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OCT 16 1953

Case No. 433.00
Ref. Symbol: 1611
Project No. ET-1208
Completed 4/6/53

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MR. L. A. DUNN - 1284

Re: Leakage and Vibration Test of Loaded H-204 Container

Object of Test

The container was a Cook Electric Company development model, Serial No. CKAD1039-X2-L2. The object of this test was to determine its performance when subjected to internal pressures of ± 1.25 psig and ± 2.50 psig, and when subjected to vibration from 10 to 60 cps at a double amplitude of 0.060 inch. The vibration test was performed with various component configurations to simulate different shipping conditions.

Authorization for Test

This test was requested by Division 1284 in a Work Order Authorization dated December 29, 1952. Mr. G. Neun was the consultant.

Summary of Results

Leakage was less than 1 mm of Hg in 1-1/2 hours during the pressure tests at ± 2.5 psig. During the vibration test the aluminum ring sectors and aluminum brackets, supporting the MC-205 and X-unit, were damaged. These support structures were replaced with steel ring sectors and angles and no further damage occurred. Also the MC-48 vibration mounts were damaged, the MC-83 inverters were broken off their mounts, and the cartridge vibration mounts were damaged.

Equipment Used

1. Leakage Test:

   Vacuum pump
   Air compressor
   Wallace and Tiernan mercury manometer
   GE Freon leak detector, Type H, No. 3206718

2. Vibration Test:

   Sonntag shake table No. 3
   Sandia vibration analyzer, Model I
   Statham accelerometer, Model A5A-100-300, Serial No. 622, range ± 100 g
   Statham accelerometers, Model A5A-5C-300, Serial Nos. 650, 653, 654, 656, and 657, range ± 50 g

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Procedure and Results

Leakage Test -- Positive and negative internal pressures were applied to the container using the compressor and vacuum pump. Freon gas was injected into the container during the positive pressure test and the GE Freon detector was used to check for leaks. Internal pressure readings were taken at 15-minute intervals using the mercury manometer. Leakage rates were negligible throughout the test, being less than 1 mm of Hg in 1-1/2 hours for ± 2.5 psig internal pressure. The consultant specified that leakage should not exceed 1 mm of Hg in 15 minutes for these internal pressures.

Vibration Test -- The loaded container was placed on a plywood board which was bolted to the shake table, and the container was fastened to the table by means of chains fastened to the clevises at the top of the container and to the shake table. This was done to simulate aircraft shipment conditions, and it allowed for some slipping between the container feet and the plywood board. Vibration was performed 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 axis) along each of two mutually perpendicular axes transverse to the longitudinal axis of the container. Axes I and II were parallel and perpendicular, respectively, to the longitudinal axis of the Abee mounts. The container feet were parallel to the longitudinal axis of the Abee mounts. Accelerations were monitored at the following locations:

A_1 - shake table
A_2 - container base
A_3 - vibration mount support ring
A_4 - cartridge mounting ring
A_5 - MC-205 at inverter mounting level
A_6 - MC-207 between dynamotor clamps

One vibration run was made using the two aluminum cartridge support structures. Each structure consisted of an aluminum angle (2 x 2 x 1/4 inches) formed into an arc of approximately 120 degrees. Five 1/4-inch thick aluminum angle brackets were welded to the curved angle. Three brackets of each structure were used to support the MC-205 and MC-207, and two brackets rested on the vibration mounts. These structures extended approximately 240 degrees around the cartridge structures, were bolted to the cartridge at six points, and supported on four vibration mounts. The aluminum support structures proved unsatisfactory. After one vibration run along axis I, four of the aluminum brackets bolted to the cartridge structures were bent and one was cracked. Also two 1/2-inch screws attaching the mounting structure, on which the aluminum bracket cracked, to the vibration mounts were loose. Amplification factors for this run are shown in Fig. 1. Steel cartridge supporting structures were then fabricated by the consultant. These structures were the same size as the aluminum structures except that 5/16-inch steel was used throughout. Another vibration run was made along axis I and no damage occurred. However, the six cartridge mounting screws had loosened and were retightened. Amplification factors for this run are shown in Fig. 2. Vibration was then perfomed along axis II and the

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MC-48 vibration mounts were severely damaged. The two mounts at one end of the MC-48 were broken. On one of these mounts the rivets holding the steel mounting pad had broken. The mount at the single suspension end of the MC-48 had unscrewed from its mounting pad. The loose steel mounting pad was refastened using 5-40 brass screws, lock washers, and nuts in place of the rivets, and the MC-48 was replaced. Vibration amplification factors for this run are shown in Fig. 3. The X-unit was removed and vibration was continued along axis II. No damage occurred during vibration along axis II. Vibration was then performed along axis I and inspection after vibration showed that both inverters had broken off their cast mounts and that the two cartridge vibration mounts toward the front of the cartridge had pulled apart approximately 1/2 inch. The MC-48 vibration mounts were slightly damaged (slight bending of the retaining covers and some loss of the steel wool damping material). Amplification factors for these two runs are shown in Figs. 4 and 5.

Because of the damage that occurred to the MC-48 and the inverters, the consultant blocked the MC-48 vibration mounts by bolting a rubber padded steel bar, which passed over the top of the MC-48, to the cartridge structure, and also specified that the inverters were to be removed when the X-unit was removed. Four vibration runs were then made with the MC-48 blocked. The last two runs were made with the X-unit and inverters removed. No damage or loosening occurred to the cartridge vibration mounts; however, the MC-48 vibration mounts were damaged again, but not so severely. It is believed that the MC-48 blocking arrangement was unsatisfactory in that it allowed the MC-48 to slip and vibrate with respect to its support. Vibration amplification factors for these runs are shown in Figs. 6, 7, 8, and 9. Damage to the MC-48 vibration mounts occurred during the vibration runs noted in Figs. 7 and 9.

