

**U.S. DEPARTMENT OF COMMERCE**  
**National Technical Information Service**

AD-A028 308

LARGE CARGO CONTAINERS

ARMY TEST AND EVALUATION COMMAND

20 SEPTEMBER 1974

232105

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TOP 10-2-214	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) U. S. Army Test and Evaluation Command Development Test II (EP) - Common Test Operations Procedures, "Large Cargo Containers"		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Aberdeen Proving Ground (STEAP-MT-M) Aberdeen Proving Ground, Maryland 21005		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCR 310-6
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Test and Evaluation Command (AMSTE-ME) Aberdeen Proving Ground, Maryland 21005		12. REPORT DATE 20 September 1974
		13. NUMBER OF PAGES 85
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office)		13. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  REPRODUCED BY NATIONAL TECHNICAL INFORMATION SERVICE U. S. DEPARTMENT OF COMMERCE SPRINGFIELD, VA. 22161		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Cargo container*      Freight container* Container              Intermodal container* Container, oversize*      Transportability              *New.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Provides guidance for evaluating physical and performance characteristics of large cargo containers. Covers initial inspection, assembly and coupling, stacking, lifting, restraint, lashing; wall, roof, and floor strength; racking. Performance tests cover compatibility with other containers, transporting media, and MHE; tests with MHE; engagement, lift, and tiedown tests; cargo loading adaptability, intermodal transfer, pendulation, shipping and handling; environmental performance tests including high and low temperatures,		

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20. snowload, salt fog, dust, condensation, shock, extended storage, corrosion, and weatherproofness; and tests for transportability, LOTS, safety, human factors, maintenance evaluation, kits, and electromagnetic interference. Describes types of containers, fittings and attachments, test facilities. Provides a container test requirement checklist.

ACCESSION NO.	
NTIS	White Section <input checked="" type="checkbox"/>
DOC	Ext. Sec. <input type="checkbox"/>
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JUSTIFICATION	
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DISSEMINATION-AVAILABILITY NOTES	
DATE	CLASS. BY
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U. S. ARMY TEST AND EVALUATION COMMAND  
DEVELOPMENT TEST II (EP) - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-109

\*Test Operations Procedure 10-2-214

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LARGE CARGO CONTAINERS

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SECTION I  
GENERAL

1. Purpose and Scope. This TOP provides guidance for planning tests of oversized cargo containers, including those of military interest in the American National Standards Institute (ANSI)/International Standards Organization (ISO) family of cargo and intermodal containers and other special large cargo containers. Test objectives are to determine conformance of the test items to ROC's/DP's or other governing documents. The tests in sections II and III are used as applicable to the particular test item and test type. A development test II (EP) test plan will include the subtests that will satisfy criteria of the ROC and test directive.

\*This TOP supersedes MTP 10-2-214, 1 September 1971.

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A development test III test plan will include the subtests pertinent to the contractual provisions of the applicable military specifications and suitability criteria as established by the test directive. This TOP is a basic guide for preparing actual test plans, and procedures may require modification to suit specific test items.

2. Background. The logistic advantages offered by containers in reduced time and costs, protection of cargo, and adaptability to intermodal transport led to their adoption as necessary items in the Army inventory. The military and industry collaborated in developing standards for cargo containers, reflected in the ANSI/ISO MH 5 series of standards, most of which are nominally 8 by 8 feet in cross-section and in lengths of 5, 6-2/3, 10, 20, 30, and 40 feet. Others, of a height of 6 feet 10-1/2 inches, have lengths of 9 feet 7 inches, 7 feet 10-1/2 inches, and 4 feet 9 inches. Examples of military developments are the TRICON (6-2/3 feet long) and the MILVAN (20 feet long). Both of these modular containers are capable of coupling into multiple lengths.

Basic requirements for a container are that it envelop a rectangular volume and have four top and four bottom corner fittings attachable from all exterior sides. The faces of the fittings control the dimensions. Structural deflection or projection under load does not extend beyond the exterior faces of the fittings.

Containers are classified in the following general categories:

- a. Closed Container. Fully enclosed with one or more openings. Openings may be hinged or movable (sliding) doors, or removable panels designed to be load-bearing, watertight, and reasonably airtight. Openings may be at one or both ends, in ends or sides (full or partial), in ends plus an opening in the roof, or a combination of these. If the opening is permanently open, it may be covered with a tarpaulin.
- b. Closed Container (Ventilated). Similar to the closed container, with similar options on openings, but with additional openings in the side or end walls for nonforced or mechanical means of ventilation.
- c. Insulated Container. Built with insulated walls, doors, roof, and floor by which heat exchange between the inside and outside can be limited without the use of a source of heat or cold.
- d. Heated Container. An insulated container fitted with a heat-producing appliance capable of raising and maintaining internal temperature.
- e. Refrigerated Container. An insulated container that uses either mechanical or other means to lower and maintain cold internal temperature. Refrigeration equipment may be either fixed or removable.
- f. Open Top Container. With bottom, side, and end walls, but no roof.

g. Platform Container. A loadable platform having the same length and width as the standard container and equipped with at least the standard base corner fittings.

h. Other Open Type Containers. With various roof, side, or end walls omitted, but with base, corner fittings, and appropriate angle structures, frame, and corner fittings.

i. Tank Container. Especially built for distributing liquids or gases in bulk.

j. Special Containers. Especially designed for conveyance of specific commodities, such as the automobile, or containers with gravity or pressure discharge provisions.

(For illustrations of different types of containers, see app. B.)

Characteristics of the ANSI/ISO family of international freight containers are shown in figure 1 and tables 1 and 2. The family consists of two series as follows:

Series 1. Having a uniform cross-section of 2,438 by 2,438 mm (8 by 8 feet), except for the 1AA and Sealand containers which are 2,591 mm high by 2,438 mm wide (8-1/2 by 8 feet).

Series 2. Having a uniform height of 2,100 mm (6 feet 10-1/2 inches) (includes CONEX).

This TOP is a revision of an earlier document and has been prepared as part of a study covered in reference 8 (app. A).

3. Equipment and Facilities. Equipment and facilities are indicated in the applicable paragraphs below and in appendix E.

## SECTION II TEST PROCEDURES

4. Supporting Tests. Subtests (generally in the preferred order of completion) to be considered in preparing a test plan are listed below with references. Procedures are formulated in specific test plans as dictated by directives, ROC's, and other requirements, as necessary to prove technical or operational performance. Primary tests for technical characteristics include those basic to ANSI/ISO requirements (12 through 19 below). Tests for operational performance involve accessory equipment and realistic site exposures (20 through 27 below). Specific tests must be selected to provide the required coverage for specific items.

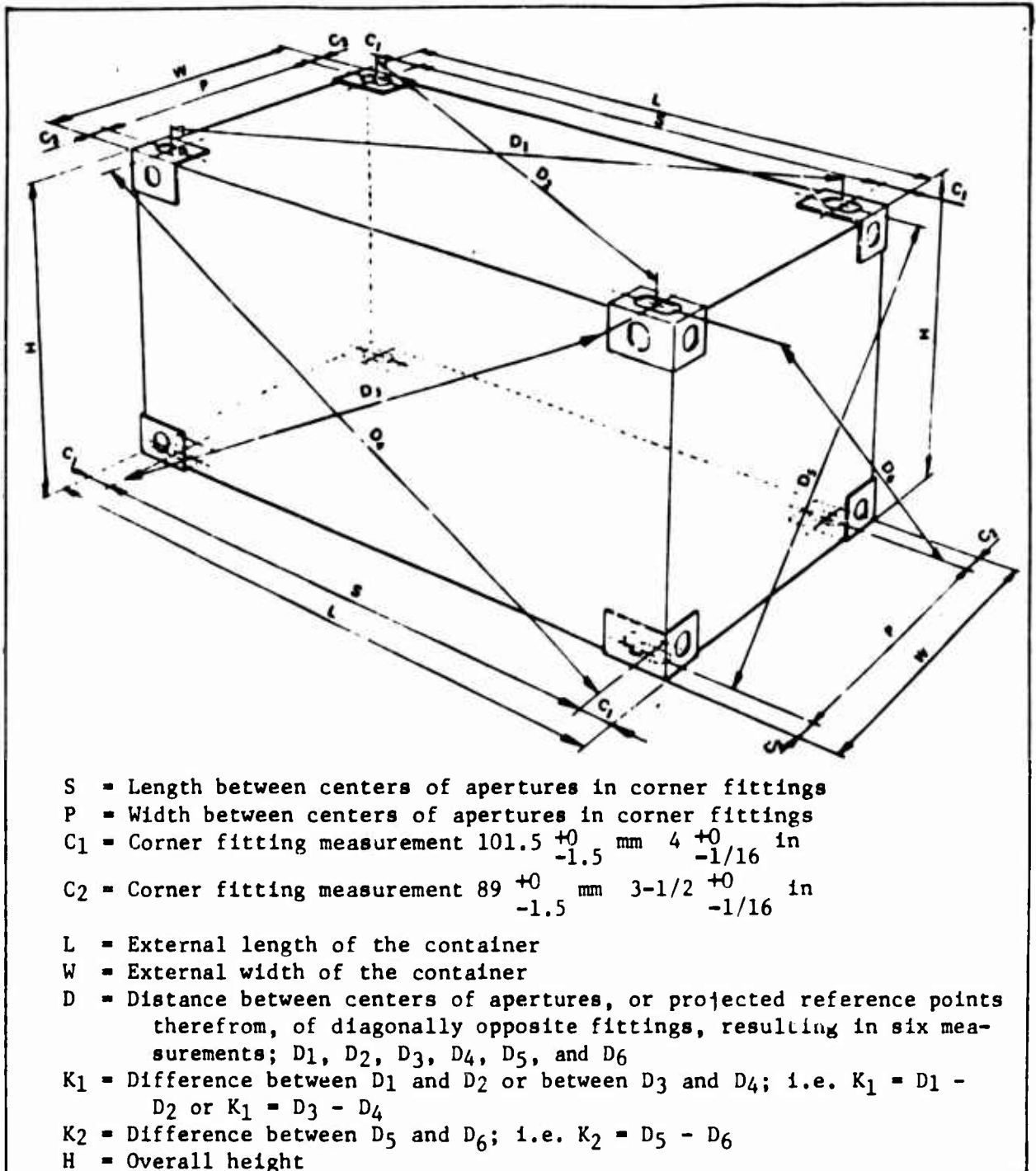


Figure 1. Assembled Corner Fittings - Diagonal Tolerances (See Table 1).

Table 1 - Assembled Corner Fittings (Diagonal Dimensions for Fig. 1)  
(See Also Table 2)

Freight Container Type	Nominal Length, ft.	Sb		Pb		K <sub>1</sub> Max		K <sub>2</sub> Max	
		mm	ft. in.	mm	ft. in.	mm	in.	mm	in.
1A & 1AA	40	11,985	39 3-7/8	2,259	7 4-31/32	19	3/4	10	3/8
Sealand	35	10,464	34 3-7/8	2,259	7 4-31/32	17	11/16	10	3/8
1B	30	8,918	29 3-1/8	2,259	7 4-31/32	16	5/8	10	3/8
Mason	24	7,113	23 4-1/16	2,259	7 4-31/32	14	9/16	10	3/8
1C	20	5,853	19 2-7/16	2,259	7 4-31/32	13	1/2	10	3/8
1D	10	2,787	9 1-23/32	2,259	7 4-31/32	10	3/8	10	3/8
1E	6-1/2	1,765	5 9-3/8	2,259	7 4-31/32	8	5/16	10	3/8
1F	5	1,267	4 1-3/8	2,259	7 4-31/32	7	1/4	10	3/8
2A	10	2,717	8 10-7/8	2,124	6 11-15/32	10	3/8	10	3/8
2B	8	2,197	7 2-3/8	1,924	6 3-15/32	9	23/64	10	3/8
2C	5	1,247	4 7/8	2,124	6 11-15/32	7	1/4	10	3/8

<sup>a</sup>At present this size is not included in the air mode.

<sup>b</sup>Dimensions S and P are reference dimensions only. The tolerances to be applied to S and P are governed by the tolerances shown in table 2 for the overall length (L) and overall width (W).



Table 2 - Actual Dimensions, Permissible Tolerances, and Ratings

Freight Container Type	Length (L)		Width (W)		Height		Rating (Max. Gross Weight)			
	mm	Tolerances, mm	ft.	in.	mm	in.	ft.	in.	kg	tons (1 ton = 2,240 lb.)
1A	12,192	+0 -10	40		2,438	8	2,438	8	30,480	30
1AA	12,192	+0 -10	40		2,438	8	2,591	8	30,480	30
Sealand <sup>a</sup>	10,668	+0 -10	35		2,438	8	2,591	8	25,400	25
1B	9,125	+0 -10	29	11-1/4	2,438	8	2,438	8	25,400	25
Matson <sup>a</sup>	7,320	+0 -10	24	3/16	2,438	8	2,591	8	25,400	25
1C	6,058	+0 -6	19	10-1/2	2,438	8	2,438	8	20,320	20
1D	2,991	+0 -5	9	9-3/4	2,438	8	2,438	8	10,160	10
1E	1,968	+0 -5	6	5-1/2	2,438	8	2,438	8	7,110	7
1F	1,460	+0 -3	4	9-1/2	2,438	8	2,438	8	5,080	5
2A	2,920	+0 -5	9	7	2,300	7	2,100	6	7,110	7
2B	2,400	+0 -5	7	10-1/2	2,100	6	2,100	6	7,100	7
2C	1,450	+0 -5	4	9	2,300	7	2,100	6	7,100	7

<sup>a</sup>At present, sizes for Sealand and Matson are not included in the air mode.

Tolerances for width and height:

bmm = +0      cin. = +0      for 1A through 1F; +3/16 for 2A through 2C.  
 -5                      -3/16                      -0

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<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
a. Initial Inspection and Physical Characteristics (refer to para 9)	ANSI MH 5.1 and others
b. Assembly and Coupling (para 10)	AR 70-44
c. Design Check (para 11)	ANSI MH 5.1
d. Stacking Test (para 12)	ANSI MH 5.1 and 5.4
e. Lifting Test (para 13)	ANSI MH 5.1 and 5.4
f. Restraint Test (para 14)	ANSI MH 5.1 and 5.4
g. Lashing Test (para 15)	ANSI MH 5.1 and 5.1.1
h. Wall Strength Test (para 16)	ANSI MH 5.1.1 and 5.4
i. Roof Strength Test (para 17)	ANSI MH 5.1.1 and 5.4
j. Floor Strength Test (para 18)	ANSI MH 5.1.1 and 5.4
k. Racking Test (para 19)	ANSI MH 5.1 and 5.1.1
l. Compatibility (para 20)	ANSI MH 5.1, AR 70-44, MIL-C-52661
m. Handling Equipment (para 21)	ANSI MH 5.1
n. Engagement, Lift, and Tiedown (para 22)	MIL-STD-209 and -814
o. Cargo Loading Adaptability (para 23)	ANSI MH 5.2
p. Intermodal Transfer (para 24)	AR 70-44, TB 55-100
q. Pendulation (para 25)	FED-STD-101
r. Shipping and Handling (para 26)	ANSI MH 5.1, AR 70-44
s. Environmental Tests (para 27):	MIL-STD-810, AR 70-38
Low Temperature	MIL-STD-810, AR 70-38

<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
High Temperature	MIL-STD-810, AR 70-38
Interior High Temperature	MIL-STD-810, AR 70-38
Snowload	MIL-STD-810, AR 70-38
Salt Fog	MIL-STD-810, AR 70-38
Dust	MIL-STD-810, AR 70-38
Condensation	
Shock	MIL-STD-810
Extended Storage	AR 70-38
Corrosion	
t. Weatherproofness (para 28)	ANSI MH 5.1.1 and 5.4
u. Transportability (para 29)	TOP 1-2-500
v. Logistics-Over-the-Shore (para 30)	TOP 1-2-510
w. Safety (para 31)	AMCR 385-100
x. Human Factors (para 32)	MIL-STD-1472
y. Maintenance Evaluation (para 33)	TOP 1-2-501
z. Kit Applications (para 34)	
aa. Electromagnetic Interference (para 35)	MIL-STD-461 and -462

SECTION III  
SUPPLEMENTARY INSTRUCTIONS

5. Test Planning.

a. Engineering test planning requires review of test guidance literature, familiarization with preceding development and test phases, study

of test criteria, and selection of appropriate samples, methods, sequence, facilities, and test equipment. (See appendix E for information on test facilities.) Standards for the test phases outlined in this section are given in the applicable ROC/DP or test directive as indicated in paragraph 1. Risk/cost and safety provisions must be given prime consideration. Data from previous and similar tests should be considered to avoid duplication and reduce the scope of further testing.

b. The tests described in paragraphs 12 through 19 are minimum basic tests that must be met for purposes of international intermodal shipping. The other tests described, including those in this section, comprise special and required military tests that must be included in test plans.

6. Materials Testing. When required, separate samples of construction materials or components are obtained for laboratory analysis. Depending on requirements and directives, special shop or laboratory tests for determining or diagnosing strain, fatigue, or material characteristics are performed as described in the following TOP's:

Metallurgical and Mechanical Tests of Materials	3-2-806
Nondestructive Testing of Materials	3-2-807
Material characteristics (weights, dimensions, etc.)	1-2-504

Data include the various measurements, diagnoses, and findings obtained from the investigations, with identity of materials or components affected, circumstances requiring the investigation, and results.

Characteristics undetermined, in question, or subject to verification are confirmed by comparisons of the collected data.

7. Comparative Testing. When requirements documents specify that performance of a container will be equivalent to that of a standard or tested container, tests are selected that will identically reproduce the test conditions of the previous item so that the resulting data can be directly compared. The scope of the tests will depend on the extent of the directed comparison which may be to establish only specific characteristics or complete item performance.

8. Refrigerated Containers. Special purpose containers require specifically planned subtests for fixtures additional to the normal requirements for containers. Typical tests for a refrigerated container as prescribed by the American Bureau of Shipping (ABS) include an air leak test and a heat transfer test (ref. 11, app. A). The manufacturer's certification that such tests have been successfully completed should be obtained.

## 9. Initial Inspection and Physical Characteristics.

9.1 Objective. To determine condition as received, basic weight and measurement data, inventory, descriptive data, and quality characteristics of the container.

