

Test specification for testing the oil compatibility with primers used in FLENDER-Gearboxes

Aim is to test the compatibility of oils with the gear inside paints which are used from Siemens Mechanical Drives according to current oil-approval-specification for FLENDER gear units. For every primer has to be recorded a separate test log sheet (see attachment).

General definitions

- 1) When submitting a test order with an approved test institute one liter oil per primer must be delivered free to the consignee's address. The following details must be reported by the purchaser:
 - Information that the test shall be done in accordance with "Test specification for testing the oil compatibility with primers used in FLENDER-Gearboxes"
 - Oil manufacturer
 - Name of the oil, name of the oil sample or oil code
 - base oil type (Mineral oil API I, mineral oil API II, semi-synthetic oil API III, PAO, PAG, synth. Ester)
 - Viscosity acc. to ISO (industrial gear oil) or acc. to SAE class (engine oils)
 - Batch number of the oil
 - Name of the primer(s) with which the compatibility tests needs to be carried out.
- 2) Four coated steel test panels type R-36, item number 71242, mat, dimensions 76x152, company Q-Lab Deutschland GmbH are used per oil for the test. All panels shall be coated only on one side and it is not allowed to cover the edges with tape.
- 3) Both test panels which are coated with the same primer must be coated with a primer of one batch. The batch number of the primer needs to be recorded.
- 4) For testing are used two cans of different sizes which necessarily must be able to be nested into each other. The bigger can comes with a volume of 2.5 liters and the inner can with a volume of about $\frac{3}{4}$ liters. The inner can in which the oil has to be filled consists either of tinsplate or of laboratory glass and must be new or cleaned without residues and without corrosion marks.



- 5) The test panels must be degreased with special-diluent butyl-acetate 98/100 before coating the panels.
- 6) The application of the primers on the test panels is done related to practice by brushing or by spraying. The primer has to be coated on the panel to reach a dry layer thickness for one-component primers of 30 to 50 μm and for two-component primers of 70 to 95 μm .

- 7) The drying of the coated test panels has to fulfill the following criteria:
- 20 days of forced drying in an oven at 25°C (+/- 1 K)
OR
 - 23 days of drying in standard climate acc. ISO 23270 (23°C)
- After the drying process the test panels can be used for testing for a maximum of 20 days.
- 8) The dry layer thickness of each test panel must be checked on at least 3 places in the lower third of the test panel before test start. Separate out as necessary test panels with failures and/or with coat thicknesses outside the allowed limits. Non-Conforming test panels should not be used. The thickness measurements must be recorded.
- 9) Secondary the test of the pendulum hardness acc. to König has to be carried out acc. to DIN EN ISO 1522 in pendulum swings at room temperature of 20 to 26°C. The measurement results must be recorded.
- 10) Furthermore the panels have to be checked in the upper area (in the not during the test with oil stressed area) with a cross-cut test in accordance to ISO 2409 inclusive the adhesive film test (e.g. Tesa 4122) at a room temperature of 20 to 26° respectively **before** the compatibility test. Panels with Gt 1 or more have to be rejected. The area of the cross-cut has to be covered. Suitable transparent adhesive tapes or approved clear varnishes, such as the PU clear varnish 7042 of Rickert, are usable for this.
- 11) The test oil has to be homogenized and dried for 24
- 12) Composition of important data:

	sample 1	sample 2	sample 3	sample 4
Test oil quantity	400 ml	400 ml	400 ml	400 ml
dry layer thickness 1-component primers	30 until 50 µm			
dry layer thickness 2-component primers	70 until 95 µm			
First test phase (without water contamination)				
period of first test phase	168 hours = 7 days			
oil temperature of first test phase	Mineral oil API I/II & synth. Ester: 95°C; Mineral oil API III, PAO & PAG: 130°C			
Second test phase (with water contamination)				
water contamination	without		with each 20 ml	
period of second test phase	5 hours			
oil temperature of second test phase	Mineral oil API I/II & synth. Ester: 80°C; Mineral oil API III, PAO & PAG: 90°C			

Test procedure „First test phase“

- 13) Fill in of 400 ml of oil into the 4 smaller vessels.
- 14) Due to protection reasons insert the smaller oil containing vessel into the 2.5 liter tin can.

