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Case No. 433.00
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Project No. TM-401
File: H-204, 3-2

TCG-SAFF-1; TCG-NNT-1,

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW
1st Review Date: 11/2/98
Authority: ADC ADD
Name: RBCramer
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Authority: ADD
Name: W Layne
Determination (Circle Numbers):
1 Classification Retained
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3 Contains No DOE Classified Information
4 Coordinate With:
5 Contains UCAI?
6 Comments: OK for Opennet

MR. W. A. GARDNER - 1282

Re: Shock Test of the H-204

Summary of Results

An H-204 container carrying a Mk 5 Mod 0 RG complement was subjected to a series of shock tests simulating the shipboard shock-loading conditions which may be encountered in naval transport, in order to determine the ability of the components of the Mk 5 RG complement to withstand such shock loading. The shock loads to which the container and weapon complement were required to be tested, as determined by the navy shipboard shock criteria, were 60 g in two orthogonal horizontal directions and 100 g in the vertical direction. Since damage and malfunctions were found to have been sustained by three of the components of the weapon complement after the container had been subjected to shock loads of 40 g in the horizontal directions and 60 g in the vertical direction, the test was terminated without further shock loading of the container.

The mounting flange of the MC-206 cartridge support sustained cracks in its outer edge at four of the mounting-bolt hole locations, and it was bent at the remaining two hole locations. All of the holes were elongated somewhat. These damages and deformations are attributed primarily to improper mounting of the cartridge support of the weapon complement support frame of the container. During disassembly of the weapon complement from the container after the shock test, it was found that the mounting bolts had not been tightened properly at the time of assembly.

During the CAT test of the electrical components of the Mk 5 RG complement, run following the shock test, the cases and/or the pressure fittings of the MC-411 and MC-221 baroswitches were found to have loosened, so that the leakage rates of both components were greater than the allowable limit of 100 feet equivalent altitude change in 20 seconds. The rate of the MC-221 baroswitch was 470 feet and that of the MC-411 baroswitch was 115 feet in 20 seconds.

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No other damage to or malfunctioning of either the electrical or the mechanical components of the weapon complement were observed following the shock test.

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Carmela Gilligan 12/9/98
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AUTHORITY: WCLayne
RECORD ID: 995N0363
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CDL No.	
ACCOUNTABILITY CARD	Bm
FILE No. H-204 3-2	

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Object of Test

The object of this shock test was to subject the H-204 container carrying a Mk-5 Mod 0 RG complement to shock loads simulating those which may be encountered in naval transport and to determine the ability of the components of the Mk-5 RG complement and the container to withstand such shock loading.

The container and weapon complement were to be subjected to maximum shock loads of 60 g in two orthogonal horizontal directions and 100 g in the vertical direction, representing the fore-and-aft, athwartship, and vertical shipboard shock loads, respectively. Although the maximum magnitudes of the fore-and-aft shipboard shock loads to which containers may be subjected are not expected to exceed 40 g, the H-204 container was to be tested to 60 g in two directions since it may be stowed with the vertical and lateral axes, (with respect to the Mk-5 RG warhead), of the weapon complement in any horizontal directions. In order to determine whether the weapon complement and container could withstand shock loads somewhat smaller than the specified values in the event of failures or damage at the specified values, the H-204 container was to be shock loaded in increments of 20 g, starting at 40 g in each direction of loading.

The shock accelerations applied to and developed on the container and those transmitted to the components of the weapon complement were to be measured at suitable locations.

Reason for Test

This shock test of the H-204 container and Mk-5 Mod 0 RG complement to shipboard shock criteria was requested in a Work Order Authorization from Division 1284 to Division 1612, dated March 9, 1956. C. D. Maytum, 1282, was test consultant.

Summary of Past Tests

No previous shock tests of the H-204 container and the Mk-5 Mod 0 RG complement have been conducted by Department 1610.

Setup for Test

In order to expedite performance of the container shock test for which no single test facility was available, two existing facilities were adapted to provide for the required shock tests. For the tests simulating shipboard shock loading in the fore-and-aft and athwartship directions, the engineering test ramp was employed. The legs of the H-204 container

were fastened to a 1-inch thick aluminum plate by bars run through the legs and bolted to the plate at the ends. To prevent sliding of the container during the tests, stop blocks were fastened on the tops of the bars at the ends by the bar bolts. The mounting plate with the container fastened to it was bolted to the reinforced steel floor of the test ramp dolly. This method of mounting the container on the ramp dolly, shown in Fig. 1, provided for the application of dolly impact shock loads to the container through the legs and base, as shipboard shock loads would be applied from decks under shock loading. To provide an impact shock acceleration signature approximating a half-sine-wave pulse, as required by the Navy shock test criteria, two 12 x 18 x 1-inch, 72 Shore durometer rubber impact pads were placed on the ramp stop. An overall view of the ramp shock-test setup is shown in Fig. 2.

For the tests simulating shipboard shock loading in the vertical direction, the dynamic jig was employed. The H-204 container shipping cover was attached to the container, and the container was suspended in the dynamic jig by a handling sling connected to the shipping cover and held by the dynamic jig release mechanism which was fastened to one of the jig chain hoists. To provide impact shock accelerations having approximately the required waveforms, an impact pad consisting of three 1-inch layers of Ensolite material (modified polyvinyl chloride) covering approximately the entire area of the container mounting plate was placed on the concrete floor of the dynamic jig under the suspended plate and container. As a safety precaution, guy lines of shock cord and rope attached to the dynamic jig structure were connected to the top of the container shipping cover to prevent accidental overturning of the container during rebound after impact.

The components of the H-204 container and Mk-5 Mod 0 RG complement given the simulated shipboard shock tests and their drawing and serial numbers are listed in Table I.

Instrumentation, recording, and test equipment employed for the shock tests included the following:

Fifteen Statham accelerometers (Table II and Figs. 1, 2, 3, and 4).
Hathaway Type MRC-21 strain gage control (amplifier) unit, Serial No. 5492-1, and power supply.
Two Miller Model H oscillographs, Serial Nos. 159 and 161, and power supplies.
Miller Type C-3, Model CA-12 amplifier unit, Serial No. 3.
Remote control console.

Engineering test ramp
Rubber impact pads
Dynamic jig No. 1
Ensolite impact pads
Container guy lines

T-1 baroswitch tester, Serial No. AH-2011-D3
T-133 timer tester, Serial No. BP-C018-H3
T-160 firing set tester
Lab-built pull-out switch tester
Simpson Model 260 multimeter tester
Dry batteries (28 volts total)

Procedure

The front and rear cartridge supports of the Mk-5 Mod 0 RG complement and one vibration-mount support of the H-204 container frame were instrumented with accelerometers installed at the locations described in Table II and shown in Figs. 1 to 4.

The H-204 container with the Mk-5 RG complement was mounted on the engineering test ramp dolly for horizontal shock loading in the manner described in the Setup for Test and illustrated in Figs. 1 and 2. The first test, with a shock load of about 40 g applied to the container, was run with the container oriented so that the equivalent positive acceleration pulse applied to the container was in the 180° direction arbitrarily marked on the container (parallel to container legs, as shown in Figs. 1 and 4). For this test, the ramp dolly was released from the 5-foot release position, as marked on the ramp incline, and allowed to roll along the track and impact upon the rubber impact pads on the ramp stop. Accelerations were recorded during the test with Accelerometers Nos. 1, 4, 7, 10, and 13.

