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PROTOCOL UMR NO. 96/92

**Verification of properties of a FUEL-CAT sample determined for
exhaust valve seat protection against knocking on engines with
cast iron cylinder head when run on lead-free petrol**

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INTRODUCTION

Based on order No. 03/92, paragraph 1, we have tested FUEL-CAT samples for the E.S.M. Ltd. company which were in the tin capsule form with a shape of a truncated cone where the base diameter was 22 mm. Six of them were closed into a cylindrical wire gauze. The objective of the test was to verify declared properties of the samples to enable fail-safe operation of an engine with a cast iron cylinder head being run on a lead-free petrol without subsequent damage of exhaust valve seats. As indicated by customer, the sample should be placed either directly into petrol tank of the vehicle to enable it free motion during drive, or into any place of the fuel system so that oscillations generated by the engine would be transmitted onto this sample. The UVMV methodology has been used during this test (see supplement 2).

Preparations for the tests

Because the test according to the paragraph 1 of the above order was executed on a brake stand, we decided to place the FUEL-CAT sample into the fuel system. The FUEL-CAT sample itself was placed into a special cartridge prepared in advance and was inserted into the fuel system between the fuel pump and carburettor. The cartridge with the sample was attached to the cylinder head cover so as to guarantee the transmission of oscillations generated by the engine onto the cartridge as requested by customer. The engine was tested to run on the following types of petrol:

- Leaded petrol "super"
- Lead free petrol - made of a mixture of 70% of product of reforming and 30% of product of isomerisation in order to guarantee it will not be contaminated by a trace of lead free production and distribution.

An engine SKODA 742.12 determined for a SKODA 120 car was used for the tests. It is a 4-cylinder, water-cooled engine with a compression ratio of 8.7 : 1, engine serial number was T-0446644/120.

Test procedure

The engine was tested within a period of 36 hours in which splitted into 1 hour periods in conformity with the UVMV methodology (see supplement 2). After each 3 hours the extent of knock of exhaust valves onto their seats was determined.

For the first period of 9 hours the leaded petrol "super" was used to prove the fail-free operation of the engine with respect to the knocking. During the second period of 27 hours the engine has been running on the lead-free petrol with periodical checks of exhaust valve knock onto their seats after every 3 hours.

Test results

All the test results of detected knocking of the exhaust valves into their seats are well arranged in a table of measured values in relation to time of test period and to type of petrol used. For better illustration the results are also arranged in the form of a diagram shown in supplement 1.

Until the 15th hour of the test the engine was running on the lead-free petrol (the 20th hour of tests in total) a positive condition with respect to valve knocking has been encountered at all exhaust valves except the 4th cylinder. After that time a low increase of the valve knocking has been detected (to the maximum of 0.04 mm) at all exhaust valves, which with small variations was nearly the same till the end of the test.

After 27 hours of testing the engine with the FUEL-CAT sample running on the lead-free petrol, a loss in weight of this sample was detected from the original weight 121.9548 g to the final 121.9432 g, i.e. a loss by 0.0216 g. Possible lower detected values of knocking the valve into the seat comparing with the former measurement is most likely caused by "knocking in" a certain layer onto the valve seat.

Table of measured values

Petrol type	Concentration of Pb (mg/l)	Time of test (hours)	Valve knocking (mm) cylinder No.			
			1	2	3	4
Super	150	0	0.00	0.00	0.00	0.00
Super	150	3	0.00	-0.02	-0.03	-0.03
Super	150	6	0.00	-0.03	-0.02	-0.01
Super	150	9	0.01	0.00	-0.02	-0.01
Lead-free	0	0	0.00	0.00	0.00	0.00
Lead-free	0	3	0.00	-0.01	0.02	0.02
Lead-free	0	6	-0.01	-0.01	0.01	0.03
Lead-free	0	9	-0.01	-0.01	0.02	0.00
Lead-free	0	12	0.00	-0.01	0.02	0.03
Lead-free	0	15	-0.01	0.01	0.01	0.03
Lead-free	0	18	0.04	0.03	0.03	0.03
Lead-free	0	21	0.03	0.02	0.03	0.02
Lead-free	0	24	0.02	0.02	0.04	0.03
Lead-free	0	27	0.02	0.03	0.03	0.03

