Hallite
Fenner Advanced Sealing Technologies

Fluid Power Seal Catalogue

EMEA

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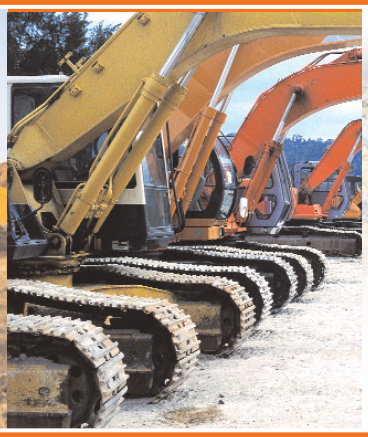


Fenner

A Culture of Excellence...

Making world class products for highly specified mission critical applications goes beyond excellence in engineering and design; it involves a total commitment to quality in every aspect of our business.

Through product and service innovation in response to changing customer needs Hallite's sealing products have set new benchmarks across a wide variety of industries, in just about every corner of the globe.

Hallite has been at the cutting edge of sealing technology solutions for over one hundred years and has built up an unrivalled wealth of knowledge and expertise over this period. Our stability and solid foundations have helped us support our customers and offer them the reliability they have now come to expect.

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All our activities conform to the highest quality assurance systems. Hallite Seals International is accredited to ISO 9001 and are approved by many of the worlds foremost O.E.M.s


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Within the introductory section (pages 2 – 21) technical data is provided to ease seal selection. Seal designs are grouped according to their prime use in a hydraulic cylinder:

- Rod Seals
- Single Acting Rod and Piston Seals
- Double Acting Piston Seals
- Single Acting Piston Seals
- Unitised Piston
- Vee Packs
- Wipers
- Bearings
- Swivel Seals
- Additional Products

Product types are then listed in numerical order from page 25 and within each product type, parts are listed in size order.

Parts suitable for ISO standard housings and Asian housings are clearly identified within each product group size lists.

A product index by function and size is included in the yellow pages section.

We are constantly adding to our range of profiles and sizes. If you cannot locate the correct profiles or size, please contact your nearest Hallite sales office or Hallite distributor.

The information contained within this catalogue is based on many years of fluid sealing experience, along with extensive in-house testing and is given in good faith. No warranty or guarantee is expressed save in our standard terms and conditions of sale (available on request), since the conditions of use are beyond our control.

Hallite Seals is continuously improving its range and reserves the right to withdraw or modify any item shown in this catalogue.

Hallite Seals
Hallite produces high performance hydraulic sealing solutions for the world's fluid power industry. The company enjoys an enviable reputation for high quality and reliability within the mobile hydraulics, mining, off-highway, construction, agriculture, mechanical handling and automation markets.

Hallite products, engineered in a wide variety of advanced materials, are chosen by leading manufacturers for their exceptional performance in the most demanding, safety-critical high specification applications.

Hallite operations are located in Australia, Canada, China, France, Germany, Italy, the UK and the USA. All Hallite locations are committed to providing quality seals in the shortest possible time. Hallite combines carefully chosen and managed stocks in local markets, supported by a fast track moulding capability. Most locations can now boast a CNC machining cell, branded Hallite Service, which can provide immediate delivery for non-standard and breakdown situations.

Additionally a worldwide network of service partners completes the global presence and ensures the full range of Hallite products is readily accessible.

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Distributor

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Seal Designs

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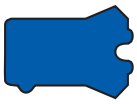
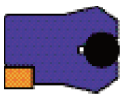
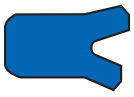
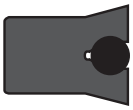
Rod Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Rod Seals	**16**	41	●			300	-30 +100°C	4.0
	605	143	●	●		400 700*	-45 +110°C	1.0
	610	161	●			400	-45 +110°C	1.0
	616	165	●			240	-45 +110°C	1.0
	620	167		●		400	-45 +110°C	1.0
	621	169	●	●		700	-45 +110°C	1.0
	652	175	●			700	-45 +110°C	1.0
	653	179	●	●		700	-45 +110°C	1.0
	663	185	●			400	-45 +110°C	1.0

* Pressure rating of seal design can be extended by the use of a back up ring. If this option is required, please seek advice from your local Hallite sales office.

Single Acting Rod and Piston Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Single Acting Rod and Piston Seals	**15**	39	●			300	-30 +100°C	0.5
	18	45	●	●		500	-30 +100°C	0.5
	511	115		●		350	-40 +110°C	0.5
	512	119		●		350	-40 +110°C	0.5

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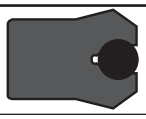
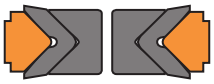
Single Acting Rod and Piston Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Single Acting Rod and Piston Seals	513	123		•		350	-40 +110°C	0.5
	601	137	•	•		400 700*	-45 +110°C	1.0

* Pressure rating of seal design can be extended by the use of a back up ring. If this option is required, please seek advice from your local Hallite sales office.

Double Acting Piston Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Double Acting Piston Seals	50	65	•			350	-30 +100°C	0.5
	51	67	•			700	-30 +100°C	0.5
	52	69	•			600	-30 +100°C	0.8
	53	71	•	•		500	-30 +100°C	0.5
	54	75	•	•		350	-30 +100°C	4.0
	56	79	•	•		500	-30 +100°C	0.5
	58	83	•	•		700	-30 +100°C	0.5
	64	89	•			400	-30 +100°C	0.5
	65	91	•	•		160	-30 +100°C	0.5
	68	95	•			500	-30 +100°C	0.5
	77	97	•	•		350	-30 +100°C	0.5

Seal Designs

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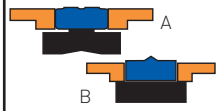
Double Acting Piston Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Double Acting Piston Seals	**714**	187		●		500	-40 +110°C	2.0
	730	191	●			700	-40 +110°C	0.3
	735	195	●	●		500	-40 +120°C	1.5
	753	199	●		 A B	400	-30 +100°C	0.5
	754	203	●	●		350 500**	-40 +110°C	1.0
	755	207		●		350	-40 +110°C	1.0
	764	209	●	●		250	-30 +110°C	1.0
	770	213		●		350	-40 +110°C	1.0
	775	215		●		350	-30 +110°C	1.0

** Pressure rating of seal design can be extended by using other face material options - see Hallite 754 datasheet.

Single Acting Piston Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Single Acting Piston Seals	**606**	157	●	●		400 700*	-45 +110°C	1.0
	659	183	●	●		400 700*	-45 +110°C	1.0

* Pressure rating of seal design can be extended by the use of a back up ring. If this option is required, please seek advice from your local Hallite sales office.

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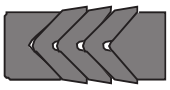
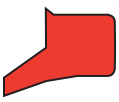
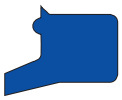
Unitised Piston

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Unitised Piston	720	189	●	●		350	-40 +110°C	1.0

Vee Packs

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Vee pack sets	07	25	●	●		700	-30 +100°C	0.5
	09	29	●	●		400	-30 +100°C	0.5
	11	33	●			400	-30 +100°C	0.5
	13	35	●			700	-30 +100°C	0.5
	14	37	●			700	-30 +100°C	0.5

Wipers

Section	Hallite Type	Page	Metric	Inch	Profile	Notes	°C	m/s
Wipers	33	51	●	●		Additional wiper seals are available on request and include ranges for standard American grooves. Hallite wipers 33 are produced in materials that are capable of operating at temperatures below 0 °C, but they are not designed to scrape ice.	-30 +100°C	4.0
	38	57	●				-40 +120°C	4.0
	335	105	●				-30 +100°C	5.0
	520	129		●			-45 +110°C	4.0

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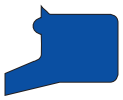
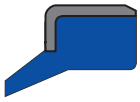
Wipers

Section	Hallite Type	Page	Metric	Inch	Profile	Notes	°C	m/s
Wipers	831	221	●			Hallite wipers 834,839 and 846 are produced in materials that are capable of operating at temperatures below 0 °C, but they are not designed to scrape ice.	-45 +110°C	4.0
	834	225	●				-45 +110°C	4.0
	839	229	●				-45 +110°C	4.0
	842	233	●	●			-45 +110°C	4.0
	846	239	●				-45 +110°C	4.0
	860	241	●	●			-40 +100°C	1.0
	862	245		●			-40 +100°C	1.0