The second test was run with the container oriented on the mounting plate for applied shock acceleration in the 270° direction (normal to container legs). The ramp dolly was released from the 5-foot 6-inch position for this test. Accelerations were recorded with Accelerometers Nos. 2, 5, 8, 11, 13, and 14.

The third test was run with the container oriented for applied shock acceleration in the 0° direction. The ramp dolly release position was 5-feet 6-inches. Accelerations were recorded with Accelerometers Nos. 1, 4, 7, 10, 13, and 14.

Prior to the fourth, horizontal shock-load test, the four vibration mounts on the H-204 container were replaced with new mounts since they had been somewhat deformed during the first three tests. The fourth test was run

with the container oriented for applied shock acceleration in the 90° direction. The ramp dolly was released from the 6-foot position. Accelerations were recorded with Accelerometers Nos. 2, 5, 8, 11, 13, and 14.

A visual inspection of the accessible components of the Mk-5 RG complement and the H-204 container was performed following completion of the four 40-g, horizontal, shock-load tests.

The test setup employed in the dynamic jig for the vertical shock-loading tests of the H-204 container is described in the Setup for Test. Since no dummy weight was available for calibration of the drop shock-test procedure, the H-204 container on the mounting plate was used to develop a procedure which would provide impact shock loads having the required acceleration pulse magnitudes and durations. The procedure which provided the best simulation of the required shock loads employed a 3-inch thick impact pad of Ensolite material having approximately the same impact surface area as that of the container mounting plate. The drop distance which produced a 40-g shock load with approximately the required waveform and duration was 13 inches.

During the initial period of the drop-test procedure calibration, the H-204 container was subjected to a shock load which was approximately equivalent in magnitude and duration to the second incremental level of vertical loading (60 g). Also during one calibration test, one side of the container received the first level shock of loading, and the opposite side received the second level of loading, as measured by the accelerometers on opposite sides of the container mounting plate. Since damage and malfunctions were found to have occurred to some components of the Mk-5 RG complement after the first series of drop tests and the shock test was discontinued, the acceleration data recorded during these two tests were analyzed along with the data from the test on which the required, applied load was obtained.

Following the first series of shock tests, the Mk-5 RG complement was removed from the H-204 container and partly disassembled, and the components of the Mk-5 RG complement and the container were given a visual, mechanical examination by Division 1612.

A cartridge assembly test, with one modification, was performed on the electrical components of the weapon complement by Division 1612 with the assistance of Division 1214. Since no cable was available for testing the XMC-453 interconnecting box with the T-160 and T-164 testers, several checks of individual components of the box were made visually and with a multi-purpose laboratory tester and dry batteries. The box wiring diagram, Dwg. No. 114061, was used for reference. The checks performed included the following: (1) visual checks of the wiring and plugs and sockets,

(2) visual and continuity checks of the fuses, resistors, and switch, (3) continuity and operational checks of the relays (mechanisms and contacts) and the switch. Since damage, or malfunctions, were found to have occurred to at least one electrical and one mechanical component of the weapon complement during the electrical test and mechanical inspection of the complement, the test was terminated by the consultant of Division 1282.

Results

The base plates and cylinders of the four vibration mounts on the H-204 container were discovered to be bent and deformed somewhat after the third horizontal shock test had been run on the container. The two mounts most severely deformed were those which had been on the higher load sides of the container during two of the three tests. The condition of the mounts is shown in Fig. 5.

The cylinders of the second set of mounts used on the container were found to be buckled and deformed somewhat at the conclusion of the vertical shock test. The damage sustained by this set of vibration mounts is partly visable in Fig. 6.

Upon examination of the damaged mounts, particularly the rubber inserts, Division 1284 which developed the H-204 container found the mounts still to be satisfactory for normal handling of the container and vibration isolation. A close-up view of the mount installation on the container is given in Fig. 7.

When the Mk-5 RG complement was disassembled from the H-204 container, it was discovered that the six bolts which attach the front cartridge support and the X-unit to the weapon complement mounting frame of the container, which is supported by the vibration mounts, were very loose, so that the components could be separated a small distance from the mounting frame brackets. In addition, the four bolts which attach the X-unit to the front cartridge support all were loose, but one of them was sufficiently snug that the entire X-unit could not be separated a measurable distance from the cartridge support. There was definite evidence that these two sets of bolts had not been properly tightened when the weapon complement was assembled and mounted on the container prior to the start of the shock test.

Examination of the front cartridge support itself revealed that four of the six container mounting holes in the mounting flange of the support were elongated and the outer edge of the flange was cracked through at hole locations. At the remaining two hole locations, the flange was bent around the holes. The cracked area of the flange at one hole location is pointed out in Fig. 8. Also pointed out in the figure is the

fillet area beside the mounting hole on the flange, which showed evidence (surface mars and indentations) that the cartridge support and X-unit had bounced up and down on the mounting frame brackets of the container during the shock tests. Both the flange damage and fillet mars probably resulted from the loose condition of the mounting bolts.

During the CAT test of the Mk-5 RG complement, the MC-411 baroswitch (remote setting) was found to have a pressure leakage rate equivalent to 115 feet altitude change in 20 seconds. The limit of leakage rate allowable according to the Assembly, Test, and Storage Procedure manual, AEC-AFSWP TP C5.2-1, is 100 feet in 20 seconds, and the leakage rate measured by Division 1214 before the start of the shock test was 80 feet.

During the test of the MC-221 baroswitch (non-remote setting), the pressure leakage rate was found to be equivalent to 470 feet altitude change in 20 seconds. The allowable limit for this baroswitch also is 100 feet, and the rate measured prior to the shock test was 60 feet in 20 seconds. Because of the very excessive leakage rate of the unit, the switch closure points (equivalent altitudes) could not be accurately measured, but the values measured all were within the allowable limits.

All the other electrical components of the weapon complement, except the baroswitches discussed above, tested and operated satisfactorily during the CAT test of the complement. However, the XMC-453 interconnecting box could not be given a normal functional test. The visual, continuity, and operational checks of the individual components of the box, enumerated in the Procedure, indicated that the box was in satisfactory condition after the shock test.

The shock acceleration data obtained from the four horizontal shock test records and that derived from the records obtained during the three vertical shock tests discussed in the Procedure are tabulated in Table III. At the request of Division 1282, the shock acceleration signatures recorded on the test oscillograms were faired, so that the initial, unidirectional shock pulses received at each location of measurement could be readily observed on the records, whenever such fairing was possible. The acceleration parameters given in Table III describe the approximate half-sine-wave pulses which best fit, or approximately fit, the faired acceleration signatures. For the few faired acceleration signatures to which approximate half-sine pulses could not be fit, the parameters of the faired signatures themselves are given in the table. The rise times and pulse durations were measured from the times of initial acceleration to the times of maximum half-sine, or faired, pulse acceleration and of final acceleration, respectively. The acceleration parameters all are illustrated in Fig. 9, which shows one of the oscillograms recorded during the horizontal shock tests, run on the engineering test ramp. One of the vertical shock-test oscillograms, from the tests run in the dynamic jig, is shown in Fig. 10.

