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SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
1 st Review Dr. <u>11/2/98</u>	Determination (Circle Numbers)
Authority: <u>WCL</u>	1. Classification Retained <u>U</u>
Name: <u>WCL</u>	2. Classification Changed to: _____
2 nd Review Date: <u>11/09/98</u>	3. Contains No DOE Classified Information _____
Authority: <u>WCL</u>	4. Contains UCAF _____
Name: <u>WCL</u>	5. Comments: <u>Secrecy</u>

OCT 17 1998
 Case No. 608.01
 Ref. Sym: 1612 (383)
 Project No. TM-448
 File: H-194, 3-2

TCG-SAFF-1; TCG-NNT-1

MR. G. H. ROTH - 5520

Re: Ramp Test of H-194 Containing FSI-1

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BY ORG. 2143

Summary of Results

Ramp tests were performed on the H-194 containing an FSI-1 to determine the impact velocity necessary to produce structural damage comparable to that actually resulting to some units from railway shipment.

Using wood bumpers on the ramp, no noticeable damage resulted to the FSI-1 from impact velocities to 7-mph. At 8-mph impact, the forward adapter clip of the H-320A was slightly bent, and the front of the X-unit was dented from contact with the H-194 container. Damage was not noticeably increased by increasing the impact velocity to 9.69 mph (15.1 mph velocity change).

With rubber bumper pads on the ramp, an 8.94 mph impact velocity run was made with a resulting velocity change of 12.46 mph on the ramp dolly. This impact resulted in increased bending of the adapter clips and the front of the X-unit, bending of the flange on the X-unit, and permanent deformation of the shock mounts.

Maximum measured faired accelerations were: Ramp dolly, -35 g; FSI-1 longitudinal, -79 g; FSI-1 vertical on the aft mounting flange, +40 g; FSI-1 vertical on the forward mounting flange, +29 g.

Object of Test

The object of this test was to subject the H-194 containing an FSI-1 to rail-road humping conditions simulated on the engineering test ramp, and to compare the extent of structural damage to that actually found on some units as a result of shipment by rail. Impact velocities were to begin at 5-mph, and be raised in 1-mph increments until structural damage occurred to the contained unit or the maximum capabilities of the ramp were reached.

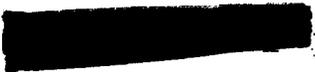
Reason for Test

The test was requested in a Work Order Authorization from G. H. Roth, 5520, to P. H. Adams, 1612, dated September 10, 1956.

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
DOWNGRADING OR DECLASSIFICATION STAMP	
CLASSIFICATION CHANGED TO: <u>U</u>	AUTHORITY: <u>WCL</u>
PERSON CHANGING MARKING & DATE: <u>Carmela Bullyo 12/9/98</u>	RECORDED ID: <u>99SN0360</u>
PERSON VERIFYING MARKING & DATE: <u>W.C. Lame 12/16/98</u>	DATED: <u>11/9/98</u>

THIS DOCUMENT CONSISTS OF 16 PAGES

UNCLASSIFIED


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OCT 17 1956

Ref. Sym: 1612 (383)

Project No. TM-448

Mr. G. H. Roth - 5520

-2-

Summary of Past Tests

No previous tests of the H-194 containing the FSI-1 unit and H-320A configuration have been conducted by Department 1610.

Setup for Test

Figure 1 shows the instrumentation on the FSI-1.

Figure 2 shows the H-194 container fastened on the ramp dolly.

Table I lists accelerometers used.

Components tested are listed in Table II.

Test equipment used included one Wm. Miller Oscillograph, Model H, Serial No. 198, and one Hathaway Amplifier Bank, Type MRC-21, Serial No. 5492-2.

Procedure

The FSI-1 mounted in an H-194 container was instrumented as shown in Fig. 1. Figure 2 shows the H-194 fastened to the ramp dolly.

To measure velocity, a microswitch fastened to the ramp dolly (Fig. 2) was triggered by actuating arms 4.00 feet apart on the track. The time required for 4 feet of travel was recorded on the oscillograph.

Impact velocities were started at approximately 5-mph, and increased in 1-mph increments until the maximum obtainable velocity of 9.65 mph was reached. Wooden bumpers were used in each case. The H-194 container cover was removed after each run and the FSI-1 inspected for structural damage.

To increase the velocity change at impact, four rubber pads (45-durometer hardness) were substituted for the wood bumpers. One run was made at an impact velocity of 8.94 mph, and the resulting velocity change of the dolly was computed. No further tests were performed because of damage to the contents of the container.

After completion of the test, a compression vs. deflection test was performed on several damaged Met-L-Flex shock mounts, and comparison made with new mounts.

Results

There was no noticeable damage caused to the FSI-1 unit from impact velocities up to and including 7-mph. At 8-mph impact, a very slight bend was formed in


UNCLASSIFIED

UNCLASSIFIED

OCT 17 1956

Ref. Sym: 1612 (383)

Project No. TM-448

Mr. G. H. Roth - 5520

-3-

the forward adapter clip, and the front of the X-unit was slightly dented from contact with the H-194 container. No further noticeable damage resulted from increasing the impact velocity to 9.65 mph (15.1 mph velocity change), using wood bumpers.

By changing to rubber bumpers, a total velocity change of 12.46 mph on the ramp dolly was effected by an 8.94 mph impact velocity. This impact produced considerable bending of the adapter clips and the flanges of the X-unit (Figs. 3, 4, and 5). Bending of the front of the X-unit from contact with the container was increased (Fig. 6). The Met-L-Flex mounts were permanently deformed (Fig. 7). Figure 8 shows typical load-deflection curves of new unused mounts compared to those of mounts that were tested on the engineering test ramp.

Table III lists accelerations and pulse times measured during the tests.

Typical oscillograph records are shown in Figs. 9 and 10.

Conclusion

No damage was done to the FSI-1 unit from impact velocities specified by SCS-5. A velocity change in excess of 12 mph was required to produce damage comparable to that found in a unit which was damaged in shipping.

