REPORT ON GUN FUME HAZARD
FROM
37mm GUN IN M5 LIGHT TANK

1. PROJECT: Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M-5 Series.


   b. Purpose - To determine the extent of the hazard from fumes released in firing the 37 mm gun in the M-5 light tank.

2. DISCUSSION:

   a. Methods -

      (1) Fire Pattern: Five bursts of 10 rounds; five seconds between rounds and 5 minutes between bursts.

      (2) Tank operation: Tank buttoned-up and engine operated at its normal idling speed. Full crew in tank. Wind from the rear.

      (3) Ammunition: 37mm AP M51 FIN: M2

3. CONCLUSIONS:

   a. Under the conditions of test, carbon monoxide concentrations exceeded slightly the maximum acceptable level of 0.05%.

   b. There was no accumulation of carbon monoxide from one burst to another.

   c. Concentrations of ammonia were not high enough to cause eye irritation.

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d. Concentrations of oxides of nitrogen were well within the acceptable limit.

e. Increased blood concentrations of carbon monoxide did not exceed 7.4 percent in any crew member during a 25 minute period of exposure.

f. Control of 37mm gun fumes in the M-5 light tank is acceptable.

4. **RECOMMENDATIONS:**

a. So long as the basic ventilation in the M-5 light tank is not changed, further consideration of the gun fume problem is unnecessary.

b. This tank should not be fired with the tank engine dead unless the turret hatch is opened.

Submitted By:

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APPROVED

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#1-Appendix I, Sampling and Analysis  
#2-Appendix II, with Tables I and II and Figure I.
APPENDIX I

SAMPLING AND ANALYSIS

1. Carbon Monoxide.

a. Collection of air samples: Three methods were employed.

(1) The Mine Safety Appliances continuous indicator.
(2) Instantaneous samples in evacuated flasks for the determination of peak concentrations and clearance rates at the end of firing.
(3) Continuous samples in evacuated flasks, sampling being continued at a constant rate throughout a given test in order to determine the average concentration for a given condition. Samples were collected in this manner at one or more crew positions.

b. Blood samples for the determination of carbon monoxide content were obtained from the tank crew members in the standard manner before and at the end of all complete tests. They were not obtained in exploratory tests.

c. CO Analysis: Evacuated flask samples were analyzed by the iodine pentoxide method and blood samples by the Scholander-Roughten and Spectro Photometric methods. The MSA CO indicator was checked at regular intervals against known air-CO mixtures.

2. Concentrations of ammonia and oxides of nitrogen were determined in portions of the instantaneous flask samples, employing the Nessler and phenoldisulphonic acid procedures respectively.
Concentration of carbon monoxide generated in the M-5 light tank during the firing of the 37Lm gun, with the fire pattern described in the body of this report, are given in Table I and are shown graphically in Figure I. Increase in blood concentrations of CO after 25 minutes exposure are presented in Table II. Concentrations of ammonia and oxides of nitrogen did not exceed 40 and 10 ppm, respectively.

### Table I

**Conc. of Carbon Monoxide**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>FROM</strong></td>
<td><strong>37Lm GUN IN M-5 LIGHT TANK</strong></td>
</tr>
<tr>
<td><strong>After 1st Burst</strong> - (9 rds), Loader</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>After 2nd Burst</strong> - (10 rds), Loader</td>
<td>0.173</td>
</tr>
<tr>
<td><strong>After 3rd Burst</strong> - (10 rds), Loader</td>
<td>0.250</td>
</tr>
<tr>
<td><strong>After 4th Burst</strong> - (10 rds), Loader</td>
<td>0.206</td>
</tr>
<tr>
<td><strong>After 5th Burst</strong> - (6 rds), Loader</td>
<td>0.063</td>
</tr>
<tr>
<td><strong>Cont. Sample</strong> - Loader</td>
<td>0.063</td>
</tr>
<tr>
<td><strong>Cont. Sample</strong> - Gunner</td>
<td>0.053</td>
</tr>
</tbody>
</table>

**Clearance Rate after last burst**

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20 Sec.

(Time for Conc. to decrease 50%)
### TABLE II

**CARBON MONOXIDE CONCENTRATIONS IN BLOOD OF CREW MEMBERS**

*(25 MINUTES EXPOSURE)*

<table>
<thead>
<tr>
<th>CREW MEMBERS</th>
<th>CO Hemoglobin as % of Total Pigment</th>
<th>% CO in Air From Continuous Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Exposure</td>
<td>After Exposure</td>
</tr>
<tr>
<td>Loader</td>
<td>4.2</td>
<td>11.6</td>
</tr>
<tr>
<td>Gunner</td>
<td>7.4</td>
<td>11.0</td>
</tr>
<tr>
<td>Driver</td>
<td>1.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Asst. Driver</td>
<td>6.0</td>
<td>6.9</td>
</tr>
</tbody>
</table>
GUN FUME TRIAL

M-5 LIGHT
37MM A.B. F.N.H. M 2

(Fig. 2)