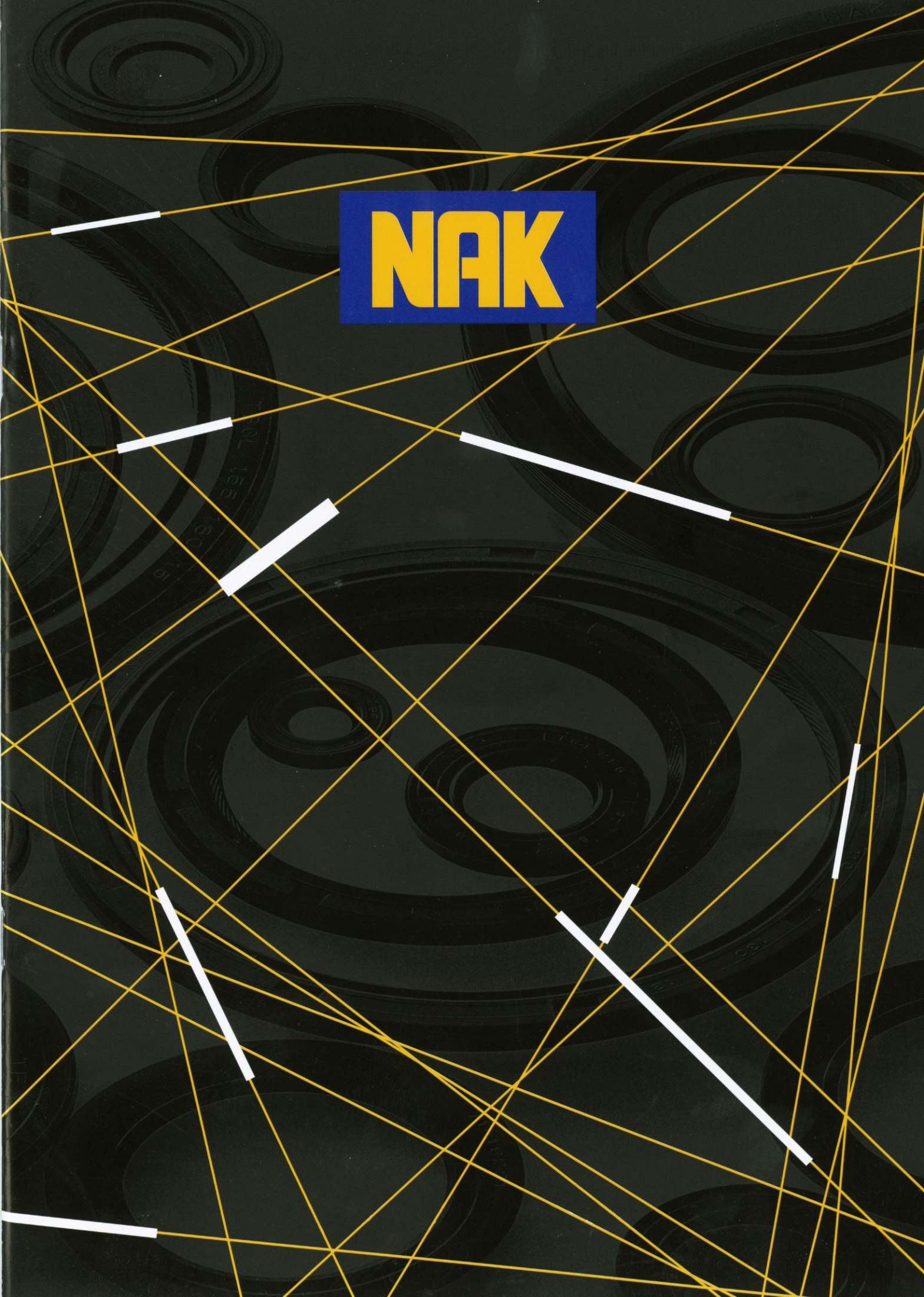


NAK



IMPORTANT INSTRUCTIONS

BEFORE INSTALLING

This catalogue contains parts information only. **NAK** does not warrant that any seals sold herein will be fit for any particular purpose or use. Where applicable, before installing any of the seals referenced in this catalogue, **always** consult the appropriate vehicle or equipment manufacturer's instruction manual for detailed installation instructions.

LIMITED WARRANTY

MATERIAL AND WORKMANSHIP

NAK ("seller") warrants its seals to be free from defects in workmanship and material for one year from date of purchase.

NAK will replace without charge, or at **NAK**'s option, repayment of purchase price, including transportation, all parts sold herein that fail due to material or workmanship shown to our satisfaction to be defective.

Malfunctions or damages resulting from accident, abuse, neglect, misuse, misapplication, improper installation, normal wear and tear or any defects resulting from specifications provided by purchaser **are not** covered by this warranty.

NO OTHER WARRANTY

It is expressly agreed that this warranty is in lieu of any other warranties and liabilities and that **NO OTHER WARRANTY IS MADE, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE AND ANY LIABILITY FOR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THE PRODUCT SOLD HEREIN.**

The forgoing states seller's entire and exclusive liability and buyer's exclusive and sole remedy. Seller will in no event be liable for any consequential, special or contingent damage or expense arising directly or indirectly for any defect in its goods or from the use thereof, nor is any other person authorized to assume for seller any such liability.

DISCLAIMER

Although care has been taken to assure the accuracy of the data compiled in this publication, **NAK** does not assume any liability for errors or omissions.

PREFACE

This catalogue is published as an introduction to **NAK** rotary shaft seals.

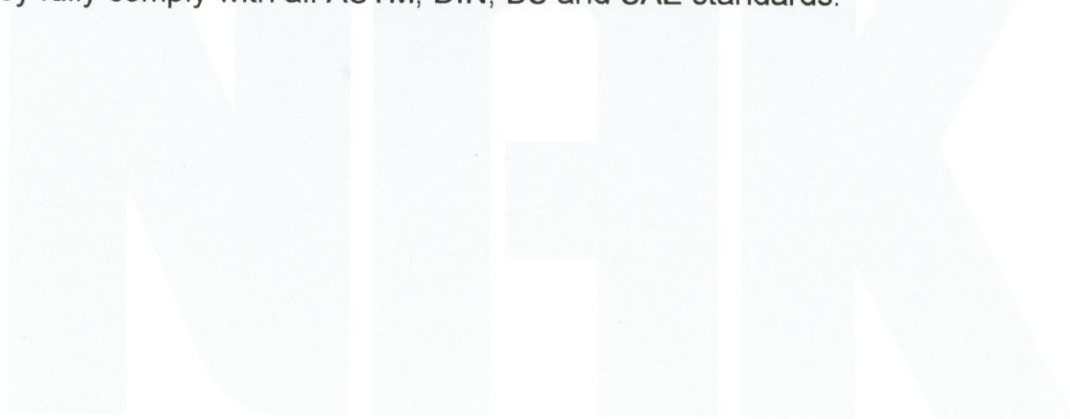
We have designed this catalogue to provide a clear and practical guide to our products.

