Frictional Torque of an Oil Seal

The frictional torque of an oil seal can be expressed by equation (1).

$$T = f \cdot Pr \cdot r \quad \cdots\cdots\cdots (1)$$

T = frictional torque (N·cm{kgf·cm})
f = coefficient of friction
Pr = radial lip load onto shaft (N{kgf})
r = radius of shaft (cm)

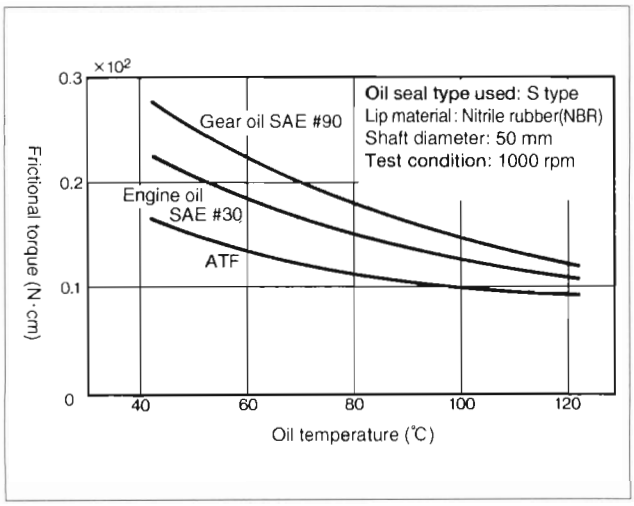
The coefficient of friction (f) is determined by many factors, but it generally means dynamic friction under lubricated conditions, and can be expressed by equation (2).

$$f = \Phi (\mu \cdot u \cdot b / Pr)^{1/3} \quad \cdots\cdots\cdots (2)$$

Φ = constant determined by the state of the oil film
μ = viscosity of sealing fluid (N·s/cm²{kgf·s/cm²})
u = linear shaft speed (cm/s)
b = lip-to-shaft contact width (cm)

It becomes evident that the coefficient of friction (f) for a specific oil seal is influenced by the viscosity (m) of the sealing fluid and the linear shaft speed (u). **Figure 1** shows the relationship between frictional torque and oil temperature by oil type. Frictional torque decreases as the oil's viscosity decreases. Also, frictional torque is inversely related to the oil temperature, since oil becomes less viscous as oil temperature increases.

Figure 1: Frictional Torque vs Oil Temperature for Several Oils



The linear shaft speed also influences frictional torque. **Figures 2 and 3** show the relationship between shaft speed and frictional torque.

Figure 2 shows a case in which the oil temperature is constant. Frictional torque increases as shaft speed increases.

Figure 2: Frictional Torque vs Shaft Speed (with constant oil temperature)

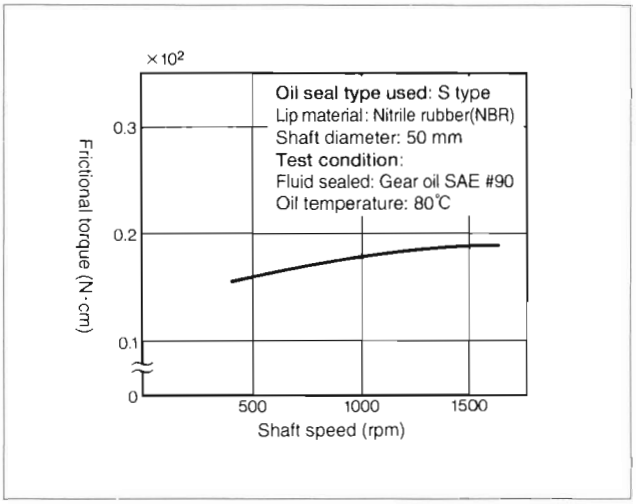
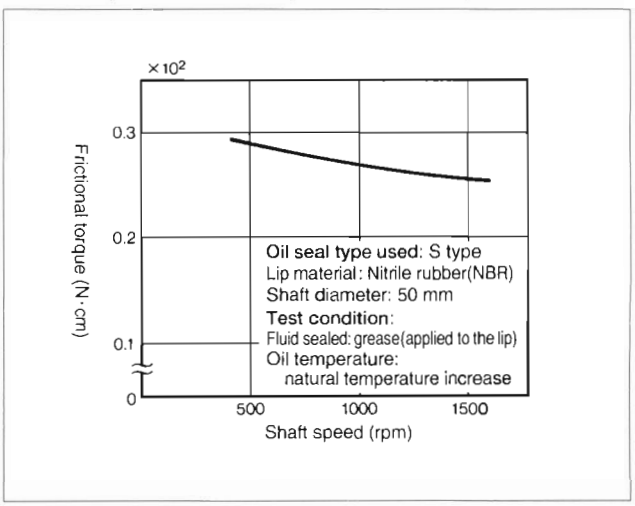


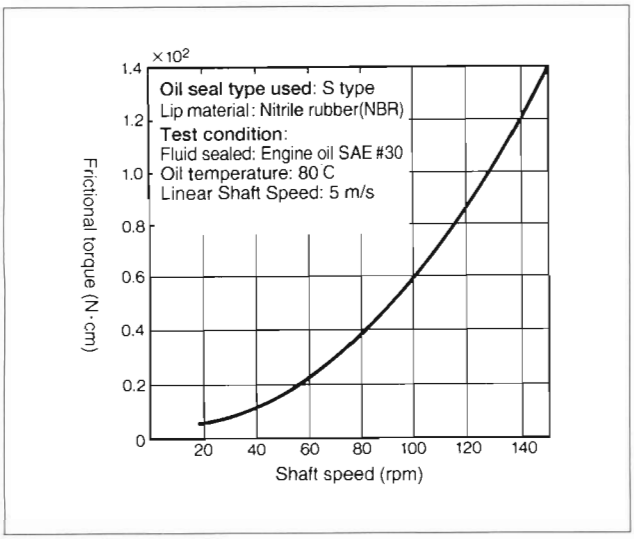
Figure 3 shows a case in which the grease temperature is not controlled (heated naturally via friction). Frictional torque decreases as shaft speed increases. This is because as the shaft speed increases, the grease temperature increases due to the heat generated by friction, thus decreasing the its viscosity and the overall frictional torque.

Figure 3: Frictional Torque vs Shaft Speed (with a natural temperature increase)



As described above, the frictional torque of an oil seal varies according to the oil type and operating conditions. Figure 4 shows the relationship between the frictional torque of an oil seal and the shaft diameter (for reference only).

Figure 4: Frictional Torque vs Shaft Diameter (reference only)



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Service Life of an Oil Seal

The failure modes and ultimate service life will vary according to the usage conditions, including operating, environmental, and lubrication conditions.

The following will discuss the degradation of lip materials and lip wear (causing a loss of lip-to-shaft interference), which are responsible for the most common oil seal failures.

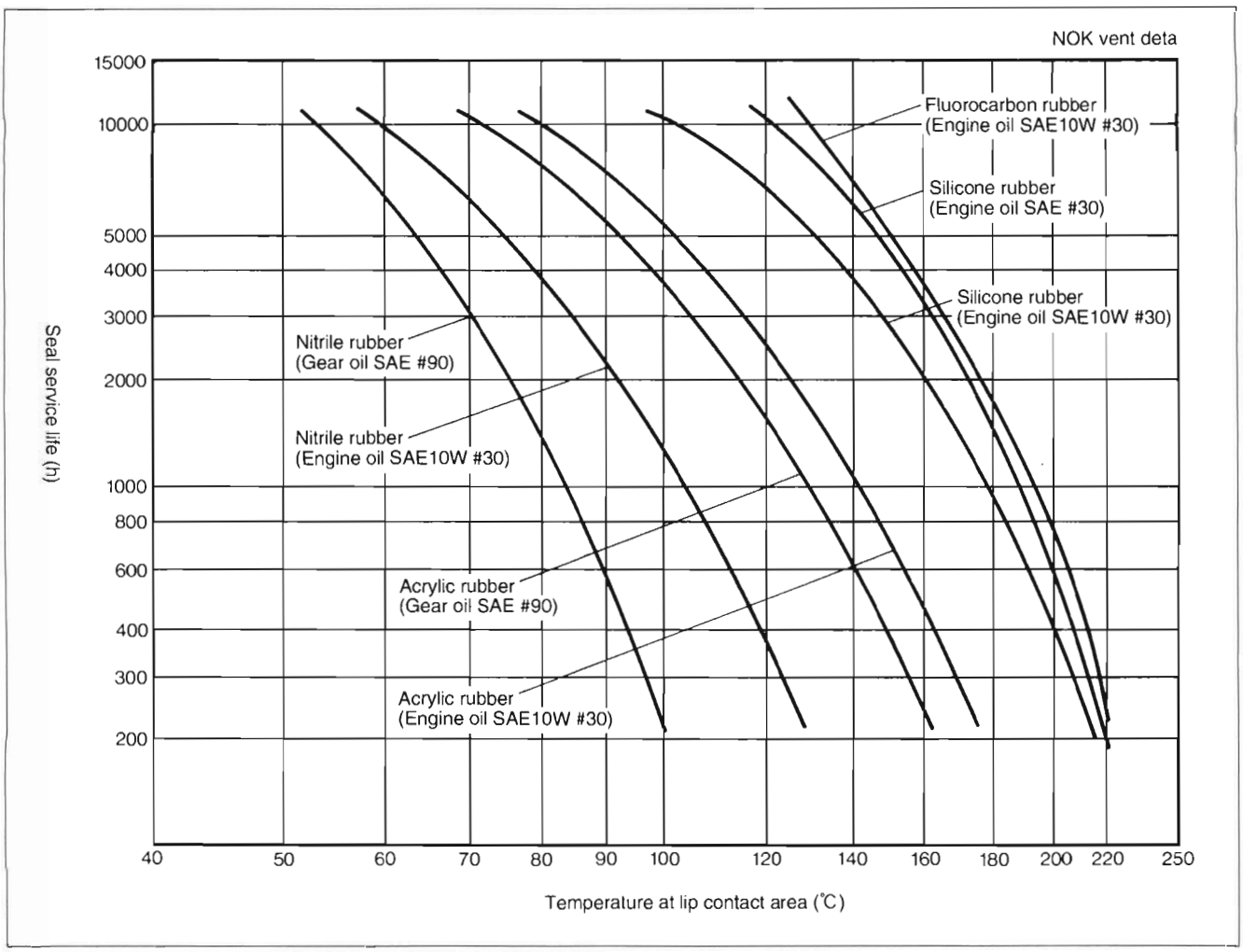
1. Lip Material Degradation

Material degradation consists of hardened or softened rubber, cracks, or taking a set. The sealing ability of an oil seal is reduce or eliminated when the lip contact area is hardened or cracked, or the lip-to-shaft interference is decreased.

This degradation often occurs as a result of a chemical reaction between the rubber and the sealing fluid, or a substance intermingled with or dissolved in the sealing fluid. Generally, degradation advances rapidly as the oil temperature increases, shortening the service life of the oil seal.

Figure 5 shows the service life of various oil seal materials vs.the temperature at the lip contact area (for reference only).

Figure 5 shows the service life of various oil seal materials vs.the temperature at the lip contact area (for reference only).



2. The Effects of Lip Wear

When there is sufficient lubrication, an oil seal continually circulates oil underneath the lip, thus minimizing lip wear. Lip wear is accelerated by a lack of or degradation of the lubricant, foreign matter trapped in the lubricant, or the entry of external dust under the main lip.

Figure 6 shows the relationship between the quantity of lubricant supplied to the lip contact area and the resulting lip wear.

Lip wear increases as the lubricant quantity decreases. However, lip wear actually progresses faster in the presence of a very small amount of lubricant than in the complete absence of lubricant.

