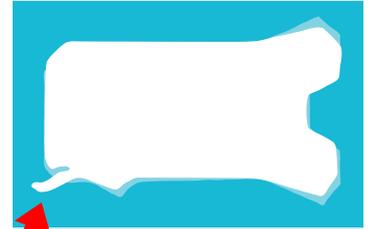


Figure 5: PU, old technology

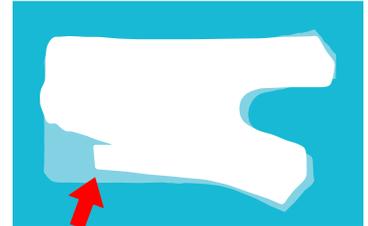


Figure 7: U-Cup, old technology

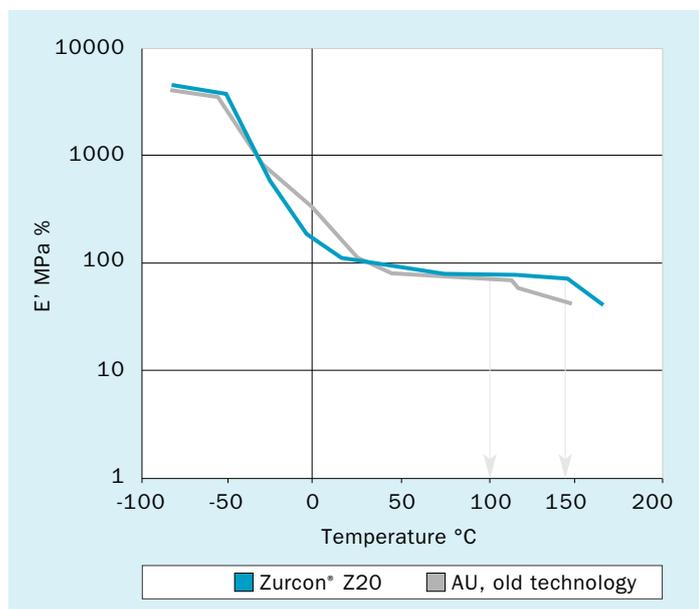


Figure 9: DMA Storage Modulus

Viscoelastic characterisation of materials by a Dynamic Mechanical Analysis (DMA)

DMA curves show the Storage Modulus E in relation with the temperature variation. DMA analysis of Zurcon® Z20 and old technology materials shows the stable elastic modulus of Zurcon® Z20 extending to +145°C and improved flexibility to -30°C.

In the area of +15°C to -30°C a significant improvement of the Zurcon® Z20 behaviour compared to the old technology material can be noticed.

Sealing solution with Zurcon® Z20 seals for hydraulic cylinder

The total sealing solution for a medium duty mobile hydraulic cylinder includes: static seals (Dualseal), piston and rod seals and scraper in Zurcon® Z20/Z201. This is a reliable and cost effective solution, which can meet the industry expectations in terms of leak free performance, life and installed cost.

