EIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

THESIS ON

THE CHOICE AND EVALUATION OF AN ACCELERATED ENGINE TEST PROCEDURE FOR LUBRICATING OILS IN THE PETTER AVI DIESEL ENGINE

SUBMITTED FOR THE
DEGREE OF MASTER OF SCIENCE

BY

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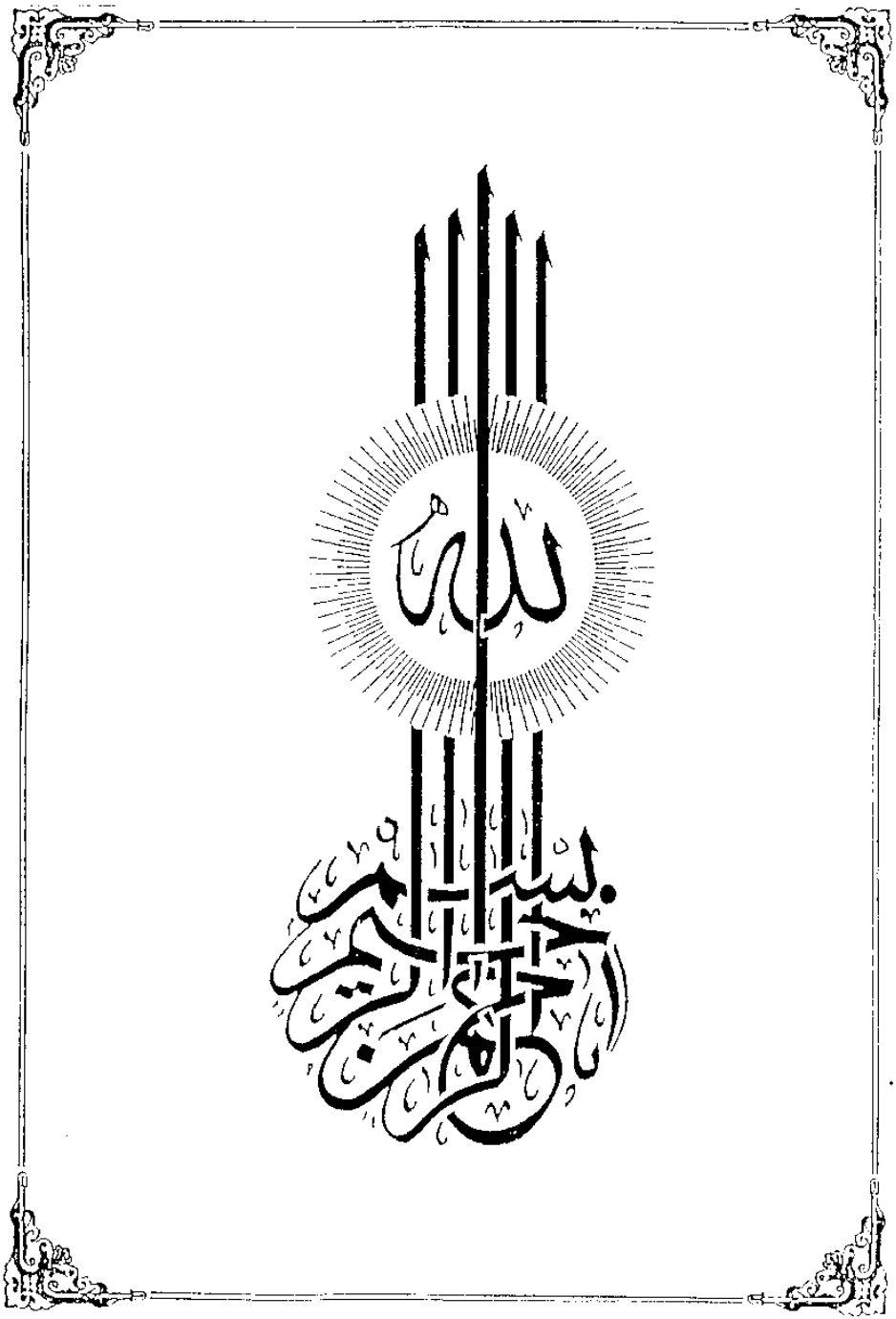
SEPTEMBER 1970

ACKNOWLEDGMENT

The author wishes to express his deepest gratitude to Prof. A.M. KAMEL, B.Sc., Ph.D., Professor of Heat Engines, Faculty of Engineering, Ain Shams University, Cairo, for his valuable remarks and encouragement during the supervision of this work. Special thanks are due to Prof. H.M. EL-SABTLGI, B.Sc., M.Sc., Ph.D., Faculty of Engineering, Cairo University, for his continuous help and advice, and Prof. M.E. NASSIF, B.Sc., Ph.D. Faculty of Engineering, Ain Shams University, for initiating this work.

