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Name: W Layne
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Z-25, 3-2
Case No. 646.00
Ref. Sym: 1611 (342)
Project No. ET-2734-A
Interim through 3/14/56

CDL No.
ACCOUNTABILITY CARD
FILE No. XW-25 3-2
BM

9 x TO DISTRIBUTION

Re: Environmental Test Series on the XW-25 Warhead

Object of Test

The object of this test was to determine if the material and seal of the XW-25 would withstand the salt spray, rain, humidity, sand and dust, vibration, sunshine, and fungus tests of SCS-5.

Authorization for Test

This test was requested by Division 1332 (now 1246) in two Requests for Materials Laboratory Investigation dated June 1, 1955 and March 12, 1956. Messrs. J. A. Anderson and G. W. Treadwell were the requestors.

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Procedure and Results

The test specimens consisted of the MC-672 case with a concrete sphere, and an MC-656 X-unit cover, both made of anodized aluminum. The enclosed volume is sealed by means of rubber gaskets, one where the X-unit cover attaches, one under the rear polar cap, and another under the AN connector in the cover, so that a pressure of 15 psig may be maintained inside. A leakage rate of about 1/4 psi in 6 hours is permitted.

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One specimen, serial No. AA-1007-H5, was exposed without injury to the SCS-5 paragraph 7, salt spray test. This consisted of 50 hours in a wet fog generated by the atomizing of a 20 per cent NaCl water solution, with the air temperature maintained at 95° F. There was some corrosion around the radial screws at the rear attachment ring (Fig. 1), and at the joint between this ring and the outer case. The weld joint running lengthwise down one side of the outer case was made visible (Fig. 2). Most of the contaminated area seen in these two figures, however, are deposits of salt, since the photographs were taken before the specimen was rinsed. Some yellow stains near screw holes and crevices were from a reaction of the salt with some chromium remaining from the anodizing process.

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Before removing the X-unit cover for inspection, the unit was pressurized to 15.1 psig. Three days later the pressure had dropped 1.9 psi, which was an average drop of 0.21 psi per 6 hours. Inspection revealed no moisture or

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corrosion inside.

For the SCS-5, paragraph 5 rain test, the same unit was assembled with a color spot humidity indicator enclosed and was sealed without pressure. The test consisted of 2 hours of simulated rainfall having a rate of 4 inches per hour. Inspection revealed no water inside, and the humidity indicator had a reading of 40 per cent relative humidity, which was the same as it had initially. Following inspection the unit was assembled and pressurized. After 24 hours it had lost only 0.5 psi.

The next test was the SCS-5, paragraph 4.2 tropical exposure test. This consisted of ten 48-hour SCEL humidity cycles, each cycle varying from 68° F to 149° F, with the humidity maintained between 90 and 98 per cent. As before, the assembly was exposed to this test without pressure. One reason for the absence of pressure was that the temperature cycling in this test causes a "breathing" in the specimen; but if it had a positive internal pressure, this would be defeated. Another reason why the unit was not pressurized was because it would not maintain a pressure for the period which the test simulates: 6 months in a tropical climate.

Moisture was in evidence inside the unit following this test. Droplets had condensed on the inside surfaces and the humidity indicator was soggy. There was no additional corrosion. (The complete warhead will have about one pound of silica gel desiccant enclosed in the sealed volume.) The specimen was then reassembled and pressurized, and after 16 hours had lost 0.2 psi.

The last test for this unit was the SCS-5, paragraph 6 sand and dust test, which involves exposure to a standard dust atmosphere of 0.1 to 0.5 grams per cubic foot for a period of 12 hours. The first 6 hours are at a temperature of 77° F, and the second at 160° F. The low wind velocity alternative, 100 to 500 ft per minute, was chosen because the absence of the nose cone and tail assembly left parts exposed which normally would not be. The examination afterwards indicated no dust had entered.