The SCS-5 test apparently is not severe enough to adequately test these units for rail shipment without escorts.

G. M. Willson
G. M. WILLSON - 1612-1

Approved by:

P. H. Adams
P. H. ADAMS - 1612

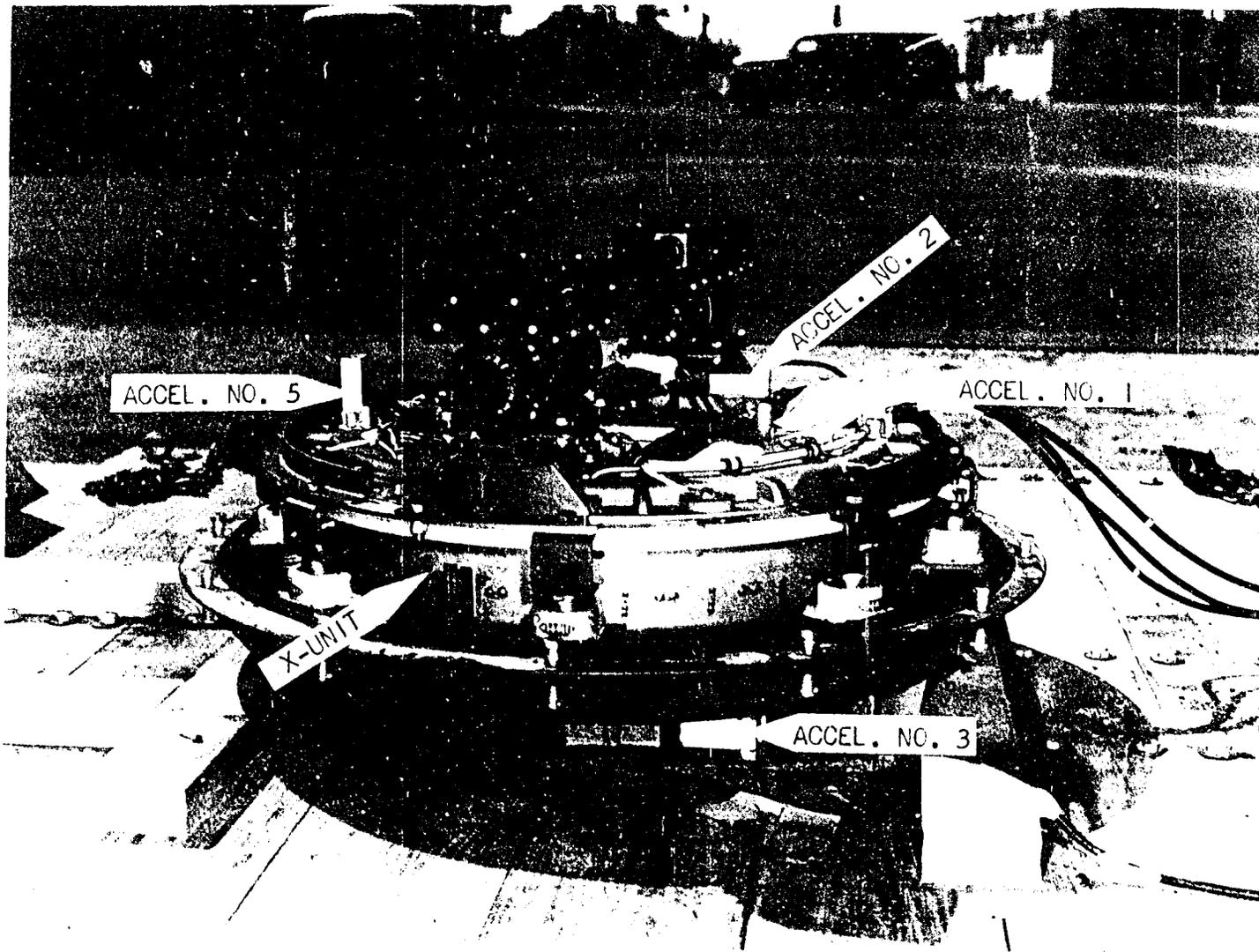
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DISTRIBUTION:

