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Examination report

Diesel fuel filter

SWK 2000/40 M

Part A : Differential pressure curves

Part B : Water separation

Part C : Solids separation
and
backwashing

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Reference no. : 3.1.2-46/84
Order no. : 47 87 82/01

Essen, 04.03.94
Scl/Dke

Report
on the examination of diesel fuel filter SWK 2000/40 M

Client ..... Willibrord Lösing
Essener Str. 108
45529 Hattingen

Examination object ..... Diesel fuel filter SWK 2000/40 M with filter elements
- 10 µm
- 30 µm

Aims of the examination .....
A. Measurement of the pressure loss curves

B. Measurement of the degrees of water separation with 30 µm filter elements

C. Measurement of solids separation and backwashing behaviour with a 30 µm filter element

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Part A

Differential pressure curves

1. Examination object

The diesel fuel filter SWK 2000/40 M to be examined is designed for installation on the suction side. The nominal flow rate is 40 l/min.

Extra light heating oil with a density of 0.840 g/cm³ (at 15 °C) was used as the test oil.

2. Examination commission

Measurement of the pressure differentials up to the nominal flow rate of 40 l/min. with the 10 µm and 30 µm filter elements and the plotting of the differential pressure curves ($\Delta p = f(\dot{V})$).

3. Results of the examination

The differential pressure curves are shown in Annex 1 of Part A of this examination report.