9.2 Standards. Figure 1, tables 1 and 2; pertinent ROC/DP, MIL-C-52661 or other procurement specification.

9.3 Method. The following inspections are made:

a. Damage. A visual inspection is made of the containers on the railcar, truck, or transporter on which they are received to assure that no damage occurred in shipment and that they were properly secured in shipment.

b. Finish and Markings. The general appearance of the finish is noted, particularly for adequate coverage of the paint and undercoating. The markings on sides, ends, and roof are checked with specified requirements. The interior stamping of the control number is found and recorded. If marking plates are used on the sides and ends, the adequacy of their attachment is noted.

c. Basic Construction. The basic type of construction and basic materials (steel, aluminum, plywood, fiberglass) used for major components are noted. Any accessible recesses or voids are located and reported. The side and front wall posts and seams in the wall panels are located. The plywood liner, if the container is so equipped, is examined to assure that the panel ends and joints are attached to structural members and that there are no protruding ends of the plywood panels. The kick plates, if the container is so equipped, are examined to see that they are securely attached to the plywood liner. Any protrusion of the sides or ends beyond the corner fittings is reported. Any sharp edges or other safety hazards are noted.

d. Floor. The appearance of the interior floor is noted. The width and length of the floorboards are noted. Any loose floorboard screws are found and tightened. The threshold plate is examined to see that it is adequately secured. The number, type, and spacing of floor crossmembers are noted. The welds, or other means of attachment, of the crossmembers to the lower side rails are examined for sound appearance. Any protrusion of the lower side rails, end sills, or crossmembers below the plane of the bottom surface of the corner fittings is reported. Skids, forklift pockets, or other materials handling equipment (MHE) access slots are noted as to number and spacing.

e. Roof. The outer and inner appearance of the roof is noted, particularly any seams in the roof sheet. Any likelihood of puddles forming on the roofs is noted. The bows are examined to see whether they are arched and whether the roof is bonded to the bows or, if not

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bonded, whether provision is made to prevent chafing. Any protrusion of the roof beyond the plane 1/4 inch below the top surface of the corner fittings is noted.

f. Doors. The doors and door hardware are inspected. The doors are opened and closed and it is noted whether one man can unlock the doors without tools and how easily the doors swing. The doors are opened against the sides of the containers and secured in the full open position. The location of the door-lock handles is noted. The appearance of the door seals is noted with particular attention to how securely the seal is mounted, whether the seal is buckled and any tendency of the seal lips to separate from their seats. The presence of graphite grease on the moving parts of door hardware is noted. Any hardware not secured against pilferage is reported (i.e., the nuts, bolts, and hinge pins should be secured by tack welding). Adequate recessing of the hinges is noted. The document holders are inspected for compliance with requirements.

g. Corner Fittings. The corner fittings are examined. The visible welds attaching the corner fittings are inspected for sound appearance. Overhang of the rear (door-end) corner fittings is noted. The proper stowage of spacer blocks, couplers, or mechanical dunnage, when provided, in each container is noted. The items, when furnished, are placed in their apertures to check proper fit.

h. Special Purpose Containers. If special purpose containers are provided, this fact is noted, and the inspection is modified as appropriate to accommodate the special features.

i. Inventory. Completeness of the inventory is assured, including the maintenance test package, kits, interior cargo tiedown systems, etc.

j. Failure Criteria. Each container is checked against any stated inspection failure criteria to be sure that the containers meet passing requirements before exposure to performance tests.

k. Weights, Measurements, and Photographs. The empty containers are weighed to obtain the actual tare weights. The overall outside dimensions, inside dimensions, door and opening dimensions, and corner fitting dimensions and distances are measured and compared with figure 1 and tables 1 and 2. Sufficient general view photographs are made to define the containers. Included are such views as both ends, side, top, bottom, three-quarter front, three quarter rear, and three-quarter rear with doors open. The containers are also photographed on single and coupled chassis where applicable. The characteristics photograph includes a tabulation of pertinent data such as exterior dimensions, interior dimensions, tare weight, maximum gross weight, shipping cubage, ISO class, and type of construction.

9.4 Data Required. The results of the inspection described above are recorded.

9.5 Analytical Plan. Observations and data are compiled and evaluated to insure that containers were received in good condition, that required quality provisions were met, and that descriptive data were obtained for purposes of AR 70-44 and other documentation.

## 10. Assembly and Coupling.

10.1 Objective. To determine proper functioning of sectionalization or knockdown provisions of the container.

10.2 Standards. As stated in the ROC/DP or military specification, and AR 70-44.

10.3 Method. Any unassembled components of the container are assembled following instructions in the applicable technical manual, including any sectionalized or knockdown provisions, end posts for flat racks, and internal tiedown or dunnage systems. After installation, functioning of the assembled part is observed and checked. Components are disassembled and stowed in appropriate positions provided.

Containers designed for coupling are coupled in each possible arrangement (fig. 2). Adjustable couplers are tightened to form a slack-free connection with spacer blocks to provide  $3 \pm 0/-1/16$  inches of spacing between containers.

Ease of assembly and disassembly is noted. Measurements are taken of assembled and sectionalized configurations.

10.4 Data Required. Any deficiencies of fit or difficulty in assembly or disassembly is described. Adequacy of instructions and time to accomplish procedures are recorded. Weights and measurements are recorded for major sections and for assembled and knockdown configurations.

10.5 Analytical Plan. Data are tabulated, summarized, and evaluated for compliance with requirements, and compiled for information required by AR 70-44.

## 11. Design Check.

11.1 Objective. To assess design characteristics of the container versus the basic requirements of ANSI, ISO, and ABS standards for the specified intermodal applications.

11.2 Standards. As stated in the ANSI MH 5 series or the ABS guide.

### 11.3 Method.

a. All available data, drawings, descriptions, and specifications on the container are reviewed and compared against the basic design requirements of the standards.

	<p><u>Nominal Length</u> 40'</p> <p><u>Actual Length</u> 40' +0" -3/8"</p>
	<p><u>Nominal Length</u> 30' 10'</p> <p><u>Actual Length</u> 29'11-1/4" +0" -3/8" 9'9-3/4" +0" -3/16"</p>
	<p><u>Nominal Length</u> 20'</p> <p><u>Actual Length</u> 19'10-1/2" +0" -1/4"</p>
	<p><u>Nominal Length</u> 10'</p> <p><u>Actual Length</u> 9'9-3/4" +0" -3/16"</p>
	<p><u>Nominal Length</u> 6-2/3'</p> <p><u>Actual Length</u> 77-1/2" +0" -1/16"</p>

Figure 2. ANSI Standardized Container Length Combinations.

b. Any deviations, differences, or additional requirements imposed by ROC/DP or military directives are noted.



c. Design capabilities of the container are checked against the specific standards for that container and modes of transport to determine potential problem areas.

d. The assumptions of ANSI MH 5.1 in respect to use of static in lieu of dynamic tests are studied for applicability to the test item to determine whether any of the directed tests may exceed the assumed conditions. If any special diagnostic or analytical tests are needed prior to continuing the normal sequence of testing, appropriate tests should be arranged.

11.4 Data Required. Detailed design data are required for comparison against basic requirements of the standards. (For primary design data see fig. 1.)

11.5 Analytical Plan. The study will use available data, data easily obtained by observation or measurement, and known characteristics. If extensive diagnosis is indicated, it is scheduled as part of later testing.

## 12. Stacking Test.

12.1 Objective. To assure conformance with compressive strength requirements of containers, simulating the combined dynamic (ship heaving) and static loads imposed on a container at the bottom of a cell in a containership.

12.2 Standards. Containers must be capable of being stacked six high, with gross weight per container equal to 1.8R (ANSI MH 5.1 and 5.4) while supported as indicated in 12.3 below. This test will also more than satisfy the lesser requirements of ABS and AS 832.

### 12.3 Method.

#### 12.3.1 Preparation of Test Container.

a. The container is placed on four level pads, one centered under each corner fitting. The pads have the same area dimension as the corner fittings.

b. The container is loaded uniformly to achieve 1.8 times its maximum gross weight (1.8R). The payload is computed as follows:

$$P = R - T$$

where

P = maximum payload

R = maximum gross weight

T = tare weight

(The 0.8R overload is used to simulate the acceleration on containers caused by the heaving of the ship during rough weather.)

12.3.2 Stacked Container Method.

- a. Five similar containers (facility containers) are uniformly loaded to the same gross weight as the test container, i.e., 1.8R.
- b. The first facility container is placed on the test container so that its corner fittings are resting on the corner fittings of the test container, with each container fitting offset 1 inch laterally and 1-1/2 inches longitudinally in the same direction.
- c. The remaining four loaded facility containers are stacked on top of the first facility container so that the corner fittings are centered on each other.
- d. The test container is left under this maximum load condition for not less than 5 minutes.

12.3.3 Pallet Method.

- a. A pallet is constructed to be substituted (loaded) for the load of five stacked containers (12.3.2 above). The pallet must have four properly located blocks to simulate container corner fittings, and the beams of the pallet must have sufficient strength to support the test load without excessive deflection.
- b. Sufficient material is assembled to make a load, including the pallet, of nine times the maximum gross weight (i.e., 9R) of the container under test.
- c. The empty pallet is placed on the container so that the corner blocks of the pallet rest on the corner fittings of the container, with each corner block offset 1 inch laterally and 1-1/2 inches longitudinally in the same direction.
- d. The load material is placed uniformly on the pallet.
- e. The test container is left in this maximum load condition for not less than 5 minutes.

12.3.4 Individual Corner Structures Method. Since the stacking test is primarily a test of the integrity of the corner structures, the corner structures may be tested individually.

- a. To determine the load to be applied to the individual corner structure, nine times the gross test container weight is divided by four (i.e.,  $9R/4$ ).
- b. Several methods may be used to apply the load:
  - (1) Place the corner structure to be tested in a compressive testing machine if a large enough machine is available.

(2) Construct a fixture that can fit over one corner diagonally so that the compressive force is applied with a calibrated hydraulic ram.

(3) Use a fixture built of beams with a crossbeam over the end of the container. Place a calibrated hydraulic ram between the crossbeam and one of the corner fittings under it. Place a steel pad, with the same area as the corner fitting, between the corner fitting and the beam, with the pad offset 1 inch laterally and 1-1/2 inches longitudinally. Adjust the ram position to the center of the pad. Apply the required load with the ram.

c. The test container is left under this maximum load condition for not less than 5 minutes.

12.3.5 Stacking Test for Coupled Containers. If the containers are designed for coupled use, the stacking test is conducted in the coupled configuration, or a load equivalent to that computed for coupled service is applied to a single container corner post.

a. The load to be stacked on the test containers is computed using the maximum gross weight of a single container of equivalent length to the coupled containers as a basis. This load is supported by the four outer corner structures with no load applied to the corners at the coupled positions.

b. The test is conducted by one of the methods described above.

12.3.6 Requirements.

a. While each of the above loads is on the test container, any deformation and any tipping of the corner fittings is noted.

b. After the compressive load is removed, the structure is examined for permanent deformation and weld failures. Any deformation that persists for 2 hours after removal of the load is considered permanent.

12.4 Data Required. Recorded data include gross weight of each loaded container in pounds, the test load on each corner, the measured load offset (inches), any permanent deformation (extent and location), and any weld failures.

12.5 Analytical Plan. Data are analyzed to insure the absence of permanent deformation or abnormality, and that tolerance requirements affecting handling, securing, and interchange of containers are satisfied.

13. Lifting Test.

13.1 Objective. To determine the ability of a loaded container to withstand forces encountered during lifting.

13.2 Standards. ANSI MH 5.4 and ABS are satisfied if the container is loaded to twice its maximum gross weight (2R) and lifted as described in 13.3 below. Requirements for ANSI MH 5.1 and AS 832 are the same except that: (a) if the container is to be rotary-wing lifted, a load of 2.5 to 2.75 R is required for 10-foot containers and 2.67R for 20-, 30-, and 40-foot containers; (b) for lifting from the top all containers 10 to 40 feet long are lifted vertically.

### 13.3 Method.

NOTE: These procedures pertain to lifting of the container as a unit by slings. For tests involving individual fittings or specific lift devices, see paras 21 and 22.

#### 13.3.1 Lifting From the Top.

a. For containers of the nominal lengths of 20, 30, and 40 feet, the lifting force is applied vertically to the top corner fittings.

b. Containers 5, 6-2/3, and 10 feet long are lifted with slings, the angle of each leg being at 30° from the vertical.

c. The test container is lifted gently to minimize acceleration or deceleration forces. The container is suspended for not less than 5 minutes. With suitable rigging, the lifting can be performed by cranes or jacks.

#### 13.3.2 Lifting From the Bottom. This test requires the construction of special slings.

a. For containers of the nominal lengths of 10, 20, 30, and 40 feet, the angle of each leg of the sling is 30° from the horizontal; for 5- and 6-2/3-foot containers the angle is 30° from the vertical.

b. The sling and spreader is constructed so that the line of force is no farther than 1-1/2 inches from the outer face of the corner fitting. To meet this requirement when testing the larger size containers it is necessary to construct the sling from structural steel rather than cable since standard cable fixtures are too large to meet the 1-1/2-inch maximum outboard requirement.

c. By the use of cranes or jacks the container is lifted gently to minimize acceleration or deceleration forces and held suspended for at least 5 minutes.

13.3.3 Lifting Tests of Coupled Containers. If the containers are designed for coupled use, the lifting tests are performed in the coupled configuration. The load is computed using the maximum gross weight of a single container of equivalent length to the coupled containers as a basis. The tests are conducted in the same manner as for a single container of equivalent length.

#### 13.3.4 Requirements.

a. While the containers are suspended, the deflections of the bottom side rails and bottom end frame members are measured by use of a taut string and a rule. A taut string is drawn between diagonal bottom corner fittings to be sure that no crossmember deflects below those fittings.

CAUTION: For safety, avoid moving the load or standing under the load.

b. After the containers are returned to the supporting surface, the side rails and side panels are inspected for deformation. Any welds broken during the test are reported.

c. After the lift tests, the containers are unloaded and uncoupled. The side rails are inspected for permanent deformation and the condition of the floor crossmembers is noted.

13.4 Data Required. Collected data include loads lifted (pounds), time suspended (minutes), deflections under load (inches, location), permanent deformation (extent and location), and weld failures.

13.5 Analytical Plan. Data are analyzed to insure that there is no abnormality or deformation rendering the container unsuitable, and that tolerance requirements affecting handling, securing, and interchange are satisfied.

#### 14. Restraint Test.

14.1 Objective. To determine the ability of the container to withstand loads at corner fittings as imposed by restraining hardware on ship decks, railcars, or other carriers.

14.2 Standards. To meet ANSI MH 5.1 and ABS requirements, the container must withstand the 2.5R longitudinal force described in 14.3 below; ANSI MH 5.4 and AS 832 require only a 1.8R force.

14.3 Method. A suitable fixture is required to provide for the securing of the bottom corner fittings through their bottom apertures.

##### 14.3.1 Single Container.

a. The bottom corner fittings at one end of the container are anchored to the fixture.

b. A force equal to 2.5 times the maximum gross weight (2.5R) is applied longitudinally, through the bottom apertures of the corner fittings at the opposite end of the container. The force is applied first in compression, then in tension, for at least 15 minutes each.

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NOTE: As an alternative, the bottom structure of each side of the container may be tested individually. In this case apply half the force used for testing both sides concurrently, or 1.25 times the maximum gross weight (1.25R).

c. The deflection of the bottom rail is measured before the longitudinal forces are applied, during compression, during tension, and after the forces are removed. This is done by stretching a taut string between reference points on the bottom corner fittings and measuring the deflection at the middle of the rail.

d. Any major structural weld failures are noted. (These should be readily apparent.) After the container is unloaded, the bottom rails, side panels, and corner posts are examined for permanent deformation and the welds for small cracks.

14.3.2 Coupled Containers. If the containers are designed for coupled use, restraint forces are computed as stated above but are based on the maximum gross weight of a single container of equivalent length to the coupled containers. The interior load is also based on the maximum gross weight of a single container of equivalent length. A single container may be tested provided that the tensile and compressive loads are applied through the bottom aperture on one end and the end aperture on the other end. The test is conducted in accordance with the procedure in 14.3.1 above.

14.4 Data Required. Collected data include gross container weight (pounds), compressive force (pounds), tensile force (pounds); side rail deflection (inches) for: empty container, loaded container before test, during compressive test, after compressive test, after tensile test, and after unloading; and identification of other deformation or cracked and broken welds.

14.5 Analytical Plan. Deformations and abnormalities are analyzed as to effects on item suitability.

## 15. Lashing Test.

15.1 Objective. To determine the ability of containers or selected panel portions to withstand externally applied forces as occasioned by containers being lashed down in the marine mode.

NOTE: Since test procedures prescribed elsewhere would make the testing for all loads indicated redundant, discretion should be used in selecting the cases to be tested.

15.2 Standards. To meet ANSI MH 5.1 and 5.1.1 requirements, the container must satisfactorily withstand the test of 15.3 below. Closed van containers must be capable of withstanding the full complement of loads defined in figure 3.

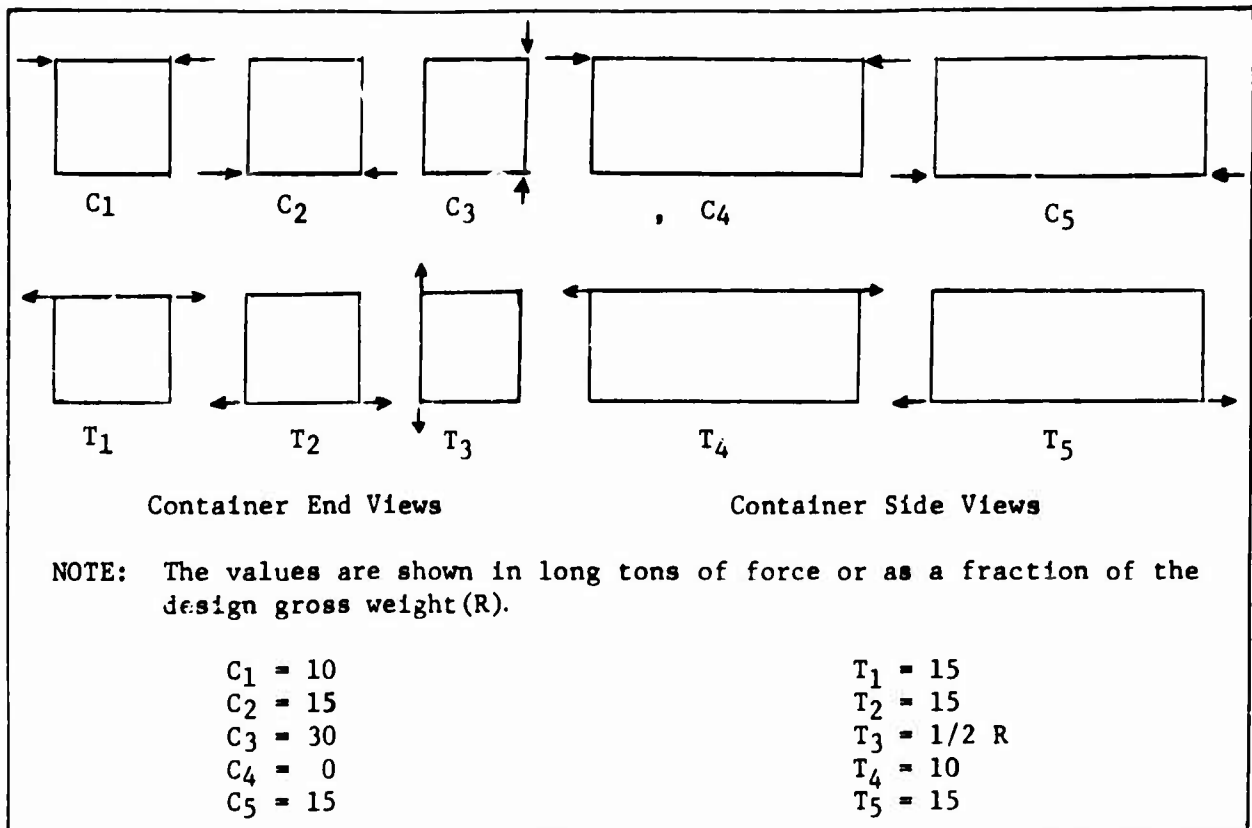


Figure 3. Externally Applied Corner Loads (Forces) Acting Parallel with the Longitudinal, Lateral, and Vertical Axes. (Loads and reactions are considered to be in line.)

### 15.3 Method.

NOTE: A complete container need not be used for this test. A wall panel or basic structure of a wall may be tested.

a. The empty container is placed so that it rests on all four bottom corner fittings supported by rigid pads lying in the same horizontal plane.

b. A compressive or tensile force having a magnitude and direction as given in figure 3 is applied successively to the appropriate corner fittings. The forces are applied to the two corner fittings that are in line with the structural member under test, and are induced through the face of the corner fitting that is perpendicular to the structural member. The forces must be applied and removed gradually.

15.4 Data Required. Data include: identity of specific structure tested, lashing force and direction, identity of corner fittings under stress, permanent deformation, and presence of defective welds.

15.5 Analytical Plan. Deformations and abnormalities are considered against specified tolerances to determine whether the container satisfies the requirements.

16. Wall Strength Test.

16.1 Objective. To determine the ability of container walls to withstand forces occasioned by shifting cargo, as against sides and ends during ship transport or ends during rail transport.

16.2 Standards. ANSI MH 5.1.1, ANSI MH 5.4, ABS, and AS 832 all contain standards for wall testing. Options and alternative procedures are permitted. Options permit forces by weighting (water), pneumatic applications, or mechanical applications. Containers may be upended and vertically weighted, or latched in normal position with force horizontally applied. ANSI MH 5.1.1 and AS 832 specify latching down to simulate the air mode as indicated in 16.3.2 below. The procedure of 16.3.1 below will meet the requirements of ANSI MH 5.4 and more than meet the requirements of ABS.

