High-Performance Seals

Parco Nitrile Selection Guide

Always Consider Nitrile First

Nitrile compounds are the most widely used industrial seal materials. Parco's nitrile seals offer excellent service in diverse fluids, including hydrocarbon fuels and fluids, solvents, water, and water-based solutions. Those seals have a long history of reliable service from -65 to 250°F at pressures up to 1,500 psi. Because of the excellent economy of nitrile seals, follow Parco's general rule: consider nitrile seals first.

Nitrile compounds are copolymers of acrylonitrile and butadiene. Acrylonitrile provides resistance to petroleum-based fluids such as oils and fuels, while butadiene contributes to low-temperature flexibility. Different nitrile compounds are formulated by adjusting acrylonitrile levels to achieve the desired balance of petroleum-based fluid resistance and flexibility at the anticipated service temperature.

Standard nitrile is also known as Buna N Rubber or by the ASTM D1418 designation NBR. Parco offers more than 100 nitrile compounds tailored to a broad range of operating conditions. Acrylonitrile content, curing system, and type and quantity of plasticizers are a few of the compounding factors that can be varied to match the seal material to the end-user's requirements.

Parco also produces special types of nitriles for more demanding applications. Hydrogenated nitrile, designated HNBR, is used with automotive lubricants and sour crude oil containing amine-based corrosion inhibitors. HNBR is also used when a seal is exposed to ozone and higher temperatures. Carboxylated nitrile, designated XNBR, provides improved abrasion resistance and superior extrusion resistance at high pressures.

If you are unfamiliar with the different types of elastomeric seal materials currently in use, consult Parco's *Elastomer Selection Guide* before reading this guide. There you will find guidelines to help you select the best elastomer for your application.

When you have determined that a nitrile compound may be appropriate for your application, use this guide to narrow your choice. Contact a Parco customer service representative to to obtain additional product information about specific nitrile compounds.

Nitrile O-rings are used in a broad range of industrial, automotive, and aircraft fluids at temperatures between -65 and 250°F. More than 50 percent of sealing needs can be met using nitrile seals.

Nitrile Compound Characteristics

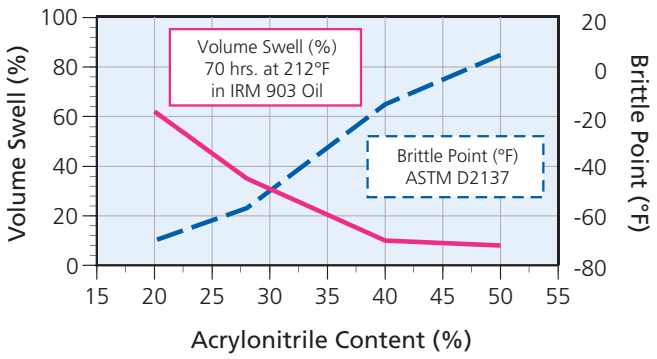
A brief review of the characteristics of nitrile compounds can remove much of the guesswork from the selection process. Consider the following five factors when selecting a nitrile seal compound:

1. Oil Resistance

The relative proportions of acrylonitrile and butadiene determine the oil resistance and low-temperature performance of nitrile seals. High acrylonitrile content improves oil resistance at the expense of low-temperature performance (Figure 1). The acrylonitrile content of commercial nitriles typically ranges from 20 to 50%.

Fig. 1:

Oil and Low-Temperature Resistance of Nitrile Compounds



Oil resistance improves (as indicated by the decrease in volume swell) with increasing acrylonitrile content. At the same time, however, the brittle point rises, reflecting a loss in low-temperature performance.

2. Compression Set Resistance

Nitrile compounds incorporate either sulfur or peroxide curative. Sulfur-cured seals, such as those made from Parco's most popular nitrile compound 4200-70, are generally more economical as they require shorter molding times. Sulfur curing produces compounds with good resistance to compression set and extrusion resistance and ultimate elongation. Sulfur-cured compounds are often used to mold rubber-to-metal bonded parts.

By contrast, peroxide-cured compounds generally have better compression set resistance, higher extrusion resistance and lower elongation. They also tend to have better heat resistance but may be more expensive due to the longer molding times required.

3. Low-Temperature Resistance

Plasticizers typically improve low-temperature flexibility and resistance to volume swell. However, nitrile seals containing ester plasticizers frequently cause surface crazing when used with some plastics. Parco manufactures several types of nitrile seals containing non-ester plasticizers specifically developed for use with plastics.

