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The influence of decreasing setting point on diesel oils.

Report No. 280
Origin: Techn. Lab. Oppau

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SUMMARY

The diesel-oil injection-pump can continue to inject fuel near the Setting Point as long as there is no filter in the suction line. Injection begins to fail when the temperature is near the point at which crystallisation commenced. Additives which lower the Setting Point have only very small influence on the point at which crystallisation begins, although they have an undoubted effect on the Setting Point itself. With or without a filter it is found that the temperature at which the pump fails can be lowered by suitable additives.

PURPOSE OF THE WORK

It was required to determine what influence the beginning of crystallisation (Cloud Point) and the Setting Point have on the passage of diesel oil to the fuel pump and what the effect of additive lowering the Setting Point would be.

The Setting Point can be fairly easily estimated in the case of engine oils, since near it the oil usually becomes very viscous so that the separation of paraffin crystals causes setting within quite narrow temperature limits. With thin diesel oils (circa 4 Cst. at 20°C) long crystals form, which float in the thin oil so that the test sample takes on a slushy consistency. Here a sharp Setting Point cannot be obtained.

It was necessary to find out if the Setting Point was the determining factor when a diesel pump fails or whether the beginning of crystallisation already impedes flow to the pump.

EXPERIMENTAL INSTALLATION

A Bosch diesel injection-pump was built into a refrigerated box (cf. Reports 259 and 269). The pump could be worked up to 60 strokes p.m. The suction line dipped into a vessel containing the oil under test.

As soon as stable conditions had been reached at the temperature in question, the oil was pumped into a second vessel with a 120 ml. calibration mark. The time to deliver 120 ml. was measured at different temperatures and hence the delivery in mls./sec. was calculated.

EXPERIMENTAL RESULTS

1. Setting Point and Cloud-Point Estimations

Table 1 shows that additives have little influence on the Cloud Point, but a stronger influence on the Setting-Point. The obvious explanation of this is that actual crystal separation is not hindered, but that the formation of more numerous and smaller crystals is favoured.

The oil analyses are given at the end of the report.

Table 1

Oil	No.	Additive %	Cloud Point °C	Setting Point °C
Karcher	547	0	<-18	-20
		0.5% PVO	-23	-45
Paraffin Oil (Messel)	561	0	*	+1
		0.5% PVO	-1	-11
Diesel Oil (Messel)	562	0	*	-6
		0.5% PVO	-6, -8	-20
Standard	557	0	-13	-18.5
		0.5% PVO	-17,-18	-38
		0.5% Paraflow	-14	<-45
Standard	583	0	-12.5	-18
		0.5% PVO	-14	<-28
		0.5% Paraflow	-15	-45
Standard	636	0	-12	-19
		0.5% PVO	-15	-35
		0.5% Paraflow	-13.5	-30
Messeller Diesel Oil	572	0	-2	-4
		0.5% PVO	-4	-17
		0.5% Paraflow	-5	-15

* accurate estimation impossible

2. PUMPING EXPERIMENTS

The results of experiments with an injection pump are shown in the attached photostatted graphs. Rate of delivery and the Setting and Cloud Points are plotted against temperature and quantity of additive respectively.

In the experiments oils 572 and 636, mentioned in Table 1, were used with addition of Paraflow and P.V.O. Table 2 shows the number of degrees by which the Cloud Point and Setting Points were lowered.

Table 2

Decrease with 0.2% Addition

Oil	Cloud Point		Setting Point	
	Paraflow	PVO	Paraflow	PVO
572	3	2	11	13
636	1.5	3	11	16

Two series of experiments were made. In one the suction line of the pump was left open in the oil container. In the other a filter, consisting of a piece of oil filter tube was drawn over the end of the suction inlet.

3. EXPERIMENTS WITHOUT A FILTER

In the case of Oil 572 (ph. graph 1) without additive, the pump fails completely at a temperature below the Setting Point.

