Parco

High Performance Seals

Nitrile Selection Guide for Popular Applications

Nitrile compounds are the most widely used industrial seal materials. Parco nitrile seals offer excellent service in diverse fluids, including hydrocarbon fuels and fluids, many solvents, water, and water-based solutions. Parco medium-hardness (60 to 75 Shore A durometer) nitrile seals have a long history of reliable service from -65 to +285°F at pressures to 1500 psi. Because of the excellent economy of nitrile seals, follow Parco's general rule: *consider nitrile seals first.*

Nitrile O-rings are used with gasoline, crude oil, power steering fluid, hexane, toluene, water, water-based hydraulic fluids, and dilute bases such as sodium hydroxide at temperatures between -65 and 285°F. More than 50% of sealing needs can be met by using nitrile seals. Parco's most popular material for O-rings is nitrile compound 4200-70. It is used for service to 1500 psi between -35 and 250°F. Selected specialty nitriles with wider temperature ranges or special characteristics are also described in this guide.

Nitrile compounds are copolymers of acrylonitrile and butadiene. Acrylonitrile provides resistance to petroleum-based fluids such as oils and fuels, while butadiene contributes low-temperature flexibility. Different nitrile compounds are formulated by adjusting acrylonitrile levels to achieve the needed 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 many nitrile compounds tailored to a broad range of operating conditions. Acrylonitrile content, curing system, and type and quantity of plasticizers are but 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 applications that are too demanding for standard nitriles. Hydrogenated nitrile, designated HNBR, is used with automotive lubricants and sour crude oil containing amine-based corrosion inhibitors. HNBR is also used for exposure 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 the Parco *Elastomer Selection Guide* before reading this guide. There you will find guidelines for selecting among the major elastomers.

When you have determined that a nitrile compound may be appropriate for your application, use this guide to narrow your choice. Contact your local Parco distributor to discuss your selection or to obtain additional product information about specific nitrile compounds.

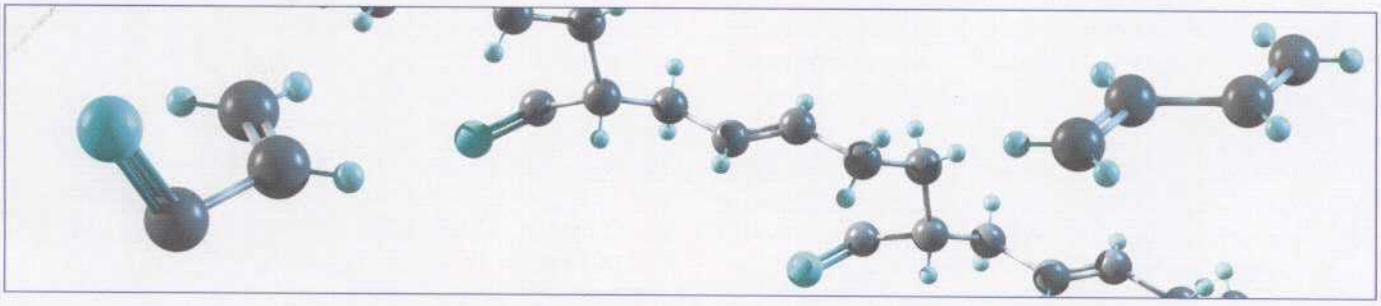


Fig. 1: Monomers of acrylonitrile (l) and butadiene (r) join to form nitrile polymers (c). Acrylonitrile provides resistance to hydrocarbon fuels and oils while butadiene contributes low-temperature flexibility. Acrylonitrile content in nitrile polymers ranges from 20 to 50%.