Lip wear causes lip-to-shaft interference to decrease, thereby decreasing the seal's ability to compensate for shaft eccentricity. Therefore, the life of a seal with respect to lip wear expires when the lip interference can no longer follow an eccentric shaft (shaft run-out). **Figure 7** shows an example of the shaft eccentricity limits of a worn oil seal. Leakage occurs when the lip interference value falls below approximately twice the shaft eccentricity (shaft run-out). Since the progress of lip wear is largely influenced by the quantity of lubricant or other environmental conditions, such as the presence of foreign matter in the lubricant, the performance of oil seals varies according to the actual application conditions.

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Figure 6: Seal Lip Wear vs Oil Supply

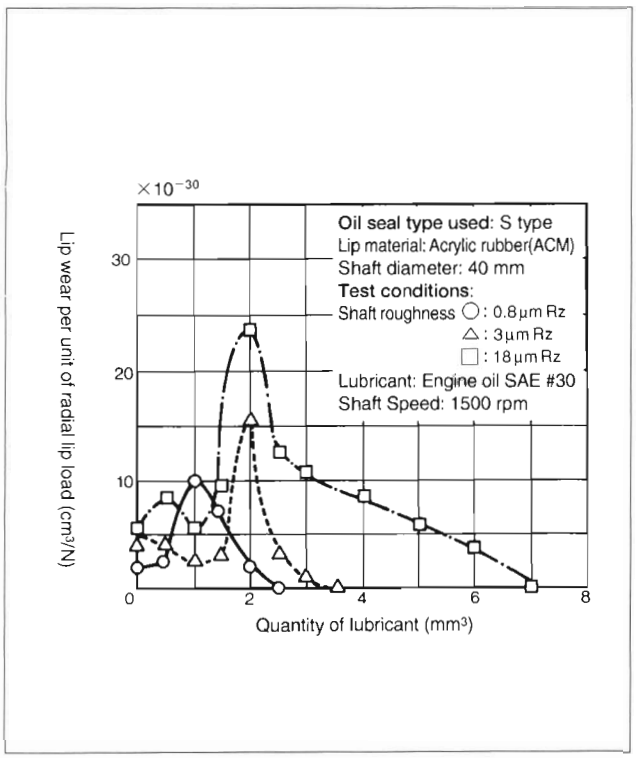
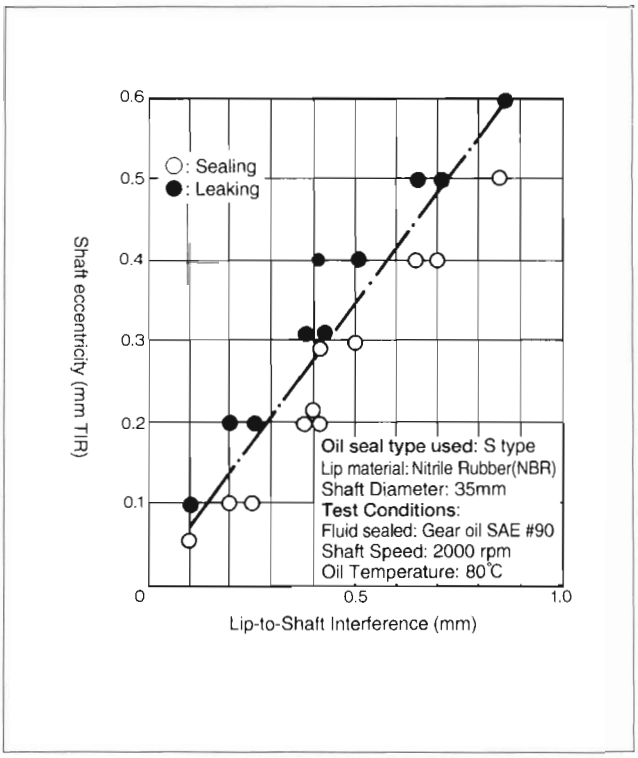


Figure 7: Shaft Eccentricity Limits vs Seal Lip Interference (TIR: Total Indicator Reading)



Oil and Chemical Resistance Ratings of NOK's Lip Materials

The following data is a summary of material test results. It shows the resistance of each lip material to various lubricants and chemicals.

After selecting a preliminary lip material in Chapter E, please verify its compatibility with the lubricant or chemicals to be used.

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How to Read the Table

The test method used are in accordance with JIS K 6258 "Testing methods of the effect of liquids for vulcanized rubber" and JIS K 6253 "Hardness testing methods for rubber, vulcanized or thermoplastic". The table displays the test temperature and time, and the post-test changes in hardness and volume.

Hardness and volume change data indicate the post-test change in hardness against the pre-test hardness, and the post-test change in volume against the pre-test volume of the test piece, respectively. Plus (+) indicates that the hardness or volume increased after the test, while minus (-) indicates that the hardness or volume decreased after the test. The absolute value is inversely related to the oil or chemical resistance of the material.

The resistance of each lip material is determined by assuming that it is used for 500 hours continuously at the listed test temperature, and based on the indicated test results.

Symbols in the "Material Resistance Rating" column are as follows:

◎ : Good resistance
○ : Resistance, except in special cases※
△ : No resistance, except in special cases※
× : No resistance

※: Consult NOK before use.

In most cases, the stability of the lip material can be determined by consulting the hardness change and volume change data; however, some materials may be classified as △ or × despite their small hardness or volume change values. Such classifications are based on other considerations and do not contradict the above-mentioned general principles.

For the classification of oil types, refer to the "Lubricant Brand Guide" published by the Lubrication News Agency. Please refer to the guide for the properties of each oil type.

There are cases in which an inorganic acid, organic acid, alkaline acid, or inorganic salt should not be used due to environmental conditions. Please consult with us before use.

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Engine Oils	Apolloil Auto Lube 30 SD (Idemitsu Petrochemical)	A727	100	200	0	− 0.9	◎
			120	200	0	− 0.9	○
		A941	100	200	+ 4	− 2.1	◎
			120	200	+ 6	− 2.7	△
		A795	100	200	+ 6	− 6.7	○
			120	200	+ 9	− 7.5	△
		A275	100	200	+ 5	− 8.9	◎
			120	200	+ 6	− 9.2	△
		T303	120	200	0	− 1.4	◎
			130	70	− 1	+ 0.4	◎
				500	+ 2	+ 0.3	◎
			150	200	+ 1	− 0.6	○
		T599	120	200	+ 2	− 1.5	◎
			130	70	− 1	− 0.2	◎
				500	+ 4	− 0.3	◎
			150	70	+ 2	− 2.3	△
				200	0	− 1.3	△
				500	+ 6	− 3.5	△
		T302	120	200	+ 3	+ 3.3	◎
			150	200	+ 5	+ 4.4	○
		S728	150	200	− 6	+ 8.8	○
			175	200	− 9	+10.4	△
		F585	150	200	− 2	+ 1.0	◎
			175	200	− 2	+ 1.1	○
		F975	150	200	+ 1	+ 2.0	◎
			175	200	+ 3	+ 2.3	○
	New Pan 10W-30 SG (Nippon Oil)	A727	100	200	− 5	+ 3.1	◎
			120	200	+ 2	+ 3.2	○
		A941	100	200	+ 2	+ 1.1	◎
			120	200	+ 7	− 0.6	△
		A795	100	200	+ 5	− 4.2	◎
			120	200	+12	− 6.1	×
		A275	100	200	− 1	− 5.7	◎
			120	200	+ 4	− 5.3	△
		T303	120	200	0	+ 2.8	◎
			150	200	+ 1	+ 2.6	○
		T599	120	200	+ 1	+ 1.9	◎
			150	200	− 1	+ 2.6	△
		T302	120	200	+ 1	+ 3.3	◎
			150	200	+ 1	+ 4.4	○
		S728	150	200	−13	+19.9	○
			175	200	−20	+25.2	△
		F585	150	200	0	+ 1.8	◎
			175	200	+ 2	+ 2.4	○
		F975	150	200	+ 2	+ 2.0	◎
			175	200	+ 6	+ 2.3	○
	Shell Formula X 5W-30 SG (Showa Shell Sekiyu)	A727	100	200	− 1	− 0.1	◎
			120	200	+13	− 0.3	×
		A941	100	200	+ 4	− 1.1	◎
			120	200	+ 9	− 2.6	△
		A795	100	200	+ 7	− 5.6	△
			120	200	+12	− 6.8	×
		A275	100	200	+ 3	− 8.6	◎
			120	200	+ 7	− 8.7	△

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Engine Oils	Shell Formula X 5W-30 SG (Showa Shell Sekiyu)	T303	120	200	0	+ 1.1	◎
			150	200	+ 1	− 0.3	○
		T599	120	200	+ 1	0	◎
			150	200	− 1	− 0.8	△
		T302	120	200	+ 5	+ 1.5	◎
			150	200	+ 5	+ 1.1	○
		S728	150	200	−13	+17.0	○
			175	200	−16	+20.4	△
		F585	150	200	− 4	+ 0.9	◎
			175	200	− 1	+ 1.4	○
		F975	150	200	+ 1	+ 1.4	◎
			175	200	+ 3	+ 1.5	○
	Mobil 1 5W-30 SE/CC (Mobil Sekiyu)	A727	100	200	− 1	+ 1.2	◎
			120	200	+ 4	+ 1.1	○
		A941	100	200	+ 2	− 0.6	◎
			120	200	+10	− 2.2	△
		A795	100	200	+ 7	− 6.0	○
			120	200	+13	− 7.0	×
		A275	100	200	+ 3	− 7.3	◎
			120	200	+11	− 7.0	×
		T303	120	70	+ 1	+ 0.9	◎
				200	− 1	+ 1.7	◎
				500	+ 4	+ 0.1	◎
			150	70	+ 1	+ 1.0	○
				200	0	+ 1.6	◎
				500	+ 6	+ 1.0	◎
		T599	120	200	0	+ 1.4	◎
			150	200	− 2	+ 1.7	△
		T302	120	200	+ 1	+ 2.6	◎
			150	200	+ 3	+ 2.4	○
		S728	150	200	−14	+17.5	○
			175	200	−18	+20.2	△
		F585	150	200	− 1	+ 1.5	◎
			175	200	0	+ 1.9	○
		F975	150	200	+ 3	+ 1.4	◎
			175	200	+ 5	+ 2.0	○
	General Motor Oil G-1 mX 5W-50 SG (General Sekiyu)	A727	100	200	+ 2	+ 0.6	◎
			120	200	+ 5	+ 0.1	○
		A941	100	200	+ 3	− 1.0	◎
			120	200	+ 7	− 2.0	△
		A795	100	200	+ 6	− 5.9	○
			120	200	+12	− 7.3	×
		A275	100	200	+ 2	− 8.1	◎
			120	200	+ 5	− 7.5	△
		T303	120	200	+ 1	+ 1.4	◎
			150	200	+ 2	+ 1.3	○
		T599	120	200	+ 2	+ 0.6	◎
			150	200	0	+ 1.2	△
		T302	120	200	+ 3	+ 2.0	◎
			150	200	+ 3	+ 2.2	○
		S728	150	200	−13	+18.3	○
			175	200	−20	+23.2	△
		F585	150	200	0	+ 1.7	◎
			175	200	+ 2	+ 2.0	○

