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EVALUATION OF THE FIRE EXTINGUISHING SYSTEM ON A MODIFIED PBY AIRPLANE

FOR LIMITED DISTRIBUTION

by

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INTRODUCTION

As a result of a request by Region 3 of the Civil Aeronautics Administration, Kansas City, Missouri, a modified PBY aircraft, designation N19Q, was flown to the Technical Development Center, Indianapolis, Indiana, on August 19, 1957, for evaluation tests of the fire extinguishing system. Two flight tests were conducted, one under takeoff power and the other under cruise power conditions. Extinguishing agent concentrations were measured by means of the Statham Model GA-2A portable gas analyzer. This instrument is capable of recording the concentrations and duration of the discharge of the extinguishing agent while the aircraft is in flight. A recorded agent concentration of at least 15 per cent, for a duration of 1/2-second or longer, is required to assure that the extinguishing system is adequate.

DESCRIPTION OF AIRCRAFT FIRE EXTINGUISHING SYSTEM

The engine nacelles of the airplane were protected only in Zone 2 (accessory compartment) and Zone 3 (oil tank and propeller feathering pump compartment) by a newly installed Walter Kidde extinguishing system which consisted of two 536-cubic-inch spherical containers and distribution tubing. Zone 1 (forward compartment) was not protected. The containers were located in the leading edge of the left wing about four feet outboard of the No. 1 engine as shown in Fig. 1. Each container was charged with 15 pounds of $CBrF_3$ (bromotrifluoromethane) and pressurized to 350 pounds per square inch (psi) with nitrogen. These containers provided a main and spare charge of agent for extinguishing a fire. Check and directional valves in the distribution system make it possible to discharge agent from these containers into either nacelle.

DESCRIPTION AND INSTALLATION OF TEST EQUIPMENT

The test equipment produces a high-speed continuous recording of the concentration of extinguishing agent simultaneously from 12 different regions. It consists of three analyzer blocks, control unit, vacuum pump, and oscillograph. Each analyzer block contains four transducers with their associated vacuum and electrical connections. Each transducer is connected to a six-foot pickup tube through which the agent sample from each test region is drawn. Critical flow of the sample through an orifice in each analyzer cell is maintained by means of the vacuum pump. A pressure drop, which occurs after the sample passes through the second of two porous plugs,

operates the transducer. The transducer output is recorded on the oscillograph. This output is directly proportional to the concentration of the agent being analyzed.

The analyzer pickups were installed in the nacelle of the No. 2 engine since this nacelle was the most remote from the agent containers. Two of the analyzer blocks were mounted on the outboard side of the Zone 2 compartment as shown in Fig. 2, and a third block was mounted inboard of the Zone 3 compartment as shown in Fig. 3. The vacuum line and the power and output cables were routed from the inboard side of the nacelle under the leading edge of the wing across to the wing pedestal and then down the left side of the pedestal through the aircraft to the compartment aft of the pilots' compartment where the control unit, the oscillograph, and the vacuum pump were located. A view of this equipment is shown in Fig. 4.

The agent concentrations were recorded from 12 stations located as follows

1. Inboard of the carburetor, shown in Fig. 5.

2. Inside of the leading edge of the wing extending inboard from the nacelle to the pedestal (Zone 3), shown in Fig. 3.

3. Above the main fuel shutoff valve (Zone 3), shown in Fig. 3.

4. Below the main fuel shutoff valve (Zone 3), shown in Fig. 3.

5. Right side of nacelle in Zone 3 by the propeller feathering pump, shown in Fig. 6.

6. Left side of oil cooler duct, shown in Fig. 6.

7. Right side of oil cooler duct, shown in Fig. 6.

8. Adjacent to the propeller feathering lines, shown in Fig. 6.

9. Adjacent to the main fuel lines, shown in Fig. 5.

10. Inboard of the fuel flow transmitters, shown in Fig. 2.

11. Adjacent to the cowl flap actuators (not shown).

12. Forward of the cowl flap actuators, shown in Fig. 2.

TEST PROCEDURE

Two in-flight tests were conducted at an altitude of 5,000 feet. Test No. 1 was initiated at normal cruise speed. After fire emergency shutdown procedure was enacted, the main extinguishing agent bottle was discharged and the agent concentrations were recorded. The indicated airspeed at the time the extinguishing agent was discharged was approximately 130 miles per hour (mph).