Nitrile compound characteristics

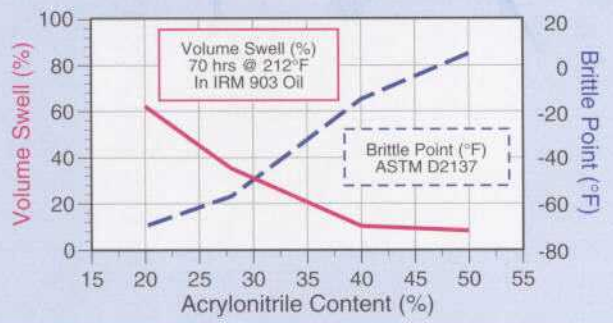
A brief review of the characteristics of nitrile compounds can remove much of the guesswork from the selection process. Consider the following five factors when selecting a nitrile seal compound:

Oil and low-temperature 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 2). The acrylonitrile content of commercial nitriles typically ranges from about 20 to 50%.

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 resilient compounds with good resistance to compression set and good 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.

Fig. 2: Oil and Low-Temperature Resistance of Nitrile Compounds



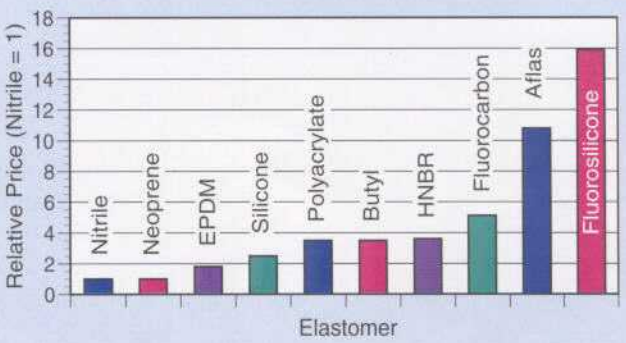
Oil resistance improves (as indicated by the decrease in volume swell) with increasing acrylonitrile content. At the same time, however, the brittle point rises, reflecting a loss in low-temperature performance.

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 in contact with some plastics. Parco manufactures several types of nitrile seals containing non-ester plasticizers specifically developed for use with plastics.

Mechanical properties — All Parco nitriles 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 mineral fillers generally have somewhat lower compression set resistance and resilience than compounds with carbon black fillers.

Price — Nitrile seals are the most economical of the popular seals available and, due to their outstanding service capabilities, offer excellent value (Figure 3). Of popular seal materials, only neoprene can routinely match the low price offered by nitrile.

Fig. 3: 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.

Selecting medium-hardness nitrile compounds

Figure 4 provides a selection diagram for the twelve 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.

Parco's most popular nitrile compounds*

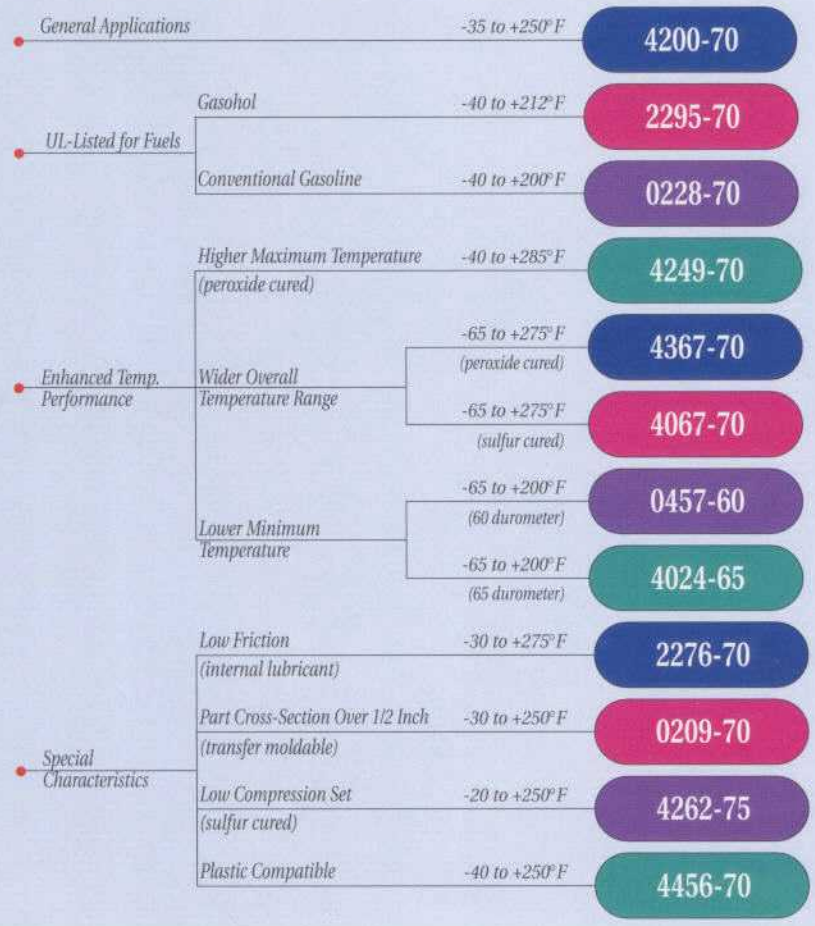
Nitrile 0457-60* — Low acrylonitrile (ACN) and high plasticizer content provide excellent flexibility at temperatures as low as -65°F; moderate volume swell in jet fuel; listed in MIL-P-5315 Qualified Product List (QPL) for use with aviation fuel systems.

