AD-A165 804 DESIGN AND DEVELOPMENT OF E3 ANTENNA CONTAINER(U) AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSON AFB OH F T HINDS 03 SEP 85 1/1

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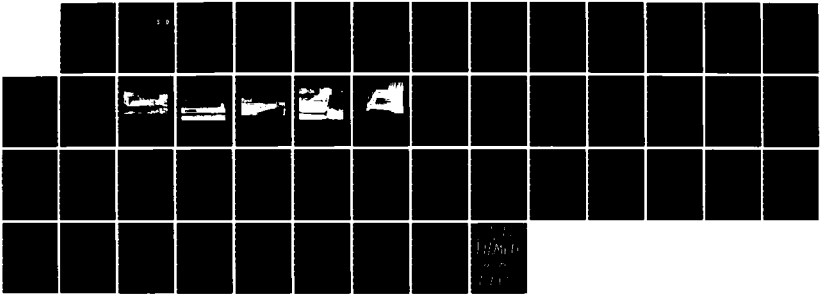

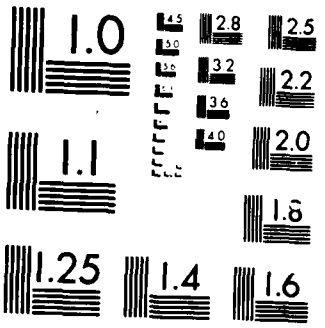

(12)

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REPORT NO:
AFPEA PROJECT NO: 84-P-125

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DESIGN AND DEVELOPMENT OF E3 ANTENNA CONTAINER

HQ AFLC/DSTZ
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433-5999

3 September 1985

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ABSTRACT

Warner-Robins ALC/DSTD, Robins AFB GA 31098, requested the Air Force Packaging Evaluation Agency, Wright-Patterson AFB Ohio 45433, to participate as a consultant in the design, development, and testing of a new container for shipping and storage of the E3 Antenna used on the airborne warning and control system (AWACS) aircraft.

Evaluation of previous efforts to provide a qualified container revealed a need for substantial changes in the containerization process. The new container must provide not only environmental protection for the E3 Antenna but also shall be transportable by C-5, C-130 or C-141 aircraft.

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PUBLICATION DATE:
11 MAR 1986

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Chief, AF Packaging
Evaluation Agency

CREDITS

A debt of gratitude and thanks are due to those individuals who spent many long hours working together in response to the Air Force's need for an acceptable E3 Antenna container. The total effort was completed in less than nine months.

William Sikes	WR-ALC/DSTD Robins AFB GA
John Schmuff	Westinghouse Electric Corporation Hunt Valley MD
Oscar Zellar	Edgewater Machine & Fabrication Edgewater FL

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INTRODUCTION

BACKGROUND: Warner-Robins ALC/DSTD, Robins AFB GA 31098, requested the Air Force Packaging Evaluation Agency (AFPEA), Wright-Patterson AFB, Ohio 45433, to participate as a consultant in the E3 container acquisition program. Westinghouse Defense and Electronic Systems Center (WEC), Hunt Valley MD 21035, had been unsuccessful in their efforts to seal a standard 40 foot Intermodal ISO container. WEC's efforts to change the sealing requirements met with substantial resistance and finally a firm no from WR-ALC/DSTD. This was the result of a meeting hosted by WR-ALC/DSTD in Feb 84 with participants from the E3 Program Office, Boeing Company, Seattle WA, WEC, and AFPEA. WEC's cost estimates of a sealed container costing in excess of one million dollars was put to rest when AFPEA engineers provided a container design 20 feet long, 8 feet wide, and 8 feet high which was sealable and at a cost of approximately $100K for a total of three containers. WEC personnel were informed that anything less than a sealed container was unacceptable.

WEC contracted with Edgewater Machine and Fabrication (EMF), Edgewater FL for the design, prototyping, and testing of the new E3 Antenna container. AFPEA engineers and a WR-ALC Packaging Specialist, acting as a consultants to WEC and EMF, were able to influence the container design substantially.

PURPOSE: The purpose of this project was to:

a. Design a sealable container for the E3 Antenna.

b. Ensure that the container design was compatible with the C-5, C-130 and C-141 aircraft as well as truck, rail and ship.

c. Establish test plan parameters.

d. Develop reprocurement drawings (level 3).

e. Evaluate the container design and determine any deficiencies.

f. Deliver a qualified container in nine months.

Container Design: The exterior dimensions of the container are 352 inches long, 98 inches wide and 99 inches high. The container is constructed of special extrusions, two and three inch square tubing, aluminum sheets, and aluminum plates. The container gross weight is approximately 13,000 pounds. The container is equipped with a rail system which allows the E3 Antenna to be moved by two people into and out of the container with relative ease. When not in use the extension rails are placed inside the container for storage. The container door is attached with 72 bolts. The sealing area around the door incorporates both a physical

stop to prevent over-compression of the gasket and a solid silicone gasket for extended life. The container is equipped with two desiccant ports/baskets, one humidity indicator, ten pressure relief valves, lifting rings, six handles on the door and forklift pockets. The base of the container is smooth for proper interface with the aircraft roller systems or 463L pallets. The exterior of the container has been painted white and the container walls, door and roof have been insulated with two-inch thick styrofoam to minimize temperature change. Particular design characteristics are identifiable in the container drawing (Atch 1) and photographs (Atch 2).

TEST PLAN

The WEC test plan (Atch 3) developed from the E3 Antenna Specification by Boeing, WEC, EMF, WR-ALC and AFPEA and based on the E3 Antenna specification was used for all tests. Vibration tests were waived based on excessive cost associated with testing a container of this size and on past experience (6 years) of shipping the antenna utilizing the same shock mitigation system without an incident of damage.

TEST PROCEDURE AND RESULTS

The container was pressure tested prior to beginning the shock test. Two small leaks were found in the container base skin. The assumption was made that the leaks were caused by improper handling of the container with short forktines. The forkwell sections were reinforced inside the container to prevent future damage during actual operations/use. The container was then subjected to the tests outlined in attachment 3. Results of the tests are identified in the test report (Atch 4). The container gasket was later changed to the proper material, silicone versus neoprene rubber, and retested. The DCAS representative witnessed the performance of this test and reported that it passed the acceptance test.

CONCLUSION

The E3 Antenna container is suitable for transportation and long-term storage of the E3 Antenna. The container meets the original specification requirements and exceeds the capabilities of the previous intermodal ISO container by being compatible with the C-5, C-130, and C-141 aircraft. The container cost to WEC from EMF was approximately $100,000 versus WEC's estimate of one million dollars.

