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M. L. A. DUNN - 1284 TCG-SAFF-1/TCG-NNT-1

e. Second Shipment Vibration Test of Loaded H-189 Container

Object of Test

The object of this test was to perform vibration tests from 10 to 60 cps on the H-189 container loaded with the MC-156 cartridge (with and without the X-unit) to simulate different shipping conditions.

INVENTORIED APR 1 1957 BY ORG. 2743

Authorization for Test

This test was requested by Division 1284 in a Work Order Authorization dated November 4, 1952. Mr. G. V. Lemmon was the consultant.

INVENTORIED MAR 7 '55 4162

Summary of Results

Difficulty was experienced in mounting the container on the vibration table. When the container was bolted tightly to the table using jigs Nos. 1 and 2 (Fig. 1), the container base cracked, the aluminum vibration mount spacers cracked, and the vibration mounts were damaged. Steel vibration mount spacers performed satisfactorily, but the mounting screws on three vibration mounts loosened. When the container was anchored to the table using jig No. 3 (Fig. 2) to simulate aircraft shipping conditions, performance was satisfactory throughout the test. In general, vibration amplification factors were higher with the X-unit and vibration mount spacers removed.

INVENTORIED MAR 1959 BY ORG. 4343

Procedure and Results

The H-189 container supplied for the vibration tests was the first development prototype manufactured by Precision Sheet Metal Company. No serial number was available. The container was supplied with eight cartridge vibration mounts, rated at 100 pounds per mount, MDI No. 813817. Channel-shaped aluminum and steel vibration mount spacers were supplied for the purpose of raising the cartridge sufficiently above the container base to allow for coiling of the electrical leads around the base of the cartridge. When the X-unit was removed, the spacers were not needed and were also removed. The steel vibration mount spacers are shown in Fig. 3.

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PERSON CHANGING MARKING
WC Layne 12/16/98
PERSON VERIFYING MARKING & DATE
WC Layne
RECORD ID 995N0350
DATED 11/4/98

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Natural frequencies of the cartridge mounted in the container were determined by shock-exciting the cartridge and measuring accelerations at the cartridge mounting ring and at the top of the cartridge shell. Natural frequencies for the conditions under which the container was vibrated are listed below:

1. With aluminum spacers and X-unit

   a. Vertical Shock
      Top of cartridge shell: 25 cps
      Cartridge mounting ring: 24 cps

   b. Horizontal Shock
      Top of cartridge shell: 15 cps
      Cartridge mounting ring: 42 cps

2. With steel spacers and X-unit

   a. Vertical Shock
      Top of cartridge shell: 26 cps
      Cartridge mounting ring: 24 cps

   b. Horizontal Shock
      Top of cartridge shell: 14 cps
      Cartridge mounting ring: 42 cps

3. X-unit and spacers removed; vibration mounts set directly on pedestals

   a. Vertical Shock
      Top of cartridge shell: 32 cps
      Cartridge mounting ring: 28 cps

   b. Horizontal Shock
      Top of cartridge shell: 9 and 18 cps
      Cartridge mounting ring: 58 cps

From this, it is evident that the type of spacers used had little effect on the natural frequencies. In general, with the spacers removed the natural frequencies were higher. The loaded container was then vibrated in two mutually perpendicular transverse planes in accordance with SCS-5, paragraph 2.1.4.3 (10-60-10 cps in 10 minutes at a double amplitude of 0.060 inch for 45 minutes per plane). Vibration was not performed along the longitudinal axis of the container. Planes I and II were at angles of 23 degrees and 67 degrees, respectively, to the longitudinal axis of the MC-158 junction box.

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Accelerations were recorded at the following locations:

A_1 - shake table (Fig. 2)
A_2 - container base
A_3 - vibration mount spacer (Fig. 3)
A_4 - cartridge mounting ring (Fig. 3)
A_5 - top of cartridge shell (Fig. 3)
A_6 - top of container (Fig. 2)

The container was mounted rigidly to the table by means of aluminum bars passed through the container feet and bolted to a mounting plate screwed to the shake table (Fig. 1, jig No. 1). The container feet were aligned in the direction of vibration. The container was vibrated for 45 minutes in Plane I with the X-unit and the aluminum vibration mount spacers in place. During this time, the rivets holding one of the bumper ring mounting brackets were broken and the welds on the bottom of the container, particularly along the container feet, were cracked. Four of the aluminum vibration mount spacers were cracked and three of the bottom retaining collars of the vibration mounts were torn or broken Vibration amplification factors for this test are shown in Fig. 4. It was felt that this method of mounting the container caused unusual loads along the feet welds of the base and was responsible for the damage to the base.

Another mounting method was then tried (Fig. 1, jig No. 2). The feet of the container were removed, an aluminum spacing disk was placed on the shake table, and the container base was placed on the disk and screwed to the table. Thus, the dynamic vibration loads were more evenly distributed throughout the base than when jig No. 1 was used. Vibration was for 15 minutes with the X-unit and steel spacers in place of the aluminum spacers. At 45 cps a very high vibration amplification factor was noted at the cartridge mounting ring, and the limit switches on the shake table shut the table off. Inspection showed that three of the vibration mounts were loose. The rivets holding two of the bumper ring mounting brackets had broken and the brackets were deformed, and the retaining nut on the bottom of one of the loose vibration mounts had partially unscrewed. Amplification factors for this test are shown in Fig. 5.

It was then decided with the consultant to inspect actual aircraft tie-downs of these and similar containers and to mount the container on the shake table in a manner closely approximating these tie-downs. As a result of an inspection of an actual aircraft tie-down of the H-43 container (very similar to the H-189), the container was placed on a plywood board bolted to the shake table and a chain was passed through the handling hole in the cover and fastened to the table by means of turnbuckles (Fig. 2). Several short vibration runs were

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made at low amplitudes to determine the effectiveness of the jig. The actual vibration tests were made with the chain arranged transverse to the direction of vibration and the feet aligned in the direction of vibration. The container was vibrated for 40 minutes in Plane I with the X-unit and steel spacers in place. The bumper ring was not installed during this run because new mounting brackets were not available. Performance was satisfactory and vibration amplification factors are shown in Fig. 6.

