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COMPATIBILITY OF QUINTOLUBRIC® 888 SERIES WITH NBR SEAL MATERIAL

OVERVIEW

One of the main considerations when choosing a hydraulic fluid, is it's compatibility with seals. More specifically it's compatibility with Nitrile Butadiene Rubber (NBR) seals.

NBR is the most cost effective and commonly used seal type in hydraulic systems. This elastomer found in various hydraulic unit applications:

- Tube inner lining
- Shaft seals
- Bladders
- O-rings

NBR SEAL MATERIAL

Chemically NBR is a co-polymer of acrylonitrile and butadiene. After polymerization the polymer is vulcanized using Sulphur in the presence of Zinc Oxide (and carbon) as filler.

The nature of NBR strongly depends on the level of acrylonitrile, which typically varies from 17-50%.

A higher level of acrylonitrile means better:

- Mechanical properties
- Resistance against high temperatures
- Resistance against oil ingression

The standard NBR seal material used in hydraulic units, O-rings for instance, normally has more than 30% of acrylonitrile[1] .

For harsh low temperature environments such as polar conditions, seal material with 17-25% of acrylonitrile are typically used, as they maintain good mechanical properties at very low temperatures.

QUINTOLUBRIC® 888 Compatibility with NBR Seals

When it comes to the compatibility of NBR seals with hydraulic fluids like QUINTOLUBRIC® 888 the question is always related to the level of acrylonitrile in the copolymer.

To evaluate the compatibility of QUINTOLUBRIC® 888 with NBR seals with different levels of acrylonitrile, a Japanese seal supplier ran a variety of tests. The results are shown in table A1 on page 2.

Additionally, tests have been run at an external recognized lab in Germany (O-ring Laboratory). In these tests two standard types of NBR were evaluated.

- NBR-1 (± 28% acrylonitrile)
- NBR-2 (± 34% acrylonitrile)

The tests were run at 80°C (175°F) and 100°C (212°F) using limitations set by VDMA and Bosch Rexroth. It is important to note that the limits used by Bosch Rexroth are the same as those used for the evaluation of standard HLP Mineral Oil based Hydraulic Fluids. The test data can be found in table B1 and B2 on pages 3 and 4.

The test data shows that the QUINTOLUBRIC® 888 Series is fully compatible with the NBR seals once their acrylonitrile level exceeds 25%, even at temperatures over 100°C.

For seals with less than 25% acrylonitrile, the data indicates the NBR seals are no longer compatible with the QUINTOLUBRIC® 888 Series. These seal types are very rarely used in the typical application where QUINTOLUBRIC® is used.

Footnote 1: https://www.applerubber.com/hot-topics-for-engineers/understanding-the-composition-of-a-nitrile-buna-n-rubber-compound/

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It is important to note that these test results were all achieved under static conditions. Under dynamic conditions the results may differ. However, seal compatibility tests under dynamic conditions are not available on a laboratory scale.

SEAL MATERIALS

While NBR seal material will work well for most applications, for high dynamic conditions, like shaft seals, the use of FPM (Viton) can be a better choice for longer term use.

Hydraulic parts manufacturers like Bosch Rexroth and Parker recommend to use FPM shaft seals with fluids like QUINTOLUBRIC® 888, as well as standard Mineral Oil based Hydraulic Fluids.

For applications where an O-ring is exposed to high pressure shocks it might help to use NBR seals with a higher Shore Hardness, instead of 70, a Shore Hardness of 90 may be recommended.