The second specimen, serial No. AA-1008-H5, was assembled using components similar to those used in the first one, with the addition of dummy mock-ups of the MC-656 X-unit and the Douglas fuze. The X-unit cover is the mount for both of these components, the X-unit attaching to a flange inside and the fuze attaching to the four brackets shown in Fig. 2. Statham accelerometers were located in the center of the sphere (pit), on the dummy X-unit, on the forward attachment ring (Fig. 2), and on the dummy fuze. Three mutually perpendicular axes were monitored at each location: Longitudinal was along the axis of the warhead; vertical was perpendicular to longitudinal and passing through the AN connector in the X-unit cover; and the transverse axis was perpendicular to each of the other two. The warhead was sealed, pressurized to 15 psig, and connected to a mercury manometer during vibration.

The low frequency phase of the resonance survey, from 10 to 60 cps, was conducted on the Sonntag vibration table, with the displacement set at 0.010 inch.

The assembly was subjected to vibrations along the three defined axes, while mounted with its longitudinal axis horizontal, and the outputs of the 12 accelerometers was recorded every 10 cps. The results indicated no resonances of the unit in this range, and there was no change in pressure during vibration. The time it was exposed to vibration was approximately one hour per axis.

It was then mounted with its longitudinal axis vertical, on the MB vibration table. Since the weight to be vibrated by the MB exceeded its 250-pound weight limit, a suspension system using elastic shock cord was devised. One end of the shock cord was attached to the uppermost surface of the dummy fuze and the other to a stationary support. The support was raised until the tension in the shock cord supported the specimen. Then, since the displacement during vibration was never greater than 0.02 inch and the stretch in the shock cord was about 4 feet, the tension force remained constant.

The table displacement was maintained at 0.010 inch up to 100 cps, which was then equivalent to 5 g, and from 100 cps up to 500 cps it was governed by the capability of the MB, with 5 g as the limit. Vibration was started at 60 cps and cycled upward. The frequency was held constant at the data points plotted in Fig. 3 while the indications of the accelerometers were recorded. The time spent on this part of the resonance survey was 2 hours. The results converted to amplification over table input appear in Fig. 3.

Resonant points were encountered at 150.5 cps (sphere), 187 cps (fuze), and 220 cps (X-unit). The sphere resonance resulted from the liner material around the concrete acting as a spring, and the fuze resonance was a result of the combined spring action of the mounting brackets and the structure of the dummy fuze. The X-unit resonance was the one chosen for the half hour of sustained vibration because the effective spring of its mount, a flange welded inside the cover, in combination with the mounting surface of the dummy X-unit was the closest to the actual condition. The table input during this period was 5 g.

Monitoring of the pressure indicated that the seals held during the vibration. Examination after vibration revealed no damage to the mounting flange, but cracks had appeared in the fuze-mounting brackets (Fig. 4). A possible cause of these cracks was the extra stress imposed on the brackets resulting from the shock-cord suspension of the whole warhead and vibration jig, which weighed about 250 pounds. To check this, another cover with the same dummy fuze and X-unit was mounted on the MB and subjected to the same vibrations the forward mounting ring saw during the previous test. The first crack appeared during the first hour and 45 minutes. The fuze resonance was 180 cps, and after 25 minutes at this frequency another four cracks appeared. This confirmed the cracks were not a result of the suspension system.

Several modifications to the brackets were then tried. The first had a reinforcing band riveted to each bracket. This cover was vibrated according to the following schedule (again based on the amplification curve of the forward mounting ring): 4-1/2 minutes (the time required to record the 12 channels of data at each frequency during the first test) at 60 cps and 2 g; 4-1/2 minutes at

180 cps and 6.4 g; 3 minutes hunting resonance, which was at 204 cps; 5 minutes at 204 cps and 1 g; and 3 minutes at 204 cps and 4 g. At this time, after 20 minutes of vibration, cracks appeared in the brackets. The second modification was to round off and polish the bracket edges to decrease stress risers. Vibration was started at 180 cps and 6.4 g, and the first crack appeared in 2-1/2 minutes with subsequent ones occurring as the vibration progressed through 200 and 220 cps.

A third modification, in accordance with Dwg. No. 126662 and DS(1332)54681, involved closing the open back of each bracket. One specimen was again fitted with the dummy X-unit and fuze and vibrated at 5 g at its resonance, 230 cps, for 25 minutes without showing any cracks. Following this test there was an increase in the weight of the fuze, so the same cover was vibrated with this increase added to the dummy fuze. The new resonance was 206 cps, and the table input was 8 g for 30 minutes. Again no cracks appeared in the new brackets.