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Conclusions

Since electrical components of the Mk-5 Mod 0 RG complement carried by the H-204 container became malfunctional during the shock tests to about 40 g in the horizontal directions and 60 g in the vertical direction, whereas the Navy shipboard shock criteria require that stores withstand, or be shock isolated to withstand, 60 g horizontally and 100 g vertically, it is concluded that shock isolation of the H-204 container will be required for shipboard stowage.

Damage to the MC-206 cartridge support during the shock tests is attributed primarily to improper mounting of the support on the H-204 container. Reference to the test oscillograph records and the acceleration data obtained from them and comparison of the acceleration magnitudes and frequencies of vibration sustained by the container mounting plate, the container frame, and the two cartridge supports show that this condition did not contribute to the case or pressure-fitting malfunctions sustained by the MC-221 and MC-411 bareswitches.

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Approved by: P. H. ADAMS - 1612

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FIG. 1 -- METHOD OF CONTAINER MOUNTING EMPLOYED FOR SHOCK TEST OF THE H-204 CONTAINER.

REF. SYM: 1612 (335)
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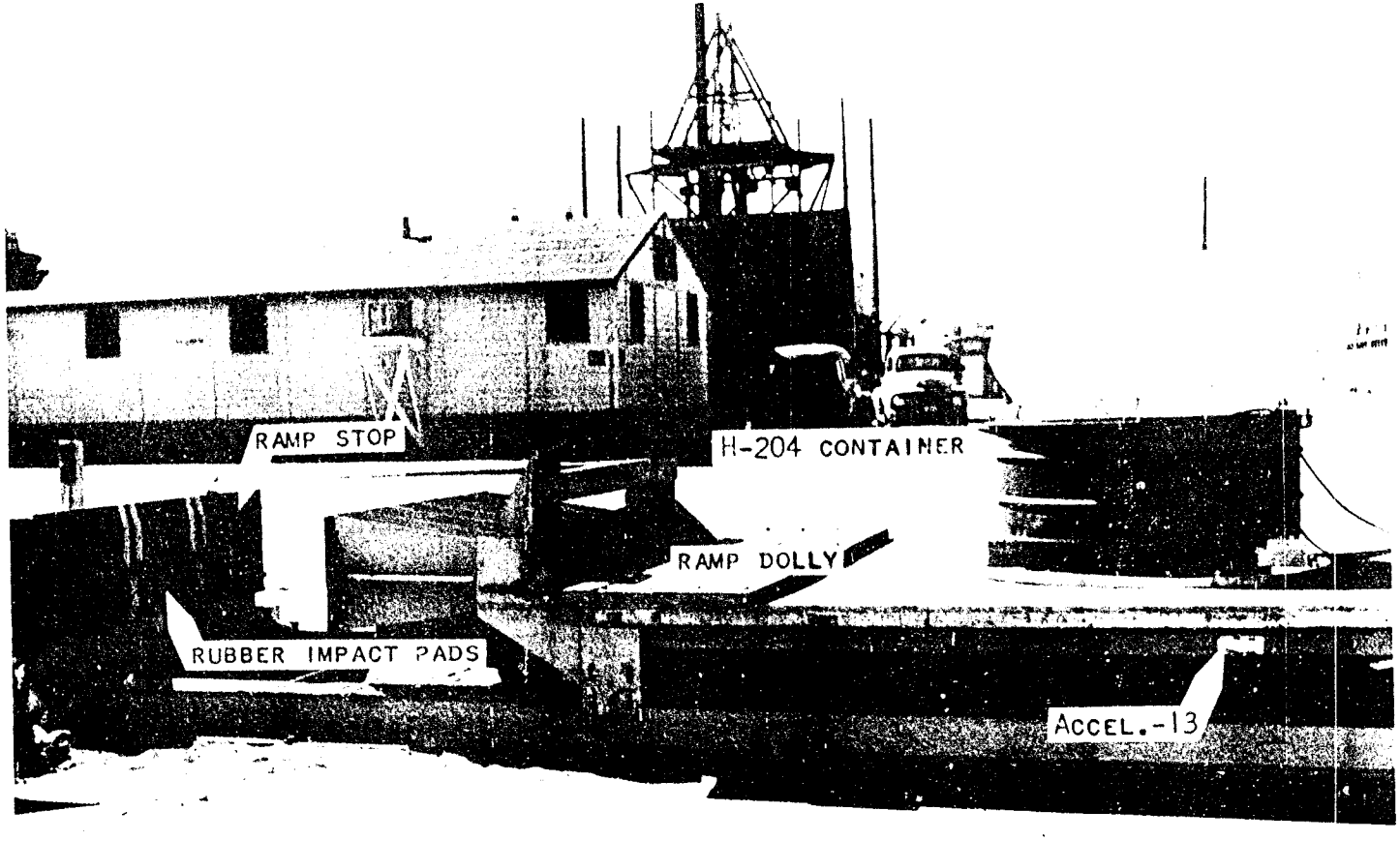

FIG. 2 -- HORIZONTAL SHOCK-TEST SETUP AT ENGINEERING TEST RAMP. SHOCK TEST OF THE H-204.