Peak vibration amplification factors ranged from 1.7 to 5.7, with respect to the container base, over a frequency range from 20 to 40 cps. The greatest amplification factor, 5.7, occurred at location A_6 (MC-207 between dynamotor clamps) during the vibration run of Fig. 8 In general, with the MC-48 free and with the steel support structures, amplification factors were higher without the X-unit in place for vibration along axis I and lower without the X-unit in place for vibration along axis II. With the X-unit and inverters in place, blocking the MC-48 caused no appreciable change in amplification factors for vibration along either axis. However, with the X-unit and inverters removed, blocking the MC-48 caused an increase in amplification factors for vibration along each axis.

R. S. Jacobson

Test Conducted by R. S. JACOBSON - 1611

R L Wagar

Approved by R. L. WAGAR - 1611

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Encl: Figs. 1 through 9

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G. M. Byrne, 1925-3 [redacted]
J. M. Ralls, 1521-4 Attn: 1500 Drawing File

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FIG. 1 – H-204 CONTAINER VIBRATION TEST – AXIS T – ALUMINUM CARTRIDGE MOUNTING RING – WITH X-UNIT AND INVERTERS

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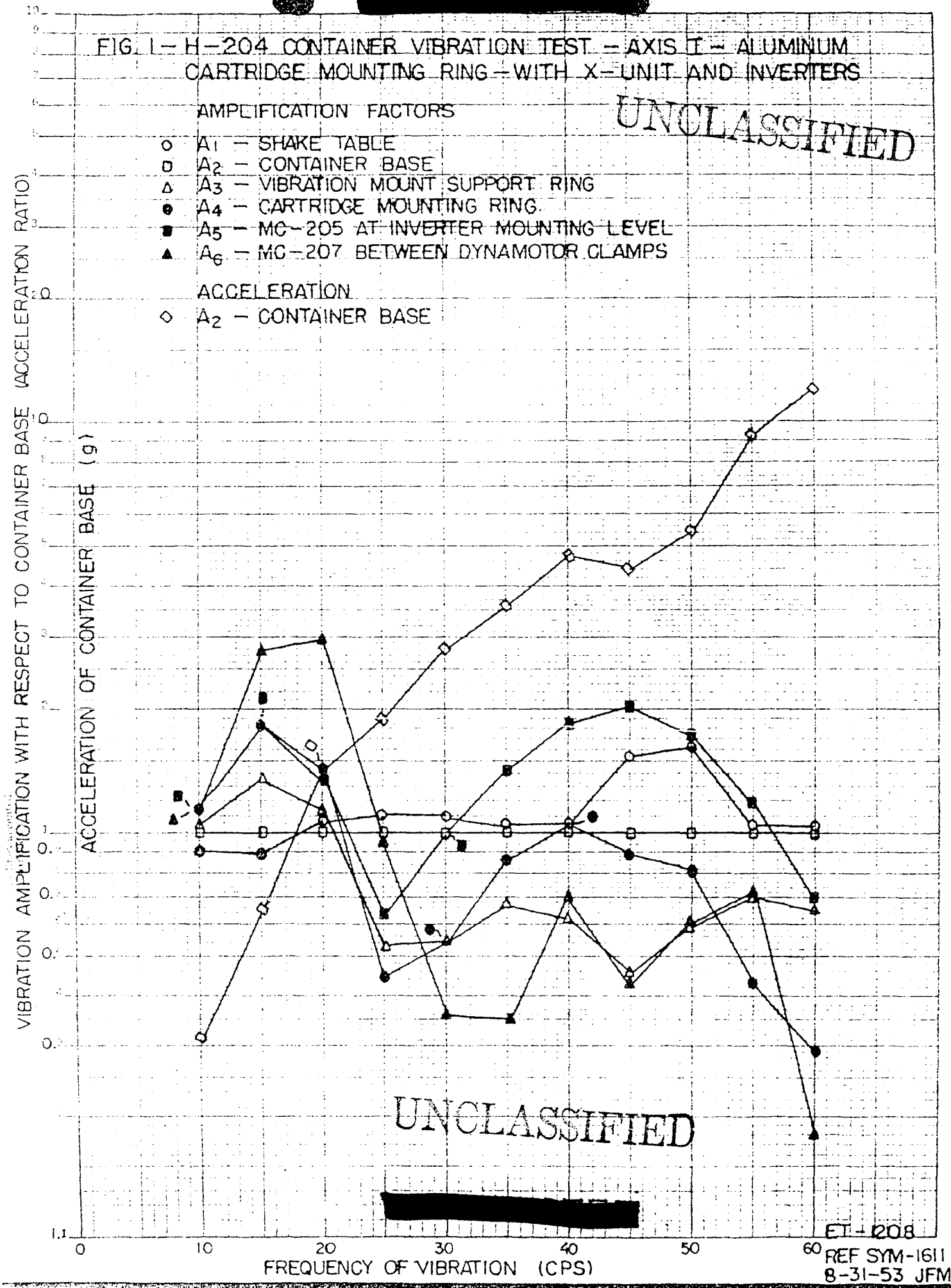

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FIG. 2 – H-204 CONTAINER VIBRATION TEST – AXIS I – STEEL CARTRIDGE MOUNTING RING – WITH X-UNIT AND INVERTERS

