AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

OPTIMUM RUNNING-IN PROGRAM FOR OVERHAULED INTERNAL COMBUSTION ENGINE

BY

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A THESIS

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the requirements of the degree of Master of Science in

Automotive Engineering

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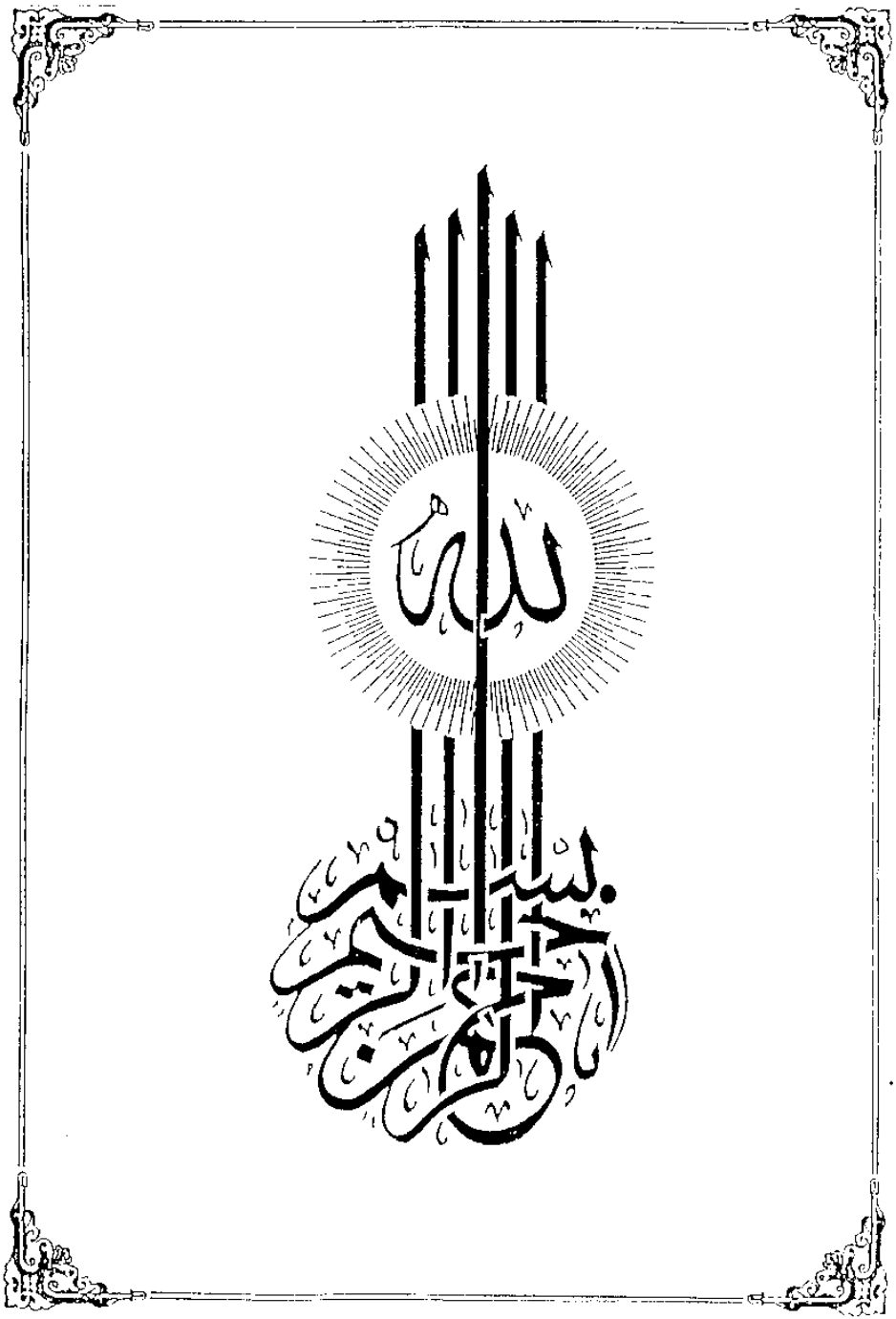

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STATEMENT

This disseration is submitted to Ain Shams University for the degree of Master of Science in Automotive Engineering.

The work included in this thesis was carried out by the auther from November 1990 to November 1994.

No part of this thesis has been submitted for a degree or a qualification at any other university or institute.