16.3 Method.

16.3.1 Test to Satisfy ANSI MH 5.4.

16.3.1.1 Preparation for Test. A plastic bag filled with water is the load force in this test. The container is closed.

a. A 6-inch hole is cut in the center of the floor of the container as an entry point for water for the interior load and for removing the water.

b. The roof must be reinforced since it is not expected to withstand the interior load the water bag will place upon it. For the end wall tests the side walls are reinforced too, if necessary. (The method of reinforcement depends upon the roof and side panel design.)

c. A plastic bag is inflated with air and placed in the container against the side or end of the container to be tested.

d. The container is placed test side (or end) down, with the two bottom test side (or end) corner fittings resting on pads on a level beam and the two top test side (or end) fittings suspended in space. To stabilize the cantilevered container, suitable rigging is attached to the other two nominal bottom fittings which are now on top (fig. 4).



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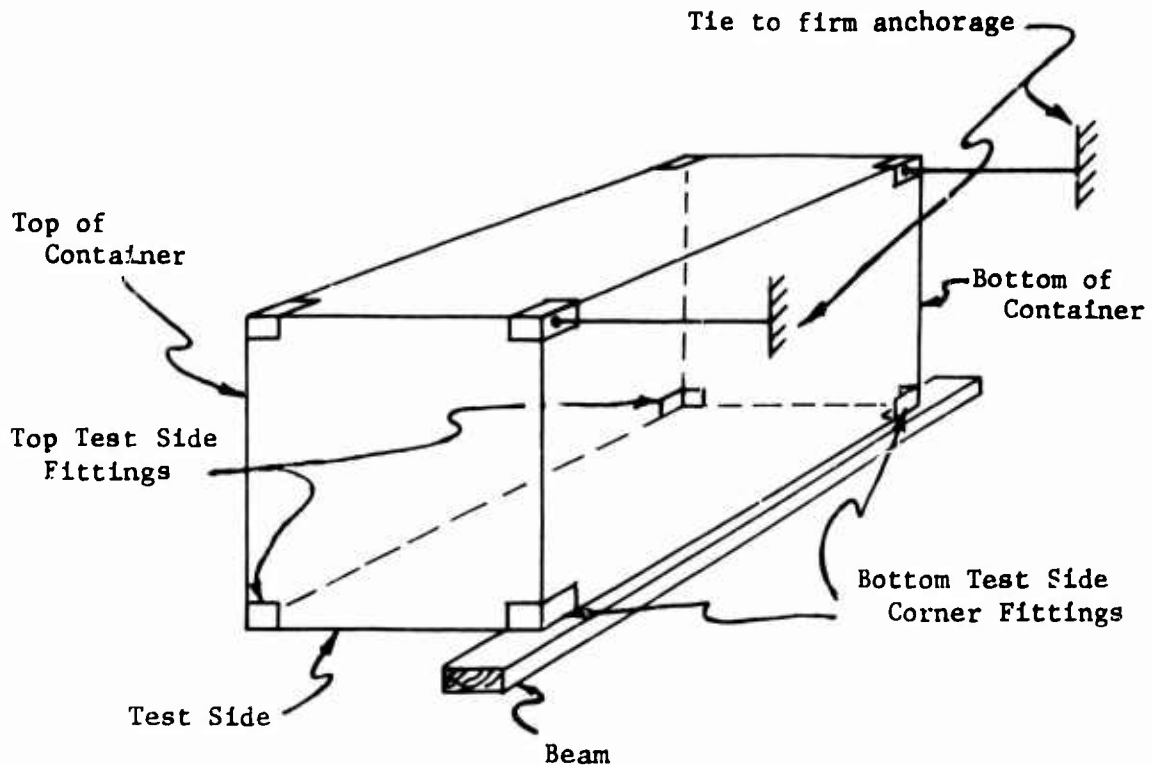


Figure 4. Setup for Wall Strength Test.

NOTE: The supporting pads must be thick enough to allow the sides of the container to cantilever freely in space when loaded as specified.

e. A water pump must be at the test site, checked for serviceability and primed.

16.3.1.2 End Wall Strength. When one end of the cargo container is blind and the other equipped with doors, both ends are tested; when both ends are identical, only one end need be tested.

a. With the container front end down, supported on level pads placed under the end faces of the two bottom corner fittings and rigged as described in 16.3.1.1d above, the amount of water required is computed and weighed, using  $P = R - T$  (para 12.3.1b).

NOTE: For 10-, 20-, 30-, and 40-foot containers the test load is equal to 0.4 times the maximum payload (0.4P); for 5- and 6-2/3-foot containers the test load is equal to 0.6 times the maximum payload (0.6P).

b. The plastic bag is filled with the required amount of water and the load imposed for 5 minutes. The water is then pumped out with the pump.

c. The container is righted and the front end wall checked for deformation, particularly as to whether the wall extends beyond the corner fittings. The end panel welds and welds in the front structure are examined for cracks.

d. If the door end is being tested, the doors and door frames are inspected. Any difficulty in operating the door lock mechanisms and in swinging the doors is reported.

16.3.1.3 Side Wall Strength. This test is similar to the end wall tests except that the plastic bag covers the wall area, the container is placed side down, and the loading is different. If both side walls are of the same construction, only one side is tested.

a. With the container test side down, supported on level pads placed under the side faces of the two bottom corner fittings and rigged, the amount of water required is computed and weighed.

NOTE: The test load is equal to 0.6 times the maximum payload (0.6P).

b. The plastic bag is filled with the required amount of water and the load imposed for 5 minutes. The water is then pumped out.

c. The container is righted and the side wall checked for deformation, particularly as to whether the wall extends beyond the corner fittings. The side panel welds and welds in the side structure are examined for cracks.

#### 16.3.2 Test Simulating Air Mode.

##### 16.3.2.1 End Wall Strength and Longitudinal Restraint.

a. The container under test is latched to the aircraft restraint system or its equivalent, engaging the load bearing latches on one side and adjusting by suitable means to assure contact with the end of the latch receptacle slot (table 3). Figure 5 shows the spacing for air mode restraint slots.

Table 3 - Number of Latch Receptacle Slots per Container Size

Length of Container		No. of Slots
ft	m	
10	3.05	2
20	6.10	5
30	9.14	8
40	12.19	11

b. A longitudinal force equal to the gross weight of the container is distributed evenly over one end panel and applied for 5 minutes. After the force is removed the container is examined to assure that there is no permanent deformation or failure on any portion of the container.

c. If the structure is not identical, both end panels are tested for restraint and panel load in the same manner.

d. The test is repeated using 10-foot containers and restraints in the fore and aft slots only.

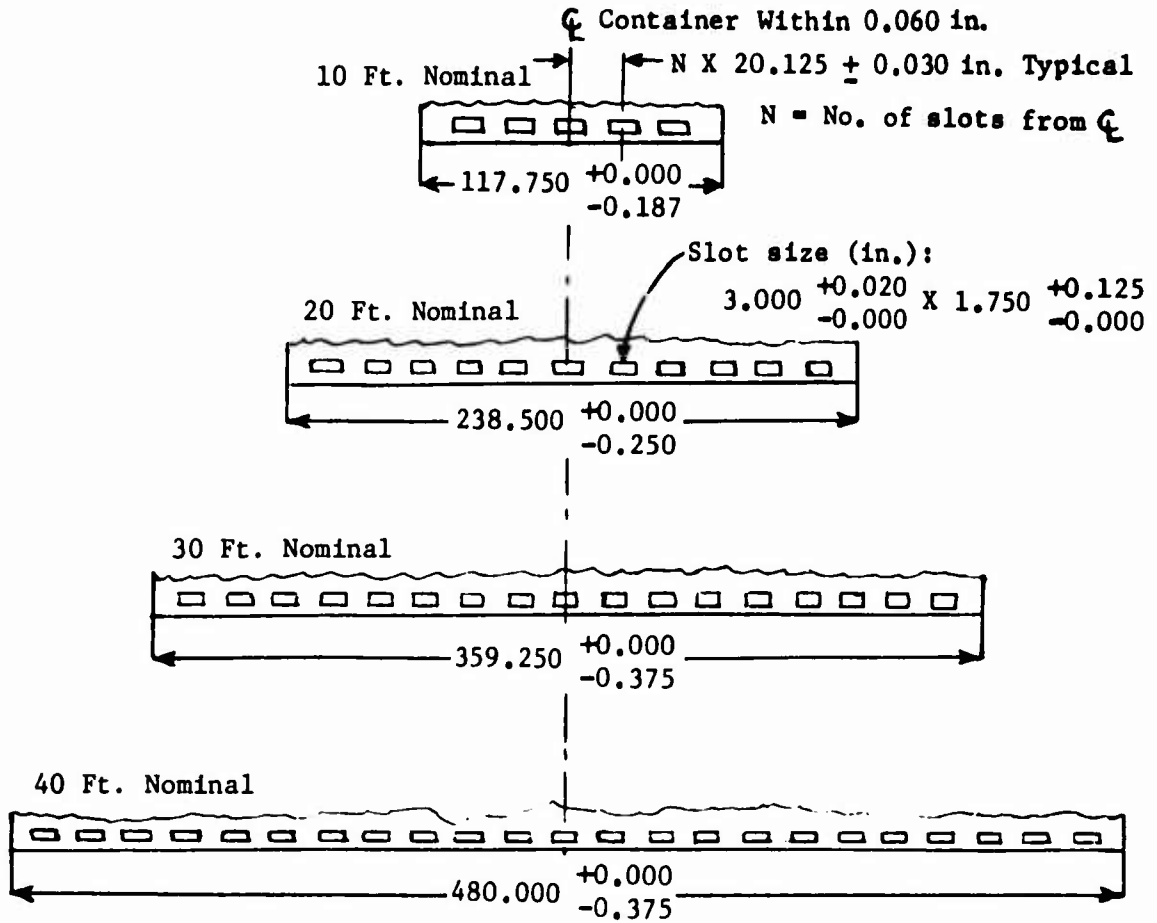
#### 16.3.2.2 Side Wall Strength and Lateral Restraint.

a. With the container on the aircraft restraint system or its equivalent, 50 percent of all the latches equally spaced on both sides are engaged and adjusted by suitable means to assure vertical restraint.

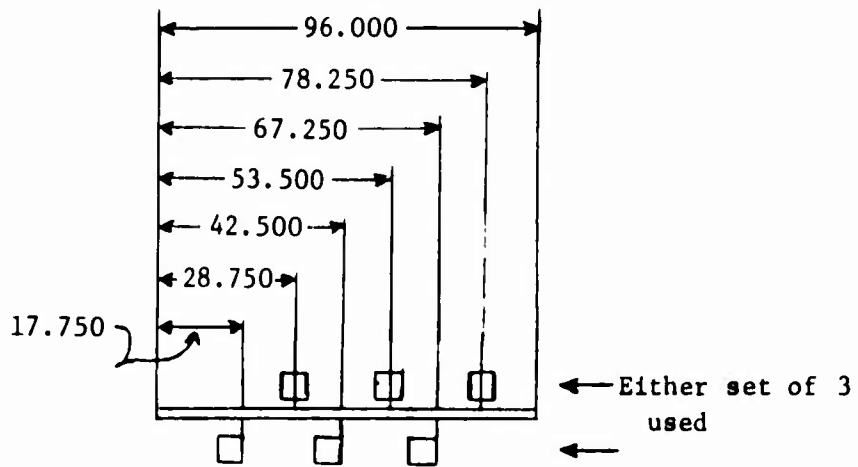
b. A lateral force equal to the gross weight of the container is applied uniformly over the inner surface of the side panel for 5 minutes. (The loading method of 16.3.1.1d above may be used.) After the force is removed the container is examined to be sure that there is no permanent deformation or damage and that the deflection at the intersection of the top and side panels does not exceed 1.5 inches.

16.4 Data Required. Data include container tare weight (pounds), actual test loads (pounds), duration of load applications (minutes), any permanent deformation, any weld failures, and any effects on operation of closures, locking, or latching mechanisms.

16.5 Analytical Plan. Data are analyzed to insure no abnormality or deformation in excess of tolerance requirements.



Side Restraint Locations



End Restraint Locations

Figure 5. Restraint Slots Location for Air Mode.

## 17. Roof Strength Test.

17.1 Objective. To determine the ability of the roof structure to withstand expected dynamic and static forces as occasioned by two 220-pound men walking on the container roof, and by inverted air mode position.

17.2 Standards. To meet the requirements of ANSI MH 5.1.1, ANSI MH 5.4, ABS, and AS 832, the containers must satisfactorily pass the test of 17.3 below.

### 17.3 Method.

#### 17.3.1 Test With 660-Pound Load.

a. A test load is prepared by attaching a steel weight to a 24-by 12-inch piece of plywood. The weight is adjusted so that the total test load weight will be 660 pounds. (This assumes that the 440-pound static weight of two men is increased 50 percent through the motion of walking.) An eye is welded to the test load for convenient handling.

b. The test load is placed gently on the roof of the container at its weakest area. (Since the weakest area is likely to be between the bows, the load is centered between the bows front to rear and side to side.) The load is oriented with the short, 12-inch side parallel to the longitudinal axis and rested on the roof for at least 5 minutes.

c. After the load is removed, the roof and roof structure are inspected for deformation and cracked welds, and any sagging of the roof is reported.

#### 17.3.2 Test Simulating Air Mode (Roof Strength and Vertical Restraint).

a. The container is suspended upside down from the aircraft loading system or its equivalent.

b. Fifty percent of the total number of latches equally distributed on both sides (fig. 5) are engaged and adjusted by a suitable means to assure contact when the load is applied.

c. A load equal to the gross weight of the container is distributed uniformly over the inside of the roof.

d. The test is repeated using 10-foot containers and restraints in the fore and aft slots only.

17.4 Data Required. Data include test load (pounds), test load area (square feet), duration of load application (minutes), location of test load on roof, resulting deformation or cracked welds.

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17.5 Analytical Plan. Data are analyzed to insure no abnormality or deformation in excess of tolerance requirements.

18. Floor Strength Test.

18.1 Objective. To determine the ability of the container floor to withstand a static load simulating the dynamic effect of the maximum payload moving upward at 1 g, and the dynamic effects of a loaded forklift operating within the container.

18.2 Standards. To meet the requirements of ANSI MH 5.1.1, ANSI MH 5.4, ABS, and AS 832, the containers must satisfactorily pass the appropriate test of 18.3 below.

18.3 Method.

18.3.1 Tests for Ground and Water Modes.

18.3.1.1 Static Floor Load Test.

a. The container is placed with its corner fittings resting on oak blocks on a level surface.

b. The container is loaded with two times the maximum payload (2P), with the load uniformly distributed as follows:

20 percent over the first 25 percent of length from the front wall.

60 percent over the center 50 percent of length.

The remaining 20 percent over the remaining 25 percent of length from the other end.

c. Unloading is started 5 minutes after the last part of the load is placed in the container.

d. While the floor is under full load, a taut string is stretched between the front and rear corner fittings to judge the deflection of the side rails. The sag of the crossmembers is observed by peering under the container.

CAUTION: Do not put any part of your body under the container.

e. After the load is removed, the side rails, end sills, and crossmembers are inspected for permanent deformation. Any cracked welds are reported. The floor boards are inspected for splitting as well as cross-grain cracks.

18.3.1.2 Dynamic Floor Load Test. This test is performed on 10-, 20-, 30-, and 40-foot containers with end doors. The test facility is a two-wheeled dolly, with a long drawbar, built to simulate an industrial truck with a 12,000-pound axle load; the wheels are spaced on 30-inch centers, with wheel width and floor contact area such that floor loading is approximately 1200 pounds per square foot. The container is blocked up at least 2 inches on a level surface (corner fittings resting on oak blocks as above).

a. With the tow vehicle outside, the dolly is moved back and forth over the floor of the container, making at least one pass down each side and one pass down the center.

b. During the test the deflection at the side rails is observed. If any loud cracking noises are heard, the position of the dolly is noted.

c. After the test the side rails and crossmembers are inspected for permanent deformation and broken welds, the floor boards for splits and cracks, and the floor board fastenings for looseness.

#### 18.3.2 Tests for Air Mode.

a. With the container on the aircraft loading system or equivalent, the floor is uniformly loaded to 1200 pounds per square foot. The load is applied to an area 5 feet wide centered in the container, and it equals but does not exceed two times the maximum payload. The container is examined to assure no permanent deformation or damage.

b. The container is uniformly loaded to 0.67 times the maximum operating gross weight and reciprocally cycled 100 times over a substantially level section of the aircraft loading system or equivalent (such as roller conveyor) at a minimum speed of 60 feet per minute. Each cycle is equal to twice the container length. At test speed, drawbar pull of the towmotor or other cycling device is recorded during the first and last cycle. Maximum allowable drawbar pull is 3 percent of the maximum operating gross weight. The maximum variation of drawbar pull from the first to the last cycle shall not exceed 0.5 percent of gross weight.

c. While the container is loaded to 0.67 times the maximum operating gross weight and retained on the aircraft loading system or equivalent, three of the complete cycles in b above are made with the doors fully opened and three with the doors fully closed. Checks are made to insure that the doors open and close with no prevalent binding and the locks engage and disengage with ease.

d. Cargo tiedown rings are tested by applying a 4000-pound tensile load at 45 degrees to the horizontal and vertical planes with the force passing through the ring attachment.

18.4 Data Required. Collected data include tare weight of the container (pounds), test load (pounds), test dolly or forklift axle weight (pounds), side rail deflection under load (inches), deflection of crossmembers if below corner fittings, permanent deformation, weld failures, cracked floorboards, loosening of internal fastenings, and other observed effects.

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18.5 Analytical Plan. Data are analyzed to insure no abnormality or deformation in excess of tolerance requirements.

19. Racking Test.

19.1 Objective. To determine the ability of the container to withstand racking forces as may be imposed on a container lashed to the deck of a rolling and pitching ship or aircraft.

19.2 Standards. The requirements of ANSI MH 5.1, ANSI MH 5.1.1, ABS, and AS 832 are satisfied if the container withstands the test below.

19.3 Method. For this test a suitable fixture is required for securing the container and for applying the test forces to the top corner fittings. The test is conducted near a source of water under pressure.

a. The container is secured to the fixture through the bottom apertures of the four bottom corner fittings and loaded to its maximum gross weight (R). The interior is checked to assure dryness in the door area, and the doors are closed and latched.

b. A hydraulic ram is placed between a top, door-end, corner fitting and the vertical column of the fixture. (See fig. 6 for direction of loads.)

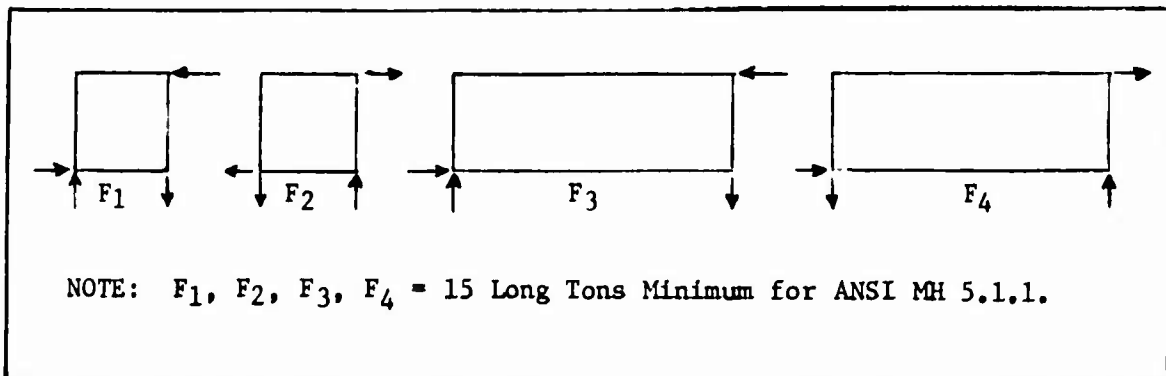


Figure 6. Externally Applied Loads (Forces) to Top Corner Fittings with Reactions Taken by Bottom Corner Fittings.

c. A lateral pushing force (see note) is applied to the corner fitting for 5 minutes. At the same time, the door seals are sprayed by the method described in the weatherproofness test (para 28).