Bearings

Section	Hallite Type	Page	Metric	Inch	Profile	Notes	°C	m/s
Bearings	87	101	●			Hallite 87, 506, 533 wear strip are also suitable for oscillating and rotary applications.	-50 +200°C	5.0
	506	107	●	●		Hallite 87 and 506 include cross sections that satisfy the requirements of ISO 10766.	-40 +120°C	5.0
	533	133		●		Hallite 506 is available in three different formats; spiral lengths, cut rings and flat coils, see the relevant data sheet for additional information.	-40 +120°C	5.0

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Swivel Seals

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Swivels Seals	80	99	●			350	-30 +80°C	0.1
	310	103	●			300	-30 +100°C	0.5
	Ro 800	219	●			350	-30 +80°C	0.2

Additional Products

Section	Hallite Type	Page	Metric	Inch	Profile	bar	°C	m/s
Additional Products	657	181	●	●		350 600	-40 +110°C	STATIC

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Material name	Material group	Designation	Temperature range °C	Temperature range °F	Hardness	Colour	Rod
Nitrile – medium	Synthetic rubber	NBR	-30 +120	-22 +250	90 IRHD	Black	H
Nitrile – high	Synthetic rubber	NBR	-10 +140	-14 +284	80 IRHD	Black	P
Nitrile – low	Synthetic rubber	NBR	-45 +100	-45 +212	80 IRHD	Black	H
Nitrile – medium	Synthetic rubber	NBR	-30 +120	-22 +250	80 IRHD	Black	
Nitrile – medium	Synthetic rubber	NBR	-30 +120	-22 +250	75 IRHD	Black	H
Nitrile – medium	Synthetic rubber	NBR	-30 +120	-22 +250	73 IRHD	Black	H
Nitrile – medium	Synthetic rubber	NBR	-30 +120	-22 +250	70 IRHD	Black	H
Nitrile – low	Synthetic rubber	NBR	-45 +100	-45 +212	70 IRHD	Black	H
Nitrile – medium	Synthetic rubber	NBR	-30 +120	-22 +250	70 IRHD	Black	H
Hallprene – rubber / fabric	Composite	Cotton/ NBR	-30 +120	-22 +250		Black	H
Fluoroelastomer rubber / fabric	Composite	Cotton/ FKM	-20 +150	-4 +302		Black	H
Fluoroelastomer	Synthetic rubber	FKM	-20 +200	-4 +392	75 IRHD	Black	HP
Hythane® 181	TPE	EU	-45 +110	-50 +230	93 IRHD	Blue	HP
Hallite ® 361	TPE	AU	-30 +110	-22 +230	96 IRHD	Orange	H
Polyurethane	TPE	AU	-40 +100	-40 +212	94 IRHD	Dark blue	
Polyurethane	TPE	EU	-45 +110	-50 +230	93 IRHD	Dark blue	
Polyurethane	TPE	EU	-45 +110	-50 +230	93 IRHD	Black	H
Polyurethane	TPE	EU	-40 +100	-40 +212	55D	Green	
Standard polyester elastomer	TPE		-40 +120	-40 +250	55D	Red	
Hydrolysis stabilised polyester elastomer	TPE		-40 +120	-40 +250	55D	Grey	H
Hydrolysis stabilised polyester elastomer	TPE		-40 +140	-40 +284	72D	Dark Red	
Hydrolysis stabilised polyester elastomer	TPE		-30 +100	-22 +212	40D	Light grey	
Lubricated polyester elastomer	TPE		-40 +120	-40 +250	55D	Cream	
Acetal	Eng. plastic	POM	-45 +120	-50 +250	R115	Orange	H
PTFE glass filled	Eng. plastic	PTFE	-50 +200	-58 +392	60D	White	HP
PTFE glass / MoS_2 filled	Eng. plastic	PTFE	-50 +200	-58 +392	62D	Grey	H
PTFE Bronze filled	Eng. plastic	PTFE	-50 +200	-58 +392	65D	Bronze	H
PTFE Bronze filled	Eng. plastic	PTFE	-50 +200	-58 +392	72D	Bronze	
Hallite® 506 polyester /polyester	Composite		-40 +120	-40 +250		Red	
Nylon 12	Eng. plastic	PA	-40 +120	-40 +250	72D	Brown	
Nylon 6 / MoS_2	Eng. plastic	PA	-40 +120	-40 +250	R115	Black	
Glass filled Nylon	Eng. plastic	PA	-40 +120	-40 +250	R124	Black	

Piston	Wiper	Bearing		Products	Compound reference
	H			11, 12, 13, 14, Vee rings, 33	9000141
P	P			Special material option	9000041
				Special material option	9000471
H			M(1)	50, 53, 65, 68, 77,730, 735, 753 Sealing elements	9001411
H				15	9000801
H				18	9000271
H				16, 54, 754, 755, 770	9000771
H				Special material option 15, 18, 56, 58	9000211
				56, 58	9000111
H				11, 13, 14, 15, 18, 21, 51, 52, 56, 58	9400251
H				Special material option for standard rubber and rubber /fabric products. (Additional tooling may be required)	9400431
HP	HP			Special material option for standard rubber and rubber /fabric products. (Additional tooling may be required)	9020051
HP	HP		M	80, 601, 605, 606, 607, 609, 610, 616, 620 ,621, 652, 653, 656, 657, 658, 659, 834, 839, 842, 846	9220181
H	H			764, 775	9220361
	H			860, 862	9220321
	H			520, 831	9220251
H				511, 512,513	9220221
	H		M	Special material option 842	9220371
H	H			38, 754, 755	9270061
H			M	716, 730, 740 ,750	9270111
H				754, 755, 770	9270051
			M(1)	155	9270201
HP				770	9270261
H		HP	M	AE rings 621, Vee pack headers, Bearing rings 53, 58, 65, 68, 77	9230011
HP				16, 54	PTFE02
H	H			416, 454, 735	CDI702
H				416, 454, 735	CDI741
		H		87	9200031
		HP	M	506, 507	
H				Support rings 50, 53, 68	9260041
H				AE rings735	CDI707
		H		533	Dynamic 533

Key: H- Hydraulic P- Pneumatic M- Suitable for water based fluid (1)- Static applications only

Materials and fluid compatibility

Max. continuous working temperatures °C and temperature ranges for materials, within fluid power fluids

			Service Fluids								
			Fluids based on mineral oils				Greases		Fuels		
Material	Continuous material service temperature range °C	Intermittent material service temperature range °C	Motor oils	Hypoid gear oils	Automatic transmission fluid	ISO 6743-4 Hydraulic oils (HL, HM, HV)	Mineral oil based greases	Silicon based greases	Diesel fuel	Fuel for gasoline/petrol engines – normal	Fuel for gasoline/petrol engines – super
			+150 -40	+150 -40	+160 -50	+100 -30	+100 -30	+250 -50			
			Maximum continuous service temperature in fluids °C								
NBR 70 IRHD NBR 90 IRHD Nitrile (medium)	+ 100 - 30	+ 120 - 30	100	90	100	100	100	100	*	*	*
FKM 75 IRHD FKM 90 IRHD Fluoro-elastomer	+ 200 - 20	+ 250 - 20	150	150	160	100	100	200	150	150	150
EPDM 70 IRHD EPDM 80 IRHD	+ 120 - 50	+ 150 - 50	NS	NS	NS	NS	NS	120	NS	NS	NS
VMQ 70 IRHD Silicone	+ 200 - 55	+ 250 - 55	*	*	*	*	100	*	NS	NS	NS
HNBR 75 IRHD Hydrogenated nitrile	+ 130 - 30	+ 150 - 30	130	110	130	100	100	130	*	*	*
IIR Butyl	+ 120 - 40	+ 140 - 40	NS	NS	NS	NS	NS	120	NS	NS	NS
FFKM Perfluoro-elastomer	+300 +200 +40 -20		150	150	160	100	100	200	150	150	150
AU Polyester PU	+ 100 - 30	+ 110 - 30	100	100	100	100	100	100	60	60	60
EU Polyether PU	+ 100 - 40	+ 110 - 45	100	100	100	100	100	100	60	60	60
Polyester-Elastomer	+ 100 - 40	+ 120 - 40	100	100	100	100	100	100	60	60	60
PA Polyamide	+ 100 - 40	+ 120 - 40	100	100	100	100	100	100	100	100	100
POM Acetal	+ 100 - 45	+ 120 - 40	100	100	100	100	100	100	100	100	100
PPS Polyphenylene sulphide	+ 200 - 40	+ 200 - 40	150	150	160	100	100	200	150	150	150
PTFE Polytetra-fluoroethylene	+ 200 - 200	+ 200 - 200	150	150	160	100	100	200	150	150	150
Thermosetting polyester resin	+ 200 - 200	+ 130 - 200	100	100	100	100	100	100	100	100	100
PEEK Polyether-etherketone	+ 250 - 65	+ 300 - 65	150	150	160	100	100	250	150	150	150