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ABSTRACT

The present work is dealing with the investigation carried out to propose the optimum running-in program for the overhauled engine, specially in the absence of automobile maker running-in program.

The running-in of the overhauled engine is usually done in two stages, to save the time taken by repairs. The first stage (*primary running-in*) is performed by the repair under taking and mainly completes the process of smoothing the irregularities on the rubbing surfaces and improves the wearing qualities of the parts, it can be done cold, hot or combined. The second stage (operating running-in) is performed during the operation of the vehicle and fully gets the rubbing surfaces ready to stand up to normal operating loads and eliminates the detrimental effect produced by unconfirmation between the mating parts. Primary running-in is only studied in this thesis due to its great effect on the engine performance and durability.

The most important factors affecting the progress of running-in of the overhauled engine are the initial geometry of the mating surfaces, the characteristics of wear of material, operating condition (load, speed) and antifriction coatings.

The change of engine friction losses is used to indicate the progress of running-in process.

The test rig constructed to measure the engine friction losses by motoring method.

The experiments are carried-out on fifty overhauled engines under fixed conditions as engines model (Petrol engine - four cylinder - 2 445 liter capacity - 78 HP - maximum torque 17 2 kg m), machining process, materials used, amount of repair accomplished and quality of repair work

The experimental results showed that

1- The major effect of running-in process on the overhauled engine takes place during the first few minutes of running-in intervale (30-40) minutes in case of cold running by continuous method, 10-15 minutes in case of cold running by multi-stages or interrupted method and 15-20 minutes in case of hot running-in to reach steady state

2 Running-in process affects clearly engine starting torque, therefore the reduction percent of the starting motoring torque is choosed as a suitable parameter to indicate running-in process

3 Cold running-in results 5% in reduction of starting motoring torque

4 Hot running-in results 26% in reduction of starting motoring torque

5 Combined running-in results 30% in reduction of starting motoring torque

6. The reduction percent occurs in the overhauled engines are 39% in case of starting motoring torque (max. static torque) and in case of steady motoring torque (dynamic torque) 22.2% during running-in intervale with respect to the total operation period (up to next overhaul).

CONTENTS

INTRODUCTION

The major breaking-in of the rubbing surfaces takes place during the first hours of the overhauled or new engine operation. It is therefore essential that during this period the engine is operated under such conditions which will promote breaking-in of the rubbing surfaces without scoring, bending or excessive wear, and prepare the engine parts for work under normal operating conditions. This object can be achieved by running-in the engine.

Running-in creates all the conditions necessary for the rubbing surfaces to become capable of taking and transmitting normal operating loads. This is why running-in should be considered part and parcel of the entire engine repair cycle, this last but very important stage getting the engine parts ready for normal operation.

The length of the overhauld engine life depends not only on the effectiveness of the repair accomplished but also on proper running-in of the engine. Through well overhaul, the engine will not give sufficiently long service unless it is properly run-in. Some automobile engines makers recommend certain rules for running-in the overhauled or rebuilt engines. In the absence of specific schedule for running-in the following thesis is carried-out to propose the optimum running-in program for the overhauled engine with regard to the following items :

* Effect of running-in methods on the friction losses entire the overhauled engines.

- Determining the monitoring factor which indicates the completion of running-in procedure
- Determining the effective factors which accelerate the completion of running-in procedure

CHAPTER I

METHODS OF ENGINE RUNNING-IN PROCEDURE

1.1. Introduction :

The running-in of the overhauled engine is usually done in two stages, to save the time taken by repairs. The first stage (primary running-in) is performed by the repair under taking, the second stage (Operating Running-in) is performed during the operation of the vehicle as shown in Fig.(1.1).

1.2. Primary Running-in (First-stage) :

The primary running-in mainly completes the process of smoothing the irregularities on the rubbing surfaces and improves the wearing qualities of the parts. This is done by preparing the surfaces with moderate operating loads. The primary running-in predetermines the performance and durability of the engine. This type of running-in is performed on special benches or directly on the vehicle. The choice of the method depends on the facilities available and the amount of repair work in hand.

Large repair undertaking will find it more practical to run-in the engine on a bench, whereas for small repair undertaking it will be more expedient to run-in the engine on the vehicle. After routine repairs (replacement pistons, piston rings and bearing shells) the engine also should be run-in on the vehicle.