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AIR TRANSPORTABILITY TESTING OF THE MHU-110/M MUNITIONS TRAILER

Mahlon E. Traylor, Jr.

TECHNICAL REPORT NO. AFSWC-TR-71-26

AIR FORCE SPECIAL WEAPONS CENTER
Air Force Systems Command
Kirtland Air Force Base
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Mahlon E. Traylor, Jr.

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Static pull tests performed on the MHU-110/M Munitions Handling Trailer indicate acceptable structural integrity, tiedown configuration, and transportability of the trailer in the C-130, C-133, and C-141 cargo aircraft.

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Static pull tests performed on the MHU-110/M Munitions Handling Trailer indicate acceptable structural integrity, tiedown configuration, and transportability of the trailer in the C-130, C-133, and C-141 cargo aircraft.

FOREWORD

This report was prepared under Program Element 6.36.03.F, Project 670A.

Inclusive dates of testing were 3 May 1971 through 10 May 1971. The report was submitted 15 June 1971 by the Air Force Special Weapons Center Test Director, Mr. Mahlon E. Traylor, Jr. (FTSE). The project office was the Armament Development and Test Center, Eglin Air Force Base, Florida.

This technical report has been reviewed and is approved.

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SECTION I

INTRODUCTION

The MHU-110/M Munitions Handling Trailer is primarily designed to carry conventional weapons. The trailer has two steerable wheels in the front and four pairs of dual wheels just aft of the center of gravity. This trailer, manufactured by Cemsco Division, Ets-Hokin Corporation, has a 15,000-pound load capacity. The trailer has an overall length of 196 inches, a deck width of 91 inches, and a nominal deck height off the running surface of 30 inches. The trailer weighs 4,200 pounds.

This testing was to establish the structural integrity of the MHU-110/M trailer and to design tiedown configurations that would enable the trailer to be transported in the C-130, C-133, and the C-141 cargo aircraft. Tiedown restraints specified by the Armament Development and Test Center, Eglin Air Force Base, Florida, were 8 g forward, 8 g aft, 1-1/2 g sideways, and 4-1/2 g down.

SECTION II

PROCEDURE

All static pull tests were performed in a large structural steel frame. Hydraulic cylinders were connected in series with load cells that transmitted the applied loads directly to electronic readout gages at a hydraulic control console. The load cells, in turn, were connected by mechanical linkage to main structural members of the test item through its center of gravity. Figures 1 and 2 illustrate the manner in which the trailer was loaded longitudinally and laterally, respectively.

To validate the integrity of a particular tiedown configuration, the stress exerted on each chain must be continuously monitored throughout the test pull. This was done by inserting a short strain link into each chain. Readouts from these strain links were recorded from bridge-balance instrumentation. Figure 3 shows how the strain links were inserted into the chains.

To simulate the loss of friction between the test item and the aircraft deck due to air turbulence and resulting resonant vibration, pairs of greased steel plates were placed between the test item and the deck at each point of contact support.

Every precaution was taken to ensure that as realistic a response as possible was achieved. Mechanical attachments to the test item were engineered to reproduce inertial load displacements and deformations. The test items were visually inspected and electronically instrumented at each increment of loading to check the physical condition of the test item and to reestablish the reliability of the test fixtures.