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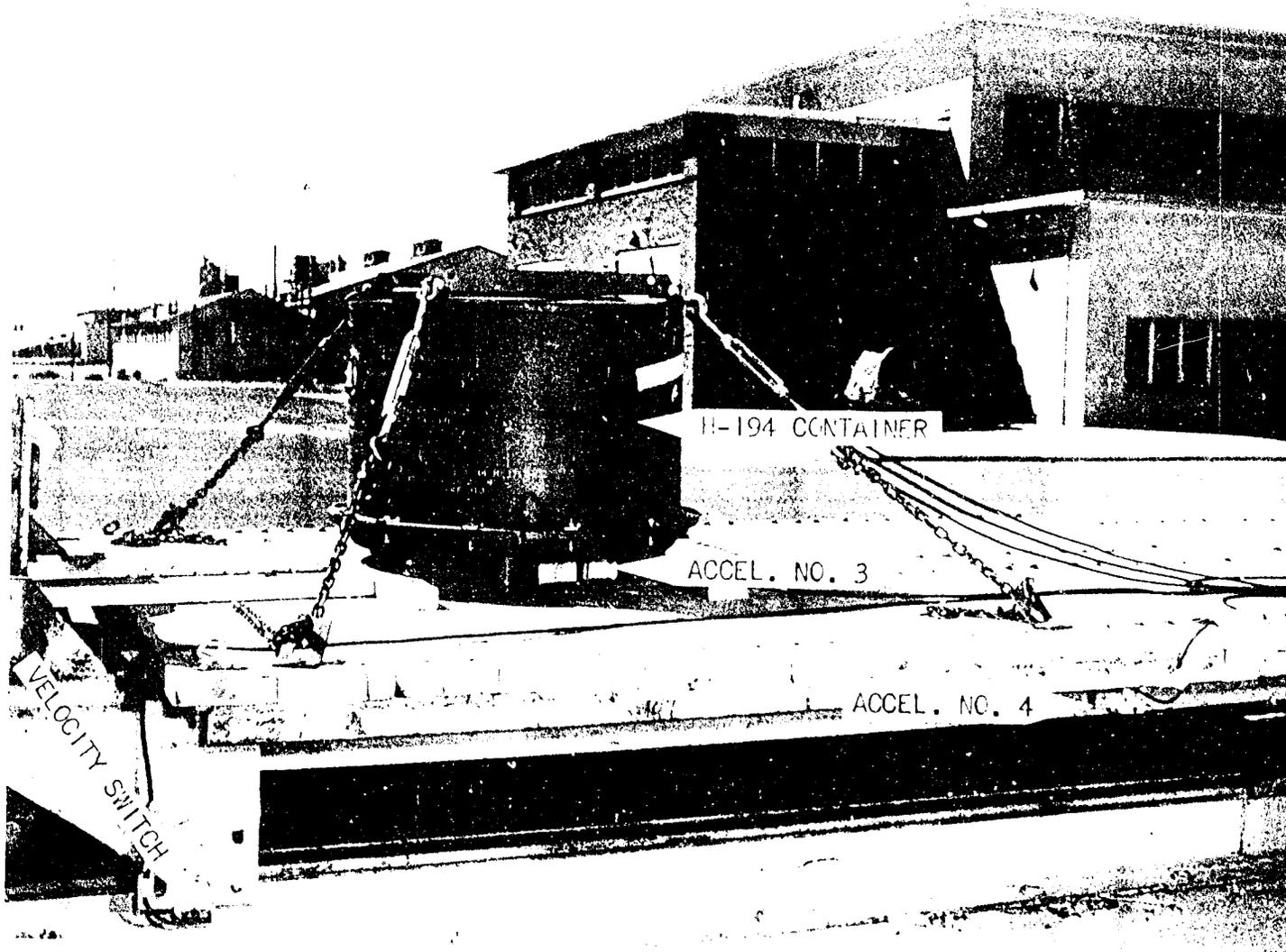
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FIG. 1 -- INSTRUMENTATION OF FSI-1 -- PAMP TEST OF H-194 CONTAINING FSI-1

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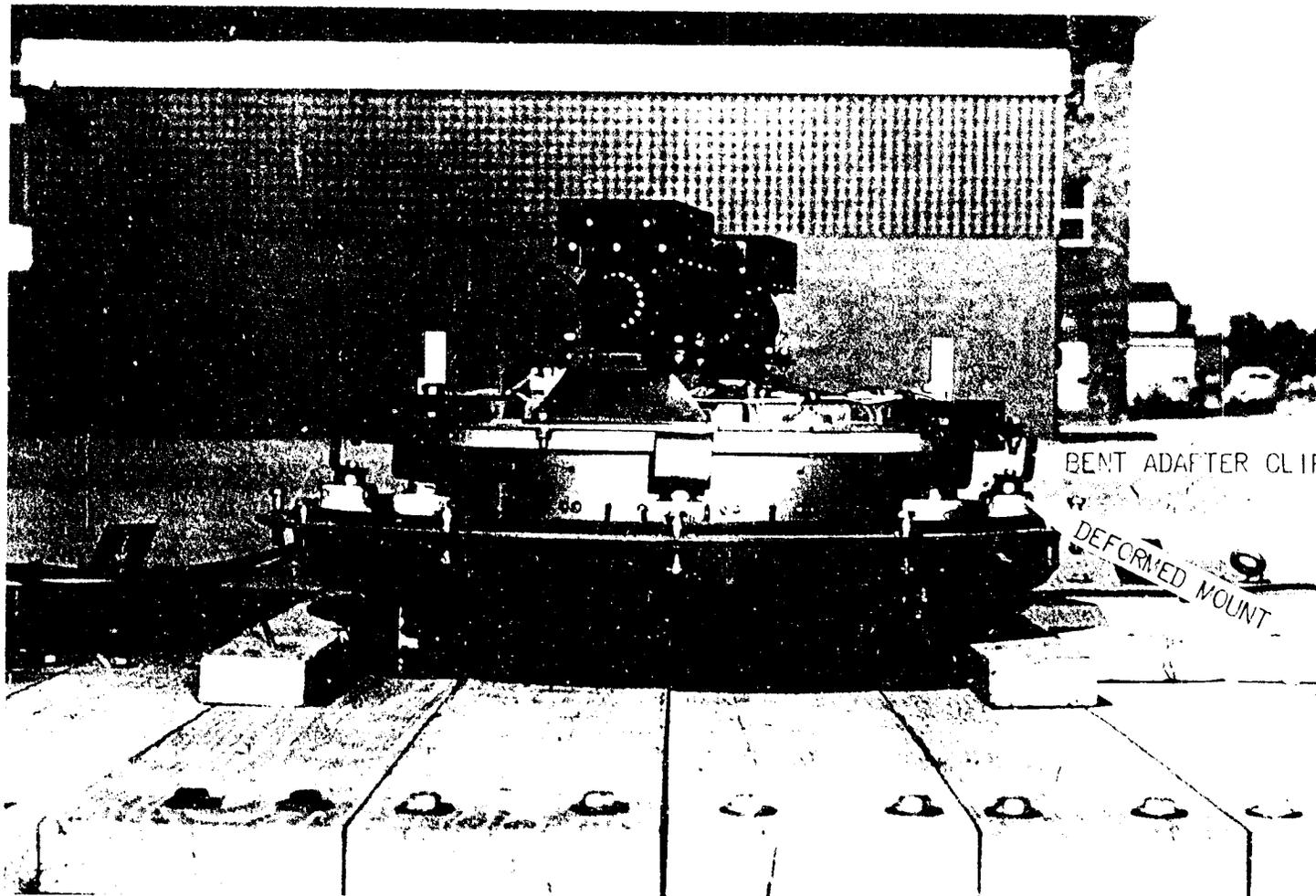
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FIG. 2 -- H-194 MOUNTED ON PAM DOLLY -- PAM TEST OF H-194 CONTAINING FSI-1