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Engine Oils	General Motor Oil G-1 mX 5W-50 SG (General Sekiyu)	F975	150	200	+ 2	+1.5	◎
			175	200	+ 5	+1.8	○
	Apolloil Gezelube 20CB (Idemitsu Petrochemical)	A103	100	70	0	−2.0	◎
		T303	130	70	+ 1	+2.7	◎
	High Diesel S-3 30CD (Nippon Oil)	A727	100	70	+ 1	−3.5	◎
		T303	130	70	+ 1	+0.1	◎
Gear Oils (for vehicles)	Apolloil Gear ZEX 90·GL-6 (Idemitsu Petrochemical)	A727	100	200	− 3	+3.6	◎
			120	200	+ 5	+5.1	○
		A941	100	200	+ 2	+1.9	◎
			120	200	+ 9	+2.7	△
		A795	100	200	+ 5	−3.3	◎
			120	200	+11	−3.7	×
		A275	100	200	+ 4	−4.3	◎
			120	200	+11	−2.8	×
		A437	100	200	+ 2	−1.7	◎
			120	200	+10	−0.1	△
		A989	100	200	+ 4	−1.8	◎
			120	200	+14	−1.0	×
		A103	100	200	+ 4	−1.6	◎
			120	200	+13	0	×
		T303	120	200	− 3	+2.4	◎
			150	200	+ 1	+2.3	○
		T599	120	200	− 2	+1.3	◎
			150	200	− 5	+1.7	△
		T302	120	200	− 3	+3.6	◎
			150	200	+ 5	+4.2	△
		S728	150	200	Immeasurable	Immeasurable	×
			175	200	Immeasurable	Immeasurable	×
		F585	150	200	0	+2.7	◎
			175	200	+ 4	+3.5	△
		F975	150	200	+ 2	+2.2	◎
			175	200	+ 7	+2.5	△
	Apolloil TH Universal 10W-30 (Idemitsu Petrochemical)	A727	100	200	− 4	+4.2	◎
			120	200	− 2	+5.0	○
		A941	100	200	0	+2.4	◎
			120	200	+ 6	+1.1	△
		A795	100	200	+ 4	−3.0	◎
			120	200	+10	−4.8	△
		A275	100	200	+ 4	−4.7	◎
			120	200	+ 3	−4.0	△
		A437	100	200	+ 2	−1.0	◎
			120	200	+ 3	−0.2	△
		A989	100	200	0	−0.5	◎
			120	200	+ 3	−0.9	△
		A103	100	200	− 1	−1.6	◎
			120	200	+ 3	−1.4	△
		T303	120	200	− 2	+3.8	◎
			150	200	− 1	+3.6	○
		T599	120	200	− 2	+3.7	◎
			150	200	− 3	+3.4	△

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Gear Oils (for vehicles)	Apolloil TH Universal 10W-30 (Idemitsu Petrochemical)	T302	120	200	− 2	+ 4.7	◎
			150	200	− 2	+ 5.0	○
		S728	150	200	−16	+20.1	×
			175	200	−33	+20.6	×
		F585	150	200	− 2	+ 1.8	◎
			175	200	− 1	+ 2.8	△
		F975	150	200	+ 2	+ 1.9	◎
			175	200	+ 4	+ 2.8	△
	Gear Lube EHD 80·GL-5 (Nippon Oil)	A727	100	200	− 3	+ 1.9	◎
			120	200	+ 2	+ 2.6	○
		A941	100	200	+ 4	+ 0.5	◎
			120	200	+ 9	+ 0.5	△
		A795	100	200	+ 6	− 4.6	○
			120	200	+11	− 5.3	×
		A437	100	200	+ 5	− 3.2	○
			120	200	+ 9	− 2.7	△
		A989	100	200	+ 5	− 3.0	○
			120	200	+11	− 3.0	△
		A103	100	200	+ 4	− 3.3	◎
			120	200	+10	− 2.8	△
		T303	120	200	+ 1	+ 1.2	◎
			150	200	+ 2	+ 1.3	○
		T599	120	200	+ 1	+ 0.4	◎
			150	200	− 1	+ 0.7	△
		T302	120	200	0	+ 2.3	◎
			150	200	+ 5	+ 2.3	○
		S728	150	200	Immeasurable	Immeasurable	×
			175	200	Immeasurable	Immeasurable	×
		F585	150	200	0	+ 1.7	◎
			175	200	+ 5	+ 2.3	△
		F975	150	200	+ 4	+ 1.2	◎
			175	200	+ 7	+ 1.5	△
	Spilacs EP90·GL-4 (Showa Shell Sekiyu)	A727	100	200	− 2	+ 0.6	◎
			120	200	+ 5	+ 1.1	○
		A941	100	200	+ 3	− 0.4	◎
			120	200	+ 7	− 0.6	△
		A795	100	200	+ 6	− 5.4	○
			120	200	+11	− 6.3	×
		A275	100	200	+ 6	− 7.3	○
			120	200	+11	− 7.3	×
		A437	100	200	+ 4	− 4.7	◎
			120	200	+10	− 4.1	△
		A989	100	200	+ 6	− 3.8	○
			120	200	+12	− 3.9	×
		A103	100	200	+ 5	− 4.0	○
			120	200	+11	− 4.0	×

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Gear Oils (for vehicles)	Spilacs EP90·GL-4 (Showa Shell Sekiyu)	T303	120	200	0	− 0.3	◎
			150	200	+ 3	+ 0.3	○
		T599	120	200	− 1	− 1.0	◎
			150	200	− 2	− 0.8	△
		T302	120	200	0	+ 1.5	◎
			150	200	+ 5	+ 1.5	○
		S728	150	200	− 6	− 0.2	△
			175	200	− 8	− 3.2	×
		F585	150	200	0	+ 1.4	◎
			175	200	+ 2	+ 2.0	△
		F975	150	200	+ 4	+ 1.0	◎
			175	200	+ 6	+ 1.0	△
	Apolloil Gear HE 90·GL-4 (Idemitsu Petrochemical)	T303	90	480	− 2	+ 6.4	◎
			110	240	− 2	+ 6.2	◎
	Apolloil Wide Gear LW 80W-90·GL-5(Idemitsu Petrochemical)	T303	120	70	+ 1	0	◎
				200	+ 2	− 0.1	◎
				500	+ 2	+ 0.5	◎
			150	200	+ 3	+ 0.1	◎
				500	+ 6	− 0.3	○
	Gear Lube SP 90·GL-4 (Nippon Oil)	A727	120	70	+ 2	− 1.2	○
		A795	120	70	+ 6	− 7.0	△
		T599	80	70	− 1	− 0.7	◎
	Antoil B 80W (Nippon Oil)	A727	100	70	− 6	+ 1.8	◎
	Diamond EP Gear Oil 80·GL-3 (Mitsubishi Oil)	A727	100	70	− 1	− 0.3	◎
		A795	100	70	0	− 2.9	◎
	Diamond EP Gear Oil 90·GL-3 (Mitsubishi Oil)	A727	100	70	0	+ 0.2	◎
		T303	100	70	− 2	+ 1.6	◎
	Diamond Hypoid Gear Oil 90·GL-4 (Mitsubishi Oil)	T303	130	70	+ 1	+ 0.7	◎
				500	+ 5	+ 1.2	◎
			150	70	+ 1	+ 1.0	◎
				300	+ 6	+ 1.0	○
				500	+ 9	− 3.5	○
		T599	100	70	0	− 0.9	◎
Class 2 Gear Oils for Industrial Use (Extreme Pressure)	(Polyglycol base) Synthese D68EP (NOK Kluber)	A727	100	200	− 8	+ 7.2	○
			120	200	−13	+12.4	△
		A941	100	200	− 1	+ 4.1	◎
			120	200	− 1	+ 5.6	○
		A795	100	200	+ 2	− 2.1	◎
			120	200	+ 4	− 1.8	○
		A275	100	200	− 2	+ 0.3	◎
			120	200	− 2	+ 1.6	○
		A437	100	200	− 1	+ 5.6	◎
			120	200	− 5	+ 3.1	○
		A989	100	200	− 2	+ 1.3	◎
			120	200	− 3	+ 1.0	○
		A103	100	200	− 2	+ 2.6	◎
			120	200	− 3	+ 2.0	○
		T303	120	200	−24	+45.1	×
			150	200	−26	+59.5	×

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Oil Resistance Data

Sealing Fluid (Manufacturer)		NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Class 2 Gear Oils for Industrial Use (Extreme Pressure)	(Polyglycol base) Synthese D68EP (NOK Kluber)	T599	120	200	−25	+47.5	×
			150	200	−34	+69.1	×
		T302	120	200	−20	+80.8	×
			150	200	−22	+57.0	×
		S728	150	200	− 6	− 0.2	△
			175	200	Immeasurable	Immeasurable	×
		F585	150	200	− 1	+ 1.4	◎
			175	200	+ 1	+ 2.0	△
		F975	150	200	+ 3	+ 1.4	◎
			175	200	+ 6	+ 0.9	△
	(Polyglycol base) Synthese D460EP (NOK Kluber)	A727	100	200	− 1	− 2.2	◎
			120	200	0	− 2.0	○
		A941	100	200	+ 4	− 2.6	◎
			120	200	+ 3	− 2.5	○
		A795	100	200	+ 6	− 6.6	○
			120	200	+ 7	− 7.1	△
		A275	100	200	+ 2	− 9.5	◎
			120	200	+ 3	− 9.1	○
		A437	100	200	+ 5	− 7.3	◎
			120	200	+ 5	− 7.5	○
		A989	100	200	+ 5	− 6.8	◎
			120	200	+ 5	− 6.7	○
		A103	100	200	+ 3	− 7.1	◎
			120	200	+ 4	− 6.8	○
		T303	120	200	− 8	+ 8.5	◎
			150	200	− 7	+11.9	○
		T599	120	200	− 9	+10.4	○
			150	200	−14	+13.9	△
		T302	120	200	−10	+14.0	△
			150	200	−10	+17.8	△
		S728	150	200	Immeasurable	Immeasurable	×
			175	200	Immeasurable	Immeasurable	×
		F585	150	200	+ 4	+ 1.7	◎
			175	200	+11	+ 3.3	×
		F975	150	200	+ 5	+ 1.1	◎
			175	200	+11	+ 1.9	×
	(Polyglycol base) Synthese HT220 (NOK Kluber)	A727	100	200	− 3	+ 1.7	◎
			120	200	− 4	+ 2.5	○
		A941	100	200	+ 2	− 0.7	◎
			120	200	+ 3	0	○
		A795	100	200	+ 5	− 5.4	◎
			120	200	+ 6	− 5.7	○
		A275	100	200	+ 1	− 5.0	◎
			120	200	+ 1	− 5.1	○
		A437	100	200	+ 3	− 2.9	◎
			120	200	+ 4	− 2.9	○

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Class 2 Gear Oils for Industrial Use (Extreme Pressure)	(Polyglycol base) Synthese HT220 (NOK Kluber)	A989	100	200	+ 2	− 3.3	◎
			120	200	+ 4	− 3.3	○
		A103	100	200	+ 2	− 2.9	◎
			120	200	+ 3	− 3.0	○
		T303	120	200	−11	+19.1	×
			150	200	− 8	+23.0	×
		T599	120	200	−16	+24.7	×
			150	200	−21	+32.2	×
		T302	150	200	−11	+28.9	×
			175	200	− 8	+30.9	×
		S728	150	200	+ 1	+ 1.7	○
			175	200	0	+ 1.8	△
		F585	150	200	− 3	+ 0.7	◎
			175	200	+ 2	+ 1.5	△
		F975	150	200	0	+ 0.5	◎
			175	200	+ 6	+ 1.3	△
	(Polyglycol base) Synthese HT680 (NOK Kluber)	A727	100	200	− 1	− 2.4	◎
			120	200	− 1	− 2.7	○
		A941	100	200	+ 4	− 2.9	◎
			120	200	+ 5	− 3.4	○
		A795	100	200	+ 6	− 6.8	○
			120	200	+ 8	− 8.1	△
		A275	100	200	+ 5	−10.0	○
			120	200	+ 5	−10.0	△
		A437	100	200	+ 6	− 8.3	○
			120	200	+ 7	− 8.7	△
		A989	100	200	+ 5	− 6.7	○
			120	200	+ 7	− 7.3	△
		A103	100	200	+ 4	− 8.7	◎
			120	200	+ 5	− 7.1	△
		T303	120	200	− 5	+ 5.4	◎
			150	200	+ 1	+ 8.0	○
		T599	120	200	− 8	+ 7.5	○
			150	200	−12	+12.2	△
		T302	120	200	− 4	+ 9.0	◎
			150	200	+ 2	+11.7	○
		S728	150	200	+ 3	+ 0.6	○
			175	200	+ 3	+ 0.3	△
		F585	150	200	− 3	+ 0.8	◎
			175	200	+ 4	+ 1.5	△
		F975	150	200	+ 1	+ 0.6	◎
			175	200	+ 8	+ 1.2	△
Machine oil (spindle oil)	No.1 Spindle oil (Nippon Oil)	A727	80	200	−14	+20.7	×
			100	70	−11	+25.1	×
				200	−14	+22.2	×
		A275	80	200	− 7	+12.1	△
			100	200	− 8	+12.2	△

