AGREEMENT

Between the Department of the Interior

and

General Motors Chemical Company

Dayton, Ohio.

WHEREAS, the Department of the Interior, acting through the Bureau of Mines (hereinafter referred to as the Bureau), is conducting investigations on the more efficient utilization of fuels and in determining the amount of air required to ventilate mines and tunnels contaminated with motor exhaust gases, and

WHEREAS, the General Motors Chemical Company (hereinafter referred to as the Company), is also interested in the same subjects, and in particular in whether there is any increase in the toxicity of motor exhaust gases due to the addition to the fuel of certain special chemical substances known as "anti-knock" compounds which enable the use of higher compression engines, thus increasing the mileage from a gallon of gasoline and conserving the liquid fuel resources of the country, and desires to cooperate with the Bureau in this research,

NOW THEREFORE, it is agreed:

(1) That the Bureau and the Company will cooperate in planning and directing an investigation on the toxicity of exhaust gas from motors using tetraethyl lead and certain halogen compounds as anti-knock materials in the fuel according to the general plan outlined in appendix A of this agreement. It is understood that this plan may be modified during the progress of the work as mutually agreed upon.

(2) The Bureau will furnish such laboratory facilities and apparatus as are at hand, heat, light, power, technical supervision of chemists, physiologists and physicists, including actual assistance of pathologist.

(3) The Company shall pay the salary of an assistant chemist to carry on the analytical work incident to this research for whatever period of time may be necessary to secure the information desired and as may be mutually agreed upon during the fiscal year ending June 30, 1925, and shall provide additional assistance as needed and mutually agreed upon by the contracting parties.

(4) The Company shall pay all expenses incurred in the purchase of supplies, repairs, and special equipment not available at the Bureau or provided by the Company. These expenses are to be paid direct by the Company on vouchers approved by the Director of the Bureau or his authorized agent; likewise the salary of the assistant chemist shall be paid in a similar manner.

(5) The investigation shall be carried on under the direction of the Superintendent of the Pittsburgh Experiment Station in a manner satisfactory to both parties of the agreement.

(6) Publication of the results of this investigation shall be under the control of the Director of the Bureau. All manuscripts, before publication, will be submitted to the Company for comment and criticism. Due acknowledgment will be made in the publications to the cooperation of the Company. No progress reports will be given out for publication before the investigation is completed without mutual consent of both parties of this agreement.

Upon the approval of the Secretary of the Interior this agreement shall remain in force until June 30, 1925.

IN WITNESS WHEREOF, the parties have hereunto set their hands by their duly authorized officers.

WITNESSES:

Ruth Sonderhoff

Graham Edgar

BUREAU OF MINES.

O. P. Hood

Acting Director

GENERAL MOTORS CHEMICAL COMPANY

Thomas Midgley Jr

VP & GM

(Title)

Approved June 22, 1924.

E. C. Finney

First Asst. Secretary of the Interior.

## Appendix "A".

Proposed outline of tests to be made in the investigation of the toxic effects of tetra-ethyl lead.

The tests are to be made in 1000 cubic foot gas chamber at the Bureau of Mines, Pittsburgh, Pa. This chamber is constructed of metal and glass so that it is gas tight and the composition of the atmosphere in it can be controlled to meet the conditions desired.

It is proposed to assemble the Delco-Light engine on the outside of the chamber and operate it on gasoline to which has been added tetra-ethyl lead in concentrations the same as sold on the market under the trade name of "Ethyl Gas", (3 cc. tetra-ethyl lead per gallon of gasoline plus an amount of organic chloride compound equivalent in chlorine content to 1.5 cc. of carbon tetrachloride per gallon of gasoline).

The exhaust from the engine is to be discharged into the gas chamber. The carburetor adjustment of the engine will be set or adjusted to produce an exhaust gas containing from 10 to 11 per cent carbon dioxide content. This to be checked each hour by gas analysis for carbon dioxide and once every three hours by complete analysis for carbon dioxide, oxygen, hydrogen, carbon monoxide, methane, and nitrogen.

The weight of gasoline used to be recorded every three hours and the revolutions of the engine kept constant at 1000 R.P.M. The throttle adjustment to be changed to give the amount of carbon monoxide desired to be fed into the chamber.

An analysis of all gasoline used to be made including an ultimate analysis for carbon and hydrogen content.

The exhaust gas entering the chamber is to be diluted with sufficient air to maintain an approximate carbon monoxide content of 0.01 to 0.02 per cent. This dilution of the concentrated exhaust gas is to be obtained by changing the ventilation of the chamber. The amount of air to be measured every hour of testing and controlled accordingly.

The exhaust to be introduced into the chamber through the inlet ventilation duct which extends to within 6" of the ceiling at one end of the chamber. The outlet ventilation duct is to take the air from a point 6" from the floor. The motion of the

air to be upwards against the ceiling and then diffuse down over the animals, leaving through the outlet near the floor.

An exhaust pipe 5 ft. long, having a regular Delco engine muffler at the end, is to be used to carry the exhaust from the engine to the inlet of the ventilation duct.

Determination of lead content in chamber atmosphere to be made by collection with various apparatus (impinger, Cottrell Precipitator, Alundum crucible) and analyses made by recognized methods.

The carbon monoxide in the chamber is to be analyzed by two methods as follows: One average sample, representing each three hours of testing, analyzed by the blood method and a continuous record made by a recording apparatus. The concentration to be further

checked by calculation from complete analysis of the exhaust gas every three hours of testing and the ventilation measurement

PHYSIOLOGICAL TESTS.

Exposure of experimental animals for intervals as given later over extended periods of time as will be mutually agreed on at conferences between the parties of this agreement.

Three sets of animals of various species (Guinea pigs, rabbits, dogs, pigeons and monkeys) are to be used: one set to be exposed for three hours each day, one set for six hours each day, and the third to be unexposed and used for controls. No animals to be fed or watered during tests and all sets to be housed together and fed when off test.

Data to be recorded:

Observation of symptoms.

Examination of the blood:

a. - Hemoglobin content
b. - Lead stippling.

Autopsy to be performed on such animals that die or are killed. Body tissue to be examined for pathological changes and analysis of carcass for lead content.