Materials and Specifications

General Elastomer Information

Dichtomatik's shaft seals are made from a wide range of materials. Depending upon a customer's application, the material color, durometer, and type can vary. Dichtomatik's standard materials and their specifications are:

Nitrile – Lip Code N (NBR)

NBR is the standard lip material for Dichtomatik's shaft seals. Dichtomatik's standard NBR compound is a 70-durometer black compound – NK701. Nitrile lip seals work well within a temperature range of -40F to 225F (-40C to 107C) and can withstand spikes of up to 250F (121C) for short periods of time. NBR seals are compatible with water and most common mineral oils and greases. NBR seals are recommended for most common applications.

Hydrogenated Nitrile – Lip Code H (HNBR)

HNBR is recommended for higher temperature applications, ranging from -40F to 302F (-40C to 150C). Compared to our standard nitrile compound, HNBR offers improved resistance to fuel, oil, heat, and chemicals. It also has good wear resistance characteristics, which make it well suited to perform in the most severe environments. Dichtomatik's standard HNBR compound is an 80-durometer black compound – HK804.

Polyacrylate – Lip Code P (ACM)

ACM compounds are recommended for higher temperature applications, ranging from -13F to 302F (-25C to 150C). ACM compounds work well with mineral oils and EP additives and greases. However, they offer poor sealing in dry running conditions and typically cost more than NBR seals. Dichtomatik's standard ACM compound is a 70-durometer black compound – PK701.

Silicone – Lip Code S (VMQ)

VMQ compounds offer the widest range of operating temperature conditions ranging from -60F to 390F (-51C to 199C). VMQ compounds do not perform well in dry running conditions and should not be used with EP based compounds and oxidized oils. The abrasion resistance of VMQ compounds is poor, so unless they are going to be used in applications that are operating in cold climates they should be avoided. Dichtomatik's standard VMQ compound is a 70-durometer black compound – SK701.

Fluorocarbon – Lip Code V (FKM)

FKM compounds are premium lip materials offering the highest temperature rating. FKM will handle temperatures ranging from -20F to 400F (-29C to 204C). FKM will resist most special lubricants and chemicals that can destroy NBR, ACM, and VMQ. FKM is extremely resistant to abrasion and provides superior wear and performance characteristics. FKM works in dry running applications, but only for intermittent periods. Dichtomatik's standard FKM compound is an 80-durometer brown compound – VN801.

Table 1: Physical Properties of the Five Major Seal Compounds

	Nitrile	Hydrogenated Nitrile	Polyacrylate	Silicone	Fluorocarbon
Compound	(Code N)	(Code H)	(Code P)	(Code S)	(Code V)
	-40F to 225F	-40F to 302F	-13F to 302F	-60F to 390F	-20F to 400F
Temperature Range	-40C to 107C	-40C to 150C	-25C to 150C	-51C to 199C	-29C to 204C
Abrasion Resistance	2	2	3	4	2
Compression Set	2	2	3	2	2
Cracking Resistance	3	2	3	1	2
Cut Growth Resistance	2	2	2	4	4
Flex Cracking Resistance	3	3	3	2	2
Impact Strength	2	1	4	3	3
Oxidation Resistance	2	1	1	1	1
Sunlight Resistance	3	2	1	1	1
Tear Resistance	2	2	4	4	3
Weather Resistance	3	2	1	1	1

Note: 1=Excellent 2=Good 3=Fair 4=Poor

For other available shaft seal materials, contact Dichtomatik Engineering. Material test reports for Dichtomatik's standard materials are on the following pages.

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Materials and Specifications

Metal Case and Spring Materials

One of the components of a shaft seal is the metal case. Standard shaft seals are made from a carbon steel metal case. However, if the application involves operating in a corrosive environment or extreme conditions, the metal case can be made out of stainless steel. In addition to the metal case, another component of some seals is a garter spring. A garter spring is included in the seal if it is intended to seal a media with a low viscosity – such as oil. A garter spring is not included with the seal if it is intended to seal a media with a high viscosity – such as grease. Garter springs are typically made from carbon steel, however, they too can be made out of stainless steel if the application requires. All of Dichtomatik's metal cases and springs are made from SAE grade metals as shown in the table below.

Table 2: Specifications of Metal Case and Garter Springs

Standard	SAE No.	Application	Material
Metal Case	1008 - 1010	General Application	Carbon Steel
	30304	Corrosive Environment	Stainless Steel
Garter Spring	1070 - 1090	General Application	Carbon Steel
	30304	Corrosive Environment	Stainless Steel

Material Code

We have now introduced the materials for each specific part of the oil seal. To allow our customers to know what the material is for each component of a seal, Dichtomatik has included a material code with each part. The material code is a 3-digit code that indicates the lip material, the case material, and the spring material in that order. The material codes are designated as shown below.