The author wishes to acknowledge also the tremendous material and technical assistance given by NILE PETROLEUM Co. and its Laboratories, without forgetting the unreserved and invaluable guidance of Messrs S.H. [redacted], B.Sc. (Mech. Engrg.), Manager of Technical Services and Research Division and M. EL-DIN [redacted], B.Sc., M.Sc., Ph.D., Head of Product Development Department.

[redacted] also due to the [redacted] of the Faculty of [redacted], Ain [redacted]



CONTENTS

SUMMARY

THE CHOICE AND EVALUATION OF AN ACCELERATED ENGINE TEST PROCEDURE FOR LUBRICATING OILS IN THE PETTER AVI DIESEL ENGINE

The aim of the present study is to establish an accelerated engine test for high speed diesel engine oils and investigate its suitability as a cheap but reliable test for quality control, additive and oil blend evaluation and screening purposes for the development of the local lubricating oil industry.

The proposed accelerated engine test should satisfy the following conditions:

(1) To be carried out on the AVI Petter engine which is easily available.

(2) To be capable of using either a piston assembly previously used in a standard AVI engine test, or a new one.

(3) To evaluate the oil with respect to piston cleanliness and ring sticking which are two of the most important aspects of high speed diesel engine oil performance.

It follows that the thesis covers three sections summarised as follows :

A- A survey of procedures already employed in accelerated engine tests, and the oil properties they measure. This survey facilitated the choice of a procedure fulfilling the above mentioned requirements.

Such procedure is based on the Standard Petter AVI procedure IP 175/64, but accelerated by approximately a threefold increase of both the piston liner clearance, and the ring side clearances, so that the oil is sufficiently exposed to the hot zones, and blow-by gases to give a measurable total demerit rating after a short running time.

The piston was turned to new dimensions to give a clearance of $0.36 \begin{smallmatrix} + 0.025 \\ - 0.015 \end{smallmatrix}$ mm at the skirt, when cold. After turning, the skirt was polished to a center line average (C.L.A.) not exceed 15 microns for the finished surface. The ring sides were ground to ring side clearance of 0.175 mm.

The operating conditions were kept the same as for the standard Petter AVI test except for the oil sump temperature, which was left uncontrolled (80°C. max. from test results).

B- An experimental work to evaluate the proposed accelerated engine test. This experimental work covered the following:

(1) Building up of a test rig similar to that built by Heenan and Froude for the standard Petter AV1 engine test method.

(2) Rating of three oils A, B and C of known demerit order according to the standard operating conditions of the AV1 engine test. The results of this work were used as a yardstick for comparison and discussion purposes. The repeatability of the standard procedure on the built up rig was also investigated.

(3) Three series of tests were carried out on the above oils plus an oil D (of demerit order 4 with respect to the other three oils), using the same test rig, but according to the accelerated procedure. The main objective was to arrive a suitable duration for the accelerated procedure. This work rated the four oils according to their normal order. Further, oils A & D were used to study the repeatability of the test results with the accelerated procedure.

C- An analysis and discussion of the test results

accelerated test. Summary of the findingsin this section shows:

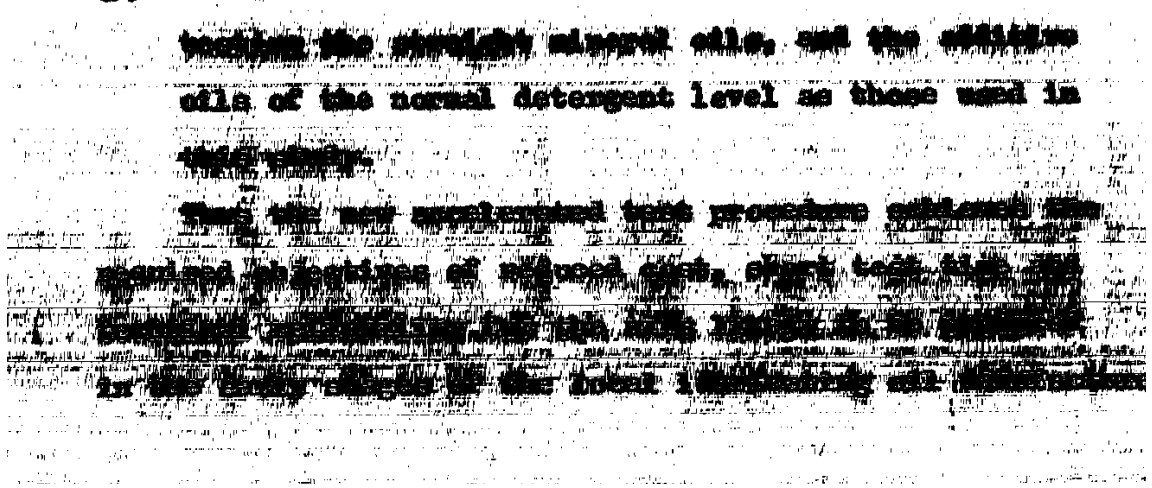
(1) The locally built test rig could be considered as a sufficiently reliable tool for carrying out standard procedure tests and in general for research work on diesel engine oil performance.