For information on other **NAK** products or applications not included in this catalogue please contact our technical department immediately or one of our many world-wide distributors.

This catalogue contains a series of criteria to enable correct seal selection for most applications. These criteria include details of lip material and style, shaft, housing and seal tolerance.

A useful design sheet is included on page 17 of this catalogue to enable correct seal selection of your new or replacement **NAK** seal. If you require further assistance for a specific seal design please complete the form and return it to us or your local **NAK** distributor.

At **NAK** we produce all of our products to the highest standards continually developing our manufacturing equipment and processes to maintain this high standard. We apply strict quality control procedures to the design and manufacture of all products bearing our name and they fully comply with all ASTM, DIN, BS and SAE standards.



1. Lip Material

It is important to consider the environment in which a seal will operate when selecting the sealing element material. The most important factors are:-

- ◆ Temperature
- ◆ Medium being sealed
- ◆ Pressure
- ◆ Shaft speed.

Table 1 and figure 1 provide general information to help select the compound according to their physical properties.

Table 1. Physical properties of the four major compounds

Compound	Nitriles (code N)	Poly Acrylates (code P)	Silicone (code S)	Fluoro Rubber (code V)
Temperature Range	-40°C to 120°C	-30°C to 150°C	-50°C to 180°C	-30°C to 200°C
Abrasion Resistance	2	3	4	2
Compression Set	2	3	2	2
Cracking Resistance	3	3	1	2
Cut Growth Resistance	2	2	4	4
Flex Cracking Resistance	3	3	2	2
Impact Strength	2	4	3	3
Oxidation Resistance	2	1	1	1
Sunlight Resistance	3	1	1	1
Tear Resistance	2	4	4	3
Weathering Resistance	2	1	1	1

- ◆ Note: 1=Excellent 2=Good 3=Fair 4=Poor
- ◆ The temperature range may vary depending on the operating conditions.
- ◆ Other compounds available include Water Resistant Nitrile, High Nitrile, Abrasion Resistant Nitrile, High Temperature Nitrile, Neoprene, Polyurethane, EPDM, Natural Rubber, Leather, Teflon, Styrene Butadiene, Felt and other specialised compounds prepared to order. For further information please send your enquiry.

2. Metal case and spring material

For standard applications carbon steel metal case and carbon steel garter springs are supplied. For applications involving corrosion or extreme working conditions a stainless steel alternative can be used. Please refer to table 2 for the material specifications.

Table 2. Specifications of metal case and garter spring

Standard	SAE No.	DIN No.	Material
Metal Case	1008 - 1010	1,624	Carbon steel
	30304	17224	Stainless steel
Garter Spring	1070 - 1090	17,223	Piano wire
	30304	17224	Stainless steel

3. Shaft

For the best results from your NAK shaft seals we must consider the shaft material, hardness, roughness, eccentricity and tolerance according to the following points.

3.1 Shaft material

Seals perform best on a medium carbon steel or stainless steel shaft. Heat treatment or nitriding is especially recommended. To seal water at low surface velocity, stainless steel is more suitable.

3.2 Shaft hardness

In the area where the sealing lip contacts the shaft we recommend that the minimum hardness is 45 HRC. Where lubrication is doubtful, abrasive matter is present or shaft speed is greater than 14 m/sec 55 HRC is preferred.

3.3 Shaft roughness

We recommend the shaft be machined to a surface roughness of $R_t = 1$ to $4\mu\text{m}$ ($R_a = 0.2$ to $0.8\mu\text{m}$), in the area of the contact surface, any rifling marks are not permitted.

3.4 Shaft eccentricity

Two types of shaft eccentricity affect seal performance. They are dynamic runout (double dynamic eccentricity) and offset (shaft to bore misalignment or static eccentricity). The allowable eccentricity is referred to in figures 2 and 3.

3.5 Shaft speed

The shaft speed corresponding to lip material is referred to in figure 1.

3.6 Shaft tolerance

The recommended tolerances are in tables 3 and 4.

Table 7. Width tolerance of seal.

Unit	Width range	Tolerance
inch	all	+/-0.015
mm	up to 10	+/-0.20
	over 10	+/-0.30

Table 8. Seal outside diameter tolerances - imperial.

Bore Diameter	Press-fit allowance		Tolerance	
	Metal case	Rubber covered case	Metal case	Rubber covered case
up to 1.000	+ 0.004	+ 0.006	+/- 0.002	+/- 0.003
1.001 to 2.000	+ 0.004	+ 0.007	+/- 0.002	+/- 0.003
2.001 to 3.000	+ 0.004	+ 0.008	+/- 0.002	+/- 0.003
3.001 to 4.000	+ 0.005	+ 0.010	+/- 0.002	+/- 0.004
4.001 to 6.000	+ 0.005	+ 0.010	+ 0.003 - 0.002	+/- 0.004
6.001 to 8.000	+ 0.006	+ 0.010	+ 0.003 - 0.002	+/- 0.004
8.001 to 10.000	+ 0.008	+ 0.010	+ 0.004 - 0.002	+/- 0.004
10.001 to 20.000	+ 0.008	+ 0.010	+ 0.006 - 0.002	+/- 0.004
20.001 to 40.000	+ 0.008	+ 0.010	+ 0.008 - 0.002	+/- 0.004
40.001 to 60.000	+ 0.008	+ 0.010	+ 0.010 - 0.002	+/- 0.004

Table 9. Seal outside diameter tolerances - metric.