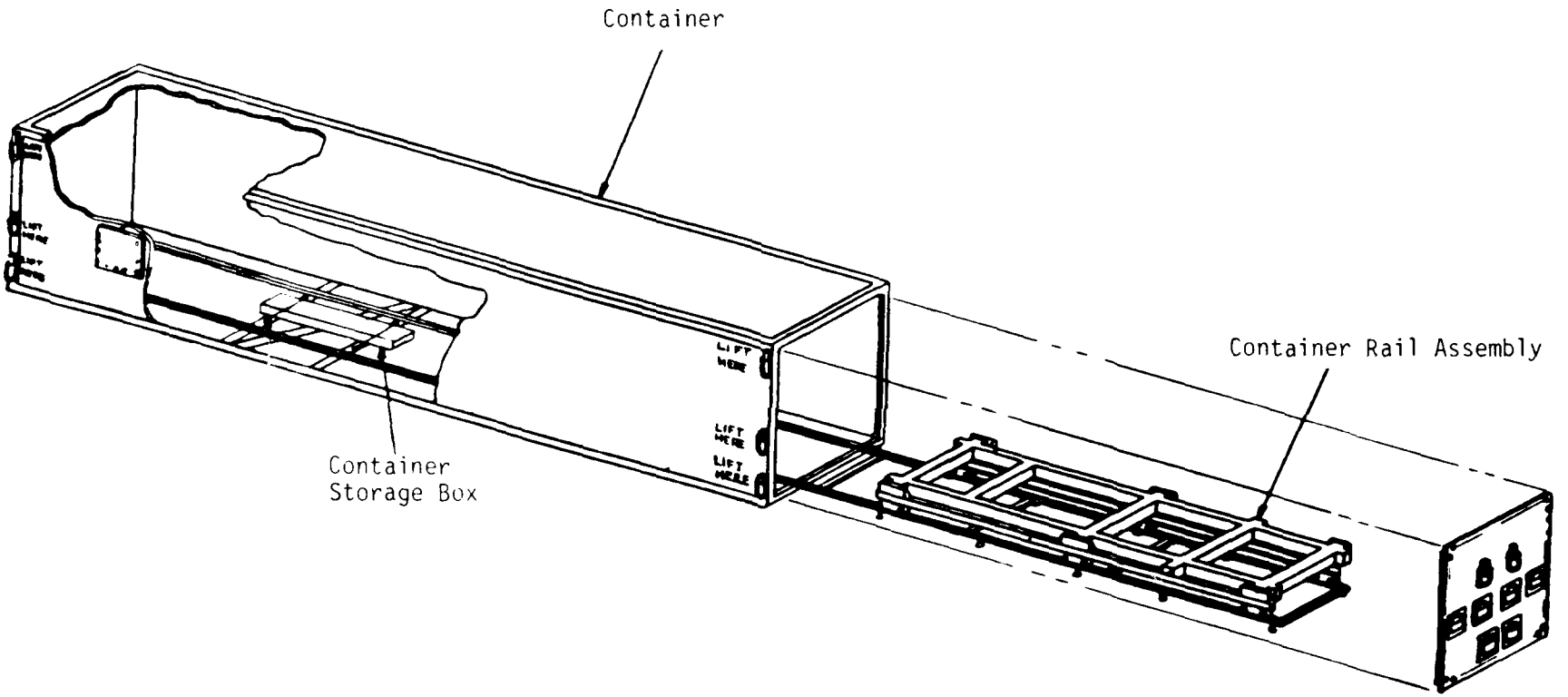
RECOMMENDATIONS

The AFPEA recommends use of the new E3 Antenna container for transportation and storage of the E3 Antenna. In addition, the use

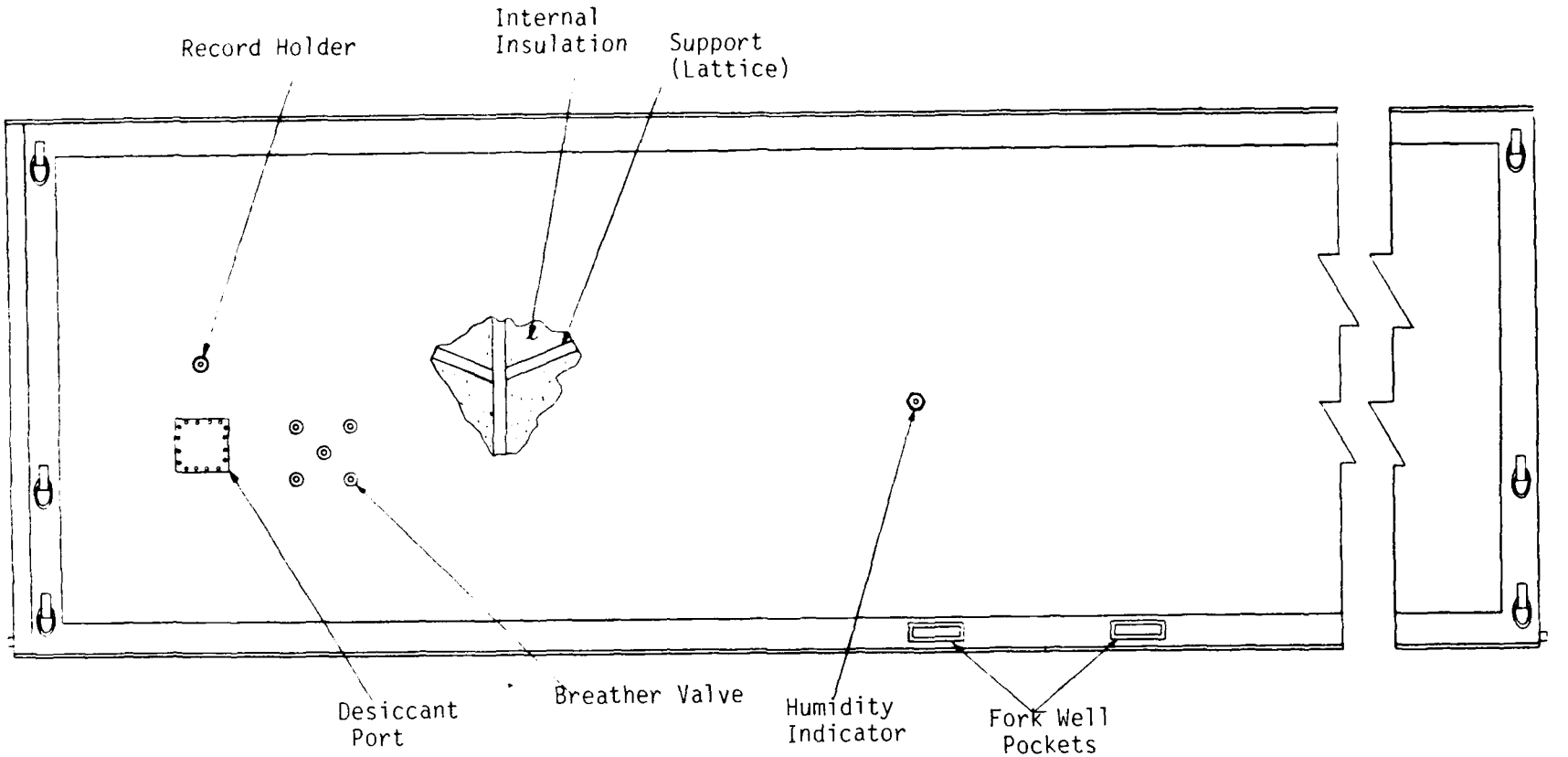
of this basic container design concept should be evaluated for use in other areas where extremely large containers are required.