Test No. 2 was conducted under similar conditions but with the engines operating under takeoff power condition prior to emergency shutdown of the No. 2 engine. The spare extinguishing agent container was discharged for this test and the agent concentrations recorded. The indicated airspeed at the time the extinguishing agent was discharged was approximately 120 mph.

RESULTS

The percentage agent concentration for each station for the duration of the respective tests is presented in the curves shown in Figs. 7 and 8. The agent concentrations for all locations were well in excess of the 15 per cent minimum requirements for a 1/2-second duration.

The lowest concentrations were recorded in the area of No. 8 pickup, however, these concentrations were 38 per cent for 1/2-second during the test under cruise condition and 39 per cent for 1/2-second during the test under takeoff condition. These concentrations are more than double the minimum that is required.

CONCLUSION

The results indicate that the extinguishing system tested provides sufficient concentration of fire extinguishing agent to extinguish fires in zones 2 and 3 of N190 aircraft.

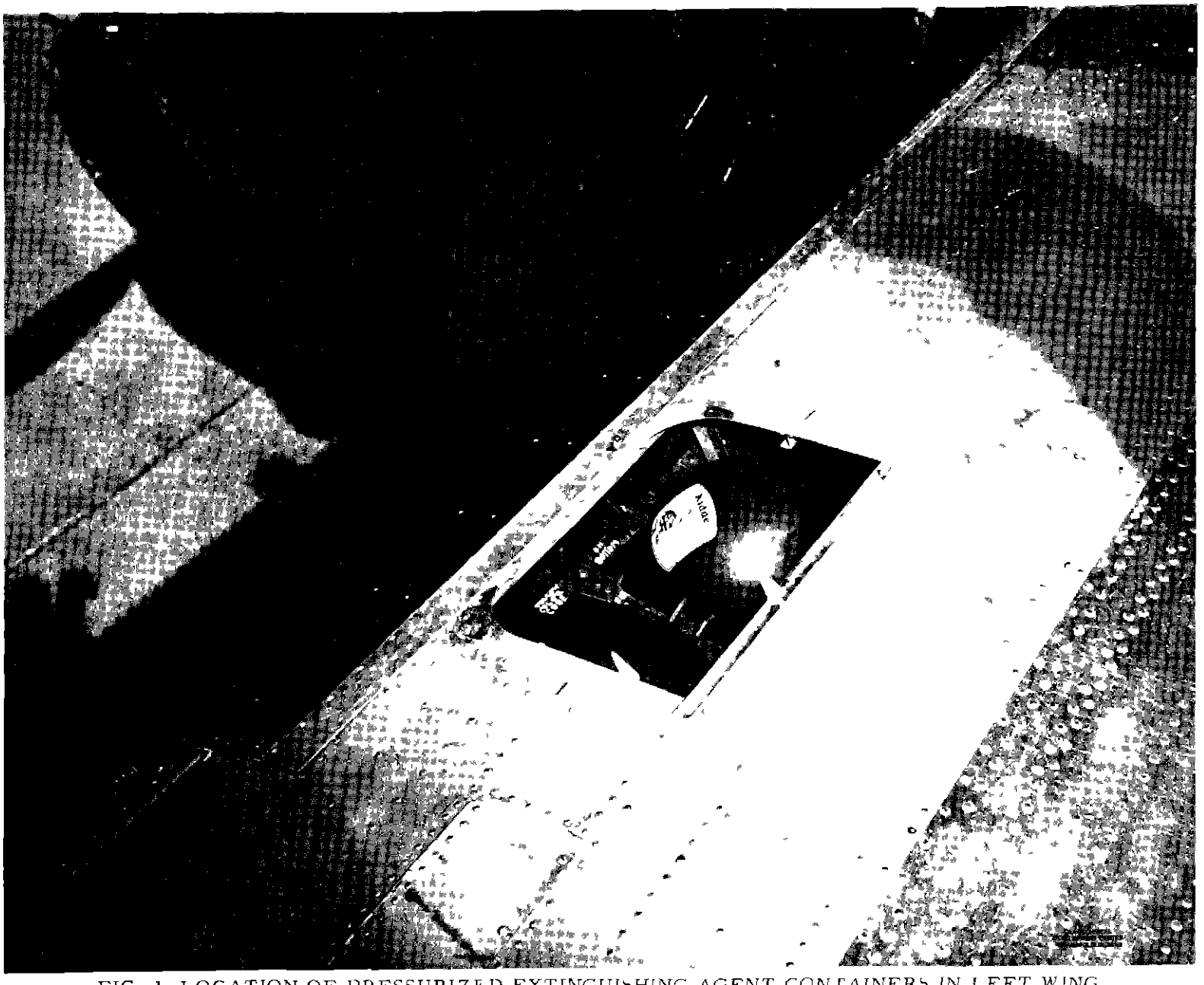

FIG 1 LOCATION OF PRESSURIZED EXTINGUISHING AGENT CONTAINERS IN LEFT WING

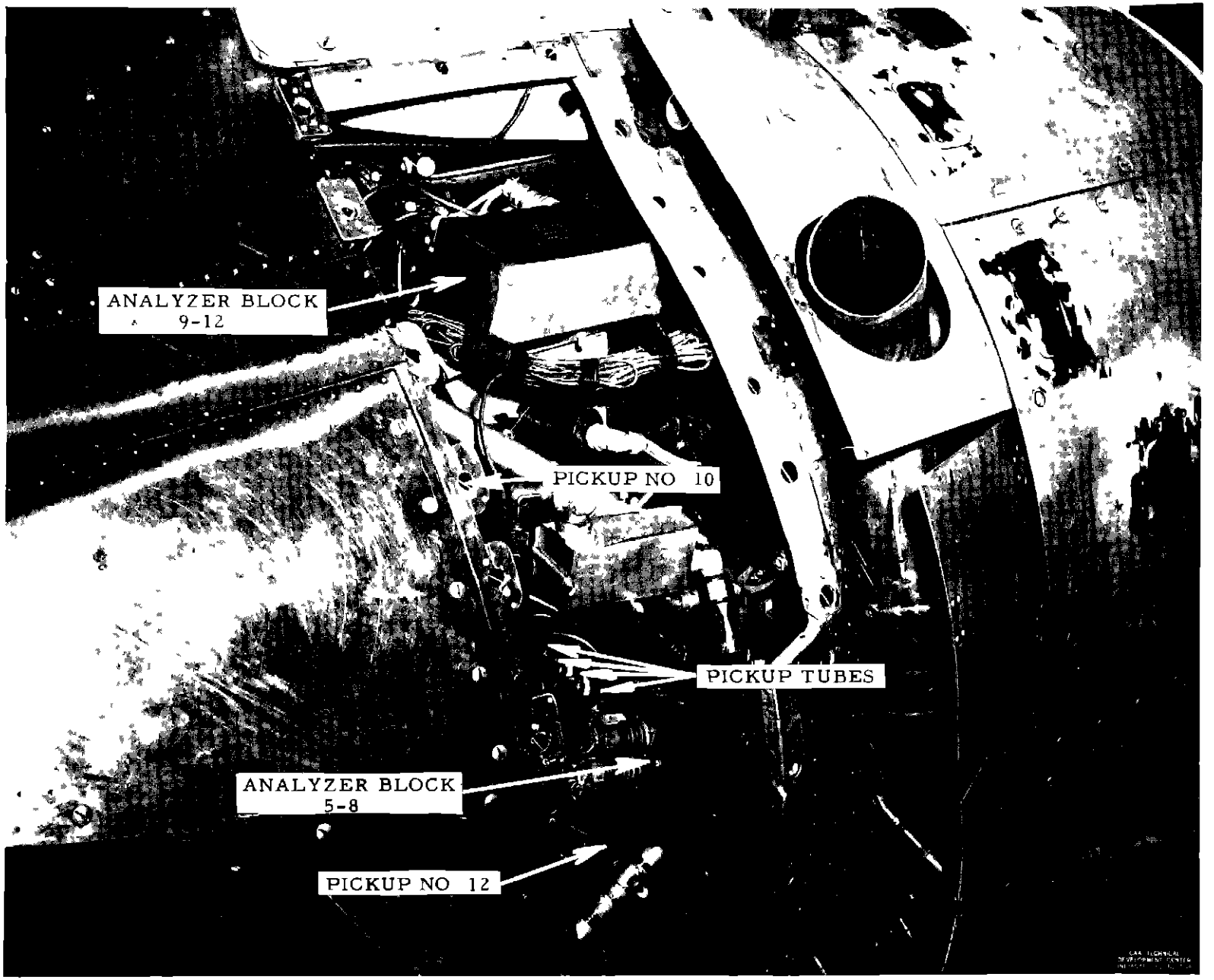

FIG 2 UPPER RIGHT SIDE OF ZONE 2 OF INSTRUMENTED NACELLE

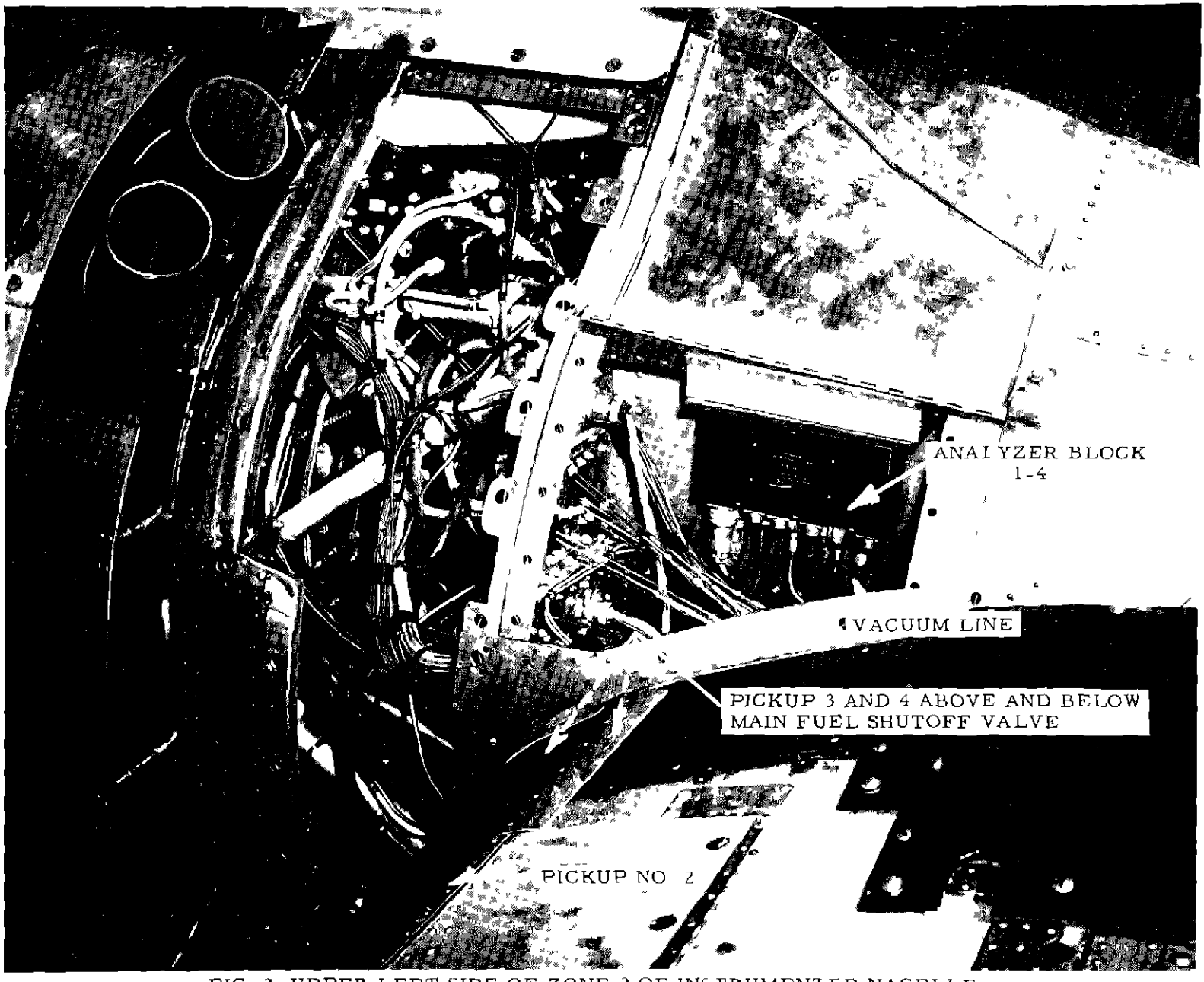

FIG 3 UPPER LEFT SIDE OF ZONE 2 OF INSTRUMENTED NACELLE