Bore Diameter	Press-fit allowance		Permissible eccentricity
	Metal case	Rubber covered case	
up to 50	+ 0.20 + 0.10	+ 0.30 + 0.15	0.25
over 50 to 80	+ 0.23 + 0.13	+ 0.35 + 0.20	0.35
over 80 to 120	+ 0.25 + 0.15	+ 0.35 + 0.20	0.50
over 120 to 180	+ 0.28 + 0.18	+ 0.45 + 0.25	0.65
over 180 to 300	+ 0.30 + 0.20	+ 0.45 + 0.25	0.80
over 300 to 500	+ 0.35 + 0.23	+ 0.55 + 0.30	1.00

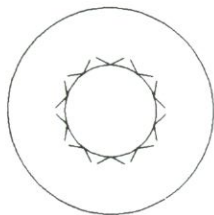
Fig. 4 - Hydrodynamic Aid Designs

The use of a hydrodynamic aid or helix can improve the performance of the sealing lip. The helix is engraved on the primary lip and causes a pumping action to push any medium back towards the fluid side. There are designs available for bi-directional, left and right hand shaft rotations.

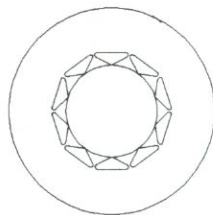
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L type <=(left hand)

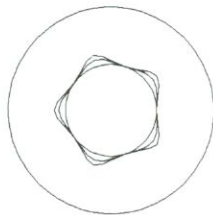
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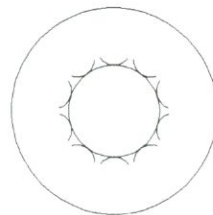
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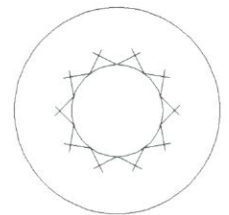
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W2



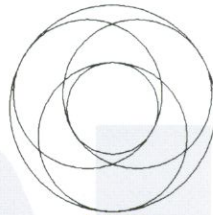
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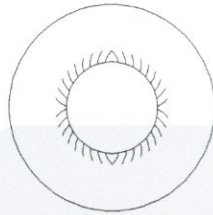
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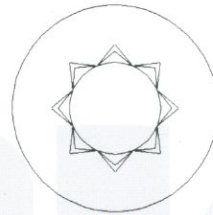
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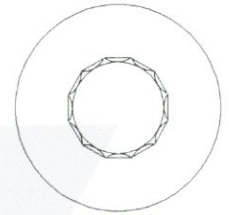
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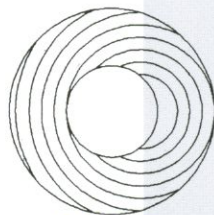
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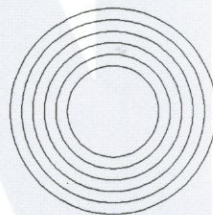
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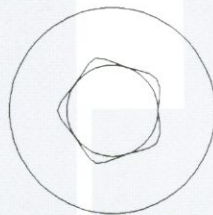
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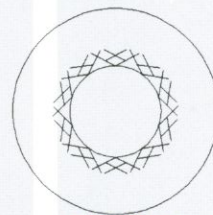
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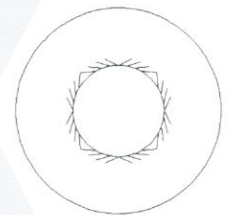
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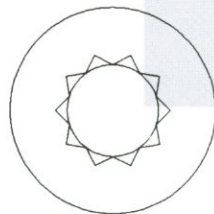
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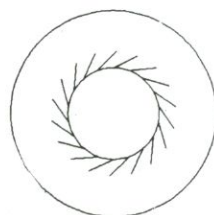
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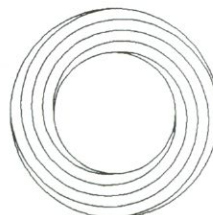
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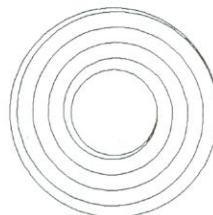
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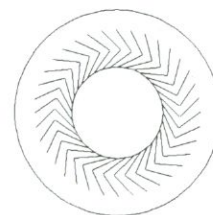
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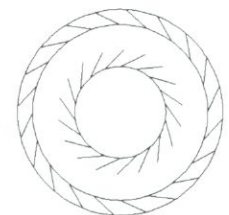
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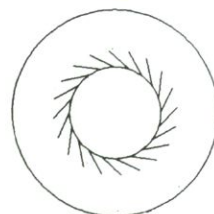
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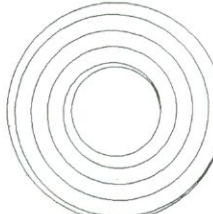
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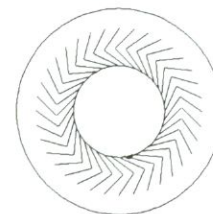
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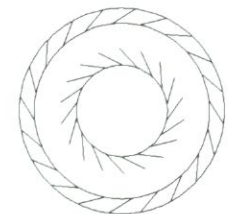
R1



R2



R3



R4

6. Seal Type...continued

6.2 Lip Design

There are 5 principal lip designs illustrated below. These lip designs are also supplemented by a range of more specialist designs for more specific application requirements.

	Profile Diagram	Remarks
S		Single Lip With A Garter Spring. Generally used for sealing lower pressure applications up to 0.5 bar however if a backup ring is used this could be increased to operate at around 10 bar. Not recommended for use in applications where the surrounding environment contains any dust or dirt.
T		Dual Lip With A Garter Spring. Generally used for sealing lower pressure applications up to 0.5 bar. The additional dust lip provides increased protection for the primary lip. The cavity between the two lips can also be filled with grease to limit shaft corrosion and allow brief operation without media lubrication.
D		Double Lip With Garter Springs. Designed to separate two media.
V		Single Lip Without A Garter Spring. Generally used for sealing a non-pressure medium, especially for sealing grease or viscous fluids. These seals are also used for dust or dirt exclusion.
K		Dual Lip Without A Garter Spring. As type V above but the additional dust lip provides increased protection for the primary lip. The cavity between the two lips can also be filled with grease to limit shaft corrosion and allow brief operation without media lubrication.