Nitrile 4024-65 — Formulated expressly for use in low-temperature aviation fuel systems; low ACN content provides minimum service temperatures a full 30°F lower than general-purpose compound 4200–70; meets requirements of Aerospace Materials Specification (AMS) 7271.

Nitrile 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

* *Compounds are listed by hardness, then by compound number.*
** *Last two digits of compound number identify hardness.*

Fig. 4: Selection Diagram for Medium-Hardness Nitrile Compounds



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

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 1500 psi.

Nitrile 0228-70 — Specifically formulated for continuous service in automobile fuels; UL listed for conventional gasolines, kerosene, liquid petroleum gas (LP gas), and hydrocarbon fuels; compatible with diester synthetic lubricants; meets SAE 120R1 Class II (fuel) requirements.

Nitrile 2276-70 — Originally developed for adjustable-beam flashlights, 2276-70 seals are suited for dynamic applications requiring low friction materials; very high ACN content and low plasticizer level provide oil resistance; incorporates an organic internal lubricant.

Nitrile 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 a full range of ethanol and methanol concentrations as well as 100% methanol; high ACN content for very low swell in fuels; compound not recommended for hot air or ATF.

Nitrile 4067-70 — Widely used for MIL-H-5606 petroleum-based "red oil" aircraft hydraulic fluid; low ACN formulation for flexibility at very low temperatures; broad service range from -65 to +275°F, 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.

Nitrile 4200-70 — General-purpose nitrile seals for service between -35 and 250°F at pressures to 1500 psi. Principal uses include dilute bases, many solvents, petroleum-based hydraulic oils, fuel oil, diesel oil and hydrocarbons. UL listed for diesel oil, fuel oil, kerosene, naphtha, LP gas, MPS gas, natural gas, and fire extinguishers (dry chemical, CO_2 and water). 4200-70 seals are also FDA conforming.

Nitrile 4249-70 — Ideal for the extreme service demands of heavy equipment; high ACN content withstands hydrocarbon fluids; peroxide cure provides best compression set resistance at elevated temperatures among Parco's most popular nitrile compounds.

Nitrile 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 MIL-R-83461 QPL for petroleum-based aircraft hydraulic fluid.

Nitrile 4456-70 — Containing no ester plasticizers, compound 4456-70 provides superior compatibility with ABS, polycarbonates and other stress-sensitive plastics; meets SAE 120R1 Class I (oil) and AMS 7270 requirements; used in injection-molded automotive power steering seals.

Nitrile 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.

Turn to Parco for nitrile seals

For more than fifty years, major industrial users have relied on Parco for quality, delivery and sealing excellence. Today, Parco research has extended the capabilities of nitrile seals far beyond their former limits.

Contact your local Parco distributor to learn how you can benefit from the latest developments in nitrile seal technology.