NOTE: For ANSI MH 5.1 the force is as specified in the companion document. For ANSI MH 5.1.1 the force is 33,600 pounds. The ABS guide varies the force according to container weight and should be consulted for the appropriate force. ABS requires a force at the top equal to that required to reduce to zero the pressure between the bottom of the container and



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the aircraft system on the side opposite to that which is restrained against sideways movement.

d. The force is removed and the container inspected as indicated in 1 below.

e. The hydraulic ram is moved to the other side of the container and the test repeated (including the water spray), racking the container laterally in the opposite direction. The force is removed and the container inspected as before.

f. A removable bracketed beam is attached to the superstructure of the fixture. The hydraulic ram is mounted between the corner fitting and the beam. The container is racked longitudinally with the longitudinal pushing force for 5 minutes while the door seals are water sprayed. The force is removed and the container inspected.

g. The hydraulic ram is moved to the opposite top corner fitting of the door end of the container, and this corner is subjected to the longitudinal racking test and spraying.

h. After both top corner fittings of the door end have been racked laterally and longitudinally, the position of the container in the test fixture is reversed and similar racking tests are performed on the front end of the container. During the test of an end without doors, no water spray is used.

i. After each phase of the racking test the container is inspected as follows:

(1) Note whether the container assumes its original attitude when the force is removed.

(2) Open the doors and note ease of operation of the door latches and hinges.

(3) Examine the interior in the door area for the presence of water which would indicate leakage of the seals. Weeping of moving seals during the racking is permitted provided that the runoff does not contaminate the cargo.

(4) Inspect the door hardware for movement and for any cracking of the tack welds that secure the attaching hardware and hinge pins.

(5) Examine the structure of the door frames for cracked welds and permanent deformation.

19.4 Data Required. Collected data include container gross weight (pounds); racking forces (pounds), point of application, and direction; water nozzle diameter (inches), distance from test section (feet), and water pressure

(psig); effects on doors and openings (ease of operation, misalignment, functioning of hardware); permanent deformation, cracks in welds or structure, water leakage.

19.5 Analytical Plan. Data are evaluated to assure that prescribed forces are endured without permanent deformation or leakage.

## 20. Compatibility.

20.1 Objective. To determine the capability of the container to mate or interface with other containers, transporting media, and handling equipment.

20.2 Standards. The requirements of ANSI MH 5.1, MIL-C-52661, and AR 70-44 are satisfied if the container passes the tests below.

### 20.3 Method.

20.3.1 Coupling. If there is a requirement for coupling, the containers are checked for compatibility with each other. The containers are coupled in each possible arrangement, both loaded and empty. Any difficulty in coupling is reported.

20.3.2 Semitrailers. If the containers are to be hauled on semitrailers, they are installed on semitrailers, then removed, and any difficulty with alignment and any interferences are reported. The requirement may be to haul the containers coupled or to haul them uncoupled on coupled semitrailers. Each applicable combination is tested; for example:

A chassis conforming to MIL-S-62076, type 2 is used for this test. The chassis is of a design that requires transmission of compressive stress through the roof rails of the containers. Bogies are placed in the most rearward position. A commercial truck-tractor may be used for the test.

Single (20-foot) configuration. A 20-foot container is mounted on a single chassis with tandem bogie, uniformly loaded with a 40,000-pound payload, and towed not less than 20 miles on hard surface roads and not less than 30 miles on secondary roads.

Coupled (40-foot) configuration. Two 20-foot containers are mounted on two chassis coupled into a 40-foot chassis with tandem bogie on the rear chassis. Containers are coupled by attachment of each to a chassis but not by couplers between lower corner fittings. Spacer blocks are used between upper corner fittings of the two containers. Each container is uniformly loaded to a payload of 20,000 pounds. The 40-foot container is towed not less than 20 miles on hard surface roads and not less than 30 miles on secondary roads.

Single (20-foot) configuration at maximum gross weight. A 20-foot container is mounted on a single chassis with tandem bogie uniformly loaded to a gross container weight of 44,800 pounds. The container is towed not less than 1,000 miles at variable speeds up to 70 miles per hour over hard surface roads and not less than 500 miles at variable speeds up to 35 miles per hour over secondary roads.

Coupled (40-foot) configuration at maximum gross weight. Two 20-foot containers are mounted on two chassis coupled into a 40-foot chassis with tandem bogie on the rear chassis. Containers are coupled by attachment of each to a chassis but not by couplers between lower corner fittings. Spacer blocks are used between upper corner fittings of the two containers. Each container is uniformly loaded to a gross container weight of 33,600 pounds. The 40-foot container is towed not less than 1,000 miles at variable speeds up to 70 miles per hour over hard surface roads and not less than 500 miles at variable speeds up to 35 miles per hour over secondary roads.

20.3.3 Handling Equipment. If specific models of handling equipment are to be used with the containers, compatibility with each is checked. This equipment includes spreaders, slings, and lift trucks (para 21).

20.4 Data Required. Collected data include:

For coupling of containers - type of couplers and spacers used, description of arrangements tested, problems encountered in coupling.

For containers and semitrailers - type and model of semitrailers used, any mismatching of container corner fittings with chassis twistlocks, container-related problems in chassis coupling, and description of arrangements of containers and semitrailers tested.

For handling equipment - nomenclature and model of equipment used, any mismatching of container fittings with handling attachments, and any problems of alignment or connection between the container and its handling equipment.

20.5 Analytical Plan. Data are summarized to state shortcomings, deficiencies, and ability to meet required degrees of compatibility. Findings are compared against criteria of the requirements.

21. Handling Equipment.

21.1 Objective. To test the ability of the container to be handled and transported by the various MHE required for intermodal movement.

NOTE: The procedures below are representative and not all-inclusive. Related aspects are also covered in paragraphs 24 and 26.

TOP 10-2-215 (when published) should be consulted. Tests should be selected to suit specific item requirements.

21.2 Standards. The test prescribed in ANSI MH 5.1 is described below.

21.3 Method.

21.3.1 Forklift Pockets. To test the strength of container forklift pockets:

a. Pockets are checked and measured to determine whether they meet the dimensional requirements shown in figure 7. The two inner pockets alone, the two outer pockets alone, or all four pockets may be incorporated in the container as directed by the specific operational loads and handling equipment.

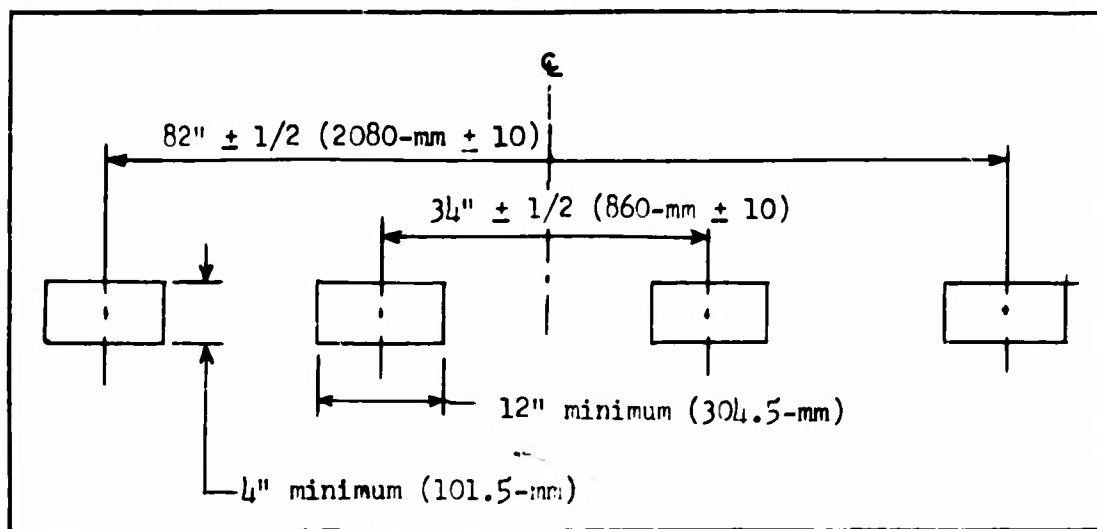


Figure 7. Fork Pockets (Typical Locations).

b. For outer pockets, the container is loaded to the design gross weight,  $R$ , times 1.25 and lifted by two fork tines or equivalent inserted in the outer pockets.

c. For inner pockets, the container is loaded to the design gross weight,  $R$ , times 0.625 and lifted by two fork tines or equivalent inserted in the inner pockets.

d. The lifting load is shared equally by the pockets being used. The load application to the pocket surface or structure by the fork tine is assumed to be uniformly distributed over a minimum area 8 inches wide by 72 inches long measured from the side of the container.

e. After testing, the container is examined to assure no significant deformation.

### 21.3.2 Gantry or Straddle-Lift Handling.

a. The bottom side edges of the container are insured to be clear and unobstructed as shown in figure 8.

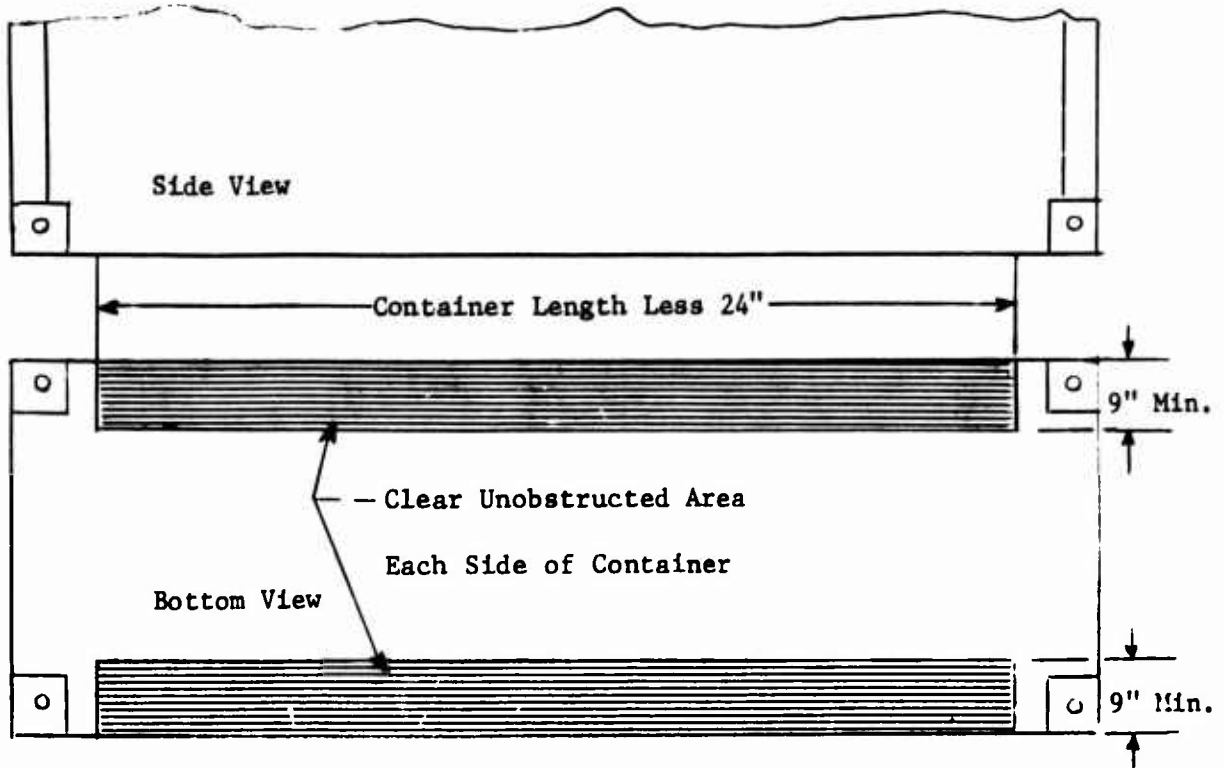


Figure 8. Gantry and Straddle-Lift Handling.

b. The container is uniformly loaded to the design gross weight,  $R$ , times the design load factor and supported equally on four lift shoes (or the equivalent), each having a bearing area of 3 by 24 inches.

c. Lifting forces are applied to the container through four bearing areas at least 24 inches long and not less than 72 square inches in area within each lifting area as specified in figure 8. The four bearing areas share the load equally. It is not necessary that the container structure contact the entire area of the lift shoe or lifting area. The minimum distance between bearing areas on the container or shoes and the lifting gear on each side of the container are assumed to be as shown in table 4.

d. After testing, the container is examined to assure no significant deformation.

Table 4 - Bearing Area Spacing per Container Length

Nominal Container Length		Center-to-Center Spacing of Minimum Bearing Areas (or Shoes)	
feet	mm	inches	centimeters
10 to 15	3048 to 4572	72	182.88
15 to 30	4572 to 9144	120	304.80
Over 30	Over 9144	192	487.68

### 21.3.3 Operational Tests.

a. The container is placed in the load-carrying position of the MHE and any dimensional incongruities are noted and measured. This includes use of tines, toplifting attachments, or other MHE engagement means. Containers may be single unit, coupled, or palletized. Containers may be loaded at various weights up to maximum capacity.

b. The MHE carrying the container operates in a simulated terminals handling environment similar to that shown on figure 9. Operations include storage, stacking, loading, and unloading of semitrailers, trucks, and flatcars, and shorthaul movements over typical terrain.

c. The MHE is required to perform loading/unloading, stacking, and storage operations as required in a forward storage area. The MHE proceeds from the storage area to other testing areas of operation using specified trails. Upon reaching each individual area, the MHE lifts or picks up the container and returns it to the storage area where it is stacked in the position specified by the test director. During the terminals handling test, the MHE is required to stack empty containers three high, loaded containers two high; load flatcars; traverse longitudinal slopes of 25 percent and side slopes of at least 15 percent; and perform left and right turning, full circle, and stopping maneuvers. (Unequal load distribution and stability will not be evaluated during these operations but may be evaluated as described in paragraph 23.)

21.4 Data Required. Data include identity and description of MHE and means of attachment to the container, description and dimensions of forklift pockets and crane-lifting areas, container loads and forces applied, any dimensional problems between container and MHE, need for container attachment or adjustment and time required, carrier stability as affected by the container, ease of loading/unloading from different carriers and time required, cycle times for various terminal operations, and ability of the container to withstand various handling and transport operations.

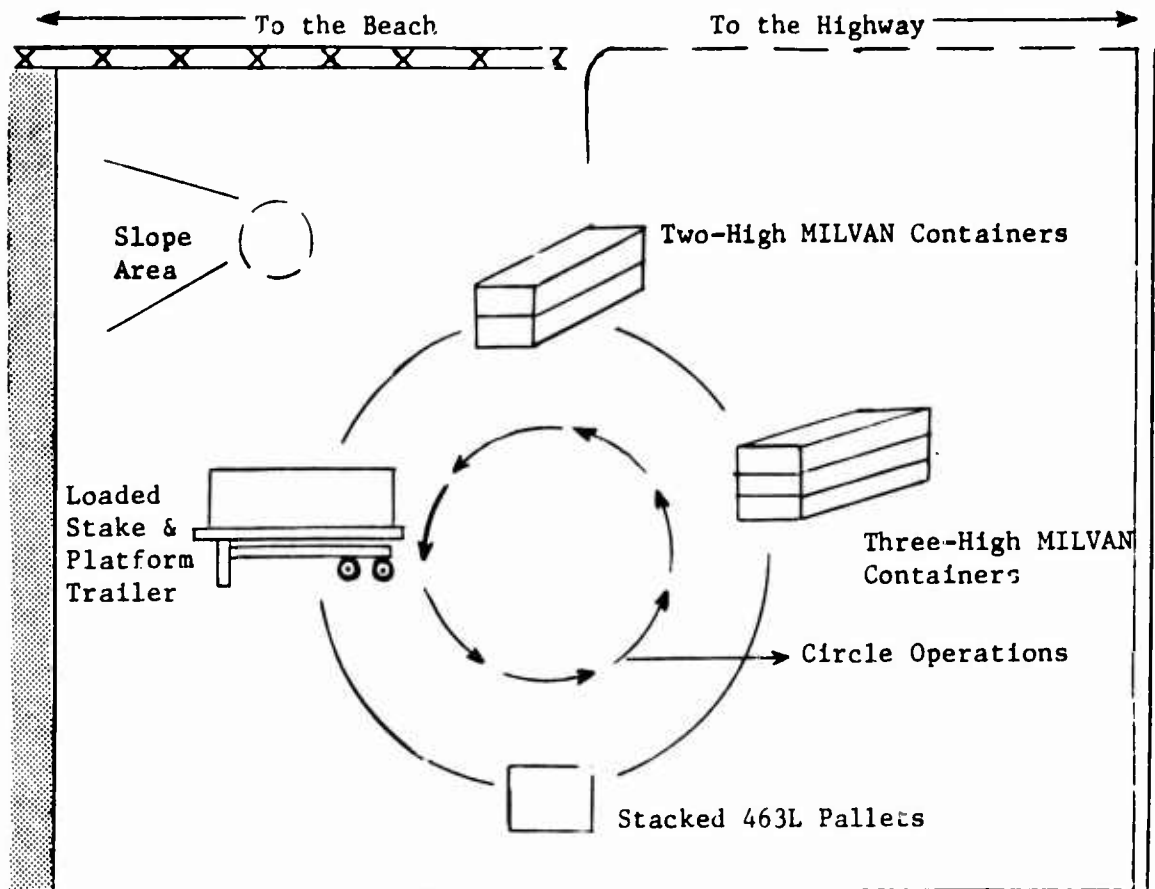


Figure 9. Terminals Handling Operations.

21.5 Analytical Plan. Data are collected in narrative or tabulated form as appropriate, evaluated, and compared against criteria to determine the degree to which the container meets dimensional limitations, functions without deformation or damage, and withstands the handling equipment environment.

22. Engagement, Lift, and Tiedown.

22.1 Objective. To determine whether the container and accessory lifting and tiedown attachments comply with requirements.

22.2 Standards. The requirements of ANSI MH 5.1, MIL-STD-209, and MIL-STD-814 are met if the container successfully passes the test below.

22.3 Method.

a. The specific systems by which the container must be engaged, lifted, and tied down are studied and the specific media required (slings,

pendants, hooks, lashing, and engagement fittings) are determined. Sizes, types, and capacities of the various fittings and gear are measured and noted. Angles and direction of force application at lift and tiedown points are noted. Distribution of gross loading among multiple fittings is computed where applicable. Information is obtained for both external container and internal cargo fittings. (See app. D for types of fittings and devices.)

b. To test lifting attachments or devices the container is securely attached to the tiedown facility (app. E, fig. 19). The fitting or device to be tested is connected by appropriate sling, lashing, and fittings, with a force dynamometer inserted in the line, to the test-prescribed static pull (by crane, hydraulic ram, etc.) in the specified direction. (To gain access to internal fittings, a hole may have to be cut in the container roof.) Minimum force on the fitting is as prescribed by the governing standard for the particular lift or suspension.

c. The container is placed in a sling lift facility (app. E, fig. 22), which permits sling apex heights to 30 feet and lift heights to 30 feet. An actual marine facility will suffice, when available. The container is lifted by the various types of lifting methods and devices shown in appendix D. Lifting and lowering speeds are selected to simulate ship-board and mobile crane handling. Dynamic measurements are made of inertial loads at corner fittings and accelerations of lifted and braked loads.

d. Various information pertinent to container engagement gathered during other test phases (such as paras 21, 24, and 26) is considered during this subtest for overall assessment of devices, to include durability of locks; extent and effects of misalignment and of impacts at hatches, hoppers, cell inserts, etc.; and various mating forces.

22.4 Data Required. Data include number, types, and locations of fittings; dimensional measurements; description of applied forces (extent, direction, point of application); lifting and lowering speeds; inertial forces; acceleration; and observation of differences or advantages of different types of devices, such as ease of securing, utilizing, and releasing.