Two of the rubber rear sealing rings, one having a durometer of 40 and the other 50, were submitted for the SCS-5, paragraphs 8 and 10, fungus and sunshine tests. Both samples proved to be fungistatic after being sprayed with the standard composite spore suspension and exposed to an atmosphere of 86° F and 95 per cent RH for 28 days.

The sunshine test consists of exposure to continuous repetitions of a 20-minute cycle of sunshine for 18 minutes, and rain for 2 minutes, for a total of 100 hours. Sixty per cent of the sunshine is above 8000 angstroms, and it is radiated at the rate of 100 to 120 watts per square foot. The chamber is maintained at 113° F. Specimens were pulled on the Instron testing machine before and after exposure, and the following is a tabulation of the results:

Deflection of Rear Seal at an Applied Force of 10 Pounds

Durometer	Condition	Deflection (inches/inch)	
40	Before sunshine	0.69,	0.53
40	After sunshine	2.75,	2.00
50	Before sunshine	0.44,	0.57
50	After sunshine	0.56,	0.56

D T Judd
Test Conducted by D. T. JUDD - 1611-1

Don Williams Jr
Approved by D. WILLIAMS, JR. - 1611

DTJ:1611-1:dr

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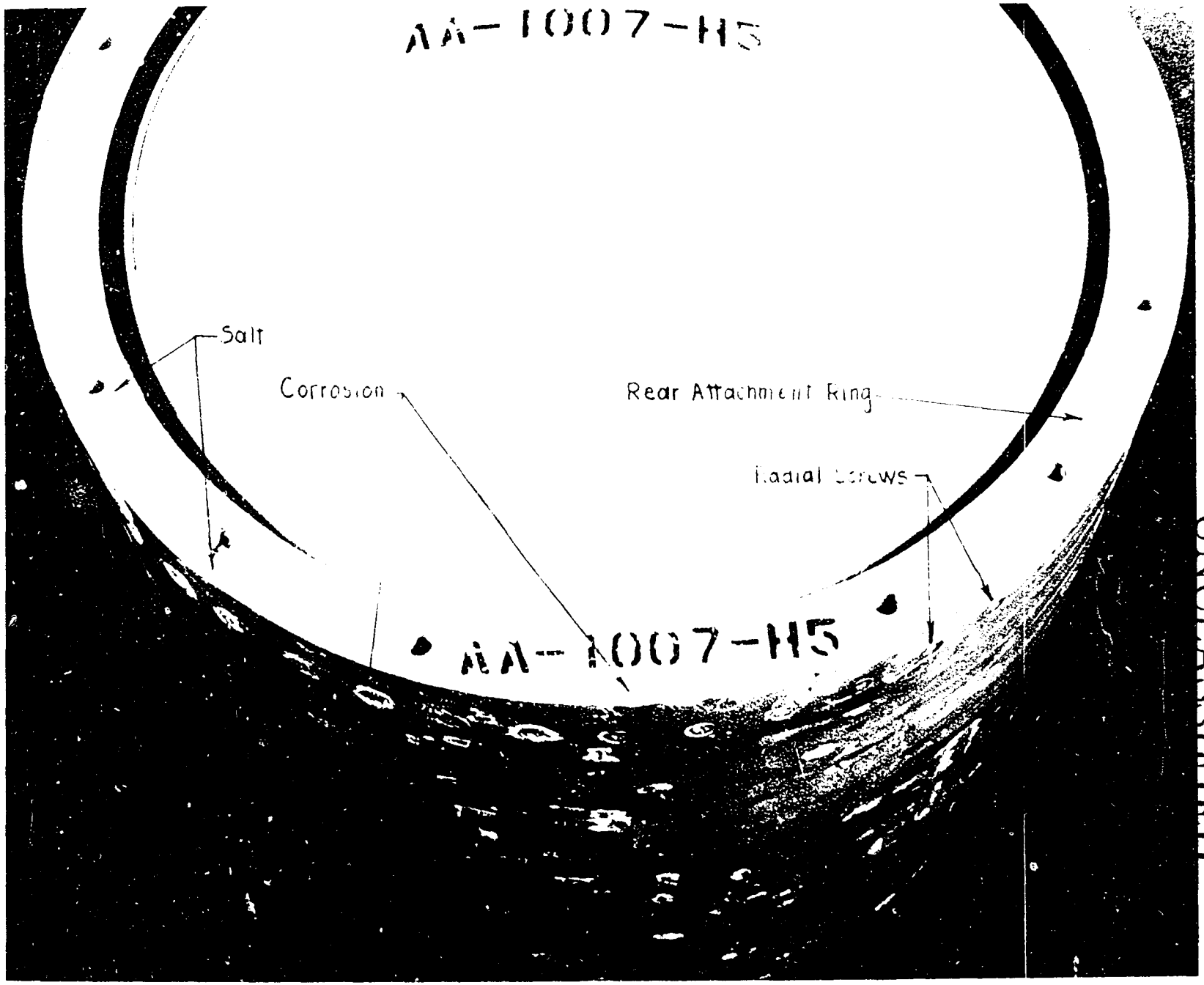