Key Features

Parco medium-hardness nitrile seals offer:

- Excellent service in a wide variety of industrial, automotive and aircraft fluids, including
  hydrocarbon fuels and fluids (such as gasoline, crude oil and power steering fluid)
  hydrocarbon solvents (such as hexane and toluene)
  water and water-based solutions (such as certain hydraulic fluids and dilute bases like sodium hydroxide)
- Temperature ratings from -65 to +285°F — *TR-10 < -60°F*
- Pressure ratings to 1500 psi — *higher-durometer seals also available for pressures over 1500 psi*
- UL listed — *selected compounds listed for gasoline, kerosene, LP gas, diesel fuels, fire extinguishers*
- MIL spec compliance — *selected compounds meet MIL-P-5315, MIL-R-25732, MIL-R-83461, etc.*
- Colored compounds for identification — *available in other compounds not listed below*
- Exceptional compounding versatility — *acrylonitrile content variable from under 20 to over 50%*
- Unsurpassed economy — *most economical high-performance seal material available*

Typical Values[1]

Property	Medium-Hardness Nitriles (60 - 75 Durometer)												ASTM Testing Method
	0457-60	4024-65	0209-70	0228-70	2276-70	2295-70	4067-70	4200-70	4249-70	4367-70	4456-70	4262-75	
ASTM Dumbbell Values													
Hardness, Shore A	60	64	72	72	70	70	73	70	72	74	69	75	D2240
Tensile strength, psi[2]	1600	1436	1940	1920	1830	1653	2020	2110	2730	1950	1916	2320	D412
Ultimate elongation, %	270	270	340	290	350	354	170	350	190	160	289	360	D412
Modulus at 100% elongation, psi	390	450	410	780	350	462	1170	650	1120	890	786	670	D412
Low-temperature properties:													
Brittle point, °F	-58	-60	-18	-27	-14	-20	-62	-33	-29	-66	-20	+4	D2137
TR-10 *(O-ring values [AS568-218])*													
10% recovery of 50% stretch[3] °F	-63	-51	-13	-25	-7	-9	-52	-13	-11	-54	-5	+8	D1329
O-Ring Values (AS568-214)													
Compression Set *(22 hrs at 212°F):*													
% of original deflection	6	16	8	6	14	20	13	6	2	11	6	4	D395B
Air Aging *(70 hrs at 212°F):*													
Hardness change, pts	+6	+8	+6	+10	+4	+7	+5	+2	+2	+3	+3	+1	D573
Tensile change, %	+29	+10	+15	+6	+9	+13	+6	+6	-7	-5	+23	+5	D573
Elongation change, %	+7	-26	-14	-20	-24	-28	-11	-24	-2	-7	-13	-23	D573
Fluid Aging:													
ASTM Oil No. 1 *(70 hrs at 212°F):*													
Hardness change, pts	+1	+4	+6	+16	+5	+23	+8	+6	+1	+6	+2	0	D471
Volume change, %	-3	-6	-5	-15	-5	-18	-9	-5	-2	-10	-2	-3	D471
IRM 903 *(70 hrs at 212°F):*													
Hardness change, pts	-10	-8	-7	+8	-6	+22	-9	-3	-7	-12	-5	-7	D471
Volume change, %	+24	+22	+9	-8	+8	0	+14	+1	+13	+14	+13	+6	D471
Reference Fuel B *(70 hrs at 73°F):*													
Hardness change, pts	-13	-12	-24	-7	-15	-12	-12	-15	-15	-11	-9	-14	D471
Volume change, %	+42	+59	+27	+8	+25	+11	+29	+28	+33	+28	+31	+25	D471

1) Values taken from Parco Test Report R-5766.
2) To convert psi to MPa, use the relationship 145 psi = 1 MPa.
3) The TR-10 Temperature Retraction Test consists of stretching a material by 50%, freezing it, and then gradually warming it until 10% of the original 50% elongation has been recovered. The TR-10 is a generally reliable indicator of the lowest temperature at which a material exhibits the elastomeric properties that allow it to function effectively as a seal. Dynamic O-ring seals generally function reliably down to the TR-10. O-rings in static service typically provide reliable sealing to about 15°F below the TR-10.

For more information or to obtain samples of these compounds, please contact your local Parco distributor.

PARCO, INC. • 2150 PARCO AVENUE • ONTARIO, CA 91761 • (909) 947-2200 • FAX (909) 923-0288

Form 2497 10/97