22.5 Analytical Plan. Measurements and data are compared with requirements to determine to what degree standards are met. Deviations are studied for their impact on transport and use of the container and to permit formulation of corrective measures.

### 23. Cargo Loading Adaptability.

23.1 Objective. To assure that the container satisfies, and is adaptable to, internal loading requirements as stated in governing documents.

23.2 Standards. Success in the test below constitutes meeting the requirements of ANSI MH 5.2 and FM 55-15.



### 23.3 Method.

23.3.1 Cargo Considerations. Based on container capacity and mission, representative cargo density/mix combinations are selected. For special containers, the specific commodity intended (such as ammunition) is used in different load configurations. Types of cargo include: unitized and nonunitized boxes, crates, drums, cans, bulk, pallets, end items, etc. Loading plans are computed to provide specific load characteristics (e.g., off-center, undistributed, distributed). (TOP/MTP 2-2-537 is used for guidance in planning this test.)

23.3.2 Stuffing and Unstuffing. Cargo is loaded in the container, using facilities indigenous to different types of terminals; i.e., marine, air, truck, rail, supply depot, etc. Various MHE, conveyors, ramps, cranes, etc., are used to accomplish different loading patterns and configurations such as packed rear; packed side; and cargo insertion from side, rear, and top. Container internal tiedown and dunnage systems are used to stabilize loads. (MTMTS Pamphlet 55-2, Guidelines for Stuffing Containers should be consulted.) After completion of the tests and examination of cargo, the containers are unloaded.

23.3.3 Dynamic Tests. The center of gravity of each loaded container configuration is determined using the procedures in TOP/MTP 2-2-800. The containers are instrumented at selected internal points on the cargo and restraining systems to provide readings on impacts and accelerations. The containers are subjected to selected transport, handling, and test situations to include: incline/pendulum impacts (para 25), drop tests (para 27), rail hump (para 27), lifting operations (para 13), and mobility (para 29). Tests are conducted in conjunction with other scheduled subtests to the maximum practical extent to obtain the required exposure of cargo to impacts, attitudes, and forces representative of container service conditions. After each transport, handling, and test operation, the cargo and its restraint systems and internal container structure are examined for damage, shifting, effects, and causes.

23.4 Data Required. Recorded data include volumes and weights of cargo; density, center of gravity, and percent of cube utilization for different cargo mixes; descriptions or diagrams of different loading patterns; lists and descriptions of different cargo used; description and effectiveness of different loading methods; types and methods of internal restraint; elapsed time for loading/unloading operations; description and parameters of transport, handling, and test situations used; description of damages and effects, using photography when appropriate.

23.5 Analytical Plan. Data are summarized, tabulated, and evaluated for compatibility of the container's cargo carrying abilities with various classes of cargo and mixtures, with attendant restrictions. Effects and conclusions are analyzed and compared against criteria of the governing documents.

## 24. Intermodal Transfer.

24.1 Objective. To insure that the container is capable of enduring the stress and forces of the interfaces encountered when moved by different modes of transportation.

24.2 Standards. Success in the test below constitutes meeting the requirements of AR 70-44 and TB 55-100.

24.3 Method. The facilities to determine the intermodal transfer characteristics of transported materiel consist essentially of the actual MHE, carriers, and loading facilities pertinent to the modes involved. Table 5 shows typical transfer operations, the types of media used, and the transfer point facility. Table 6 shows the types of equipment needed to effect intermodal transfer operations for the various container interfaces.

The intermodal environments consist of a warehouse, a field supply point, a motor terminal, a port, and rail and air terminals. The various transfer media include forklifts, conveyors, cranes, dollies, carts, and other MHE; special vehicles, ramps, dock cranes, ship's cranes, and lift gear. The ramps are of different types: for the loading of trucks, railcars, and aircraft, and for access by landing craft and amphibians. The provisions for lashing and tiedown differ for the various modes. The containerized cargo may be palletized or in unit loads. Existing facilities permit the makeup and simulation of most intermodal environments. The use of a landship facility will permit realistic simulation of the marine port environment.

Tests for intermodal transfer capabilities consist of a check of the various physical and performance characteristics (clearance, lifts, tiedowns, etc.) and the conduct of selected applicable operations from tables 5 and 6. Using the facilities and planned tests for all modes, compatibility during intermodal transport is normally determined during in-site and between-site movements and during the preparation for succeeding test phases.

Specific test phases are arranged where appropriate to the particular test; for example, comparison of different loading/unloading techniques and movement by different media, including respective cycle times; measurement of repetitive motions, displacements, and effects encountered; and investigation of stresses during lifts, drops, skidding, or MHE contacts.

24.4 Data Required. Data include description of the specific transfers arranged and tested, with facilities and equipment used. Measurements include shock and energy forces, duration times, strains, deformations, deflections, and other effects on containers and cargo. Observed data include adequacy and problems in the various intermodal operations, damages encountered, and durability of the containers.

Table 5 - Intermodal Transfer

<u>Operation</u>	<u>Media Used</u>	<u>Facilities</u>
Warehouse to transfer point	Forklift, skids, warehouse tractor, or trailer	Stacking areas, aisles, hardstand, roads
Loading on truck	Forklift, crane	Loading dock
Loading on rail flatcar	Forklift, crane	Loading dock
Loading on rail boxcar	Forklift, conveyor	Loading dock
Loading on rail hopper car	Crane	Loading dock
Trailer/vehicle on railcar	Drive-on ramp, truck/tractor	Loading dock
Rail train makeup	Switch engine	Railway
Loading dock to truck	Forklift, MHE	Ramp
Loading dock to van/trailer	Forklift, MHE	Ramp
Truck to conventional ship	Ship's cargo gear	Pier
Truck to roll-on and roll-off ships	Drive-on ramp	Dock, ramp
Trailers to roll-on and roll-off ships	Roll-on and roll-off tractors, spotters	Dock, ramp
Vehicle to loading craft	Ramp, crane, ship's gear	Beach, dock
Vehicle to amphibian	Forklift, ramp, crane	Land and water ramp
Dock to ship (vehicle)	Slings	Port, waterway
Dock to ship (pallets)	Slings	Port, waterway
Dock to ship (packages)	Cargo net, slings	Port, waterway

Table 5 (Cont)

<u>Operation</u>	<u>Media Used</u>	<u>Facilities</u>
Barge to ship	Ship's gear	Port, waterway
Landing craft/amphibious to ship	Ship's gear	Port, waterway
Containers to container ships	Ship's gear	Container port
Container to dolly or truck	Crane, forklift	Hardstand
Container to railcar	Crane, forklift	Loading ramp
Container to conventional ship	Ship's gear, slings	Port
Container to landing craft	Crane, ship's gear	Port, beach
Supply point to airfield	Trucks, tractor/trailer	Roadway
Airfield to aircraft	Forklift, truck/tractor	Landing field
Aircraft loading	MHE, ramp, winch, conveyor	Hardstand
Aircraft airdrop	Parachute, cushioning, pallets	Airway
Airdrop retrieval	Forklift, crane, trucks	Drop zone
Helicopter to supply point	Slings	Field
Helicopter to ship	Slings	Airway, anchorage
Helicopter to vehicle	Slings	Field
Offroad movement	RT forklift, trucks, tracked carriers	Unprepared terrains
Over-the-shore movement	RT forklifts, trucks, tracked carriers	Beach

Table 6 - Equipment Intermodal Capability

Container Transfer Equipment*	Equipment Used For Transfers To					
	RR Car	Highway Chassis	Ship	Air-to-Air Lift	Ground	Stacking
Railway Overhead Straddle Crane	x	x			x	
Flexi-Van Equipment	x	x				
Mobile Crane Lift	x	x	x		x	x
Front Loading Fork Truck	x	x		x	x	x
Side Loading Fork Truck	x	x		x	x	x
Hydraulic Push Pull	x	x				
Straddle Carrier		x			x	x
Towtainer					x	
Container Transporter					x	
Tilt Bed Trailer		x			x	
Helicopter	x	x	x	x	x	x
Pier Side Crane	x	x	x		x	x
Ship-Based Gantry Crane	x	x	x		x	x
Ship's Rigging	x	x	x		x	x

\*All equipment listed can be furnished from commercial or military sources to move the design weight capacity of 40-foot ANSI standard containers.

24.5 Analytical Plan. Measured and observed data are compared against the predetermined criteria for analysis of performance. Data are summarized, tabulated, and plotted to show peak and critical measurements. Data are evaluated for compliance with requirements.

25. Pendulation.

25.1 Objective. To determine the effectiveness of pendulation control, and ability of the container to withstand effects of pendulation during lifting and transfer operations.

25.2 Standards. The container must successfully pass the test indicated below.

25.3 Method.

a. The sling facility (fig. 22, app. E) is used, or a comparable existing facility is arranged, permitting sling apex heights to 30 feet and lift heights to 30 feet, and space for the container to swing longitudinally and laterally. At ground level, full size mockups simulating ship hatch openings or other cargo platform outlines to be spotted by the lifting gear are required. Also required is provision for the slung container to be placed in motion similar to that occasioned by marine or helicopter lift. Accessory equipment includes manual or powered tagline controls, container hoppers, or other motion-dampening devices intended to be used. The container is instrumented to record accelerations and impacts during handling. Using taglines, the forces for dampening pendulation and the extent of dampening, horizontal and vertical, are measured. In spotting the containers, slewing and luffing distances are measured and positioning times determined.

b. The container under different loaded configurations is lifted and placed in pendulum motion, approximating the test condition (for example, 30°, 15-second period for marine). Taglines are activated, with due consideration to safety of personnel, as the cargo is lowered and spotted on the cargo hatch/platform outline. Occurrences and positions of contact on the hatch coverings or cargo deck are noted and correlated with measured impacts. Time periods and effectiveness of the dampening media and methods in attenuating pendulation to acceptable limits are recorded.

c. To determine effects on container and cargo of controlled horizontally applied impacts, an instrumented barrier is placed at the bottom of the pendulum swing. Tests as described in FED-STD-101B, method 5012, are performed. Impacts on each end of the container are made at 1-inch, vertical height increments up to the specified limitations. Pendulum height versus peak impact force is recorded. Container, cargo, and restraining systems are examined for damage.

25.4 Data Required. Data include description of the specific loads and test conditions; measured forces, stresses, acceleration, and impact; tagline pull, attenuation times and forces; points of impact and resulting damages; spotting and alignment effectiveness; and observed effectiveness of control and dampening procedures.

25.5 Analytical Plan. Measured and observed data are correlated with circumstances and damages. The ability of the container and cargo to withstand the simulated environments is evaluated against the performance

requirements. Adequacy of procedures and equipment is assessed in regard to authorized instructions and equipment; needed changes to instructional materials are prepared.

26. Shipping and Handling.

26.1 Objective. To determine the effects on containers and cargo of sustained actual or realistically simulated shipments and handling by respective transportation modes.

26.2 Standards. The container must successfully withstand the tests below, as appropriate.

26.3 Method.

26.3.1 Road Tests. Vehicle test courses are used, selected to suit specific test requirements. Methods such as the following for the MILVAN, using paved and gravel courses described in TOP 1-1-011, are arranged.

a. Each container is installed on a single 20-foot chassis with tandem bogies installed. If ammunition type containers are tested, the restraint crossmembers are used to block the load. The container is loaded to 44,800 pounds, gross. The tandem bogies are placed in the rearmost position. A commercial tractor, if available, is used as the prime mover. If a commercial tractor is not available, a standard tactical tractor of the M52 series is used. Weight distribution of the loaded semitrailer and semitrailer-tractor combination is recorded. Any overloaded condition is reported as an incompatibility of the container. The semitrailer is towed 1500 miles as shown in table 7.

Table 7 - Road Test

Item	Single 20-Foot Chassis and Coupled 40-Foot Chassis
Number of bogies	Tandem
Position of bogies	Rearmost
Perryman paved, mileage	1000
Perryman paved, speed (mph)	Variable to 50
Munson gravel, mileage	500
Munson gravel, speed (mph)	Variable to 35

b. After the test as single units have been accomplished, the loads in the containers are adjusted so that the gross vehicle weight of each chassis with single bogie is 31,000 pounds. The chassis are coupled, and tandem bogies are positioned in the rearmost position. The gross

vehicle weight of the coupled chassis is then 62,000 pounds. Weight distribution of the load-coupled semitrailer and the semitrailer-tractor combination is determined. Any overloading of the chassis is reported as a container incompatibility. The coupled 40-foot chassis are towed 1500 miles as shown in table 7.

c. An extended test is conducted on only one pair of containers. The road test above is continued for 17,000 miles to make a total of 20,000 miles. The test is broken into four cycles as shown in table 8. Otherwise the procedure is the same as in a and b above.

Table 8 - Extended Road Test

Course	One Cycle, Extended Mileage			Total Extended Mileage
	Single Unit	Coupled Unit	Total	
Perryman paved	1415	1415	2830	11,320
Munson gravel	710	710	1420	5,680
Total	2125	2125	4250	17,000

d. When dollies or bogies are added to containers to convert the combination to a towed trailer, or where off-road effects on the transported container are to be determined, tests are conducted in accordance with TOP/MTP 2-2-506 for Group 9 equipment.

### 26.3.2 Rail Tests.

a. The test items are loaded aboard railroad freight cars using the specified loading schedule and appropriate MHE. The following information is recorded: MHE used, difficulties encountered during loading, impactograph readings, and condition of bracing.

b. The railroad car is operated over a course consisting of level roadbeds, trestles, and grades, and extending a minimum of 500 miles, using normal operating speeds and performing stops and starts a minimum of once each 50 miles.

NOTE: If a test course is unavailable, the containers are subjected to a minimum of 500 miles continuous travel.

c. At the completion of the mileage, the containers and loads are examined and the following information noted:

- (1) Condition of bracing within the freight car.



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(2) Direction and distance of shifting of load (each layer).

(3) Amount and type of damage to containers, binding, packing, and container contents.

(4) Impactograph recording values.

d. The containers are unloaded from the freight cars, and the equipment used in unloading and any difficulties encountered are recorded.

### 26.3.3 Ship Tests.

a. The test items are loaded aboard ships or ship-simulating facilities, using the specified loading schedule and appropriate MHE. Simulators must be capable of simulating an actual ship with respect to loading methods, hold or deck space, and pitch and roll. The type of ship used/simulated, MHE, location of stowage, and any difficulties encountered while loading in the ship's hold or deck, if applicable, are noted; also: amount of broken stowage space in wings between decks (distance from top of container load to ceiling), condition of bracing and tiedown attachments, and impactograph readings.

b. Tests using an actual ship are made with the ship proceeding through rough waters: 10- to 18-foot waves; about 25 mph wind. The sea states encountered and their durations are recorded together with the following:

(1) Impactograph recording values.

(2) Condition of bracing and tiedowns.

(3) Direction and distance of shifting of load (each layer).

(4) Amount and type of damage to containers, binding, packing, and container contents.

c. Tests using ship-simulating facilities are conducted by applying a roll of 30° from the vertical to either extreme list at a frequency of 15 seconds and a pitch of 5° from the horizontal to either extreme rise or fall at a frequency of 20 seconds for a minimum of 1 hour. The duration of the pitch and roll motion is recorded as well as the effects as indicated in (1) through (4) above for tests with an actual ship.

d. After the test the containers are unloaded from the ship or simulator, and a record is made of the equipment used for unloading and any difficulties encountered while unloading from the ship's hold or deck, if applicable.

26.3.4 Air Tests. The test items are loaded aboard aircraft or aircraft-simulating facilities using the specified loading schedule and appropriate MHE. The following information is recorded: type of aircraft used/simulated, MHE used, difficulties encountered while loading, condition of tiedown attachments, and impactograph recording values. The test items are then unloaded from the aircraft/simulated aircraft, and the MHE used in unloading and any difficulties encountered while unloading are recorded.

26.4 Data Required. Data include description of the load, mode of transport, and extent of exposure; distances traveled, speeds, type of terrain, roadway, airway, or seaway; measured readings of impacts and accelerations; observed condition or damages to containers, cargo, or restraining systems; correlation, where practical, of damages with circumstances; and assessment of ability of the container and cargo to endure each required mode of transport.

26.5 Analytical Plan. Measured and observed data are summarized into narrative, tabular, and charted form and are analyzed for compliance with stated requirements. Analysis of failures and effects of stresses is made. Where practical, data obtained from this subtest are used to satisfy transportability requirements (para 29).

## 27. Environmental Tests.

27.1 Objective. To determine the ability of the container to withstand environmental extremes or limitations.

NOTE: Large cargo containers may be required to withstand the rigors of extreme climates in accordance with expected employment of the containers in certain geographical areas. Climatic conditions will be stipulated either in specifications or in ROC's that relate to certain climates of AR 70-38. Specific test procedures are selected based on the particular container requirements.

27.2 Standards. The environments described below should have no adverse effects upon the container.

### 27.3 Method.

#### 27.3.1 Low Temperature.

a. The container is placed in an environmental chamber and loaded to its maximum gross weight (R).

b. With the door of the container open, the container is conditioned at the prescribed temperature for a minimum of 24 hours. (If AR 70-38 is prescribed, -30° F is used for intermediate cold or -50° F for cold climate simulation.)

c. The door of the container is sealed and the racking test in paragraph 19 is conducted.

### 27.3.2 High Temperature.

a. The procedure in a and b of 27.3.1 above is followed except that a temperature of 120° F is employed or other high temperature if stipulated.

b. The door of the container is sealed and the lifting test in paragraph 13 is conducted.

27.3.3 Interior High Temperature Measurement. This test is conducted only when there is a requirement for measuring the internal temperature of the container when it is sitting in the hot sun.

a. Thermocouples are mounted inside of the container 6 inches above the floor, 6 inches below the ceiling, and halfway up.

b. During a hot day, preferably when the temperature exceeds 95° F and solar radiation exceeds 300 Btu/ft<sup>2</sup>/hr, the closed container is placed in the sun on sand extending considerably beyond the area occupied by the container.

c. The temperatures are recorded, and each peak temperature is corrected to the conditions required, or to those of AR 70-38 if so specified, in the following manner:

$$T_c = T_M + (T_R - T_o) + \frac{R_R - R_o}{R_R} (T_M - T_o)$$

where

$T_c$  = corrected temperature inside container to simulate required conditions of temperature and solar radiation, °F.

$T_M$  = peak measured temperature inside container, °F.

$T_R$  = peak required temperature, °F.  
(125° F for hot-dry conditions of AR 70-38 and 110° F for intermediate hot conditions)

$T_o$  = peak outdoor air temperature measured in accordance with Weather Bureau procedure, °F

$R_R$  = peak required solar radiation, Btu/ft<sup>2</sup>/hr.

$R_o$  = peak outdoor solar radiation.

27.3.4 Snowload. The top surface of the closed container is loaded uniformly with sandbags to the weight specified in the directive. (If AR 70-38 is specified, use 40 pounds per square foot.) Observations are made for damage from the load.

27.3.5 Salt Fog Test. Component test data are reviewed to assure a satisfactory salt fog test. If adequate data are not available, the salt fog test is conducted on a representative section, such as a door, in accordance with MIL-STD-810B/C. The container/section is examined for corrosion, and notes are made on the extent of the corrosion.

27.3.6 Dust Test. The standard dust test described in MIL-STD-810B/C is not usually practical for cargo containers because the container is often larger than the available dust chamber. If a dust test is deemed necessary, the use of a modified sandblaster as described in MIL-STD-810B/C should be considered. Relative humidity should be maintained under 30 percent, and the dust should conform to that specified in MIL-STD-810B/C. The sandblaster would be aimed at the cracks around doors, ventilator openings, etc. Following exposure, the interior of the container is examined for dust penetration, and all moving parts are checked for ease of operation.