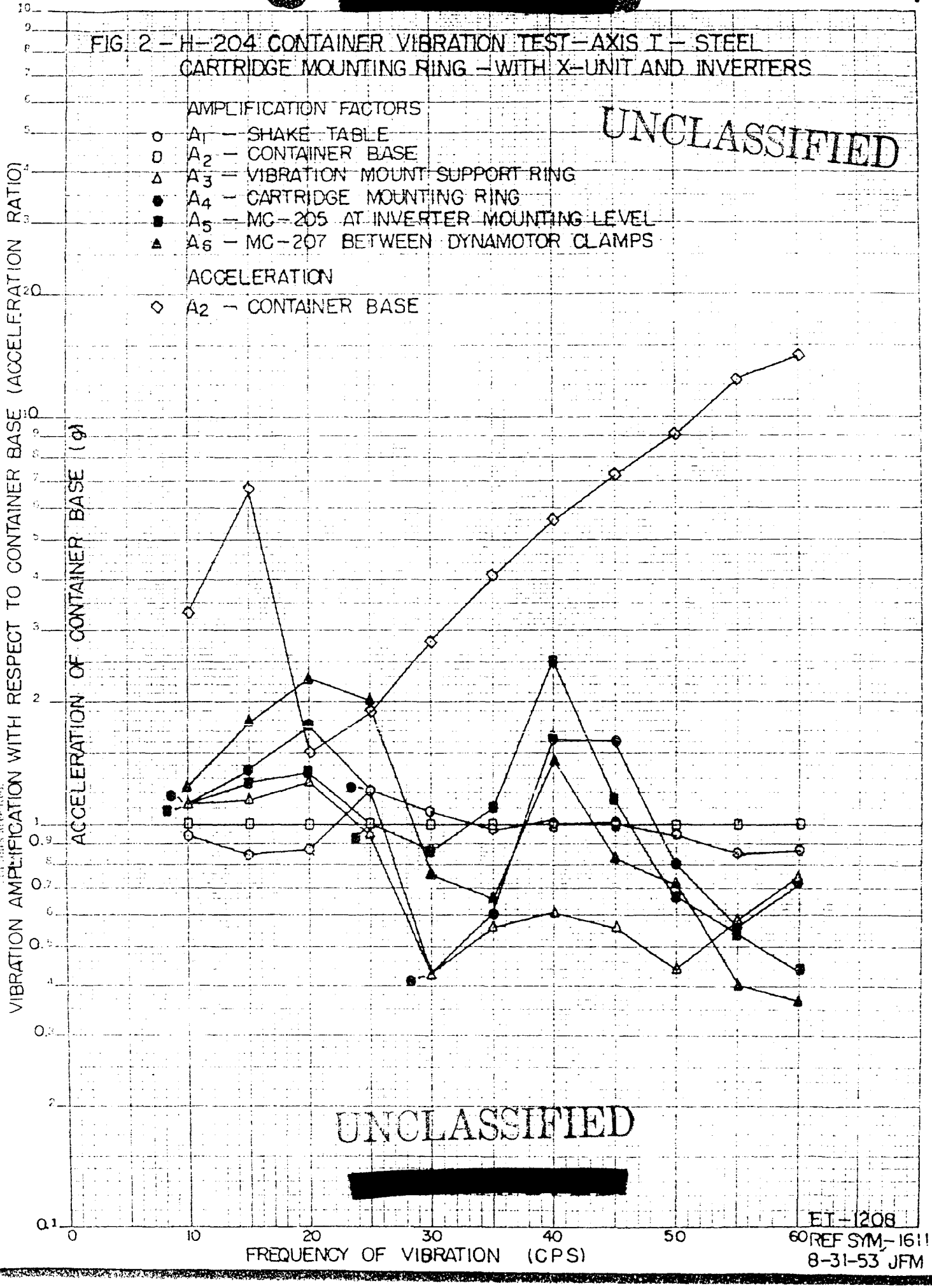

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FIG. 3 – H-204 CONTAINER VIBRATION TEST – AXIS II – STEEL CARTRIDGE MOUNTING RING – WITH X-UNIT AND INVERTERS