Since Cloud and Setting Points are close together, a decision as to which has the decisive influence cannot be made.

When additive is present, the delivery above the Cloud Point is somewhat smaller as the additive increases the viscosity. With both Paraflow and PVO, delivery ceases at a temperature below that of the decreased Setting Point. The Cloud Point does not appear to influence the delivery curve. With Oil 636 (ph. graph 2) the delivery rate falls strongly near the Setting Point when no additive is present and reaches zero value well below it. Both additives delay the fall in the delivery rate until lower temperatures are reached. Although the additives influence the Setting Point of oil 636 about as much as 572 (PVO even having a greater effect) the influence on pump delivery is very much smaller.

4. EXPERIMENTS USING A FILTER

The presence of the filter causes a noticeable decrease in ease of delivery.

In the experiment with 572, without additive (ph. graph 3) a sharp decrease in delivery rate occurs at the Cloud Point. Delivery ceases shortly after the Setting Point. Both additives allow of delivery at lower temperatures.

Cessation of delivery of the oil with additive is much closer to the corresponding Setting Point than in the case of the trial without a filter (ph. graph 1).

The results using oil 636 (ph. graph 4) were similar.

The experiments show then, that the pump can work with diesel oil containing crystals, as long as the oil flows to the pump, i.e. does not set. If a filter is fitted the influence of the Cloud Point (beginning of crystallisation) is unmistakeable. The latter is not the sole influence on the pump-delivery since otherwise additives lowering the Setting Point, but hardly affecting the Cloud Point, could not influence the working of the pump. These additives are shown to improve the pump range even with a filter. It was observed that at temperatures below the Cloud Point the oil supply became richer in crystals. Thus it is conceivable that in practice delivery only ceases when the fluid part of the tank contents is all sucked away. The filter, being under the hood, will have warmed up during this period and thus will cause no difficulties. The same applies to the contents of the tank, insofar as it is under the hood or the seat. In the case of tanks at the side or back of the vehicle experiments in a refrigerated room are necessary to establish whether delivery tubes and pumps are capable of transmitting the oil below the Cloud Point.