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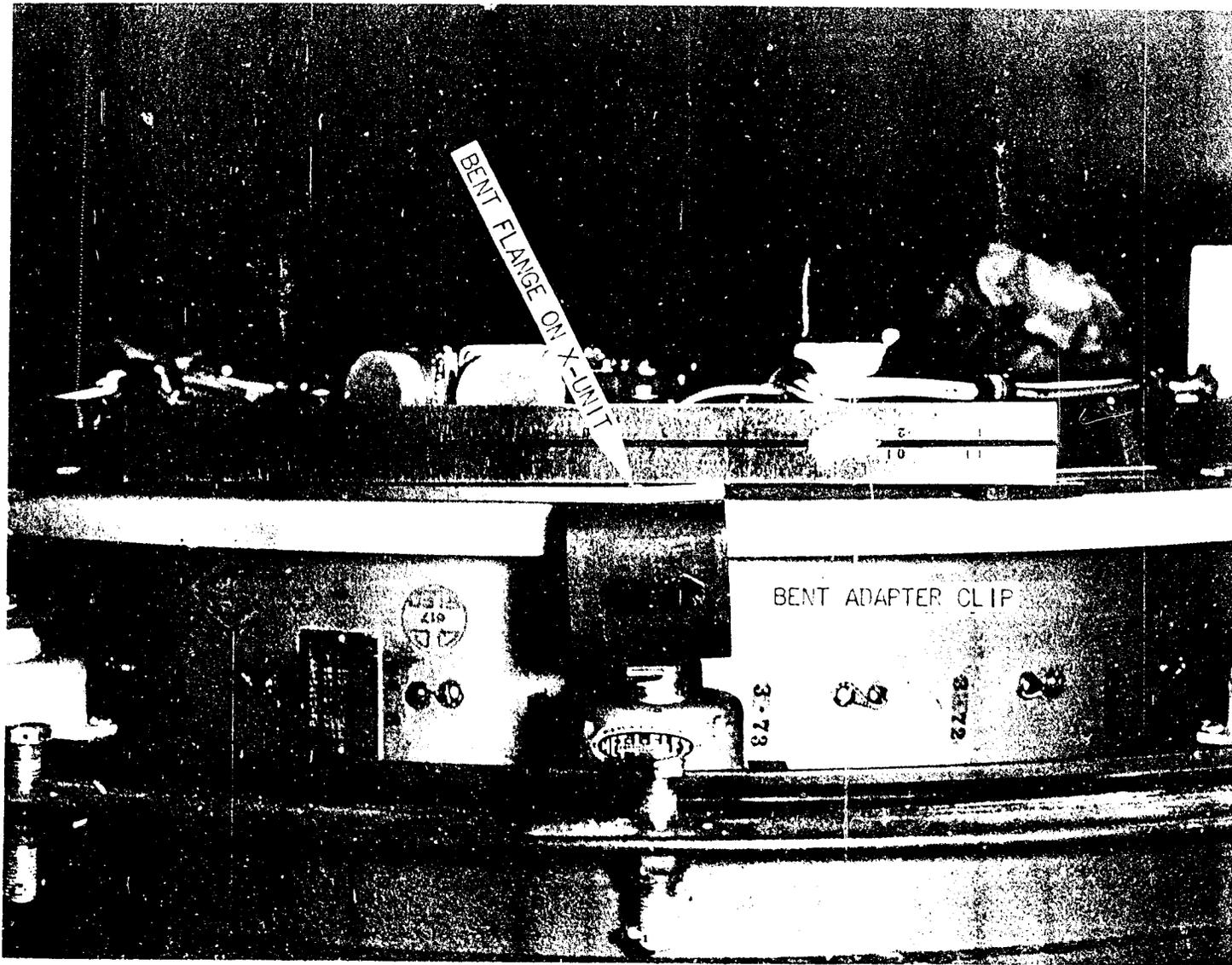
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FIG. 3 -- FSI-1 DAMAGED FROM IMPACT -- RAMF TEST OF H-194 CONTAINING FSI-1

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FIG. 4 -- DAMAGED X-UNIT AND ADAPTER CLIPS -- PART TEST OF H-194 CONTAINING FSI-1