TABLE SECTION

Table A1

ACRYLONITRILE CONTENT %		LOW <25			MEDIUM 25 - 30			MEDIUM - HIGH 31 -35			HIGH 36 - 42		
TEMPERATURE °C		80	100	120	80	100	120	80	100	120	80	100	120
QUINTOLUBRIC® 888-46	Hardness Change	-10	-12	-13	-4	-3	-5	-1	-4	-5	3	0	-1
	Tensile Strength Change	-7.8	-9.4	-6.1	1	11	8.7	5.4	6.7	5.2	7.1	13	19
	Elongation Change	-13	-23	-19	-17	-13	-15	-11	-21	-15	-5.6	-9.7	-8.3
	Volume Change	16	20	24	2.2	3.9	4.2	3.2	3.5	4.3	-1.6	-0.5	-0.3
QUINTOLUBRIC® 888-68	Hardness Change	-10	-12	-14	-3	-4	-7	-1	-5	-3	6	0	-3
	Tensile Strength Change	-13	-4	7	5	7	11	7	12	10	5	16	23
	Elongation Change	-19	-15	-6	-12	-13	-10	-8	-13	-11	6	10	14
	Volume Change	18	20	24	2	4	6	3	3	4	-1	-1	0
Mineral Oil ISO: HM or HLP	Hardness Change	-3	-5	-5	2	4	6	1	1	3	4	5	5
	Tensile Strength Change	2	15	-5	9	17	4	1	9	-12	5	11	7
	Elongation Change	-13	-13	-32	-17	-17	-50	-21	-35	-60	-8	-19	-47
	Volume Change	6	8	10	-1	-1	-1	2	3	2	-1	-1	0

● = Good | ● = Bad | ● = Moderate

COMPATIBILITY OF QUINTOLUBRIC® 888 SERIES WITH NBR SEAL MATERIAL

TABLE SECTION

Table B1

VDMA 24 568		NBR 1 BLACK - 170317828		NBR 2 BLACK - 170317762		UNIT
Hardness	As delivered	79		69		SHORE-A
Density		1.23		1.18		g/cm³
Tensile strength		23.1		19.7		N/mm²
Elongation at break		189		350		%
Stress at 100% elongation		10.0		3.9		%
		1008h / 80°C NBR 1		1008h / 80°C NBR 2		
		RESULTS	ISO VDMA LIMITS	RESULTS	ISO VDMA LIMITS	
Change volume	QUINTOLUBRIC® 888-46	6.5	-3/10	3.8	-3/10	%
Change weight		4.8		2.4		%
Change hardness		-4	-10/10	-2	-10/10	SHORE-A
Tensile strength		22.9		20.4		N/mm²
Change of median		-1	-30/30	3	-30/30	%
Elongation at break		188		348		%
Change of median		-1	-30/30	-1	-30/30	%
Stress at 100% elongation		9.7		4.0		N/mm²
Change of median		-4		2		%

The specifications of VDMA 24 568 are achieved, tested and concluded by the O-ring lab

COMPATIBILITY OF QUINTOLUBRIC® 888 SERIES WITH NBR SEAL MATERIAL

TABLE SECTION

Table B2

RFT-EC -REXROTH FLUID-TEST-ELASTO-MER-COMPATIBILITY HLP / HVLP / HEPR		NBR 1 BLACK - 170317828		NBR 2 BLACK - 170317762		UNIT
Hardness	As delivered	79		69		SHORE-A
Density		1.23		1.18		g/cm³
Tensile strength		23.1		19.7		N/mm²
Elongation at break		189		350		%
Stress at 100% elongation		10.0		3.9		%
		1008h / 100°C NBR 1		1008h / 100°C NBR 2		
		RESULTS	ISO VDMA LIMITS	RESULTS	ISO VDMA LIMITS	
Change volume	QUINTOLUBRIC® 888-46	6.9	-5/10	3.4	-5/10	%
Change weight		4.8	-5/10	2.0	-5/10	%
Change hardness		-4	-5/9	-2	-5/9	SHORE-A
Tensile strength		21.9	> 10	19.9	> 10	N/mm²
Change of median		-5	-25/25	1	-25/25	%
Elongation at break		178	> 100	350	> 100	%
Change of median		-6	-60/30	0	-60/30	%
Stress at 100% elongation		10.1	-	3.8	-	N/mm²
Change of median		0	-30/75	-3	-30/75	%

The results regarding to the Elastomer Compatibility are within the required range of Bosch Rexroth, and tested and concluded by the O-ring lab.