ANALYSES OF OILS USED

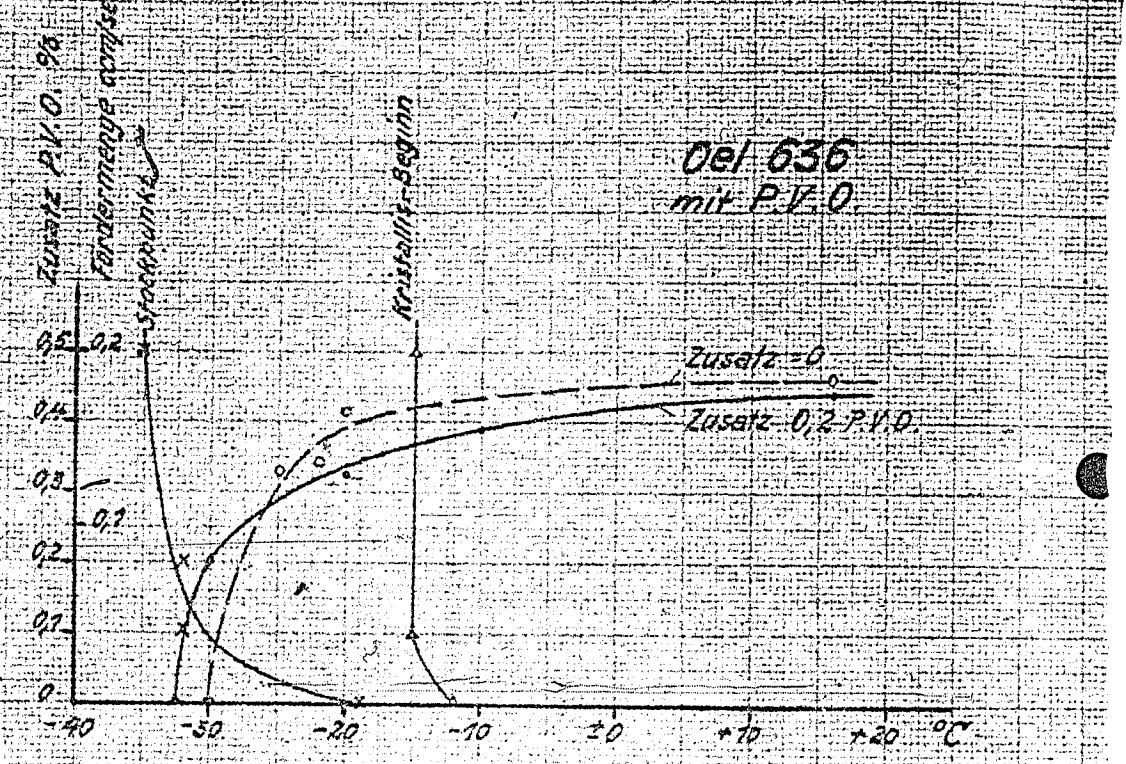
Oil No.	547	561	562	557	583	573	636
Source:	Karcher	Messel Paraffin Oil	Messel Diesel Oil	Standard.	Standard.	Messeler Diesel Oil	Standard.
S.G.	0.860	0.891	0.873	0.871	0.864	0.885	0.856
Aniline Point °C.	68.6	48.6	44.3	60.4	61.4	39.8	65.1
Sol. in Dimethyl-Sulphate %	6	13	17	7	0	18.5	4.5
Creosote %	0	0	0	0	0	0.5	0
Boiling Range:							
5%	235	226	206	239	234	229	227
15	252	269	225	250	238	241	240
25	263	290	245	238	250	253	251
35	273	305	262	266	260	261	266
45	282	319	282	273	269	270	268
55	291	330	300	281	277	278	276
65	301	344	316	291	286	287	286
75	319	360	335	303	299	299	297
85	337	-	359	315	316	315	310
95	-	-	-	348	350	341	341
End at °C and %	365 93.5	370 83.5	375 92.0	350 97.0	355 95.0	342 95.5	350 96.5
Cloud Point.	-18	could not be accurately estimated.		-12	-12.5	-2	-12
Setting Point.	-20	+1	-6	-18.5	-18	-4	-19