Lip Material
N = NBR
H = HNBR
P = ACM
S = VMQ
V = FKM

Case Material
C = Carbon Steel
S = Stainless Steel

Spring Material
C = Carbon Steel
S = Stainless Steel
O = Without Spring

Material Code Example
N = NBR Lip Material
CC = Carbon Steel Case
C = Carbon Steel Spring

NK701 (NBR) Material Properties

Specification: ASTM D2000 M2BG714 A14 B14 EO14 EO34 EF11 EF21 EA14 F17
Recommended Service Temperature: -40 F to 212 F (-40 C to 100 C)

Original Properties	**Specification**	**NK701**
Hardness, Shore A	70±5	71
Tensile Strength, psi	2031 (min)	2591
Ultimate Elongation, %	250 (min)	425
Tear Strength (kg/cm)	50 (min)	87
Specific Gravity	1.29±0.02	1.29
Heat Resistance - A14 (70 hrs @ 100 C)		
Hardness Change, points	±15 (max)	+10
Tensile Strength Change, %	±30 (max)	+13
Elongation Change, %	-50 (max)	-18
Volume Change, %		-6
Compression Set, % - B14 (22 hrs @ 100 C)		
Permanent Set, %	+25 (max)	+7
Fluid Resistance, ASTM #1 Oil - EO14 (70 hrs @ 100 C)		
Hardness Change, points	-5 to +10	+9
Tensile Strength Change, %	-25 (max)	+12
Elongation Change, %	-45 (max)	-15
Volume Change, %	-10 to +5	-4
Fluid Resistance, IRM 903 Oil - EO34 (70 hrs @ 100 C)		
Hardness Change, points	-10 to +5	-1
Tensile Strength Change, %	-45 (max)	+9
Elongation Change, %	-45 (max)	-12
Volume Change, %	0 to +25	+3
Fluid Resistance, ASTM Fuel A - EF11 (70 hrs @ 23 C)		
Hardness Change, points	±10 (max)	+2
Tensile Strength Change, %	-25 (max)	-2
Elongation Change, %	-25 (max)	-5
Volume Change, %	-5 to +10	0
Fluid Resistance, ASTM Fuel B - EF21 (70 hrs @ 23 C)		
Hardness Change, points	0 to -30	-8
Tensile Strength Change, %	-60 (max)	-21
Elongation Change, %	-60 (max)	-22
Volume Change, %	0 to +40	+14
Water Resistance - EA14 (70 hrs @ 100 C)		
Hardness Change, points	±10 (max)	-3
Tensile Strength Change, %		+5
Elongation Change, %		-8
Volume Change, %	±15 (max)	+7
Low Temperature Resistance - F17 (3 min @ -40 C)		
Brittleness	Non-brittle	Pass

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HK804 (HNBR) Material Properties

Specification: ASTM D2000 M4DH820 A26 B36 EO16 EO36 F17
Recommended Service Temperature: -40 F to 302 F (-40 C to 150 C)

Original Properties	**Specification**	**HK804**
Hardness, Shore A	80±5	81
Tensile Strength, psi	2900 (min)	3210
Ultimate Elongation, %	150 (min)	319
Tear Strength (kg/cm)	50 (min)	72
Specific Gravity	1.34±0.02	1.344
Heat Resistance - A26 (70 hrs @ 150 C)		
Hardness Change, points	+10 (max)	+3
Tensile Strength Change, %	-15 (max)	+5
Elongation Change, %	-25 (max)	-20
Compression Set, % - B36 (22 hrs @ 150 C)		
Permanent Set, %	+35 (max)	+24
Fluid Resistance, ASTM #1 Oil - EO16 (70 hrs @ 150 C)		
Hardness Change, points	-5 to +10	+4
Tensile Strength Change, %	-20 (max)	+9
Elongation Change, %	-30 (max)	-19
Volume Change, %	-10 to +5	-3
Fluid Resistance, IRM 903 Oil - EO36 (70 hrs @ 150 C)		
Hardness Change, points	-15 (max)	-8
Tensile Strength Change, %	-40 (max)	+1
Elongation Change, %	-30 (max)	-6
Volume Change, %	+25 (max)	+14

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PK701 (ACM) Material Properties

Specification: ASTM D2000 M3DH710 A26 B36 EO16 EO36
Recommended Service Temperature: -13 F to 302 F (-25 C to 150 C)