- 15) Only one test panel is suspended in each test vessel.
The bigger tin can (2,5 l) has to be prepared with holes opposed at the upper end.
The holes' height should be chosen in consideration of the hanging test panel which has to have a distance to the bottom of the smaller tin can (0,75 l) of about 1 cm
- 16) Hook the prepared test panels into the oil vessel so that about 30% of the surface of the test panel are in contact with the test medium. Afterwards cover the 2.5 liter can with a detached lid.



- 17) Place the cans with the test panels inside in the convection oven. Heating-up the convection oven at the specified temperature and maintaining the temperature for the first test phase
Mineral oil API I/II & synthetic Ester: 95 °C;
Mineral oil API III, PAO & PAG: 130 °C
The first test phase lasts over a test periode of 168 hours = 7 days.
- 18) Take the cans out of the oven, close the oven and already adjust the test temperature for the second test phase in accordance with point 12) and switch the oven on or leave it switched on.
- 19) Only **visual (optical) evaluation** of the test panels has to be carried out after the first testing period of 168 hours. All determined changes of the test panels has to be recorded. To do that all test specimen are taken out of the oil and an examination of surface blistering and separation phenomena has to be carried out, except border area (1 cm all around). If necessary a lint free rag can be used.
In case the visual (optical) evaluation shows that the primer is already damaged (destroyed) and/or surface blistering is greater than 1 in accordance with ISO 4628-2 the panels have to be photographed and the evaluation is: **not resistant**. To ensure that the surface blistering can be well recognized on the photo either a detail has to be photographed or an enlarged section of a high quality photo has to be shown in the test report. If necessary the test specimen can be cleaned with white spirit. The test can be stopped in case the evaluation is “not resistant”.
- 20) Visual assessment of the oil for deposits or streaks. If such are detected, they have to be documented by taking a photograph and noted in the test report.

If the evaluation is **not** „not resistant“ the test is continued instantaneously with the second test phase as follows:

Test procedure „Second test phase“

- 21) After inspection, test panels 1 and 2 have to be placed again into the test cans and cover the cans with the detached lids.
- 22) Add 5% (20 ml) warm tap water at 80°C to 90°C oil temperature in the cans 3 and 4 and disperse it for one minute until the mixture is completely homogenised.
- 23) Hook the test panels 3 and 4 again into the respective test cans, cover the cans with the detached lids.
- 24) As previously put the four test cans into the oven and temper the oven to the required oil temperature

unrestricted

Flender GmbH, 46395 Bocholt, Tel. 02871/92-0

Link: <https://www.flender.com/de/testdescriptionslubricants>

Mineral oil API I/II & synthetic Ester: 80 °C;
Mineral oil API III, PAO & PAG: 90 °C
Maintain the required oil temperature for 5 hours.

- 25) Instantaneously after finishing the five-hours second test part take the test specimen out of the oven and check the oil loaded areas of the panels for surface blistering and separation phenomena (except border area 1 cm all around). If necessary the test specimen can be cleaned with white spirit. The results have to be recorded (see also attachment). The test specimen has to be photographed when the surface blistering in accordance with ISO 4628-2 is greater than 1. To ensure that the surface blistering can be well recognized on the photo either a detail has to be photographed or an enlarged section of a high quality photo has to be showed in the test report. The cross-cut test and the pendulum hardness test according to König are not necessary when the surface blistering in accordance with ISO 4628-2 is greater than 1.
- 26) Visual assessment of the oil for deposits or streaks. If such are detected, they have to be documented by taking a photograph and noted in the test report.
- 27) The test panels have to be stored for 16 to 24 hours at room temperature from 20°C to 26°C in accordance with ISO 2409. Before that they have to be cleaned with white spirit.
- 28) Measurement the pendulum hardness test (in seconds) according to König in accordance with ISO 1522 on the oil loaded area and the non-oil loaded area of the test panels [in pendulum swings](#) at room temperature from 20°C to 26°C.
- 29) Carry out the cross-cut test according to ISO 2409 inclusive the adhesive film test (e.g. Tesa 4122) on the oil loaded area and the non-oil loaded area of the test panels at room temperature from 20°C to 26°C. Two cross-cut tests have at least to be carried out on the oil loaded area. The higher value has to be used.
- 30) If not already done, take photos of the test panels now. In case no clear assignment between the photo and the test panels is apparent.