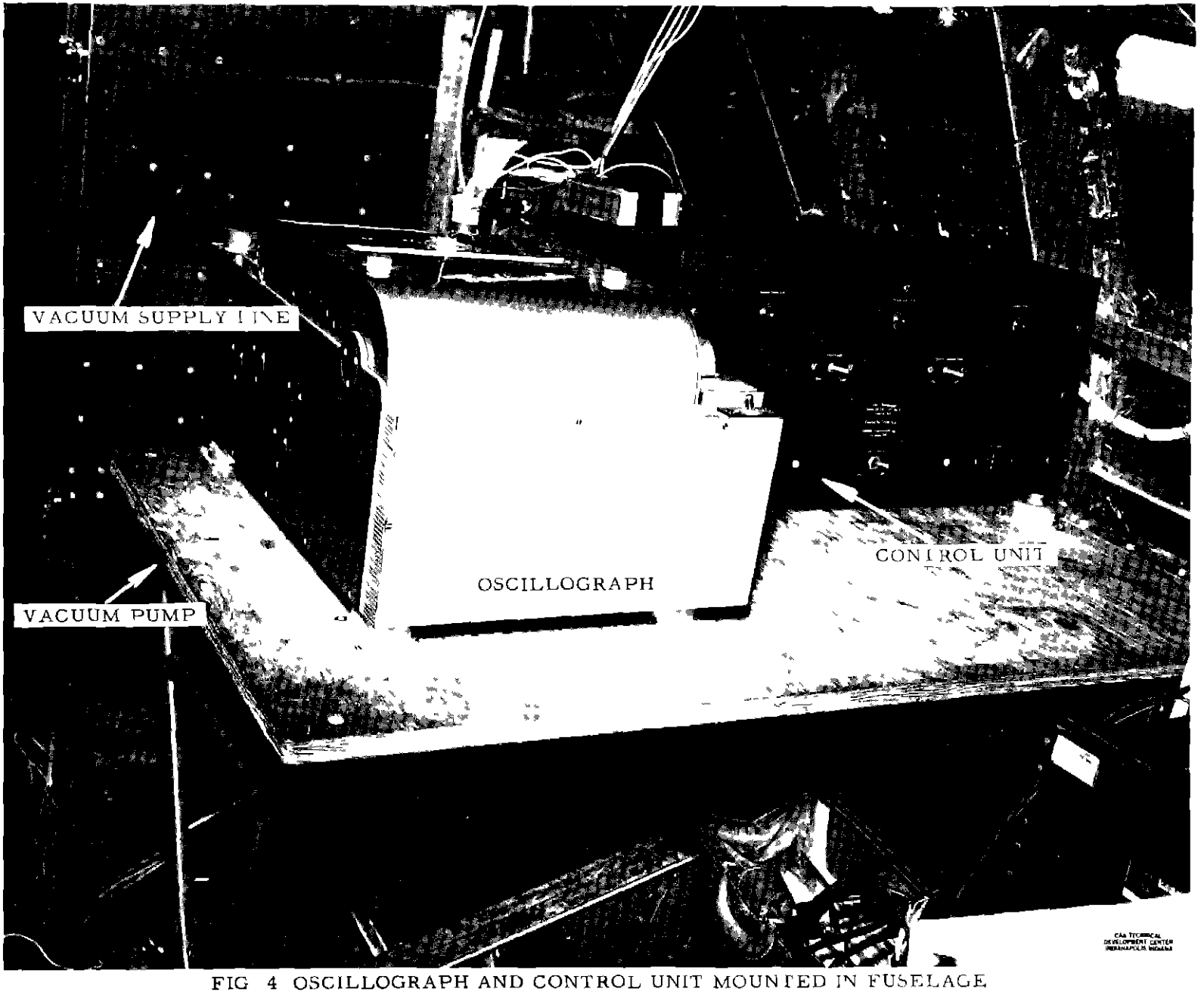

FIG 4 OSCILLOGRAPH AND CONTROL UNIT MOUNTED IN FUSELAGE

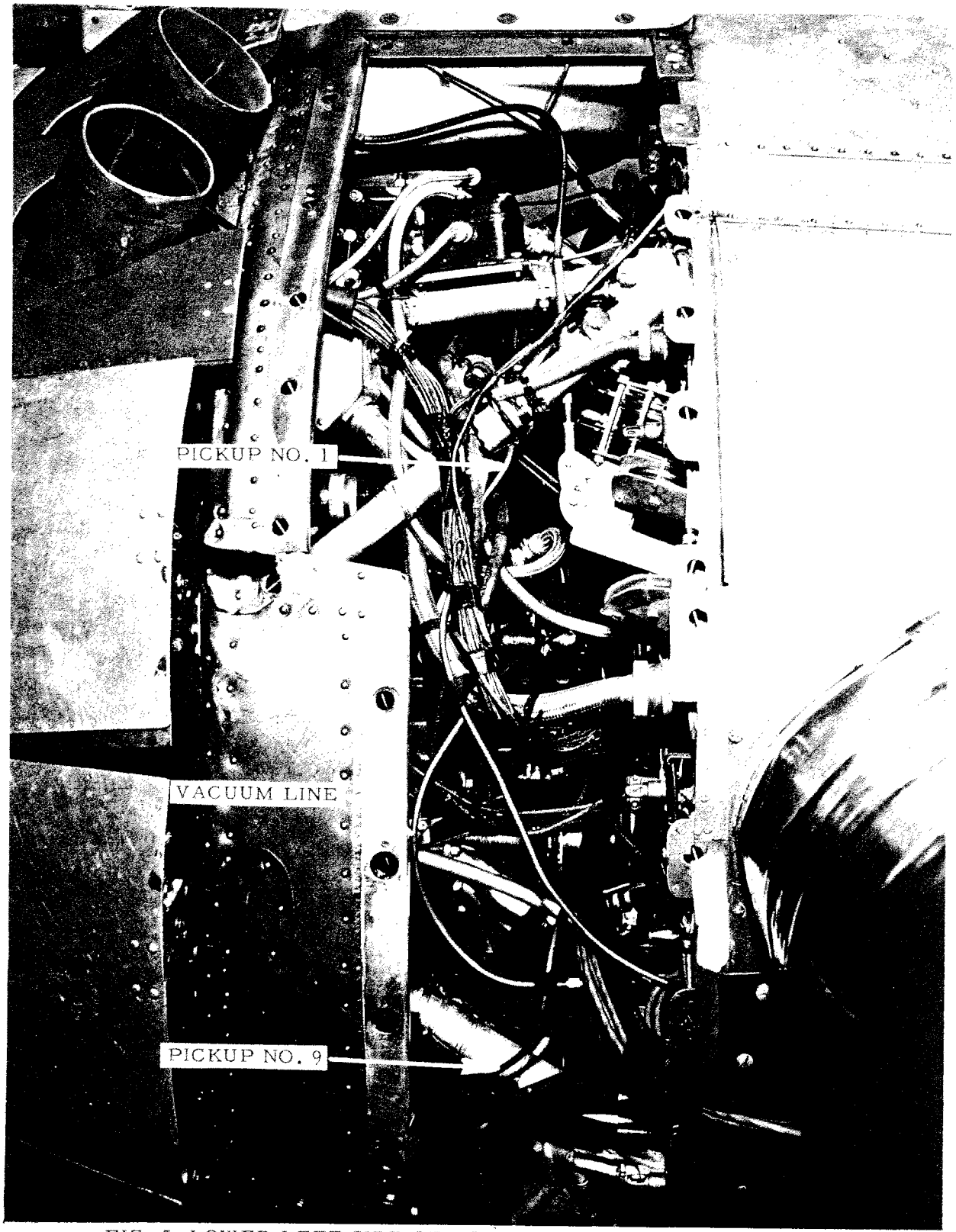

FIG. 5 LOWER LEFT SIDE OF ZONE 2 OF INSTRUMENTED NACELLE

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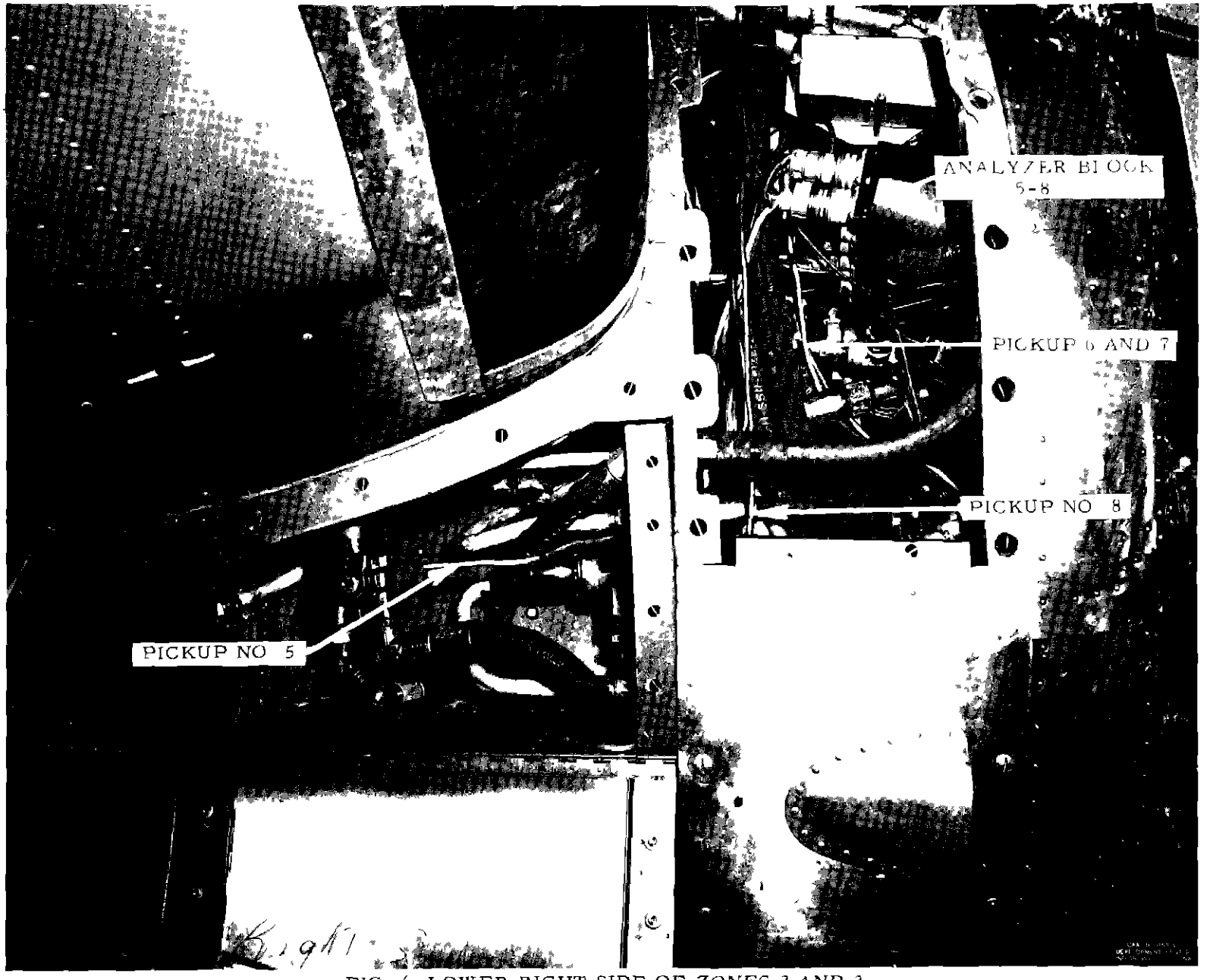