* Denotes that values vary greatly for individual elastomers within this group NS Denotes that the elastomer is not suitable

The work of the BFPA technical working group 'TC16/WG8' in the compilation of this table is acknowldged

Materials and fluid compatibility

Max. continuous working temperatures °C and temperature ranges for materials, within fluid power fluids

Service Fluids											
Fire-resistant hydraulic fluids					Environmentally acceptable fluids				Other service fluids		
ISO 6743-4 HFA-Fluids (5/95 waterbased)	ISO 6743-4 HFB-Fluids (60/40 invert emulsion)	ISO 6743-4 HFC-fluids (water glycol)	ISO 6743-4 HFDR-fluids (phosphate ester ALKYL (Aero))	ISO 6743-4 HFDR-Fluids (phosphate ester ARYL (ind.))	ISO 6743-4 HETG fluids (Vegetable oil based)	ISO 6743-4 HEES fluids (Synthetic ester based)	ISO 6743-4 HEPG fluids (Synthetic glycol based)	ISO 6743-4 HEPR fluids (Synthetic hydrocarbons)	Water	Air	Brake fluids
+60 +5	+60 +5	+60 -30	+100 -50	+150 -0	+60 -10	+100 -40	+100 -50	+150 -50	+60 (1) -5	+200 +2	+130 -50
Maximum continuous service temperature in fluids °C											
60	60	60	NS	NS	60	60	60	100	80	100	NS
60	60	NS	NS	150	60	100	80	150	100	200	NS
NS	NS	60	80	80	NS	NS	NS	NS	120	120	120
NS	NS	NS	NS	NS	NS	NS	NS	*	100	200	80
60	60	60	NS	NS	60	60	80	130	130	130	NS
NS	NS	60	100	120	NS	NS	NS	NS	120	120	80
60	60	60	100	150	60	100	100	150	150	200	130
40	40	NS	NS	NS	60	60	60	100	40	40	NS
60	60	40	NS	NS	60	80	60	100	60	80	NS
60	60	NS	NS	NS	60	80	60	100	60	80	NS
60	60	60	100	100	60	100	100	100	60	80	80
60	60	60	100	100	60	100	100	100	80	80	80
60	60	60	100	150	60	100	100	150	150	200	130
60	60	60	100	150	60	100	100	150	150	200	130
60	60	40	100	100	60	100	100	100	80	100	NS
60	60	60	100	150	60	100	100	150	150	200	130

In view of the variations in formulation of both oils and polymers, the compatibility of all combinations should be confirmed by testing and field service performance for each application.
(1) Temperature range for water in fluid power applications

Products and Typical Fluid Compatibility

D = Dynamic Application, S = Static Application
R = Recommended, P = Possible , NS = Not Suitable

Product	Fluids Based on Mineral Oil		Water Based Fluids								Other Fluid Types					
			HFA (5/95)		HFB (60/40 invert emulsion)		HFC (water glycol)		Water		HFD (Phosphate ester Aryl type)		Synthetic esters (HEES, HFDU)		Air/Nitrogen	
	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S
Rod Seal																
16	R	P	P	P	P	P	P	P	P	P	R[1]	P[1]	R	P	P	NS
605,610,616	R	R	P	P	R	R	P	P	P	P	NS	NS	R	P	P	P
621,652	R	R	R	R	R	R	P	P	P	P	NS	NS	R	P	P	P
653	R	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	P	NS	NS	NS
Rod/Piston seals																
15,18	R	R	P	R	R	R	R	R	P	R	P[2]	P[2]	P	P	P	P
511,512,513	R	R	P	P	P	P	P	P	P	P	NS	NS	R	R	P	P
601	R	R	P	R	R	R	P	P	P	P	NS	NS	R	R	P	P
DA Piston seals																
50,53,64,68	R	R	P	R	R	R	P[3]	P[3]	P	R	NS	NS	P	P	NS	P
51,52,56,58	R	R	P	R	R	R	R	R	P	P	P[2]	P[2]	P	P	NS	P
54	R	P	P	R	P	P	P	P	P	P	R[1]	P[1]	R	P	P	NS
65,77	R	R	P	R	R	R	R	R	P	P	NS	NS	P	P	NS	P
714	R	NS	NS	NS	NS	NS	NS	NS	NS	NS	P[1]	NS	R	NS	NS	NS
730	R	R	R	R	R	R	NS	NS	P	P	NS	NS	R	P	NS	P
735	R	P	NS	NS	P	P	P	P	NS	NS	NS	NS	R	P	NS	NS
753	R	R	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	R	P	NS	NS
754,755	R	R	P	R	P	R	NS	NS	P	P	NS	NS	R	R	P	P
764	R	R	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	R	R	P	P
770	R	R	P	P	P	P	NS	NS	P	P	NS	NS	R	R	P	P
SA Piston Seals																
606,659	R	R	P	P	R	R	P	P	P	P	NS	NS	R	P	P	P
Unitised Piston																
720	R	P	NS	NS	NS	NS	NS	NS	NS	NS	P[4]	P[4]	R	P	NS	NS
Vee Packs																
07,09,11,13,14	R	P	P	P	R	P	R	P	P	P	P[2]	P[2]	P	P	NS	NS

1 Suitable energiser material required e.g. FKM,EPDM. N.B. NBR unsuitable.
2 Suitable compounds required e.g FKM,EP. N.B. NBR unsuitable.
3 Use PA backing rings, not polyester.
4 Suitable seal set required.

In view of the variation in formulation of oils and other hydraulic fluids, the compatibility of all combinations should be confirmed by testing and field service performance for each application.

Use and fitting of seals

Our quality control methods for material and manufacturing processes ensure that all seals leaving our factories are in a condition capable of giving a long and reliable service life.

We have found from many years experience, that premature seal failure can be avoided if the following recommendations are considered at the design and manufacturing stage of the cylinder:

1 Specify piston and gland bearings which are adequately proportioned to support the cylinder loads.

As a result of mounting misalignments and / or the working action of the cylinder, piston and gland bearings will be subjected to side-loading, causing damage to the rod or the tube surface and hence the seal, if the bearings are inadequate.

2 Ensure that seals are stored distortion free in a cool, dry and dark place prior to fitting.(See page 17)

3 Check that the seal housing is free from damage likely to harm the seal. Remove all sharp edges and burrs from metal parts, paying particular attention to ports, grooves and threads over or through which the seal passes during assembly.

4 Clean all seal housing areas, ensuring that all metallic particles and other contaminants have been removed. Check that other surfaces adjacent to the passage of the seal on fitting are also free of dirt, swarf or other contaminants. Check that both static and dynamic housing surface finishes meet specifications.

5 Where the difference between a thread diameter over which the seal must pass and the seal diameter is small, use some form of protection over the thread, such as a fitting sleeve made of hard plastic.

6 Check that the seal is of the correct type, part number and size, and that the specified material is correct. If there is any doubt regarding the material contact your local Hallite sales office.