Fig. 1 XW-25 after Salt Spray (Rear End)

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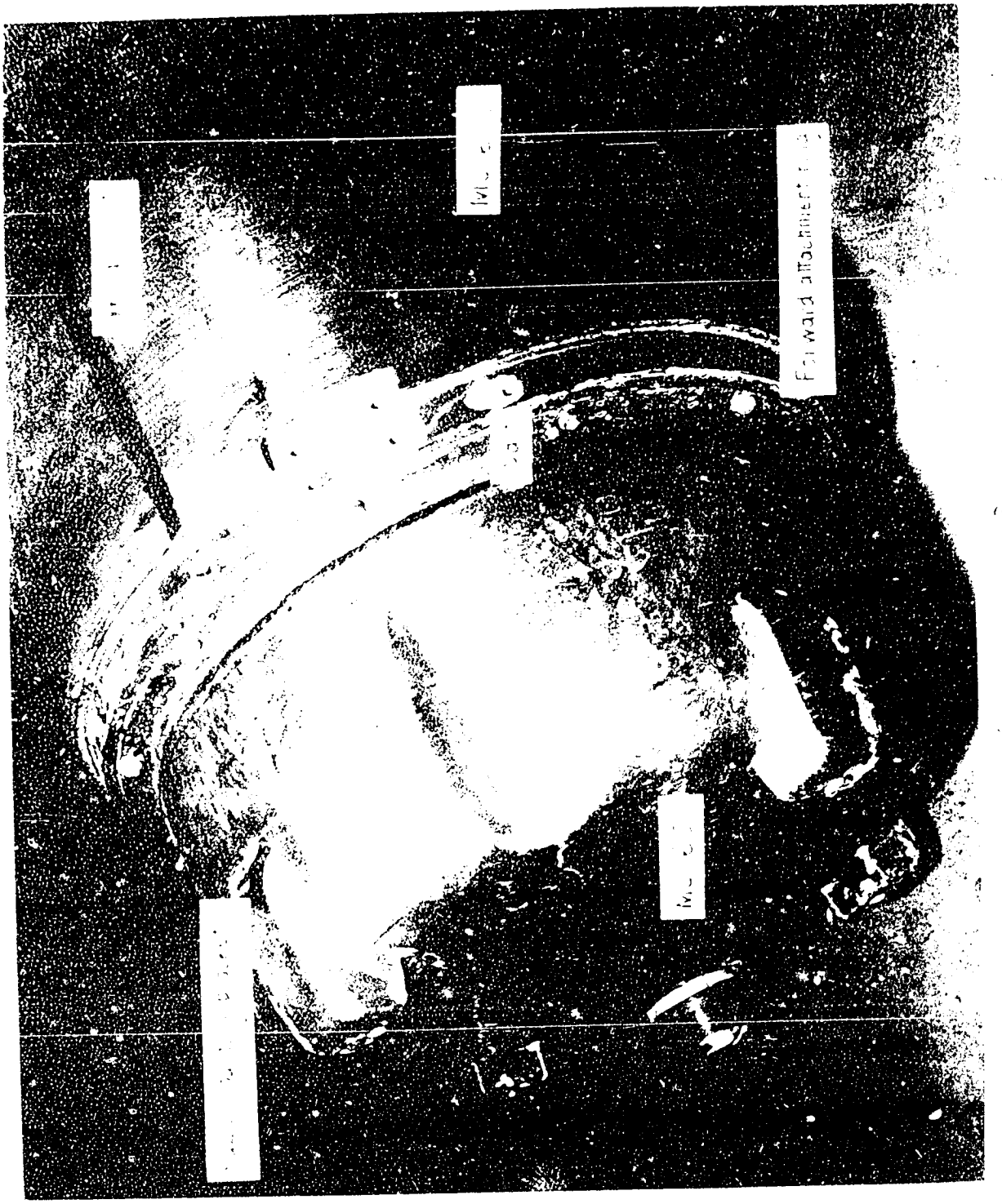