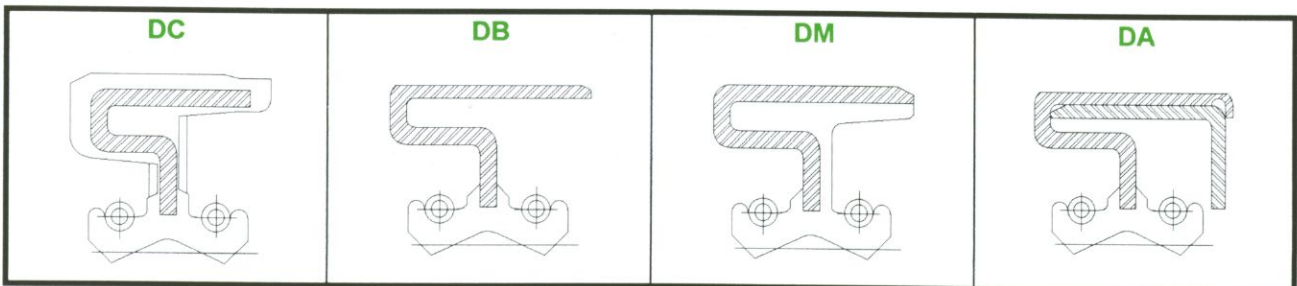
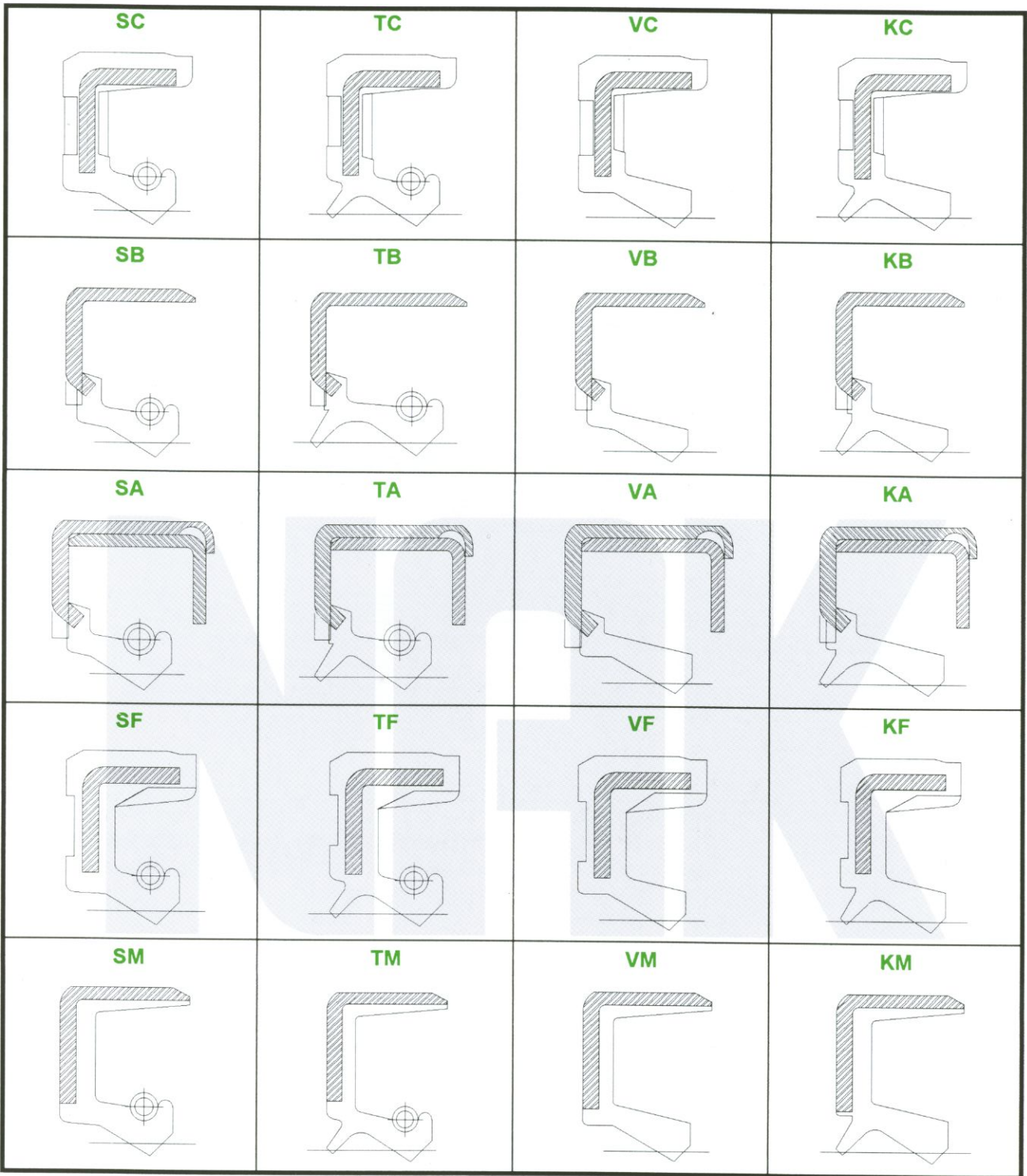
6. Seal Type...continued

6.3 Case and seal O.D. construction

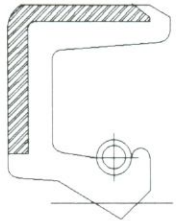
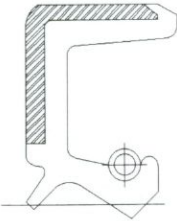
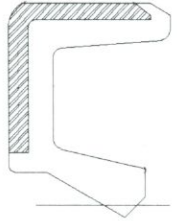
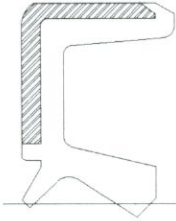
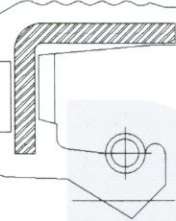
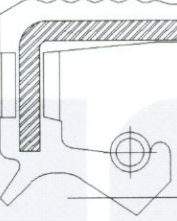
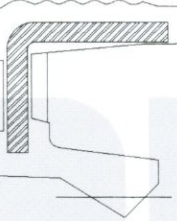
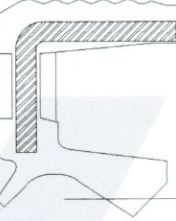
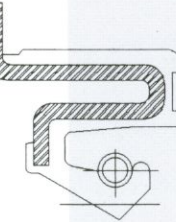
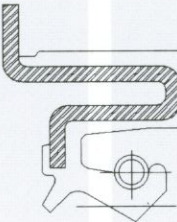
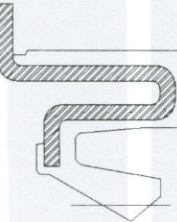
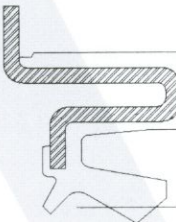
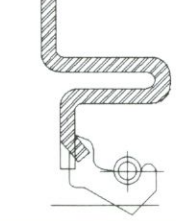
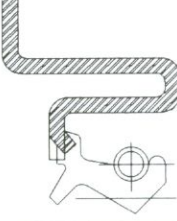
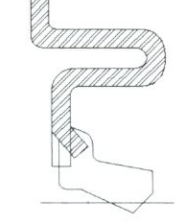
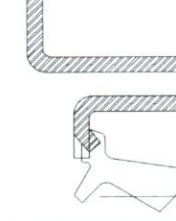
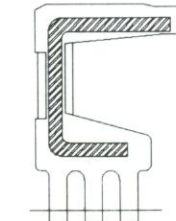
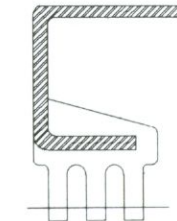
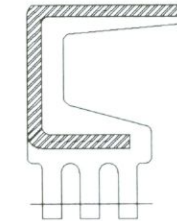
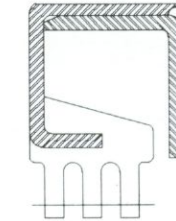
These can be split into 5 basic types but other more specific designs are also available. The 5 basic types are as follows:-