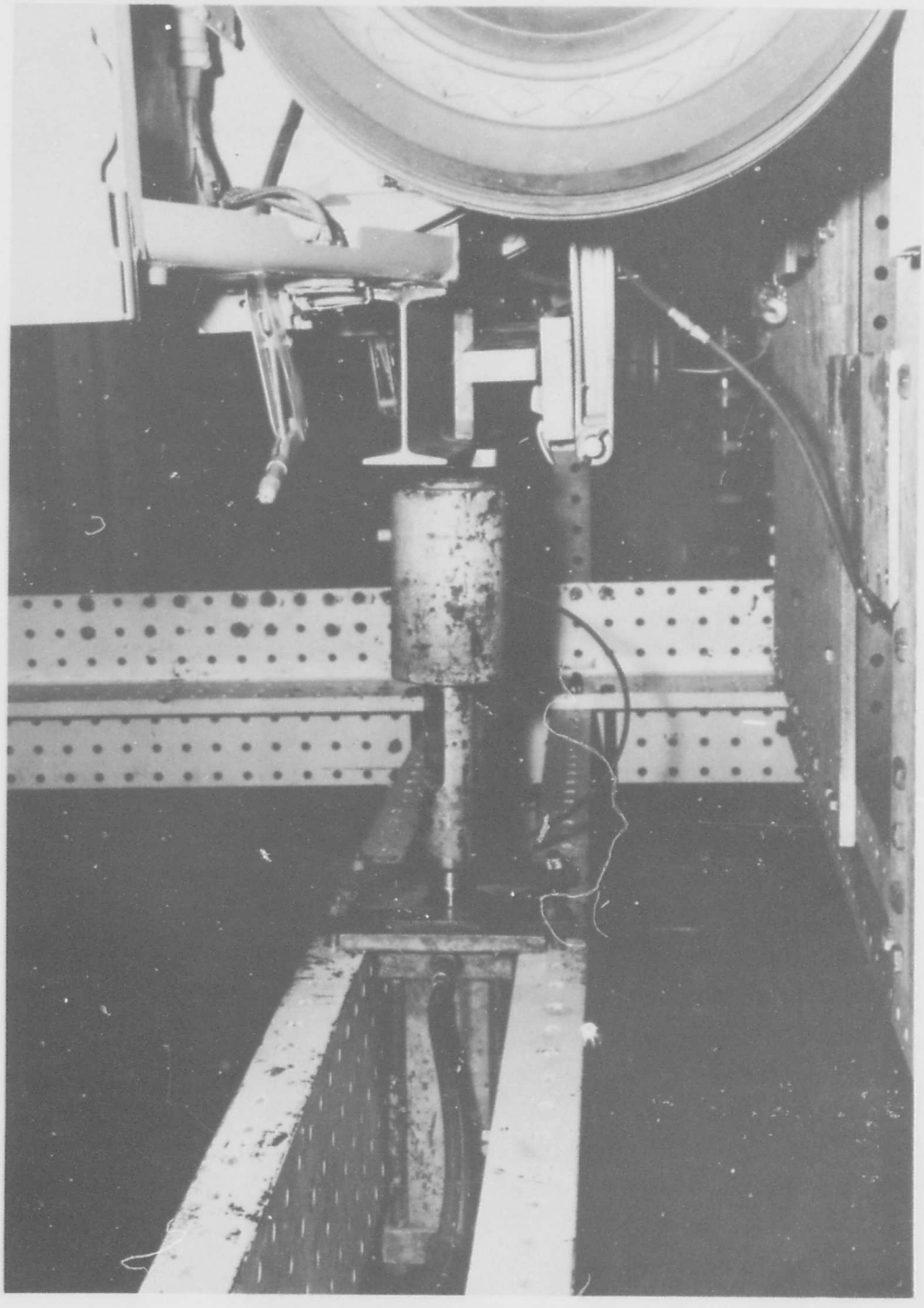


Figure 1. Longitudinal Loading

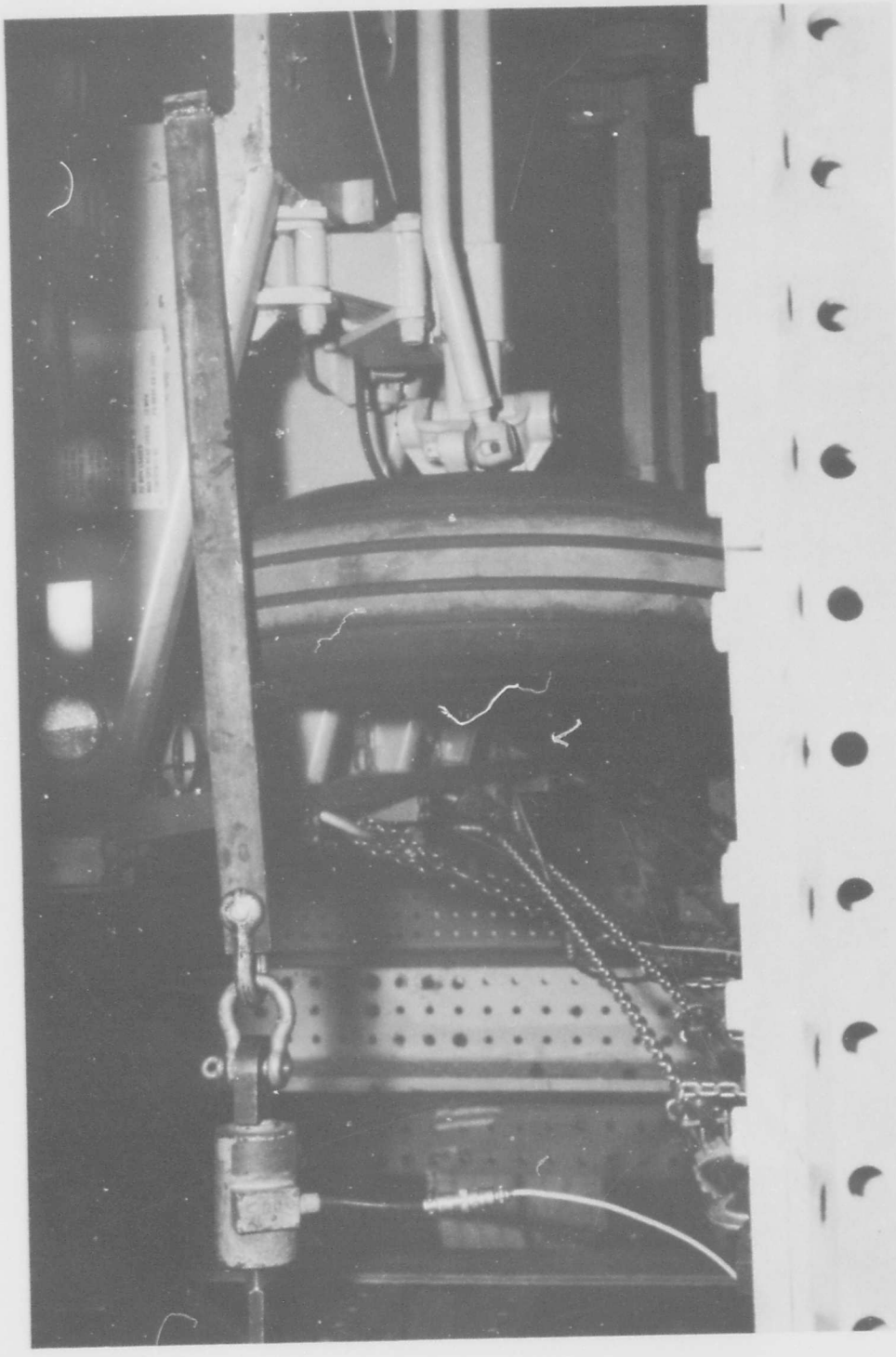


Figure 2. Lateral Loading

Figure 3. Strain Links

SECTION III

RESULTS

During the initial design stages for an acceptable tiedown that would fit all three required aircraft, two facts became immediately obvious. First, because of the relative widths between trailer and aircraft, only the 60-inch butt line rows of attachments could be used. Second, interference by the stanchion blocks at the forward tie rings dictated that the two forward sets of chains would have to be crossed. Figure 4 shows the first attempted tiedown. The forward pull of 8 g was successful as shown in table I; none of the chains sustained their allowable limit of 10,000 pounds. When an attempt was made to pull this same configuration in the aft direction, chains 1 and 16 picked up a disproportionate share of the total load and the pull was discontinued (table II). The second configuration tested is shown in figure 5. Table III shows all forces on the chains to be within the allowable limit. The forward pull was not repeated because the aft restraint was not altered. Table IV is the tabulation of data from the 1-1/2 g side pull using the second tiedown configuration. Lateral motion of the trailer during this pull was 3 inches at the front and 2-1/2 inches at the rear of the trailer. Table V is a compilation of chain geometry data for the second configuration before being pulled. Figure 6 illustrates this geometry on the left side of the trailer.

The down load of 4-1/2 g was accomplished by using a dead weight of steel billets uniformly spaced over the deck. Total vertical deflection under this load was 1-3/8 inches at the front and 1-3/4 inches at the rear of the trailer.

Posttest examination of the test item showed no signs of any visible damage or deformation.