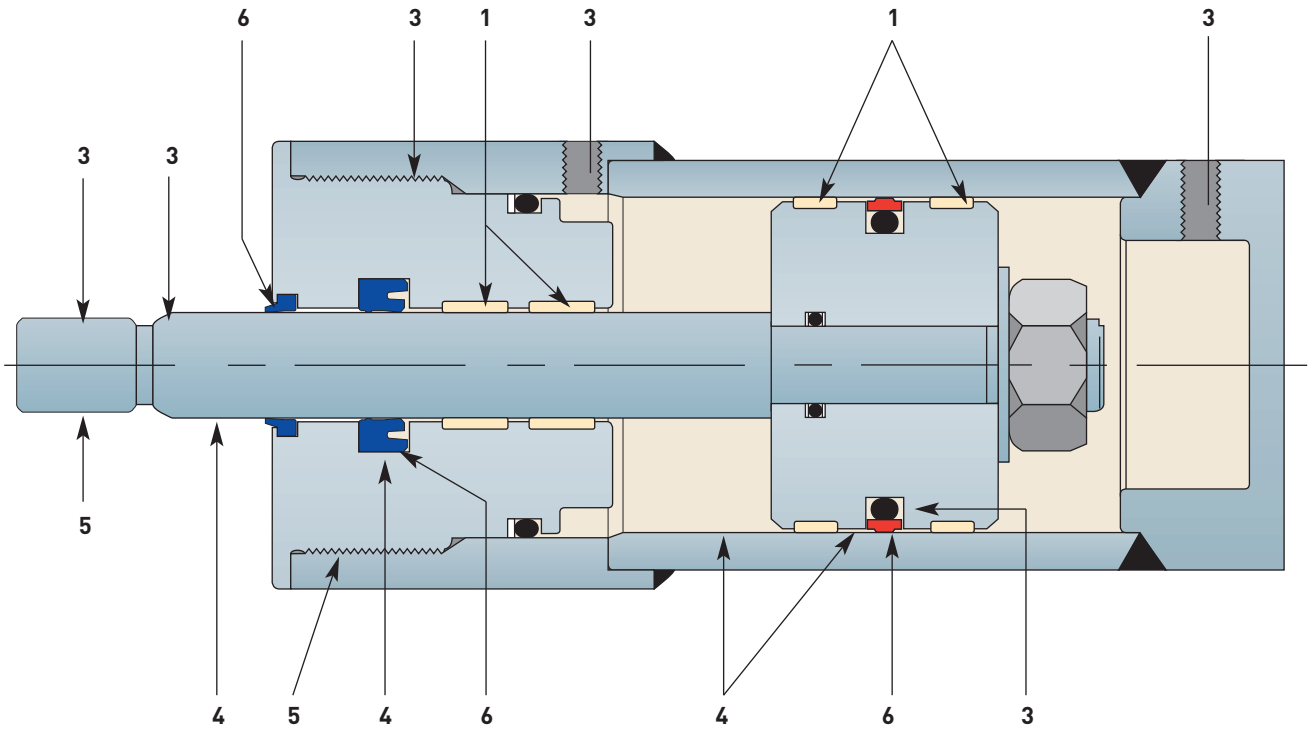
7 Lubricate all seals and metal components liberally with clean operating fluid or a compatible grease prior to assembly. N.B. Silicone grease should not be used in normal hydraulic applications.

8 Where seals fitted to sub-assemblies, such as pistons, are awaiting further fitting operations, ensure that the seals are not subjected to any misaligned or localised loading which will cause local deformation. Ensure that sub-assemblies remain clean.

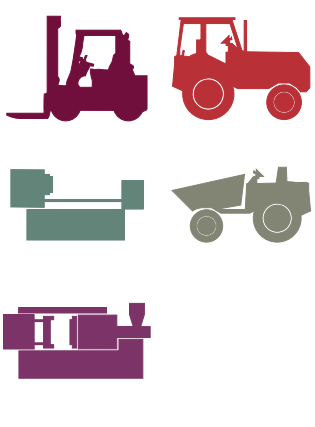
9 The use of metal levers is not recommended but should they be used it is imperative that they are completely smooth and free from nicks and burrs. When using them ensure that the metal surfaces adjacent to the seal are not damaged.

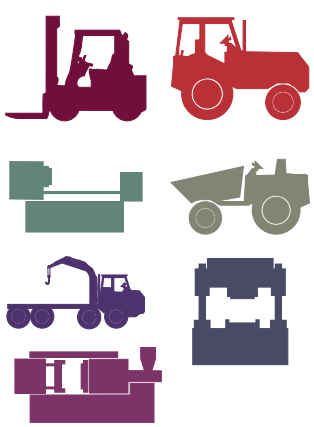
10 Flush the hydraulic system thoroughly before connecting the cylinder to it.

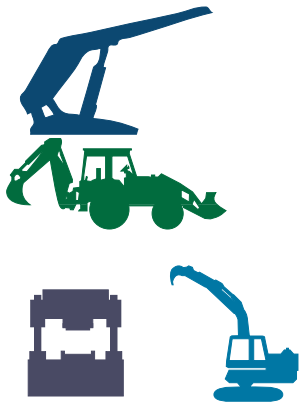
Typical hydraulic cylinder layout showing installation features to be considered for satisfactory seal life.



Cylinder specification		Light duty	Medium duty	Heavy duty
Pressure	**Max**	350 bar 5000 psi	500 bar 7500 psi	700 bar 10000 psi
	Normal	160 bar 2300 psi	250 bar 3600 psi	400 bar 6000 psi
	Working	No Pressure Peaks	Intermittent Pressure Peaks	Regular Pressure Peaks
Design		Lower operating stresses Rigid well aligned mounting, minimal side loading.	Steady operating stresses with intermittent high stress, some side loading.	Highly stressed for majority of its working life. Side loading common.
Condition of Fluid		Good system filtration no cylinder contamination likely.	Good system filtration but some cylinder contamination likely.	Contamination unavoidable from internal and external sources.
Working Environment		Clean and inside a building. Operating temperature variations limited.	Mixture of indoor and outdoors but some protection from the weather.	Outdoors all the time or a dirty indoor area. Wide variations in temperature, both ambient and working. Difficult service conditions.
Usage		Irregular with short section of stroke at working pressures. Regular usage but at low pressure.	Regular usage with most of the stroke at working pressure.	Large amount of usage at high pressure with peaks throughout the stroke.
Typical Applications		Machine tools Lifting equipment Mechanical handling Injection moulding machines Control and robot equipment Agricultural machinery Packaging equipment Aircraft equipment Light duty tippers	Heavy duty lifting equipment Agricultural equipment Light duty off-road vehicles Cranes and lifing platforms Heavy duty machine tool Injection moulding machines some Auxiliary mining machinery Aircraft equipment Presses Heavy duty tippers (telescopic) Heavy duty mechanical handling	Foundry and metal fabrication plant Mining machinery Roof supports Heavy duty earth moving machinery Heavy duty off-road vehicles Heavy duty presses







Pressure, Speed, Temperature Range

From many years of application experience with sealing hydraulic equipment, supported by the results from an extensive test programme, we know that it is necessary to link the three main operating features of speed, pressure, and temperature to achieve a satisfactory seal performance. After carefully considering each product we are able to specify the maximum speed and pressure with a temperature range within which the seal will operate safely.

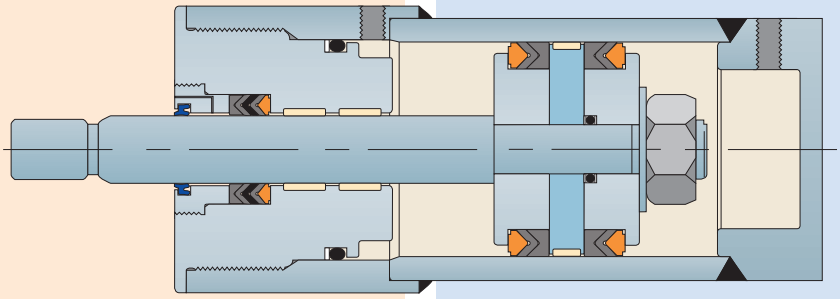
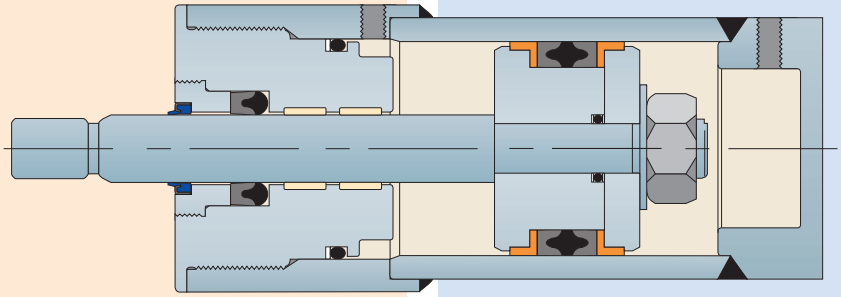
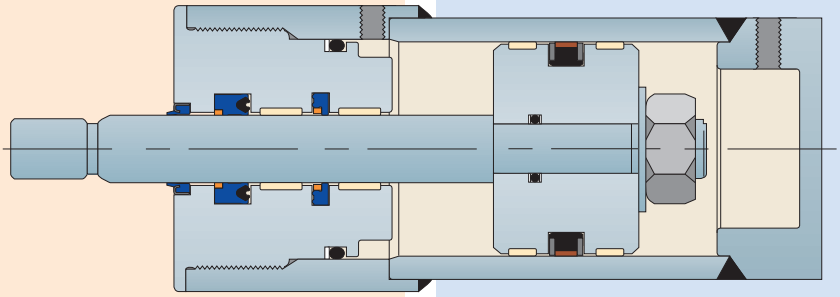
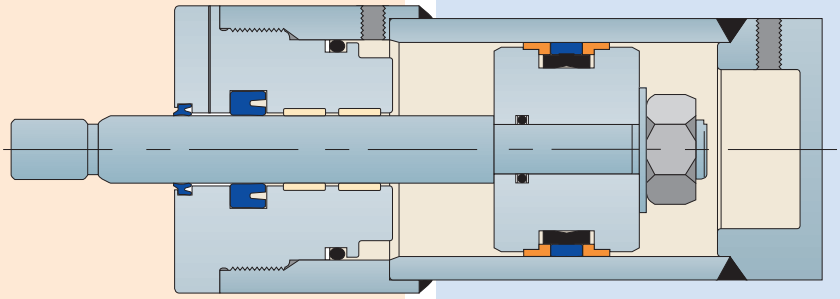
If your operating conditions do not comply with those recommended please send your details to your local Hallite sales office.