	Profile Diagram	Remarks
A		Outer Metal Case With Reinforcing Plate. This type is designed with an additional inner case providing increased structural rigidity when a more robust design is required. Particularly suitable for larger diameters or when the seal is fitted from behind.
B		Outer Metal Case. This type is most suitable for steel or cast iron housing materials. The metal case gives a particularly firm and accurate seat in the housing but static sealing on the O.D. is partially limited.
C		Rubber Covered O.D. This type is preferred for soft alloy or plastic housing materials as well as cast iron or steel. It is also more suitable to use this design in a replacement environment where minor damage to the housing surface has occurred.
F		Rubber Covered O.D. Similar to design C but additional rubber covering fully protecting the internal steel case. Particularly suitable for applications where corrosion could be a problem.
M		Outer Metal Case With Rubber Lining. Similar to design B but an additional rubber lining covering the internal face of the steel case. Particularly suitable for applications where corrosion could be a problem.

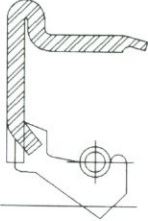
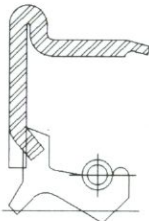
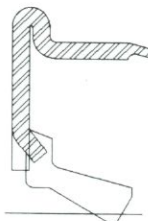
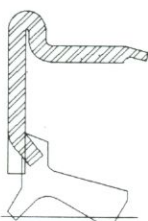
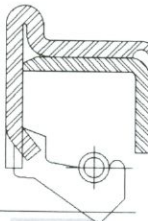
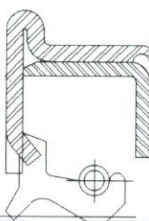
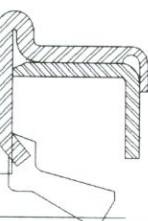
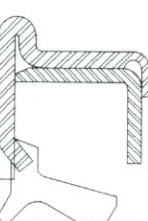
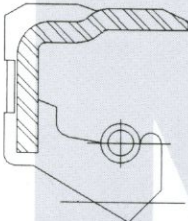
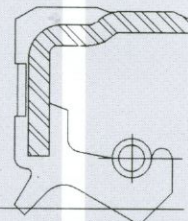
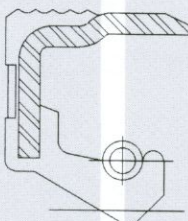
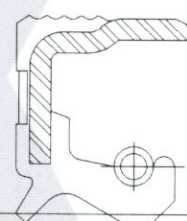
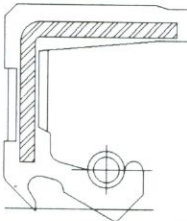
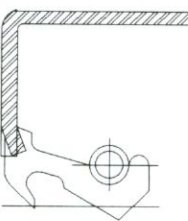
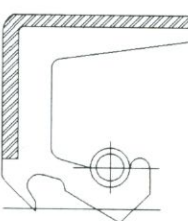
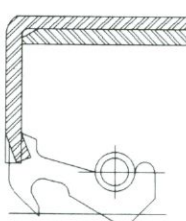
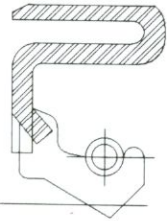
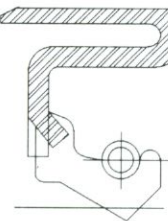

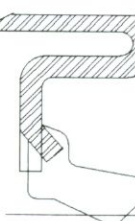
Principal NAK Shaft Seal Designs



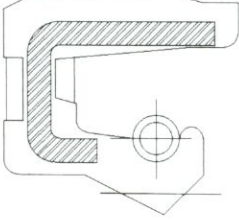
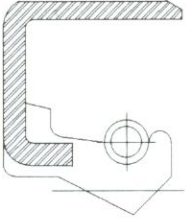
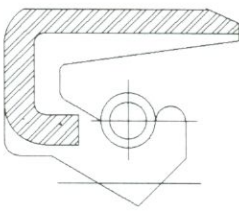
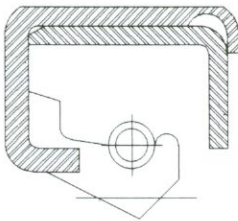
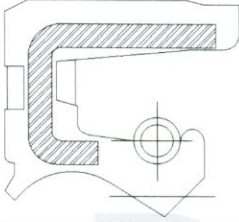
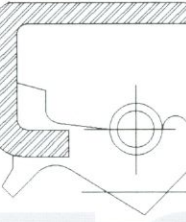
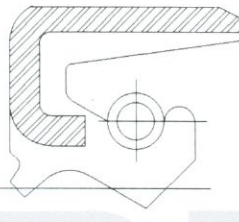
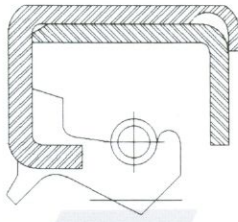
Supplementary NAK Shaft Seal Designs