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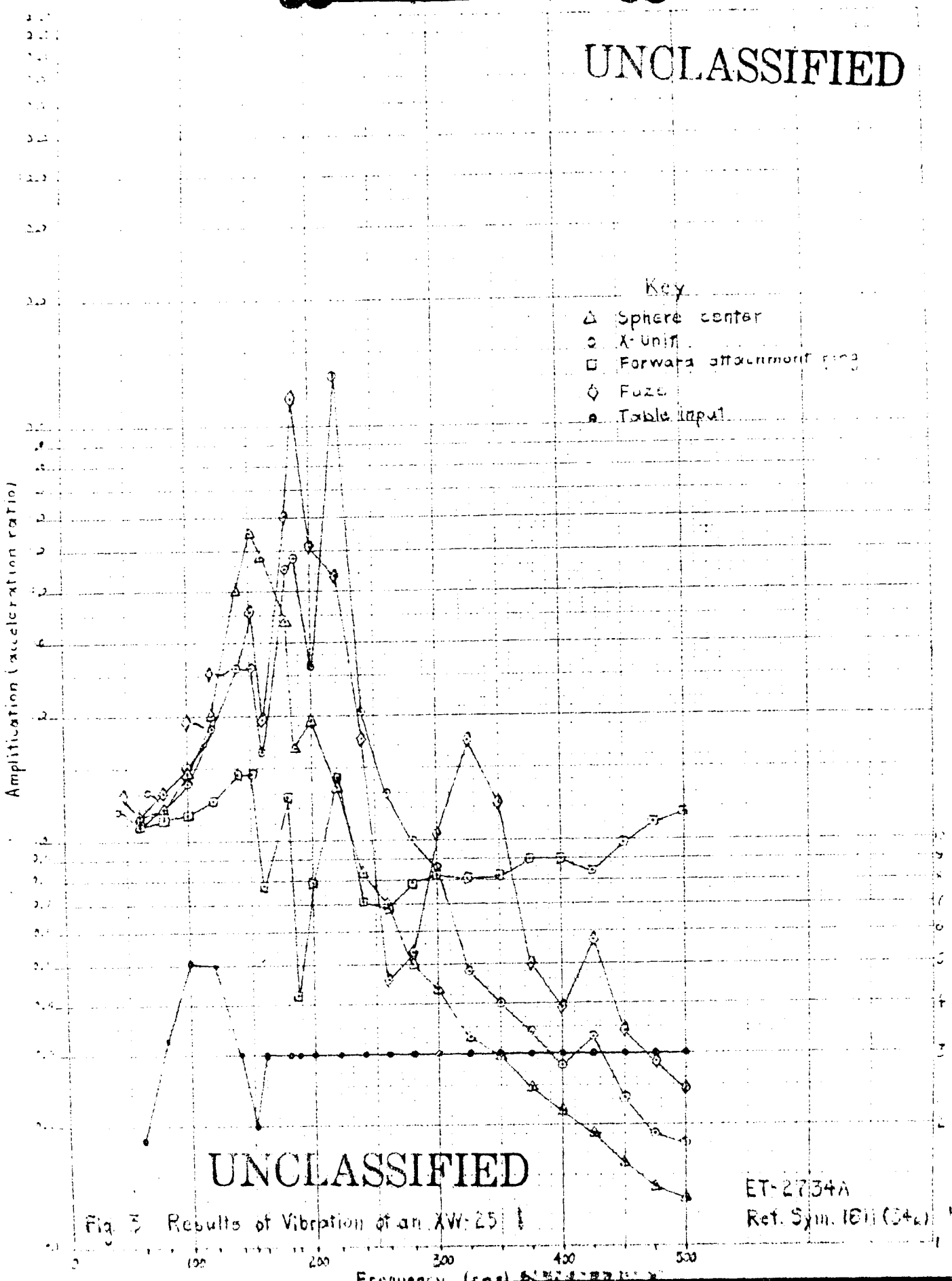