FIG 6 LOWER RIGHT SIDE OF ZONES 2 AND 3

FIG 7 AGENT CONCENTRATIONS DURING FIRST TEST

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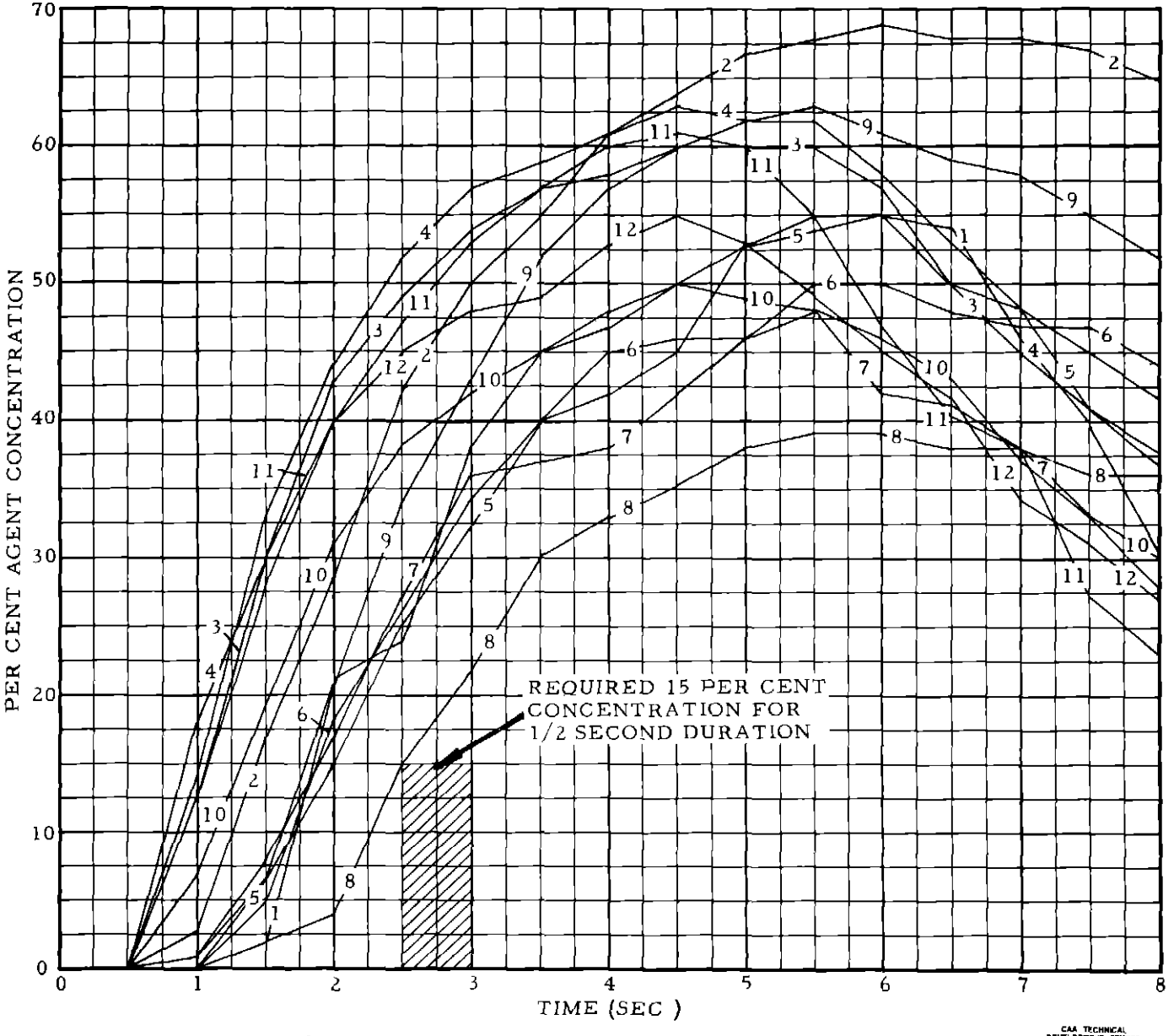

FIG 8 AGENT CONCENTRATIONS DURING SECOND TEST