Upon receipt of new bumper ring mounting brackets, the bumper ring was installed and the tests were continued. Vibration runs were made in both planes with and without the X-unit and steel spacers. Planes were changed by turning the cartridge 90 degrees on the cartridge mounting ring. The container cover, mounting chain, and container base remained in the same position for these runs. The mounting chain was transverse to the direction of vibration and the container feet were aligned in the direction of vibration. After 1-1/2 hours of vibration, the bottom retaining screw of one of the vibration mounts fell out. Other than this the performance of the container was satisfactory throughout the test. Since some slippage occurred between the container base and the table, vibration amplification factors are plotted in Figs. 7 through 10 with respect to the container base. In general, vibration amplification factors were higher with the X-unit and vibration mount spacers removed. A comparison of Figs. 6 and 7 also shows that vibration amplification factors were generally higher without the bumper ring installed than with it installed. However, accelerations were generally higher throughout the cartridge with the bumper ring installed. The reason for the opposite trend in amplification factors is that greater slippage between the container feet and the table, and therefore lower accelerations at the container base amplification reference point and throughout the cartridge, occurred with the bumper ring removed. The exact reason for different degrees of slippage between the container base and the table is not known. It could possibly be due to different jig chain tensions or different degrees of abrasion of the plywood mounting board. In the author's opinion, it does not seem likely that the presence or absence of the bumper ring could affect the slippage of the container on the shake table to this extent.

A previous test was conducted on this container and is discussed in a report to Mr. L. A. Dunn (ET-852, dated March 23, 1953). That test was performed at low amplitudes for the purpose of determining the suitability of vibration mounts rated from 50 to 150 pounds each; vibration mount spacers were not used.

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A direct comparison between this test and the previous test (ET-852) would not be logical because of the different mounting methods and different amplitudes of vibration.

Equipment Used

Sonntag shake table No. 2
Sandia six-channel vibration analyzer, Model 1
Statham accelerometer, Model A5A-100-300,
  Serial No. 622, range ±100 g
Five Statham accelerometers, Model A5A-50-300,
  Serial Nos. 650, 653, 654, 656, and 657,
  range ±50 g

R. S. Jacobson

Test Conducted by R. S. JACOBSON - 1611

R. L. Wagar

Approved by R. L. WAGAR - 1611

RSJ:1611:jf

Copy to:
1/9A - F. J. Given, 5300
2/9A - L. E. Lamkin, 1280
3/9A - A. F. Cone, 1510
4/9A - T. B. Morse, 1610
5/9A - K. O. Thorp, 1630
6/9A - L. J. Biskner, 2530
7/9A - L. A. Dunn, 1284
8/9A - G. M. Byrne, 1925-3 [redacted]
9/9A - J. M. Ralls, 1521-4 Attn: 1500 Drawing File

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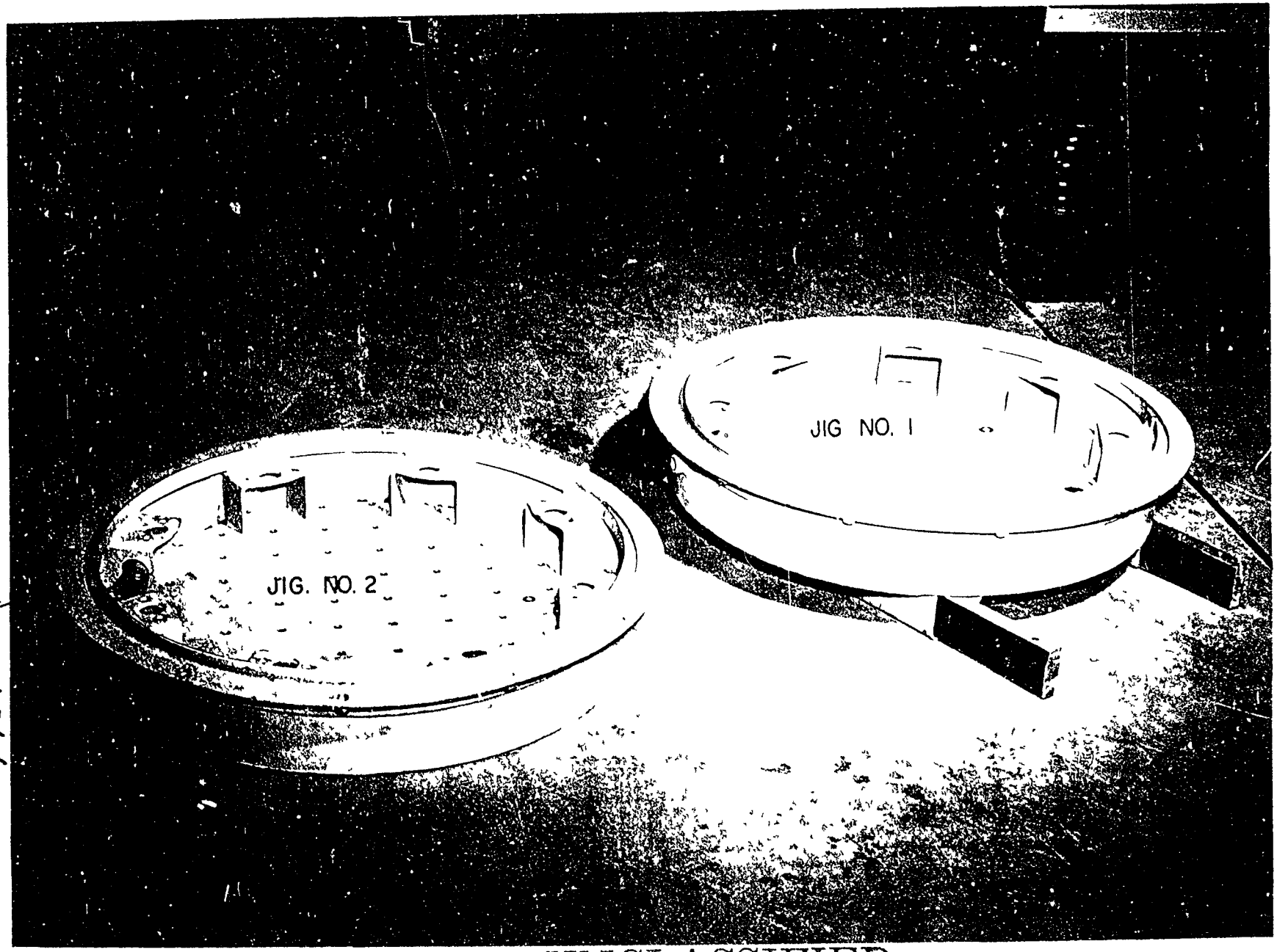

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FIG 1 – MOUNTING JIGS NOS. 1 AND 2 FOR H-189 CONTAINER VIBRATION TEST