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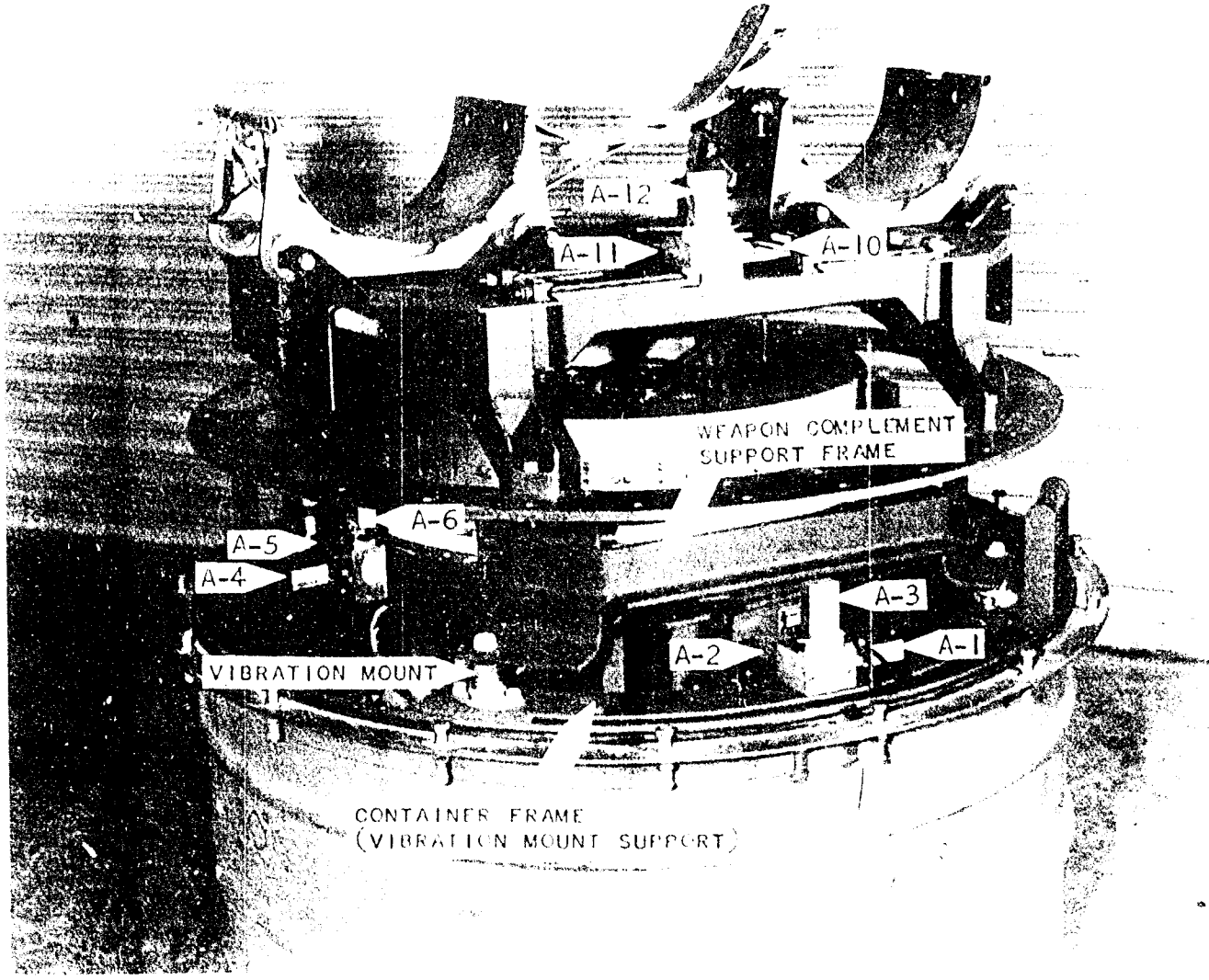

FIG. 3 -- ACCELEROMETER LOCATIONS ON H-204 CONTAINER AND MK [illegible] MOD 0 RG COMPLEMENT. SPACE TEST OF THE H-204.

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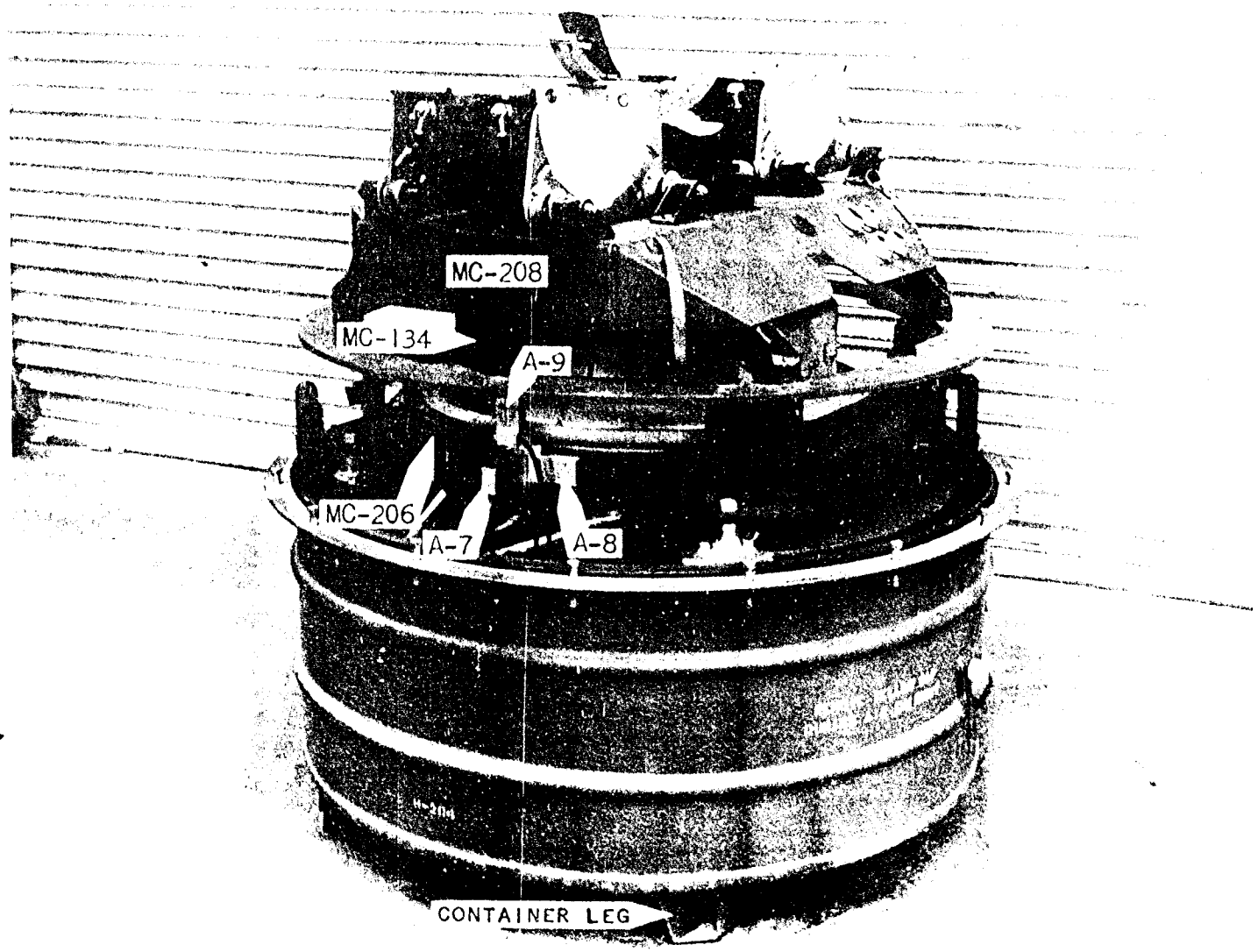

FIG. 4 -- ACCELEROMETER LOCATION ON MK 5 MOD 0 RG COMPLEMENT MOUNTED ON H-204 CONTAINER. SHOCK TEST OF H-204.