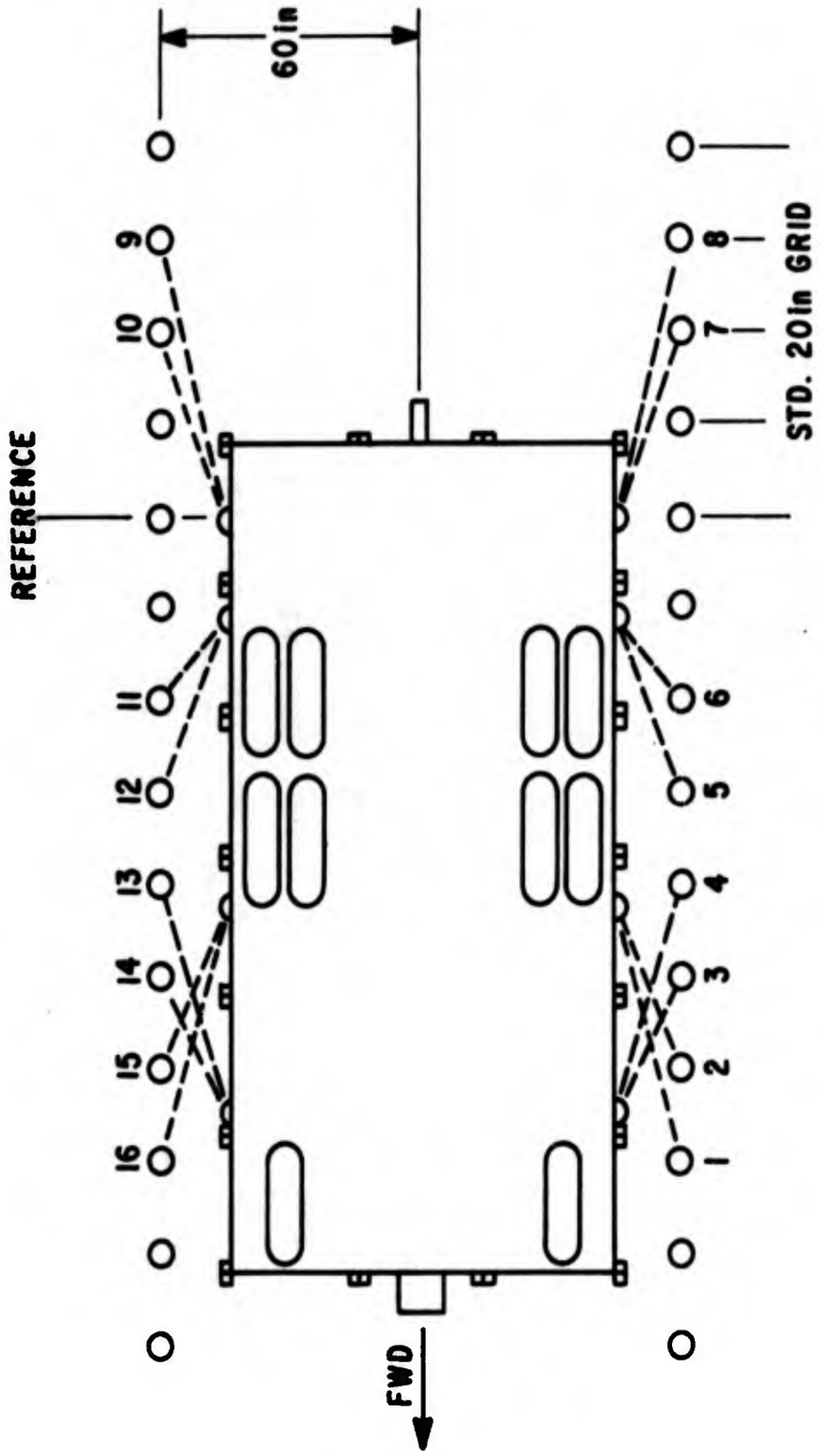


Figure 4. Trial Tiedown

Table I

TIEDOWN REACTION--STATIC LOAD TEST
(Tiedown Number 1, Pull Number 1)