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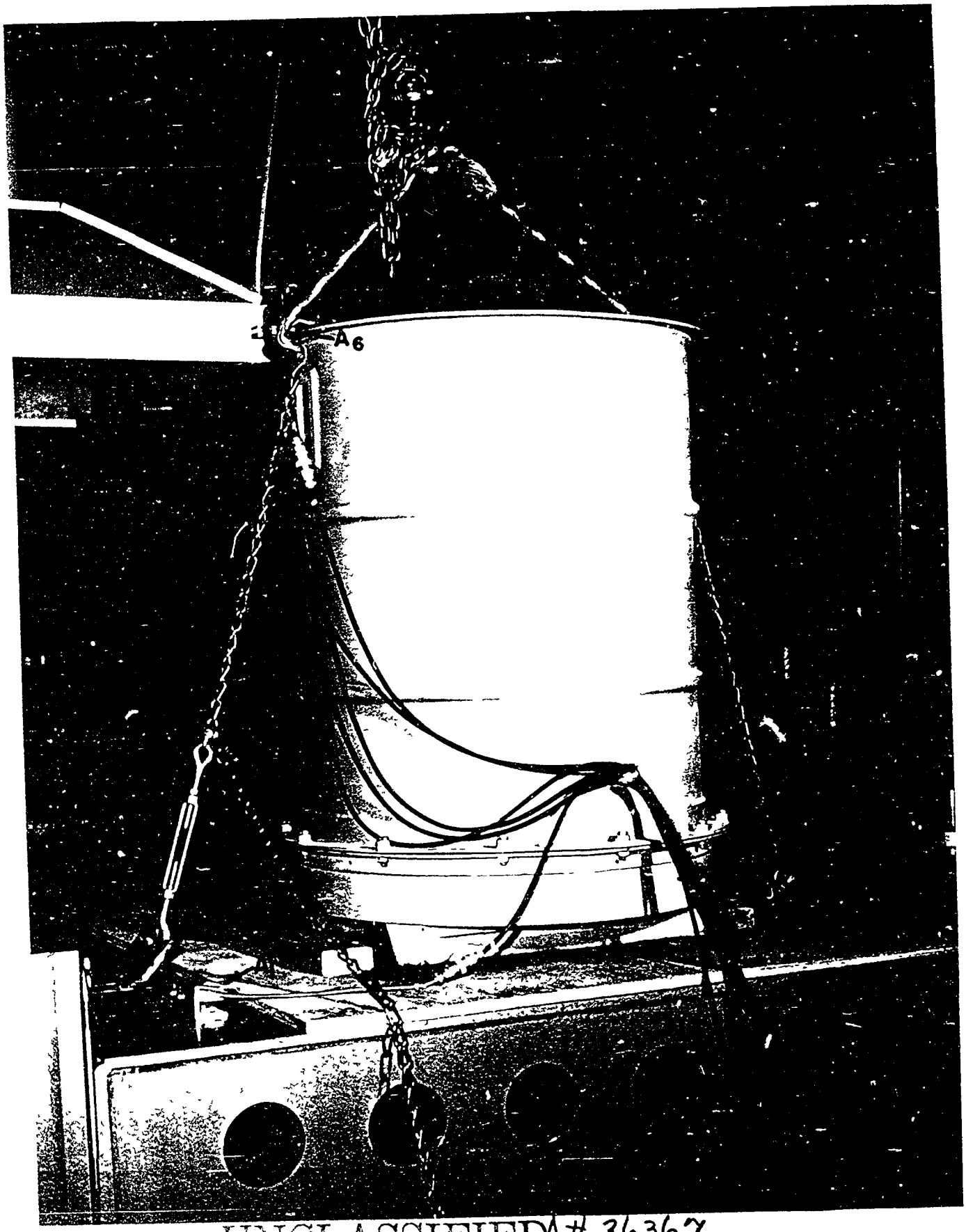

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FIG 2-MOUNTING JIG NO. 3 AND LOCATION OF ACCELEROMETERS A_1 AND A_6 FOR H-189 CONTAINER VIBRATION TEST

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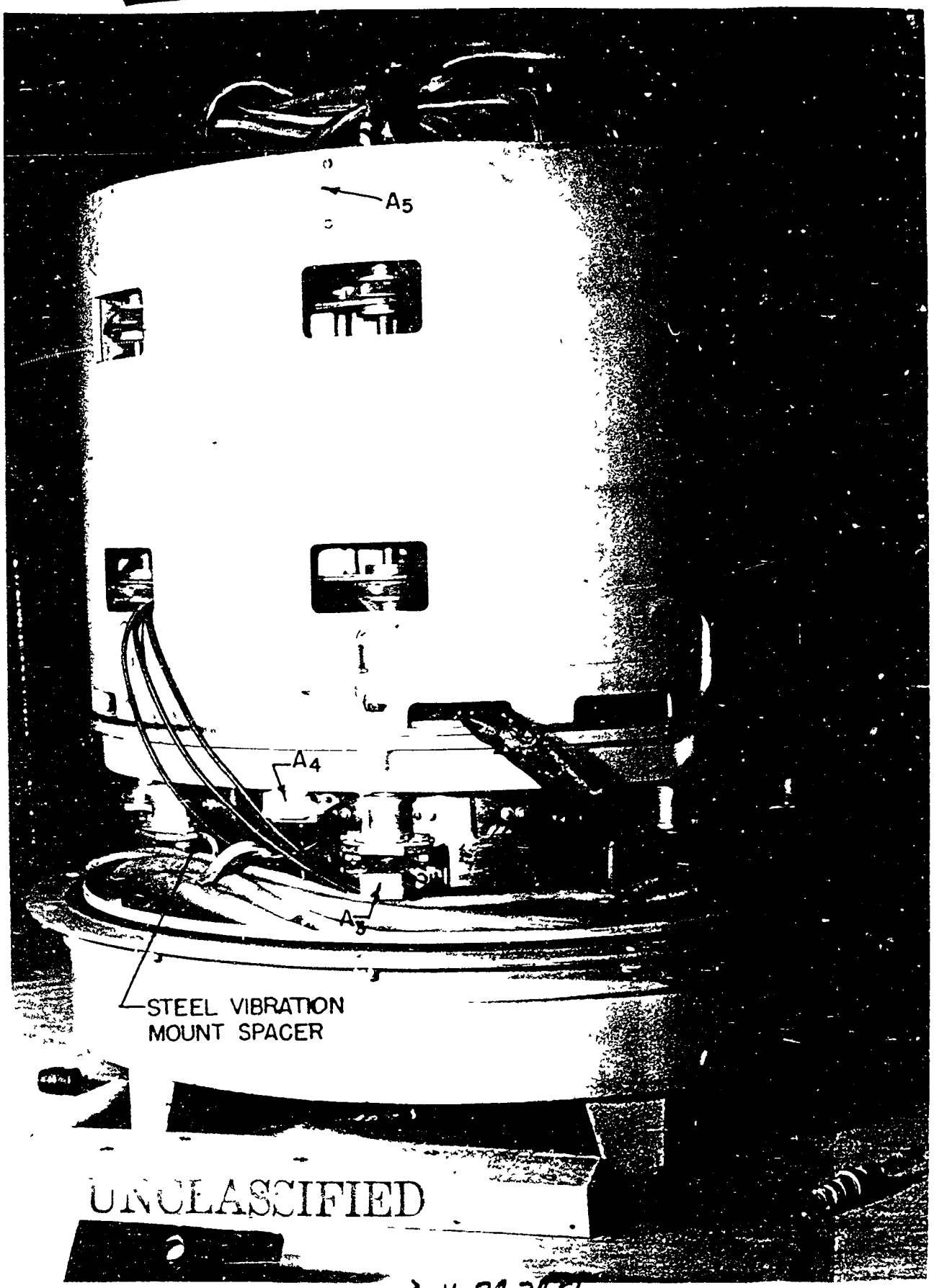