Annex

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To part A of the report dated 04.03.94
Reference no.: 3.1.2-46/84
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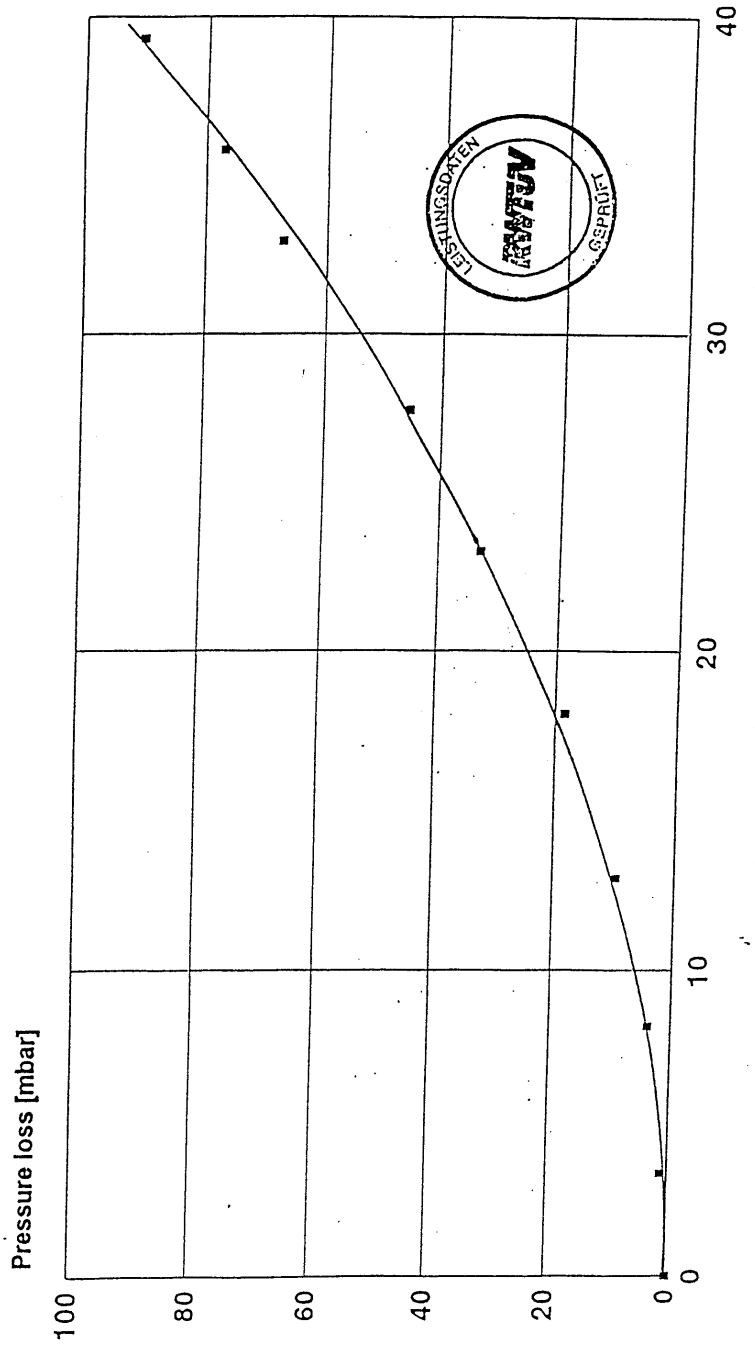
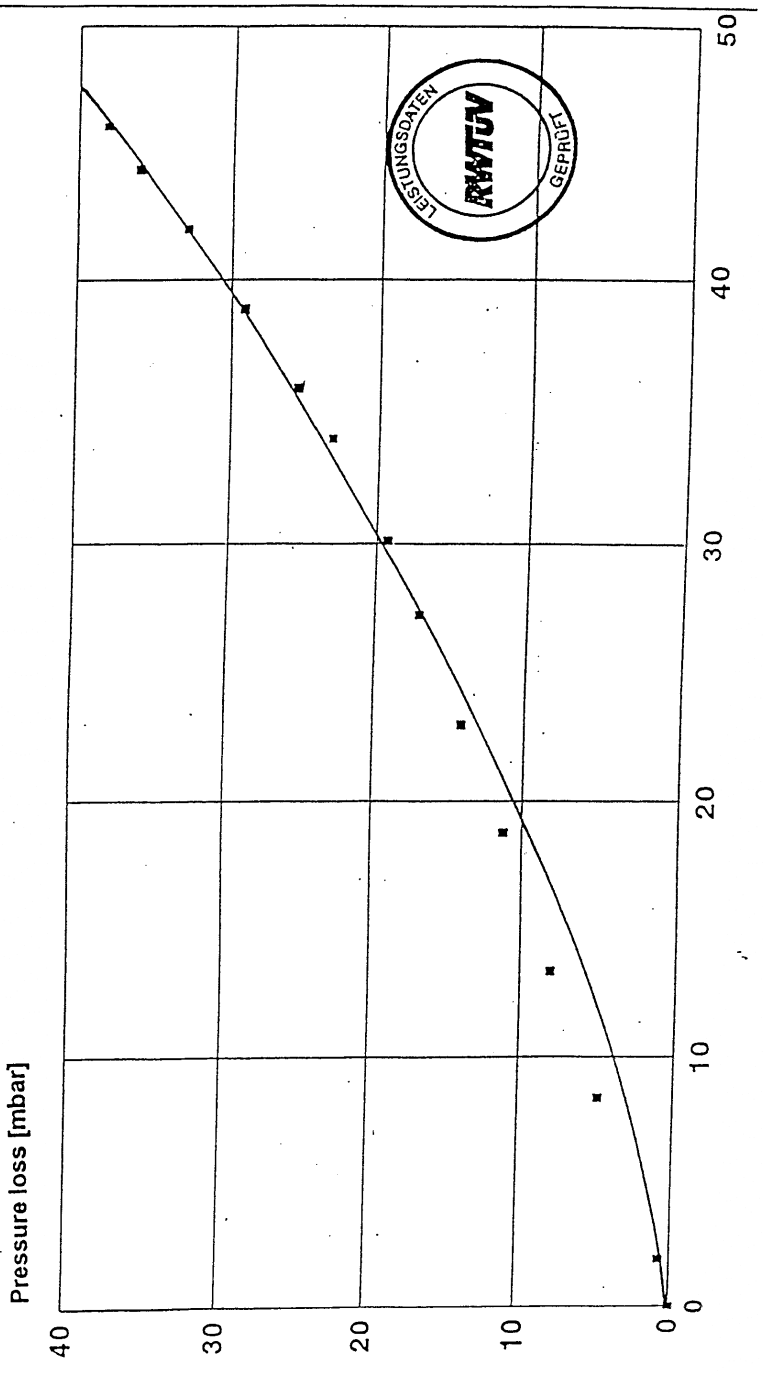
Pressure loss measurement on a diesel fuel filter