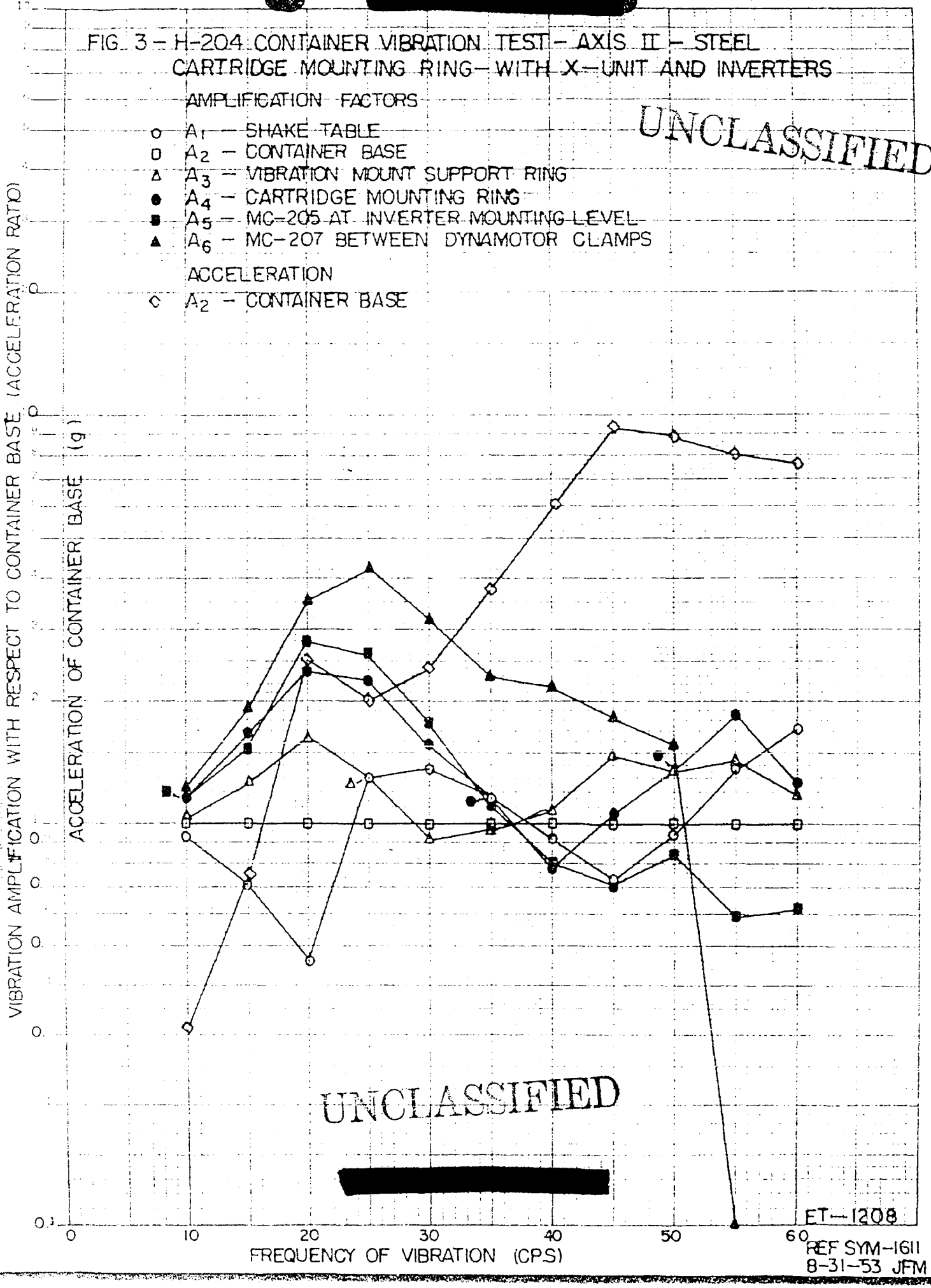

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FIG. 4 – H – 204 CONTAINER VIBRATION TEST – AXIS II – STEEL CARTRIDGE MOUNTING RING – WITHOUT X-UNIT AND INVERTERS

AMPLIFICATION FACTORS

- ○ A_1 – SHAKE TABLE
- □ A_2 – CONTAINER BASE
- △ A_3 – VIBRATION MOUNT SUPPORT RING
- ● A_4 – CARTRIDGE MOUNTING RING
- ■ A_5 – MC-205 AT INVERTER MOUNTING LEVEL
- ▲ A_6 – MC-207 BETWEEN DYNAMOTOR CLAMPS

ACCELERATION

- ◇ A_2 – CONTAINER BASE

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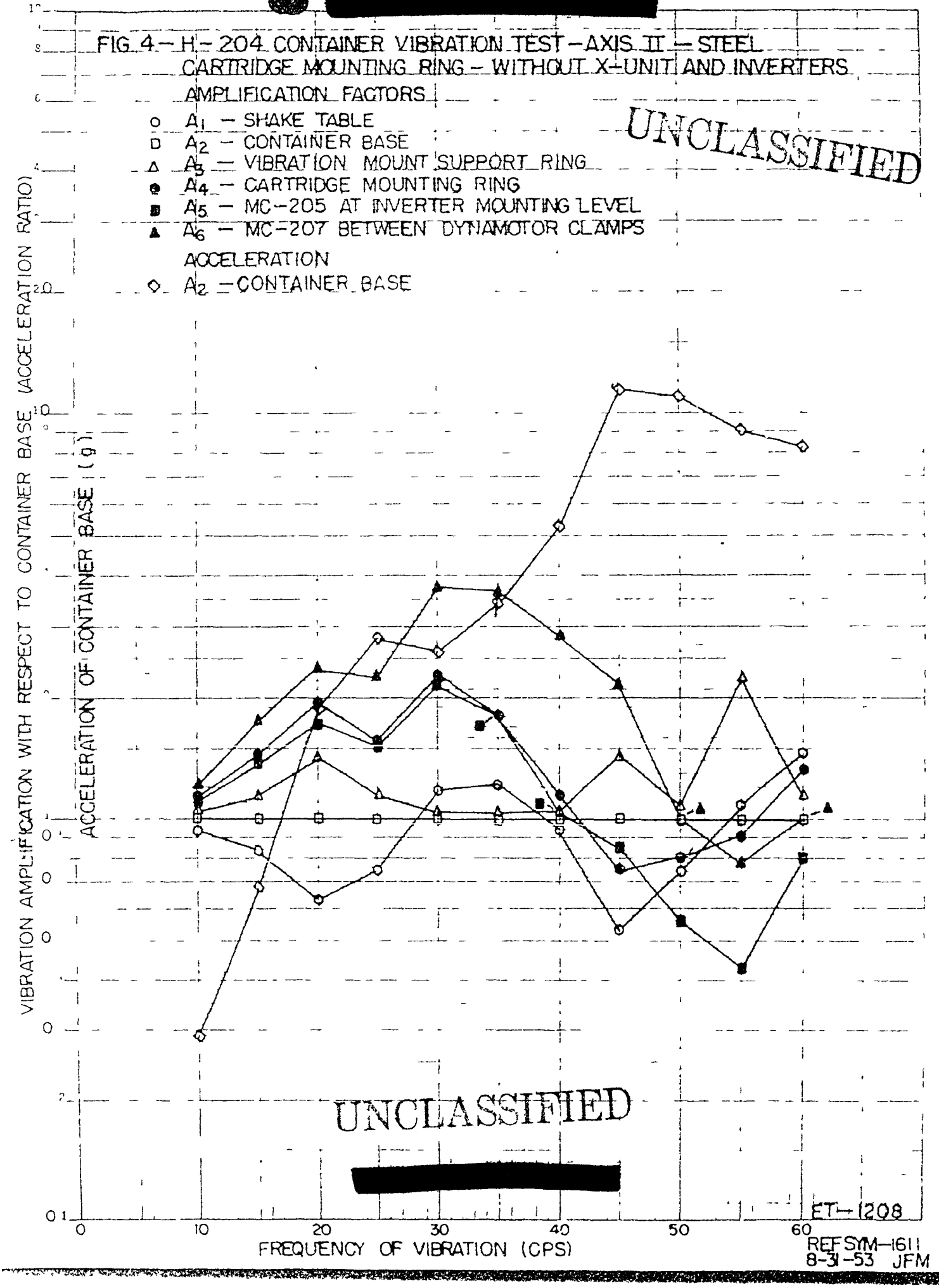