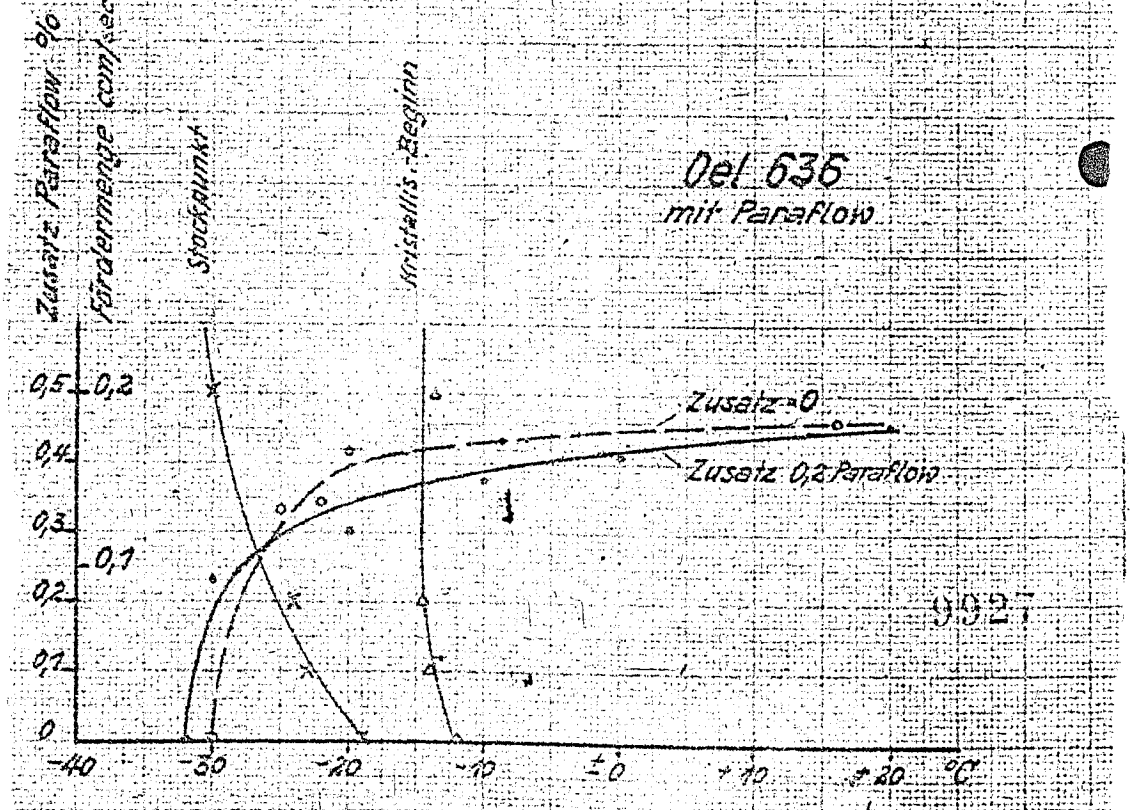
T.A./V. 1

Techn. Prüfstand Op: 200

Blatt 2

Einfluß von Stockpunkterniedriger auf Dieselöl [ohne Filter]