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Fig. 3 Results of Vibration of an XW-25

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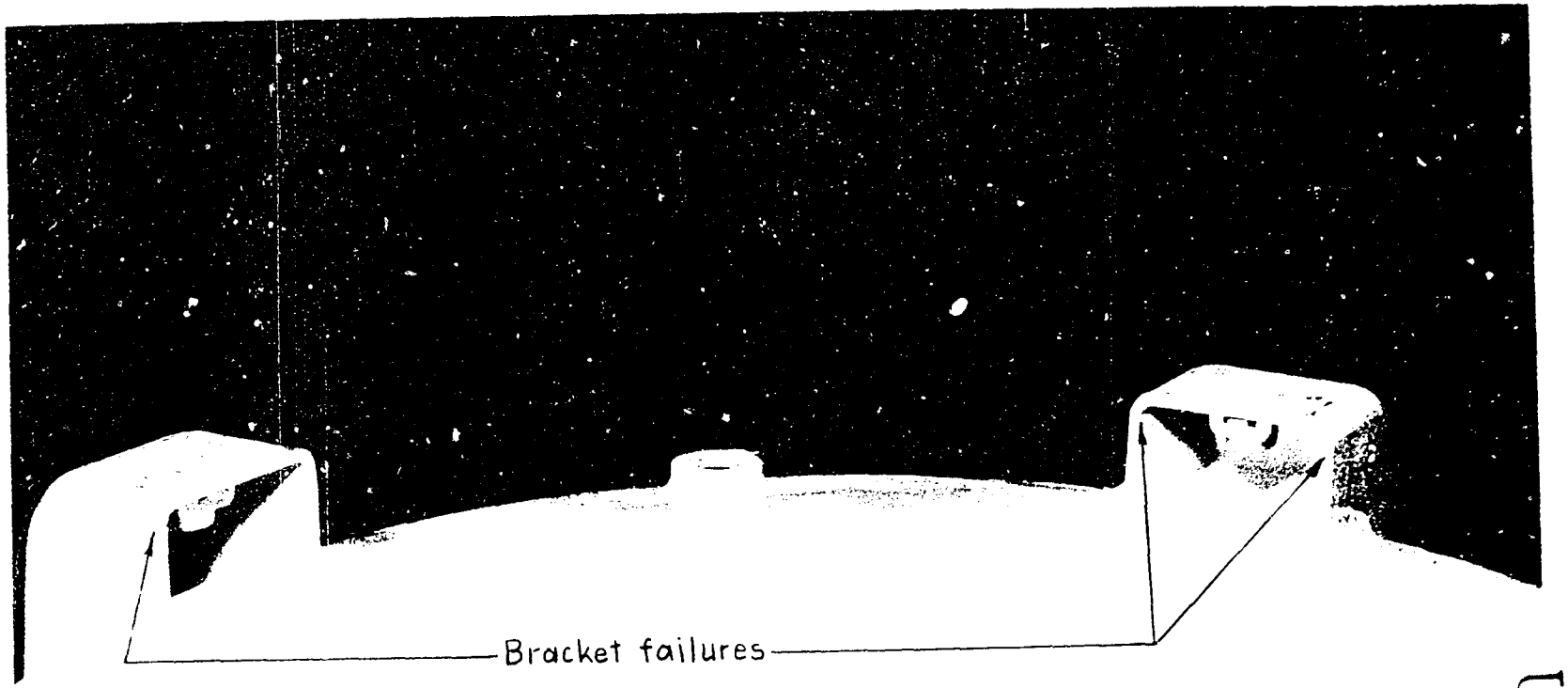

Fig 4 Fuze-Mounting Brackets after Vibration

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