CONTAINER DRAWINGS

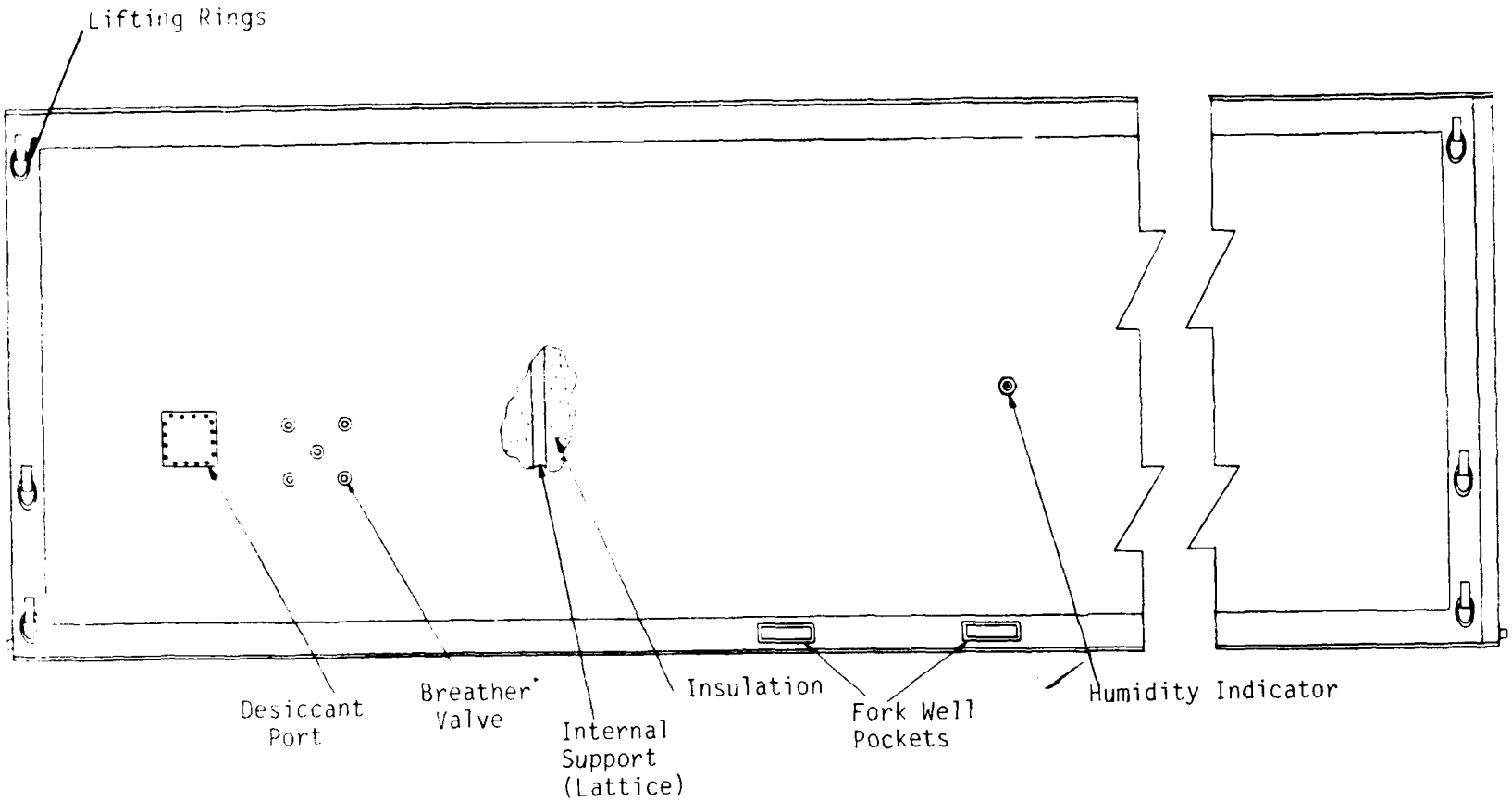
Attachment 1



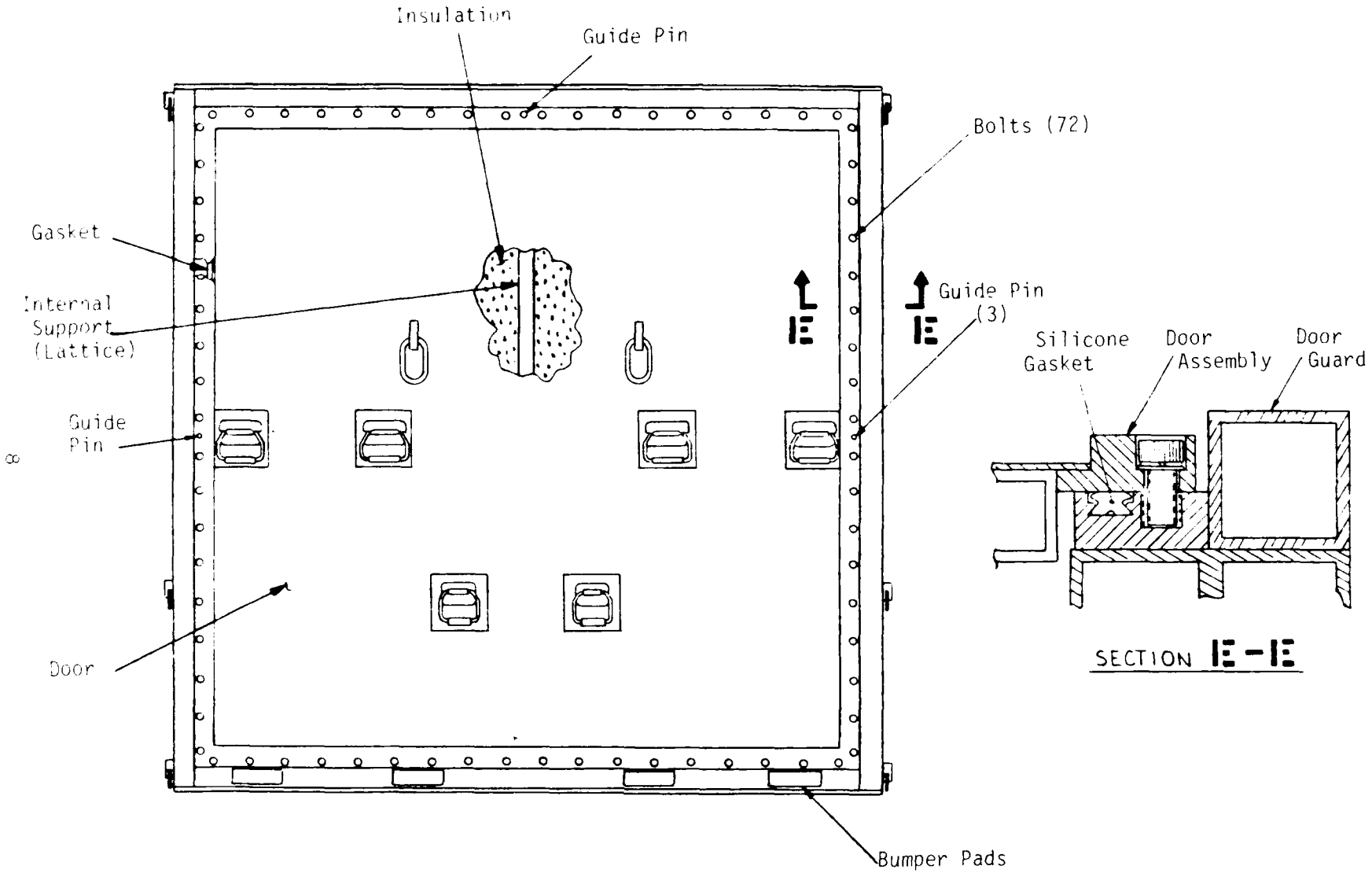
E3 ANTENNA CONTAINER



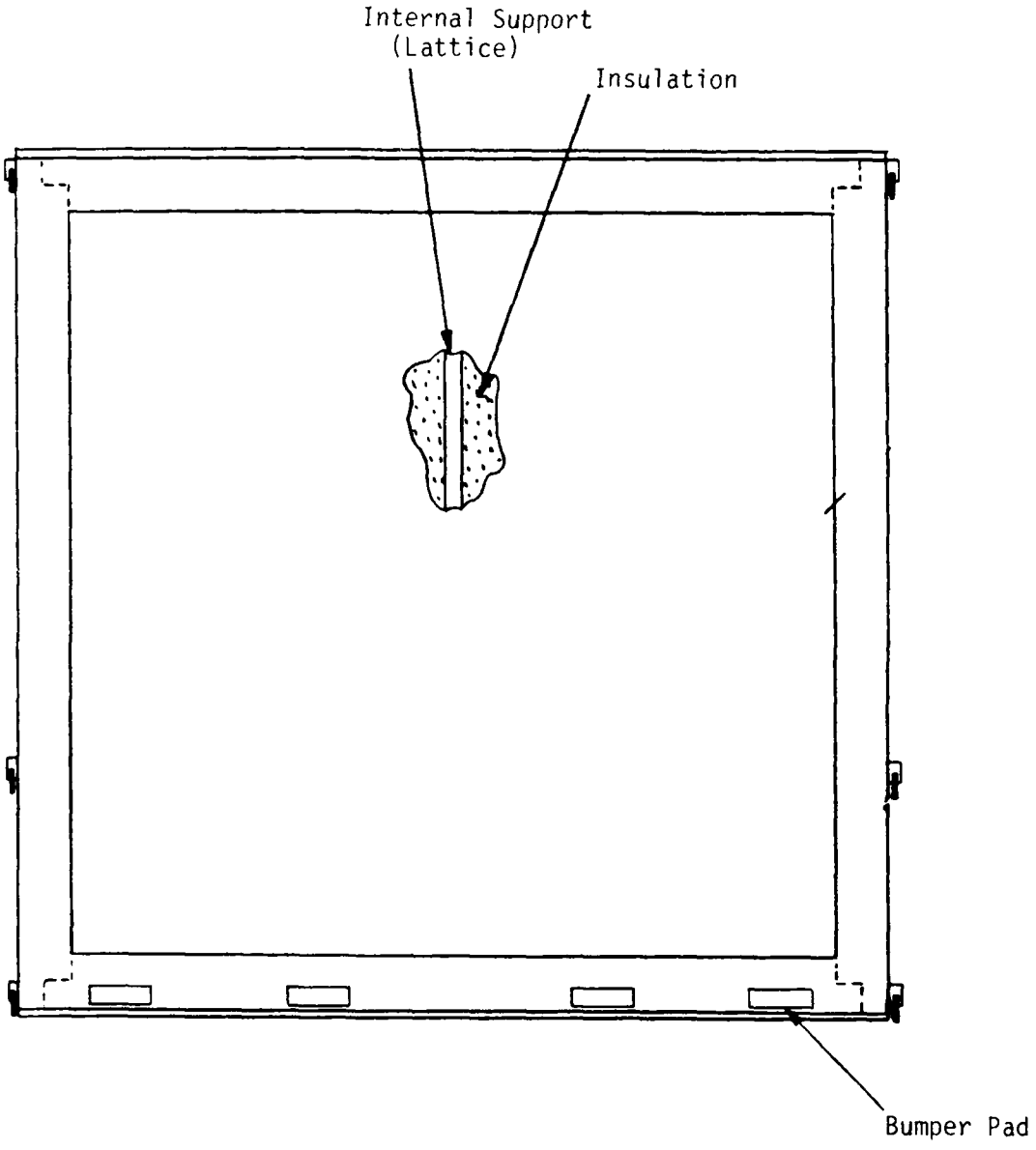
CONTAINER RIGHT HAND SIDE



CONTAINER LEFT HAND SIDE



CONTAINER DOOR END



CONTAINER FORWARD END

CONTAINER PHOTOGRAPHS

Attachment 2

Figure 1

Front View of Container Loaded on Truck

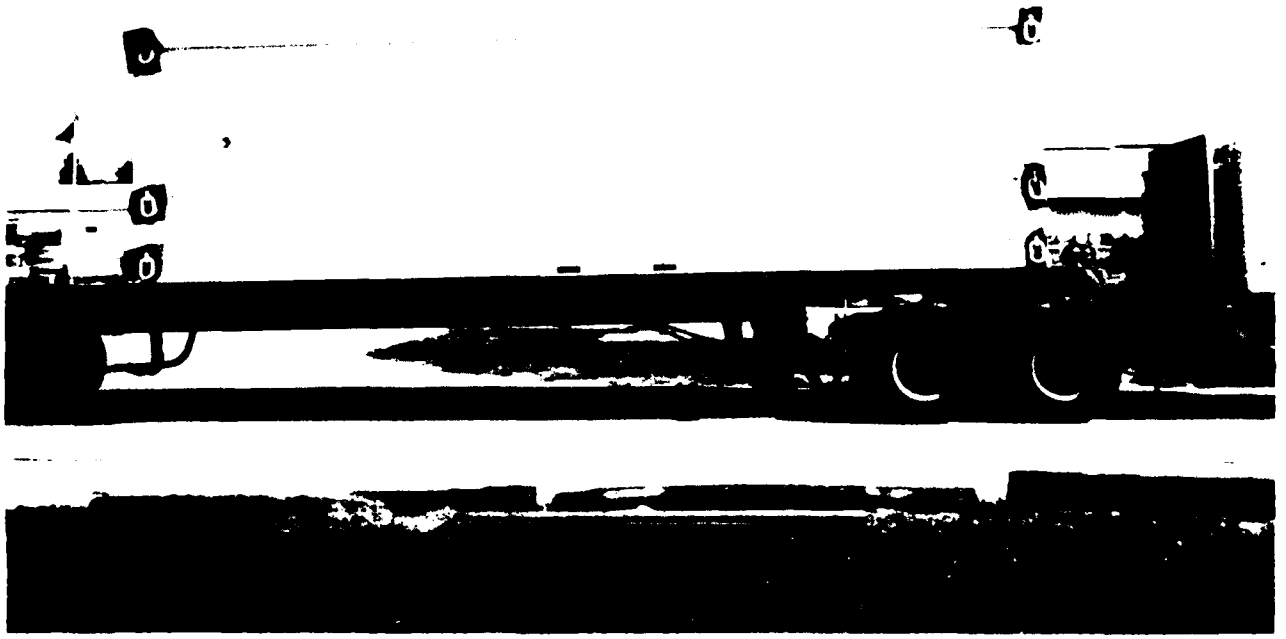


Figure 3

Side View of Container Loaded on Truck

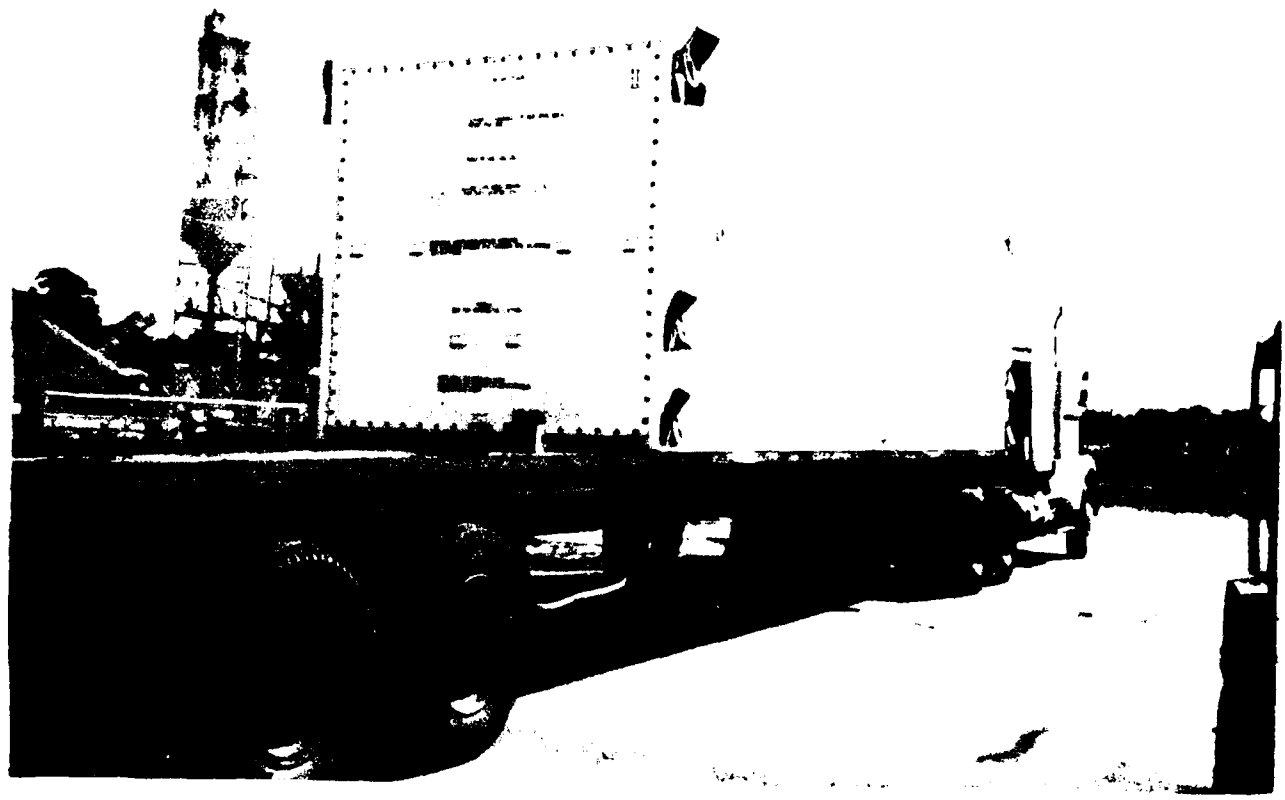


Figure 2

Rear View of Container Loaded on Truck

Figure 5

Container Rail System Cutaway Container for Loading and Unloading the Rail Carrier

WEC TEST PLAN

Attachment 3

E 3

SPARE ANTENNA CONTAINER

TEST PLAN

#E30-00-0501

REV. A

Prepared by:

Westinghouse Electric Corporation

Packaging Engineering

(301)667-5627

June, 1984

DATE 6/4/84	**Westinghouse Electric Corporation** Hunt Valley, MD., 21030
APPR.	TEST PLAN
APPR.	#E30-00-501 Rev. A
APPR.	17

ATCH 3

E3 SPARES ANTENNA CONTAINER TESTING PLAN

TABLE OF CONTENTS

Rotational Drop Test

Ref. - Cornerwise Drop - Method 5005.1

PURPOSE -

This test will be performed to determine the container's ability to withstand a drop impact on any of its corners.

