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A COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF  
AQUEOUS FILM FORMING FOAM (AFFF) IN EXTINGUISHING  
NEAT AND MODIFIED JET A TURBINE FUEL FIRES

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Purpose

The purpose of this effort was to compare the firefighting effectiveness of AFFF in extinguishing neat and modified Jet A turbine fuel fires.

Background

The Federal Aviation Administration (FAA) is engaged in programs to reduce the probability and/or severity of fire in commercial jet transport aircraft that are involved in ground crash situations. One of the approaches being taken is the development of a modified aviation turbine fuel that will provide a significant reduction in crash-fire hazard. A number of types of modified fuels have been developed, some under FAA sponsorship, others by various chemical and petroleum manufacturers. However the possibility of a ground crash-fire situation still remains when employing a modified fuel; therefore, it was determined that an effort should be undertaken to evaluate and compare the extinguishing effectiveness of AFFF on neat and various types of modified Jet A turbine fuel fires.

The modified fuels tested were:

1. XD-8103, an antimisting fuel developed by the Dow Chemical Company, Midland, Michigan
2. FM-4, an antimisting fuel manufactured by Imperial Chemical Industries, Slough, Bucks, England
3. CL12-C, a gel fuel manufactured by Anheuser-Busch, Incorporated, St. Louis, Missouri
4. AM-1, an antimisting fuel developed by the Continental Oil Company, Ponca City, Oklahoma

## Test Procedure

The firefighting effectiveness of AFFF in extinguishing neat and modified Jet A fuels was determined by modifying the fire test procedure required in Military Specification MIL-F-24385 (NAVY), section 3.11.1 Fire Performance (28-square-foot test). In this specification the fire requirements are determined in terms of fire performance and foam burn-back resistance. The fire extinguishing tests were conducted in a level circular pan 6 feet in diameter and 5 inches in depth using a standard 2.0-gallon-per-minute nozzle as provided for in the military specification under the test equipment provision. The variation of the standard fire test procedure contained in the military specification was made by introducing a removable 3- by 4- foot titanium backboard upon which the discharged foam stream could impinge and flow back over the burning fuel to extinguish the fire. The fire test bed configuration is shown in Figure 1.

A series of five experiments was performed, one with neat Jet A, the others with the remaining four modified Jet A fuels. Each experiment employed 10 gallons of the individual test fuel. In each test the fuel was ignited and allowed a preburn time of 15 seconds (Figure 2) after which AFFF was discharged across the test pan to impinge in the approximate center of the titanium backboard for a period of 90 seconds (Figure 3) and the time required to obtain fire control and extinguishment was recorded. Fire control was judged to be the time for approximately 90 percent of the fuel surface to be covered by foam, and fire extinguishment was recorded as the total elapsed time from the start of foam application until all flames were extinguished within the test pan. The residual foam blanket for a typical test is shown in Figure 4.

The burnback test was begun 30 seconds after the end of the foam application. A steel pan 1 foot in diameter having 2-inch sidewalls was charged with one quart of JP-4 fuel. The JP-4 fuel was ignited and the pan was then placed in the center of the foam blanket (Figure 5). The small pan was removed from the test area after the fuel in the large pan sustained permanent ignition (Figure 6). Burnback time commenced with the positioning of the small pan of JP-4 fuel and terminated when 25 percent of the test fuel area (7 square feet) originally covered with foam was aflame (Figure 7).

The relative effectiveness of the AFFF agent is judged under the military specification on the basis of achieving fire extinguishment in 84 seconds or less and exhibiting a 25-percent burnback time of at least 240 seconds.

## Summary of Test Data

The test results are summarized in Table 1.

The test data shows that the AFFF failed to meet the extinguishing time required in the military specification only on the CL12-C fuel. The

firefighting effectiveness of the AFFF agent was of the same order of magnitude on the three antimisting fuels as that obtained for the neat Jet A fuel. All established AFFF foam blankets conformed with the minimum burnback requirements for the military specification.