Load Pounds (%)	Reaction in Pounds*															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Min	320	400	350	340	220	180	170	200	240	140	200	230	220	200	220	230
50	0	0	1750	3800	0	0	1200	3770	3160	1820	0	30	3800	1490	0	0
66.67	0	0	2120	5200	0	0	1570	5120	4030	2400	0	0	5120	2020	0	0
75	0	0	2300	5930	0	0	1720	5800	4440	2540	0	0	5850	2300	0	0
85	0	0	2560	6850	0	0	1920	6480	5200	2830	0	0	6700	2620	0	0
90	0	0	2660	7140	0	0	2000	6740	5430	2920	0	0	6980	2730	0	0
95	0	0	2820	7640	0	0	2120	7200	5800	3050	0	0	7500	2930	0	0
100	0	0	2950	8070	0	0	2200	7550	6110	3170	0	0	7900	3100	0	0
0	60	100	110	90	30	40	70	110	0	70	0	80	70	100	170	50

*Numbers refer to chain number

NOTES:

Type of aircraft--C-130
Direction of pull--Fwd
Load--8 g

Table II

TIEDOWN REACTION--STATIC LOAD TEST
(Tiedown Number 1, Pull Number 2)

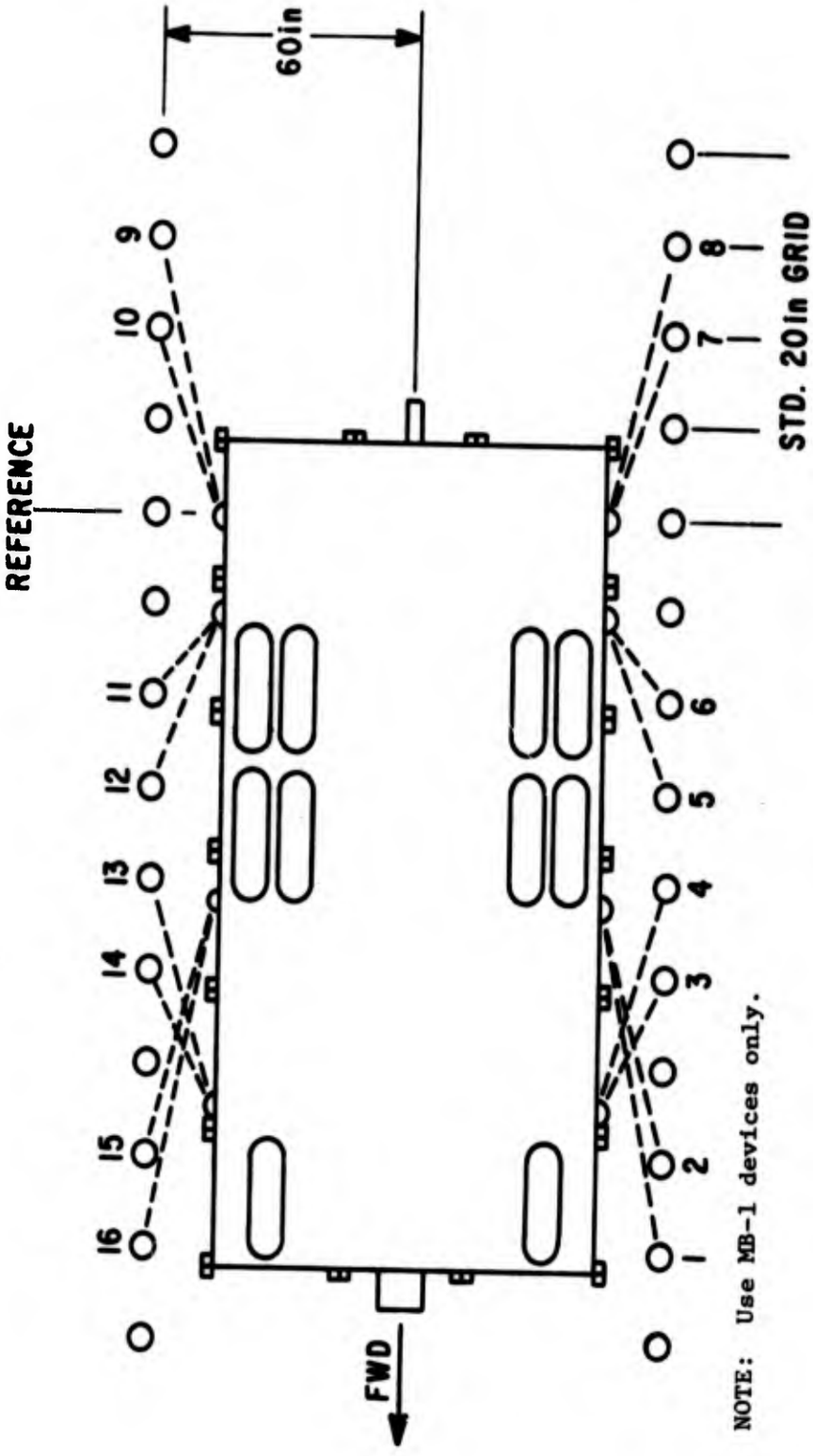
Load Pounds (%)	Reaction in Pounds*															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Min	220	260	240	230	220	180	170	190	140	190	230	230	290	160	170	300
50	4960	2820	0	0	3730	0	0	0	0	0	0	3250	80	0	3000	4890
66.67	6720	3650	0	0	4930	0	0	0	0	0	0	4280	80	0	4030	6590