(2) The selected accelerated procedure succeeded to raise the rate of accumulation of deposits on the piston parts with a significant degree thus shortening the test time.

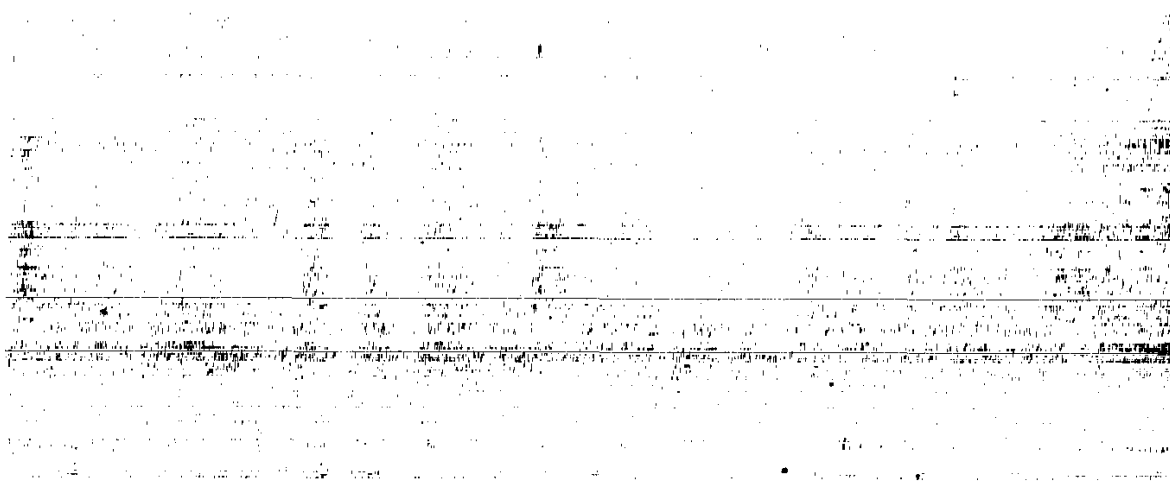
(3) The selected procedure agree with the standard one in rating the tested oils in the same order given by the supplying firm.

(4) The repeatability of the results of the accelerated test procedure is acceptable. Also this procedure give a sufficiently clear differentiation between the four oils.

(5) A duration of 48 hours, was considered suitable for testing the straight mineral oils, and the additive oils of the normal detergent level as those used in this work.



INTRODUCTION



THE CHOICE AND EVALUATION OF AN ACCELERATED ENGINE TEST PROCEDURE FOR LUBRICATING OILS IN THE PETTER AV1 DIESEL ENGINE

INTRODUCTION

The production of lubricating oils has only recently started in the U.A.R. The volume of lubricating oil consumption over the period 1965-1968 is given in appendix I. Since diesel engine lubricating oils represent about 45% of this consumption, the present investigation is concentrated on the evaluation of these oils. The prediction of the quality of diesel engine lubricating oils is preferably done in a diesel engine not in a petrol engine, to ensure that it is evaluated under the actual working conditions, which include :

(1) Contamination of the oil by SO3 originating from the combustion of the sulphur in the diesel fuel, and which may cause corrosion of metallic parts, and intensify the formation of sludge and piston lacquer

(2)

presence of the moisture resulting also from the combustion of hydrocarbon fuels. The most important property of the oil in dealing with soot formation is "detergency" and "dispergency" or more properly "anti-flocculancy", i.e. the ability to wash away the soot particles and keep them dispersed throughout the oil unable to settle out on engine components. Accumulation of sooty deposits in the grooves is a further cause of ring sticking besides the products of oils oxidation (1).

(3) High pressures in the combustion chamber of the diesel engines cause high load on pins, piston rings, and bearings, thus increasing the strain on the lubricating oil film (1).

(4) In diesel engine the blow-by gases are over 90% pure air. The movement of high temperature air through the passages between rings, piston and cylinder has an oxidizing influence of considerable severity on the oil (3).