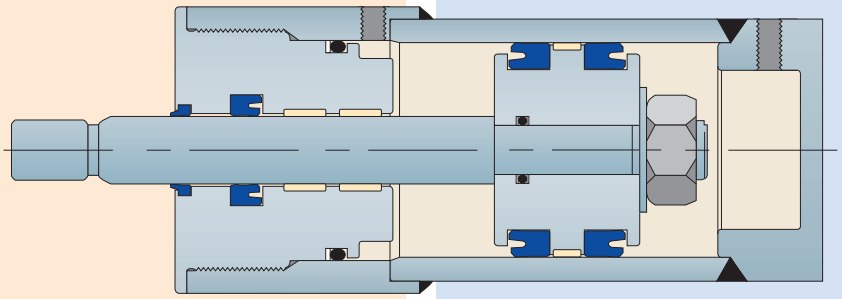
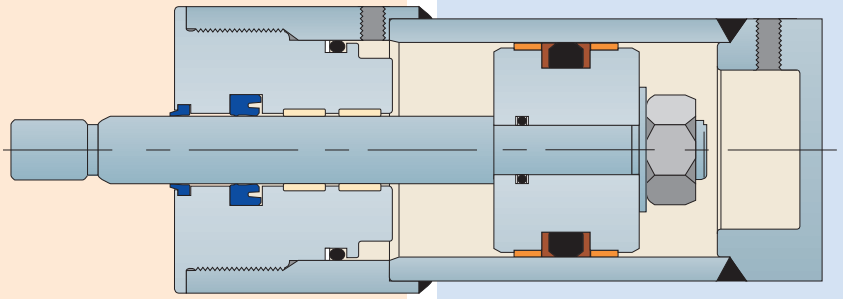
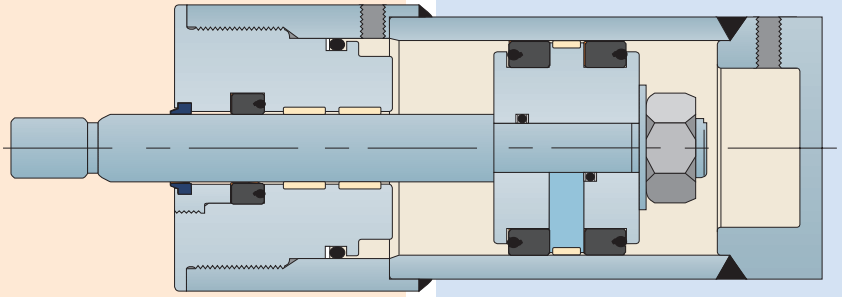
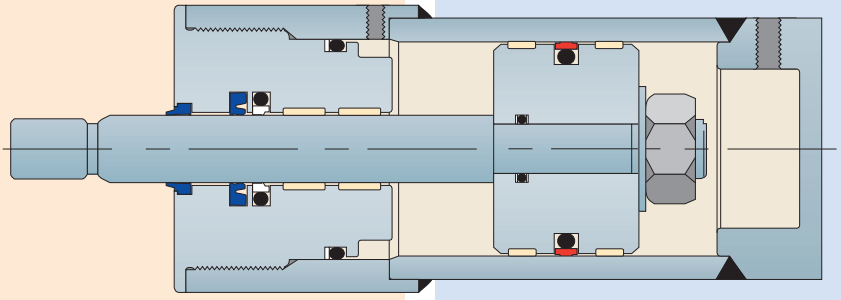
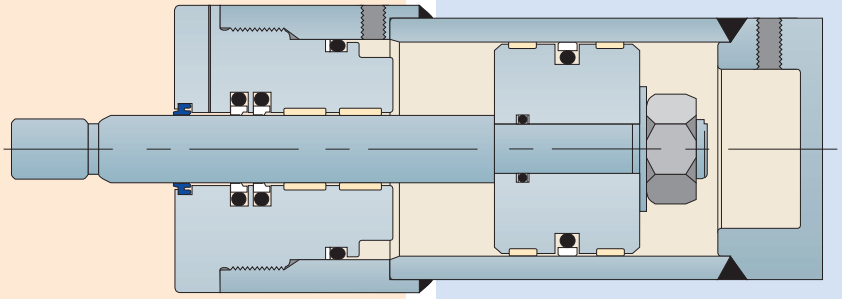
Cylinder housings and seal options

The following diagrams illustrate how Hallite's wide range of products can be applied to a selection of some of the most popular cylinder designs servicing the world's fluid power industry.

The diagrams show different gland and piston arrangements to illustrate alternative sealing methods currently in use and a suitable Hallite product.

If the application which you are interested in is of a non-standard nature please contact Hallite's technical department.

Gland		Piston
Heavy duty Type 13, 14		**Heavy duty** Type 51, 52
Heavy duty Type 18		**Heavy duty** Type 58
Heavy duty Type 621, 652, 653		**Heavy duty** Type 730, 735
Medium duty Type 601, 605		**Medium duty** Type 753

Gland		Piston
Medium duty Type 601, 605		**Medium duty** Type 606
Medium duty Type 605		**Medium duty** Type 53
Medium duty Type 513		**Medium duty** Type 511, 512
Light to Medium duty Type 616, 16		**Light to Medium duty** Type 754, 755 770
High speed light duty Type 16		**High speed light duty** Type 54

Hallite 87, 506 & 533 bearing strip

Hallite 87 strip is a low friction bronze filled PTFE compound produced in a flat tape style ready for easy cutting to size to suit individual applications and is particularly effective in friction conscious applications such as servo cylinders.

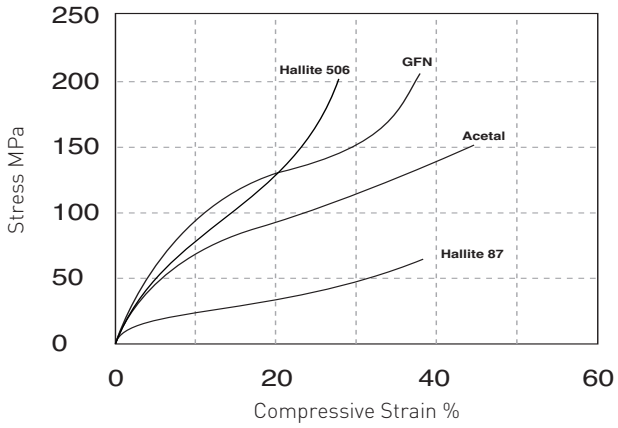
Hallite 506 can be supplied in spiral lengths, generally in 10 metre, as individual cut bearings and also in 10 metre lengths packed flat in a box dispenser. Hallite 506 bearing strip is manufactured to extremely accurate thickness tolerances, ensuring reliable cylinder alignment. Other sizes of type 506 are available on request, special sections and diameters can also be produced to suit individual requirements.