APPARATUS -

a) Wood support (see figure #1)

b) Overhead crane (or other convenient, applicable lifting device)

c) Quick release hook (or equivalent)

d) Sling (approx. 40 feet of 1/2" diameter cable or equivalent)

e) Smooth Concrete surface (or similarly unyielding surface)

SPECIMEN -

One container, per approved drawings with dummy load (simulating the antenna in weight and center of gravity) shall constitute the testing specimen.

The antenna container shall have exterior dimensions of approximately 352 inches (L) X 102 inches (W) X 99 inches (H), and be constructed of aluminum sheeting reinforced with square tubing. The flooring shall be constructed of aluminum plate reinforced with square tubing. The walls and ceiling shall be insulated with expanded polystyrene.

TEST LOCATION -

This test will be performed at the Edgewater Machine & Fabricator's facility located at 200 N. Flagler Ave., Edgewater, Florida 32032.

TEST CONDITION -

No special conditioning of container or contents is required. All tests shall be performed at a temperature of 70 degrees (± 30 degrees) Fahrenheit.

REPORT -

Following completion of each test, a "Container Test Data Sheet" will be filled out in its entirety for that test.

TEST PROCEDURE -

a) Place the wood support (figure 1) under one end of the container along edge, such that one corner is raised 6 inches, and the other corner 12 inches.

b) Raise the unsupported end via the sling and overhead crane (with the quick release hook interfacing the two) until the lower corner on that end reaches a height of 9 inches. Release the hook and allow the container to fall to the floor.

c) Inspect and record all damage to container.

d) Reverse the wood support at the same end such that the corner that was raised 6 inches is now raised 12 inches, and vice versa.

e) Repeat steps b) and c).

f) Move wood support to opposite end of container and repeat steps b) thru e).

ACCEPTANCE/REJECTION CRITERIA -

Reference paragraph 7.1.5 of FED-STD-101C, method 5005.1. for guidelines (note - if minor denting is sustained on corners which does not affect the ability of the container to function as protection for the antenna, it shall not be cause for rejection.)

NOTES: 1. MATERIAL-WOOD
2. GLUE AND/OR NAIL WHERE REQUIRED CLEAN SURFACES THOROUGHLY PRIOR TO GLUING.