Type of filter: Separ SWK 2000/40 M

Filter element: 10 µm

Pressure loss measurement on a diesel fuel filter



Type of filter: Separ SWK 2000/40 M

Filter element: 30 µm

Part B

Water separation

1. Examination object

The diesel fuel filter SWK 2000/40 M to be examined is designed for installation on the suction side. The nominal flow rate is 40 l/min.

Extra light heating oil with a density of 0.840 g/cm³ (at 15 °C) was used as the test oil.

The water was continuously fed into the filter's suction line and intermittently extracted from the filter casing without interruption of the test run (cf. section 2: Notes).

2. Examination commission

Determining the degrees of water separation using 10 µm and 30 µm filter elements.

- Feeding water into the test oil stream : 0.2 % by volume
- Test oil flow rates : 20 l/min., 25 l/min., 30 l/min., 36 l/min. and 40 l/min.
- Test time : 60 mins in each case
- Sampling after 15 mins, 30 mins, 45 mins and 60 mins.

Notes

1. Determination of the degrees of water separation at 36 l/min. and 40 l/min. test oil flow rates was performed using filter elements which were divided by a central web.
2. At 40 l/min. test oil flow rate the test run was interrupted every 10 mins and the water was drained from the casing with the vent open, cf. Annexes 2 and 3 to part B of this examination report.

3. Results of the examination

The results of the measurements are shown in Annexes 1 to 3 to part B of this examination report.

In the calculation of the degree of separation only the water rate specifically fed into the test oil stream, namely 0.2 % by volume, was taken into account.

Annex

Water separation
Diesel fuel filter SWK 2000/40M

Filter element : 30 µm
Test oil flow rates : 20 l/min and 25 l/min
Seeding water : 0.2 % by volume

Point when sample taken [min]	Sample no. [1] [-]	Water content in test oil stream [mg/kg]	Water content of the sample [mg/kg]	Degree of water separation [%]
-	**1st 0-sample**	0 + 40	40 - 40 = 0	100
15	40-30-20-15	2381 + 42	30 - 42 = -	100
30	40-30-20-30	2381 + 45	40 - 45 = -	100
45	40-30-20-45	2381 + 47	40 - 47 = -	100
60	40-30-20-60	2381 + 50	30 - 50 = -	100
-	**2nd 0-sample**	0 + 50	50 - 50 = 0	100
15	40-30-25-15	2385 + 52	40 - 52 = -	100
30	40-30-25-30	2385 + 55	100 - 55 = 45	98,11
45	40-30-25-45	2385 + 57	60 - 57 = 3	99,87
60	40-30-25-60	2385 + 60	90 - 60 = 30	98,74
-	**3rd 0-sample**	0 + 60	60 - 60 = 0	100

[1] Structure of sample no.: type of filter - size of pores [µm] - test oil flow rate [l/min] - point when sample taken [min]

Water separation
Diesel fuel filter SWK 2000/40M

Filter element : 30 µm 2)
Test oil flow rates : 30 l/min and 36 l/min
Feeding water : 0.2 % by volume