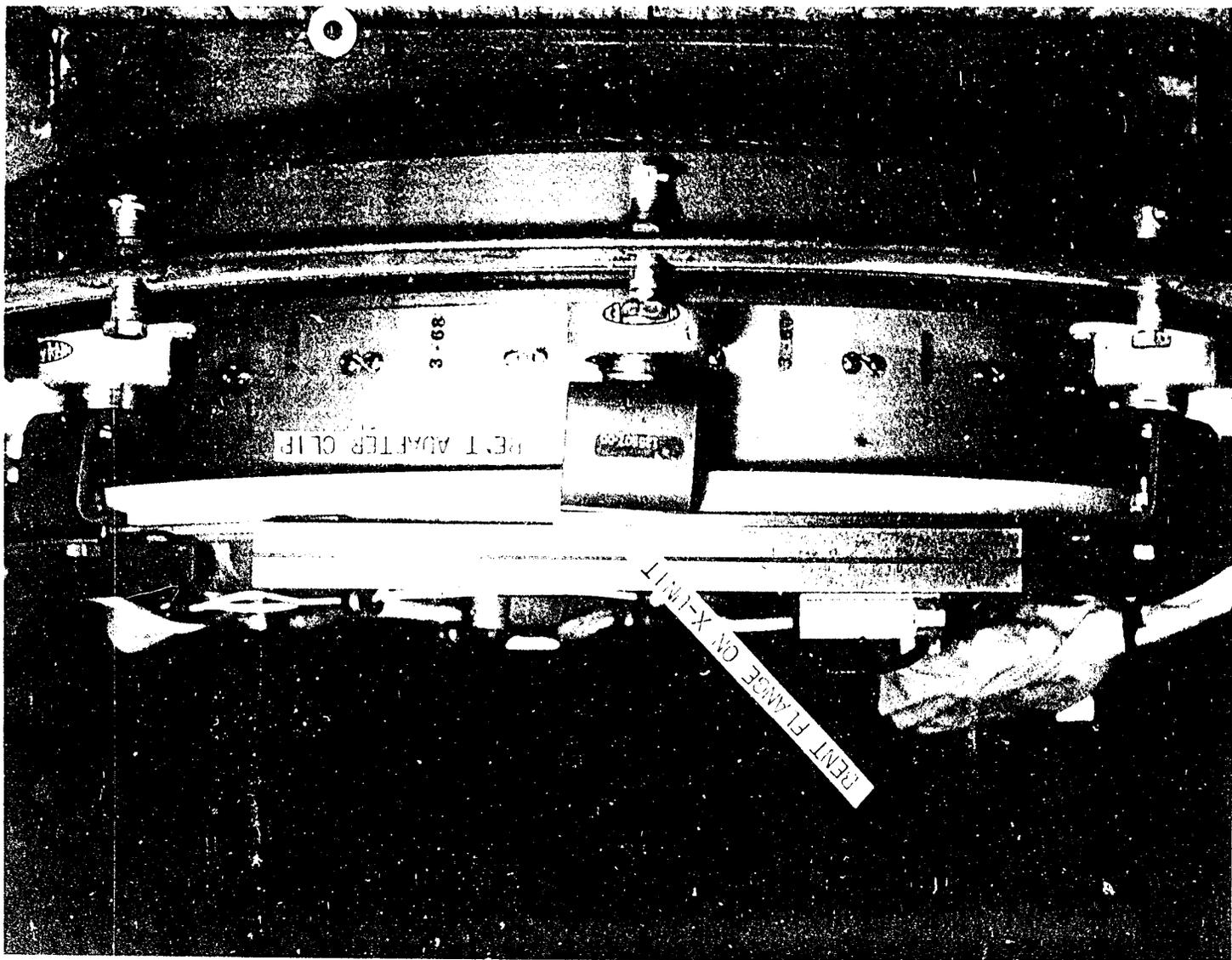
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REF. SYM: 1612 (393)
TM-448

-8-

FIG. 5 -- INWARD X-JOINT AND ADAPTER CLIPS -- EVAL TEST OF H-194 OBTAINED 9 PSI-1



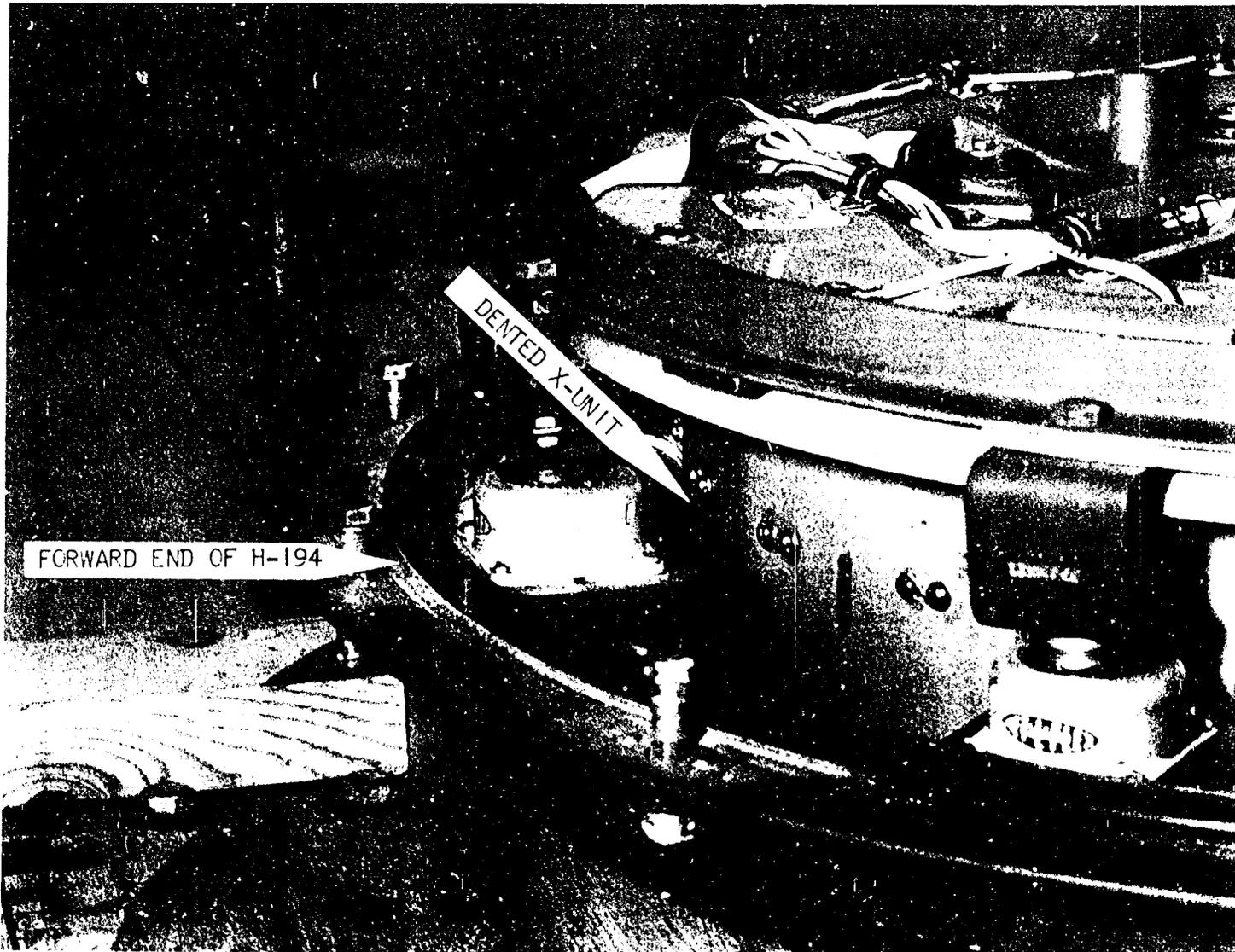
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FIG. 6 -- X-UNIT DENTED FROM CONTACT WITH THE H-194 -- RAMP TEST OF H-194 CONTAINING FSI-1