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FIG 3 – VIEW SHOWING STEEL VIBRATION MOUNT SPACERS AND LOCATIONS OF ACCELEROMETERS A_3; A_4, AND A_5 FOR HUSS CONTAINER VIBRATION TEST

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FIG 4 — H-189 CONTAINER VIBRATION TEST - PLANE I, JIG NO. I, WITH X-UNIT AND ALUMINUM VIBRATION MOUNT SPACERS — AMPLIFICATION FACTORS AND TABLE ACCELERATION

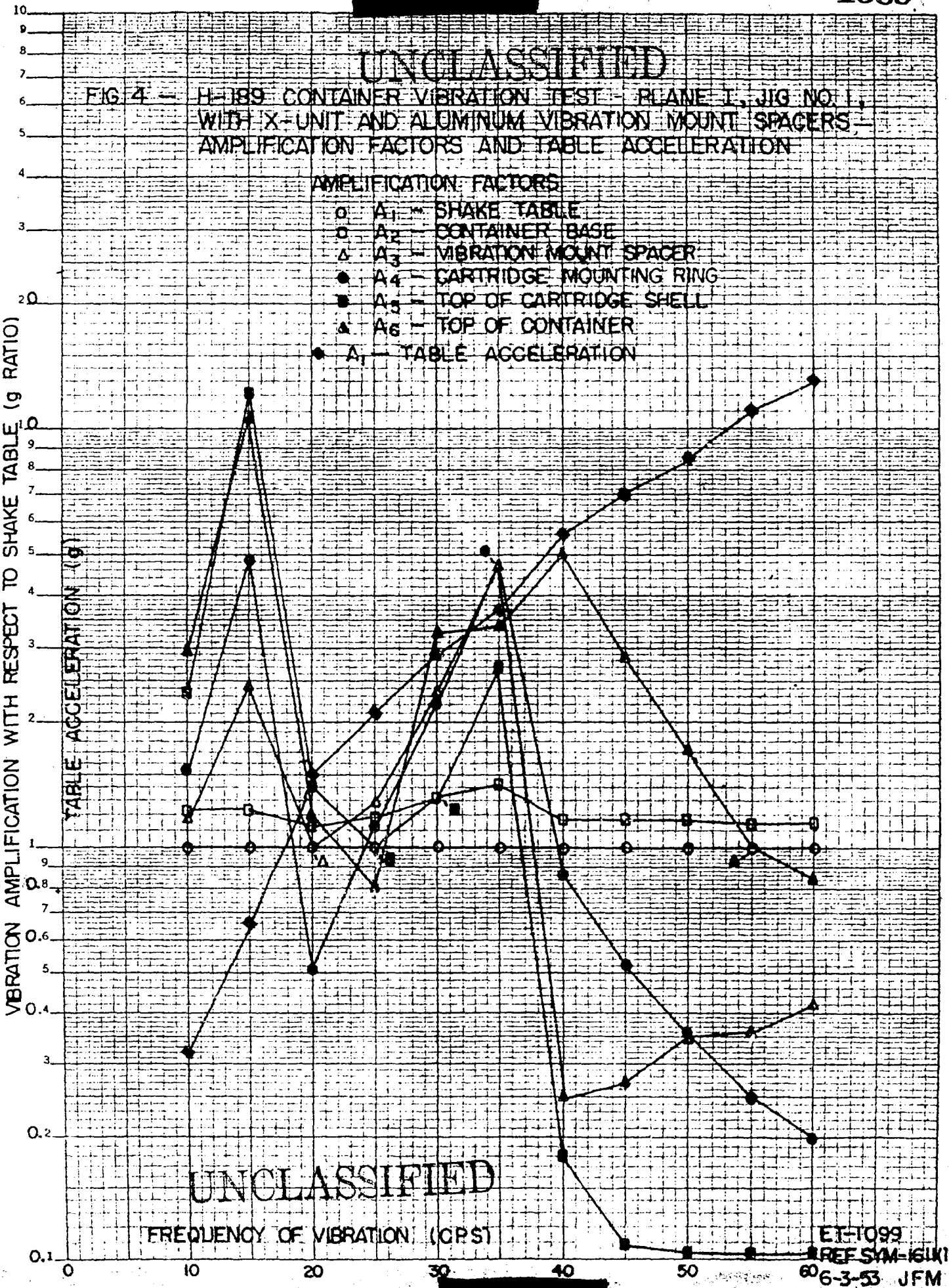

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FIG. 5 — H-189 CONTAINER VIBRATION TEST — PLANE 1, JIG NO. 2, WITH X-UNIT AND STEEL VIBRATION MOUNT SPACERS — AMPLIFICATION FACTORS AND TABLE ACCELERATION