Bearing Type	Standard material
87	PTFE + Bronze
506	Polyester + PTFE
533	GFN

Bearing strip housing tolerances

As tolerances are not specified "on line" for types 87 & 506, please refer to the information below and on the next page for tolerances as indicated on the product's data sheet.

Compressive bearing stress versus strain for non metallic materials



Hallite 506 specified tolerances

	Bearing length L_1	Bearing cross section S
Tolerances (in)	-0.005 to -0.025	-0.001 to -0.003

Hallite 506 specified tolerances

	Bearing length L_1	Bearing cross section S
Tolerances (mm)	-0.1 to -0.6	-0.02 to -0.08

Hallite 533 specified tolerances

	Bearing length L_1	Bearing cross section S
Tolerances (in.)	-0.000 to -0.010	-0.001 to -0.004

Hallite 87 specified tolerances

	Bearing length L_1	Bearing cross section S
Tolerances (mm)	-0.1 to -0.5	+0.03 to -0.05

Specified tolerances

Nominal sizes mm		Shafts (outside diameter) Units 0.001 mm								Bores (inside diameter) Units 0.001 mm				
over	to	f8	f9	h8	h9	h10	h11	js10	js11	H8	H9	H10	H11	Js11
1.6	3	-6 -20	-6 -31	0 -14	0 -25	0 -40	0 -60	+20 -20	+30 -30	+14 0	+25 0	+40 0	+60 0	+30 -30
3	6	-10 -28	-10 -40	0 -18	0 -30	0 -48	0 -75	+24 -24	+37.5 -37.5	+18 0	+30 0	+48 0	+75 0	+37.5 -37.5
6	10	-13 -35	-13 -49	0 -22	0 -36	0 -58	0 -90	+29 -29	+45 -45	+22 0	+36 0	+58 0	+90 0	+45 -45
10	18	-16 -43	-16 -59	0 -27	0 -43	0 -70	0 -110	+35 -35	+55 -55	+27 0	+43 0	+70 0	+110 0	+55 -55
18	30	-20 -53	-20 -72	0 -33	0 -52	0 -84	0 -130	+42 -42	+65 -65	+33 0	+52 0	+84 0	+130 0	+65 -65
30	50	-25 -64	-25 -87	0 -39	0 -62	0 -100	0 -160	+50 -50	+80 -80	+39 0	+62 0	+100 0	+160 0	+80 -80
50	80	-30 -76	-30 -104	0 -46	0 -74	0 -120	0 -190	+60 -60	+95 -95	+46 0	+74 0	+120 0	+190 0	+95 -95
80	120	-36 -90	-36 -123	0 -54	0 -87	0 -140	0 -220	+70 -70	+110 -110	+54 0	+87 0	+140 0	+220 0	+110 -110
120	180	-43 -106	-43 -143	0 -63	0 -100	0 -160	0 -250	+80 -80	+125 -125	+63 0	+100 0	+160 0	+250 0	+125 -125
180	250	-50 -122	-50 -165	0 -72	0 -115	0 -185	0 -290	+92 -92	+145 -145	+72 0	+115 0	+185 0	+290 0	+145 -145
250	315	-56 -137	-56 -186	0 -81	0 -130	0 -210	0 -320	+105 -105	+160 -160	+81 0	+130 0	+210 0	+320 0	+160 -160
315	400	-62 -151	-62 -202	0 -89	0 -140	0 -230	0 -360	+115 -115	+180 -180	+89 0	+140 0	+230 0	+360 0	+180 -180
400	500	-68 -165	-68 -223	0 -97	0 -155	0 -250	0 -400	+125 -125	+200 -200	+97 0	+155 0	+250 0	+400 0	+200 -200
500	630	-76 -186	-76 -251	0 -110	0 -175	0 -280	0 -440	+140 -140	+220 -220	+110 0	+175 0	+280 0	+440 0	+220 -220
630	800	-80 -205	-80 -280	0 -125	0 -200	0 -320	0 -500	+160 -160	+250 -250	+125 0	+200 0	+320 0	+500 0	+250 -250

Nominal sizes in.		Shafts (outside diameter) Units 0.001 in.								Bores (inside diameter) Units 0.001 in.				
over	to	f8	f9	h8	h9	h10	h11	js10	js11	H8	H9	H10	H11	Js11
0.04	0.12	-0.3 -0.9	-0.3 -1.2	0 -0.6	0 -1.0	0 -1.6	0 -2.5	+0.8 -0.8	+1.3 -1.3	+0.6 0	+1.0 0	+1.6 0	+2.5 0	+1.3 -1.3
0.12	0.24	-0.4 -1.1	-0.4 -1.6	0 -0.7	0 -1.2	0 -1.8	0 -3.0	+0.9 -0.9	+1.5 -1.5	+0.7 0	+1.2 0	+1.8 0	+3.0 0	+1.5 -1.5
0.24	0.40	-0.5 -1.4	-0.5 -1.9	0 -0.9	0 -1.4	0 -2.2	0 -3.5	+1.1 -1.1	+1.8 -1.8	+0.9 0	+1.4 0	+2.2 0	+3.5 0	+1.8 -1.8
0.40	0.71	-0.6 -1.6	-0.6 -2.3	0 -1.0	0 -1.6	0 -2.8	0 -4.0	+1.4 -1.4	+2.0 -2.0	+1.0 0	+1.6 0	+2.8 0	+4.0 0	+2.0 -2.0
0.71	1.19	-0.8 -2.0	-0.8 -2.8	0 -1.2	0 -2.0	0 -3.5	0 -5.0	+1.8 -1.8	+2.5 -2.5	+1.2 0	+2.0 0	+3.5 0	+5.0 0	+2.5 -2.5
1.19	1.97	-1.0 -2.6	-1.0 -3.4	0 -1.6	0 -2.5	0 -4.0	0 -6.0	+2.0 -2.0	+3.0 -3.0	+1.6 0	+2.5 0	+4.0 0	+6.0 0	+3.0 -3.0
1.97	3.15	-1.2 -3.0	-1.2 -4.1	0 -1.8	0 -3.0	0 -4.5	0 -7.0	+2.3 -2.3	+3.5 -3.5	+1.8 0	+3.0 0	+4.5 0	+7.0 0	+3.5 -3.5
3.15	4.73	-1.4 -3.6	-1.4 -4.8	0 -2.2	0 -3.5	0 -5.0	0 -9.0	+2.5 -2.5	+4.5 -4.5	+2.2 0	+3.5 0	+5.0 0	+9.0 0	+4.5 -4.5
4.73	7.09	-1.6 -4.1	-1.6 -5.6	0 -2.5	0 -4.0	0 -6.0	0 -10.0	+3.0 -3.0	+5.0 -5.0	+2.5 0	+4.0 0	+6.0 0	+10.0 0	+5.0 -5.0
7.09	9.85	-2.0 -4.8	-2.0 -6.5	0 -2.8	0 -4.5	0 -7.0	0 -12.0	+3.5 -3.5	+6.0 -6.0	+2.8 0	+4.5 0	+7.0 0	+12.0 0	+6.0 -6.0
9.85	12.41	-2.2 -5.2	-2.2 -7.3	0 -3.0	0 -5	0 -8.0	0 -12.0	+4.0 -4.0	+6.0 -6.0	+3.0 0	+5.0 0	+8.0 0	+13.0 0	+6.5 -6.5
12.41	15.75	-2.5 -6.0	-2.5 -8.0	0 -3.5	0 -6.0	0 -9.0	0 -14.0	+4.5 -4.5	+7.0 -7.0	+3.5 0	+6.0 0	+9.0 0	+14.0 0	+7.0 -7.0
15.75	19.69	-2.8 -6.5	-2.8 -8.8	0 -4.0	0 -6.0	0 -10.0	0 -16.0	+5.0 -5.0	+8.0 -8.0	+4.0 0	+6.0 0	+10.0 0	+16.0 0	+8.0 -8.0
19.69	24.80	-3.0 -7.0	-3.0 -9.9	0 -4.3	0 -6.9	0 -11.0	0 -17.3	+5.5 -5.5	+8.7 -8.7	+4.3 0	+6.9 0	+11.0 0	+17.3 0	+8.7 -8.7
24.80	31.49	-3.1 -8.1	-3.1 -11.0	0 -4.9	0 -7.9	0 -12.6	0 -19.7	+6.3 -6.3	+9.8 -9.8	+4.9 0	+7.9 0	+12.6 0	+19.7 0	+9.8 -9.8

Hallite Seals' product data sheets give information indicating the allowable extrusion gap a seal can see at pressure during its working life. The extrusion gap can be calculated using the tolerance build ups within the cylinder and any dilation that may occur under pressure.