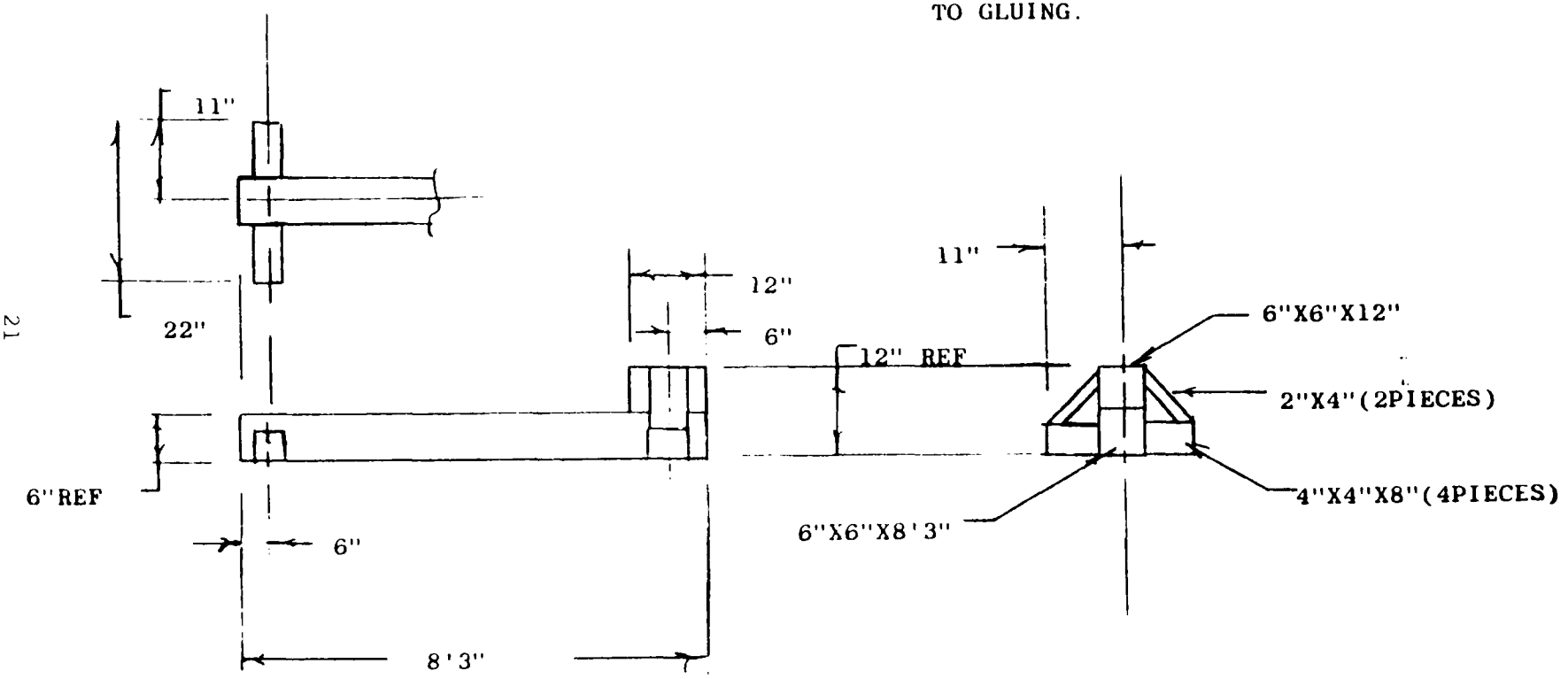


FIG. 1: WOOD SUPPORT

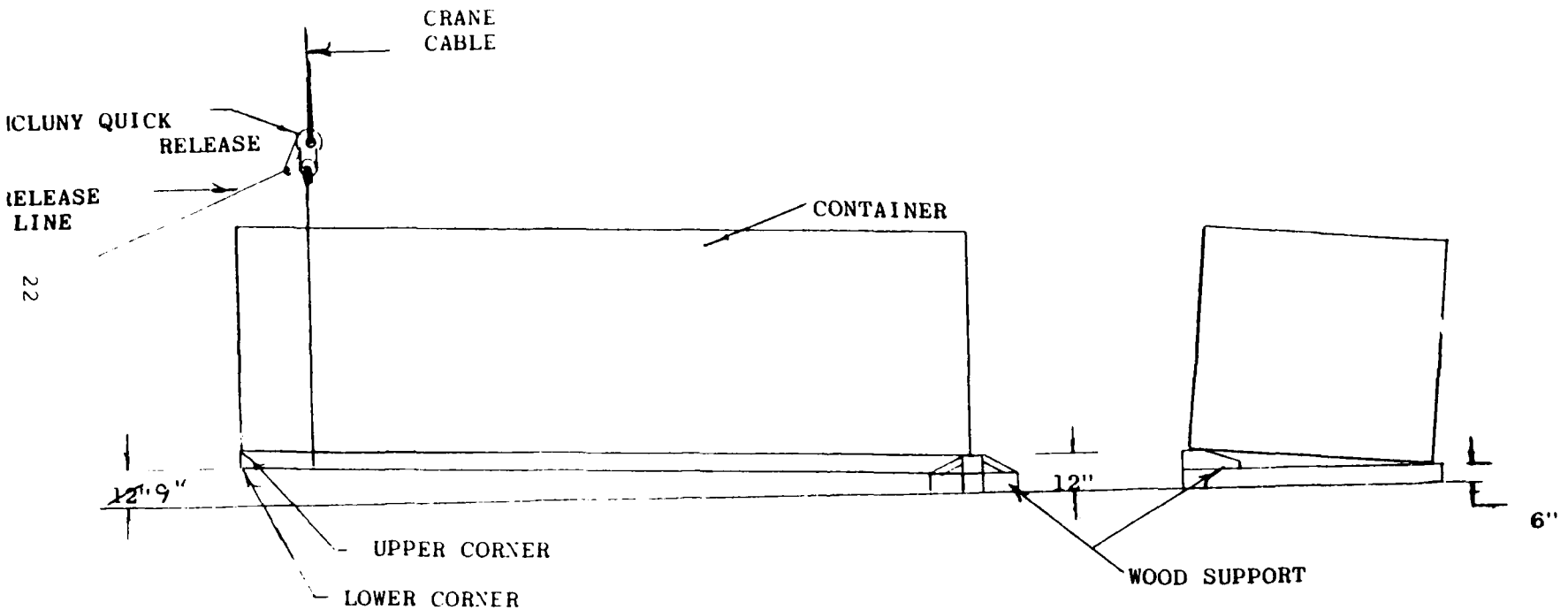


FIG. 2 TEST SETUP

Impact Test

Ref. - Pendulum - Method 5012

PURPOSE -

This test will be performed to determine the container's ability to withstand horizontal impact.

APPARATUS -

a) Platform (29-1/2" x 7-1/4'x 1/4" steel plate with square tubing as lengthwise reinforcement on 2-1/2' centers).

b) Cables (four 1/2" diameter cables of equal length).

c) Concrete or similar abuttment with 3/4" lumber or plywood facing (18" above ground x min. 10' long, rigidly mounted to the ground).

d) Overhead crane (or other convenient, applicable lifting device).

e) Overhead mounting fixture (see figure #1).

f) Forklift (or equivalent).

g) Quick release hook (or equivalent).

SPECIMEN -

One container, per approved drawings with dummy load (simulating the antenna in weight and center of gravity) shall constitute the testing specimen.

The antenna container shall have exterior dimensions of approximately 352 inches (L) X 102 inches (W) X 99 inches (H), and be constructed of aluminum sheeting reinforced with square tubing. The flooring shall be constructed of aluminum plate reinforced with square tubing. The walls and ceiling shall be insulated with expanded polystyrene.

TEST LOCATION -

This test will be performed at the Edgewater Machine & Fabricator's facility located at 200 N. Flagler Ave., Edgewater, Florida 32032.

TEST CONDITION -

No special conditioning of container or contents is required. All tests shall be performed at a temperature of 70 degrees (± 30 degrees) Fahrenheit.

REPORT -

Following completion of each test, a "Container Test Data Sheet" will be filled out in its entirety for that test.

PROCEDURE - (Ref. Figure #2 for test apparatus set-up).

a) Attach four cables to four rigid, overhead points, a minimum of 16' above the ground.

b) Attach platform to cables, then adjust so that the top of the platform is 9" above the ground, making sure all four cables are equal in length.

c) Adjust overhead mounting fixture such that the platform is 3" (+1", -0") from the abuttment.

NOTE: Steps a) thru c) may be set-up prior to test day to expedite testing.

d) Load container onto platform and insure that leading edge is flush with abuttment vertical face while hanging free.

e) Utilizing the crane, pull the container away from the abuttment until bottom of container has increased in vertical height by 9" (± 1"). (Total 18" ± 1" above ground).

f) Stabilize, then release quick release hook, allowing the container to swing free againist the abuttment.

g) Repeat steps d) thru f) for the opposite end of the container.

h) Remove container and inspect for damage. Record all data.

ACCEPTANCE/REJECTION CRITERIA -

Reference paragraph 7.1.5 of FED-STD-101C, method 5012 for guidelines.