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TM-401

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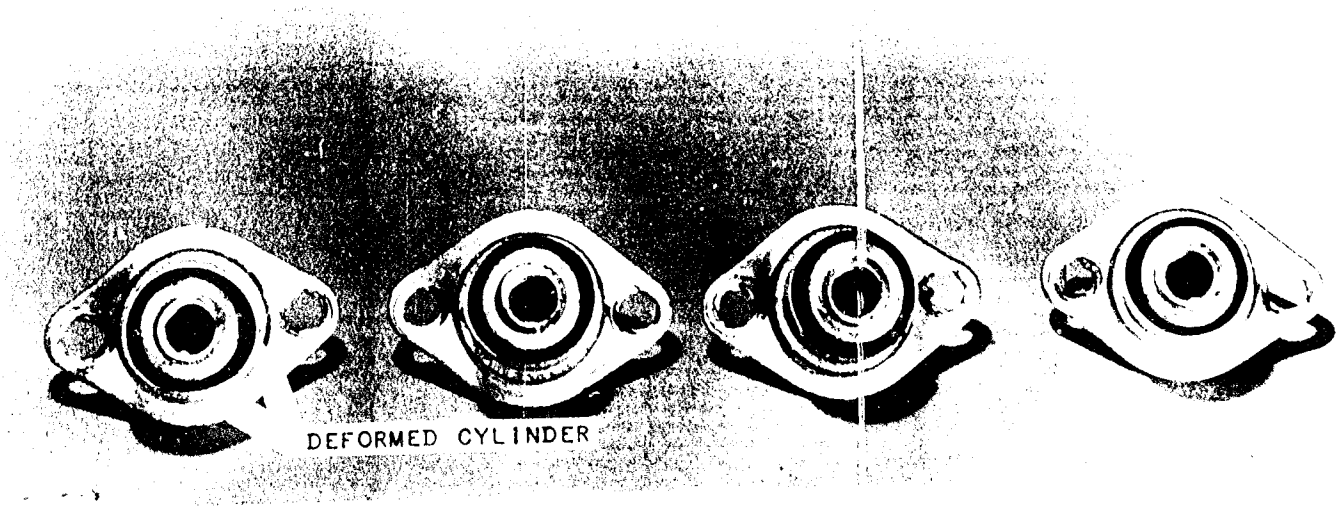

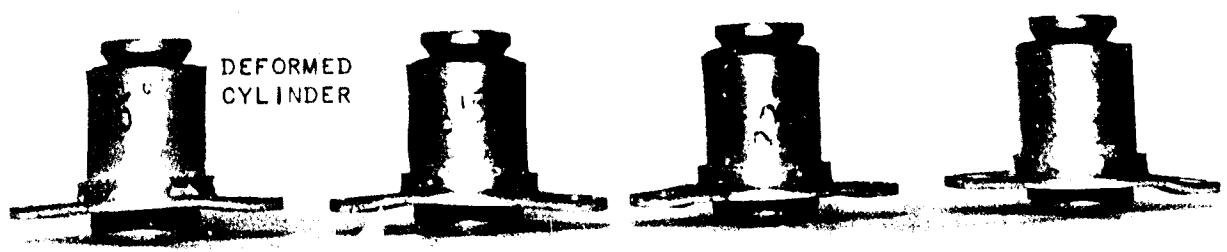

FIG. 5 -- CONTAINER VIBRATION MOUNTS DAMAGED DURING HORIZONTAL SHOCK TESTS OF THE H-204 CONTAINER.

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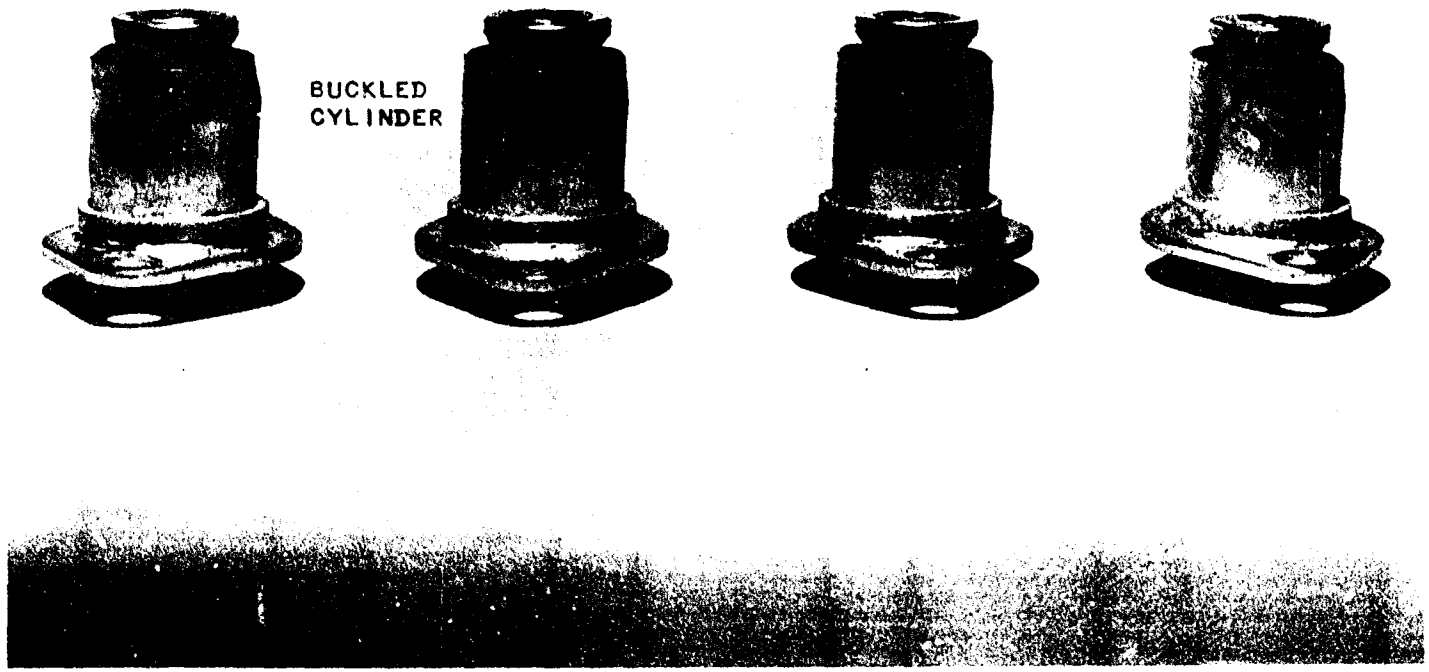

FIG. 6 -- CONTAINER VIBRATION MOUNTS DAMAGED DURING VERTICAL SHOCK TESTS OF THE H-204 CONTAINER.