4. Mechanical Properties

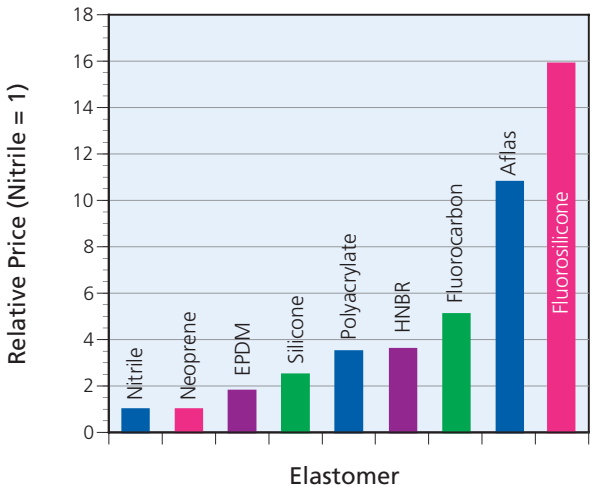
All Parco nitrile compounds contain filler materials that reinforce the compound and generally improve the mechanical properties of the seal. Carbon black, the most commonly used filler, improves the tensile strength, extrusion resistance, and abrasion resistance of the compound. When non-black seals are required for identification, mineral fillers are used instead of carbon black. Compounds with carbon black fillers generally have better compression set resistance and resilience than compounds with mineral fillers.

5. Price

Nitrile seals are the most economical of the popular seals available and, due to their outstanding service capabilities, offer excellent value (Figure 2). Of popular seal materials, only neoprene can routinely match the low price offered by nitrile.

Fig. 2:

Relative Prices of Popular Elastomers



This chart shows the prices of Parco O-rings made of the most popular compound of each elastomer and is intended to provide a rough estimate of relative price. These prices are based on a comparison of 30 popular sizes of O-rings for each compound.

Parco's Most Popular Nitrile Compounds[1]

4457-65[2]

Low acrylonitrile (ACN) and high plasticizer content provide excellent flexibility at temperatures as low as -65°F; moderate volume swell in jet fuel; listed in AMS-P-5315 Qualified Product List (QPL) for use with aviation fuel systems.

[1]Compounds are listed by hardness, then by compound number.
[2]Last two digits of compound number identify hardness (durometer, Shore A).

4465-65

Formulated expressly for use in low-temperature aviation fuel systems; low ACN content enables compounds to meet requirements of Aerospace Materials Specification (AMS) 7271, QPL listed, including passing low-temperature fuel seal test at -65°F.

0209-70

High ACN content with low plasticizer level provides excellent resistance to petroleum oils, automatic transmission fluid (ATF), and crude oil; formulated as a transfer-moldable variant of Parco general-purpose nitrile 4200-70 for producing thick cross-section custom molded parts; used extensively in oil tool seals and packing elements for pressures to 1,500 psi.

0228-70

Specifically formulated for continuous service in automobile fuels; UL-listed for conventional gasolines, kerosene, liquid petroleum gas (LP gas), and diesel fuels, manufactured or natural gas; compatible with diester synthetic lubricants.

2276-70

Incorporating an organic internal lubricant, 2276-70 seals are well suited for dynamic applications requiring low-friction materials; very high ACN content and low plasticizer level provide oil resistance; used on power steering reservoir caps.

2295-70

Resists fuels rich in alcohol better than 4200-70 general-purpose nitrile seals; UL-listed for gasoline, diesel fuel, kerosene, naphtha and gasoline alcohol blends with up to 15% ethanol and methanol concentrations, high ACN content for very low swell in fuels; compound not recommended for hot air or ATF.

4067-70

Widely used for MIL-PRF-5606 petroleum-based "red oil" aircraft hydraulic fluid; low ACN formulation for flexibility at very low temperatures; broad service range from -65 to +250°F in aerospace applications, extending 30°F lower and 25°F higher than general-purpose compound 4200-70; TR-10 below -50°F; meets MIL-P-25732 QPL for aircraft hydraulic fluid service.

4200-70

General-purpose nitrile seals for service between -35 and 250°F at pressures to 1,500 psi. Principal uses include dilute bases, many solvents, petroleum-based hydraulic oils, fuel oil, diesel oil and hydrocarbons. UL-listed for diesel oil, duel oil, kerosene, naphtha, LP gas, MPS gas, natural gas, and fire extinguishers (dry chemical, CO_2 and water).

4367-70

Low ACN content extends low-end temperature range; TR-10 below -50°F; peroxide cure enhances heat and compression set resistance; greater high-end durability than 4067-70 seals; meets AMS-83461 QPL for petroleum-based aircraft hydraulic fluid.