Point when sample taken [min]	Sample no. 1) [-]	Water content in test oil stream [mg/kg]	Water content of the sample [mg/kg]	Degree of water separation [%]
-	**1st 0-sample**	0 + 48	48 - 48 = 0	100
15	40-30-30-15	2381 + 54	73 - 54 = 19	99,20
30	40-30-30-30	2381 + 61	130 - 61 = 69	97,10
45	40-30-30-45	2381 + 67	178 - 67 = 111	95,34
60	40-30-30-60	2381 + 73	199 - 73 = 126	94,71
-	**2nd 0-sample**	0 + 73	73 - 73 = 0	100
-	**1st 0-sample**	0 + 43	43 - 43 = 0	100
15	40-30-36-15	2381 + 46	54 - 46 = 8	99,66
30	40-30-36-30	2381 + 50	57 - 50 = 7	99,71
45	40-30-36-45	2381 + 53	52 - 53 = 0	100
60	40-30-36-60	2381 + 57	51 - 57 = 0	100
-	**2nd 0-sample**	0 + 57	57 - 57 = 0	100

1) Structure of sample no.: type of filter - size of pores [µm] - test oil flow rate [l/min] - point when sample taken [min]
2) At 36 l/min: test oil flow rate; filter element with central web

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Water separation
Diesel fuel filter SWK 2000/40M

Filter element : 30 µm 2)
Test oil flow rates : 40 l/min
Feeding water : 0.2 % by volume

Point when sample taken [min]	Sample no. 1) [-]	Water content in test oil stream [mg/kg]	Water content of the sample [mg/kg]	Degree of water separation [%]
0	**1st 0-Probe**	0 +30	30 - 30 = 0	100
10	40-30-40-10	2390 +30	29 - 30 = 0	100
10	**2nd 0-Probe**	0 +27	27 - 27 = 0	100
20	40-30-40-20	2372 +27	27 - 27 = 0	100
20	**3rd 0-Probe**	0 +30	30 - 30 = 0	100
30	40-30-40-30	2378 +30	27 - 30 = 0	100
30	**4th 0-Probe**	0 +29	29 - 29 = 0	100
40	40-30-40-40	2390 +29	26 - 29 = 0	100
40	**5th 0-Probe**	0 +31	31 - 31 = 0	100
50	40-30-40-50	2399 +31	25 - 31 = 0	100
50	**6th 0-Probe**	0 +32	32 - 32 = 0	100
60	40-30-40-60	2390 +32	29 - 32 = 0	100
60	**7th 0-Probe**	0 +30	30 - 30 = 0	100

1) Structure of sample no.: type of filter - size of pores [µm] - test oil flow rate [l/min] - point when sample taken [min]
2) Filter element with central web

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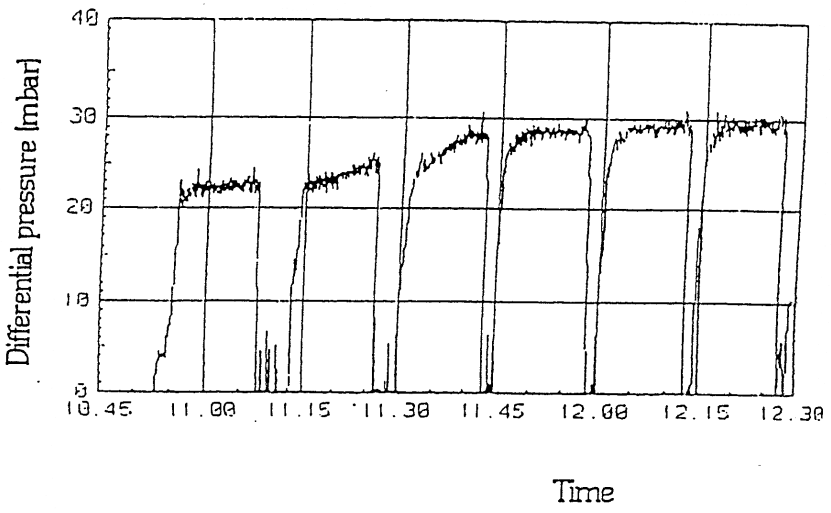
Energy Technology Subdivision

Water separation

Filter	:	SWK 2000/40M
Filter element	:	30 µm (with central web)
Test oil flow rate	:	40 l/min.
Water feeding	:	0.2 % by volume



The chart shows the course of the differential pressures at the water impact intervals of 10 minutes in each case.