REF. SYM: 1612 (383)
TM-448

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FIG. 7 -- PERMANENTLY DEFORMED MET-L-FLEX MOUNT -- RAMP TEST OF H-194 CONTAINING FSI-1

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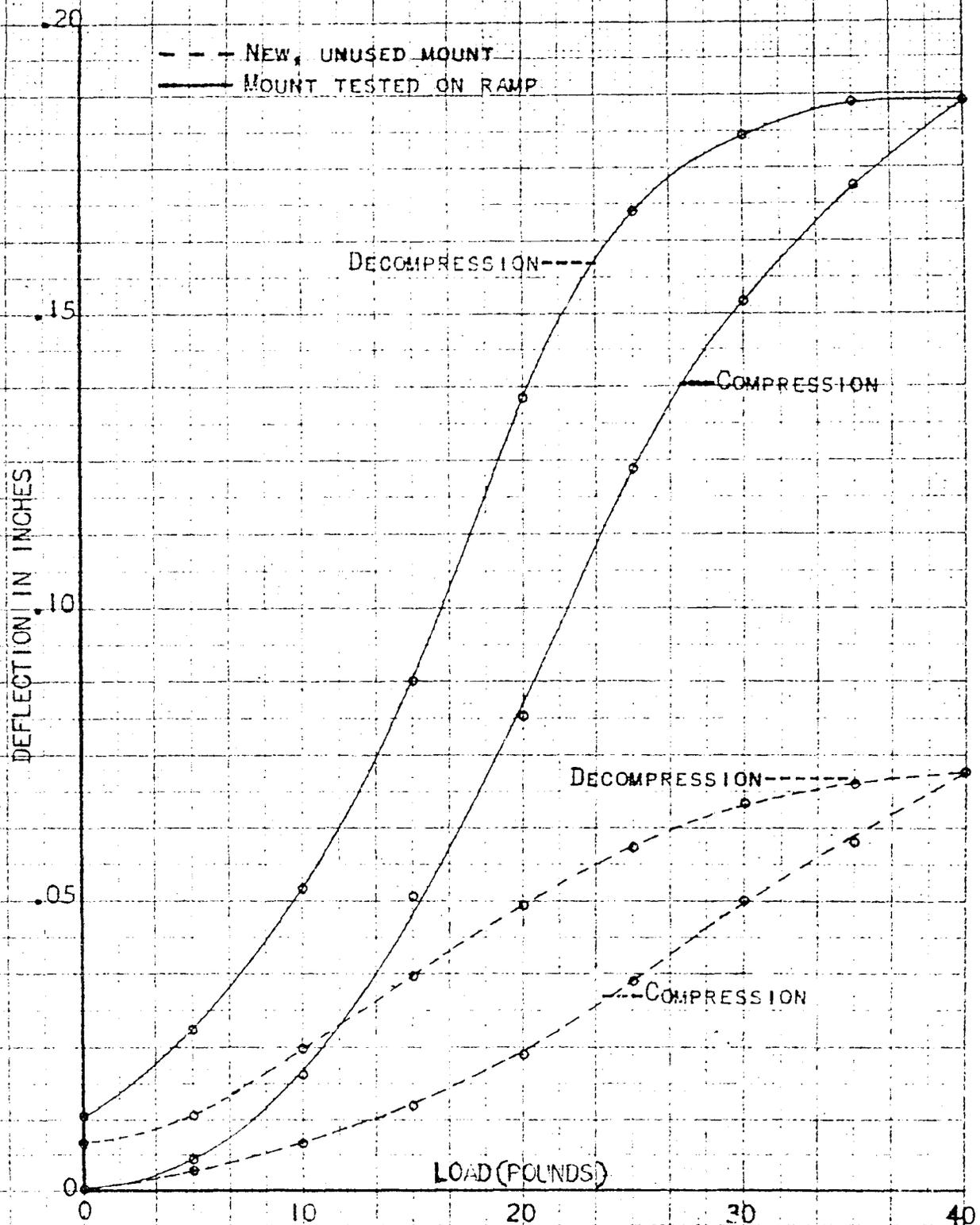