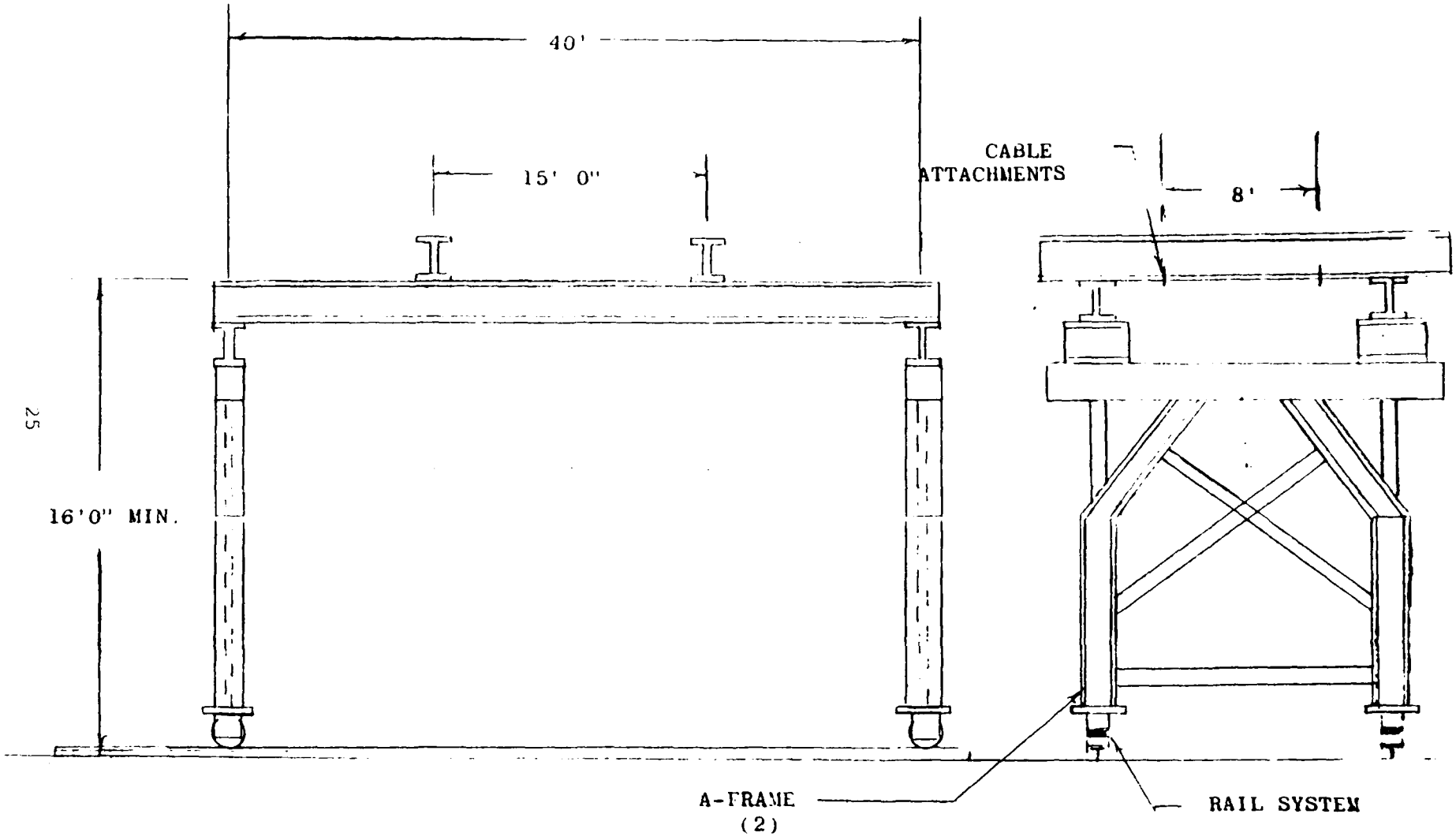


FIG. 1 OVERHEAD MOUNTING FIXTURE

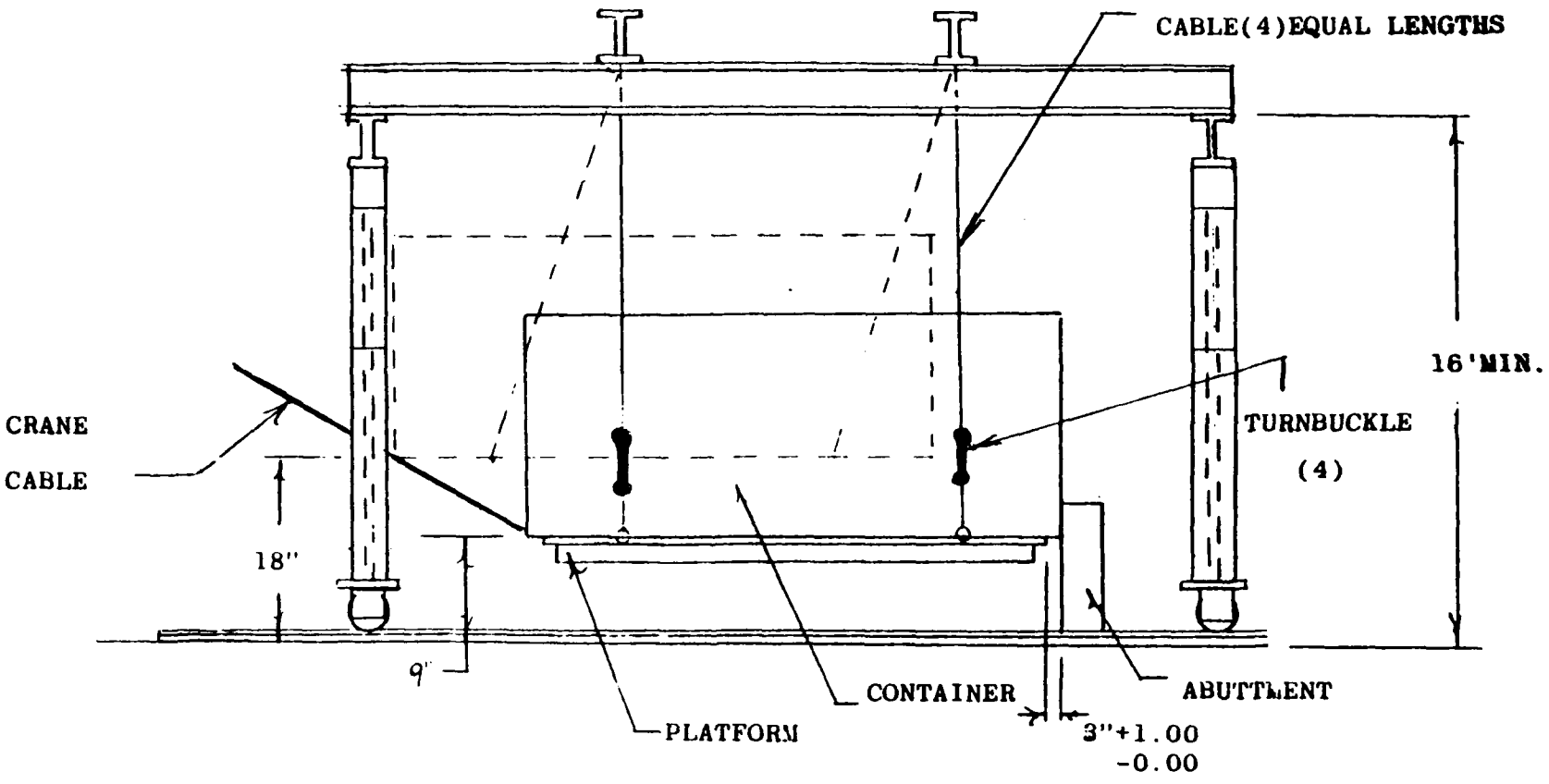


FIG. 2 TEST SETUP

Superimposed Load Test

Ref. - Uniformly Distributed, Without Dunnage - Method 5017

PURPOSE -

This test will be performed to determine the container's ability to withstand static load evenly distributed on its top horizontal face.

APPARATUS -

a) A combination of steel plates and/or sand (totaling 18,700 pounds) used to impose load.

b) Overhead crane (or other convenient, applicable lifting device)

c) Flat smooth surface.

SPECIMEN -

One container, per approved drawings with dummy load (simulating the antenna in weight and center of gravity) shall constitute the testing specimen.

The antenna container shall have exterior dimensions of approximately 352 inches (L) X 102 inches (W) X 99 inches (H), and be constructed of aluminum sheeting reinforced with square tubing. The flooring shall be constructed of aluminum plate reinforced with square tubing. The walls and ceiling shall be insulated with expanded polystyrene.

TEST LOCATION -

This test will be performed at the Edgewater Machine & Fabricator's facility located at 200 N. Flagler Ave., Edgewater, Florida 32032.

TEST CONDITION -

No special conditioning of container or contents is required. All tests shall be performed at a temperature of 70 degrees ($\pm$ 30 degrees) Fahrenheit.

REPORT -

Following completion of each test, a "Container Test Data Sheet" will be filled out in its entirety for that test.

TEST PROCEDURE -

a) Place specimen on its bottom face on flat smooth surface

b) Using the formula w = A x 50 x S, where
W = Superimposed load (in pounds)
A = Top face are a (in square feet)
S = 1.5

c) Determine amount of load required. Determine weight of steel plate(s) to be used. Place steel plate(s) on top face of container using crane or other device.

d) Subtract weight of steel plate(s) from total load needed. Determine amount of sand needed to make up the difference in weight.

e) Place necessary amount of sand on top of steel plate(s), and spread evenly to distribute load.

f) Leave load in place for one hour, during which time any changes, deflections, failure and the like of the container should be noted.

g) After one hour, record any vertical defections using a taut string. Measure any bowing of the top face using a straight edge across the midlength of the container. In addition, note any bulging of side and end panels, as well as any buckling or failure of support members.

h) Remove the load from the top face of the container and note any recovery to container condition.

i) Make observations of container's ability to protect contents despite any distortions imposed by the load.

ACCEPTANCE/REJECTION CRITERIA -

Reference paragraph 7.1.5 of FED-STD-101C, Method 5017 for guidelines.

Leak Test

Ref. - Pneumatic Pressure Technique - Method 5009.2

PURPOSE -

This test will be performed to demonstrate the container's ability to provide method IId protection for the antenna by sealing it from the environment.

APPARATUS -

a) Supply of compressed air (sufficient to evenly pressurize the container to the specified level).

b) Manometer (with gauge graduated to read in inches of water) and/or pressure gauge.

c) Ultrasonic Leak Detector (with associated instrumentation) and/or bubble-supporting liquid.

NOTE: All instruments used for measurement in conjuction with this test must be properly calibrated to comply with government standards.

SPECIMEN -

One container, per approved drawings shall constitute the testing specimen.

The antenna container shall have exterior dimensions of approxiammtely 352 inches long x 102 inches wide x 99 inches high, and be constructed of aluminum sheeting reinforced with square tubing. The flooring shall be constructed of aluminum plate reinforced with square tubing. The walls and ceiling shall be insulated with expanded polystyrene.

TEST LOCATION -

This test will be performed at the Edgewater Machine & Fabricator's facility located at 200 N. Flagler Ave., Edgewater, Florida 32032.

TEST CONDITION -

No special conditioning of the container is required. All tests shall be performed at a temperature of 70 degrees ($\pm$ 30 degrees) Fahrenheit.

REPORT -

Following the completion of each test, a "Container Test Data Sheet" will be filled out in its entirety for that test.

PROCEDURE -

a) Close and seal container door. Remove pipe plugs and attach air supply and manometer.

b) Gradually introduce compressed air into container until manometer reads 5" ($\pm$ 1/2") of water.