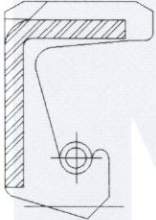
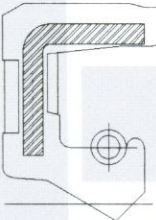
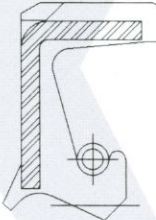
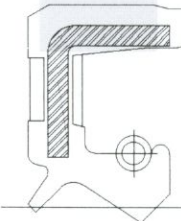
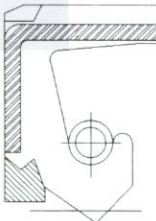
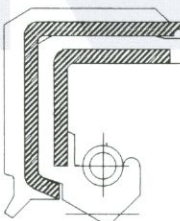
<p>NAK Type Z</p>	<p>Metal O.D. with ground surface and rubber covered top face for improved O.D. sealing ability.</p>		
<p style="text-align: center;">SZ</p> 	<p style="text-align: center;">TZ</p> 	<p style="text-align: center;">VZ</p> 	<p style="text-align: center;">KZ</p> 
<p>NAK Type G</p>	<p>Corrugated O.D. for use where the housing material is subject to a large thermal expansion or for press fitting into a housing where installation is usually difficult.</p>		
<p style="text-align: center;">SG</p> 	<p style="text-align: center;">TG</p> 	<p style="text-align: center;">VG</p> 	<p style="text-align: center;">KG</p> 
<p>NAK Type J</p>	<p>The flange will allow easy installation or replacement, gives additional structural rigidity and restricts the installation depth into the housing.</p>		
<p style="text-align: center;">SCJ</p> 	<p style="text-align: center;">TCJ</p> 	<p style="text-align: center;">VCJ</p> 	<p style="text-align: center;">KCJ</p> 
<p style="text-align: center;">SBJ</p> 	<p style="text-align: center;">TBJ</p> 	<p style="text-align: center;">VBJ</p> 	<p style="text-align: center;">KBJ</p> 
<p>NAK Type U</p>	<p>Triple flat lip design for use in heavy dirt applications. Commonly used in agricultural equipment.</p>		
<p style="text-align: center;">UC</p> 	<p style="text-align: center;">UB</p> 	<p style="text-align: center;">UM</p> 	<p style="text-align: center;">UA</p> 

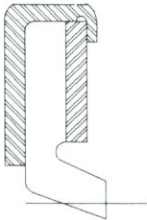
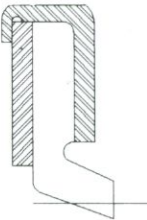


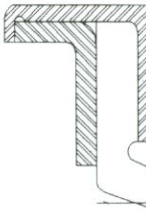
Supplementary NAK Shaft Seal Designs

NAK Type P	The flange will allow easy installation or replacement and restricts the installation depth into the housing.		
SBP	TBP	VBP	KBP
			
SAP	TAP	VAP	KAP
			
NAK Type BC/G	This design provides the benefit of a metal to metal fit and the outside diameter sealing ability of rubber to counter rough or worn housings.		
SBC	TBC	SBG	TBG
			
NAK Type X	The cavity will allow pre-lubrication of the seal to combat initial dry running or where space is limited and a secondary lip for dirt exclusion is required.		
TXC	TXB	TXM	TXA
			
NAK Type H	The case design adds structural rigidity particularly when there is a large radial seal width. It also allows installation from both sides.		
SH	SH1	VH	VH1
			

Supplementary NAK Shaft Seal Designs

NAK Type E	The metal case reinforcement of the lip flex section makes this series suitable for high pressure applications depending on the shaft speed and runout.			
SEC	SEB	SEM	SEA	
				
TEC	TEB	TEM	TEA	
				

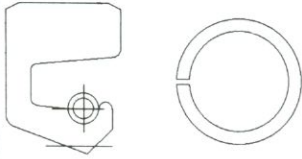
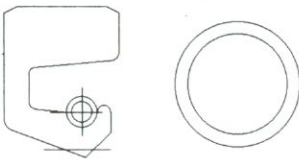
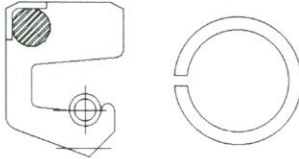
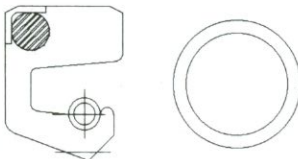
NAK Type N	The short flex section makes this series suitable for high pressure applications depending on the shaft speed and runout.		
SCN	SCN1	TCN	
			
TCN1	CNB	TDN	
			

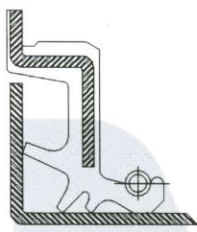
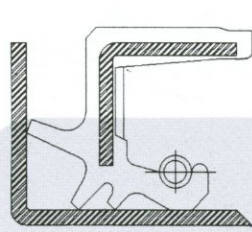
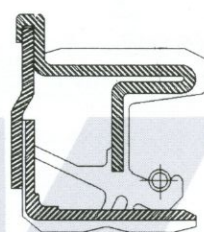
NAK Type VA	Grease retention seals with variations depending on the application or installation conditions.				
VA1	VA2	VA3	VA4	VA5	
					

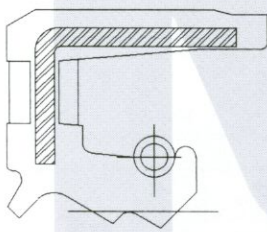
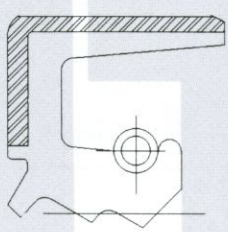
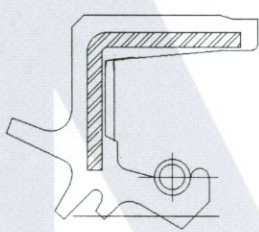
Supplementary NAK Shaft Seal Designs

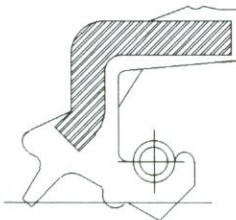
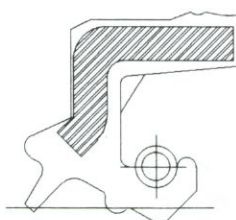
NAK Type O	The external series have the same characteristics as the internal series but are designed for use to seal a rotating housing		
OSC	OTC	OVC	OKC
OSB	OTB	OVB	OKB
OSA	OTA	OVA	OKA
OSF	OTF	OVF	OKF
OSM	OTM	OVM	OKM
OUC	OUB	OUM	OUA