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FIG. 5 — H-204 CONTAINER VIBRATION TEST — AXIS I — STEEL CARTRIDGE MOUNTING RING — WITHOUT X-UNIT AND INVERTERS

AMPLIFICATION FACTORS.

- ○ A_1 — SHAKE TABLE
- □ A_2 — CONTAINER BASE
- △ A_3 — VIBRATION MOUNT SUPPORT RING
- ● A_4 — CARTRIDGE MOUNTING RING
- ■ A_5 — MC-205 AT INVERTER MOUNTING LEVEL
- ▲ A_6 — MC-207 BETWEEN DYNAMOTOR CLAMPS

ACCELERATION

- ◇ A_2 — CONTAINER BASE

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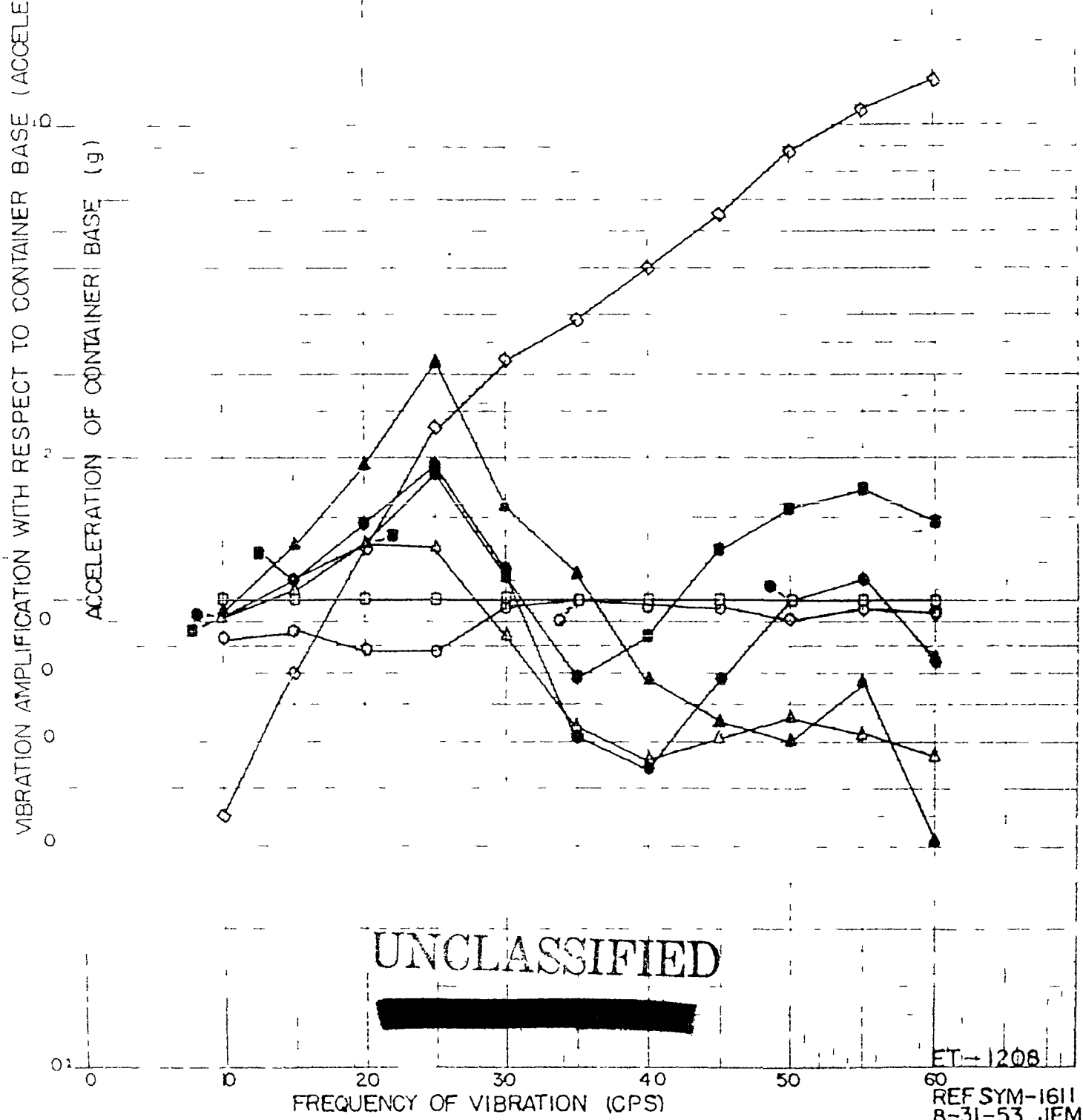