TABLE 1.--SUMMATION OF TEST DATA

Fuel Type	Foam Agent Aqueous Film Forming Foam (AFFF)				
	Neat Jet A	XD-8103	FM-4	CL12-C	AM-1
Ambient Air Temperature (°F)	73	64	72	71	76
Wind Velocity (mph)	8-10	7-9	6-8	8-10	8-10
Foam Solution Temperature (°F)	75	61	68	72	74
Foam Expansion Ratio	7.2:1	7.2:1	7.1:1	7.1:1	7.1:1
25% Drainage Time (min:sec)	3:58	3:58	3:52	3:52	3:52
Fire Preburn Time (sec)	15	15	15	15	15
Fire Control Time (sec)	48	49	50	70	49
Fire Extinguishing Time (sec)	67	69	73	90	67
25% Burnback Time (sec)	255	249	244	310	253

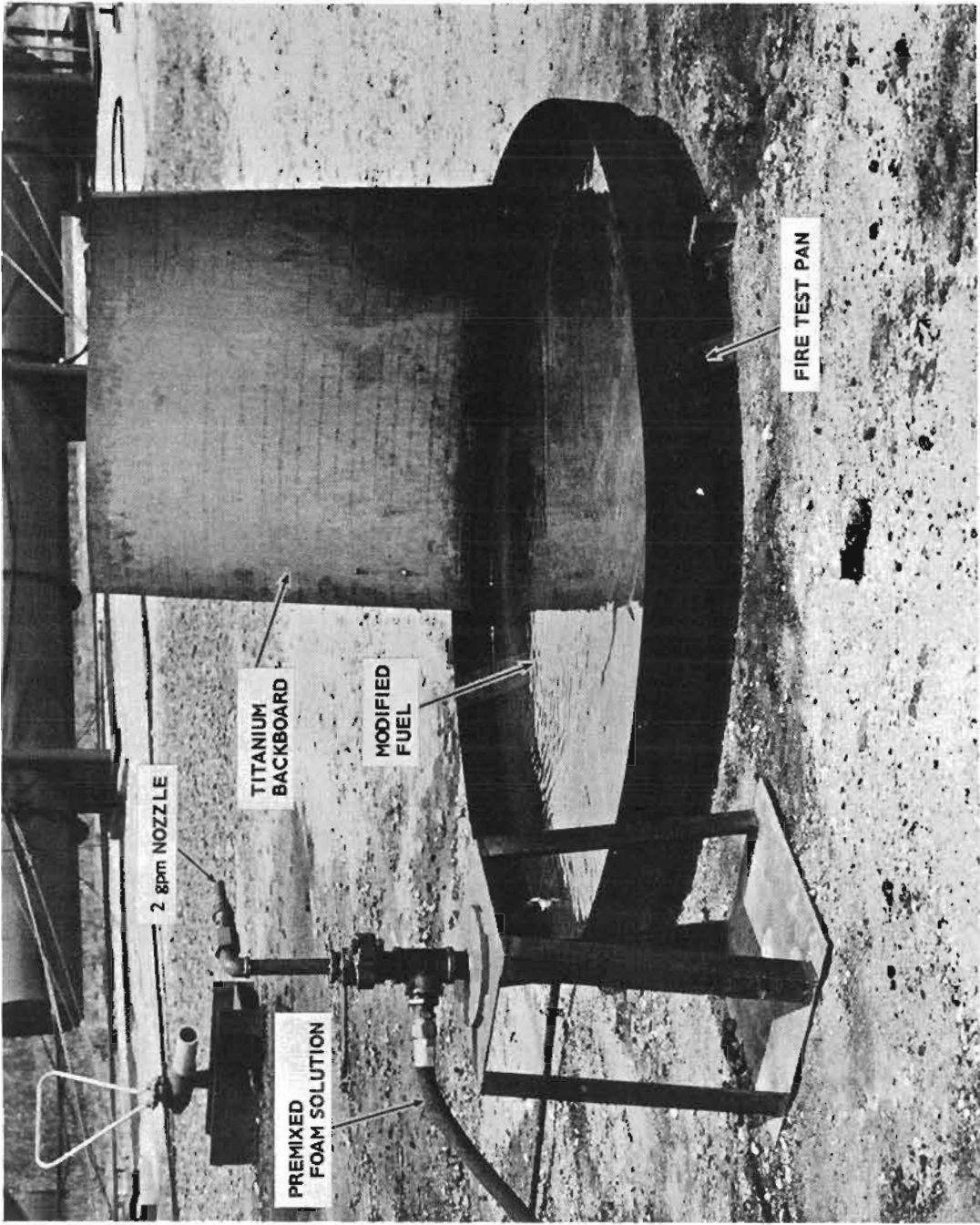


FIGURE 1 - FIRE TEST BED CONFIGURATION



FIGURE 2 - FIRE PREBURN PERIOD



FIGURE 3 - FOAM APPLICATION PHASE

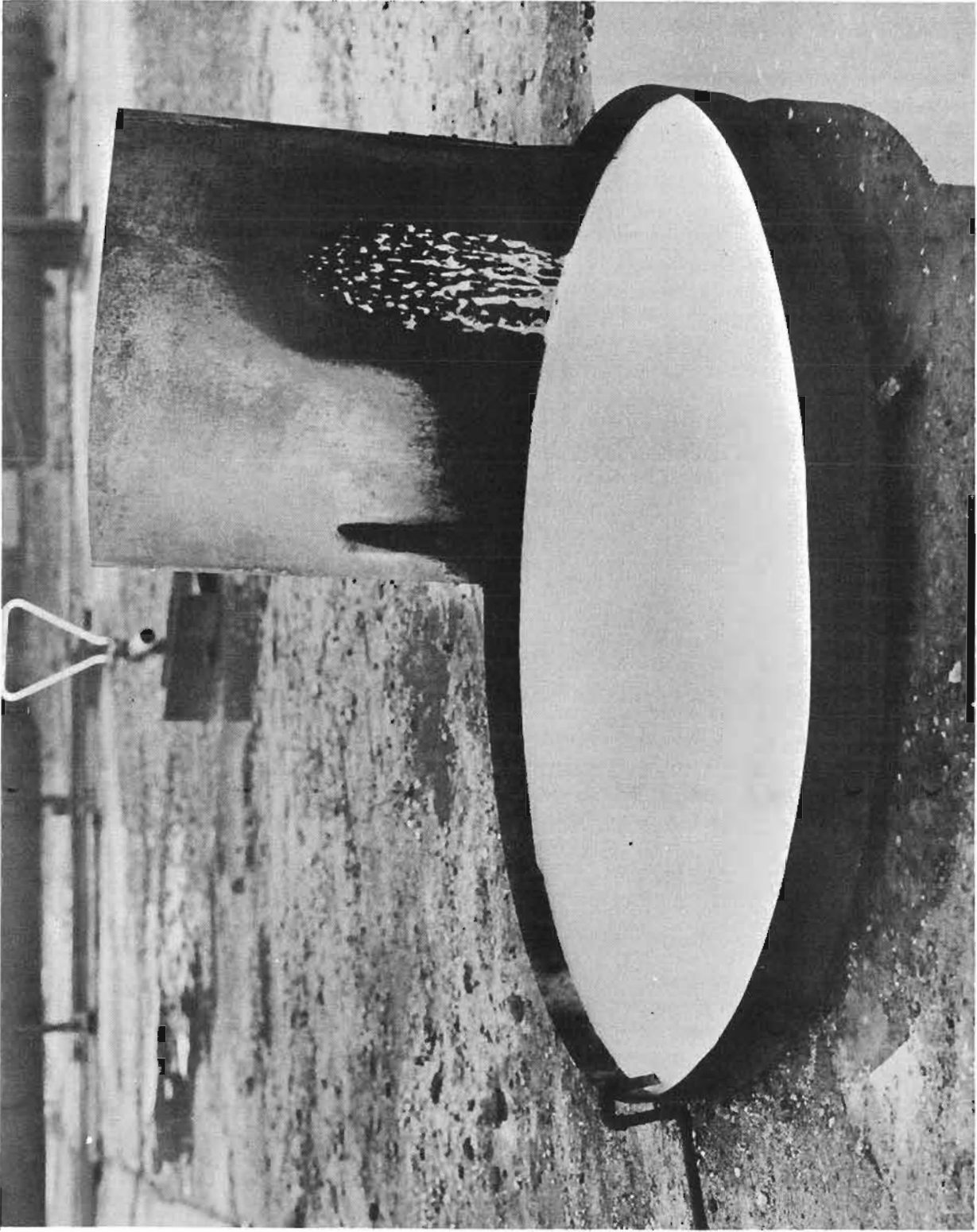


FIGURE 4 - RESIDUAL FOAM BLANKET



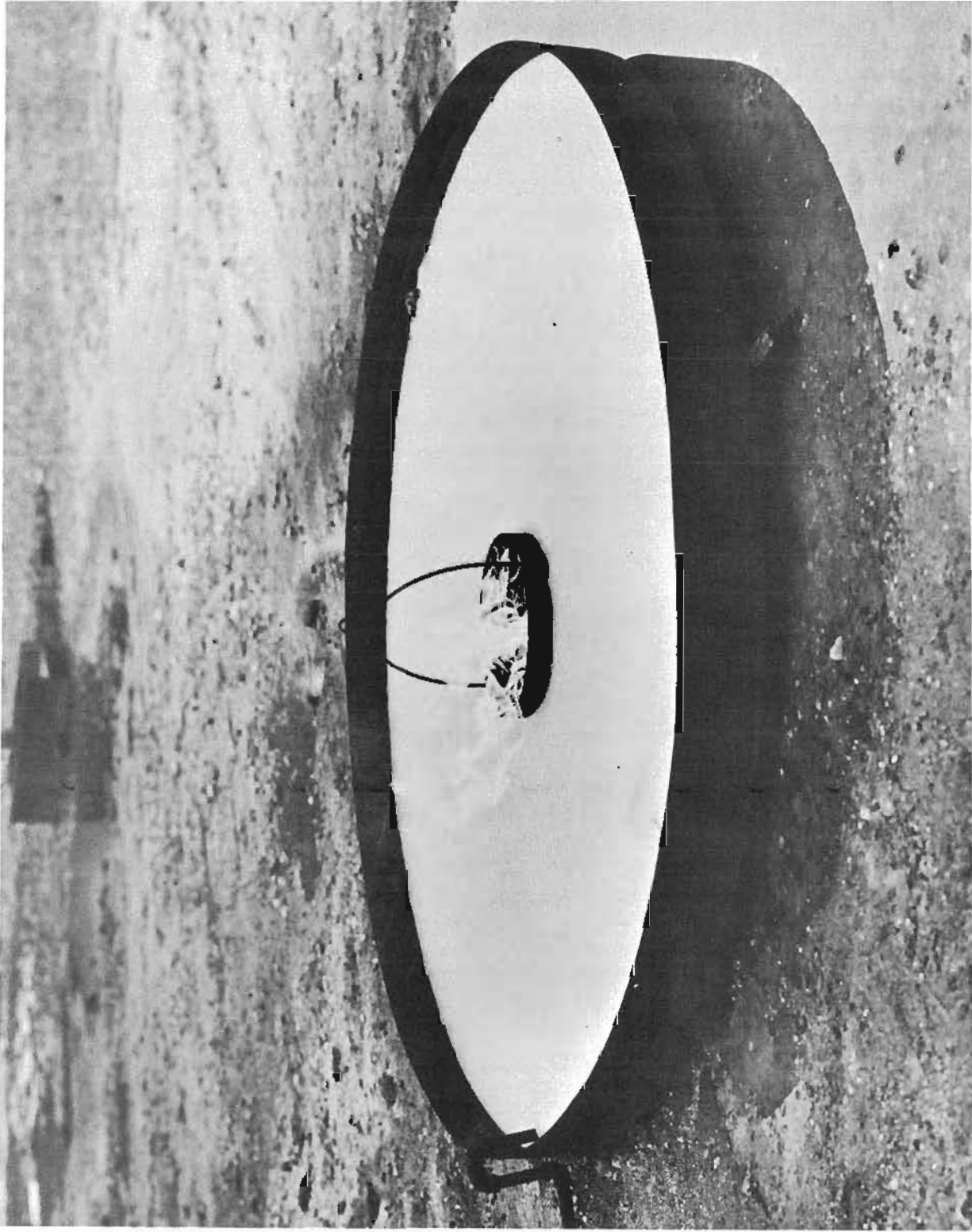