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Machine oil(spindle oil)	No.1 Spindle oil (Nippon Oil)	A103	100	70	−16	+31.0	×
		G418	80	200	− 7	+11.3	△
			100	200	− 7	+11.3	△
		T303	80	200	−11	+12.5	△
			100	200	−10	+12.8	△
		T599	80	200	− 8	+12.5	△
			100	200	− 9	+12.8	△
		T302	80	200	−10	+13.8	△
			100	200	−13	+15.7	△
		S728	80	200	−15	+39.4	×
			100	200	−16	+42.6	×
		F585	80	200	− 4	+ 2.0	◎
			100	200	− 4	+ 3.4	◎
		F548	80	200	0	+ 1.2	◎
			100	200	− 1	+ 2.9	◎
		F975	80	200	− 2	+ 1.6	◎
			100	200	− 2	+ 3.1	◎
	No.2 Spindle oil (Nippon Oil)	A727	100	200	− 8	+11.1	○
			120	200	−10	+11.7	△
		A275	100	200	− 2	+ 2.8	○
			120	200	− 3	+ 3.3	○
		A103	130	70	−12	+12.4	△
		G418	120	200	− 1	+ 3.3	○
			150	200	− 1	+ 3.4	△
		T303	120	200	− 2	+ 5.8	○
			150	200	− 1	+ 6.5	○
		T599	120	200	− 3	+ 5.8	○
			150	200	− 3	+ 6.5	△
		T302	120	200	− 3	+ 7.1	○
			150	200	+ 2	+ 7.3	○
		S728	120	200	−13	+23.1	×
			150	200	−15	+27.4	×
		F585	120	200	− 3	+ 6.8	◎
			150	200	− 4	+ 7.7	◎
		F548	120	200	0	+ 1.6	◎
			150	200	0	+ 2.4	◎
		F975	120	200	− 1	+ 2.0	◎
			150	200	− 1	+ 3.1	◎
Class 2 turbine oil	Shell Turbo Oil T32 (Showa Shell Sekiyu)	A727	100	200	+ 1	− 0.5	◎
			120	200	+ 1	− 0.5	○
		A941	100	200	− 2	− 2.7	◎
			120	200	0	− 2.9	○
		A275	100	200	+ 6	− 8.5	○
			120	200	+10	− 8.7	△
		T303	120	200	+ 1	− 0.8	◎
			150	200	+ 3	− 0.8	○
		S728	150	200	−13	+13.9	△

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Class 2 turbine oil	Shell Turbo Oil T32 (Showa Shell Sekiyu)	S728	175	200	−19	+17.5	×
		F585	150	200	− 3	+ 1.3	◎
			175	200	− 3	+ 1.9	○
	Shell Turbo Oil T68 (Showa Shell Sekiyu)	A727	100	200	+ 1	− 2.1	◎
			120	200	+ 3	− 2.1	○
		A941	100	200	+ 5	− 2.9	◎
			120	200	+ 5	− 3.1	○
		A275	100	200	+14	− 8.5	×
			120	200	+15	− 8.7	×
		T303	120	200	+ 1	− 1.3	◎
			150	200	+ 2	− 1.4	○
		S728	150	200	− 7	+ 9.4	○
			175	200	−11	+11.4	△
		F585	150	200	− 2	+ 0.6	◎
			175	200	− 2	+ 0.9	○
Torque converter oil / Automatic Transmission Fluid	Apolloil Mission Fluid (Idemitsu Petrochemical)	A727	100	200	− 2	+ 2.8	◎
			120	200	0	+ 2.5	○
		A941	100	200	+ 3	+ 0.9	◎
			120	200	+ 6	− 0.2	△
		A795	100	200	+ 5	− 3.9	◎
			120	200	+11	− 5.9	×
		A275	100	200	+ 3	− 5.7	◎
			120	200	+ 1	− 5.6	○
		G418	120	200	+ 5	− 4.3	◎
			150	200	+ 7	− 3.6	△
		T303	120	200	− 1	+ 1.6	◎
			150	200	+ 2	+ 1.5	○
		T599	120	200	− 1	+ 1.5	◎
			150	200	− 3	+ 2.1	△
		T302	120	200	+ 2	+ 3.1	◎
			150	200	+ 3	+ 3.4	○
		S728	150	200	−15	+20.6	×
			175	200	−27	+22.1	×
		F585	150	200	− 1	+ 1.9	○
			175	200	+ 2	+ 2.4	○
		F975	150	200	+ 2	+ 1.6	○
			175	200	+ 4	+ 2.1	○
	Pegasus Torque Converter Fluid (Mobil Sekiyu)	A727	100	200	− 3	+ 6.1	◎
			120	200	− 3	+ 6.1	○
		A941	100	200	+ 1	+ 3.5	◎
			120	200	+ 2	+ 3.2	○
		A795	100	200	+ 5	− 1.7	○
			120	200	+ 6	− 2.7	△
		A275	100	200	+ 2	− 2.5	◎
			120	200	+ 2	− 2.0	△
		G418	120	200	+ 2	− 1.1	◎
			150	200	+ 4	− 1.6	△
		T303	120	200	− 3	+ 4.6	◎
			150	200	− 2	+ 6.0	○
		T599	120	200	− 1	+ 4.5	◎
			150	200	− 2	+ 6.3	△
		T302	120	200	− 1	+ 6.3	◎
			150	200	0	+ 9.0	○
		S728	150	200	−18	+34.8	×

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Automatic Transmission Fluid	Pegasus Torque Converter Fluid (Mobil Sekiyu)	S728	175	200	−22	+39.7	×
		F585	150	200	− 4	+ 3.2	○
			175	200	− 5	+ 4.0	○
		F975	150	200	− 2	+ 3.2	○
			175	200	− 2	+ 3.9	○
	Apolloil ATF D-2 (Idemitsu Petrochemical)	A727	100	70	− 4	+ 2.8	◎
			120	70	− 5	+ 3.5	○
				140	− 6	+ 4.2	○
		A103	100	70	− 2	− 1.2	◎
			120	70	− 2	− 1.5	△
				140	− 2	− 2.0	△
		T599	135	70	− 2	+ 4.4	◎
				300	0	+ 4.1	◎
				500	0	+ 3.9	◎
			150	70	− 2	+ 4.8	○
				300	− 1	+ 4.4	○
				500	0	+ 4.0	○
		T303	120	70	− 2	+ 4.0	◎
				500	+ 2	+ 3.2	◎
			150	70	− 1	+ 3.9	◎
				300	+ 3	+ 2.9	◎
				500	+ 3	+ 2.8	◎
			165	70	+ 4	+ 2.8	△
				150	+ 7	+ 2.3	△
		S728	150	70	−15	+29.7	×
				500	−24	+31.1	×
			175	70	−25	+35.5	×
				500	−40	+38.7	×
		F384	150	70	0	+ 0.5	△
				200	+ 1	+ 0.2	△
	Mobil ATF 200 (Idemitsu Petrochemical)	A727	130	70	0	+ 5.4	△
				200	+ 3	− 9.6	△
		A103	130	70	+ 2	− 1.2	△
				200	+ 5	− 2.6	△
		T303	130	70	0	+ 5.0	◎
				200	+ 2	+ 4.4	◎
Hydraulic actuation oil/General purpose oil for industrial use (additive)	Duffny Hydraulic Fluid 32 (Idemitsu Petrochemical)	A727	100	200	+ 2	− 0.4	◎
			120	200	+ 1	+ 0.1	○
		A941	100	200	+ 4	− 1.5	◎
			120	200	+ 6	− 1.3	△
		A795	100	200	+ 8	− 5.4	○
			120	200	+11	− 6.1	×
		A275	100	200	+ 7	− 7.9	○
			120	200	+ 9	− 8.3	△
		A437	100	200	+ 6	− 4.8	○
			120	200	+ 8	− 4.9	△
		A989	100	200	+ 6	− 3.8	○
			120	200	+ 7	− 3.8	△
		A103	100	200	+ 3	− 4.6	○
			120	200	+ 4	− 4.9	△
		G418	120	200	+ 7	− 6.8	○
			150	200	+10	− 6.8	△
		T303	120	200	0	− 0.3	◎
			150	200	+ 2	− 0.1	○

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Hydraulic actuation oil/General purpose oil for industrial use (additive)	Duffny Hydraulic Fluid 32 (Idemitsu Petrochemical)	T599	120	200	+ 2	− 0.7	◎
			150	200	0	− 0.5	△
		T302	120	200	− 3	+ 1.5	◎
			150	200	− 2	+ 2.0	○
		S728	150	200	−19	+17.0	○
			175	200	−22	+17.6	×
		F585	150	200	0	+ 0.9	◎
			175	200	+ 1	+ 1.3	○
		F975	150	200	+ 1	+ 1.6	◎
			175	200	+ 3	+ 1.7	○
		F548	150	200	0	+ 0.9	◎
			175	200	+ 1	+ 1.3	○
	Shell Terrace Oil C10 (Showa Shell Sekiyu)	A727	100	200	− 5	+ 6.9	◎
			120	200	− 5	+ 7.7	○
		A941	100	200	0	+ 4.0	◎
			120	200	+ 2	+ 4.0	△
		A795	100	200	+ 4	− 1.8	○
			120	200	+ 6	− 2.6	△
		A275	100	200	+ 2	− 1.6	◎
			120	200	+ 3	− 0.8	△
		A989	100	200	− 2	+ 1.8	◎
			120	200	+ 1	+ 2.1	△
		A103	100	200	− 1	+ 2.0	◎
			120	200	+ 1	+ 1.7	△
		G418	120	200	+ 2	− 0.9	◎
			150	200	+ 4	− 0.6	△
		T303	120	200	− 4	+ 5.2	◎
			150	200	− 3	+ 6.6	○
		T599	120	200	− 2	+ 4.8	◎
			150	200	− 4	+ 7.2	△
		T302	120	200	− 3	+ 7.2	◎
			150	200	− 2	+ 9.8	△
		S728	150	200	−24	+50.9	×
			175	200	−28	+61.1	×
		F585	150	200	− 4	+ 3.9	◎
			175	200	− 4	+ 4.9	○
		F975	150	200	− 1	+ 3.9	◎
			175	200	− 2	+ 4.8	○
		F548	150	200	− 1	+ 2.7	◎
			175	200	− 1	+ 3.5	○
	Shell Terrace Oil C46 (Showa Shell Sekiyu)	A727	100	200	− 3	+ 1.5	◎
			120	200	− 4	+ 1.1	○
		A941	100	200	+ 3	− 0.4	◎
			120	200	+ 5	− 0.4	△
		A795	100	200	+ 7	− 0.5	○
			120	200	+ 8	− 1.4	△
		A275	100	200	+ 5	− 6.7	○
			120	200	+ 6	− 6.5	△
		A437	100	200	+ 4	− 8.0	◎
			120	200	+ 4	−10.5	△