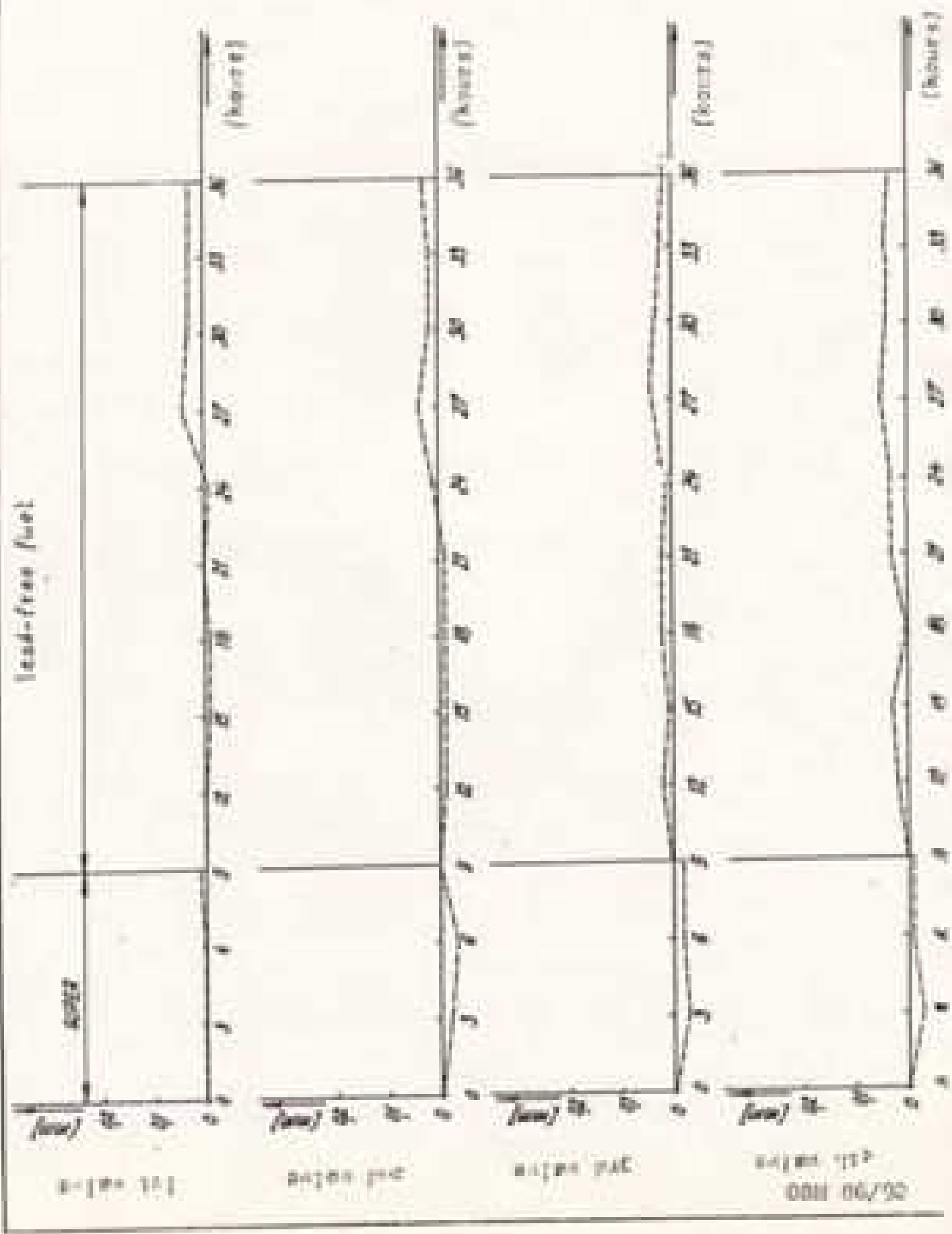
Conclusion

It is evident from the presented results that when using this variant of placing the FUEL-CAT sample into the fuel system of an engine with a cast iron valve head and running the engine on lead-free petrol, the sample has a positive effect on protection of the exhaust valve seats. It considerably decreases the tendency of knocking.

FUEL-Less

with
 of breaking of the exhaust valve into their seats in
 relation to time of operation

22/10/1930



10000 RPM

10000 RPM

10000 RPM

10000 RPM

25/10/1930