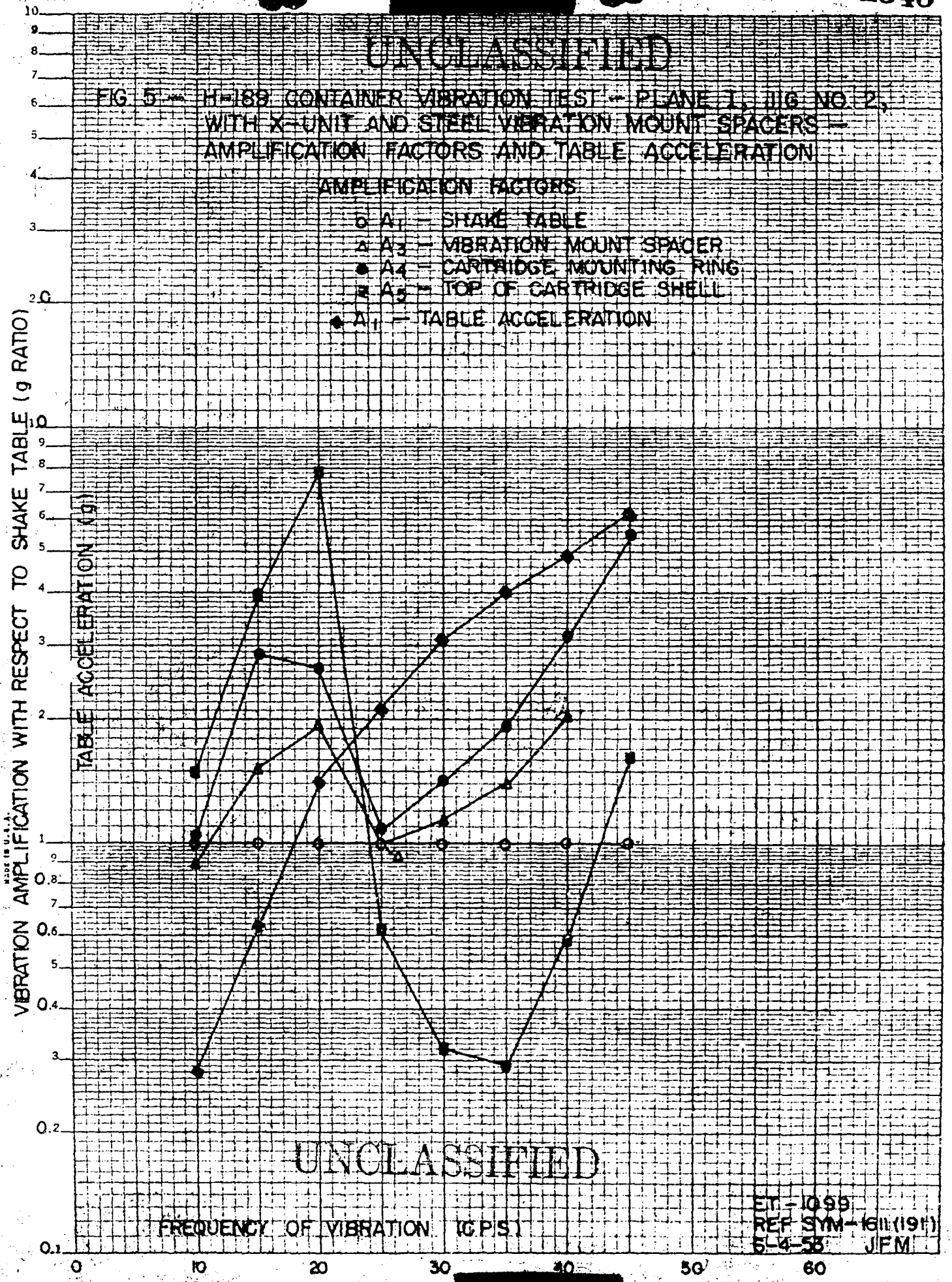

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FIG 6 — H-189 CONTAINER VIBRATION TEST - PLANE I, JIG NO 3, WITH X-UNIT AND STEEL VIBRATION MOUNT SPACERS - BUMPER RING REMOVED - AMPLIFICATION FACTORS AND ACCELERATION OF CONTAINER BASE

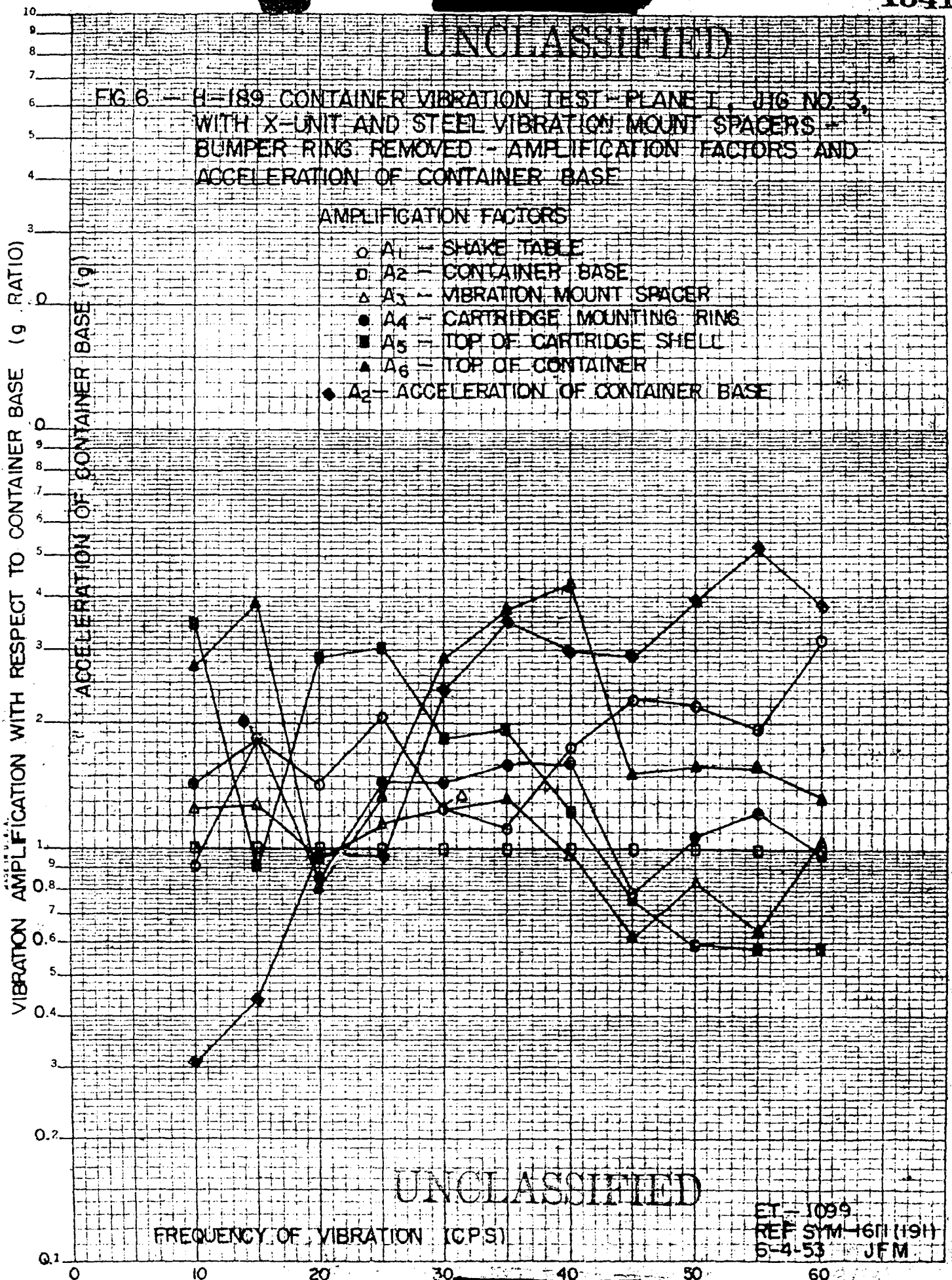

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FIG. 7 — H-189 CONTAINER VIBRATION TEST — PLANE I, JIG NO. 3, WITH X-UNIT AND STEEL VIBRATION MOUNT SPACERS — AMPLIFICATION FACTORS AND ACCELERATION OF CONTAINER BASE