Pull discontinued at load 66.67 percent to change rear restraint chains.

*Numbers refer to chain number

NOTES:

Type of aircraft--C-130
Direction of pull--Aft
Load--8 g



NOTE: Use MB-1 devices only.

Figure 5. Recommended Tiedown

Table III

TIEDOWN REACTION--STATIC LOAD TEST
(Tiedown Number 2, Pull Number 3)

Load Pounds (%)	Reaction in Pounds*															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Min	220	240	150	230	190	170	200	300	120	120	200	350	200	300	190	290
50	2800	4130	0	0	3750	0	0	0	0	0	0	3230	100	0	3770	3830
66.67	3900	5470	0	0	4950	0	0	0	0	0	0	4150	100	0	5180	5180
75	4390	6030	0	0	5440	0	0	0	0	0	0	4530	100	0	5800	5740
85	5050	6800	0	0	6090	0	0	0	0	0	0	5050	100	0	6570	6520
90	5400	7200	0	0	6430	0	0	0	0	0	0	5360	100	0	6980	6930
95	5800	7600	0	0	6770	0	0	0	0	0	0	5640	100	0	7400	7350
100	6130	8000	0	0	7100	0	0	0	0	0	0	5940	100	0	7800	7750
0	40	70	130	100	130	310	130	100	0	100	390	200	200	170	100	130

*Numbers refer to chain number

NOTES:

Type of aircraft--C-130
Direction of pull --Aft
Load--8 g

Table IV

TIEDOWN REACTION--STATIC LOAD TEST
(Tiedown Number 2, Pull Number 4)

Load Pounds (%)	Reaction in Pounds*															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Min	220	270	190	280	180	230	150	210	140	200	180	190	160	350	250	210
50	450	770	1450	900	610	1140	370	460	0	0	0	50	0	0	100	270
66.67	590	1110	2170	1200	890	1580	430	540	0	0	0	30	0	0	50	330
75	630	1220	2360	1270	1000	1750	450	550	0	0	0	0	0	0	0	270
85	720	1450	2840	1500	1150	1970	500	620	0	0	0	0	0	0	0	330
90	750	1530	2970	1540	1220	2080	520	630	0	0	0	0	0	0	0	300
95	790	1610	3100	1600	1300	2180	530	640	0	0	0	0	0	0	0	270
100	820	1680	3230	1680	1360	2280	550	670	0	0	0	0	0	0	0	260
0	300	520	700	600	430	580	180	320	100	50	30	60	80	50	130	180

*Numbers refer to chain number

NOTES:

Type of aircraft--C-130
Direction of pull--Side
Load--1-1/2 g

Table V

CHAIN GEOMETRY DATA

Chain No.	Horizontal Angle (deg)	Vertical Angle (deg)
1	12.3	19.9
2	16.3	25.8
3	32.2	42.2
4	19.9	30.1
5	22.0	52.8
6	37.7	46.0
7	23.0	34.0
8	15.8	25.2
9	By symmetry	
10		
11		
12		
13		
14		
15		
16		

NOTE:

Horizontal angle is the angle between the longitudinal direction and plan projection of the chain.

Vertical angle is the angle between the aircraft deck and the chain.