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change :Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Hydraulic actuation oil/General purpose oil for industrial use (additive)	Shell Terrace Oil C46 (Showa Shell Sekiyu)	A989	100	200	+ 4	− 3.2	◎
			120	200	+ 6	− 3.4	△
		A103	100	200	+ 2	− 3.9	◎
			120	200	+ 3	− 4.5	○
		G418	120	200	+ 5	− 5.8	◎
			150	200	+ 7	− 5.8	△
		T303	120	200	− 1	+ 0.3	◎
			150	200	+ 2	+ 0.3	○
		T599	120	200	− 2	0	◎
			150	200	0	+ 0.1	△
		T302	120	200	+ 2	+ 1.8	◎
			150	200	+ 5	+ 2.3	○
		S728	150	200	− 11	+ 13.8	○
			175	200	− 14	+ 16.5	△
		F585	150	200	− 4	+ 1.6	◎
			175	200	− 5	+ 2.1	○
		F975	150	200	+ 1	+ 1.5	◎
			175	200	0	+ 1.5	○
		F548	150	200	− 1	+ 1.1	◎
			175	200	0	+ 1.4	○
	Duffny Neofluid 46 (Idemitsu Petrochemical)	A795	100	70	− 12	+ 20.5	×
		F384	100	70	− 9	+ 9.6	○
	Duffny Super Hydro LW 46 (Idemitsu Petrochemical)	A727	100	70	0	− 1.1	◎
		A795	100	70	+ 6	− 5.4	○
		F384	100	70	0	+ 0.1	◎
	Mulpose 32 (Nippon Oil)	A727	80	168	− 2	+ 0.8	◎
		T303	80	168	− 2	+ 0.7	◎
	Unipower SQ 32 (Esso Sekiyu)	A727	100	70	− 2	+ 0.5	◎
				166	0	+ 1.2	◎
	Unipower SQ 46 (Esso Sekiyu)	A727	100	70	0	− 0.1	◎
				166	+ 1	+ 0.3	◎
	Unipower SQ 68 (Esso Sekiyu)	A727	100	70	0	− 0.7	◎
				166	+ 1	− 0.4	◎
	Mobil Velocity Oil No. 3 (Mobil Oil)	A727	80	168	− 13	+ 12.0	◎
	Mobil Velocity Oil No. 6 (Mobil Oil)	A727	80	168	− 8	+ 5.7	◎
	Kyoseki Hydolux 32(Kyodo Oil)	A727	80	168	− 3	+ 0.2	◎
		A795	80	168	+ 1	− 3.5	◎
		T303	80	168	− 2	+ 0.3	◎
	(Phosphoric ester base) Highland FRP46 (Nippon Oil)	A727	100	200	− 40	+149.4	×
			120	200	− 66	+202.9	×
		A795	100	200	− 30	+ 97.4	×
			120	200	− 40	+123.7	×
		A437	100	200	− 25	+ 93.3	×
			120	200	− 28	+117.6	×
		T303	100	200	− 26	+ 98.4	×
			150	200	− 32	+123.1	×
		S728	100	200	− 2	+ 3.2	○
			150	200	− 7	+ 7.7	△
		F585	100	200	− 10	+ 14.5	△
			150	200	− 13	+ 19.5	×
		F384	100	200	− 3	+ 4.0	◎
			150	200	− 4	+ 6.6	○

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Fire resistant fluid	(Phosphoric ester base)	F548	100	200	− 4	+ 12.1	△
	Highland FRP46 (Nippon Oil)		150	200	− 7	+ 16.2	×
	(Water+glycol base)	A727	80	200	+ 4	+ 5.7	△
	Moresuco Hydoll HAW (Matsumura Sekiyu)	T303	80	200	−31	+ 29.0	×
		S728	80	200	− 1	+ 4.7	×
		F585	80	200	+ 1	+ 4.7	○
		F975	80	200	+ 2	+ 4.9	○
	(Water+glycol base)	A727	80	168	− 3	+ 0.2	△
	Kosumo Fluid HQ 46 (Kosumo Oil)	A103	80	70	− 7	+ 2.1	△
		A795	60	70	− 4	+ 2.1	△
			80	70	− 5	+ 5.2	△
		F384	80	70	− 5	+ 9.3	○
	(Water+glycol base)	A103	80	70	− 7	+ 1.8	△
	Naiback FR200 Fluid (Mobil Sekiyu)	A795	80	70	− 5	+ 3.0	△
		F384	80	70	− 5	+ 7.5	○
	(Water+glycol base)	A103	80	70	− 9	+ 7.7	△
	Mobil Hydro Fluid HFC (Mobil Sekiyu)	F384	80	70	−11	+ 16.2	△
	(Water+glycol base) Kyoseki Hydoria G(Kyoseki Sekiyu)	A103	80	70	− 6	− 0.5	△
	(Oil+water emulsion base)	A103	100	70	− 9	+ 6.8	◎
	Horto Safe 5040 (E.F. Horton & Co.)	S728	100	70	−17	+ 39.0	×
Gasoline	Idemitsu 100 Gasoline (High-octane gasoline) (Idemitsu Petrochemical)	A727	25	200	−24	+ 50.1	×
		A795	25	200	−16	+ 23.9	△
		T303	25	200	−25	+ 53.0	×
		S728	25	200	−16	+110.5	×
		F585	25	200	− 4	+ 4.1	△
		F384	25	200	− 2	+ 3.2	◎
	Regular Gasoline (General Sekiyu)	A795	25	24	−11	+ 21.6	△
			25	72	−15	+ 29.3	△
		F585	25	70	− 1	+ 1.0	△
		F384	25	70	− 1	+ 1.0	◎
	Nonleaded High-octane Gasoline (Mitsubishi Oil)	F975	25	70	− 2	+ 1.8	△
	Magnum 100 (Kosumo Oil)	A795	25	24	−15	+ 34.3	×
			25	72	−17	+ 30.1	×
	Esso Extra (Esso Sekiyu)	A795	25	24	−16	+ 34.8	×
			25	72	−17	+ 30.2	×
	Formula Shell Super X (Show Shell Sekiyu)	A795	25	24	−17	+ 34.4	×
			25	72	−17	+ 31.4	×
Light oil / Kerosene / Heavy oil	Light oil (JIS No.2)	A727	25	200	− 5	+ 6.6	×
		A795	25	200	+ 3	+ 2.0	△
		T303	25	200	− 3	+ 1.9	×
		S728	25	200	−13	+ 44.7	×
		F585	25	200	0	− 0.2	△
		F384	25	200	0	− 0.2	◎
	Kerosene	A795	25	200	− 1	+ 3.3	△
		T303	80	168	−11	+ 13.9	×
		F384	25	200	0	+ 0.2	◎
	Heavy oil (C heavy oil)	A727	50	200	− 7	− 7.8	×
		A795	50	200	0	− 2.8	△
		A941	50	200	− 2	− 6.3	△

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Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Heavy oil	Heavy oil (C heavy oil)	T303	50	200	− 5	− 3.5	×
		S728	50	200	− 5	−11.6	×
		F585	50	200	− 2	− 0.5	△
		F384	50	200	0	− 0.3	◎
Cutting fluid	Similon VLQ-25 (Daido Chemicals)	A727	100	70	+ 2	+ 4.2	○
	Shell Macron Oil 27 (Showa Shell Sekiyu)	S728	120	70	−12	+30.5	×
Rust preventive oil	Standard Anti-rust ND32 (Mobil Sekiyu)	A103	120	70	−10	+13.3	○
		S728	120	70	−10	+58.8	×
Insulating oil	Insulating Oil JIS No.2 (Nihon Sekiyu)	A103	100	70	− 5	+ 7.3	○
	Insulating Oil JIS No.3 (Idemitsu Petrochemical)	A103	100	70	− 6	+11.5	○
	Cable Filler No.58	A103	100	70	+ 2	− 2.8	○
		S728	120	70	− 1	+ 4.2	◎
Grease	Auto Lex A (Idemitsu Petrochemical)	A727	100	70	− 2	+ 0.9	◎
				200	− 2	+ 1.1	◎
		A941	100	200	+ 1	0	◎
		A795	100	200	+ 5	− 4.7	◎
		A275	100	200	+ 3	− 7.2	◎
		A437	100	200	+ 5	− 4.2	◎
		A571	100	200	+ 1	− 3.3	◎
		A368	100	200	− 2	+ 2.2	◎
		A103	100	70	+ 1	− 1.7	◎
				200	+ 2	− 4.7	◎
		T303	100	70	− 2	+ 2.4	◎
				200	− 2	− 0.4	◎
		T599	100	200	− 3	− 0.1	◎
		T302	100	200	− 1	+ 1.7	◎
		S728	100	200	− 2	+ 5.0	◎
		S817	100	200	− 4	+ 4.7	◎
		F585	100	200	− 4	+ 0.3	◎
		F975	100	200	0	+ 0.2	◎
	(Fluorocarbon oil base) SEALUB S-11 (NOK Kluber)	A727	100	200	+ 2	− 1.1	◎
		A941	100	200	+ 4	− 0.7	◎
		A795	100	200	+ 4	− 1.8	◎
		A275	100	200	+ 2	− 2.9	◎
		A437	100	200	+ 3	− 2.8	◎
		A571	100	200	+ 3	− 1.5	◎
		A368	100	200	+ 2	− 0.5	◎
		A103	100	200	+ 2	− 1.6	◎
		T303	100	200	− 3	− 1.0	◎
		T599	100	200	− 1	− 1.1	◎
		T302	100	200	+ 1	0	◎
		S728	100	200	+ 3	− 0.7	◎
		S817	100	200	− 1	+ 1.0	◎
		F585	100	200	− 1	0	◎
		F975	100	200	− 1	− 0.6	◎
			150	70	+ 2	0	◎
		F384	150	70	+ 1	− 0.7	◎
	(Mineral oil base) DUOTEMP PASTE (NOK Kluber)	A727	100	70	− 3	+ 1.5	◎
				250	− 2	+ 1.1	◎
		T303	100	70	− 1	+ 0.4	◎
				250	− 1	+ 0.2	◎
	(Ester base) ISOFLEX NBU 15 (NOK Kluber)	A727	70	70	− 3	+ 3.3	◎