Original Properties	**Specification**	**PK701**
Hardness, Shore A	70±5	70
Tensile Strength, Mpa	10 (min)	10.4
Ultimate Elongation, %	200 (min)	221
Tear Strength (kg/cm)		30
Specific Gravity		1.41
Heat Resistance - A26 (70 hrs @ 150 C)		
Hardness Change, points	+10 (max)	+3
Tensile Strength Change, %	-25 (max)	+4
Elongation Change, %	-30 (max)	-2
Volume Change, %		-1
Compression Set, % - B36 (22 hrs @ 150 C)		
Permanent Set, %	+50 (max)	+38
Fluid Resistance, ASTM #1 Oil - EO16 (70 hrs @ 150 C)		
Hardness Change, points	-5 to +10	0
Tensile Strength Change, %	-20 (max)	+6
Elongation Change, %	-30 (max)	-7
Volume Change, %	-5 to +5	-1
Fluid Resistance, IRM 903 Oil - EO36 (70 hrs @ 150 C)		
Hardness Change, points	-15 (max)	-8
Tensile Strength Change, %	-30 (max)	-5
Elongation Change, %	-30 (max)	+5
Volume Change, %	+25 (max)	+10

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SK701 (VMQ) Material Properties

Specification: ASTM D2000 M5GE706 A19 B37 EO16 EO36 F19
Recommended Service Temperature: -40 F to 302 F (-40 C to 150 C)

Original Properties	**Specification**	**SK701**
Hardness, Shore A	70±5	73
Tensile Strength, PSI	870 (min)	1142
Ultimate Elongation, %	150 (min)	178
Tear Strength (kg/cm)	10 (min)	20
Specific Gravity	1.31±0.02	1.31
Heat Resistance - A19 (70 hrs @ 225 C)		
Hardness Change, points	+10 (max)	+1
Tensile Strength Change, %	-25 (max)	-14
Elongation Change, %	-30 (max)	-13
Compression Set, % - B37 (22 hrs @ 175 C)		
Permanent Set, %	+25 (max)	+9
Fluid Resistance, ASTM #1 Oil - EO16 (70 hrs @ 150 C)		
Hardness Change, points	0 to -15	-5
Tensile Strength Change, %	-20 (max)	+7
Elongation Change, %	-20 (max)	-6
Volume Change, %	0 to +10	+4
Fluid Resistance, IRM 903 Oil - EO36 (70 hrs @ 150 C)		
Hardness Change, points	-30 (max)	-19
Tensile Strength Change, %		-8
Elongation Change, %		-9
Volume Change, %	+60 (max)	+30
Low Temperature Resistance - F19 (3 min @ -55 C)		
Brittleness	Non-brittle	Pass

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VN801 (FKM) Material Properties

Specification: ASTM D2000 M2HK810 A1-10 B38 EO16 EO36 EF31 F15
Recommended Service Temperature: -20 F to 400 F (-29 C to 204 C)

Original Properties	**Specification**	**VN801**
Hardness, Shore A	80±5	80
Tensile Strength, psi	1450 (min)	2014
Ultimate Elongation, %	150 (min)	172
Tear Strength (kg/cm)	25 (min)	36
Specific Gravity	2.18±0.02	2.18
Heat Resistance - A1-10 (70 hrs @ 250 C)		
Hardness Change, points	+10 (max)	+5
Tensile Strength Change, %	-25 (max)	+26
Elongation Change, %	-25 (max)	-20
Volume Change, %		-4
Compression Set, % - B38 (22 hrs @ 200 C)		
Permanent Set, %	+50 (max)	+10
Fluid Resistance, ASTM #1 Oil - EO16 (70 hrs @ 150 C)		
Hardness Change, points	-5 to +10	+2
Tensile Strength Change, %	-20 (max)	+6
Elongation Change, %	-30 (max)	+5
Volume Change, %	-5 to +5	-1
Fluid Resistance, IRM 903 Oil - EO36 (70 hrs @ 150 C)		
Hardness Change, points	-15 (max)	+1
Tensile Strength Change, %	-40 (max)	-3
Elongation Change, %	-40 (max)	+5
Volume Change, %	+25 (max)	+1
Fluid Resistance, ASTM Fuel C - EF31 (70 hrs @ 23 C)		
Hardness Change, points	-5 to +5	-1
Tensile Strength Change, %	-25 (max)	-8
Elongation Change, %	-20 (max)	-3
Volume Change, %	0 to +10	+3
Low Temperature Resistance - F15 (3 min @ -25 C)		
Brittleness	Non-brittle	Pass

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