

PROGRESS REPORT NO. 5

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

D. J. PATTERSON

PERIOD: JULY 1, 1969 to JULY 31, 1969

July 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

Initial emission tests were run on the production 350 CID Chevrolet engine. Speed was set at 1200 rpm and load at a calculated road value. Spark timing was varied from TDC to 50° BTC and air-fuel ratio from rich to lean misfire limit. CO₂, CO, and HC were measured by NDIR. HC emissions were measured by FID simultaneously. Further tests will include load and speed effects. A computer data reduction program has been written. Upon completion of baseline tests on the production engine, similar tests will be run using the DuPont reactor.

Wet chemical techniques are being set up for aldehyde measurements. Most of the equipment is now on hand to analyze for total aldehydes and ketones by the DNPH method and formaldehyde for a Chromotropic Acid method. A Bausch and Lomb Spectronic 20 Colorimeter has been obtained for the colorimetric comparison. Several calibration tests have been run using standard formalin solution as the formaldehyde source.

All necessary parts have been ordered for the subtractive column set up. It is anticipated that construction will begin next month.

PHASE II PROGRESS

Work has begun on the computer modeling phase. Initial efforts will be toward a relatively simple model based on overall rate data obtained from the literature. A trip to Mobil Scientific Laboratory is anticipated in the near future for the purpose of discussing their modeling approach.

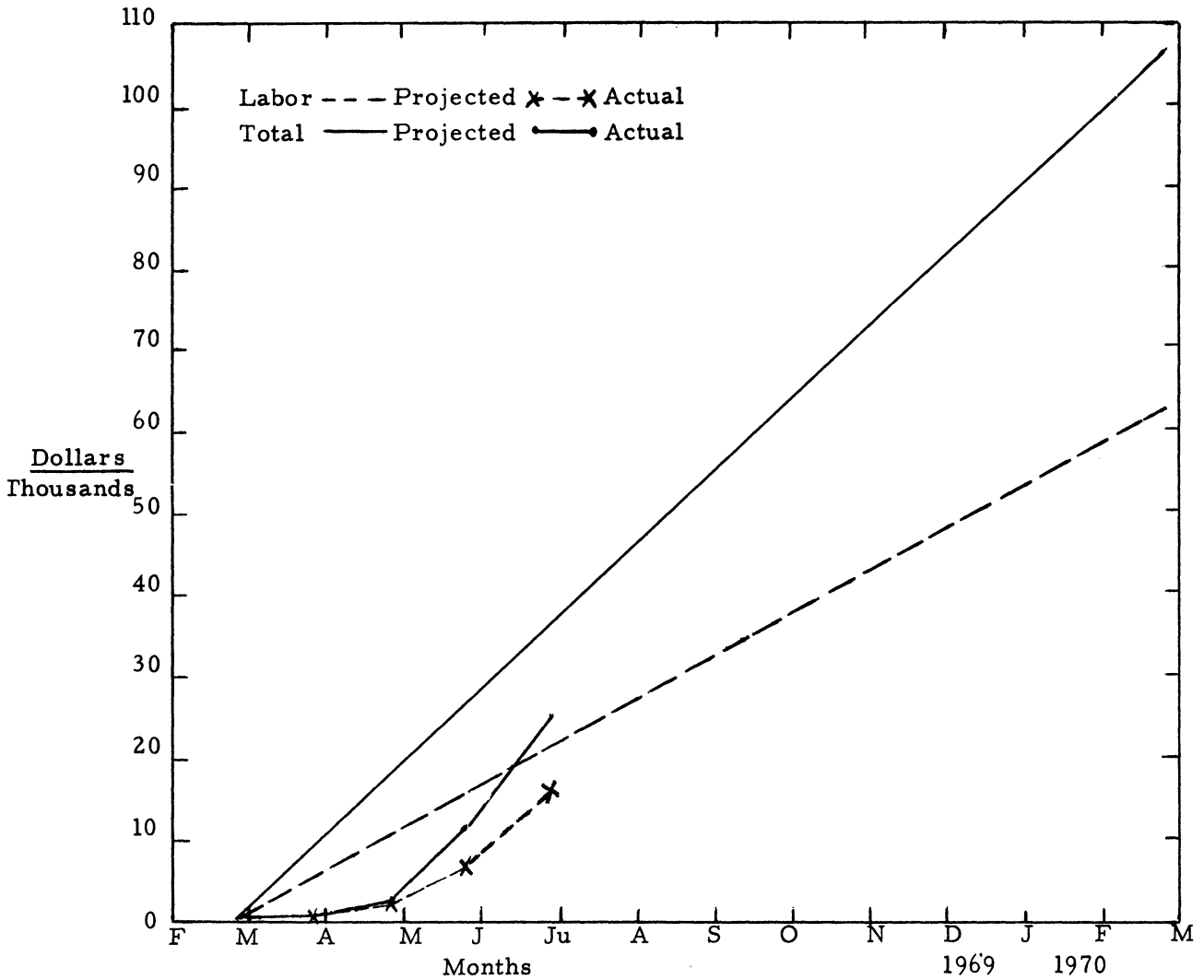
PHASE III PROGRESS

Studies of both timed and continuous sampling techniques continue. An electronic control is being built up for the Cox timed sampler.

CRC CAPE 8-68 PROGRAM

OVERALL FINANCIAL SUMMARY

Program Total: February 24, 1969 - February 23, 1970	\$106,455
Cumulative Expenditures through June 24, 1969	<u>25,237</u>
Balance	\$ 81,218



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