27.3.7 Condensation. The container is loaded to one-half of its inside volume while in an ambient temperature of 95° F (dry bulb), 90 percent relative humidity. While still open, the container and its contents remain in this ambient condition until all components and contents have stabilized at the ambient condition - a period of 1 hour or longer if required. Container contents are selected to include items which easily show the presence or effects of condensation without unwarranted damage to the items. The container is closed and sealed as for shipment. The container ambient is reduced to 70° F dry bulb over a period of 3 hours and allowed to remain at that temperature for an additional 3 hours, after which the container is reopened. The extent and effects of condensation are observed, including points of dripping or collection, damage potential to cargo, and indicated need for corrective insulation or sealing. If condensation is insufficient to determine probable effects, the procedure may be recycled until the desired conditions of condensation can occur and be assessed.

27.3.8 Shock Tests. Both the vertical deceleration and the rail humping shock tests are conducted using a minimum of three test containers, each loaded with an evenly distributed, rated load. The load is secured within the container, when applicable, with timber bracing.

27.3.8.1 Vertical Deceleration Test (Drop Test). A drop test facility is required for this test. The test containers are dropped as specified in the test directive or standards document or as indicated in table 9 and described below.

a. Free Fall Drop Test. The container is dropped cornerwise onto a hard, level, concrete floor or equal surface on each of its eight corners, falling freely through the vertical distance specified in table 9. Prior to each drop, the container is suspended with its center of gravity vertically above the striking corner.

b. Edgewise Drop Test. One end of the base of the container is supported on a sill 5 to 6 inches in height. The opposite end is raised and allowed to fall freely to a hard, level, concrete floor or equal surface from the height specified in table 9. The test is applied once to each end of the container. If the size of the container and the location of the center of gravity are such that this drop cannot be made from the prescribed height, the greatest height attainable is substituted.

Table 9 - Drop Test Height per Container Size and Weight

Container Maximum Gross Weight (pounds)	Container Maximum Dimensions, Edge-to-Edge or Diameter (inches)	Height of Drop (inches)		
		Free Fall	Edgewise	Cornerwise
150	60	18	--	--
200	60	16	--	--
600	72	--	36	36
3000	No Limit	--	24	24
No Limit	No Limit	--	12	12

c. Cornerwise Drop Test. One corner of the base of the container is supported on a block approximately 5 inches in height. A block nominally 12 inches in height is under the other corner of the same end. The opposite end of the package is raised and allowed to fall freely to a hard, level, concrete floor or equal surface from the height specified in table 9. This test is applied once to each of two diagonally opposite corners of the base. If the size of the container and the location of the center of gravity are such that this drop cannot be made from the prescribed height, the greatest height attainable is substituted. When the proportions of width and height of the container cause instability in the cornerwise drop test, edgewise drops are substituted. In such instances two edgewise drops in each corner are made.

NOTE: Alternate methods of performing drop tests are contained in procedures D775, D997, D1083, and D1185 of reference 12 (app. A).

The distance dropped and g's attained are recorded as well as any damage that occurs to the test item or its contents.

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27.3.8.2 Rail Humping or Inclined Plane Tests. This test is conducted using a carriage mounted on an inclined plane having a maximum slope of 20 degrees, a length a minimum of 10 times the length of the carriage, and a barrier at the bottom of the decline.

a. The loaded container is tied down on the carriage.

b. The loaded carriage is positioned on the incline. Positions are computed so that incrementally increased velocities are achieved to provide up to the maximum specified shock level. The impact when the carrier hits the barrier is recorded.

c. Any damage incurred to the container or its load is recorded.

27.3.9 Extended Storage. The test items are stored for at least 6 months in the open, subject to the temperature/humidity conditions of desert, tropics, arctic, and ocean front. At the completion of the exposure periods, the exterior and interior of all containers are examined and any damage is recorded.

27.3.10 Corrosion. In conjunction with various exposure tests, particularly when the container is left exposed to the elements over periods of time in beach or open areas, the container is subjected to detailed inspection of components and parts for areas incurring corrosion that may interfere with design functioning, lead to deterioration of structure, or cause undue maintenance. The incidence of corrosion is identified as to location, type, cause, effects, and indicated time to occurrence of unacceptable conditions. Corrective action taken or needed is described.

27.4 Data Required. Conditions of each exposure are described, indicated measured temperatures and other parameters are recorded, and various effects and damages to the container, its components and contents are noted.

27.5 Analytical Plan. Data are reduced and summarized to reveal significant deficiencies when performance is compared with requirements. Data are presented in narrative or graphic form as appropriate, reflecting the degree to which specified requirements are met.

## 28. Weatherproofness.

28.1 Objective. To determine the effectiveness of the container in protecting cargo against spray and rain.

28.2 Standards. The requirements of ANSI MH 5.1.1, ANSI MH 5.4, ABS, and AS 832 are met if the container passes the test below.

28.3 Method. This test is conducted with an empty container located near a source of water under pressure. A hose with a 0.5-inch (inside-diameter) nozzle is required.

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a. With the nozzle pressure at 15 psig and the nozzle held 5 feet from the container, the water is sprayed continuously, moving across the surface at a rate of approximately 4 feet per second. The entire surface of the container is covered with the spray.

b. During the test an observer is stationed inside the container searching with a flashlight for penetration of water in the area being sprayed.

c. After the test the container is opened and inspected thoroughly for water penetration. If any water is found in the container, the leak is located and reported. The document holders are inspected for the presence of water.

Since water leakage is a function of the time of exposure, the exposure described above is maintained for a total period of not less than 2 hours for the entire container to demonstrate the adequacy of the design of all joints and seals in the container. The test duration of 2 hours is applicable to prototype testing only and shall not be construed as a routine production test period. When the spray is concentrated on seams and seals only, ANSI MH 5.4 and AS 832 permit a lesser time, 15 minutes being stated by the latter.

28.4 Data Required. Data include nozzle diameter (inches) and distance from test item (feet), water pressure (psig), and location and extent of water leakage.

28.5 Analytical Plan. The container is considered satisfactory if the interior on completion of the tests is free from penetration or accumulation of water.

## 29. Transportability.

29.1 Objective. To insure that the container is transportable without restrictions by the specified modes of transport.

NOTE: Since a container in itself is a transportation medium, transportability is inherent in its design. All subtests of this TOP relate to determining transportability. This subtest provides guidance in the event specific or further aspects of transportability need to be tested.

29.2 Standards. As stated in requirements documents and AR-70-44.

29.3 Method. The requirements of the container are reviewed. The need for transportability data as prescribed by AR 70-44 is reviewed. Inter-modal requirements are considered. TOP 1-2-500 is consulted for specific tests for different conditions. Other subtests such as assembly and coupling (para 10) and shipping and handling (para 26) are reviewed to

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determine the potential for collection of data for multiple use during other test phases. Specific procedures for aspects requiring further testing are selected and planned.

Other information is contained in AR 70-39, TB 55-100, MIL-STD-209, and MIL-STD-814.

29.4 Data Required. Overall data required for the transportability evaluation are shown in appendix C. These data consist of numerous descriptions, measurements of characteristics, and performance data relating to transport and handling of the container.

29.5 Analytical Plan. Data are collected from various subtests throughout the test program and supplemented with paper study and research where appropriate. Data are compared with parameters required by the intended service, and the degree of transportability is assessed.

### 30. Logistics-Over-the-Shore (LOTS).

30.1 Objective. To determine whether the container is capable of being transported from ocean carriers to prepared beach storage areas without benefit of conventional port facilities.

30.2 Standards. As stated in the requirements document.

30.3 Methods. General procedures for LOTS testing are contained in TOP 1-2-510. These documents should be consulted in consideration that containers present special problems in LOTS testing due to their bulk, weight, and requirement for special transport media.

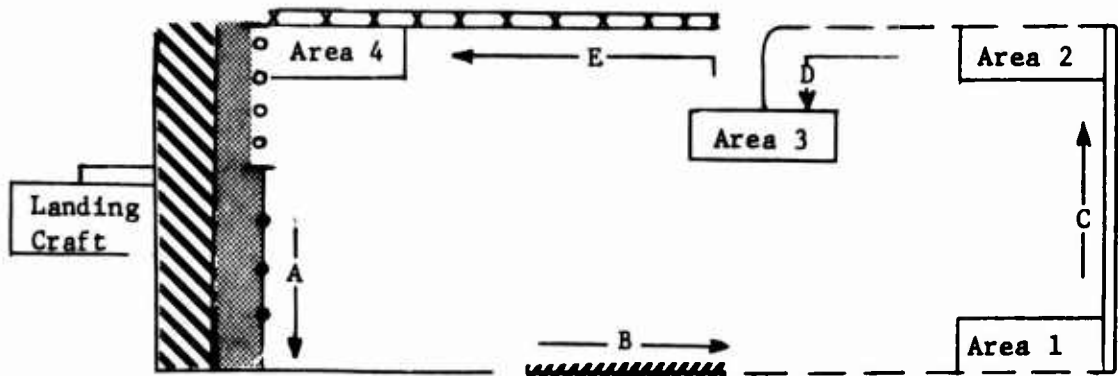
Effective LOTS testing is highly dependent on the use of actual resources (container ships, roll-on/roll-off ships, landing craft, amphibians, helicopters, etc.). When practical, such testing should be planned in conjunction with operational or training exercises, other tests, or with TOE mission operations. Some aspects of LOTS container handling defy practical simulation; for example, effects of relative motion between the ship and lighter at sea.

Specific conditions may be adequately simulated with limited facilities such as for beach mobility (fig. 10) using available MHE. Findings of other subtests (paras 10 and 26) may provide data permitting evaluation of certain LOTS characteristics by paper study.

30.4 Data Required. Data to be obtained are described in the TOP cited above.

30.5 Analytical Plan. Summarized data and observations are considered against the requirements for LOTS transfer, and assessment is made as to the adequacy of the container to perform.





SCHMATIC PLAN OF TEST COURSE

Legend	Description	Approximate Distance		Area No.	Remarks
		ft	m		
	Beach area			1	Empty containers will be stacked 3 high.
	Surf (max. 60 in. or less)			2	Loaded containers will be stacked 2 high.
	Wet sand - beach area	500	152	3	Loaded containers will be loaded on S&P trailers.
	Dry sand operations	250	76	4	Breakbulk palletized cargo will be stored.
	Sand dunes	100	30		
	Sand trails	100	30		
	Combination mud, sand trails, and sand dunes	300	91		
	Shallow fording 30 in. or less	100	30		
	Hard surface roads	600	183		

PROCEDURE: Containers are evaluated during the following MHE test cycle: An empty cargo container is transported from the beach and landing area to storage area 1 via avenues A and B. The MHE, after depositing ("storing") the container, returns to the landing craft (using avenues C, D, and E). The MHE lifts a loaded MILVAN container and transports it from the beach over avenues A, B, and C to storage area 2 and deposits it. The MHE returns to the landing area (via avenues D and E) and picks up another loaded container. This container is transported to area 3 via avenues A, B, C, and D and is placed on a waiting stake-and-platform trailer. (After the load has been secured, the MHE returns to the landing area via avenue E and off-loads a 463L pallet. The pallet is transported over the mobility test course to storage area 4 where the pallet is stacked. After the MHE returns to the beach and landing area, one MHE test cycle is considered complete.)

Figure 10. Beach Operation and Mobility Test Course.

31. Safety. Various tests (e.g., paras 11 through 19, 22) are performed to verify the structural design and safety of the container. Any hazards involved in performing these tests must be known to participating personnel. Applicable SOP's must cover any hazardous operations. If none is available on a particular item but is required, an SOP outlining the precautions to be observed must be formulated and approved prior to conducting the test. Transported containers must assume the safety characteristics of the transporter or other media or mode by which they are carried and conform to the special regulations which apply. In planning the safety subtest, appendix F and TOP/MTP 10-2-508 should be consulted.

During the tests frequent supervisor/test director inspections should be used to identify and prevent or correct physical hazards, accident-related maintenance deficiencies, personnel handling deficiencies, accessory equipment deficiencies, training deficiencies, etc.

32. Human Factors. Observations of the compatibility of the man and the test item are made throughout the test. Some factors to consider are:

- a. Adequacy of markings for identification.
- b. Location of doors and door handles for access.
- c. Ease or difficulty of operating doors, door handles, and lock mechanisms with and without the use of heavy gloves.
- d. Ability or inability of one man without tools to operate a latching mechanism.
- e. Compatibility of coupling containers with each other.
- f. Any difficulty in installing or removing containers from semi-trailers, if applicable.
- g. Compatibility of the handling equipment that is used with the particular container.

33. Maintenance Evaluation. Throughout the test program, an evaluation is conducted of the maintenance characteristics of the test item in accordance with TECOM Supplement 1 to AR 750-1. The adequacy of the maintenance test package is also verified. The maintenance evaluation in both test plan and test report is to consist of the following elements:

- a. Data acquisition - This includes the timing of all maintenance tasks (scheduled and unscheduled), malfunctions and failures, parts repaired or replaced, etc. From these data mean time to repair (MTTR), mean-time-between-failures (MTBF), mean downtime (MDT), maintenance ratio (MR), mean time between maintenance (MTBM), mean active maintenance downtime (M), inherent availability ( $A_i$ ), and achieved availability ( $A_a$ ) are obtained.

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b. Tools and test equipment - Common and special tools used with the test item are evaluated to determine whether they are suitable and needed for the intended purpose and prescribed maintenance level.

c. Equipment publications - Equipment publications provided in the maintenance test package are evaluated for simplicity, clarity, and completeness.

d. Repair parts - Repair parts are evaluated for interchangeability, ease of installation, and for possible replacement by standard parts in the logistics system.

34. Kit Applications. Various kits may be provided as accessory items for the container, such as lighting, storage bins, floor roller systems, 463L pallet/MILVAN adaptor, coupling kits, dunnage systems, etc. Each kit is studied as to its design and intended function, and tests are developed accordingly to test the operational performance, durability, and other characteristics of the kit against its prescribed requirements.

35. Electromagnetic Interference. This test will apply only to power-supplied special containers, in which event the procedures of TOP 2-2-613 will be used.

Recommended changes to this publication should be forwarded to Commander, U. S. Army Test and Evaluation Command, ATTN: AMSTE-ME, Aberdeen Proving Ground, Md. 21005. Technical information may be obtained from the preparing activity: Commander, U. S. Army Aberdeen Proving Ground, ATTN: STEAP-MT-M, Aberdeen Proving Ground, Md. 21005. Additional copies are available from the Defense Documentation Center, Cameron Station, Alexandria, Va. 22314. This document is identified by the accession number (AD No.) printed on the first page.

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APPENDIX A  
REFERENCES

1. AR's:
  - a. 55-55, "Transportation of Radioactive and Fissile Materials Other Than Weapons."
  - b. 70-38, "Research, Development, Test, and Evaluation of Materiel for Extreme Climatic Conditions."
  - c. 70-39, "Criteria for Air Transport and Airdrop of Materiel."
  - d. 70-44, "DOD Engineering for Transportability."
2. AMCR 385-100, "Safety Manual."
3. FM 55-15, "Transportation Reference Data."
4. TB 55-100, Transportability Criteria Shock and Vibration."
5. FED and MIL STD's:
  - a. FED-STD-101B, "Preservation, Packaging, and Packing Materials, Test Procedures."
  - b. MIL-STD-209D, "Slinging and Tiedown Provisions for Lifting and Tying Down Military Equipment."
  - c. MIL-STD-271D, "Nondestructive Testing Requirements for Metals."
  - d. MIL-STD-461A, Notice 4 (EL), "Electromagnetic Interference Characteristics, Requirements for Equipment, Subsystem, and System."
  - e. MIL-STD-462, Notice 3 (EL), "Electromagnetic Interference Characteristics, Measurement Of."
  - f. MIL-STD-810B/C, "Environmental Test Methods."
  - g. MIL-STD-814A, "Requirement for Tiedown, Suspension and Extraction Provisions on Military Material for Airdrop."
  - h. MIL-STD-1320, "Truckloading of Hazardous Materials."
  - i. MIL-STD-1472A, "Human Engineering Design Criteria for Military Systems, Equipment and Facilities."
6. Military Specifications:
  - a. MIL-C-52661, "Container, Cargo."

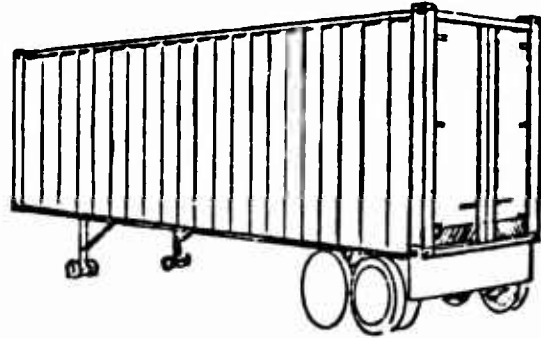
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- b. MIL-C-62076A, "Semitrailer, Van, Demountable Transmodal Container."
7. TECOM Suppl 1 to AR 750-1, "Maintenance Evaluation During Testing."
8. Dye, John H., "Special Study of Containerization Testing," TECOM Project 9-CO-001-000-114, Aberdeen Proving Ground, Md., Report APG-MT-4459, May 1974.
9. MTMTS (Military Traffic Management and Terminal Service Agency) Pam 55-2, "Guidelines on Stuffing Containers."
10. American National Standards Institute, American Society of Mechanical Engineers, 345 E. 47th St., New York, N.Y. 10017:
  - a. ANSI MH 5.1-1971, "Basic Requirements for Cargo Containers."
  - b. ANSI MH 5.1.1-1971, "Requirements for Closed Van Containers."
  - c. ANSI MH 5.2-1969, "Air-Land Demountable Cargo Containers" (American Society of Mechanical Engineers publication AS 832).
  - d. ANSI MH 5.3-1970, "Specifications for Identification and Marking of Cargo Containers."
  - e. ANSI MH 5.4-1971, "Specifications for International (ISO) Freight Containers."
11. "Guide for the Certification of Cargo Containers," American Bureau of Shipping, 45 Broad Street, New York, N.Y. 10004, 1969.
12. "ASTM Handbook," Sec. 15, American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa.

APPENDIX B  
TYPES OF CONTAINERS

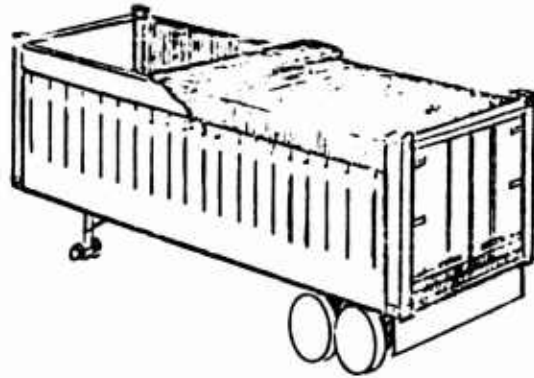
DRY CARGO VAN

Type used for most unitized, palletized and packaged cargo. On/off-loading through rear door.



DRY CARGO-OPEN TOP

Used for special cargo, e.g., pipes and machinery. On/off-loaded vertically from the top or through rear door.



CONTROLLED TEMPERATURE

For perishable cargo which must be maintained at low constant temperatures.

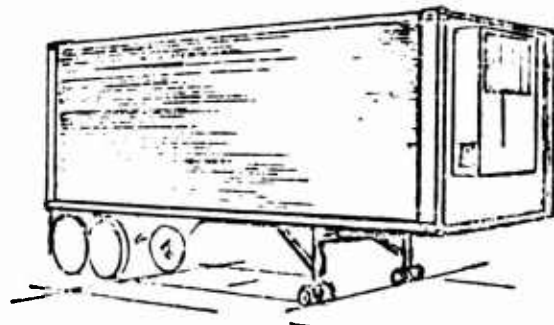
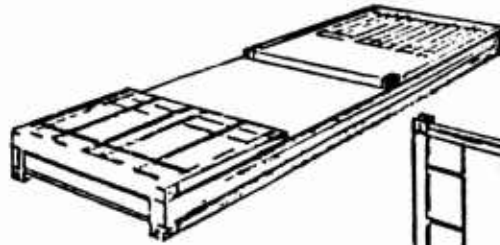
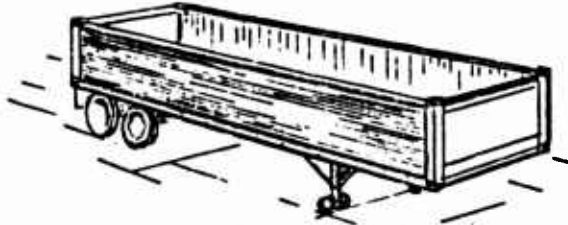


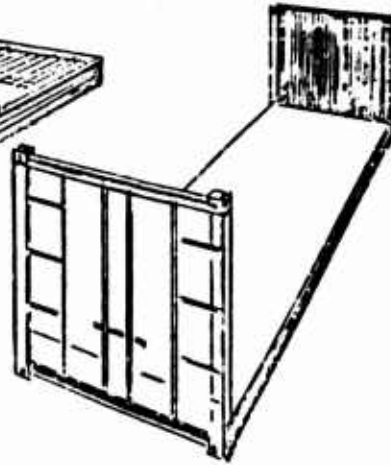
Figure 11. Container Types Used in Cargo Distribution.