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TM-401

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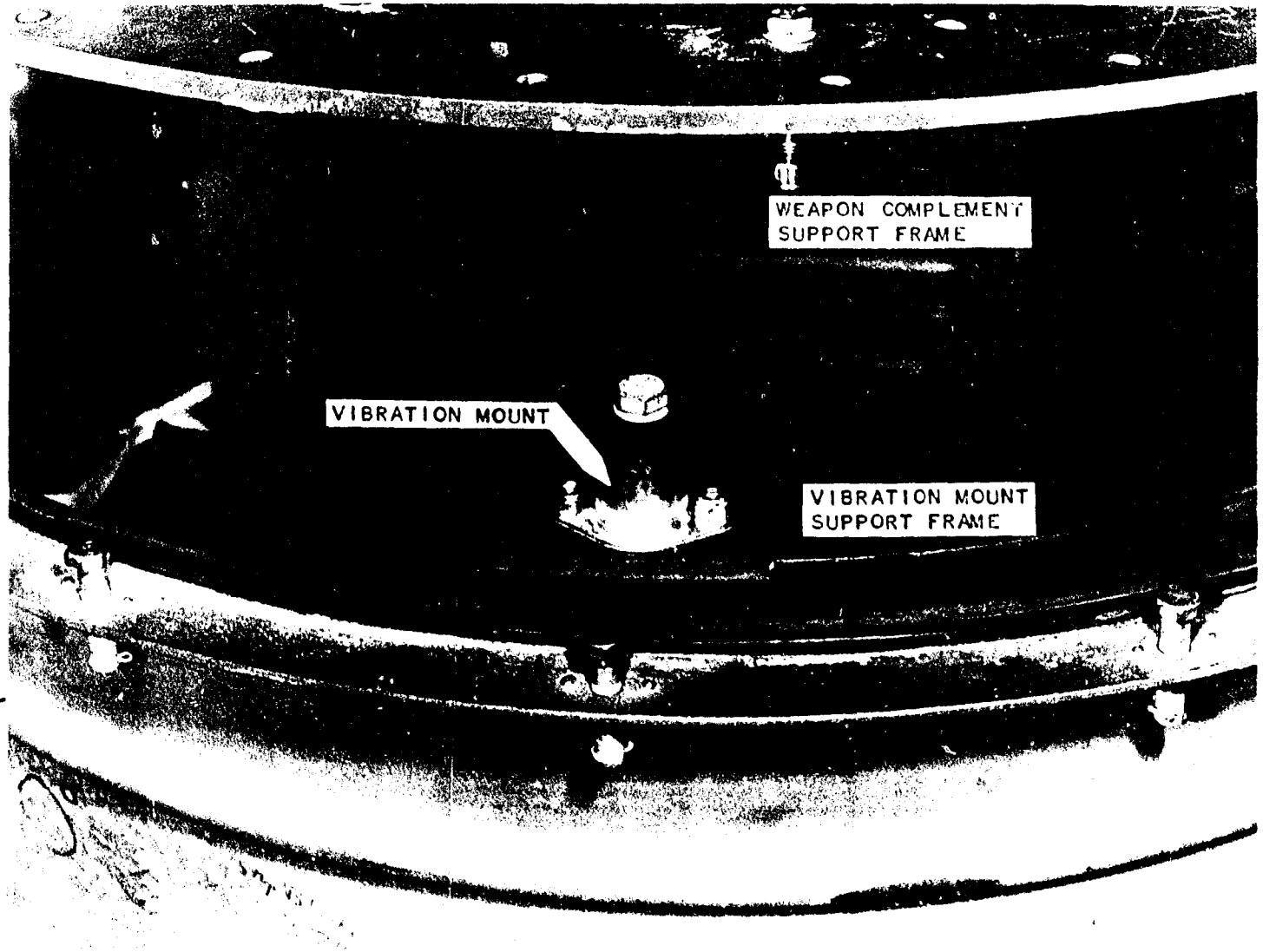

FIG. 7 -- VIBRATION MOUNT INSTALLATION ON H-204 CONTAINER. SHOCK TEST OF H-204.

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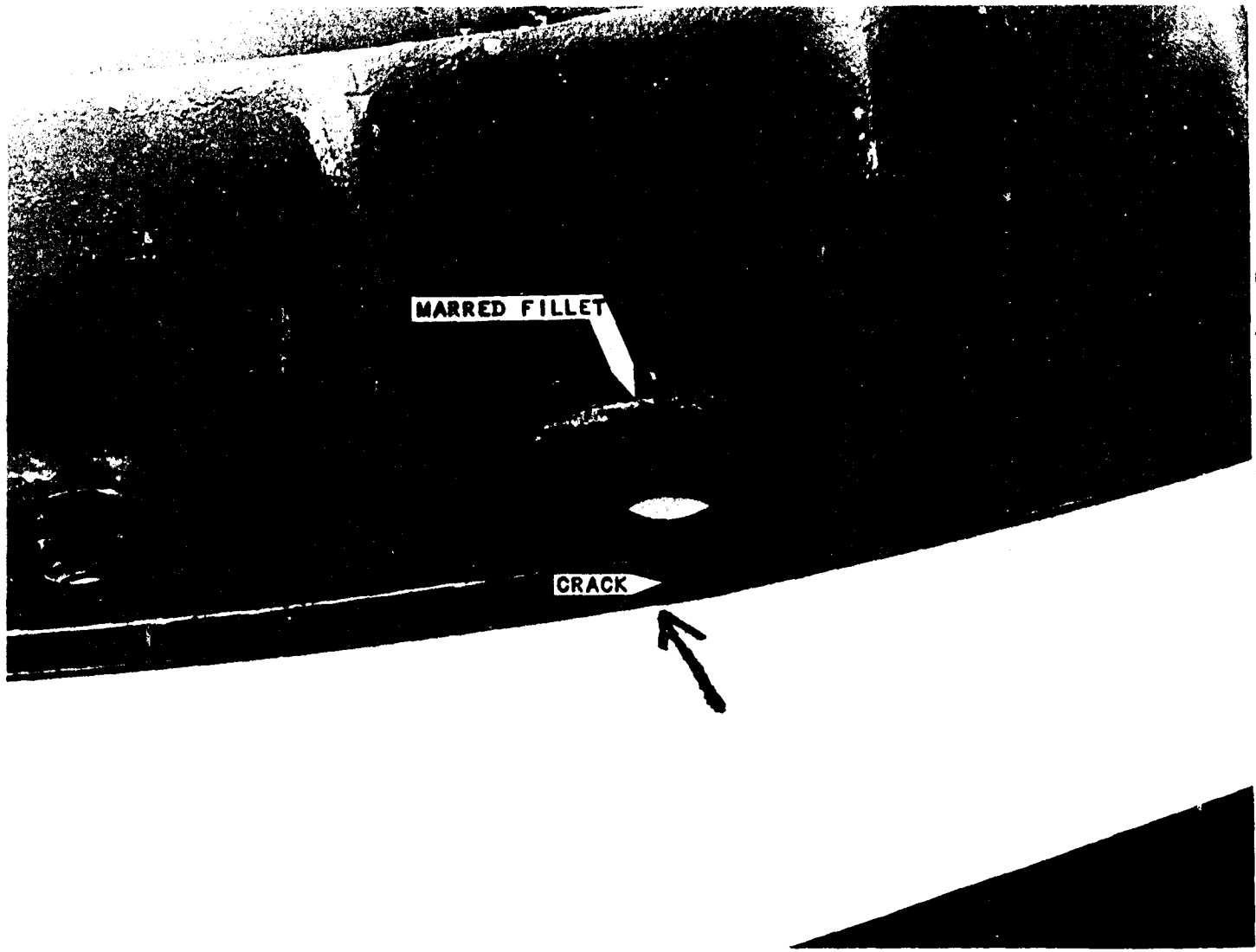

FIG. 8 -- CRACKED MOUNTING FLANGE OF MC-206 CARTRIDGE SUPPORT. SHOCK TEST OF H-204.