Maximum extrusion gap = F max (see drawing below).

F max is the maximum extrusion gap for the seal

Minimum metal to metal clearance = F min (see drawing below).

F min for cylinders with minimal side loading should be > 0.1mm (0.004").

Rods

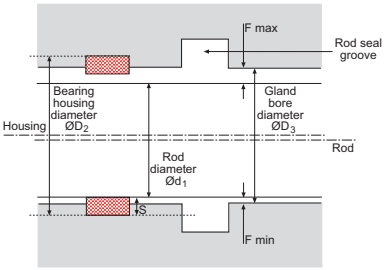
Maximum extrusion gap

$$F\ max = \frac{(ØD3\ max + ØD2\ max)}{2} - S\ min - Ød1\ min$$

Minimum metal to metal clearance (extrusion gap)

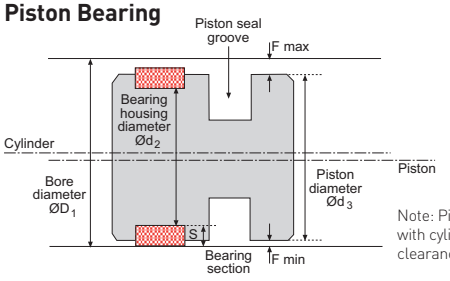
$$F\ min = S\ min - \frac{(ØD2\ max - ØD3\ min)}{2}$$

Rod Bearing



Note: Rod is not concentric with gland, because of clearances. (shown exaggerated)

Piston Bearing



Note: Piston is not concentric with cylinder bore, because of clearances. (shown exaggerated)

Pistons

Maximum extrusion gap

$$F\ max = ØD1\ max - S\ min - \frac{(Ød3\ min + Ød2\ min)}{2} + dilation$$

Minimum metal to metal clearance (extrusion gap)

$$F\ min = S\ min - \frac{(Ød3\ max - Ød2\ min)}{2}$$

Calculate both F max and F min.

Ensure the F min is greater than 0.1mm (0.004") and F max is less than the maximum extrusion gap stated on the seal data sheet at the application's working pressure.

For built-in metal bearings, the extrusion gap calculation is simpler.

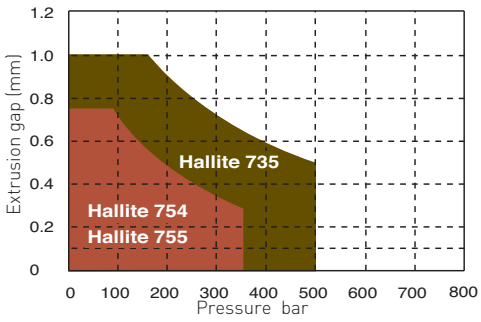
For F max:
Rod = ØD3 max - Ød1 min
Piston = ØD1 max - Ød3 min + dilation

F min must be zero

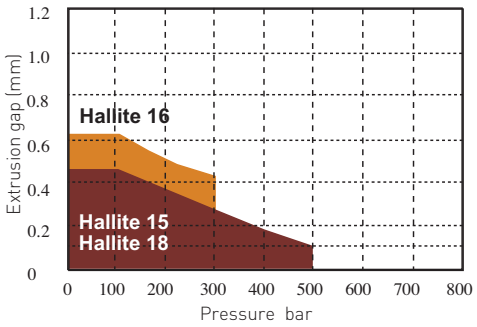
Extrusion is closely linked to pressure and temperature. In general, the best seal performance and life is provided by specifying the smallest possible extrusion gap.

The figures shown for the extrusion gap within the operating conditions of Hallite's product data sheets, relate to the maximum permissible, worst case situation with the gap all on one side.

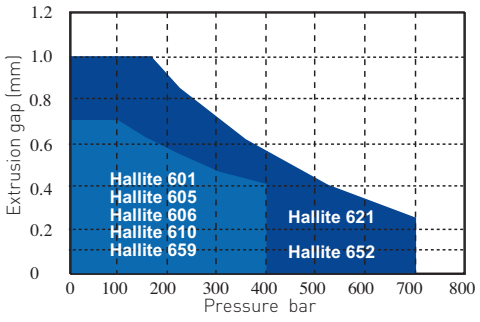
Type 735, 754, 755



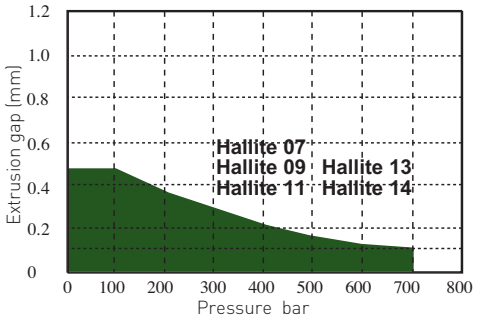
Type 15, 16, 18



Type 601, 605, 606, 610, 621, 652, 659



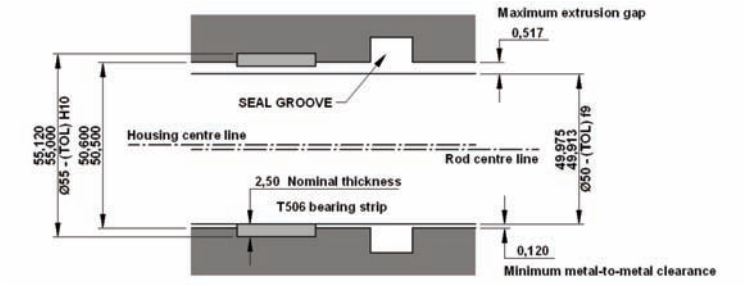
Vee pack sets



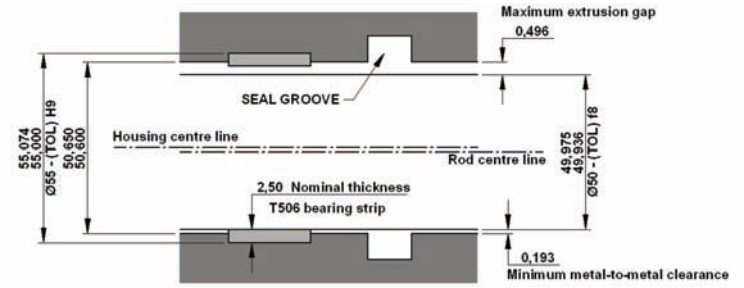
This should be read in conjunction with the section Housing Designs in the Hallite Fluid Power Seal Catalogue

Extrusion gaps and metal-to-metal clearance

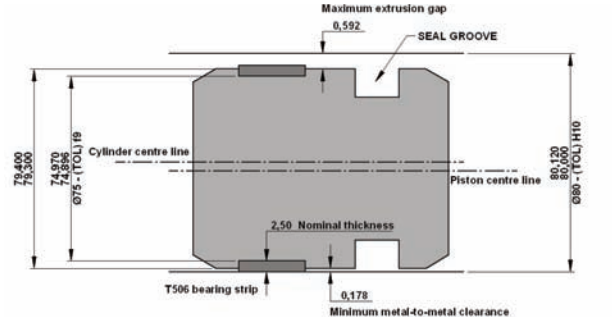
The use of remote bearing strips, such as Hallite 506, often creates a conflict between maximising the metal-to-metal clearance, to avoid metal-to-metal contact, and minimising the extrusion gap for the seal. The design decisions that have to be made in this respect are not trivial. The following examples show the effects of looser and tighter tolerances on the minimum metal-to-metal clearance and the maximum extrusion gap. The values have been calculated using the housing design formulae. No allowance has been made for the deflection of the bearings under side load, and, in the case of the piston examples, for the cylinder dilation.



