

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING

DEPARTMENT

DIPLOMA PROJECT

FITTING PARAMETERS OF A CATALYTIC
CONVERTER IN A PASSENGER CAR
EXHAUST SYSTEM

M/775

PANAYIOTIS COSTANTINOU

JUNE 1997

**FITTING PARAMETERS OF A CATALYTIC
CONVERTER IN A PASSENGER CAR EXHAUST
SYSTEM**

by
Panayiotis Constantinou

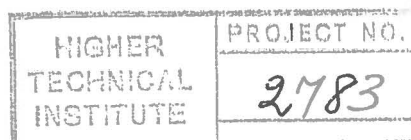
Project report
Submitted to

the Department of Mechanical Engineering
of the Higher Technical Institute
Nicosia Cyprus
in partial fulfillment of the requirements
for the diploma of
TECHNICIAN ENGINEER
in

MECHANICAL ENGINEERING

Supervisor: Dr. Nicos Angastiniotis

June 1997



CONTENTS:

Acknowledgments.....	I
Abstract.....	II
Introduction.....	III
Chapter 1: FUEL AND EMISSIONS	
1.1 Spark-ignition engine fuels.....	1
Chapter 2: POLLUTANTS	
2.1 Combustion.....	5
2.2 Formation of pollutants.....	5
2.3 Characteristics of pollutant components.....	7
Chapter 3: ENGINE DESIGN AND EMISSIONS	
3.1 Compression ratio.....	11
3.2 Combustion chamber form.....	12
3.3 Valve timing.....	13
3.4 Intake passage design.....	14
3.5 Charge stratification.....	15
3.6 Other measures in the engine.....	16
chapter 4: OPERATING CONDITIONS AND EMISSIONS	
4.1 Operating conditions.....	19
4.2 Mixture formation.....	21
4.3 Fuel Induction.....	22
4.4 Ignition.....	23
Chapter 5: IGNITION AND EMISSIONS	
5.1 Breaker-triggered coil ignition (CI).....	27
5.2 Transistorized ignition.....	28
5.3 Electronic ignition (EI).....	28
5.4 Distributorless semiconductor (VZ).....	31

Chapter 6: KNOCK CONTROL AND EMISSIONS	
6.1 Knock limit.....	36
6.2 Knock sensor.....	36
6.3 Control unit (ECU).....	37
6.4 Knock control and with turbocharged engines.....	38
6.5 Special functions.....	40
6.6 Safety and diagnosis.....	40
Chapter 7: LAMBDA CLOSED-LOOP CONTROL	
7.1 Lambda sensor.....	45
7.2 Operation of lambda close-loop control.....	47
Chapter 8: CATALYST	
8.1 Structure.....	56
8.2 How it works.....	57
8.3 Catalytic converter systems.....	58
Chapter 9: CATALYTIC EXHAUST TREATMENT	
9.1 Substrate systems.....	68
9.2 Operating conditions.....	69
Chapter 10: EXHAUST GAS TESTING	
10.1 Exhaust gas testing.....	72
10.2 Exhaust gas analyzers for spark ignition engines.....	79
Chapter 11: SPRAY DRYING	
11.1 Basic process.....	82
11.2 Mechanism for a single Droplet.....	83
11.3 Atomization.....	84
11.4 Mixing and drying.....	86
11.5 Separation.....	89
11.6 Ancillary Equipment.....	90
11.7 A special case.....	91
Conclusions.....	98

ACKNOWLEDGMENTS

I would like to express my sincere thanks to my project supervisor Dr. Nicos Angastiniotis for valuable help and guidance given to me throughout the project period.

Also I would like to extend my thanks to Dr. Chistala Demetriadou for the help she offered me during my attendance at Higher Technical Institute.

Also my deep thanks to all those who helped me in presenting this project.

ABSTRACT

The general purpose of this project was to investigate the literature on various techniques and materials for using in the fitting of a catalytic converter in a passenger car exhaust system and to identify the limiting parameters on the improvement of the system.

Also to investigate the selection of materials in accordance to their compatibility to the catalytic body as well as their respective properties and cost and also to plan and experimentally carry out the fitting procedure.

INTRODUCTION

An exhaustive literature survey on the topic had to be take place to assess the common practice in the building catalytic converters.

As far as the limited parameters of the improvement of the fitting are concerned the weight the temperature resistance and the adhesion properties of the material to be used are of major significance. In project the nature of the manufacturing process in such as all three factors, that is weight, adhesion and thermal stability are satisfied intrinsically. In one step the fitting material and the catalyst are presses to such on extent until they adhere to the exhaust pipe.

The selection of the materials was based entirely on the availability and the cost. We managed to avoid entirely the presents of platinum and substituted it with high surface area of ZrO_2 (zirconium oxide. The fitting material was made out of pure iron at a critical thickness which enables the adhesion both two the exhaust pipe and the ceramic body.

The experimental set-up has the flexibility to accommodate various exhaust pipe, catalyst and fitting material diameters.