

PROGRESS REPORT NO. 4

KINETICS OF OXIDATION AND QUENCHING OF COMBUSTIBLES
IN EXHAUST SYSTEMS OF GASOLINE ENGINES

D. J. PATTERSON

PERIOD: JUNE 1, 1969 to JUNE 30, 1969

June 1969

This project is under the technical supervision of the:

Coordinating Research Council
APRAC-Cape 8-68 Steering Committee

and is work performed by the:

Department of Mechanical Engineering
The University of Michigan
Ann Arbor, Michigan

Under Contract No. CAPE-8-68(1-68)-CRC
and Contract No. CPA-22-69-51-HEW

LONG-RANGE OBJECTIVES

It is well-known that a significant amount of CO and unburned fuel may be consumed in the exhaust system of gasoline engines. Such combustion phenomena in exhaust reactors may be used to advantage to reduce the emission of these undesirable constituents. This process is the basis of exhaust air injection systems currently installed on some automobiles.

The overall objectives of this three-year research program are:

- *To determine the chemical and physical processes which affect the emission characteristics of exhaust reactors installed on selected typical engines operating at various conditions on a dynamometer test stand.
- *To identify the chemical species and significant chemical reactions present before, within, and after the reactor.
- *To obtain information which will be helpful in predicting the design of the next generation of gasoline engine exhaust reactors.

PHASE I PROGRESS

The Beckman NDIR analyzer cart (CO, CO₂, and HC) has been completed and checked out. Calibrating gases (CO, CO₂, NO, and hexane) have been received. Some preliminary emission testing has been done. Next cross-sectional engine and emission data will be recorded. Initially the effect of spark timing, air-fuel ratio, speed and load will be studied with the standard engine exhaust system. Then the du Pont reactor will be installed and evaluated in similar tests.

A Kistler 601A pressure transducer has been installed in the Number 1 cylinder of the engine. This is the cylinder to be used for the single cylinder reactor. Design work is still in progress to install a see-through quartz window in the exhaust port. The speed of sound technique for measuring instantaneous exhaust temperature appears to be too expensive and poses a major development problem in itself. A thin film resistance thermometer technique will be explored instead.

A decision has been made to measure aldehydes by the DNPH method. This method is essentially that proposed by Oberdorfer.¹ In addition a decision has been made to analyze hydrocarbon emissions in more detail by using the class analysis technique proposed by Sigsby.² For the present detailed GC analysis has been de-emphasized. Next these two wet chemical techniques will be set up.

An initial single cylinder exhaust reactor design has been completed. Parts have been ordered. This reactor will be used to obtain design information for successive generations of reactors.

PHASE II PROGRESS

Dr. Kadlec has indicated that work will begin next month—July, 1969.

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1. Oberdorfer, P. E., "Determination of Aldehydes in Automobile Exhaust Gas," SAE Preprint 670123, Jan. 1967.
 2. Sigsby, J. E., Environmental Science and Technology, 1, No. 4, April 1967, p. 309.

PHASE III PROGRESS

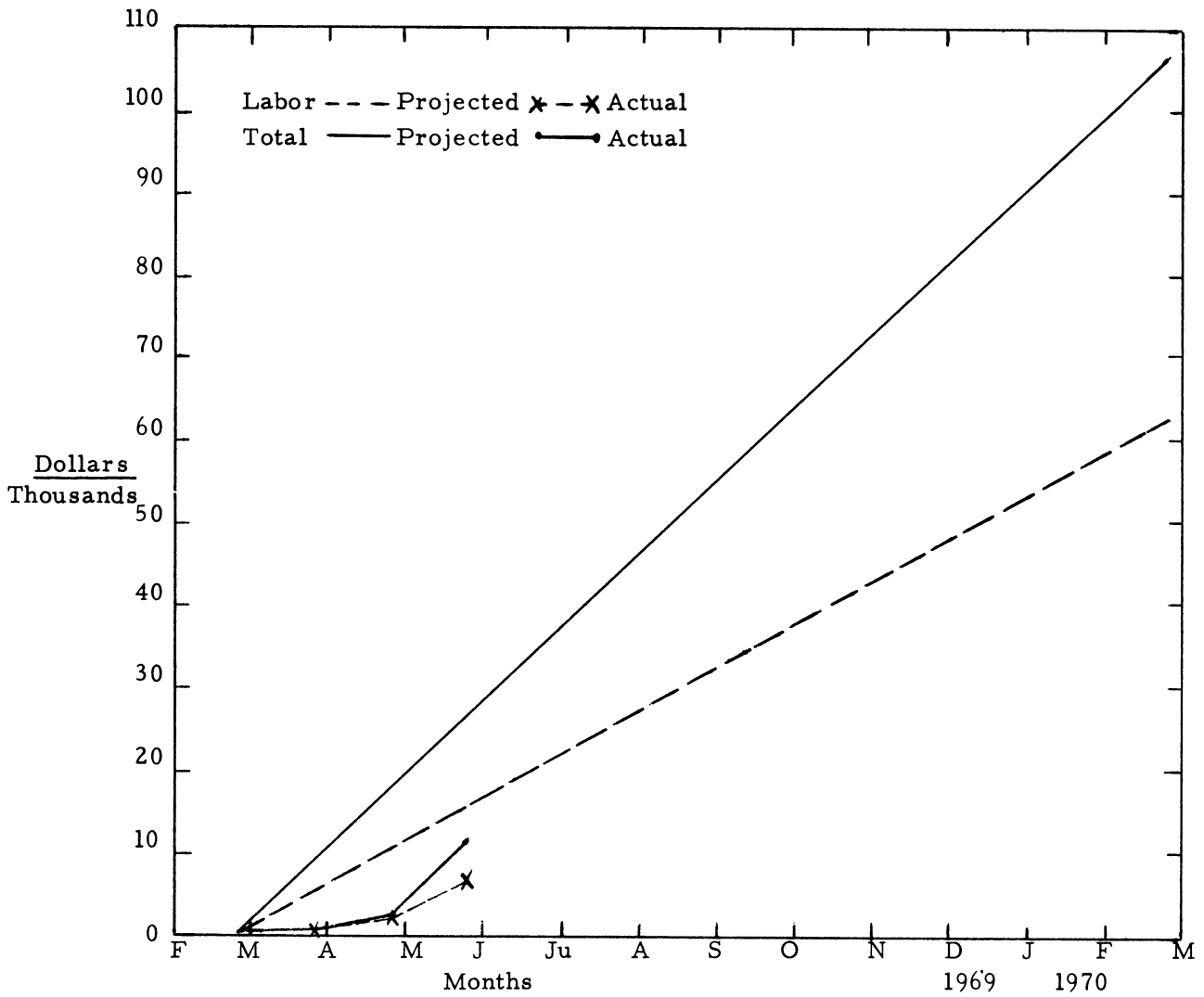
Construction of subtrative columns for class analysis will begin next month as reported in Phase I. Studies of both timed and continuous sampling techniques are in progress.

OTHER

A meeting of the CAPE-8 technical subcommittee with University of Michigan personnel was held on June 27, 1969, in the conference room of the Automotive Laboratory. The overall project was reviewed. The next project meeting was set for October 7, 1969, in Ann Arbor.

CRC CAPE 8-68 PROGRAM
OVERALL FINANCIAL SUMMARY

Program Total: February 24, 1969 - February 23, 1970	\$106,455
Cumulative Expenditures through May 24, 1969	<u>11,785</u>
Balance	\$ 94,670



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