4456-70

Containing no ester plasticizers, compound 4456-70 provides superior compatibility with ABS, polycarbonates and other stress-sensitive plastics used in injection-molded automotive power steering seals.

4262-75

Excellent compatibility with drilling muds and petroleum oils; withstands service demands of heavy equipment hydraulic systems; Parco's lowest compression-set, sulfur-cure nitrile.

Nitrile compounds are the most widely used industrial seal materials. The most important factors to consider when selecting a nitrile seal compound are 1) oil resistance, 2) compression set resistance, 3) low-temperature resistance, 4) mechanical properties, and 5) price.

Selecting Medium-Hardness Nitrile Compounds

Figure 3 provides a selection diagram for the eleven most popular Parco nitrile compounds. The eleven specialty nitriles have been formulated specifically for applications with service requirements outside the performance range of Parco 4200-70 general-purpose nitrile seals.

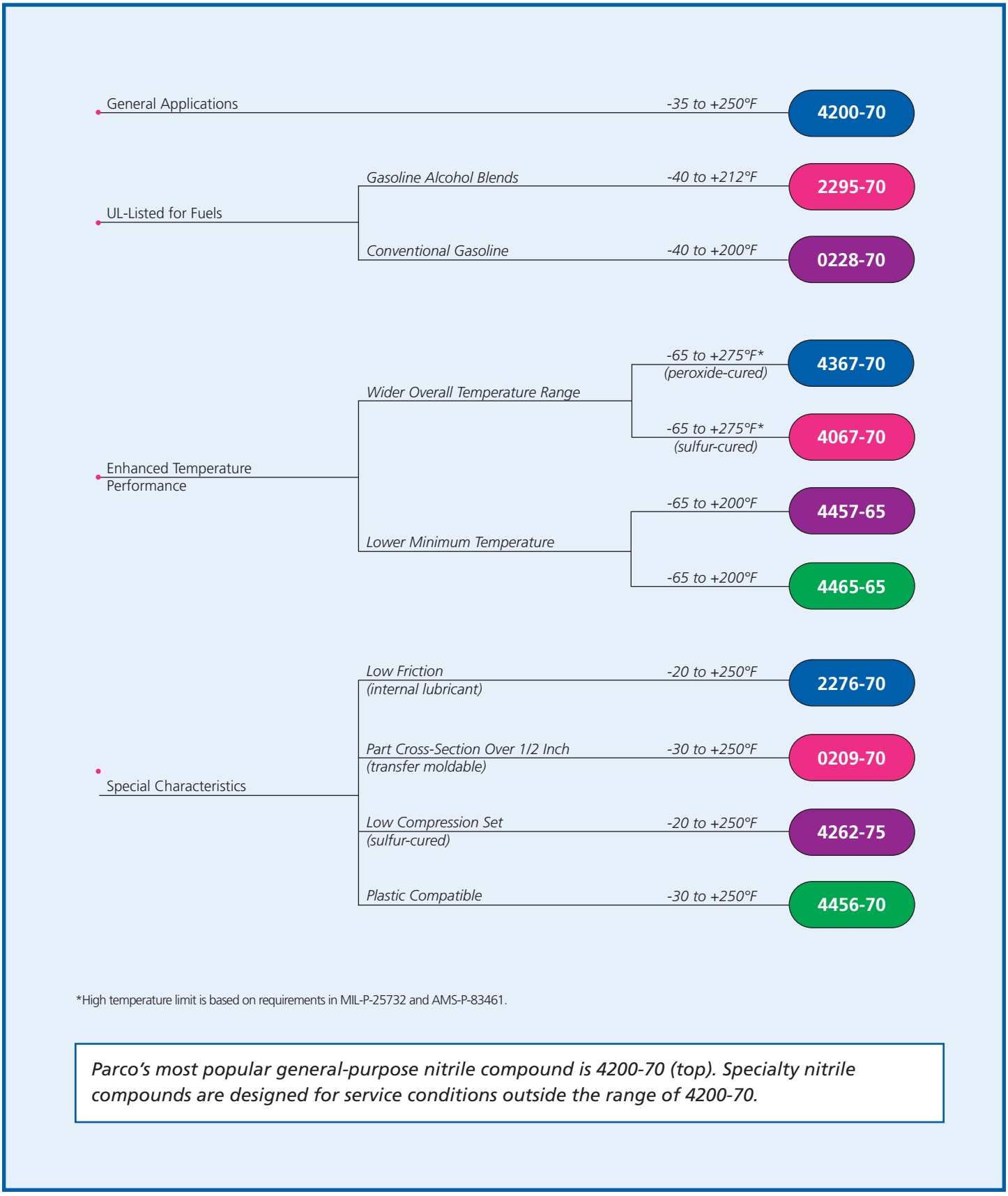
Rely on Parco for Nitrile Seals

Founded in 1941, Parco was the first manufacturer to specialize in O-rings, still one of our primary products. Today, Parco has two modern facilities manufacturing O-rings, custom-molded elastomeric seals, rubber-to-metal bonded parts, and machined metal parts.