Supplementary NAK Shaft Seal Designs

NAK Type Q	For use where radial space is limited and can be supplied with a split for ease of installation. SQS design incorporates a spring insert for added rigidity.		
SQ	SQ1	SQS	SQS1
			

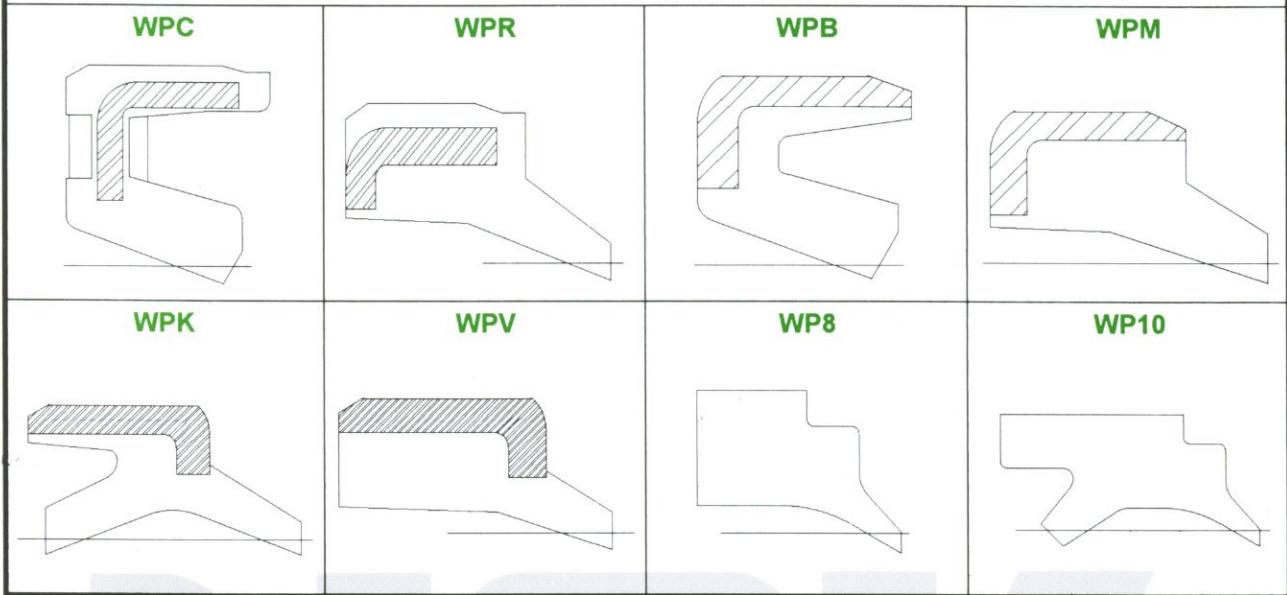
NAK Type A	Multi lipped, pre-lubricated seals used in conjunction with integral wear sleeves. For sealing in lubricants while keeping out high levels of dirt.	
AJ	AO	AP
		

NAK Type 4/9	Design 4 is used for linear applications such as motorcycle forks, while design 9 has the ability to act as a rotary shaft and axial face seal.	
TC4	TM4	TC9
		

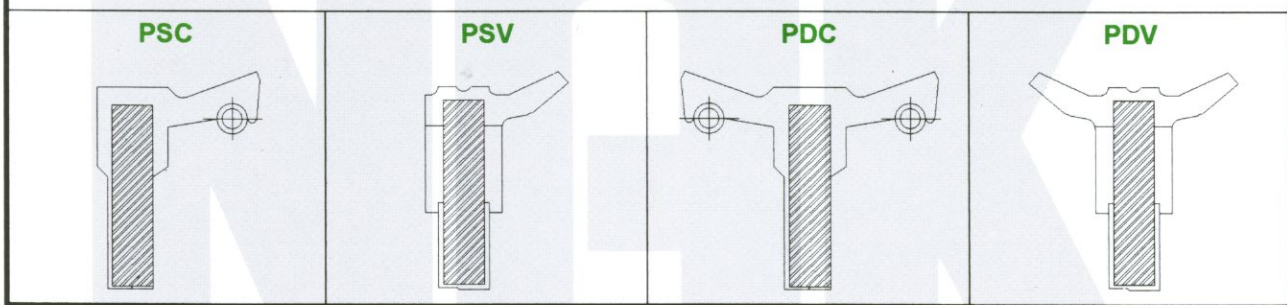
NAK Type TH	For heavy duty applications where dirt exclusion and outside sealing ability in the housing is required
TBH	TCH
	