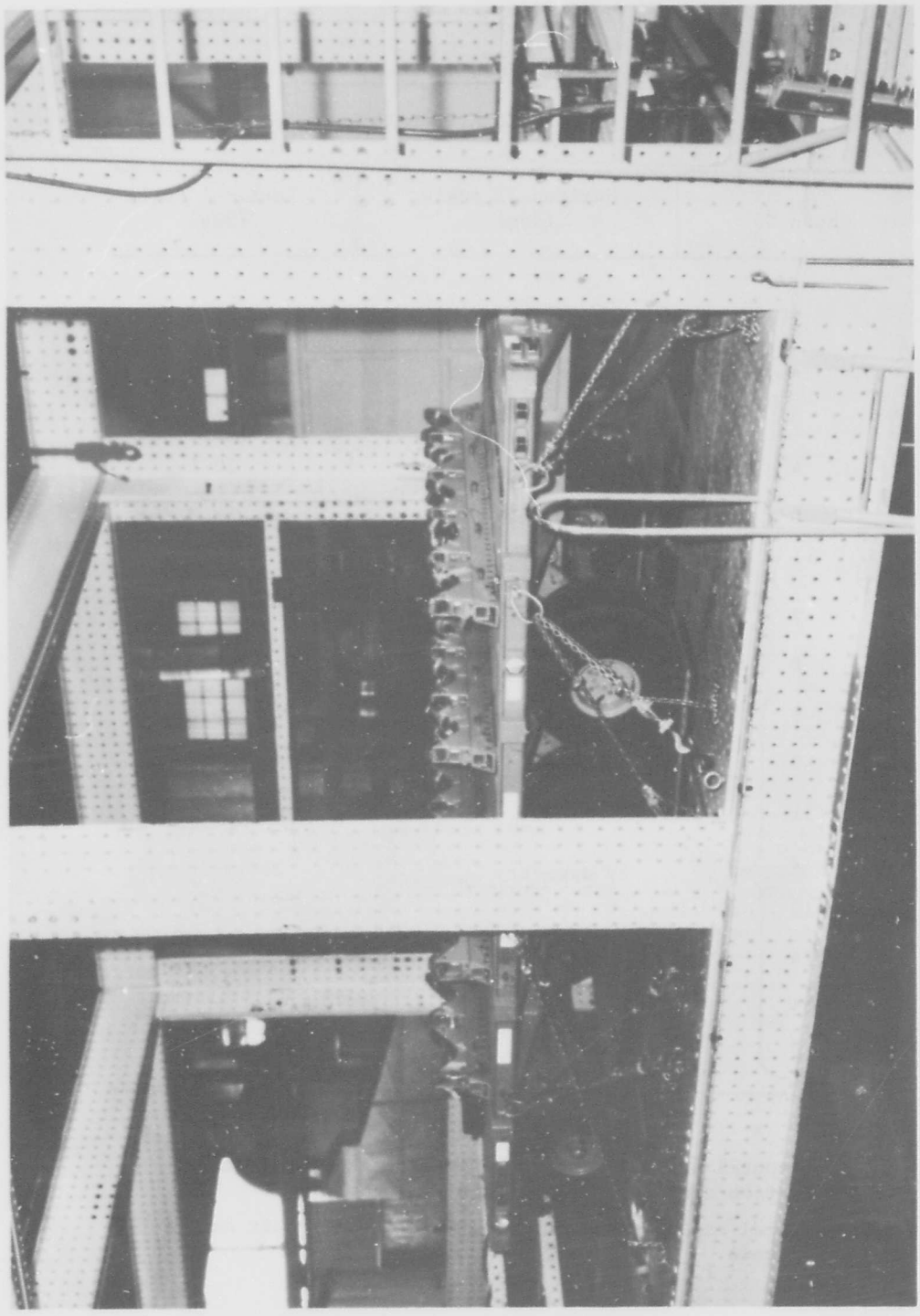


Figure 6. Recommended Tiedown, Left Side

SECTION IV

CONCLUSION AND RECOMMENDATION

CONCLUSION

The MHU-110/M trailer tested is structurally sound and is air transportable in the C-130, the C-133, and the C-141 aircraft.

RECOMMENDATION

It is recommended that the tiedown configuration shown in figure 5 be the only one used in operation.