FIGURE 5 - BURNBACK TEST SHOWING PLACEMENT OF IGNITION SOURCE



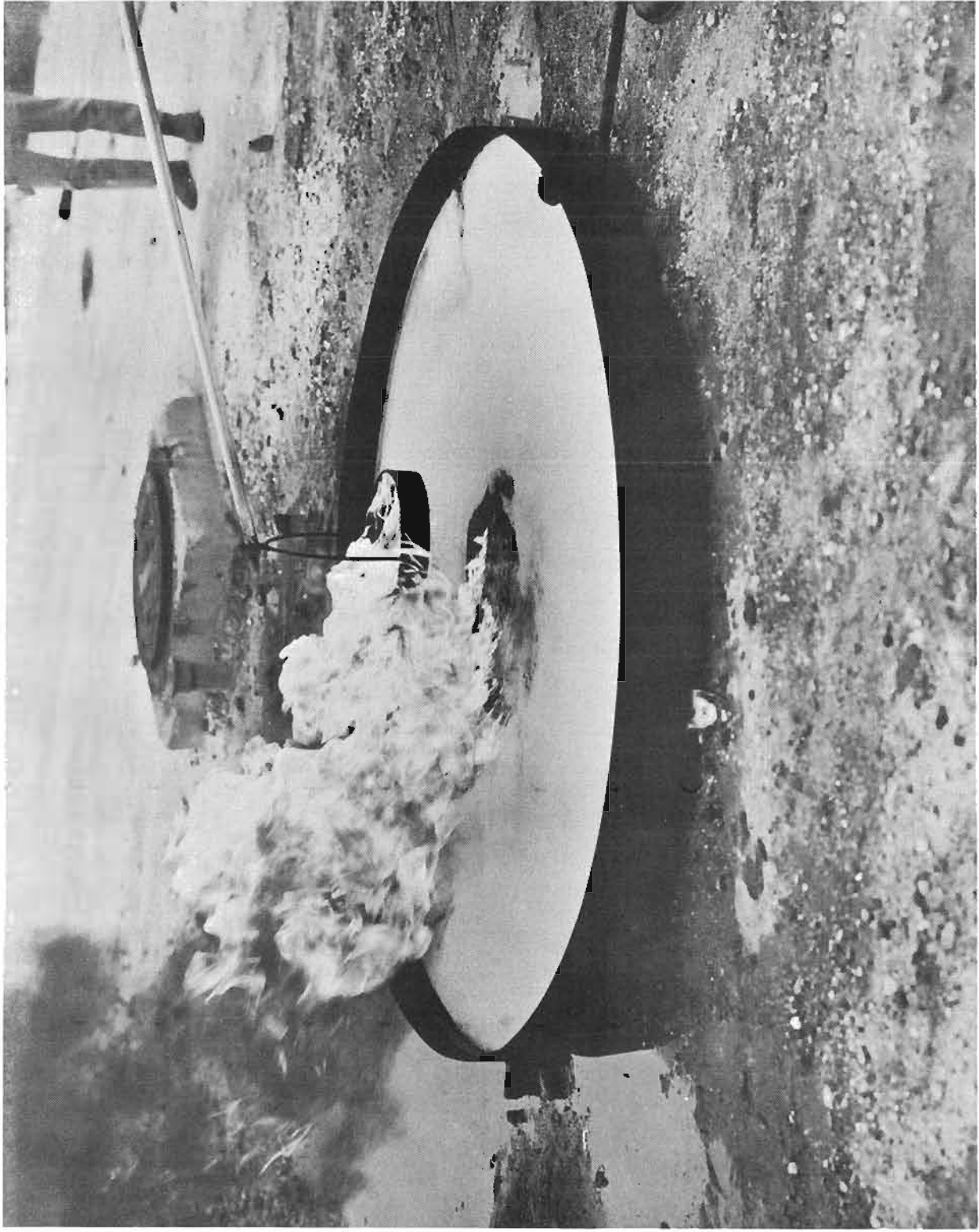


FIGURE 6 - REMOVAL OF IGNITION SOURCE AFTER THE FUEL SUSTAINED  
PERMENENT IGNITION IN THE TEST PAN



FIGURE 7 - TERMINATION OF THE BURNBACK TEST SHOWING 25% OF  
THE FOAM BLANKET DESTROYED