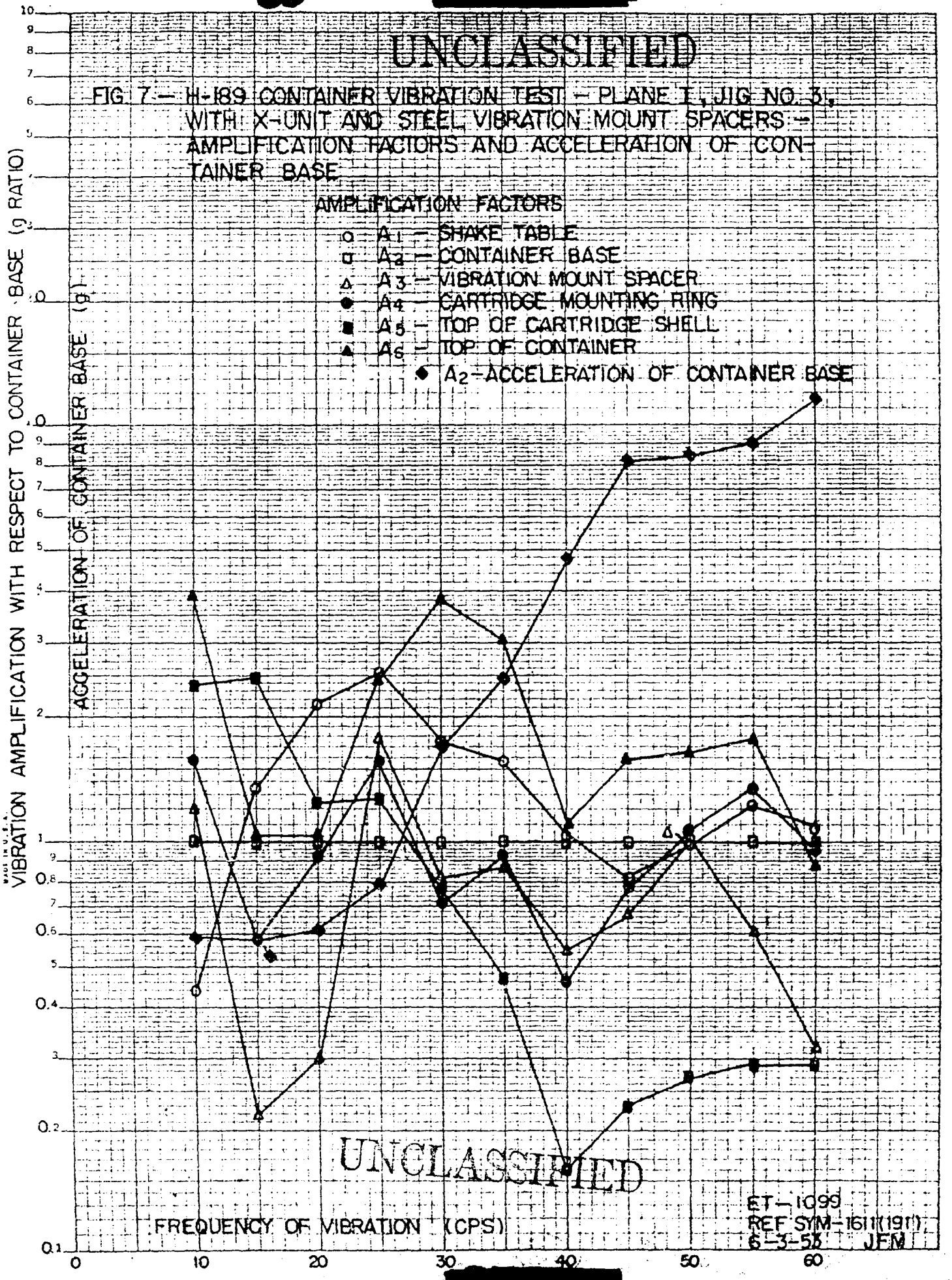

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FIG. 7 — H-189 CONTAINER VIBRATION TEST — PLANE I, JIG NO. 3, WITH X-UNIT AND STEEL VIBRATION MOUNT SPACERS — AMPLIFICATION FACTORS AND ACCELERATION OF CONTAINER BASE