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Grease	(Ester base) ISOFLEX NBU 15 (NOK Kluber)	F384	70	70	0	− 0.2	◎
	(Mineral oil base)	A727	100	70	− 1	+ 0.6	◎
	SEALUB S-1 (NOK Kluber)	A103	100	70	− 2	− 2.1	◎
		A275	80	70	+ 1	− 7.1	◎
		A571	100	70	0	− 1.8	◎
		T599	120	70	+ 3	+ 3.3	◎
			150	70	− 2	+ 2.9	◎
	(Poly α olefin base)	A727	100	70	0	− 0.8	◎
	SEALUB S-14 (NOK Kluber)	A103	70	70	0	− 3.5	◎
			100	70	− 3	− 4.8	◎
		T303	150	70	+ 3	− 0.8	◎
		S728	150	70	− 8	+ 15.0	◎
	(Mineral base) Anbligon TA 30/0 (NOK Kluber)	A727	100	70	+ 1	− 1.4	◎
	Beacon 325 (Esso)	A727	70	70	−17	+ 23.0	×
		A103	60	70	−10	+ 10.1	△
	O.S. Grease No. 1 (Kyodo Oil and Fat)	A727	100	70	− 1	+ 2.7	◎
		T303	130	70	− 5	+ 1.4	◎
	Multemp MS No. 2 (Kyodo Oil and Fat)	A727	70	70	−19	+ 30.7	×
	Multi Knock Urea (Nihon Sekiyu)	T599	100	70	− 2	+ 1.4	◎
			120	70	− 2	+ 1.9	◎
	Albania Grease 3 (Showa Shell Sekiyu)	F585	120	70	− 1	+ 1.1	◎
			150	70	0	+ 2.0	◎
			175	70	+ 1	+ 2.4	○
	Albania EP Grease 2 (Showa Shell Sekiyu)	A103	100	70	− 6	+ 0.2	◎
				500	− 3	− 0.1	◎
			120	70	− 5	0	△
				500	0	− 0.2	△
			150	70	− 4	+ 0.2	×
				500	+ 5	+ 2.3	×
		A275	100	70	+ 1	− 6.3	○
Brake fluid	(Glycol ether base)	A727	100	200	−33	+ 70.1	×
	DOT 3 (Nihon Sekiyu)	T303	100	200	−42	+131.2	×
		S728	100	200	− 3	+ 4.0	◎
		F585	100	200	−35	+ 54.0	×
		E309	100	200	− 4	+ 4.2	◎
		R189	100	200	− 7	+ 11.5	○
	(Glycol ether base)	A727	100	200	−42	+ 71.5	×
	DOT 5 (Nihon Sekiyu)	T303	100	200	−40	+126.1	×
		S728	100	200	− 4	+ 3.7	◎
		F585	100	200	−53	+121.0	×
		E309	100	200	− 5	+ 3.2	◎
		R189	100	200	− 9	+ 11.5	○
	(Silicone oil base)	A727	100	200	− 5	+ 5.9	○
	DOT 5 (Sanshin Chemical)	T303	100	200	− 9	+ 5.3	○
		S728	100	200	−18	+ 40.1	×
		F585	100	200	−17	+ 22.5	×
		E309	100	200	− 6	+ 5.2	○
		R189	100	200	− 4	+ 5.3	○
MIL fluid	MIL-S-3136 Type 2	F384	25	70	− 1	+ 0.7	◎
	MIL-S-3136 Type 3	F384	20	72	− 4	+ 1.1	◎
	MIL-H-5606 Aerohydraulic Oil HFA (Mobil Sekiyu)	A727	100	70	− 3	+ 7.7	◎
		A103	80	70	− 1	+ 4.1	◎
		S728	150	70	−18	+ 83.1	×
		F384	150	70	− 2	+ 3.1	◎

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
MIL fluid	MIL-O-6081B Aplex M Turbo 201/1010 (Mobil Sekiyu)	F384	100	70	0	+ 0.7	◎
	MIL-L-6082 Grade 1065	F384	200	72	0	+ 2.7	◎
	MIL-L-6086 Type 1	A103	100	70	− 3	+ 6.1	◎
		S728	100	76	−17	+77.5	×
	MIL-L-6086 Aeroshell Fluid 5L	S728	25	70	− 6	+10.3	◎
		F384	150	70	0	+ 1.0	◎
			175	70	0	+ 0.4	◎
	MIL-L-7808 Esso Turbo Oil TJ-15 (Esso Sekiyu)	S728	100	70	− 8	+18.1	△
		F384	100	70	− 4	+ 3.5	◎
			150	70	− 5	+ 4.9	○
			175	70	− 8	+10.4	△
			200	70	− 9	+11.5	△
	MIL-L-7808 (Aplex S Turbo #256 (Mobil Sekiyu)	S728	120	70	−11	+20.5	○
			150	70	−14	+28.3	△
		F384	120	70	− 2	+ 5.1	◎
			150	70	− 5	+ 9.0	○
			200	72	− 9	+12.5	△
	MIL-L-7808 Esso Turbo Oil #35 (Esso Sekiyu)	F384	120	70	− 2	+ 3.8	◎
	MIL-L-23699 Esso Turbo Oil 2380 (Esso Sekiyu)	F384	200	72	− 7	+ 7.7	○
	MIL-L-23699 Esso Extra Turbo Oil #274 (Esso Sekiyu)	A727	150	70	−16	+31.4	×
		T303	150	70	−11	+27.6	×
		S728	150	70	− 8	+12.6	○
		F384	150	70	− 5	+ 4.6	◎
	MIL-L-23699 Mobil Jet Oil II (Mobil Sekiyu)	S728	120	70	− 5	+ 7.2	○
		F384	120	70	− 2	+ 5.1	◎
Fluorine oil	Daifuroru #20 (Daikin Industries)	S728	100	48	− 2	+ 6.7	◎
	BARIERTA J100 FLUID (NOK Kluber)	A103	70	100	− 4	− 0.8	◎
			70	166	+ 1	− 0.2	◎
		T303	70	100	− 4	+ 0.2	◎
			70	166	+ 1	− 0.8	◎
			70	200	− 3	0	◎
		F384	70	100	− 3	− 0.2	○
			70	166	+ 1	− 0.5	○
			70	200	− 2	0	○
Silicone oil	KF96 10cSt (Shin-Etsu Chemical)	S728	100	70	−20	+75.8	×
	KF96 10000cSt (Shin-Etsu Chemical)	A103	100	70	+ 7	− 6.3	◎
			120	70	+ 9	− 6.9	△
		S728	120	70	− 4	+ 8.0	△
Vegetable oil	Castor oil	A103	100	70	− 3	+ 2.1	◎
	Turpentine oil	F384	60	70	− 1	+ 2.8	◎
Water	Distilled water	A727	98	200	+ 5	+ 6.8	○
		A941	98	200	0	+ 9.5	◎
		A275	98	200	− 2	+ 1.6	◎
		A571	98	200	− 2	+ 5.5	◎
		A368	98	200	− 1	+ 2.4	◎
		A989	98	200	− 6	+ 8.0	◎
		A103	98	200	− 5	+ 5.2	◎
		T303	98	200	−27	+46.8	×
		S728	98	200	+ 1	+ 3.4	○
		S817	98	200	0	+ 1.0	○
		F585	98	200	+ 1	+ 8.0	△
	Sea water	A727	40	168	− 1	+ 1.7	◎
		A103	20	320	− 3	+ 0.8	◎
		T303	40	168	− 5	+21.8	×

Oil Resistance Data

	Sealing Fluid (Manufacturer)	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Water	Sea water	S728	40	168	− 3	+ 0.4	○
		F384	40	168	− 1	+ 0.1	◎
Test oil	ASTM No.1 oil (Nippon Sun Sekiyu)	A727	100	70	+ 1	− 1.7	◎
			120	70	+ 4	− 3.1	○
		A103	80	70	+ 2	− 4.1	◎
			100	70	+ 3	− 4.4	◎
			120	70	+ 4	− 6.4	○
			130	70	+ 5	− 4.9	△
		A104	100	70	+ 3	− 5.6	◎
			130	70	+ 3	− 5.0	△
		A795	100	70	+ 6	− 6.6	◎
		T303	150	70	+ 3	− 2.0	◎
			175	70	+ 6	− 3.2	△
		S728	150	70	+ 1	+ 3.5	◎
			175	70	− 2	+ 7.0	△
			200	70	− 8	+ 6.2	×
		F384	150	70	0	− 0.1	◎
			175	70	+ 1	+ 0.2	◎
	ASTM No.3 oil (Nippon Sun Sekiyu)	A727	100	70	− 6	+ 10.0	○
			120	70	− 9	+ 10.1	△
		A103	80	70	− 8	+ 10.3	○
			100	70	− 9	+ 11.7	○
			120	70	− 7	+ 9.5	○
			130	70	− 9	+ 10.8	△
		A104	100	70	− 8	+ 8.7	○
			130	70	− 9	+ 10.0	△
		A795	100	70	0	+ 2.5	◎
		T303	150	70	− 4	+ 9.5	○
			175	70	− 1	+ 11.1	△
		S728	150	70	− 7	+ 27.5	△
			175	70	−11	+ 40.0	×
			200	70	−21	+ 47.5	×
		F384	150	70	0	+ 0.9	◎
			175	70	+ 1	+ 2.3	◎
	ASTM flame-retardant oil B	S728	25	70	Immeasurable	+215.0	×
		F384	25	70	− 1	+ 0.7	◎
	ASTM flame-retardant oil C	F384	20	72	− 4	+ 1.1	◎
	ASTM service fluid No. 101	F384	200	70	− 6	+ 7.8	○

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Chemical Resistance Data

Note: Refer to page J-6 before use.

	Sealing Fluid	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Inorganic acids (see note)	10% hydrochloric acid solution	A727	40	168	− 5	+ 14.8	○
		T303	40	168	− 6	+ 8.6	○
		S728	40	168	− 3	+ 8.1	○
		F384	40	168	− 7	+ 8.1	○
	30% sulfuric acid solution	A727	40	168	—	+ 0.3	△
		T303	40	168	—	+ 3.7	△
		S728	40	168	—	+ 0.3	×
		F384	40	168	—	+ 15.0	△
	Sulfurous acid	A727	40	168	− 15	+ 157.0	×
		T303	40	168	− 21	+ 100.0	×
		S728	40	168	− 5	+ 43.7	×
		F384	40	168	− 10	+ 7.6	△
	10% nitric acid solution	A727	40	168	+ 14	+ 31.0	×
		T303	40	168	− 19	+ 40.0	×
		S728	40	168	+ 2	+ 21.2	×
		F384	40	168	− 12	+ 17.8	△
	Chromic acid (saturated aqueous solution)	A727	40	168	Immeasurable	Immeasurable	×
		T303	40	168	− 5	+ 18.0	△
		S728	40	168	− 10	+ 7.6	△
		F384	40	168	− 6	+ 6.9	○
	Silicic acid (saturated aqueous solution)	A727	40	168	− 1	+ 3.1	◎
		T303	40	168	− 10	+ 35.6	×
		S728	40	168	+ 3	+ 0.9	◎
		F384	40	168	+ 1	+ 0.3	◎
	85% phosphoric acid solution	A727	40	168	− 1	+ 0.5	◎
		T303	40	168	0	− 0.2	◎
		S728	40	168	+ 1	+ 0.3	◎
		F384	40	168	− 2	+ 7.6	○
Organic acids (see note)	Glacial acetic acid	A727	40	168	—	+ 32.6	×
		T303	40	168	—	+ 166.0	×
		S728	40	168	—	+ 19.0	△
		F384	40	168	—	+ 45.3	×
	10% acetic acid solution	A727	40	168	− 13	+ 122.0	×
		T303	40	168	− 10	+ 50.5	×
		S728	40	168	− 1	+ 4.7	×
		F384	40	168	0	+ 4.5	◎
	40% acetic acid solution	A727	40	168	− 11	+ 72.0	×
		T303	40	168	− 10	+ 61.4	×
		S728	40	168	− 1	+ 7.7	×
		F384	40	168	− 14	+ 17.4	△
	70% acetic acid solution	A727	40	168	—	+ 81.0	×
		T303	40	168	—	+ 64.2	×
		S728	40	168	—	+ 16.8	×
	30% methonoic acid solution	A727	40	168	− 12	+ 114.0	×
		T303	40	168	− 10	+ 53.2	×
		S728	40	168	− 1	+ 9.3	△
		F384	40	168	− 5	+ 7.6	○
	30% mono-chloroacetic acid solution	A727	40	168	− 11	+ 25.2	×
		T303	40	168	− 6	+ 42.5	×
		S728	40	168	− 4	+ 29.3	△
		F384	40	168	− 11	+ 11.3	△
	Oleic acid	A727	40	168	− 3	+ 22.4	△

Chemical Resistance Data

Note: Refer to page J-6 before use.