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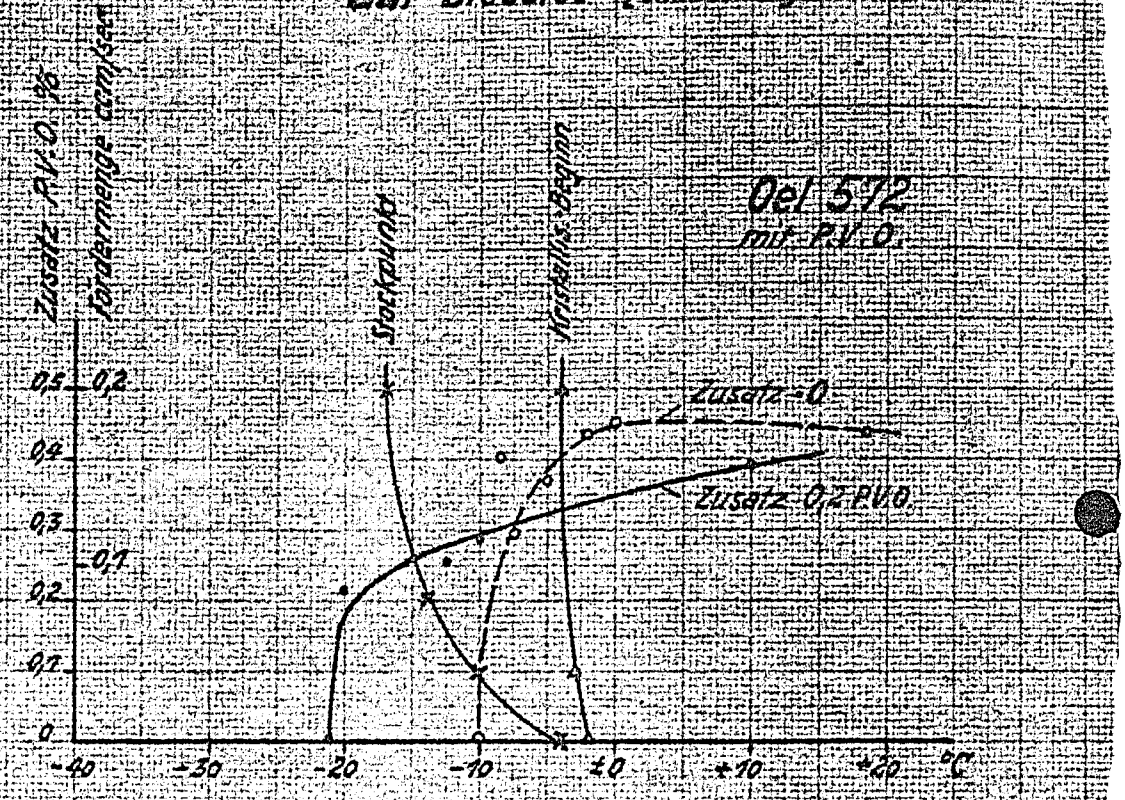
Zum Bericht vom 22.I.35

