

PROGRESS REPORT NO. 3

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

D. J. PATTERSON

PERIOD: MAY 1, 1969 TO MAY 31, 1969

MAY 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.

CONTRACT PROGRESS

The final CRC and HEW contracts with the University were executed this month. Full funding is now available to the program.

PHASE 1 PROGRESS

A stainless steel sampling system has been installed on the 350 CID Chevrolet engine exhaust system. Exhaust gas samples can be withdrawn from each exhaust port as well as below the exhaust wye and behind the muffler. The

engine has been installed with the vehicle exhaust system. A photograph of the installed engine is included at the end of this report.

Pressure transducers have been ordered for the intake manifold, one cylinder, and exhaust system. Suitable designs have been formulated to install these transducers.

Design work is in progress to install a see-through quartz window in the exhaust system. A velocity of sound technique is being considered for instantaneous exhaust port temperature measurements. Build-up work is nearly complete on the emission cart containing the NDIR analyzers. A separate cart will house the NO analyzer. In addition techniques are being explored for aldehyde measurement and for class analysis by subtractive columns. A decision has been made to delay purchase of the Beckman GC-4 chromatograph. It is thought that the Perkin-Elmer unit in our laboratory may be adequate for the investigation envisioned in this contract. If the Perkin-Elmer proves inadequate, then the GC-4 will be considered again.

Mr. Cantwell, du Pont, has suggested that the two multicylinder reactors which they are providing will be ready around July 1, 1969. He is installing 1 inch diameter quartz windows at both ends. This will provide a direct optical path through the core of the reactor. The total cost of these reactors and modifications to the contract will be \$2,000. The single cylinder reactor design is progressing.

During June it is anticipated that preliminary emission data will be measured on the standard engine.

Mr. Herbert Lord, a former U. of M. student, who will receive his doctorate

in August has been engaged as a full-time Research Associate on Phase I of this program.

PHASE II PROGRESS

No progress this month.

PHASE III PROGRESS

We have decided not to pursue our request to lease some equipment. This resulted from our decision to delay purchase of the GC-4. The immediate plan for Phase III is to begin setting up a subtractive column system for hydrocarbon class analysis.

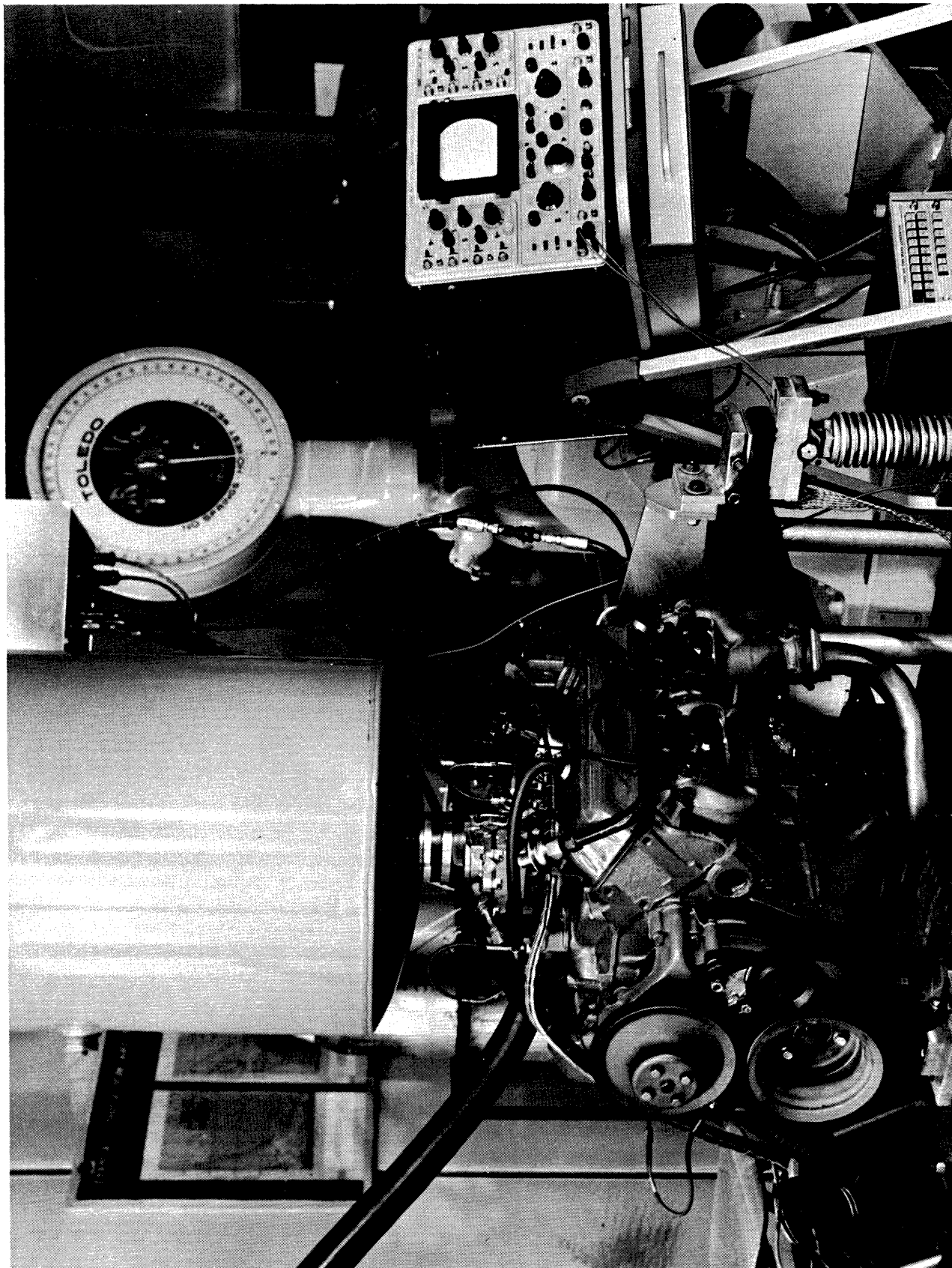
FINANCIAL SUMMARY

Contract Term: February 24, 1969 to February 23, 1970

Overall Budget: \$106,455

Cumulative Expenditures Reported to April 30, 1969: None

Unspent: \$106,455



Chevrolet 350 CID engine set up for test.

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