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FIG. 6 — H-204 CONTAINER VIBRATION TEST - AXIS I - STEEL CARTRIDGE MOUNTING RING - WITH X-UNIT AND INVERTERS - MC-48 BLOCKED

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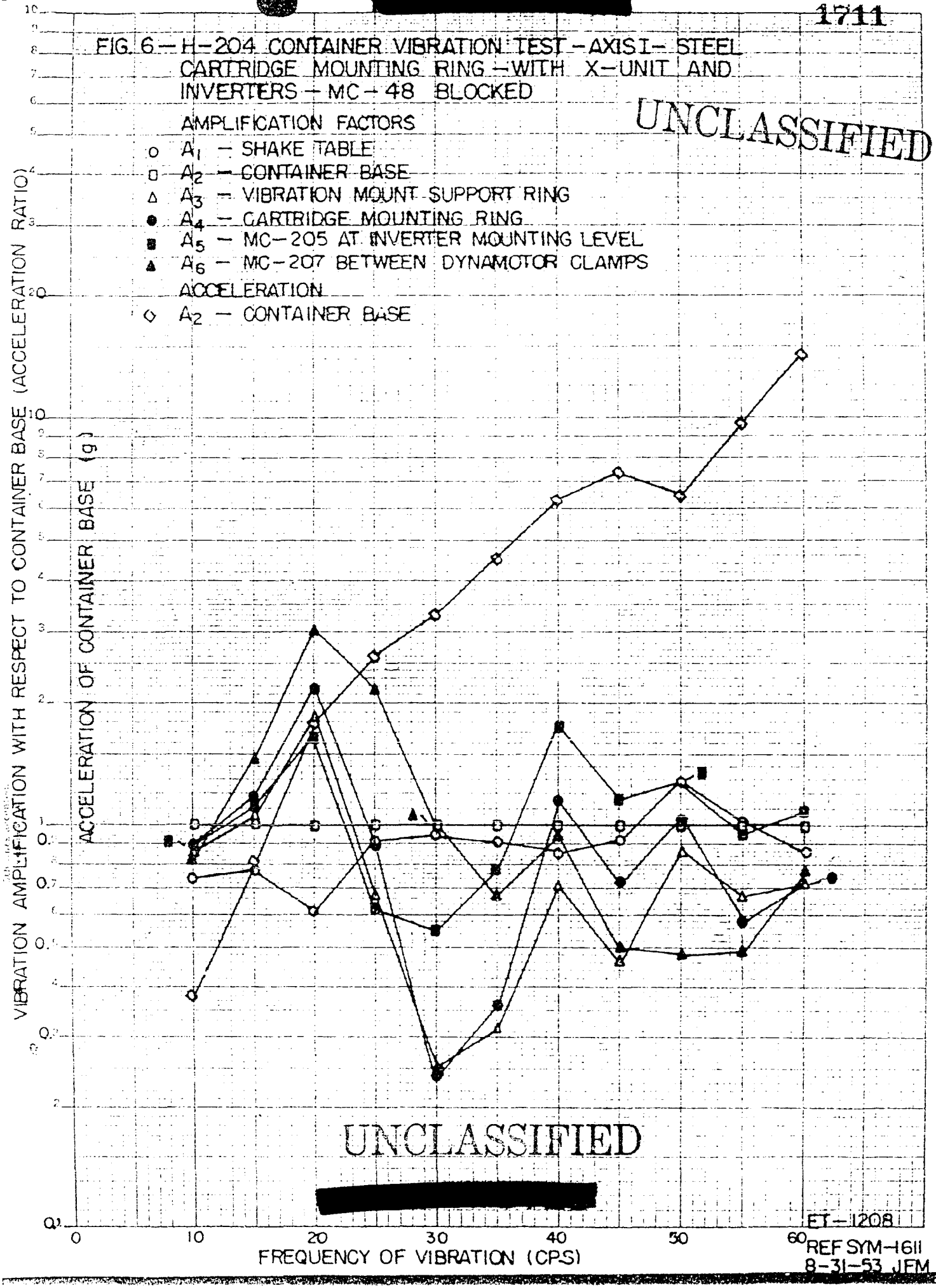

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FIG. 7 - H-204 CONTAINER VIBRATION TEST - AXIS III - STEEL CARTRIDGE MOUNTING RING - WITH X-UNIT AND INVERTERS - MC-48 BLOCKED