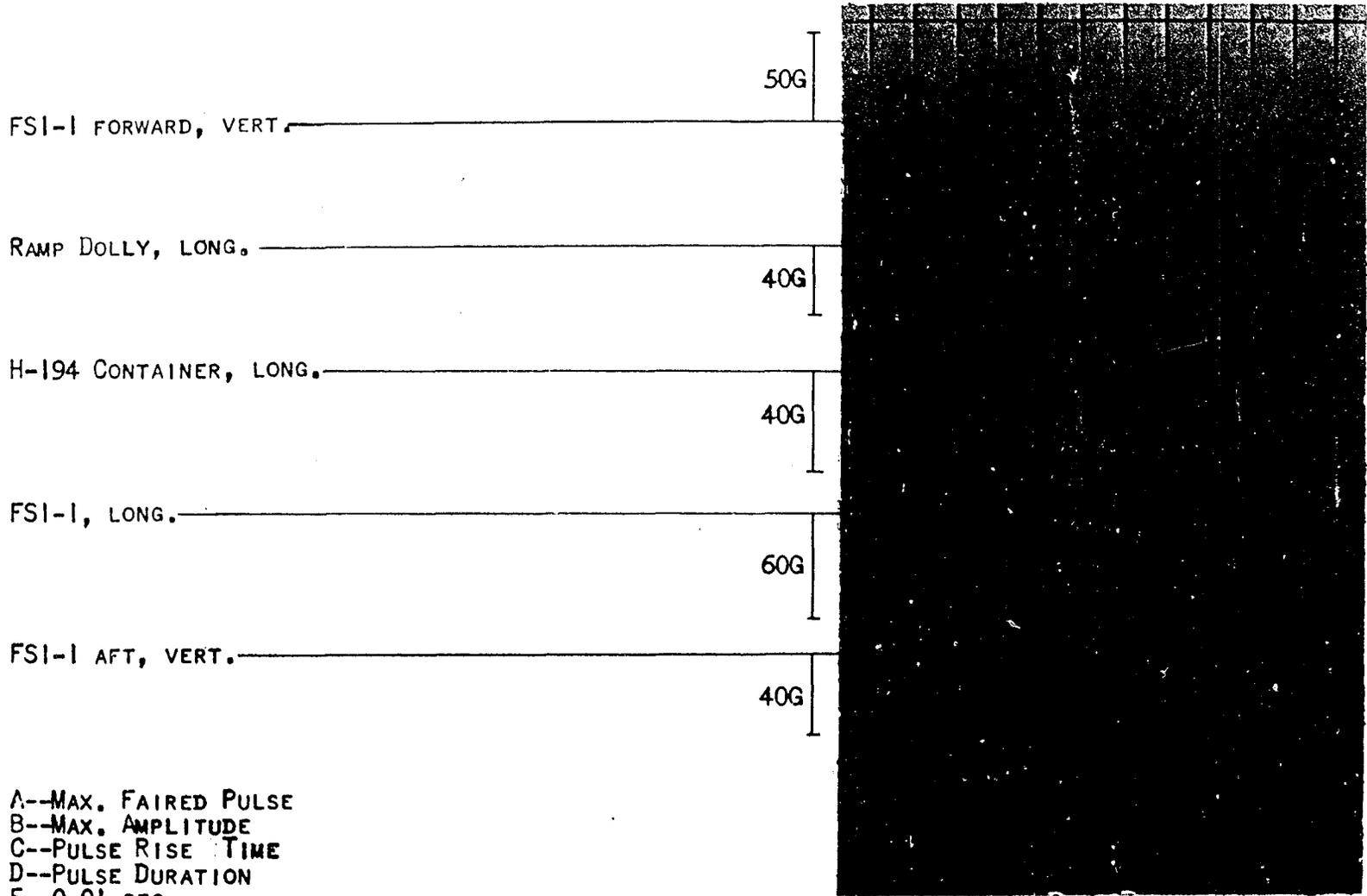
FIG. 8 LOAD-DEFLECTION CURVES FOR ROBINSON MET-L-FLEX MOUNTS NO. 1202-4A---RAMP TEST OF H-194 CONTAINING FSI-1

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UNCLASSIFIED

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A--MAX. FAIRED PULSE
 B--MAX. AMPLITUDE
 C--PULSE RISE TIME
 D--PULSE DURATION
 E--0.01 SEC.

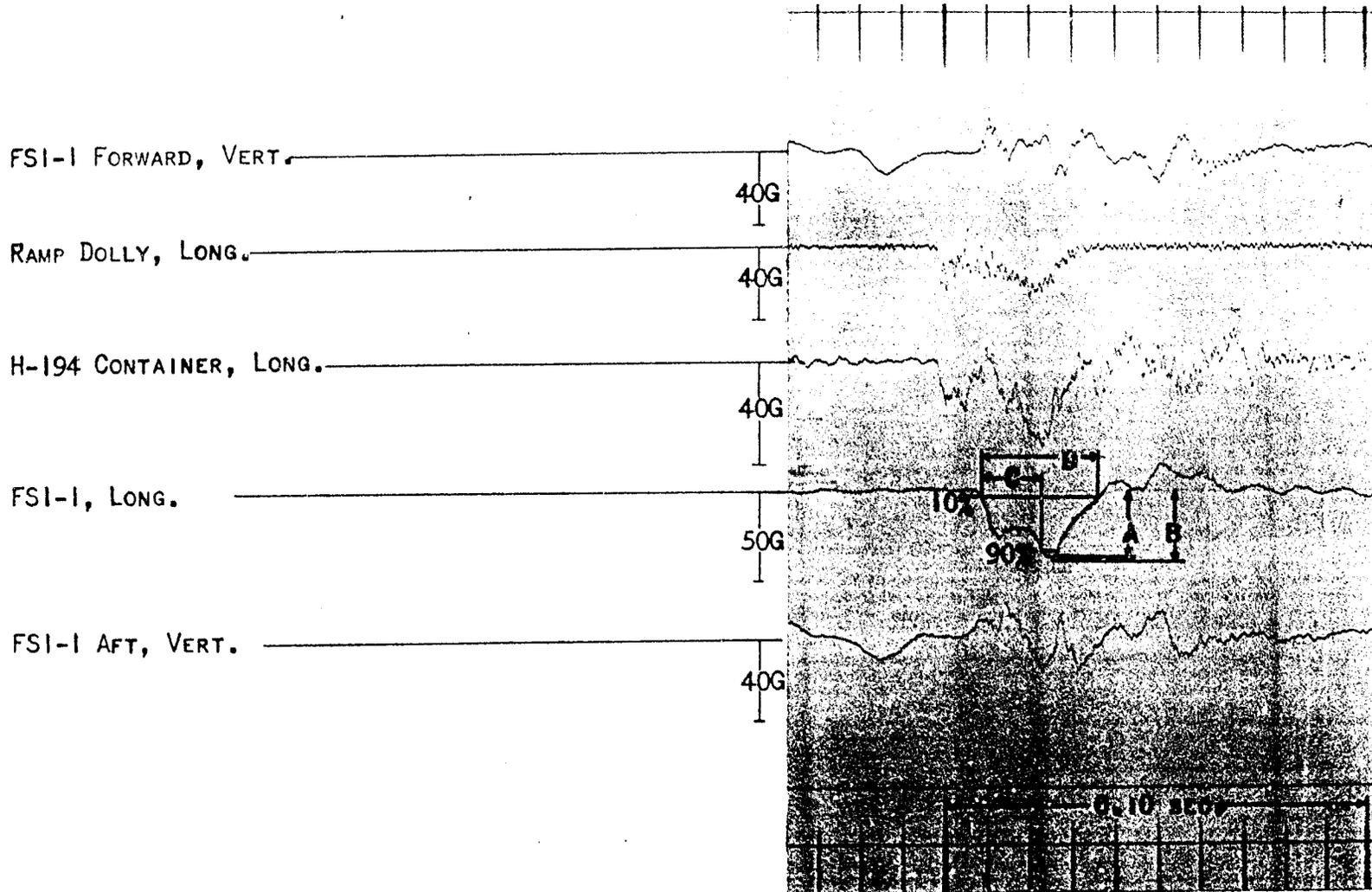
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FIG. 9 TYPICAL OSCILLOGRAPH RECORD; 8.94 MPH IMPACT WITH RUBBER BUMPERS---RAMP TEST OF H-194 CONTAINING FSI-1