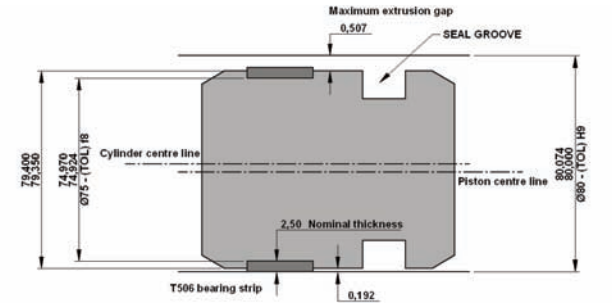
Gland for 50mm rod using 'standard' tolerances



Gland for 50mm rod with tighter tolerances, showing that the minimum metal-to-metal clearances can be increased and the maximum extrusion gap reduced.



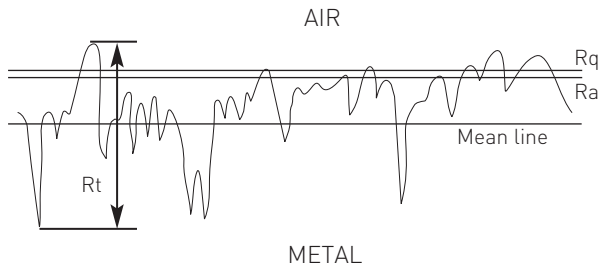
Piston for 80mm bore using 'standard' tolerances



Piston for 80mm bore with tighter tolerances showing that minimum metal-to-metal clearance can be increased and maximum extrusion gap reduced.Once the maximum extrusion gap has been calculated the correct seal can be specified with regard to the required operating pressure of the cylinder

For further advice, please contact Hallite Seals

Surface roughness has a very important influence on the life and leakage performance of a recipricating sealing system.



Note : The vertical scale is 40 times the Horizontal scale

Definitions

Many parameters can be used to describe surface finishes and these are explained in ISO 4287 and ISO 4288. Those in most common use in the fluid power industry include:-

Ra, which is defined as the arithmetical mean deviation of the assessed profile. The inch equivalent parameter is CLA (centre line average). A surface finish of 0.4 µm Ra is exactly equivalent to 16 µin CLA.

Rt, which is the total height of the profile.There is no mathematical relationship between Ra and Rt.

Rq, which is the root mean square deviation of the assessed profile. The equivalent term in inches is RMS (Root Mean Square). The Rq (RMS) of a surface is approximately 10% greater than the Ra (CLA) value.

The surface roughness parameters given above do not give any indication of the sharpness of the surface. The peaks of the profile should be well rounded as sharp surface finishes can lead to rapid seal wear.

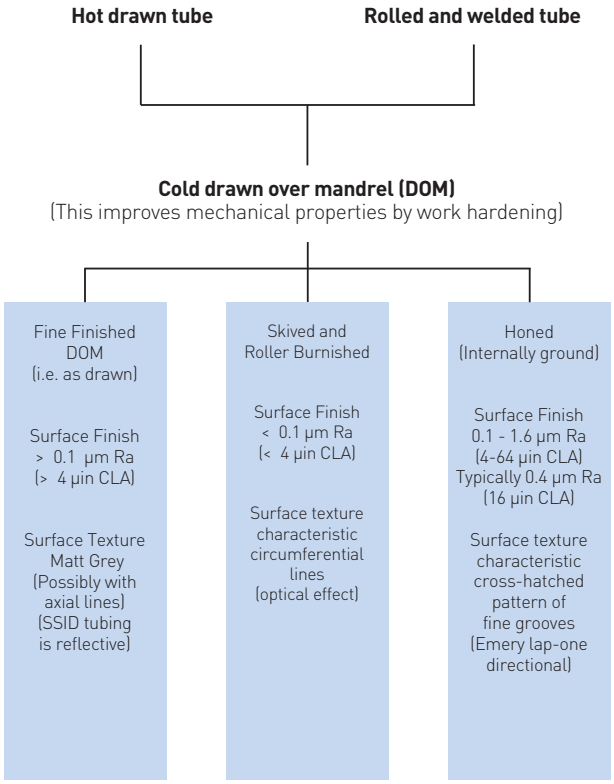
Dynamic surface finishes

Piston rods are generally hard chrome plated. The hardness should be at least 67 Rockwell C. This gives an excellent tribological surface and provided the rods are produced by an established supplier within a surface finish range of 0.1 to 0.3 µm Ra (4-12 µin CLA) no major problem should ensue, although the optimum surface finish may well depend on the seal material.

Bore surface finishes can be more problematic.
The typical methods of obtaining a bore finish are summarised in the figure below. Drawn over mandrel (DOM) tubing, as is, can be adequate, or a potential disaster depending on the actual surface texture achieved and the application. Increasing use is being made of Special Smooth Inside Diameter (SSID) DOM tubing, but in certain circumstances, mainly when the seal is being driven into the pressure, it can lead to wear of the seal through flow erosion. Such DOM tubing requires careful specification. The consistency of roller burnished or honed tube is to be preferred. Skived and roller burnished tubing is very smooth (less than 0.1µm Ra) (4 µin CLA) and may be too smooth for rubber sealing elements in some applications. True honed tube, produced between (0.1 and 0.4 µm Ra) (4-16 µin CLA) is the most expensive, but has the best finish.

Static surface finishes

The static sealing surface finish must not be ignored in the control of leakage. Generally, these are fine turned and should be free from chatter marks.



Methods of manufacturing of tubes for hydraulic cylinders and resulting surface textures.

Storage conditions

Most polymeric items including vulcanized rubber and other elastomers tend to change their properties during storage and may become unserviceable. This may be due to hardening, softening, cracking, crazing or other degradation and may be the result of oxygen, ozone, light, heat and/or humidity.

The following recommendations indicate the most suitable conditions for storing elastomeric items, whether as a single item or composite product.

1 Temperature
Storage temperatures should not exceed 50° C (120°F). Low temperatures are not permanently harmful provided the rubber items are handled carefully and not distorted. When taken from low temperatures items should be raised to approximately 30°C (70°F)before they are used.

2 Humidity
Optimum humidity is about 65% in a draft-free atmosphere.

3 Light
Protection from direct sunlight and strong artificial light with a high ultraviolet content is important. Unless packed in opaque containers, it is advisable to cover windows with red or orange screens or coatings.

4 Oxygen and Ozone
Elastomeric items should be protected from circulating air wherever possible. As ozone is particularly harmful to rubber, storage rooms should be free from equipment that may give rise to electric sparks or discharge. Wrapping, storage in airtight containers or other suitable means should be used for vulcanised rubber items.

5 Deformation
Where possible, rubber items should be stored in a relaxed position, free from tension or compression. Laying the item flat and avoiding suspension or crushing keeps it free from strain and minimises deformation.

6 Contact with Liquid and Semi-Solid Material
Contact with liquids and semi-solid materials, particularly solvents, such as oils or greases should be avoided unless so packed by the manufacturer.

7 Contact with Metals
Metals such as manganese, iron and copper, or copper alloys can have a harmful effect on rubber. A layer of paper, polyethylene or cellophane will keep these separated.

8 Contact with Non-Metals
Contact with other rubbers or creosotes should be avoided.

9 Stock Rotation
Elastomers should be stored for as short a period as possible, and strict stock rotation should be practiced.

10 Cleaning
Organic solvents such as trichloroethylene, carbon tetrachloride and petroleum are the most harmful agents. Soap and water and methylated spirits are the least harmful, and all parts should be dried at room temperature before use.

11 Shelf Life
The table shows the storage life of seal components made from the more common materials under ideal conditions. Storing under less than ideal conditions will reduce the life.

Careful inspection of the following should be made before installation after storage:

a Mechanical damage
b Permanent distortion
c Cracks or surface crazing
d Tackiness or surface softening/hardening

Thin components (less than 1.6mm {1/16in}) tend to be more critically affected.

The appearance of 'bloom' is relatively unimportant, except in certain non-toxic applications.

Base Polymer (ISO Designation)	Primary storage period (years)	Extension of storage period after re-inspection (years)
FLUOROCARBON (FKM) ETHYLENE PROPYLENE (EPDM)	10	5
NITRILE (NBR) HYTHANE (EU) THERMOPLASTIC POLYESTER ELASTOMER	7	3
POLYUERETHANE (AU)	5	2
ENGINEERING THERMOPLASTICS: ACETAL (POM) POLYAMIDE (PA) GLASS FILLED NYLON (PA) PTFE POLYPHENYLENE SULPHIDE (PPS)	UNLIMITED	
ENGINEERING THERMOSETS: TYPE 506 BEARING STRIP	UNLIMITED	