Part C

Solids separation and backwashing behaviour

1. Examination object

The diesel fuel filter SWK 2000/40 M to be examined is designed for installation on the suction side. The nominal flow rate is 40 l/min.

Extra light heating oil with a density of 0.840 g/cm³ (at 15 °C) was used as the test oil.

Coarse air cleaner test dust was used as the solid.

2. Examination commission

Measurement of solids separation and backwashing behaviour with use of 10 µm and 30 µm filter elements (with central web) was as follows:

(1) Exposure of the filter to clean test oil and the measurement of pressure loss.

(2) Switching over to the contaminated oil tank.

(3) At $\Delta p > 300$ mbar the pump was switched off and, at the same time, the filter was shut off on both the suction and the pressure sides.

(4) Opening of the vent screw and draining of the test oil from the filter casing including all the solid slurry; determination of the solids content in this sample.

(5) Restart-up of the system with clean test oil and measurement of pressure loss.

(6) etc.

- Test oil flow rate : 30 l/min.
- Solids concentration in the test oil : 0.5 % by weight

3. Results of the examination

The results of the measurements conducted with regard to the solids separation behaviour are shown in Annex 1 of Part C of this examination report.

Annex

For the contents

Dipl.-Ing. R. Schüler

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To part C of the report dated 04.03.94
Reference no.: 3.1.2-46/84
Order no.: 47 87 82/01

Annex 1

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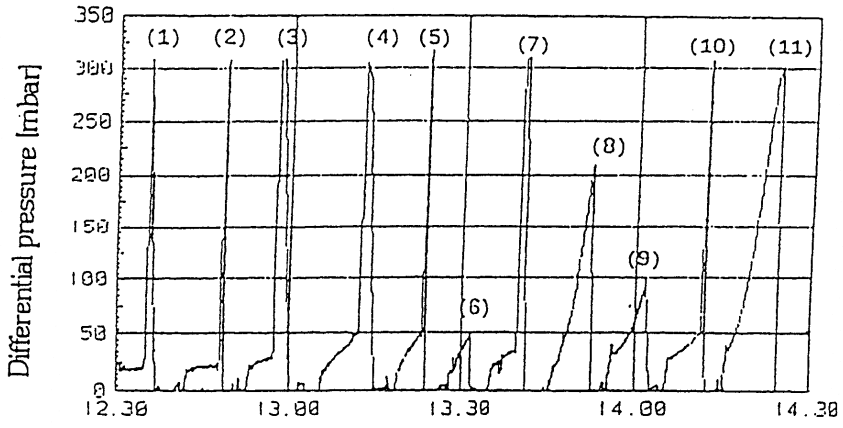
Solids separation measurement

Filter	:	SWK 2000/40M
Filter element	:	30 µm (with central web)
Solid	:	Coarse air cleaner test dust
Solid concentration rate at the start	:	0.5 % by weight (corresponding to 378 g)
Test oil flow rate	:	30 l/min.



Legend

(1) - (5), (7), (10) : pressure build-up with test dust and backwashing
(6), (8) + (9), (11) : pressure build-up with clean oil and backwashing

Δp at the start	: 19 mbar		
Δp after run 1	: 21 mbar;	amount of solids in the sample:	56.7 g
Δp after run 2	: 28 mbar;	amount of solids in the sample:	35.4 g
Δp after run 3	: >50 mbar;	amount of solids in the sample:	7.8 g
Δp after run 4	: >50 mbar;	amount of solids in the sample:	17.0 g
Δp after run 5 + 6	: 35 mbar;	amount of solids in the sample:	13.2 g
Δp after run 7 - 9	: >50 mbar;	amount of solids in the sample:	9.8 g
Δp after run 10	: --- ;	amount of solids in the sample:	9.0 g
		total amount of solids:	148.9 g