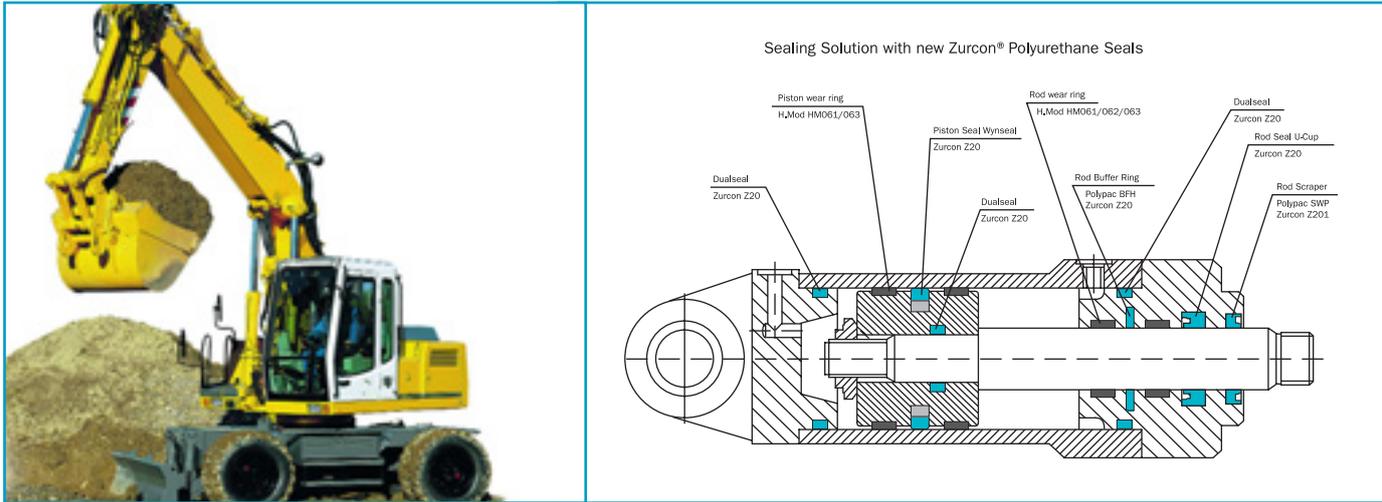


Figure 10

Zurcon® Z20 / Z22 material performance

Zurcon® materials outperform old technology polyester and polyether materials in all critical properties.

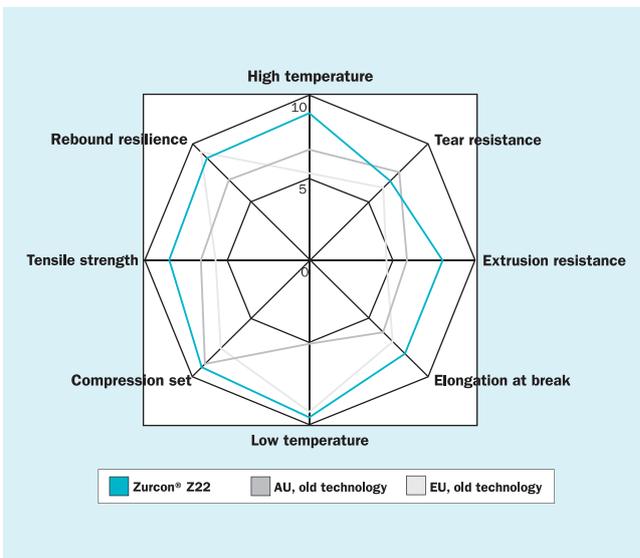


Figure 11

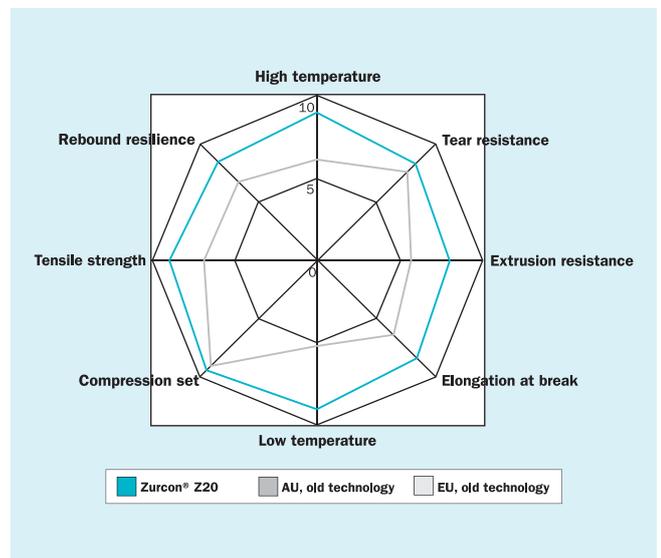


Figure 12

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