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A--MAX. FAIRED PULSE
 B--MAX. AMPLITUDE
 C--PULSE RISE TIME
 D--PULSE DURATION

FIG. 10 TYPICAL OSCILLOGRAPH RECORD; 8.9 MPH
 IMPACT WITH WOOD BUMPERS---RAMP TEST
 OF H-194 CONTAINING FSI-1

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UNCLASSIFIED

-14-

Ref. Sym: 1612 (383)
Project No. TM-448

TABLE I

ACCELEROMETERS

RAMP TEST OF H-194 CONTAINING FSI-1

<u>Accel. No.</u>	<u>Location and Direction</u>	<u>Serial No.</u>	<u>Range (g)</u>	<u>Statham Model No.</u>	<u>Natural Freq. (cps)</u>
1	FSI-1 Unit; Aft, Vert.	617	+100	A5A-100-300	740
2	FSI-1 Unit; Long.	618	+100	A5A-100-300	740
3	H-194 Container; Long.	621	+100	A5A-100-300	850
4	Ramp Dolly; Long.	615	+100	A5A-100-300	750
5	FSI-1 Unit; Forward, Vert.	619	+100	A5A-100-300	740

UNCLASSIFIED

UNCLASSIFIED -15-

Ref. Sym: 1612 (383)
Project No. TM-448

TABLE II

COMPONENTS TESTED

RAMP TEST OF H-194 CONTAINING FSI-1

<u>Component</u>	<u>Drawing No.</u>	<u>Serial No.</u>	<u>Part No.</u>
FSI-1 Firing Set (Containing the following)	300126	35902	
MC-134A X-Unit			310126-00
MC-251 Inverter		AF-30071-D6	MG-58B
MC-251 Inverter		AF-30066-D6	MG-58B
H-194 Container			115477-00
H-320A Assembly			321106-00
Mount, Vibration			826711-00
Adapter, Clip			125507-00
Adapter, Container			119127-01
Clamp, Angle			125508-00

UNCLASSIFIED

Ref. Sym: 1612 (383)
Project No. TM-448

UNCLASSIFIED

-16-

TABLE III

ACCELERATIONS AND TIMES

RAMP TEST OF H-194 CONTAINING FSI-1

Run No.	Impact Velocity (mph)	Accel. No.	Location	Accelerations		Times (sec.)	
				Max. Faired	Max. Amp.	Rise Time	Pulse Duration
1	5.1 (Wood Bumper)	1	FSI-1 Aft; Vert.	+8	+11	.004	.010
		2	FSI-1; Long.	-22	-24	.008	.029
		3	H-194 Container; Long.	-16	-23	.016	.032
		4	Ramp Dolly; Long.	-17	-23	.003	.022
		5	FSI-1 Forward; Vert.	-14	-15	.006	.018
2	6.05 (Wood Bumper)	1	FSI-1 Aft; Vert.	-10	-13	.001	.013
		2	FSI-1; Long.	-34	-36	.008	.021
		3	H-194 Container; Long.	-18	-25	.015	.037
		4	Ramp Dolly; Long.	-17	-24	.005	.031
		5	FSI-1 Forward; Vert.	-15	-16	.008	.016
3	7.0 (Wood Bumper)	1	FSI-1 Aft; Vert.	-17	-21	.002	.006
		2	FSI-1; Long.	-33	-39	.005	.023
		3	H-194 Container; Long.	-19	-33	.007	.031
		4	Ramp Dolly; Long.	-14	-27	.002	.031
		5	FSI-1 Forward; Vert.	+18	+20	.005	.015
4	8.0 (Wood Bumper)	1	FSI-1 Aft; Vert.	-30	-49	.001	.010
		2	FSI-1; Long.	-46	-54	.003	.018
		3	H-194 Container; Long.	-20	-36	.006	.035
		4	Ramp Dolly; Long.	-17	-28	.001	.034
		5	FSI-1 Forward; Vert.	+25	+38	.002	.004
5	8.9 (Wood Bumper)	1	FSI-1 Aft; Vert.	+13	+18	.008	.015
		2	FSI-1; Long.	-38	-39	.017	.028
		3	H-194 Container; Long.	-30	-34	.022	.033
		4	Ramp Dolly; Long.	-25	-28	.024	.034
		5	FSI-1 Forward; Vert.	-16	-18	.003	.007
6	9.65 (Wood Bumper)	1	FSI-1 Aft; Vert.	+14	+17	.004	.010
		2	FSI-1; Long.	-40	-41	.018	.030
		3	H-194 Container; Long.	-24	-45	.021	.037
		4	Ramp Dolly; Long.	-35	-37	.021	.031
		5	FSI-1 Forward; Vert.	+17	+18	.004	.007
7	8.94 (Rubber Pads Bumper)	1	FSI-1 Aft; Vert.	+40	+44	.007	.015
		2	FSI-1; Long.	-79	-117	.005	.017
		3	H-194 Container; Long.	-38	-61	.013	.025
		4	Ramp Dolly; Long.	-31	-32	.011	.030
		5	FSI-1 Forward; Vert.	+29	+50	.007	.009

* Plus accelerations are: longitudinal; towards front of ramp - vertical; up.

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