Since oil oxidation has a great effect on the quality of the used oil (2,3), the need for a short duration and inexpensive engine test for oil oxidation control [illegible] engine test is a recent necessity. Because

the absence of a pilot plant in which the optimum refining conditions could be found out, and the lack of a continuous supply of a selected uniform quality of crude oil, have created a condition which requires frequent change of the refining operating conditions which in turn necessitates following-up on production quality through performance engine testing apart from laboratory analysis.

To evaluate a newly developed or a newly formulated HD oil destined for a certain type of service, the oil is tested in consecutive steps to detect the deficiency in its properties in the early stages. If this deficiency was slight the oil may be remedied by a simple adjustment in its formulation, while if the deficiency was serious the oil may be rejected. The procedure followed at the Shell Thornton Research Laboratory described by Kendall (6) in year 1953 is mentioned as an example. In this procedure tests in steps 1,2 are quite sufficient for manufacturing control and screening purposes, while tests in steps 1,2, 3,4 and 5 are necessary if a complete evaluation for the newly developed oil is required.

1 - The newly developed oil sample has to meet the [illegible] limits for physical properties, [illegible]

2 - Oxidation stability and detergency under engine working conditions are then evaluated in two separate engine tests carried out in a single cylinder Petter Series II gasoline engine, and Gardner type L-2, single cylinder diesel engine respectively. Details of these tests are given in appendix II, tests Nos. 2, and 3.

3 - After the oil has successfully met requirements in the Petter and Gardner engine tests, it will then be submitted for further specific evaluation in engine tests, such as the standard diesel engine ring sticking procedure, which is carried out in a single cylinder Fowler engine. Details of this test is given in appendix II, test 5.

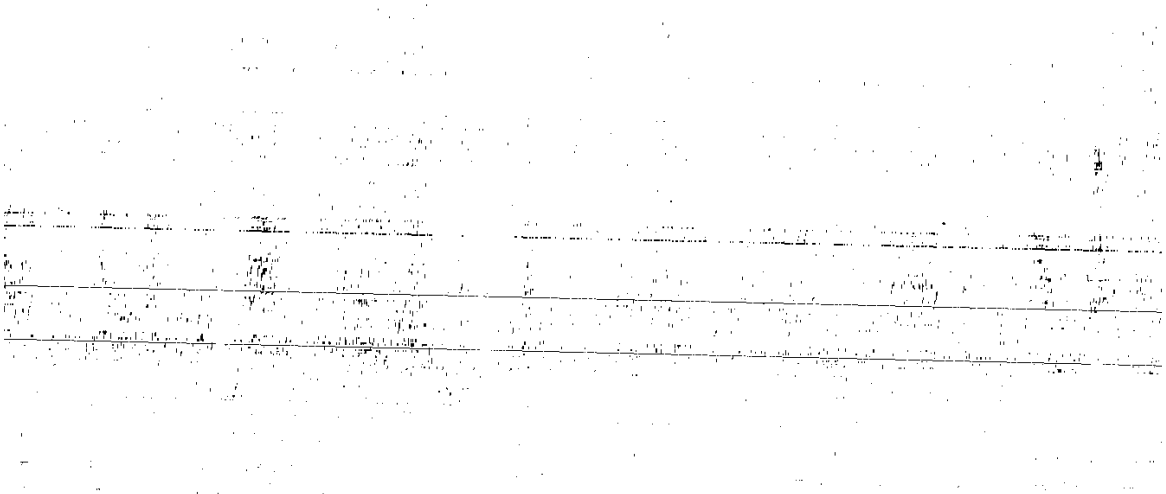
4 - After satisfactory performance in the Fowler engine test the oil is then passed on the standard CRC-L-4 test in the Chevrolet engine.

5 - Finally the standard CRC-L-1 test.

Since some of the above test engines are not available locally, the present study has the objective to find out

a suitable accelerated engine test for screening and manufacturing control purposes to substitute the Gardner test in step 2 of the Thornton procedure, and makes use of the spare parts used in the standard Petter AV1 engine, which are easily available locally. In selection of this test, care was taken to keep within the lines followed by other similar recorded or published studies for similar purpose.

To evaluate the effectiveness of the selected method, its results were compared to that of the Petter AV1 standard test IP 175/64 for the same oil samples. The results obtained demonstrate that the selected method can be used to predict the performance of the oil and its suitability to undergo the Petter AV1 standard test with a reasonable degree of certainty.



CHAPTER I

PROPOSED ACCELERATED ENGINE TEST

I- Review of engine tests.

II- The proposed accelerated engine test.