SHORT HEIGHT-OPEN TOP

Same as dry cargo-open top with one-half height. For high density cargo which makes full height container weight limited.

PALLET CONTAINER

For cargo which can be tied to container floor. Advantage of collapsibility and side loading.

TANK CONTAINER

For bulk liquids. Many alternative configurations.

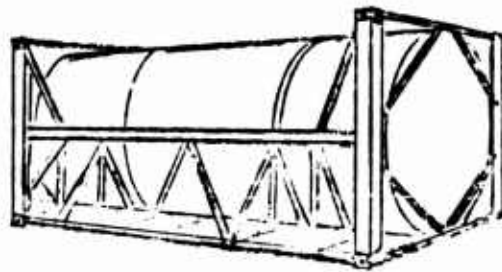
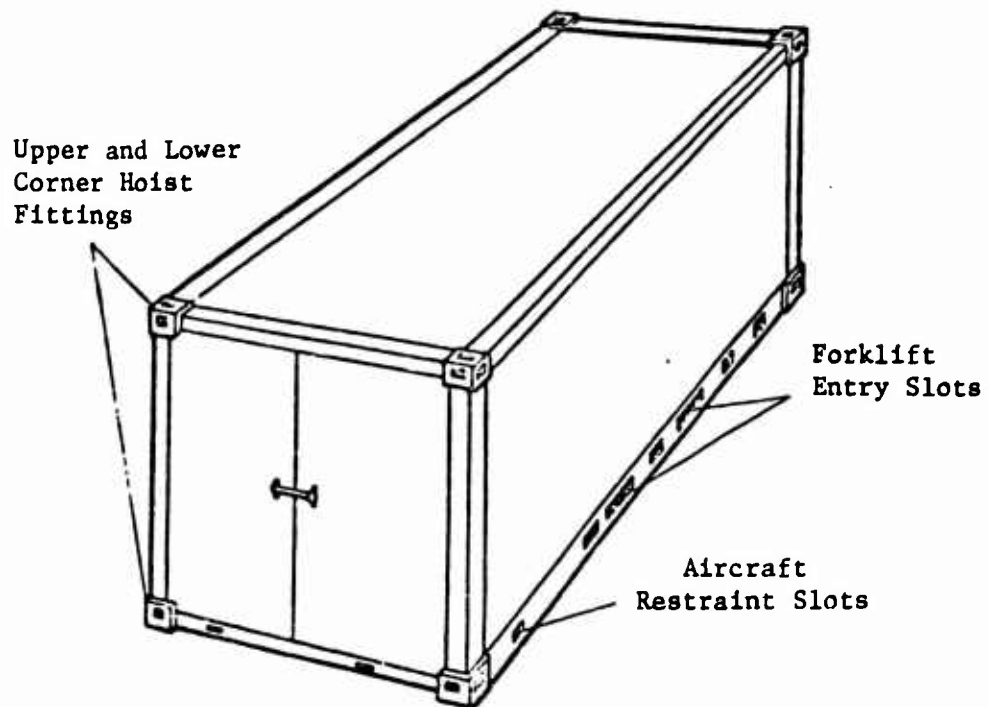


Figure 12. Container Types Used in Cargo Distribution.

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NOTE: Society of Automotive Engineers (SAE) containers are 8' wide, 8' high, and in lengths of 10', 20', 30', and 40'.

Figure 13. SAE Container, TYPE IID.



APPENDIX C  
CONTAINER REQUIREMENTS CHECKLIST

Table 10 - Container Requirements Checklist

Requirement	Critical Factors	Test Provisions
<u>Part One - Data Needed to Satisfy Requirements of AR 70-44 as to Transportability</u>		
1. Nomenclature and description of item.	Type designation, intended use, features, and type of construction.	Established by design.
2. Intermodal application.	Whether all-mode, selected mode, or specific combinations; rail, air, marine, highway, off-road.	Tests are tailored to suit designated applications (see MH 5 standards).
3. Need for specialized service or MHE.	Type of handling: transporter containership, rail cushioned cars, etc.; power hookup for refrigerated containers.	Provided by specific test plans. Consult terminals handling aspects of TOP's 10-2-215 and 1-2-500.
4. Configuration:		
a. Sketch with dimensions.	Location of doors, ports, machinery, etc.	Established by design.
b. Weights.	Tare, cargo, gross.	Determined during inspection.
c. Unusual features.	Coupling provisions, special purpose design.	Described in the procurement specifications.
d. Internal provisions.	Tiedown fittings or systems, blocking, bracing.	Included in specific test plans. Consult TOP 1-2-500.

Table 10 - Container Requirements Checklist (Cont)

Requirement	Critical Factors	Test Provisions
<u>Part One (Cont)</u>		
5. Ruggedness:	Identity of critical modes. Need for special considerations in handling. Compliance with design load factors (table 11). ROC's usually refer to TB 55-100.	Various design tests (MH 5), endurance tests such as mobility, and performance tests included in test plans.
a. Fragility.		
b. Shock.		
c. Vibration.		
6. Unusual characteristics:	By definition, characteristics exceeding 8 ft. W x 8 ft. H x 22 ft. L and 11,200 lb. gross constitute a transportability problem for the military. For containers, this position is modified by provision of special transporters.	For identified types, tests are to the applicable specifications and standards, MH 5, MIL-C-52661, AR 70-38, etc.
a. Climatic limits.		
b. Performance limits.		
c. Special handling.		
d. Other.		
7. Dangerous features:		
a. DOT class, article, explosive weight.	Whether container is designed for special commodity or is general cargo type adapted to carry dangerous commodities.	Specific regulations such as AR 55-55 and procedures of MIL-STD-1320 apply.
b. Venting, protective features, grounding requirements.	Provisions to suit the particular application and service.	Specific tests not currently provided. ANSI refers to test of pressure equalization device for air mode.

Table 10 - Container Requirements Checklist (Cont)

Requirement	Critical Factors	Test Provisions
<u>Part One (Cont)</u>		
c. Disaster response force requirements, security, fire-fighting, medical, other.	Whether the container poses specific problems in the cited situations.	Other than design structure and locking provisions, specific tests not currently provided.
d. Compliance with applicable codes and regulations.	Federal legislation prohibits preference to marine shippers on basis of dimensions. Some highway limits require values less than ANSI/ISO standards. Secretary of Defense may rule size waivers in view of military shipping requirements.	Tests to ANSI/ISO standards provide maximum opportunity for compliance.
e. Military quantity/distance class and storage compatibility groups.		Test data (chamber and environmental site) provide information on storage compatibility.
8. When coupled to transporter (only if different from data already available for the transporter):	Effects on the transporter or transporting media due to characteristics of the container. Applies particularly if possibility exists that media design capability and clearance features may be exceeded.	Determined in mobility, performance, and transportability tests in accordance with test plans and TOP's/MTP's.
a. Footprint data and relative position of ground contact.		

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Table 10 - Container Requirements Checklist (Cont)

<u>Requirement</u>	<u>Critical Factors</u>	<u>Test Provisions</u>
<u>Part One (Cont)</u>		
b. No. of tires, size, location, pressures.		
c. No. of tracks, size, ground pressure.		
d. Axle loads: spacing, individual, loaded, empty.		
e. Ground clearances, component and distance.		
f. Speeds, turning radii, performance data.		
g. Front and rear overhang, wheelbase.		
h. Compliance with state and federal regulations.		
9. Safety.		

Detailed procedures need to be developed. Overall intent of ABS/ANSI standards is to assure required safety from structural integrity aspect.

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Table 10 - Container Requirements Checklist (Cont)

Requirement	Critical Factors	Test Provisions
<u>Part One (Cont)</u>		
a. Federal safety standards.	See 7 above.	
b. Safety release.	ROC/DP and AMC Safety Manual apply.	
c. Other.	Various mode applications present different hazards. Required waivers.	
10. Sectionalization:		
a. Coupling.	Maintenance of dimensional conform- mance and strength.	Specifications provide for details. Military items currently use coupling. (Basic coupling patent belongs to Strick.) Tests of assembled items are essentially as for noncoupling types.
b. Knockdown pro- visions.	Feasibility or need for disassembly for handling, return shipment, or obstacle clearance.	
11. Additional data for air loading:		
a. Skid data - diagram showing location, length, width, and distance between skids.	Standards require special skid designs and slot spacing for air mode containers.	ANSI MH 5.2 (AS 832) contains special guidance for air mode container.

Table 10 - Container Requirements Checklist (Cont)

Requirement	Critical Factors	Test Provisions
<u>Part One (Cont)</u>		
b. Identity of needed and suitable MHE or transporter.	Use of conveyors in air loading requires special skid design for use of plywood dunnage.	
c. Need for in-flight power requirements of containers.	As required for cooled or heated containers.	
d. Need for technical escort.		
e. Applicable safety waivers.		
f. Need for section-alization, re-assembly and operational test.		
g. Other limitations.		

Part Two - Data Required for Preparation of Transportability Guidance Documents

- |   |  |   |
|---|--|---|
| <p>1. Specific aircraft by which the container is transportable (including externally slung by helicopter).</p> | <p>Capability to handle various standard containers is shown on fig. 3.3-2, ref. 8 (app. A).</p> | <p>Dimensional and weight determinations are made by paper study. Static tests (ANSI/ISO/AS 832) provide for in-flight effects.</p> |
|---|--|---|

Table 10 - Container Requirements Checklist (Cont)

Requirement	Critical Factors	Test Provisions
<u>Part Two (Cont)</u>		
2. Specific highway vehicles by which transportable.	Governed by specific container size and vehicle design (see fig. 3.3-1, ref. 8, app. A).	Conventional vehicle testing procedures for transported cargo apply.
3. Off-road traffic data (for the transported item).	Identity of obstacles and limitations. Need for special procedures or equipment. Point of necessary break-bulk.	Arranged to suit the particular container, expected TOE environment, and authorized handling media.
4. Specific rail carriers and limitations.	Need for cushioned impact. Width and height limitations. Provision for loading and off-loading.	ANSI static tests provide for ride effects, not hump. With special tiedown, conventional hump tests (TOP 1-2-500) apply.
5. Instructions and diagrams for sectionalization.	See part one, item 10 above.	If available as part of maintenance test package, review and checkout procedures apply. TOP 1-2-500 contains guidance.
6. Sketches, procedures, lists of materials for loading, bracing, and tiedown on various media.	For standard containers, generally involves only fit to corner fitting locks, and slot hooks for air mode. Internal provisions may have to suit particular commodities.	Provide as for transportability evaluations (TOP 1-2-500).
7. Sketches on turning radii, ramp angles, etc., for transported containers.	Needed only where the container alters known characteristics of the handling media.	Determined during mobility or vehicle test phases.

Table 10 - Container Requirements Checklist (Cont)

Requirement	Critical Factors	Test Provisions
8. Special shipment data; volumes, cubes, areas, weights.	Identity of potential for exceeding the acceptable limits of respective transport modes.	Information results from characteristics determination and evaluation.

Part Two (Cont)

Table 11 - Design Load Factors

Direction of Load Relative to Axis of Container	Terminal Operations	Marine	Highway	Rail	Fixed Wing	Rotary Wing	SAE 832* Fixed Wing
Downward	2.0	1.8	1.7	1.5	2.0	3.75 (10' only)	3.0
Upward	0.0	0.0	0.0	0.0	1.11	2.67 (20', 30', 40')	1.0
Lateral	0.2	0.6	0.1	0.3	0.67	0.67	1.0
Longitudinal	0.7	0.6	0.7	1.8	0.67	0.83	1.0

\*For special air-land containers.



APPENDIX D - CONTAINER FITTINGS AND ATTACHMENTS

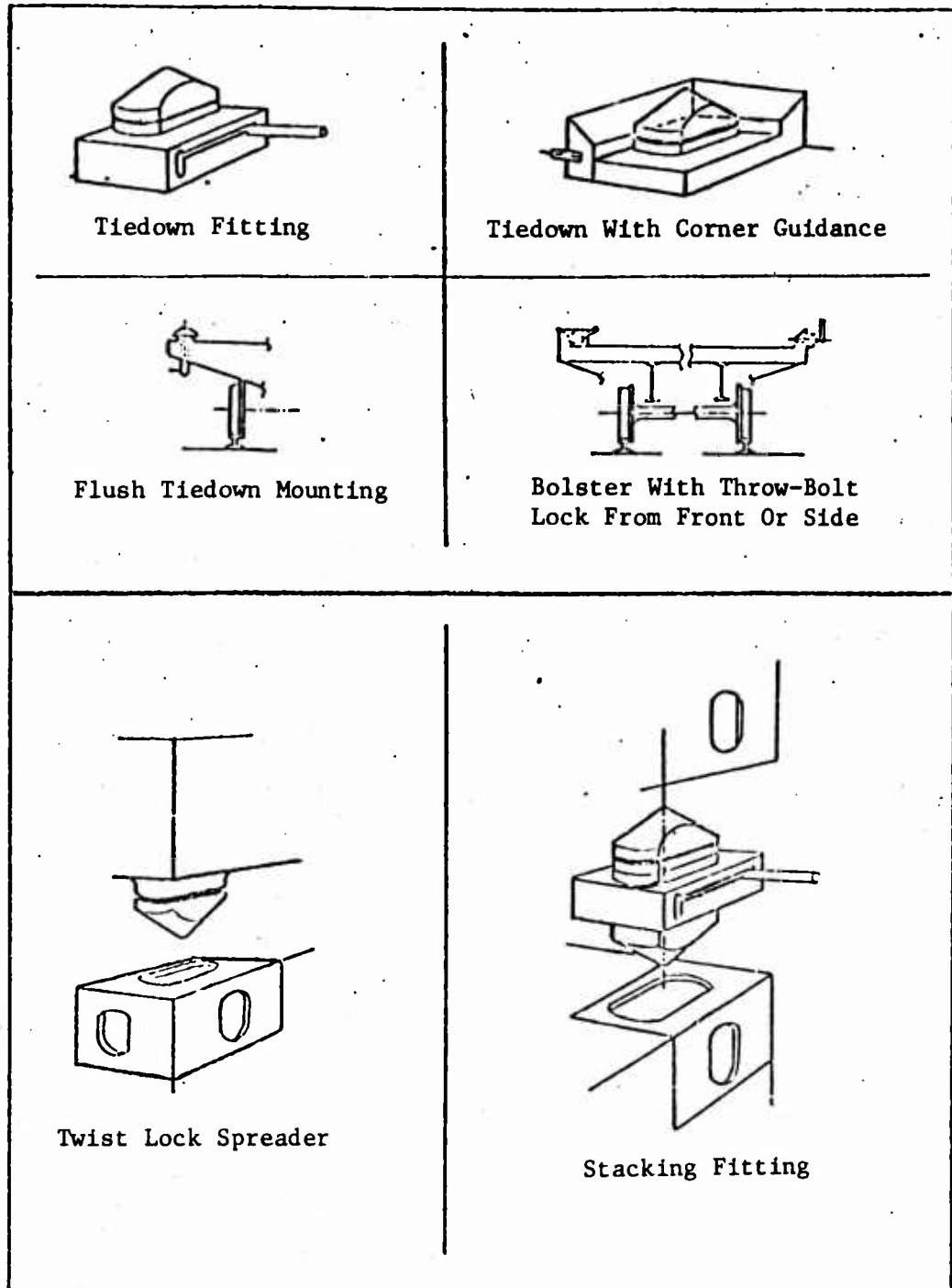


Figure 14. Typical Tiedown and Stacking Fittings Used On Standard Container Corners.

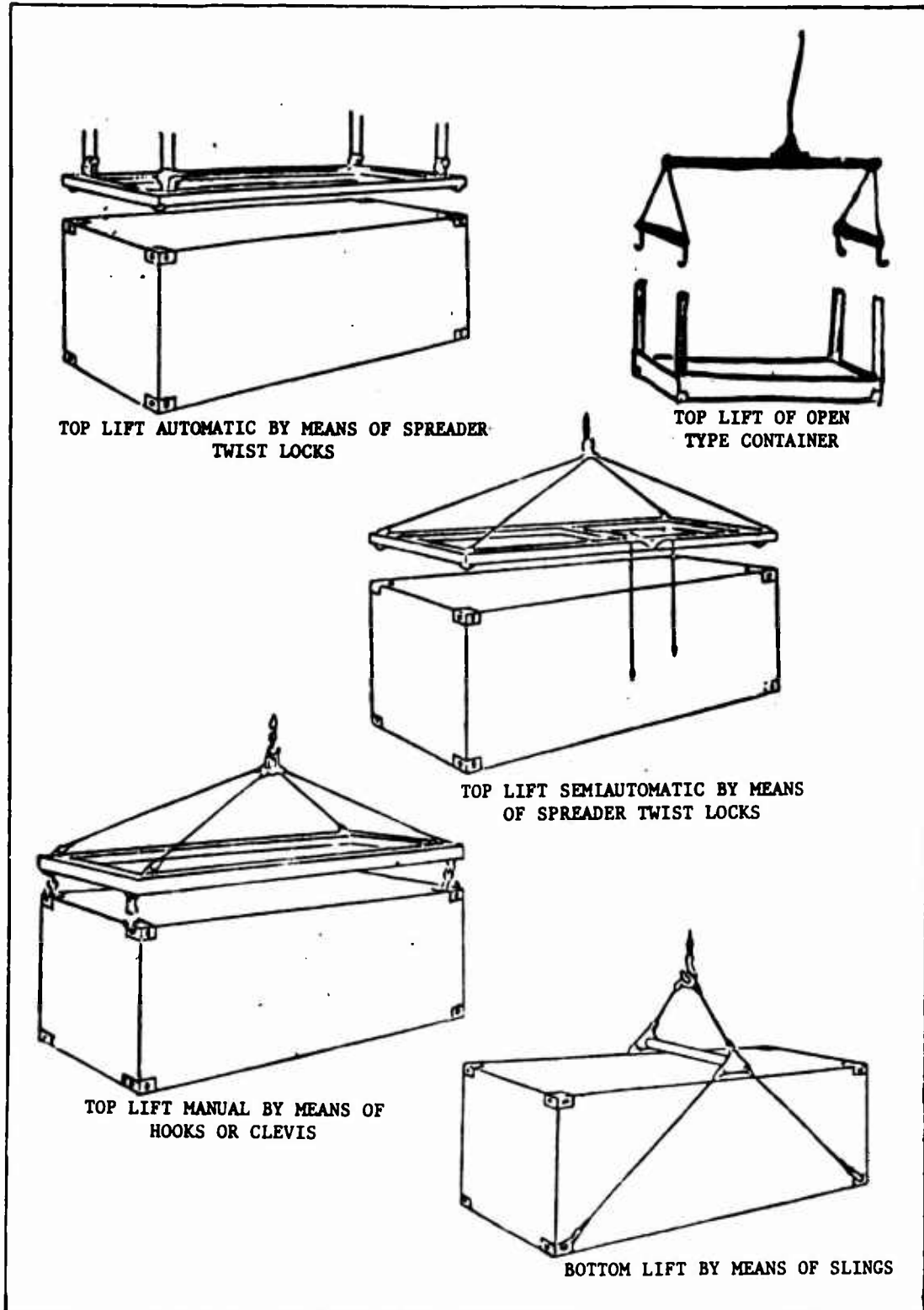


Figure 15. Examples of Methods of Lifting Containers by Corner Fittings.