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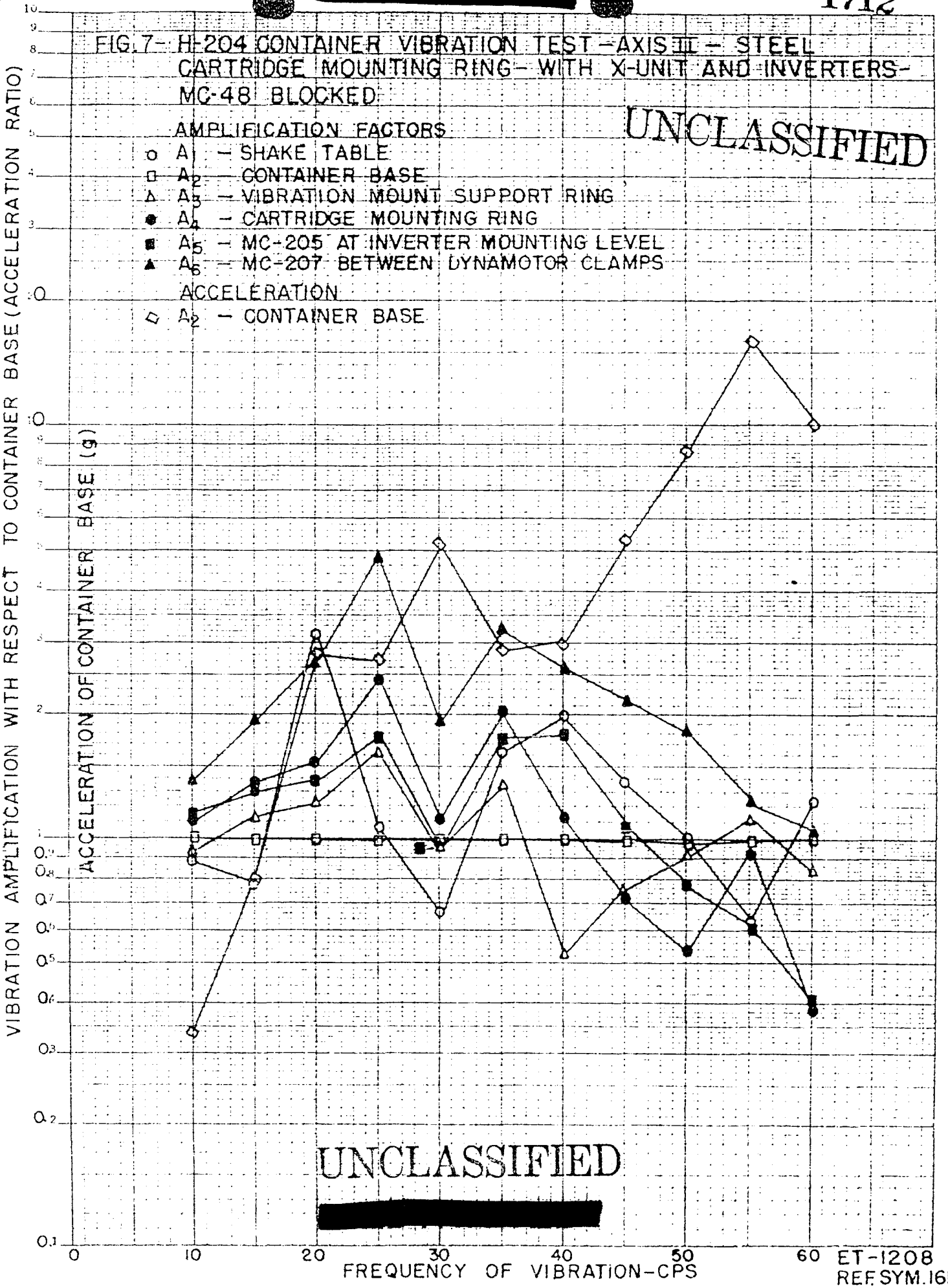

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FIG. 8 – H-204 CONTAINER VIBRATION TEST – AXIS II – STEEL CARTRIDGE MOUNTING RING – WITHOUT X-UNIT AND INVERTERS – MC-48 BLOCKED

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AMPLIFICATION FACTORS

- ○ A_1 – SHAKE TABLE
- □ A_2 – CONTAINER BASE
- △ A_3 – VIBRATION MOUNT SUPPORT RING
- ● A_4 – CARTRIDGE MOUNTING RING
- ■ A_5 – MC-205 AT INVERTER MOUNTING LEVEL
- ▲ A_6 – MC-207 BETWEEN DYNAMOTOR CLAMPS