CAUTION! PNEUMATIC PRESSURE MAY CAUSE EXPLOSIVE FAILURE IN WEAK CONTAINER, USE CAUTION!

c) When manometer indicates that equalized pressure has been attained within the container, record initial reading.

d) After 30 minutes time has elapsed from initial reading, record final manometer reading. If no change is noted between initial and final gauge pressure, the container is considered sealed. However, if any loss in pressure is detected, the leaks can be located by means of an ultrasonic leak detector, or a bubble-supporting film method; and repaired as required to seal the container.

e) If a leak is found, steps b) thru d) must be repeated until the container satisfies the requirements of the test, and is found to be sealed.

ACCEPTANCE/REJECTION CRITERIA -

Not applicable, test must be performed until requirements are satisfied.

TEST REPORT

Attachment 4

E3

SPARE ANTENNA CONTAINER

TEST REPORT

(14)

Westinghouse Packaging Engineering

CONTAINER TEST DATA SHEET

Test Name: Superimposed Load Test Test Date: 10/23/84

Ref. Westinghouse Test Plan: E30-00-0501, Rev. A

Ref. FED-STD-101C Method: 5017

Deviations From Test Specification: NONE

Test Location: EMF, EDGEWATER, FLORIDA

Dummy Load Required? _____ yes _____ no

Instrumentation/Apparatus Used: 8' STRAIGHT EDGE, STRING

(Description) (Model/Serial Number) (Calibration Date, If App.)

Container Completed As Per Approved Drawings? ✓ yes _____ no

Describe Container Prior To Testing: (Note Dents, Scratches, Etc.)

1) CONTAINER POSITIONED ON A FLAT CONCRETE SURFACE

2) REQUIRED LOAD APPLIED ACCORDING TO PROCEDURE

3) NO DEFLECTIONS OR BULGES NOTED ON CONTAINER

Temperature: 80.5° F start 80.5° F finish

Test Time: 1:11 AM start 2:12 AM finish

Data/Observations: MEASUREMENTS WHERE TAKEN PRIOR TO LOADING.
86 3/8" RECORDED ON ENDS OF CONTAINER AND 86 1/2" ON CENTER.
AFTER ONE (1) HOUR MEASUREMENTS WERE RECHECKED, DIMENSIONS
REMAINED THE SAME WITH NO DISTORTIONS ON THE CONTAINER
IMPOSED BY THE LOAD.

29 Nov 84

Data Recorded By:

F H Wing

F.H. Wing (EMF Q.A.)

29 Nov 84

Westinghouse Packaging Engineering

CONTAINER TEST DATA SHEET

Test Name: Rotational Drop Test Test Date: 10/25/84

Ref. Westinghouse Test Plan: E30-00-0501, Rev. A

Ref. FED-STD-101C Method: 5005.1

Deviations From Test Specification: NONE

Test Location: EMF, EDGEWATER, FLORIDA

Dummy Load Required? _____ yes _____ no

Instrumentation/Apparatus Used: WOOD SUPPORT, CRANE, QUICK RELEASE HOOK.

(Description) (Model/Serial Number) (Calibration Date, If App.)

Container Completed As Per Approved Drawings? ✓ yes _____ no

Describe Container Prior To Testing: (Note Dents, Scratches, Etc.)

NO WARP, BENDS OR CRACKS OR OTHER DISTORTIONS NOTED PRIOR TO TEST.

Temperature: 79.5° F start 80° F finish

Test Time: 9:55 AM start 10:57 AM finish

Data/Observations: CONTAINER WAS DROPPED ON CORNERS IN ACCORDANCE WITH TEST PROCEDURE. NO INTEGRAL DAMAGE TO THE CONTAINER WAS NOTED. WELD ON THE 3" TUBE ON THE LEFT, FRONT, BOTTOM OF CONTAINER THAT SHIELDS THE DOOR WAS OBSERVED TO HAVE SUSTAINED TWO CRACKS WHICH WERE REPAIRED.

Data Recorded By:

F.H. Wing

F.H. WING (EMF Q.A.)

Westinghouse Packaging Engineering

CONTAINER TEST DATA SHEET

Test Name: Impact Test Test Date: 10/25/84

Ref. Westinghouse Test Plan: E30-00-0501, Rev. A

Ref. FED-STD-101C Method: 5012

Deviations From Test Specification: NONE

Test Location: EMF, EDGEWATER, FLORIDA

Dummy Load Required? _____ yes _____ no

Instrumentation/Apparatus Used: PLATFORM, CABLES, CRANE, CONCRETE BLOCKS

(Description) (Model/Serial Number) (Calibration Date, If App.)

Container Completed As Per Approved Drawings? ✓ yes _____ no

Describe Container Prior To Testing: (Noe Dents, Scratches, Etc.)

NO DENTS OR DISTORTION OF CONTAINER NOTED PRIOR TO TESTING.

Temperature: 82° start 83° finish

Test Time: 11:31 FRONT start 12:12 FRONT finish
2:15 BACK 2:35 BACK

Data/Observations: CONTAINER TESTED IN ACCORDANCE WITH PROCEDURE. NO DAMAGE NOTED TO CONTAINER AFTER TESTING. CONTAINER WAS OPENED AFTER TESTS AND INSPECTED INTERNALLY THE CARRIER WAS OBSERVED TO HAVE SHIFTED 2 3/4" ON THE RAIL SYSTEM WITH THE ROLLER BRAKES HOLDING THE DUMMY LOAD. SLIGHT GOUGING OF RAILS WAS NOTED DUE TO THE SHIFT.

29 NOV 84

Data Recorded By:

F H Wing

F.H. WING (EMF Q.A.)

29 NOV 84

Westinghouse Packaging Engineering

CONTAINER TEST DATA SHEET

Test Name: Leak Test Test Date: 10/26/84

Ref. Westinghouse Test Plan: E30-00-0501, Rev. A

Ref. FED-STD-101C Method: 5009.2

Deviations From Test Specification:

Test Location: EMF, EDGEWATER, FLORIDA

Dummy Load Required? _____ yes _____ no

Instrumentation/Apparatus Used: WESTINGHOUSE SUPPLIED MANOMETER

(Description)	(Model/Serial Number)	(Calibration Date, If App.)
DWYER MANOMETER/ CAT. NO. 104-8	/	2/16/84 WESTINGHOUSE)
(CONTROL #57057)		

Leak Test 10/23/84 page 2 of 2

Container Completed As Per Approved Drawings? X yes ____ no

Describe Container Prior To Testing: (Note Dents, Scratches, Etc.)

1) CONTAINER PREPARED IAW PROCEDURE

2) Barometer reading - 27.99

Temperature: 79° F start 80.5° F finish

Test Time: 10:57 a.m. start 1:45 p.m. finish

Data/Observations: Container pressurized to 5" water

11:25 a.m. - Manometer indicates 4.7" water

Test restarted 11:45 a.m.

Freon 12 added into container to detect any leaks. Two (2) small leaks found and repaired.

1:10 p.m. - Container pressurized to 5" water. Temperature 80.5°F.

After 30 minutes manometer indicates 4.9" water at 80.5°F.

29 Nov 84

29 Nov 84

Data Recorded By:

F H Wing

F. H. Wing (EMF. Q.A.)

Container Completed As Per Approved Drawings? ✓ yes _____ no

Describe Container Prior To Testing: (Note Dents, Scratches, Etc.)

1) CONTAINER PREPARED IAW PROCEDURE

2) DAYTONA BEACH AIRPORT CONTACTED TO VERIFY TEMPERATURE AND BAROMETRIC PRESSURE - TEMP. 80° - PRESSURE - 29.93 HOLDING.

Temperature: 79° start 80° finish

Test Time: 10:01 start 10:31 finish

Data/Observations: 10:05 - 79° - 5.1" Water

10:10 - 79° - 5.15" Water

10:15 - 80° - 5.2" Water

10:20 - 80° - 5.25" Water

10:25 - 80° - 5.25" Water

10:31 - 80° - 5.3" Water

CONTAINER TESTING IAW PROCEDURE WITH NO LOSS OF PRESSURE INDICATED.

TESTING COMPLETED AT 10.31 or 10/26/84

MANOMETER APPARATUS DISCONNECTED AND SCALE CHECKED, SCALE READING RETURNED TO ZERO.

29 Nov 84

29 NOV 84

Data Recorded By:

E. H. Wing (QMF. Q.A.)

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