	Sealing Fluid	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Organic acids (see note)	Oleic acid	T303	40	168	− 4	+ 15.8	△
		S728	40	168	0	+ 14.8	○
		F384	40	168	0	+ 20.0	○
	Oxalic acid	A727	40	168	+ 2	+ 1.9	◎
		T303	40	168	− 9	+ 30.0	×
		S728	40	168	− 1	+ 0.5	◎
		F384	40	168	0	+ 25.3	△
	Maleic acid	A727	40	168	−10	+ 90.3	×
		T303	40	168	−10	+ 41.7	×
		S728	40	168	− 3	+ 11.2	○
		F384	40	168	− 8	+ 6.4	○
	Tannic acid (saturated solution)	A727	40	168	+ 3	+ 3.6	◎
		T303	40	168	− 2	+ 43.9	×
		S728	40	168	+ 5	+ 0.6	◎
		F384	40	168	+ 5	+ 1.3	◎
	Gallic acid	A727	40	168	− 7	+ 17.5	△
		T303	40	168	−18	+ 48.9	×
		S728	40	168	− 3	+ 1.1	◎
		F384	40	168	+ 5	+ 2.9	◎
Alkalis (see note)	10% ammonia aqueous solution	A727	40	168	− 3	+ 5.9	○
		T303	40	168	−16	+ 86.2	×
		S728	40	168	+ 9	+ 1.3	×
		F384	40	168	− 4	+ 10.6	○
	28% ammonia aqueous solution	A727	40	168	− 5	+ 6.1	○
		T303	40	168	−29	+118.0	×
		S728	40	168	+ 3	+ 3.0	×
		F384	40	168	−10	+ 30.1	×
	10% sodium hydroxide solution (saturated solution)	A727	40	168	+ 3	+ 0.5	◎
		T303	40	168	−10	+ 1.5	△
		S728	40	168	− 3	− 7.1	×
		F384	40	168	−10	− 9.0	×
	40% sodium hydroxide solution (saturated solution)	A727	40	168	+ 1	− 0.9	◎
		T303	40	168	−12	+ 18.9	×
		S728	40	168	− 3	− 10.6	×
		F384	40	168	− 5	− 3.7	×
	10% potassium hydroxide solution (saturated solution)	A727	40	168	− 1	+ 0.3	◎
		T303	40	168	−15	+ 31.5	×
		S728	40	168	− 1	− 10.0	×
		F384	40	168	−20	− 8.0	×
	40% potassium hydroxide solution (saturated solution)	A727	40	168	− 1	+ 0.4	◎
		T303	40	168	Immeasurable	Immeasurable	×
		S728	40	168	+ 3	− 3.3	×
		F384	40	168	+ 8	+ 4.4	△
	Aluminum hydroxide (saturated solution)	A727	40	168	− 1	+ 2.3	◎
		T303	40	168	− 7	+38.5	×
		S728	40	168	+ 4	+ 1.0	◎
		F384	40	168	− 2	+ 1.8	◎
	Barium hydroxide (saturated solution)	A727	40	168	− 1	+ 1.3	◎
		T303	40	168	− 5	+16.2	×
		S728	40	168	+ 2	− 0.6	◎
		F384	40	168	− 2	+ 1.2	◎
	Calcium hydroxide (saturated solution)	A727	40	168	+ 1	+ 1.9	◎

Chemical Resistance Data

Note: Refer to page J-6 before use.

	Sealing Fluid	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Alkalis (see note)	Calcium hydroxide (saturated solution)	T303	40	168	− 4	+30.2	×
		S728	40	168	+ 5	+ 1.1	◎
		F384	40	168	+ 4	+ 1.6	◎
	Magnesium hydroxide (saturated solution)	A727	40	168	+ 1	+ 1.9	◎
		T303	40	168	− 5	+39.5	×
		S728	40	168	+ 3	+ 2.1	◎
		F384	40	168	+ 1	+ 2.5	◎
Inorganic salts (see note)	Cupric chloride (saturated solution)	A727	40	168	− 2	+14.0	○
		T303	40	168	+ 5	+ 4.1	○
		S728	40	168	+ 6	+ 0.1	○
		F384	40	168	+ 2	+10.0	○
	Sodium chloride (saturated solution)	A727	40	168	+ 1	0	◎
		T303	40	168	+ 5	+ 2.9	○
		S728	40	168	− 1	+ 0.4	◎
		F384	40	168	− 2	+ 0.6	◎
	Barium chloride (saturated solution)	A727	40	168	0	0	◎
		T303	40	168	− 1	+ 6.0	○
		S728	40	168	+ 2	− 1.1	◎
		F384	40	168	− 5	+ 0.9	◎
	Magnesium chloride (saturated solution)	A727	40	168	0	+ 1.0	◎
		T303	40	168	0	+ 7.1	○
		S728	40	168	+ 2	− 0.3	◎
		F384	40	168	0	− 0.8	◎
	Potassium chlorate (saturated solution)	A727	40	168	+ 1	+ 1.6	◎
		T303	40	168	+ 4	+12.7	○
		S728	40	168	+ 1	− 0.1	◎
		F384	40	168	+ 1	+ 0.1	◎
	Potassium Permanganate (saturated solution)	A727	40	168	Immeasurable	Immeasurable	×
		T303	40	168	−10	+46.3	×
		S728	40	168	+ 2	− 0.2	◎
		F384	40	168	− 6	+ 1.7	○
	Potassium chromate (saturated solution)	A727	40	168	− 1	+ 1.0	◎
		T303	40	168	− 2	+ 6.9	○
		S728	40	168	+ 2	− 0.3	◎
		F384	40	168	+ 2	+ 2.3	◎
	Sodium chromate (saturated solution)	A727	40	168	− 5	+ 0.5	○
		T303	40	168	− 5	+ 4.6	×
		S728	40	168	− 1	− 0.4	◎
		F384	40	168	− 1	− 2.0	◎
	Lead acetate (saturated solution)	A727	40	168	−10	+20.6	×
		T303	40	168	− 7	+12.4	△
		S728	40	168	− 3	+ 1.4	◎
		F384	40	168	− 5	+ 0.7	○
	Ammonium bicarbonate (saturated solution)	A727	40	168	− 6	+ 1.0	○

Chemical Resistance Data

Note: Refer to page J-6 before use.

	Sealing Fluid	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Inorganic salts (see note)	Ammonium bicarbonate (saturated solution)	T303	40	168	−13	+22.2	×
		S728	40	168	− 1	+ 5.0	◎
		F384	40	168	− 5	+ 8.4	○
	Ammonium nitrate (saturated solution)	A727	40	168	0	− 0.3	◎
		T303	40	168	0	+ 2.1	◎
		S728	40	168	+ 2	− 0.2	◎
		F384	40	168	+ 2	− 0.3	◎
	Silver nitrate (saturated solution)	A727	40	168	−60	Immeasurable	×
		T303	40	168	− 8	+ 7.6	○
		S728	40	168	− 3	+ 0.7	◎
		F384	40	168	+ 5	+ 1.4	○
	Lead nitrate (saturated solution)	A727	40	168	− 4	+ 5.5	○
		T303	40	168	− 7	+14.4	△
		S728	40	168	− 1	+ 0.5	◎
		F384	40	168	+ 1	+ 1.1	◎
	Sodium nitrate (saturated solution)	A727	40	168	− 5	+ 0.5	◎
		T303	40	168	− 3	+ 3.7	◎
		S728	40	168	− 1	+ 0.2	◎
		F384	40	168	− 3	+ 0.7	◎
	Ammonium carbonate (saturated solution)	A727	40	168	+ 4	+ 3.0	◎
		T303	40	168	−14	+57.4	×
		S728	40	168	+ 8	+ 4.1	○
		F384	40	168	+ 4	+ 8.2	○
	Potassium carbonate (saturated solution)	A727	40	168	− 2	+ 0.9	◎
		T303	40	168	0	+ 8.8	○
		S728	40	168	− 1	− 0.4	◎
		F384	40	168	0	+ 0.5	◎
	Sodium nitrite (saturated solution)	A727	40	168	− 1	+ 0.6	◎
		T303	40	168	− 4	+ 3.5	△
		S728	40	168	+ 2	+ 0.3	◎
		F384	40	168	− 5	+ 0.7	○
	Sodium sulfite (saturated solution)	A727	40	168	− 2	+ 0.5	◎
		T303	40	168	+ 2	+ 4.4	△
		S728	40	168	+ 2	+ 0.2	◎
		F384	40	168	0	+ 1.2	◎
	Ammonium chloride (saturated solution)	A727	40	168	+ 1	+ 0.7	◎
		T303	40	168	− 2	+ 5.1	○
		S728	40	168	+ 6	+ 0.1	○
		F384	40	168	0	+ 1.2	◎
	Zinc chloride (saturated solution)	A727	40	168	− 1	+12.8	○
		T303	40	168	+10	+ 6.0	×
		S728	40	168	+ 6	− 0.5	○
		F384	40	168	+ 5	+ 0.7	◎
	Potassium chloride (saturated solution)	A727	40	168	0	0	◎
		T303	40	168	− 2	+ 4.6	◎
		S728	40	168	+ 1	+ 1.5	◎
		F384	40	168	+ 1	+ 0.5	◎
	Calcium chloride (saturated solution)	A727	40	168	− 1	− 0.5	◎
		T303	40	168	+ 1	+ 0.5	◎
		S728	40	168	+ 2	− 0.1	◎
		F384	40	168	− 1	− 0.4	◎
	Stannic chloride	A727	40	168	− 6	+22.6	×

Chemical Resistance Data

Note: Refer to page J-6 before use.

	Sealing Fluid	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Inorganic salts (see note)	Stannic chloride	T303	40	168	− 8	+13.9	△
		S728	40	168	− 1	+ 1.5	◎
		F384	40	168	−11	+ 9.0	×
	Mercuric chloride (saturated solution)	A727	40	168	+ 7	+27.4	×
		T303	40	168	−16	+44.7	×
		S728	40	168	− 1	+ 2.8	◎
		F384	40	168	− 2	+ 1.6	◎
	Ferric chloride (saturated solution)	A727	40	168	− 6	+41.0	×
		T303	40	168	− 5	+41.6	×
		S728	40	168	+ 5	− 0.2	◎
		F384	40	168	− 5	− 1.9	◎
	Sodium carbonate (saturated solution)	A727	40	168	− 1	+ 0.2	◎
		T303	40	168	−10	+ 7.3	△
		S728	40	168	0	− 0.7	◎
		F384	40	168	+ 1	− 3.2	◎
	Alum (potassium alum) (saturated solution)	A727	40	168	− 2	+ 2.3	◎
		T303	40	168	−10	+22.9	×
		S728	40	168	+ 5	0	○
		F384	40	168	− 2	+ 1.4	◎
	Potassium iodide (saturated solution)	A727	40	168	− 1	+ 1.0	◎
		T303	40	168	− 2	− 3.5	◎
		S728	40	168	+ 1	+ 0.8	◎
		F384	40	168	+ 4	− 0.5	◎
	Sodium sulfide (saturated solution)	A727	40	168	− 1	0	◎
		T303	40	168	−18	Immeasurable	×
		S728	40	168	+ 2	− 1.5	◎
		F384	40	168	−17	+13.9	×
	Zinc sulfate (saturated solution)	A727	40	168	0	+ 1.1	◎
		T303	40	168	− 1	+ 9.8	○
		S728	40	168	+ 2	− 0.3	◎
		F384	40	168	− 3	+ 0.6	◎
	Ammonium sulfate (saturated solution)	A727	40	168	− 8	− 0.3	△
		T303	40	168	+ 8	+ 2.7	△
		S728	40	168	+ 4	+ 0.8	◎
		F384	40	168	− 5	+ 0.1	◎
	Potassium sulfate (saturated solution)	A727	40	168	+ 7	+ 1.9	△
		T303	40	168	−10	+ 9.7	△
		S728	40	168	+ 2	+ 0.2	◎
		F384	40	168	− 2	+ 2.0	◎
	Calcium sulfate (saturated solution) (gypsum)	A727	40	168	− 1	+ 2.5	◎
		T303	40	168	+ 8	+39.8	×
		S728	40	168	+ 4	+ 0.7	○
		F384	40	168	+ 1	+ 1.3	◎
	Ferrous sulfate (saturated solution)	A727	40	168	+ 5	+ 1.7	○
		T303	40	168	− 5	+12.0	△
		S728	40	168	− 1	+ 2.1	◎
		F384	40	168	− 3	+ 0.9	◎
	Ferric sulfate (saturated solution)	A727	40	168	− 2	+ 2.5	◎
		T303	40	168	−13	+ 5.9	×
		S728	40	168	− 5	− 0.4	◎
		F384	40	168	− 6	+ 8.3	○
	Copper sulfate (saturated solution)	A727	40	168	− 3	+ 2.3	○

Chemical Resistance Data

Note: Refer to page J-6 before use.