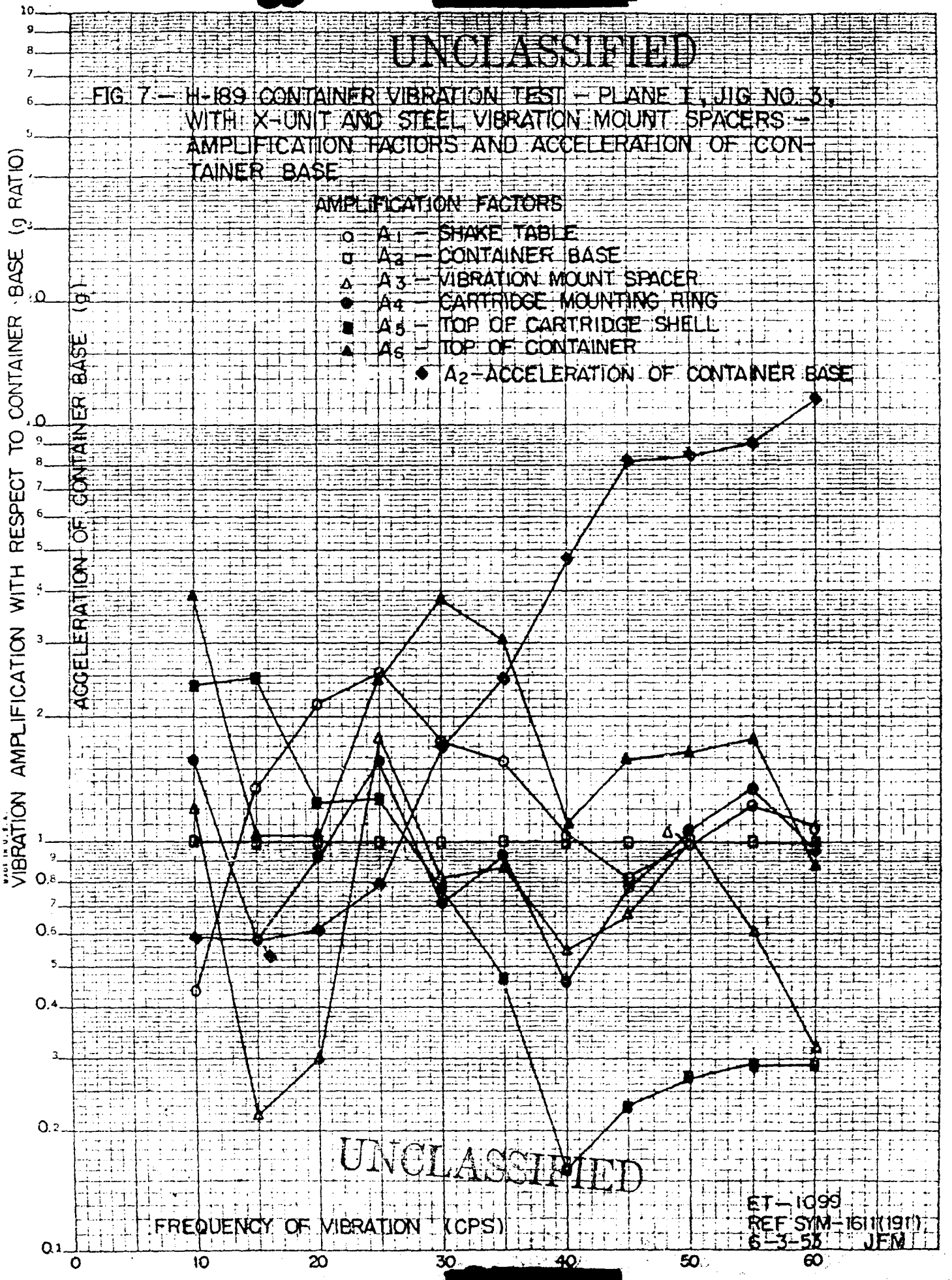

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FIG 8 — H-189 CONTAINER VIBRATION TEST — PLANE II, JIG NO 3, WITH X-UNIT AND STEEL VIBRATION MOUNT SPACERS — AMPLIFICATION FACTORS AND ACCELERATION OF CONTAINER BASE

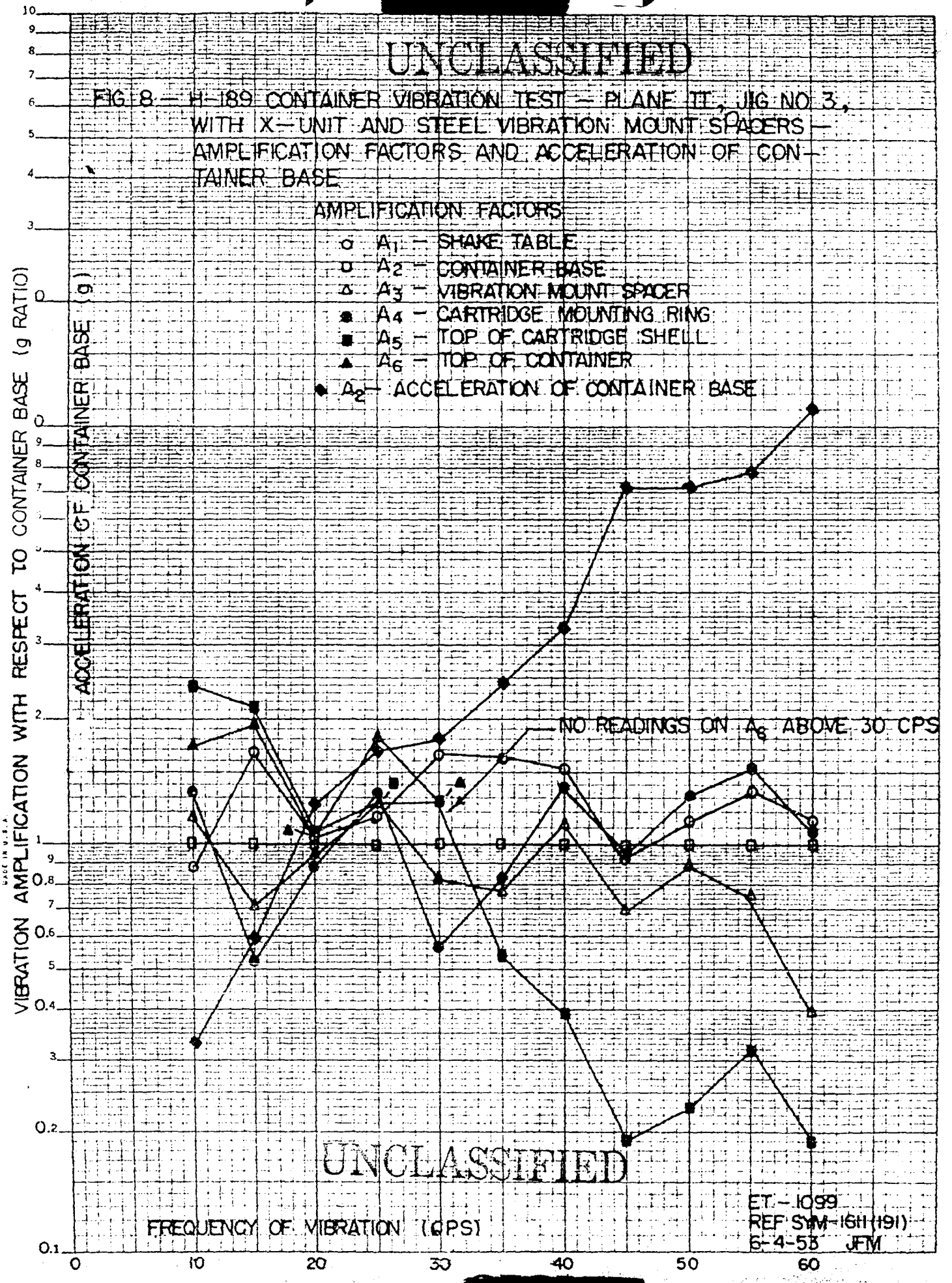

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FIG. 9 — H-189 CONTAINER VIBRATION TEST — PLANE T, JIG NO. 3, X-UNIT AND STEEL VIBRATION MOUNT SPACERS REMOVED — AMPLIFICATION FACTORS AND ACCELERATION OF CONTAINER BASE

