## ENCLOSURE (B) 13

# THE SPECTROSCCFIC INVESTIGATION ON THE MECHANISM OF THE COMBUSTION OF ALCCHOL

by

CHEM. ENG. LIEUT. COMDR.
Y. MOMCTARI

CHEM. ENG. LIEUT.
Y. KAKIUCHI

Research-Period: 1944

Prepared for and Reviewed with Authors
by U. S. Naval Technical Mission to Japan

December 1945

## LIST OF TABLES AND ILLUSTRATIONS

Table I(B)13 Spectrum Intensities.....Page 151

Figure 1(B)13 Radio Intensity of Spectrum.....Page 152

Figure 2(B)13 Sketch of the Apparatus for Combustion Flame.....Page 152

ENCLOSURE (B)13

## SUMMARY

The more excessive the air-ratio,* the more remarkably intense is the observed spectrum of the lead-oxide band in the flame spectrum of the leaded alcohol. On the other hand, when leaded commercial iso-octane is used for combustion, not only the intensity is generally weaker than that of alcohol but a certain maximum point appears.

This experiment was started in Nov., 1944, but was not finished.

## I. INTRODUCTION

Organic lead compounds are the excellent anti-knocks for gasoline, but, on the other hand, they rather promote knocking when employed for alcohol. With this in mind, the spectroscopic investigation on the difference of their conditions for combustion was carried out.

## II. DETAILED DESCRIPTION

Each definite quantity (0.2% vol. %) of tetramethyl-lead was added to ethanol and commercial iso-octane, and spectroscopic photographs were taken of their inner flame as they were burnt under different conditions of air-ratio. The intensity of each spectrum was measured by a microphotometer. See Figure 2(B)13.

The results were as follows:- When leaded alcohol is used for combustion, the more the air-ratio, the more remarkably intense is the spectrum of the lead-oxide band ($\lambda\lambda$5678) in the flame spectrum.

On the other hand, when leaded commercial iso-octane is used for combustion, not only the intensity is generally weaker than that of alcohol but a maximum point (about 88% air-ratio) appears. See Figure 1(B)13.

Table I(B)13
SPECTRUM INTENSITIES

| | | | | | |
|---|---|---|---|---|---|
| Alcohol | Air-Ratio | 62% | 75% | 88% | 105% |
| | Rel. Int. of PbO-Band* | 1.1 | 1.4 | 4.1 | 11.2 |
| Isooctane | Air-Ratio | 71% | 82% | 93% | 95% |
| | Rel. Int. of PbO-Band* | 0.7 | 1.7 | 1.5 | 1.0 |

* This is the relative intensity of the PbO-band ($\lambda\lambda$ 5678) against that of the Pb line spectrum ( $\lambda$ 3672).

---

* The "air-ratio" is defined as follows: Air actually supplied at combustion theoretical air volume at complete combustion.

ENCLOSURE (B)13

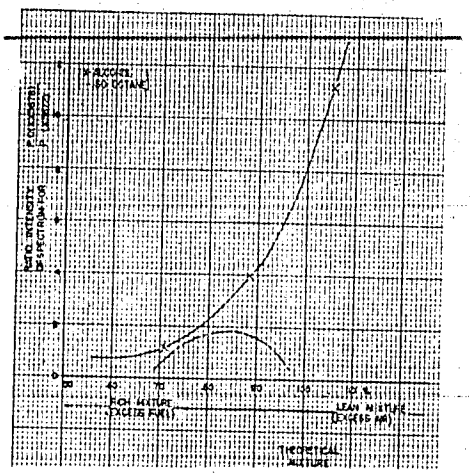
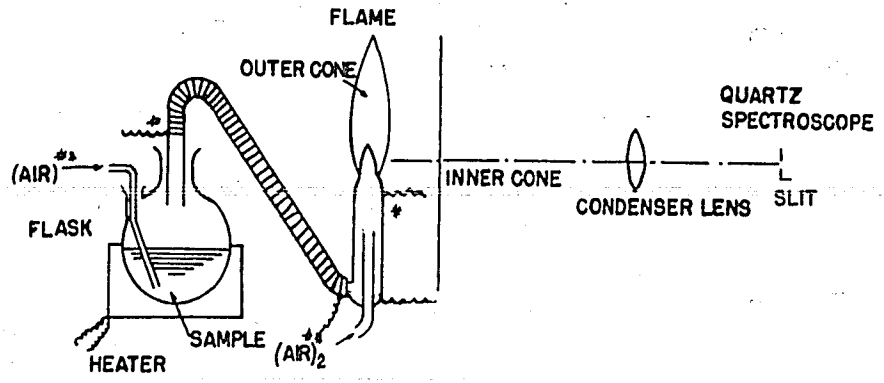


Figure 1 (B)13
RADIO INTENSITY OF SPECTRUM FOR : $\frac{Pb0(\lambda\lambda 5678)}{Pb\ (\lambda 367?)}$




* The temperature of the passage way though which the sample air mixture passes is properly heated electrically.
** The "air ratio" defined previously is

$$\frac{(air)1 + (air)2}{\text{theoretical air volume for complete combustion}}$$

Figure 2 (B)13
SKETCH OF THE APPARATUS FOR COMBUSTION FLAME