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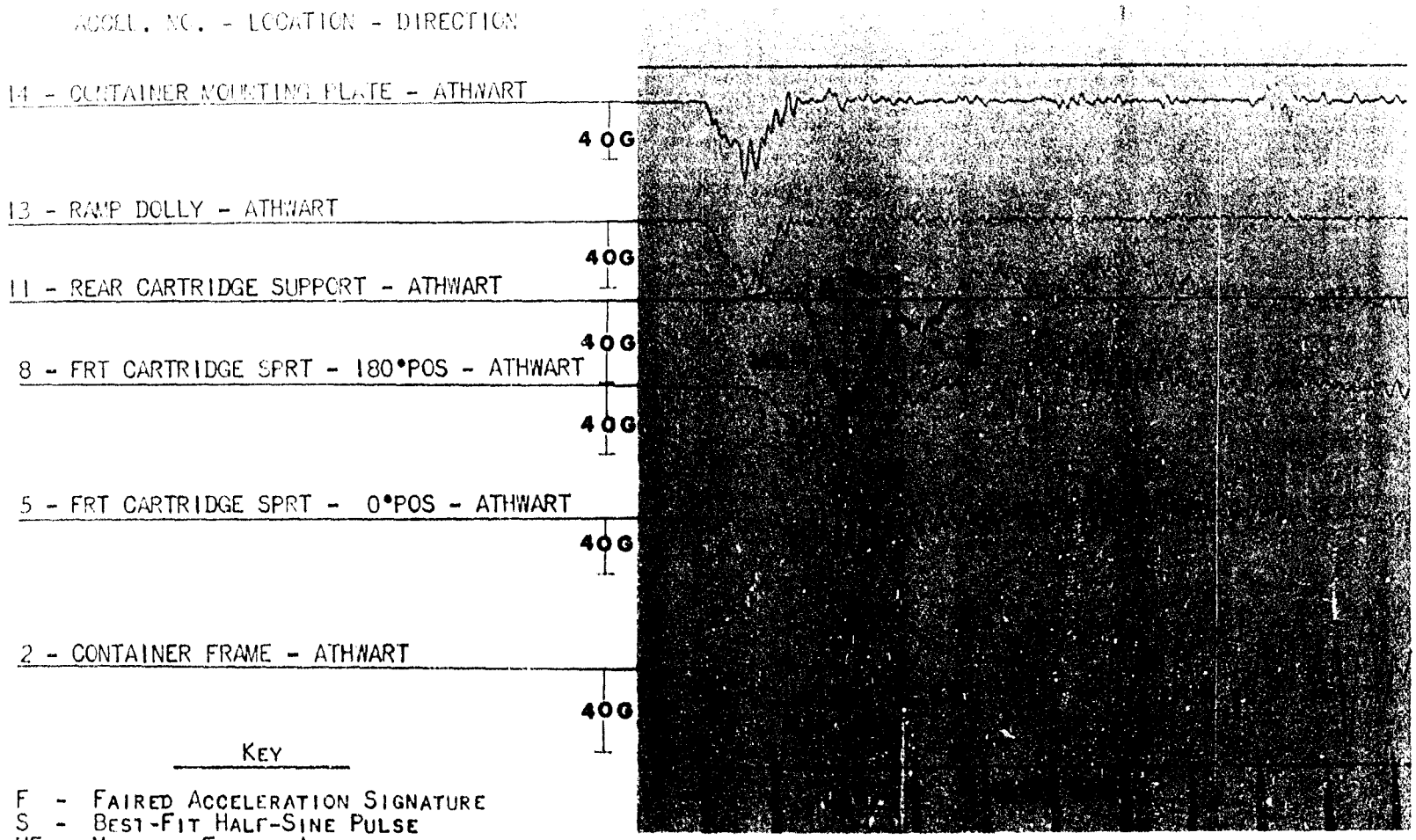

KEY

F - FAIRED ACCELERATION SIGNATURE
S - BEST-FIT HALF-SINE PULSE
MF - MAXIMUM FAIRED ACCELERATION
M - MAXIMUM ACCELERATION
R - RISE TIME
D - PULSE DURATION

FIG. 9 -- OSCILLOGRAM SHOWING ACCELERATION SIGNATURES RECORDED DURING A HORIZONTAL SHOCK TEST (ATHWARTSHIP SHOCK LOADING). SHOCK TEST OF THE H-204.

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REF. SYM: 1612 (335)
TM-401

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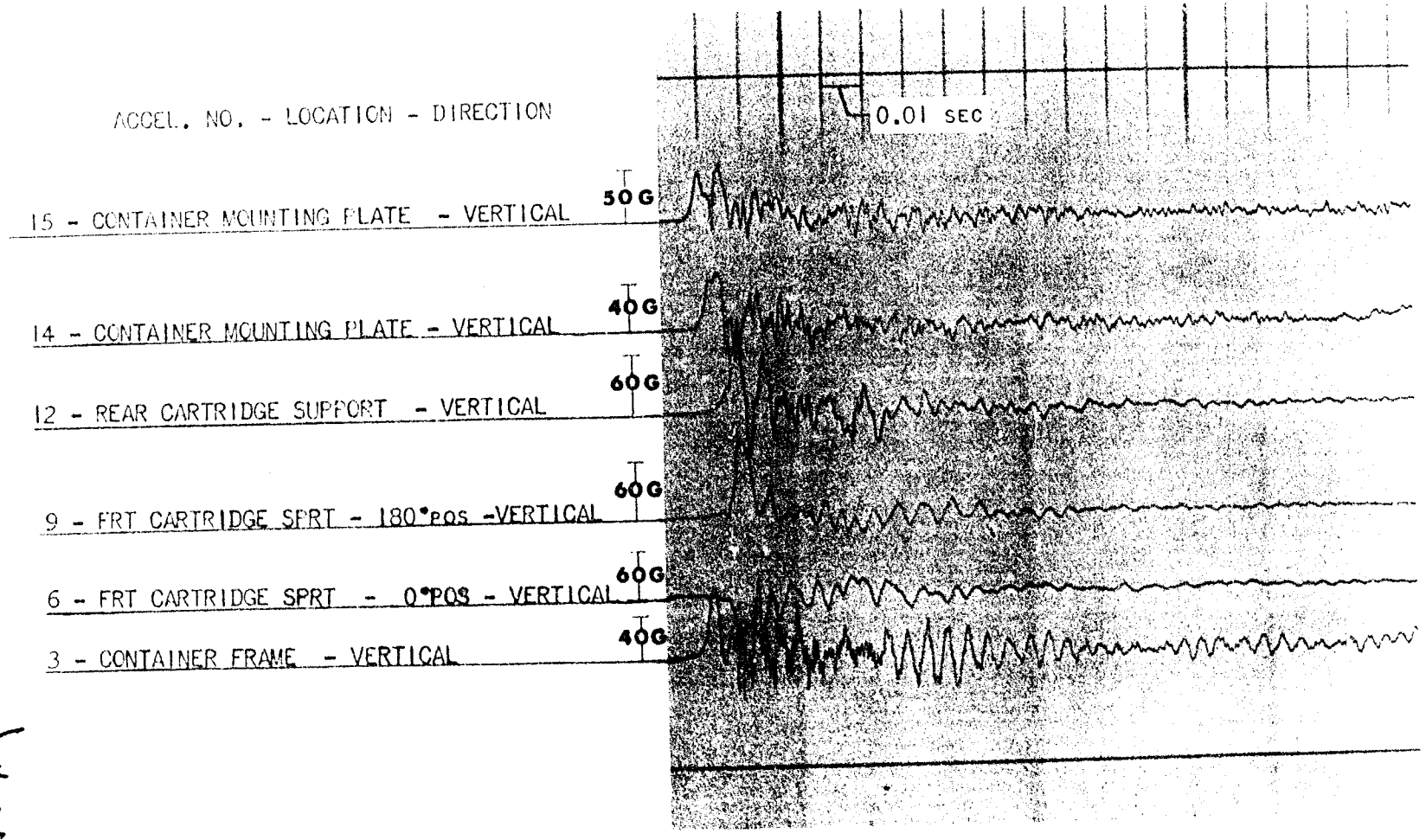