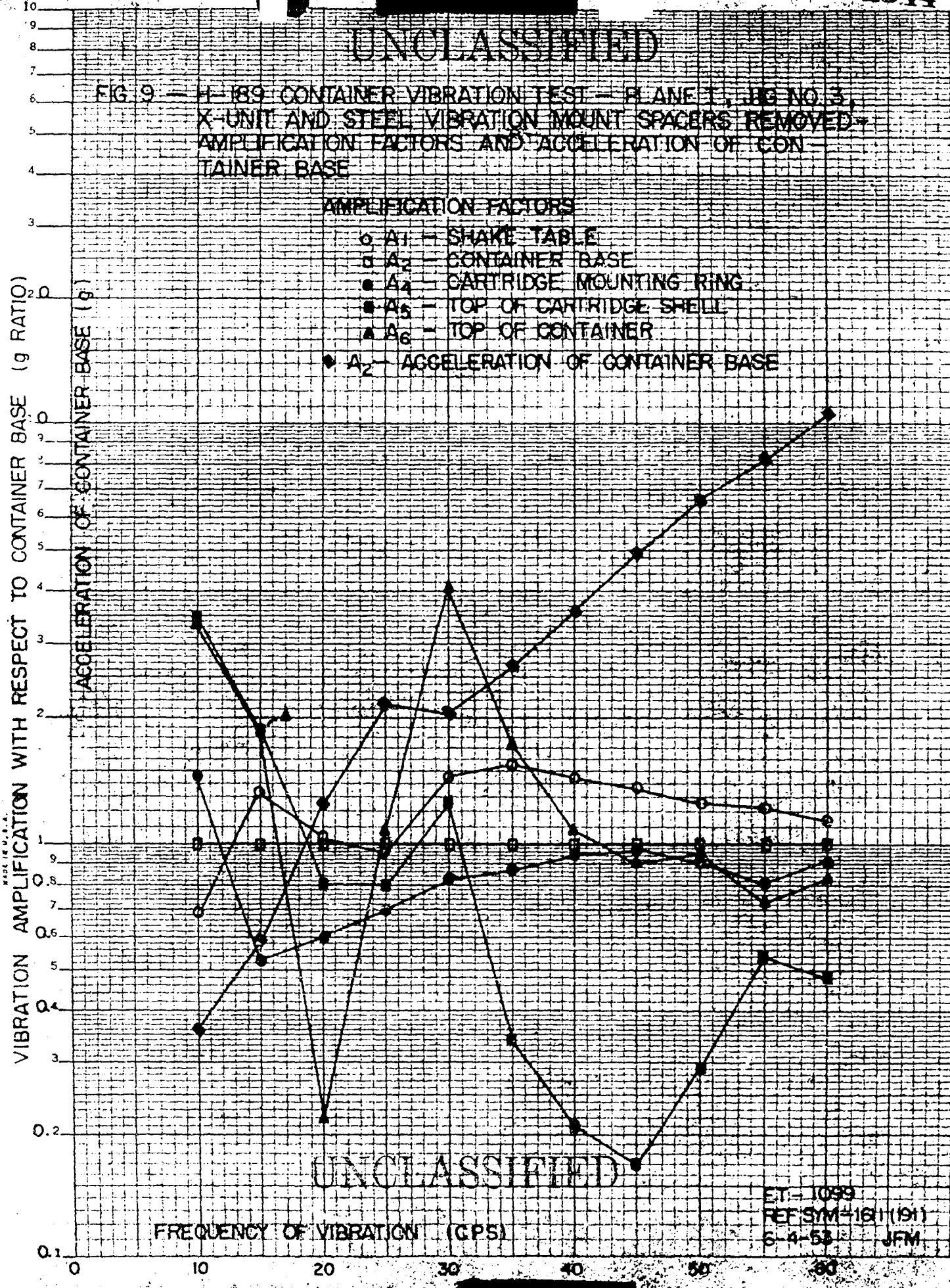

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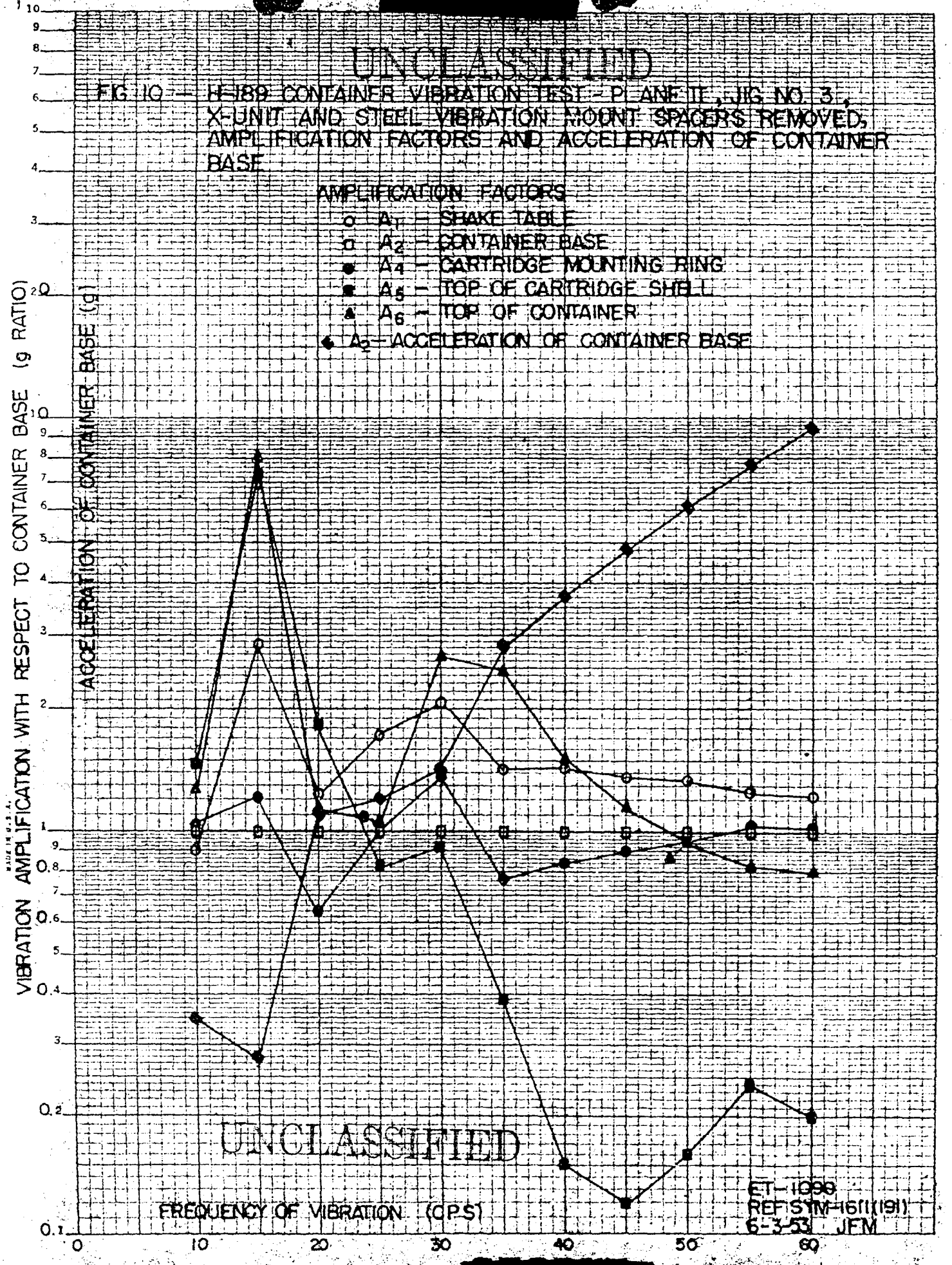
FIG. 10 — H-189 CONTAINER VIBRATION TEST - PLANE II, JIG NO. 3, X-UNIT AND STEEL VIBRATION MOUNT SPACERS REMOVED, AMPLIFICATION FACTORS AND ACCELERATION OF CONTAINER BASE



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