Other NAK Sealing Product Designs

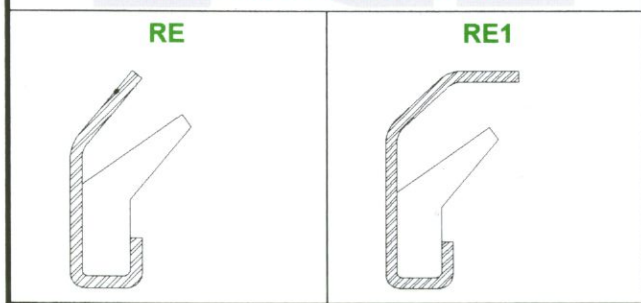
NAK Rod Wiper Seals



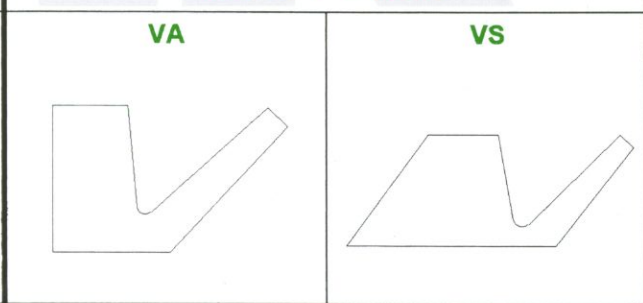
NAK Piston Seals



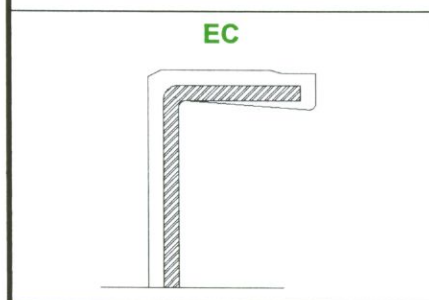
NAK Axial Face Seals



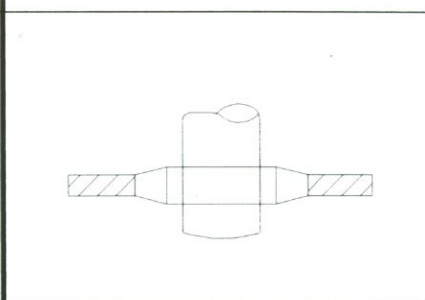
NAK 'V' Seals



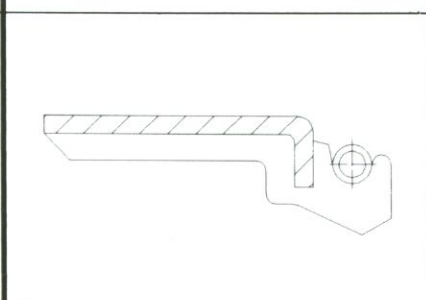
NAK End Cap



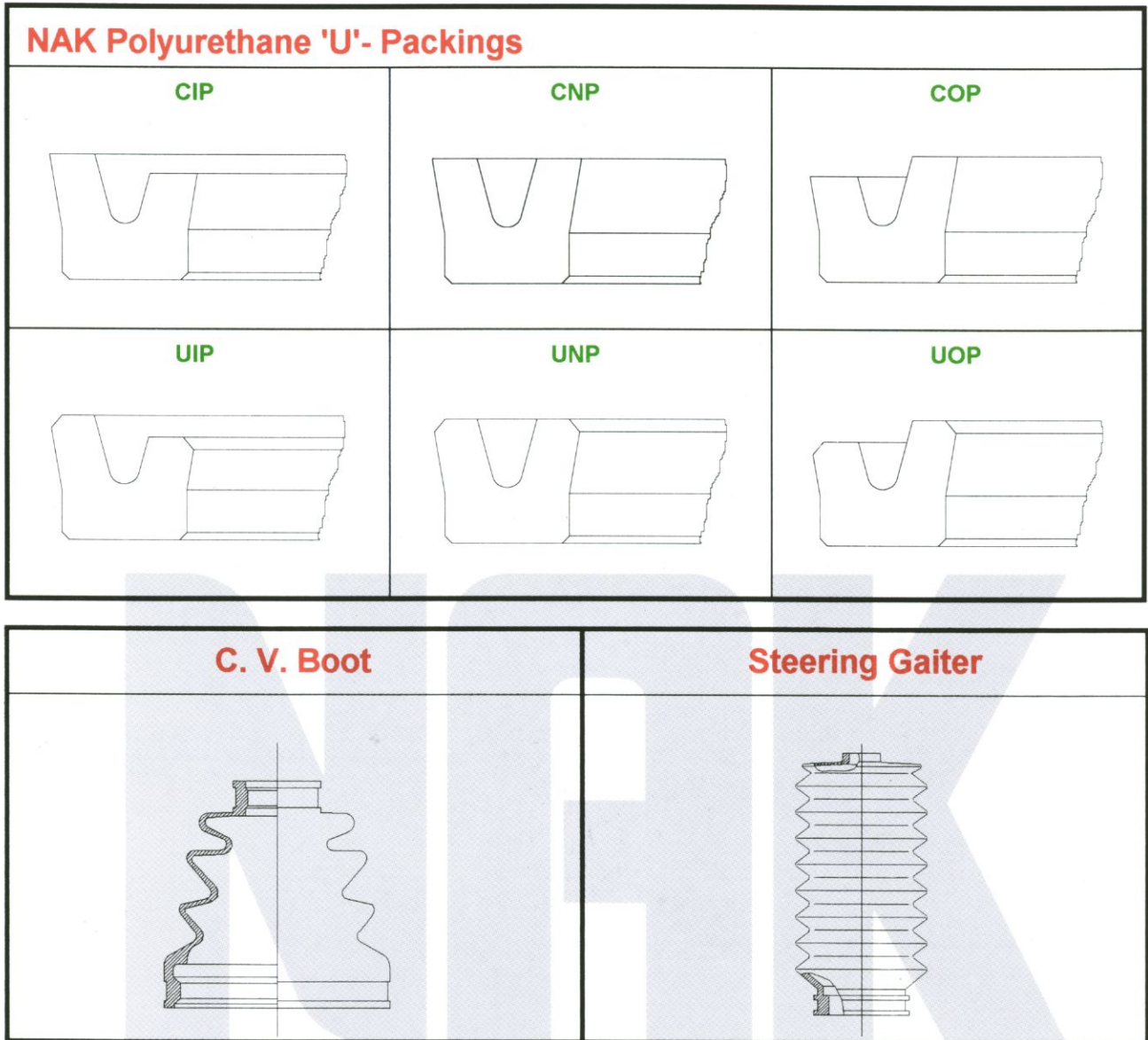
Bonded Seal



Valve Stem Seal



Other NAK Sealing Product Designs



Other Products Manufactured By NAK Include:

Gaskets

'O' - Rings

'O' - Ring Cord

Assorted 'O' - Ring Kits

Rubber Mouldings To Customers Design

NAK Shaft Seal Design Sheet

Reference No:	
Application:	
Quantity:	
Drawing No:	

Shaft Details	Diameter	Material	Finish	Hardness	<input type="checkbox"/> Horizontal <input type="checkbox"/> Vertical
Housing Details	Diameter	Material	Finish	Hardness	Installation direction
Motion Details	<input type="checkbox"/> Rotating	Normal speed	Shaft runout	Frequency of rotation	Shaft Direction: <input type="checkbox"/> Clockwise <input type="checkbox"/> Counter Clockwise <input type="checkbox"/> Bi-Directional
		RPM	TIR		
	Max. speed	Misalignment	<input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent		
	RPM				
Fluid Medium	<input type="checkbox"/> Internal <input type="checkbox"/> External	Stroke length Degree of arc	Cycles/min Cycles/min	Special operating conditions.	
	Type				
	Type Level <input type="checkbox"/> Dry <input type="checkbox"/> Mist <input type="checkbox"/> Flooded			Recommendation	
Temperature	<input type="checkbox"/> °C <input type="checkbox"/> °F	Minimum Normal Maximum			
Pressure	Normal		PSI/Bar		
	Maximum		PSI/Bar		

[] - Please enter ✓ where applicable.

Please complete as much information as possible on this form to allow the best seal recommendation for your application.