	Sealing Fluid	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Inorganic salts (see note)	Copper sulfate (saturated solution)	T303	40	168	−16	+23.1	×
		S728	40	168	− 5	+ 0.3	◎
		F384	40	168	+ 7	+ 2.1	×
	Sodium sulfate (saturated solution)	A727	40	168	+ 5	+ 1.0	◎
		T303	40	168	− 7	+12.4	△
		S728	40	168	+ 2	+ 0.1	◎
		F384	40	168	+ 5	+ 0.4	◎
	Nickel sulfate (saturated solution)	A727	40	168	—	+ 0.6	◎
		T303	40	168	—	+16.7	△
		S728	40	168	—	+30.0	×
		F384	40	168	—	+ 0.8	◎
	Magnesium sulfate (saturated solution)	A727	40	168	—	+ 1.3	◎
		T303	40	168	—	+17.8	△
		S728	40	168	—	+ 0.9	◎
		F384	40	168	—	+ 1.7	◎
	Disodium hydrogenphosphate	A727	40	168	− 3	+ 1.5	◎
		T303	40	168	− 9	+12.4	△
		S728	40	168	+ 1	0	◎
		F384	40	168	− 6	+ 0.6	×
Alcohols	Methyl alcohol	A727	40	168	− 8	+ 4.8	○
		T303	40	168	−32	+46.2	×
		S728	40	168	− 3	+ 2.0	◎
		F384	40	168	−18	+17.9	△
	Ethyl alcohol	A727	40	168	−10	+ 6.6	○
		T303	40	168	−29	+50.6	×
		S728	40	168	− 8	+12.6	○
		F384	40	168	−13	+ 9.8	○
	Isopropyl alcohol	A727	40	168	− 8	+ 7.4	○
		T303	40	168	−18	+57.7	×
		S728	40	168	−10	+11.4	△
		F384	40	168	− 8	+ 4.8	○
	Butyl alcohol	A727	40	168	−18	+12.9	△
		T303	40	168	−12	+58.0	×
		S728	40	168	−12	+20.2	○
		F384	40	168	− 1	+ 2.7	◎
	Isoamyl alcohol	A727	40	168	− 4	− 0.3	◎
		T303	40	168	−23	+47.3	×
		S728	40	168	−12	+20.8	△
		F384	40	168	− 5	+ 1.9	◎
	Ethylene glycol	A727	40	168	− 4	− 1.1	◎
		T303	40	168	−20	+18.1	×
		S728	40	168	0	+ 0.9	◎
		F384	40	168	0	+ 0.3	◎
	Glycerin	A727	40	168	0	+ 0.5	◎
		T303	40	168	− 5	+ 2.9	○
		S728	40	168	0	+ 0.5	◎
		F384	40	168	+ 1	− 0.8	◎
Aldehydes/ketones	Formalin	A727	40	168	− 8	+ 7.1	○
		T303	40	168	−16	+41.3	×
		S728	40	168	− 3	+ 1.0	◎
		F384	40	168	− 4	− 0.4	◎
	Acetaldehyde	A727	40	168	−17	+66.1	×

Chemical Resistance Data

	Sealing Fluid	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Aldehydes/ketones	Acetaldehyde	T303	40	168	−31	+ 58.1	×
		S728	40	168	− 8	+ 5.0	○
		F384	40	168	−52	+ 85.8	×
	Methyl ethyl ketone	A727	40	168	−24	+102.0	×
		T303	40	168	−27	+139.0	×
		S728	40	168	−12	+ 20.0	△
		F384	40	168	測定不能	測定不能	×
Esters	Methyl acetate	A727	40	168	−29	+ 59.3	×
		T303	40	168	−39	+210.0	×
		S728	40	168	− 9	+ 13.3	○
		F384	40	168	—	+203	×
	Ethyl acetate	A727	40	168	−19	+ 81.1	×
		T303	40	168	−25	+102.0	×
		S728	40	168	−12	+ 21.5	△
		F384	40	168	測定不能	測定不能	×
	Butyl acetate	A727	40	168	−26	+123.0	×
		T303	40	168	−32	+129.0	×
		S728	40	168	−23	+105.0	×
		F384	40	168	測定不能	測定不能	×
	Isoamyl acetate	A727	40	168	−19	+ 79.8	×
		T303	40	168	−27	+165.0	×
		S728	40	168	−19	+ 91.9	×
		F384	40	168	—	+104.0	×
	Dibutyl phthalate	A727	40	168	−24	+139.0	×
		T303	40	168	−29	+154.0	×
		S728	40	168	− 1	+ 3.4	○
		F384	40	168	−26	+ 60.8	×
Hydrocarbons	Isooctane	A727	40	168	− 7	+ 2.6	△
		T303	40	168	− 8	+ 8.1	△
		S728	40	168	−16	+ 77.7	×
		F384	40	168	− 3	+ 8.4	○
	Liquid paraffin	A727	40	168	− 1	+ 0.7	◎
		T303	40	168	− 5	+ 2.7	◎
		S728	40	168	0	+ 4.6	◎
		F384	40	168	− 2	+ 3.5	◎
	Kerosene	A727	40	168	− 9	+ 7.6	△
		T303	40	168	− 5	+ 8.9	△
		S728	40	168	−22	+107.0	×
		F384	40	168	− 1	+ 1.4	◎
	1.2-dichloroethane	A727	40	168	—	+243.0	×
		T303	40	168	—	+310.0	×
		S728	40	168	—	+ 36.5	×
		F384	40	168	—	+ 55.3	×
	Trichlene (trichloroethylene)	A727	40	168	−21	+132.0	×
		T303	40	168	−33	+222.0	×
		S728	40	168	−19	+ 98.5	×
		F384	40	168	−47	+ 70.6	×
	1.1.1-trichloroethane	A727	60	48	−16	+134.0	×
		S728	60	48	−25	+ 46.3	×
		F384	60	48	−12	+110.0	×

Chemical Resistance Data

	Sealing Fluid	NOK Lip Material	Test Temperature (℃)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Hydrocarbons/Halogenated hydrocarbons	Benzene	A727	40	168	−29	+160.0	×
		T303	40	168	−27	+277.0	×
		S728	40	168	−22	+120.0	×
		F384	40	168	−36	+ 66.3	×
	Toluene	A727	40	168	−23	+137.0	×
		T303	40	168	−37	+241.0	×
		S728	40	168	−22	+130.0	×
		F384	40	168	−33	+ 64.8	×
	Methaxylene	A727	40	168	−14	+ 84.8	×
		T303	40	168	−25	+157.0	×
		S728	40	168	−16	+ 80.0	×
		F384	40	168	−26	+ 48.8	×
	Ethylbenzene	A727	40	168	−21	+ 46.1	×
		T303	40	168	−30	+114.0	×
		S728	40	168	−19	+ 66.7	×
		F384	40	168	−20	+ 67.5	×
	Styrene	A727	40	168	−27	+176.0	×
		T303	40	168	−39	+253.0	×
		S728	40	168	−22	+177.0	×
		F384	40	168	−31	+ 37.5	×
	Monochlorobenzene	A727	40	168	−23	+213.0	×
		T303	40	168	−39	+278.0	×
		S728	40	168	—	+120.0	×
		F384	40	168	−25	+ 77.8	×
	Trichlorobenzene	A727	40	168	−16	+165.0	×
		T303	40	168	−31	+220.0	×
		S728	40	168	−17	+ 25.3	×
		F384	40	168	−16	+ 18.6	×
	Bromobenzene	A727	40	168	−24	+206.0	×
		T303	40	168	−32	+250.0	×
		S728	40	168	−17	+ 57.7	×
		F384	40	168	−21	+ 25.7	×
Miscellaneous	Dioxane	A727	40	168	−28	+164.0	×
		T303	40	168	−24	+168.0	×
		S728	40	168	− 6	+ 8.3	○
		F384	40	168	Immeasurable	Immeasurable	×
	Phenyl ether (diphynyloxide)	A727	40	168	−15	+ 15.1	×
		T303	40	168	−25	+ 73.5	×
		S728	40	168	− 7	+ 10.0	○
		F384	40	168	+ 1	+ 8.6	○
	Phenol	A727	40	168	−35	+113.0	×
		T303	40	168	−32	+150.0	×
		S728	40	168	− 5	+ 4.0	◎
		F384	40	168	− 6	+ 19.1	△
	Cresol	A727	40	168	Immeasurable	Immeasurable	×
		T303	40	168	Immeasurable	Immeasurable	×
		S728	40	168	0	+ 0.8	◎
		F384	40	168	− 3	+ 3.4	△
	Aniline	A727	40	168	−29	+217.0	×
		T303	40	168	−46	+290.0	×
		S728	40	168	0	+ 2.3	◎
		F384	40	168	− 5	+147.0	×

Chemical Resistance Data

	Sealing Fluid	NOK Lip Material	Test Temperature (°C)	Test Duration (h)	Hardnes Change (Durometer A) (points)	Volume Change (%)	Resistance Ratinaerial
Miscellaneous	Nitrobenzene	A727	40	168	−25	+199.0	×
		T303	40	168	−42	+269.0	×
		S728	40	168	0	+ 4.0	◎
		F384	40	168	−50	+103.0	×
	Urea (saturated solution)	A727	40	168	+ 2	− 0.8	◎
		T303	40	168	− 9	+ 9.2	△
		S728	40	168	+ 1	+ 0.3	◎
		F384	40	168	− 2	+ 1.2	◎
	Carbon disulfide	A727	40	168	−20	+ 47.8	×
		T303	40	168	−11	+ 47.7	×
		S728	40	168	0	+ 3.7	◎
		F384	40	168	−12	+ 12.3	×
	Hydrogen peroxide water	A727	40	168	− 3	+ 10.5	△
		T303	40	168	−53	+ 78.2	×
		S728	40	168	− 1	+ 1.7	◎
		F384	40	168	0	+ 0.9	◎
	Chlorine water	A727	40	168	− 4	+ 3.1	◎
		T303	40	168	− 8	+ 54.3	×
		S728	40	168	− 3	+ 19.5	○
		F384	40	168	− 6	+ 3.0	○
	Urea water	A727	40	168	+ 3	+ 21.7	×
		T303	40	168	−40	+394.0	×
		S728	40	168	+ 1	+ 22.6	△
		F384	40	168	0	+ 2.5	◎