Parco sells to many Fortune 500 companies, who demand world-class quality. To maintain the highest quality we make our own molds, develop and mix our own compounds, and mold our parts in computer-controlled presses. Our quality management system is certified to international standards ISO 9001 and ISO/TS 16949 and aerospace standards AS9100 and AC7115.

Fig. 3

Nitrile Selection Diagram



*High temperature limit is based on requirements in MIL-P-25732 and AMS-P-83461.

Parco's most popular general-purpose nitrile compound is 4200-70 (top). Specialty nitrile compounds are designed for service conditions outside the range of 4200-70.

Key Features

Parco's nitrile seals are an excellent choice for various applications. Key features include the following:

- **Excellent resistance to various chemicals:**
  Parco nitrile seals resist a broad range of industrial, automotive, and aircraft fluids.
- **Wide range of service temperatures:**
  Parco nitrile seals are suitable for applications from -65° to +285°F, depending on the compound.
- **UL-listed:**
  Certain Parco nitrile seals are UL-listed for gasoline, kerosene, LP gas, diesel fuels, and fire extinguishers.
- **MIL SPEC conforming:**
  Parco offers nitrile seals to meet demanding military and aerospace specifications.
- **Unsurpassed economy:**
  Nitrile is the most economical high-performance seal material available.

Typical Values for Popular Parco Compounds

Sequence: Hardness, Compound No.	Medium-Hardness Nitriles (65-75 Durometer)											ASTM Test Method[2]
	4457-65[1]	4465-65	0209-70	0228-70	2276-70	2295-70	4067-70	4200-70	4367-70	4456-70	4262-75	
Original Properties												
Hardness, Shore A	65	65	68	66	73	70	75	70	70	74	71	D2240
Tensile strength, psi.[3]	1303	2300	2417	1924	1974	2123	2748	2385	1878	2038	2755	D412
Ultimate elongation, pct.	266	399	387	347	361	330	174	363	175	268	382	D412
Modulus at 100 pct., elongation, psi.	541	544	570	620	814	825	1654	617	779	873	715	D412
Compression Set, Solid 22 hours at 100°C (212°F)												D395 Method B
Pct. of original deflection, max.	9	8	7	10	16	30	13	13	18	8	7	
Heat Aging 70 hours at 100°C (212°F)												D573
Hardness change, pts., Shore A	6	7	4	2	6	15	5	4	4	3	5	
Tensile strength change, pct.	21	8	8	10	6	3	-8	6	-3	3	9	
Ultimate elongation change, pct., max.	-14	-22	-7	-17	-26	-31	-17	-20	-20	-15	-41	
Fluid Aging, Fuel B 70 hours at 23°C (73°F)												D471
Hardness change, pts., Shore A	-11	-20	-24	-14	-16	-10	-12	-11	-19	-9	-7*	
Tensile strength change, pct.	-31	-49	-31	-14	-35	-17	-21	-39	-60	-32	-36*	
Ultimate elongation change, pct.	-34	-53	-20	-25	-42	-8	-24	-41	-48	-27	-18*	
Volume change, pct.	24	49	27	19	25	9	23	28	33	26	20*	
Low Temperature Flexibility												D1329
TR-10°C (°F)	-51(-59)	-28(-18)	-26(-15)	-34(-30)	-23(-10)	-21(-5)	-47(-53)	-28(-19)	-52(-61)	-17(1)	-13(9)	
Glass Transition, Midpoint °C(°F)	-54(-66)	-60(-75)	-28(-19)	-35(-31)	-42(-43)	-32(-26)	-54(-65)	-26(-15)	-56(-69)	-15(5)	7(45)	

*Testing Performed on size -200 series O-rings.

Source: Parco R & D data.

[1]Last two digits of compound number identify hardness (durometer, Shore A).
[2]ASTM is the acronym for the American Society for Testing and Materials.
[3]To convert psi to MPa, use the relationship 145 psi = 1 MPa.

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