FIG. 10 -- OSCILLOGRAM SHOWING ACCELERATION SIGNATURES RECORDED DURING A VERTICAL SHOCK TEST. SHOCK TEST OF THE H-204.

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Project No. TM-401

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TABLE I

COMPONENTS OF MK-5 MOD 0 AS COMPLEMENT AND H-204
CONTAINER GIVEN SHOCK TEST

	Component	Drawing Number	Serial Number
2 - MC-77	Support, Radar	577865	None
MC-132	Pulse Circuit, Thyratron Controlled	105495	FT-10258-B4
MC-133	Switch, Spark Gap, Pulse Triggered	104924	Unavailable
MC-134	X-Unit	100023	XAE-471-F3
MC-164	Adapter Flange	105601	None
MC-206	Support, Cartridge, (Front)	579549	None
MC-208	Support, Cartridge, (Rear)	579502	None
MC-218	Converter	104666	0410-BX-K2
MC-218	Converter	104666	1110-BX-L2
MC-221	Baroswitch, Non-Remote Setting	105730	XBL-0148-C3
MC-251	Inverter No. 1	117720	AF-1480-L3
MC-251	Inverter No. 2	117720	AF-5833-D4
2 - MC-255	Antenna (Mounted in H-204 Container Cover)	117835	Unavailable
MC-337	Timer, Interval	109963	00016
MC-388	Pull-Out Switch	119136-00	FX-1012-B4
MC-411	Baroswitch, Remote Setting	121659-00	BL-7263-L4
XMC-453	Interconnecting Box	121398	AA-0006-B5
H-204	Container	109923	ES-1012-C4
4 -	Container Vibration Mounts	835352	None

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TABLE II

ACCELEROMETER DATA
SHOCK TEST OF THE H-204

Gage No.	Location	*Direction	Serial No.	Range	Model	Natural Frequency	Figure Reference
1	Container Frame	Fore and Aft	2190	±100g	A5A-100-300	760	3
2	Container Frame	Athwartship	1685	±100g	A5A-100-335	660	3
3	Container Frame	Vertical	1667	±200g	A5A-200-335	960	3
4	Front Cartridge Support at 0° Pos.	Fore and Aft	623	±100g	A5A-100-300	740	3
5	Front Cartridge Support at 0° Pos.	Athwartship	624	±100g	A5A-100-300	740	3
6	Front Cartridge Support at 0° Pos.	Vertical	1666	±200g	A5A-200-335	920	3
7	Front Cartridge Support at 180° Pos.	Fore and Aft	616	±100g	A5A-100-300	800	4
8	Front Cartridge Support at 180° Pos.	Athwartship	2192	±100g	A5A-100-300	660	4
9	Front Cartridge Support at 180° Pos.	Vertical	1668	±200g	A5A-200-335	950	4
10	Rear Cartridge Support	Fore and Aft	633	±100g	A5A-100-300	760	3
11	Rear Cartridge Support	Athwartship	634	±100g	A5A-100-300	750	3
12	Rear Cartridge Support	Vertical	1665	±200g	A5A-200-335	940	3
13	Ramp Dolly Main Frame	**Shock-Load	632	±100g	A5A-100-300	750	2
14	Container Mounting Plate	**Shock-Load (Ramp Test) Vertical (Drop Tests)	618	±100g	A5A-100-300	740	1
15	Container Mounting Plate Diametrically Opposite Gage No. 14	Vertical (Drop Tests)	617	±100g	A5A-100-300	740	--

* Horizontal directions noted are taken WRT the arbitrary markings on the H-204 container and are as follows: Fore and aft - 0°-180° axis, Athwartship - 90°-270° axis.

** Direction is along axis of applied shock load: Fore and aft tests - parallel to 0°-180° axis of H-204, Athwartship tests - parallel to 90°-270° axis of H-204.

TABLE III

ACCELERATION DATA
SHOCK TEST OF THE H-204

Gage No. and Location	Max. Faired Accel. (g)	Max. Accel. (g)	Rise Time (ms)	Pulse Duration (ms)	Max. Faired Accel. (g)	Max. Accel. (g)	Rise Time (ms)	Pulse Duration (ms)	Max. Faired Accel. (g)	Max. Accel. (g)	Rise Time (ms)	Pulse Duration (ms)
	*Fore and Aft Shock Loading											
	0° Direction				180° Direction							
1. Container Frame	54	63	6	9	56	88	7	10				
4. Front Cartridge Support at 0° Pos.	31	45	5	19	31	62	4	14				
7. Front Cartridge Support at 180° Pos.	36	49	5	17	26	36	7	19				
10. Rear Cartridge Support	41	45	9	17	33	55	8	15				
13. Ramp Dolly	36	44	6	10	40	45	6	11				
14. Container Mounting Plate	40	50	6	11								
	*Athwartship Shock Loading											
	90° Direction				270° Direction							
2. Container Frame	46	57	5	9	42	57	4	11				
5. Front Cartridge Support at 0° Pos.	30	113	7	17	24	74	8	25				
8. Front Cartridge Support at 180° Pos.	30	53	4	11	26	43	7	25				
11. Rear Cartridge Support	45	52	5	16	51	61	6	17				
13. Ramp Dolly	39	47	6	11	40	47	5	11				
14. Container Mounting Plate	42	53	5	11	42	55	5	11				
	Vertical Shock Loading											
	40-44-g Test				40-60-g Test				50-62-g Test			
3. Container Frame	46	62	3	6	64	104	5	7	32	72	2	7
6. Front Cartridge Support at 0° Pos.	42	64	6	10	46	63	4	10	34	47	12	23
9. Front Cartridge Support at 180° Pos.	60	70	3	7	58	100	3	8	35	50	7	12
12. Rear Cartridge Support	58	72	3	6	74	104	4	6	18	30	8	23
14. Container Mounting Plate	44	46	5	8	60	78	3	7	62	100	6	12
15. Container Mounting Plate Diametrically Opposite Gage No. 14	40	56	6	11	40	54	3	9	50	98	4	9

* Horizontal directions of shock loading noted are taken WRT the arbitrary markings on the H-204 container and are as follows: Fore and Aft - 0°-180° axis, athwartship - 90°-270° axis.