ACCELERATION

- ◇ A_2 – CONTAINER BASE

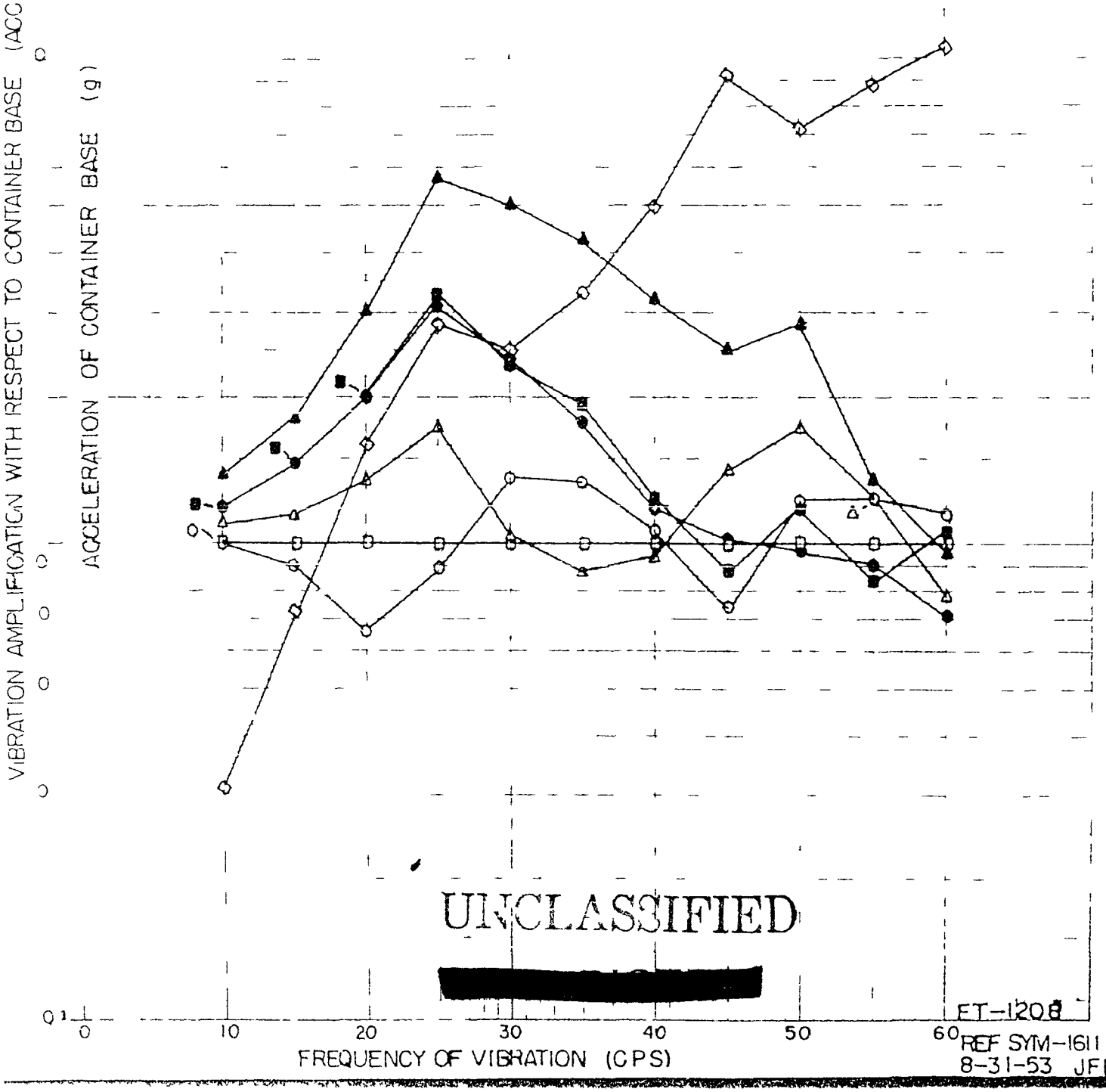

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FIG. 9 — H-204 CONTAINER VIBRATION TEST — AXIS I - STEEL CARTRIDGE MOUNTING RING — WITHOUT X-UNIT AND INVERTERS — MC-48 BLOCKED

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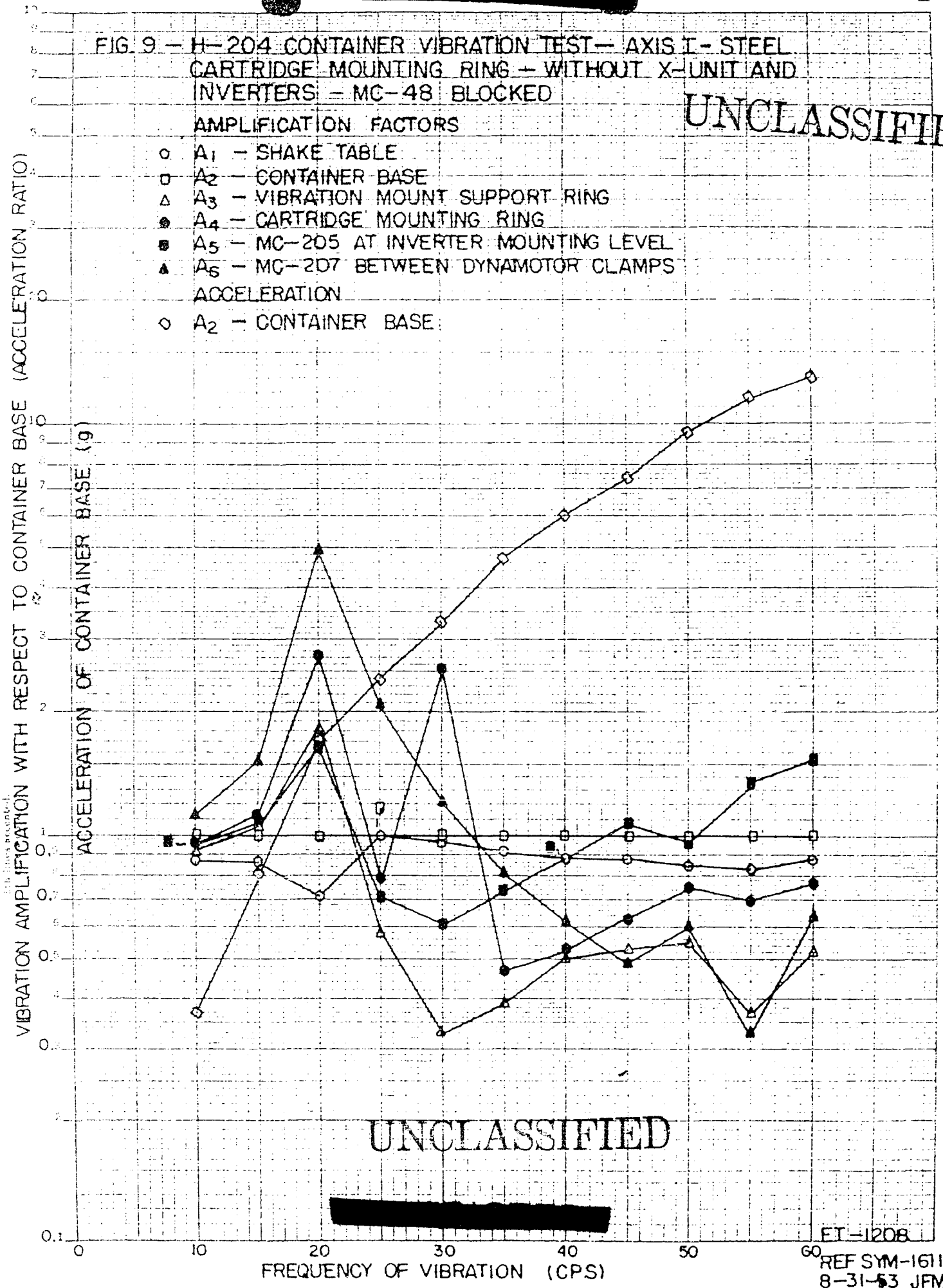

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