The compatibility of the oil with a primer is sufficient then if the limits indicated in the following table are not exceeded:

measurements	without water contamination		with water contamination	
	sample 1	sample 2	sample 3	sample 4
Cross-cut before test	< Gt 1	< Gt 1	< Gt 1	< Gt 1
surface blistering after the first test phase	≤ 1 (S1)	≤ 1 (S1)	≤ 1 (S1)	≤ 1 (S1)
surface blistering after the second test phase	≤ 1 (S1)	≤ 1 (S1)	≤ 1 (S1)	≤ 1 (S1)
Cross-cut after the second test phase non-oil loaded area	≤ Gt 1	≤ Gt 1	≤ Gt 1	≤ Gt 1
Cross-cut after the second test phase oil loaded area	≤ Gt 1	≤ Gt 1	≤ Gt 2	≤ Gt 2
Pendulum hardness quotient [Pendulum hardness oil-loaded area after test] / [Pendulum hardness before testing]	≥ 0,5	≥ 0,5	≥ 0,5	≥ 0,5

31) Completion of the test report (see also attachment). For each tested panel a photo has to be taken for documentation. In case of irregularities like blisters or a cross-cut $Gt > 0$, these have to be documented with photos. So that the abnormalities / peculiarities are clearly visible, they must be shown as a detail..

This test specification was created by company Flender GmbH supported by companies Mäder Germany GmbH, RICKERT GmbH & Co. KG., iLF Forschungs- und Entwicklungsgesellschaft Lacke und Farben mbH, and ISP Salzbergen GmbH & Co. KG.

Contact

Flender GmbH
 Alfred-Flender-Strasse 77
 46395 Bocholt
 lubricants@flender.com

Attachment – Example Test Result Table

Results of the test "Compatibility of oil with primers for use in FLENDER gearboxes"

Revision 2 - Status: 07 November 2017

Bitte Feld markieren und mittels rechtem Pfeil Kunden auswählen:

Labo name Teil 1
Labo name Teil 2
Straße, Nummer
Postleitzahl Ort

Testing standards:
Cross-out test (ISO 2409)
Pendulum hardness test - König (ISO 1622)
Evaluation of degree of blistering (ISO 4822-2)
Tester:
Name 1

Validation date:
xx.yy.zzzz

Rating:
Compatible

Date primer coating:
xx.yy.zzzz

Primer Charge:
4711

Primer:
605.1.3.1.400 Ekokat Aktiv Primer Typ M20, seidenmatl. ab. RAL 7 036 schatgrau, MV5:1 mit 655.0.0.14.00

Oil Viscosity ISO VG / SAE:
VG 220

Oil / sample name:
Fluid W

Oil / sample Charge:
best one 1

Test start (date):
xx.yy.zzzz

No.	Pendulum hardness before the test		Dry film thickness [µm] before the test		Phase 1 16.6 h at 95 °C / 130 °C	Phase 2 plus 5 h at 80 °C / 90 °C	Phase 2 with water	Blistering after		after phase 2				Remark	Compa- tibility	
	average	[σ]	measured	Ø				Phase 1	Phase 2	area with oil contact	area without oil contact	Pendulum hardness	Cross-out test [G]			Pendulum hardness
1	82	115	46	46	46			0	0	79	111	0	80	112	0.56	yes
2	83	116	49	49	47	X		0	0	75	105	0	80	112	0.50	yes
3	84	118	49	49	47		X	0	0	58	81	0	80	112	0.69	yes
4	85	119	49	49	47			0	0	60	84	0	80	112	0.71	yes

^{*)} Pendulum hardness quotient: [Pendulum hardness on area with oil contact after test] / [Pendulum hardness before test]

Picture for No. 1	Picture for No. 2	Picture for No. 3	Picture for No. 4