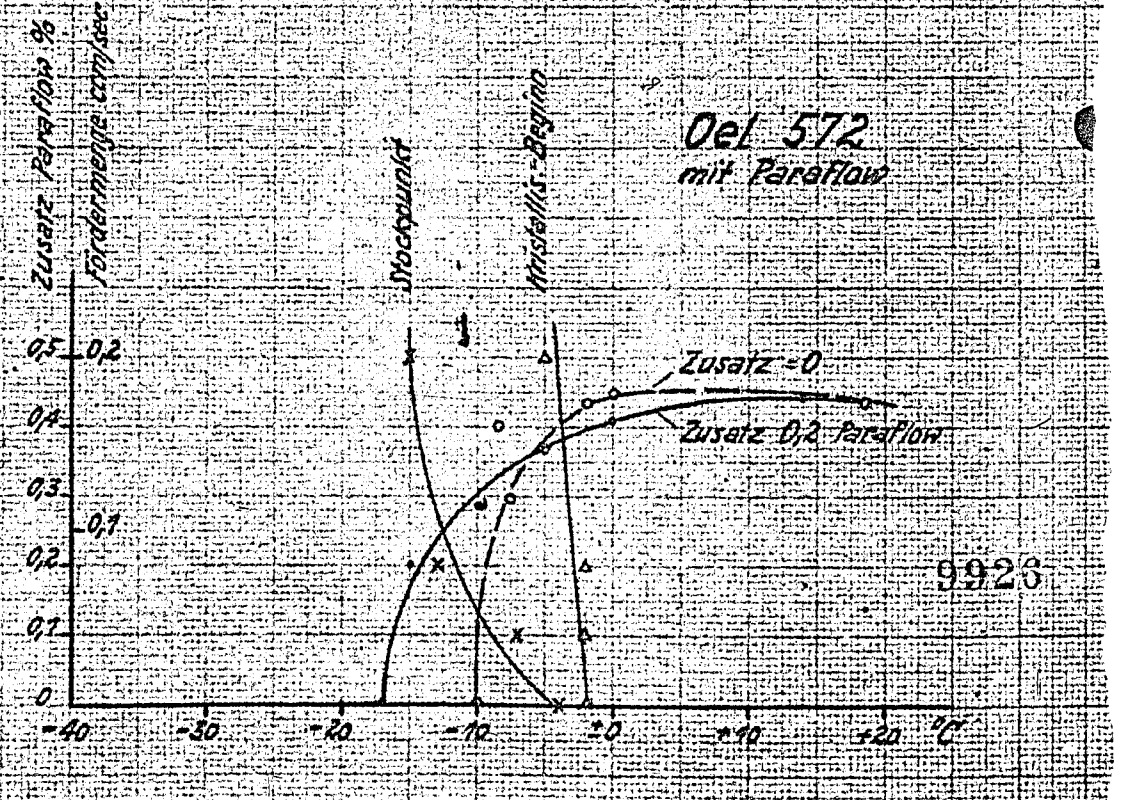
TLD 873

T.A./V.

