

Static oil compatibility tests with Freudenberg O- Ring – compounds for the release to be used in FLENDER- gear units (Tabellen T 7300)

Test Documentation

This document is a translation of Freudenberg Sealing Technologies (FST) internal test procedure FS PLM 111 0118. In case both documents contradict each other, the original German version is valid.

1. Introduction

When selecting a suitable material for a sealing solution, in addition to the temperature range consideration of chemical and physical resistance of the elastomeric material is often decisive. The knowledge about all media that come into contact with the elastomeric material, is decisive for reliability.

Depending on the application, FLENDER gear units are using NBR- or FKM-compounds to seal. These are influenced by different ageing- and wearing-effects, which are essential for the lifetime of a seal. A lot of material properties, like hardness, volume, tensile strength and elongation at break, are changed by temperature- and media-influence.

To release lubricants for the use in FLENDER gear units, they have to pass static and dynamic compatibility tests with NBR- and FKM-compounds of Freudenberg. This document describes the static compatibility tests for O- rings .

The oil sample to be tested must be clearly marked with the ISO VG viscosity class at 40 °C or the SAE-class if necessary and the type of the base oil (mineral oil, poly- α -olefin, poly-glycol or synthetic ester) and the API- classification .

2. Static test

2.1 Immersion test according to DIN ISO 1817 (08/2008)

The volume of the oil to be tested is about 80 times the combined volume of the samples. The free hanging samples have to be fully immersed in and surrounded from all sides by the oil. According to DIN ISO 1817 the volume of air above the oil shall be minimal. For immersion, test vessels are used closed with glass lids using silicone grease (e. g. Baysilone) to prevent influence of air. The samples have to be prepared in accordance with DIN ISO 23529 (01/2007).

2.2 Test procedure

For the static immersion test in media, test samples type S2 (DIN 53504) and discs (\varnothing 36.6 mm) are cut out of elastomeric sheets with thickness ($2\pm 0,2$) mm. The cutting die has to be in perfect condition to avoid micro fractures in the samples. Properties for tensile strength and elongation at break are measured at five S2-samples. For clear identification, three discs are marked and used for determination of volume and hardness. In deviation to DIN ISO 1817, hardness is measured according to Shore A-method DIN ISO 7619-1 (02/2012), tensile test is measured according to DIN 53504 (10/2009).

Test samples and test setup without oil are shown in picture 1 and 2.

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Picture 1: Samples



Picture 2: Immersion of samples in test vessel

Source: Freudenberg New Technologies

Test temperatures to be used for the different oil types and sealing materials are defined in table 1. Immersion duration is 1008 h (± 2 h).

Table 1: Test temperatures

Elastomeric material	Temperature / °C		
	Mineral Oil (API 1 & API 2) & Synth. Ester (API 5)	Mineral Oil (AP3) &PAO- oils (API 4)	Polyglycole (API 5)
NBR- compounds	80	80	80
FKM- compounds	100	110	120

The test procedure is set in the Freudenberg-internal instruction document "Durchführung von statischen Tests zur Freigabe für den Einsatz in Flender-Getrieben".

2.3 Evaluation of test results

After the immersion in the test oil, the samples are measured and evaluated concerning changes in hardness, values of tensile strength and elongation at break and volume according to DIN ISO 1817 (08/2008). Test results are signed calculated using the following equation: "Value after the test" minus "value before the test". Percentages are based on the "value before the test".

In addition a picture of each tested oil before and after is added to document the oil condition. The assessment of the oil condition (discoloration) is carried out by Flender if required. A difference of the discoloration between the test vessels for different specimen is an indication for insufficient sealing of the lid and additional air ingress.

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Limits for maximum acceptable changes , depending on the compounds are listed in the table 2.

Table 2: Acceptable change of function values (valid for O- ring Compounds 80 FKM 610 ; 72 NBR872); (median values)

Change in hardness Shore A in hardness degrees	Change in volume in %	Change in tensile strength in %	Change in elongation at break in %	Points
-10 ≤ x ≤ 10	-10 ≤ x ≤ 10	-25 ≤ x ≤ 10	-25 ≤ x ≤ 10	2
-15 ≤ x < -10 oder 10 < x ≤ 15	-15 ≤ x < -10 oder 10 < x ≤ 15	-50 ≤ x < -25 oder 10 < x ≤ 50	-50 ≤ x < -25 oder 10 < x ≤ 50	1 **)
x < -15 oder x > 15	x < -15 oder x > 15	< -50	< -50	0

***) *only if the deviation to bold written limits exceeds one of the four test criteria limits. If more than one test criteria is exceeded: no point.*

2.4 Necessary amounts of oil / test cost

It is mandatory the oil containers are marked with oil designation, base oil type, the API- Group, ISO- viscosity, and corresponding purchase order number / test conditions. In addition an actual material safety data sheet in German must be attached.

In order to achieve an oil release of a homologous series with various viscosities by Flender the preferred viscosity for static testing is ISO VG 320.

For one test with one elastomer compound and one oil , one liter oil is needed . A static test costs 660.- EUR

3. Evaluation and report

The results of the static and dynamic tests are listed on a separate form and sent to the customer. Next to the evaluated characteristic data, a photo documentation is done in case of extraordinary optical conspicuities and attached to the report.

The results of the static are evaluated with 0 up to maximum 2 points according to the criteria listed above. The reached number of points can be seen on the individual report.

The overall evaluation of static and dynamic results is made by Flender after submitting the application for release for an oil. To be released by Flender, all tests have to reach one point at minimum.

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3.1 Example of the report form

The report contains information about the test conditions besides the material properties.

The required information is shown on the attached example of the report form.

This test method was developed in cooperation of Freudenberg Sealing Technologies, and Flender.

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FREUDENBERG SEALING TECHNOLOGIES		FREUDENBERG INNOVATING TOGETHER	
Results of Static Seals Compatibility Test acc. to FS PLM 111 0119 Rev. 01			
pictures of test vessel with test samples			
PO: xxx	PP-Nr.: PC1700xxx_001	date: 01.01.2018	page 2 (2)
customer: xxx			
elastomer material: 72 NBR 902	attempt started: xx.xx.xxx		
test sheet batch No. : 2018_01			
test conditions:		test medium:	
time: 1008 h	temperature: xx °C	name: xxxxx	type: PAO
testing laboratory: MF- W technikum		nominal viscosity: VG 320	volume: 80 times of elastomer volume
used measuring instruments:	hardness tester : Bareiss SH A Nr. 10938	tension: Zwick / Roell Z 005 Nr. 12391	
	oven No. : 0	volume: Satorius PM0 Nr. 383	
remarks: test remark			
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>before test</p>  </div> <div style="text-align: center;"> <p>after test</p>  </div> </div>			
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