Techn. Prüfstand Dr. 200-
Blatt 1

Einfluß von Stockpunkterniedriger auf Dieselöl (ohne Filter)





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I.G. Farbenindustrie Aktiengesellschaft
Ludwigshafen a. Rh.

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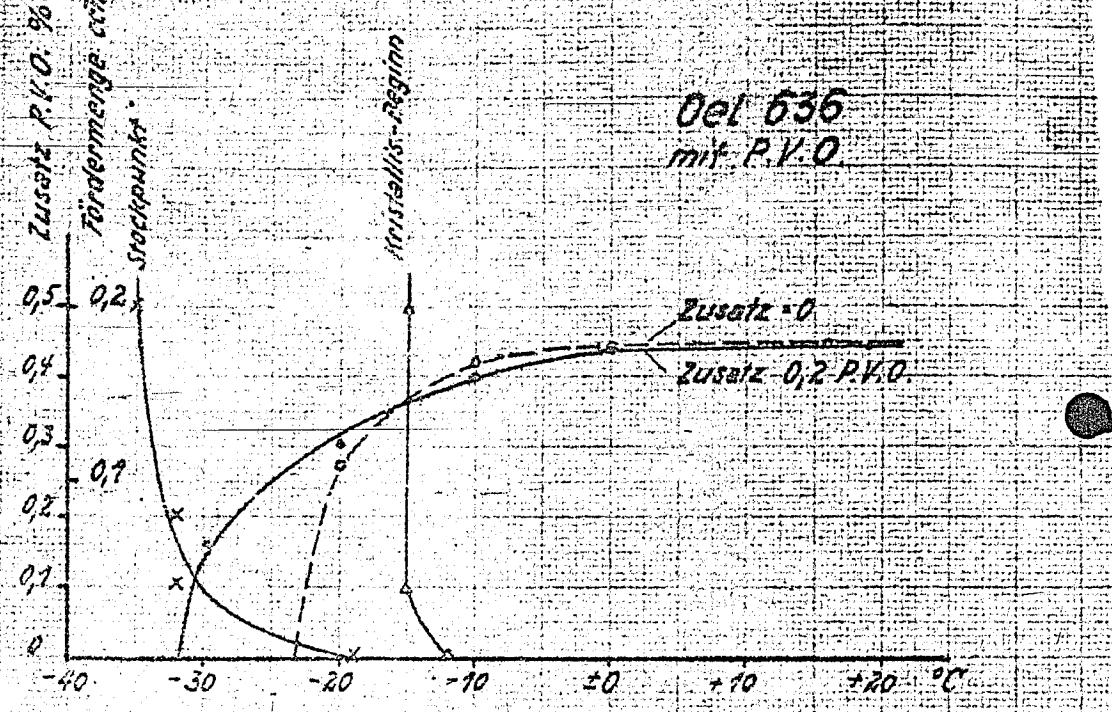
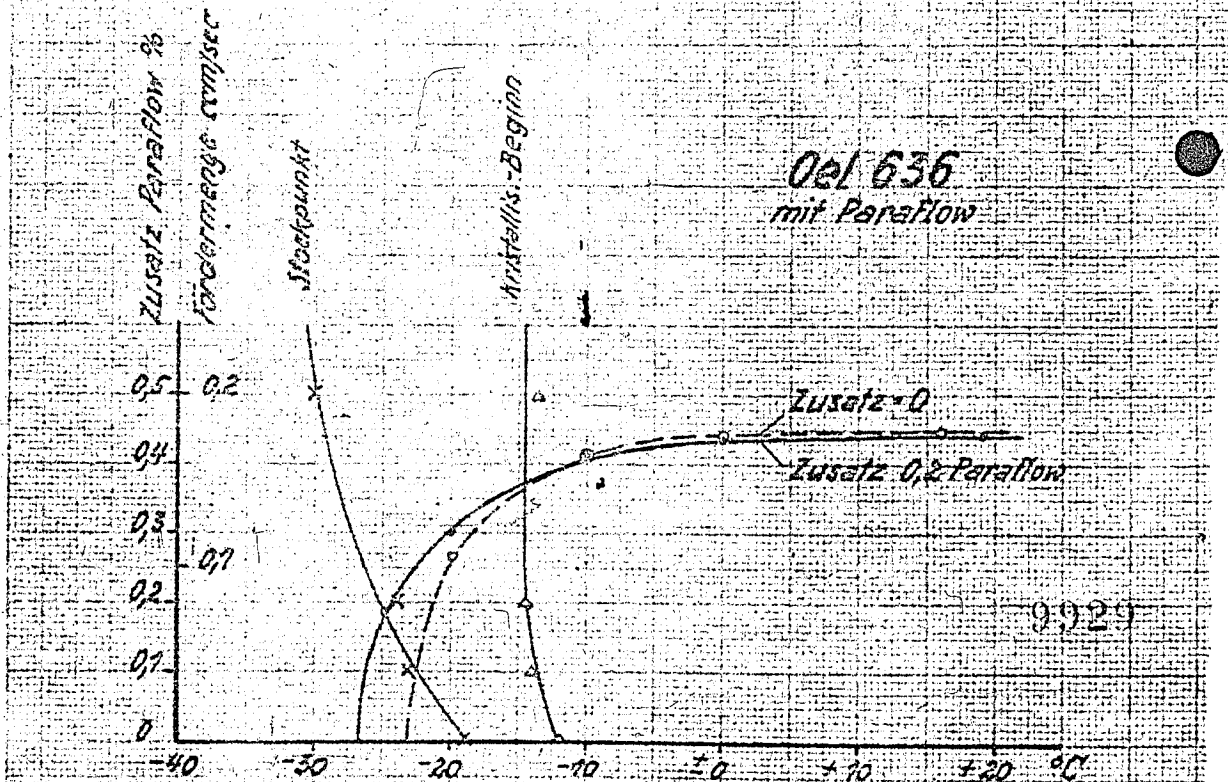
TLD 874

T.A./V.

Techn. Prüfstand Op. 200
Blatt 4

Einfluß von Stockpunkterniedriger auf Dieselöl [mit Filter]





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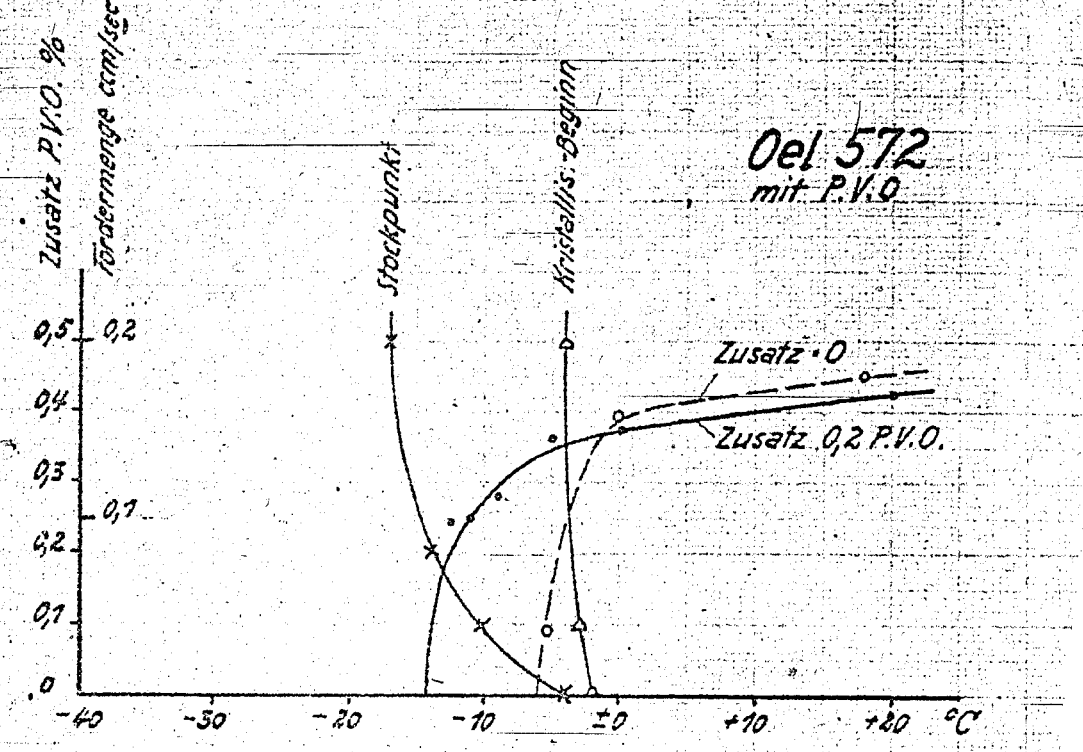
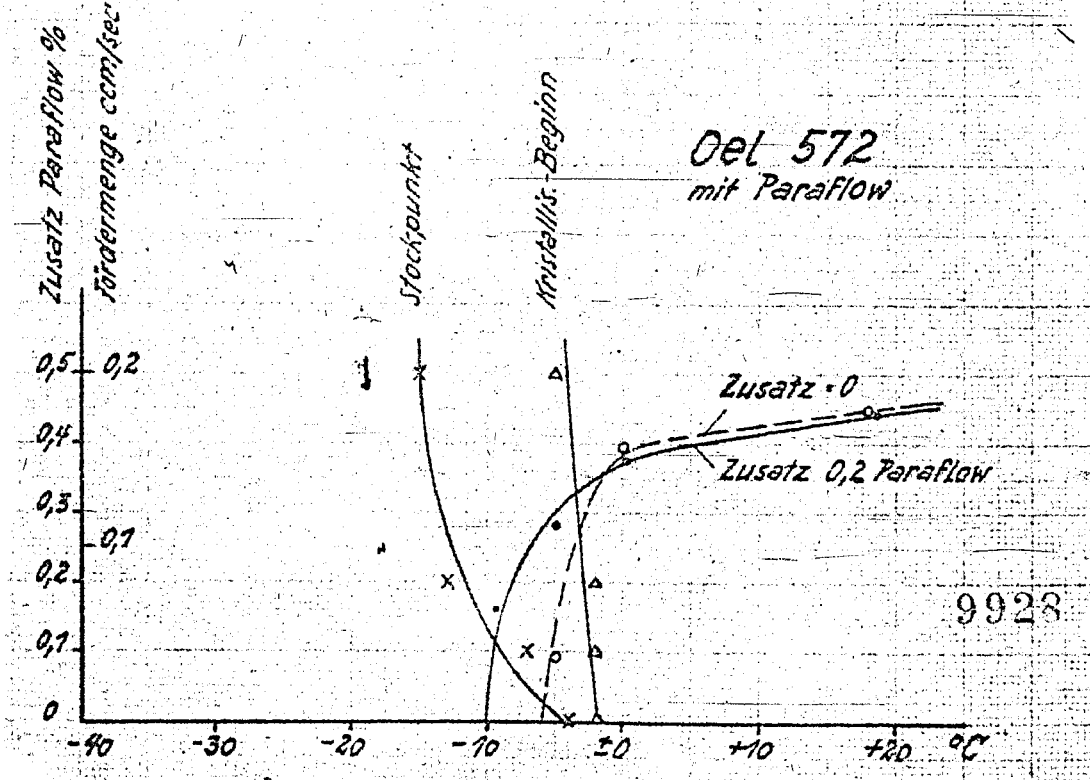
TLD 875

Einfluß von Stockpunkterniedriger auf Dieselöl [mit Filter]





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TLD 876