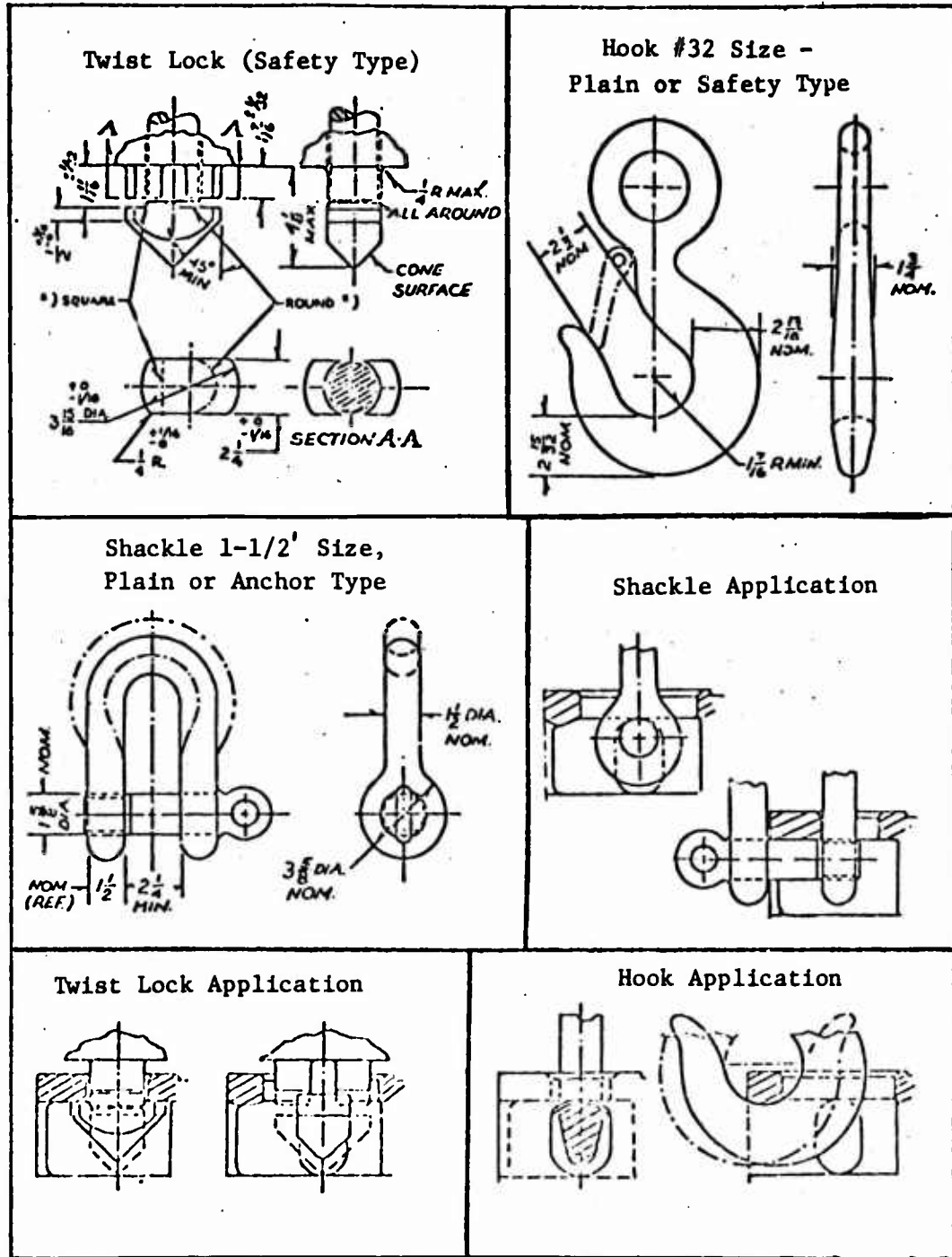


Figure 16. Typical Upper Corner Fitting Lifting Devices.

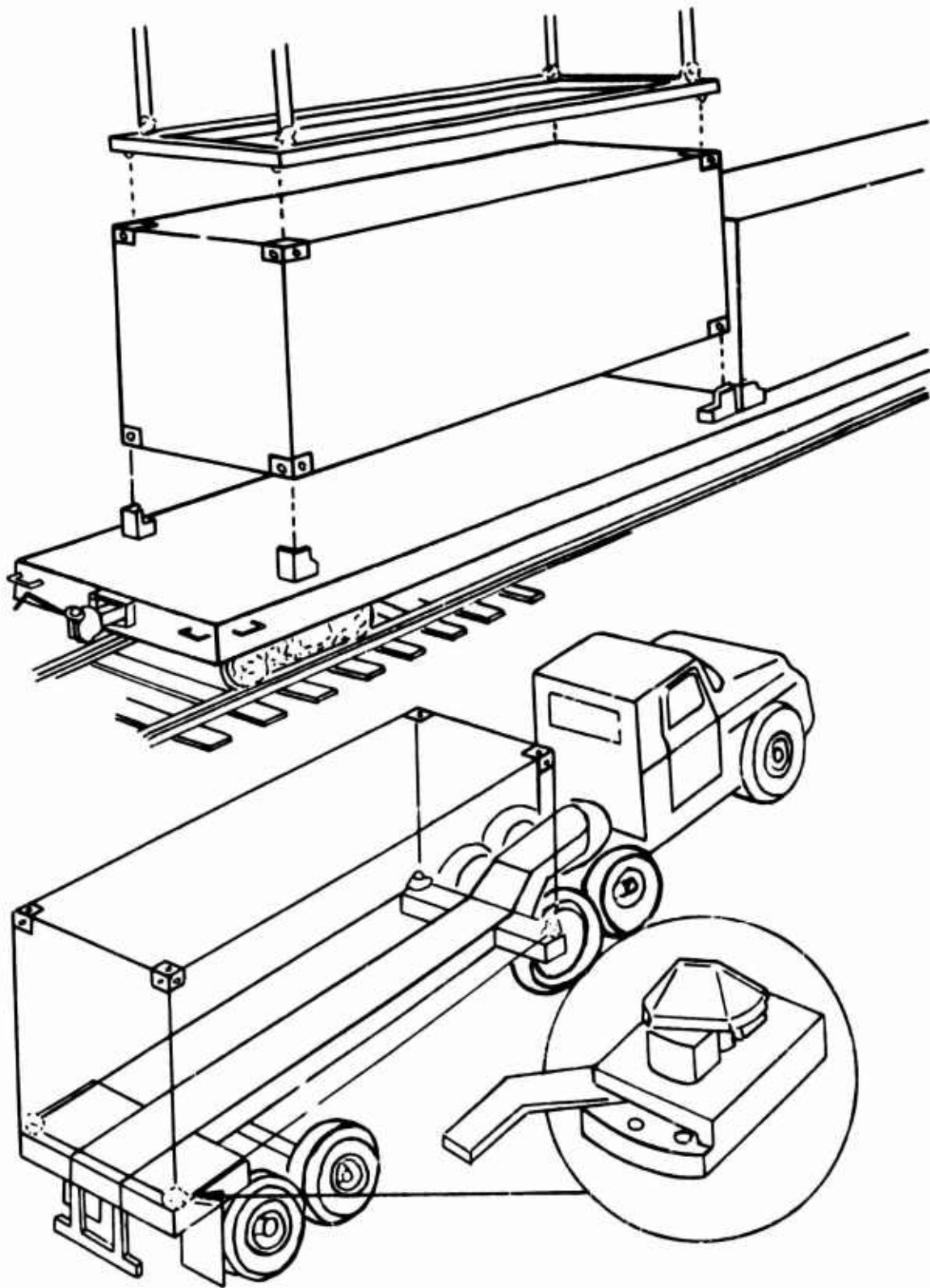


Figure 17. Use of Corner Fittings on Railcar and Trailer.

**APPENDIX E  
FACILITIES**

Facilities for container testing consist essentially of many general support facilities usable for all items; a container test rack; certain existing or planned equipment for vehicle, transportability, and special container tests (figs. 18 through 22); and major remote and borrowed facilities. Particular general support facilities include: climatic chambers, vehicle test courses, rail facilities (cars and trackage), laboratory equipment and instrumentation, MHE test facilities, shop and mobile lift equipment, docks and terminals areas; and supporting land, air, and marine vehicles, cargo and accessory equipment. Table 3.4-I of reference 8 (app. A) describes facilities, capabilities, and limitations as applied to container testing.

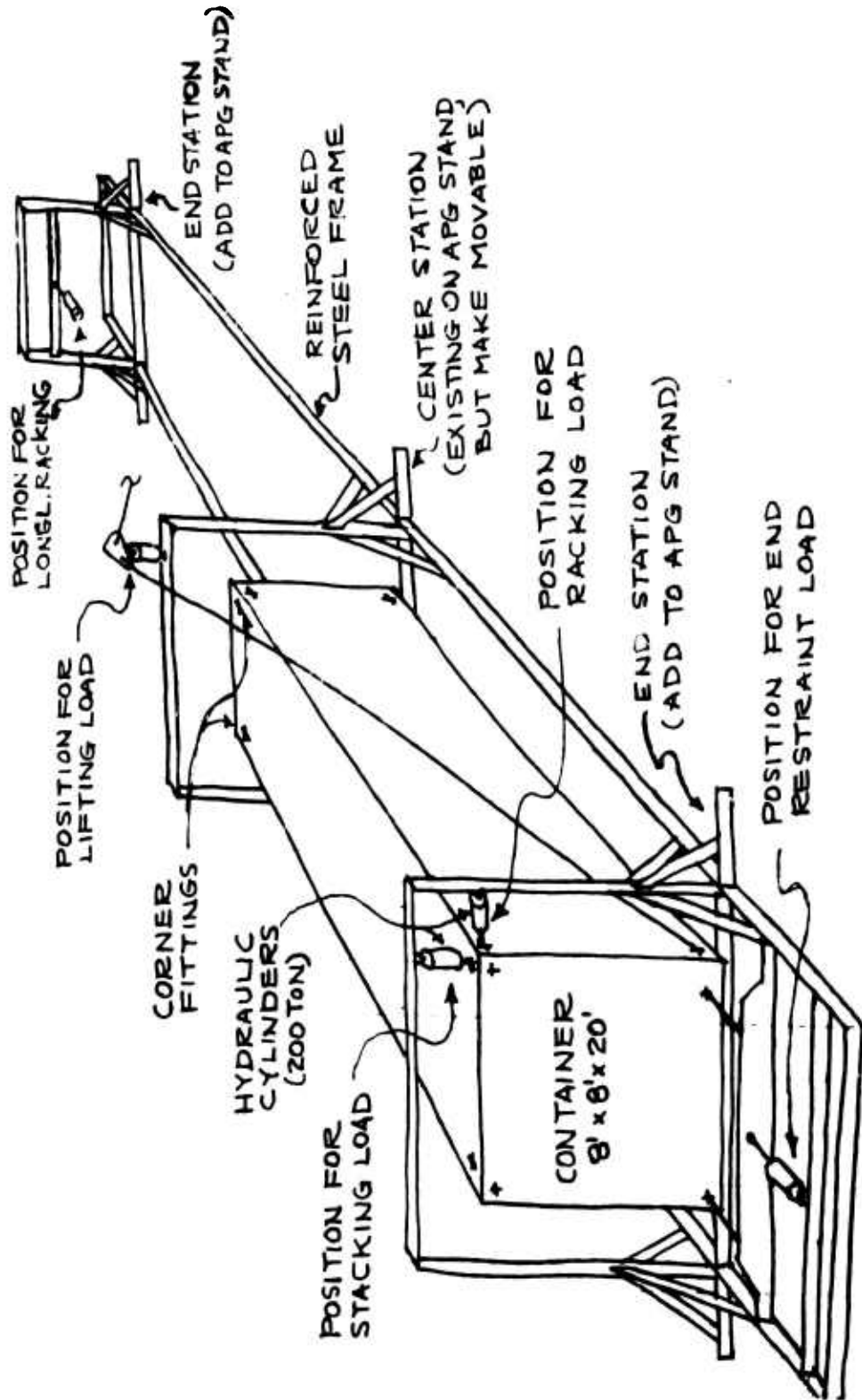


Figure 18. Container Test Stand.

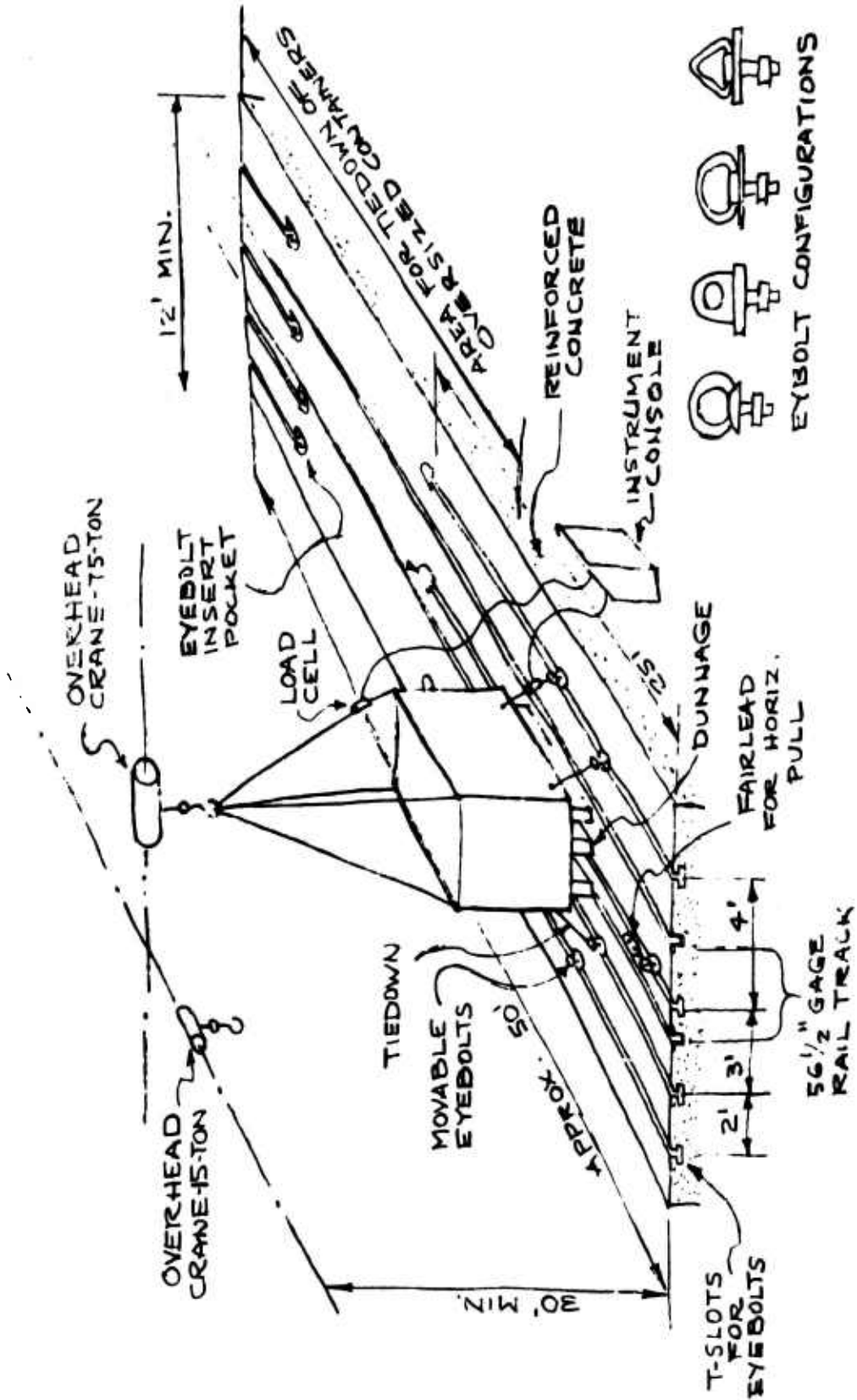


Figure 19. Tiedown Facility.

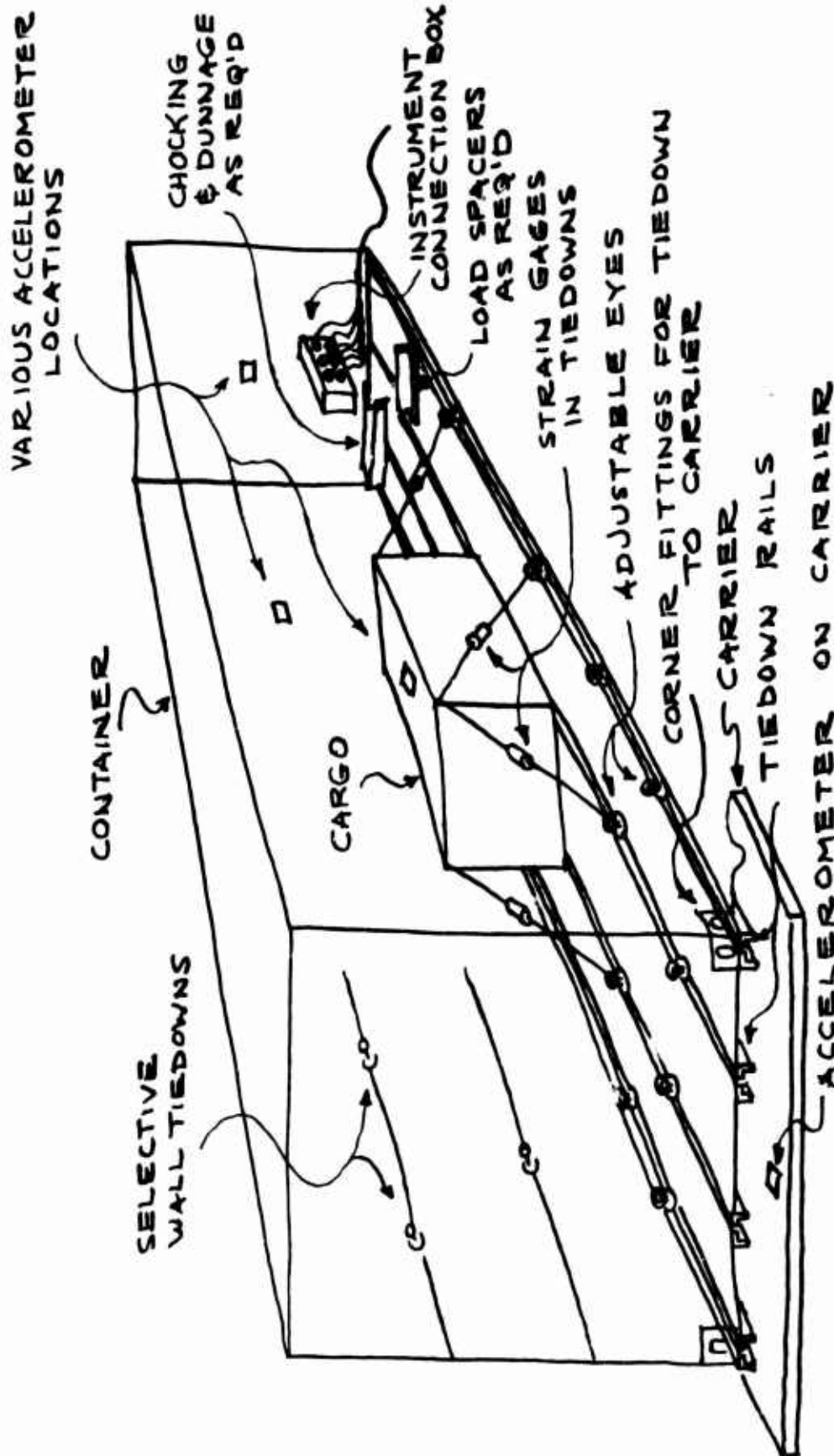


Figure 20. Instrumented Container.



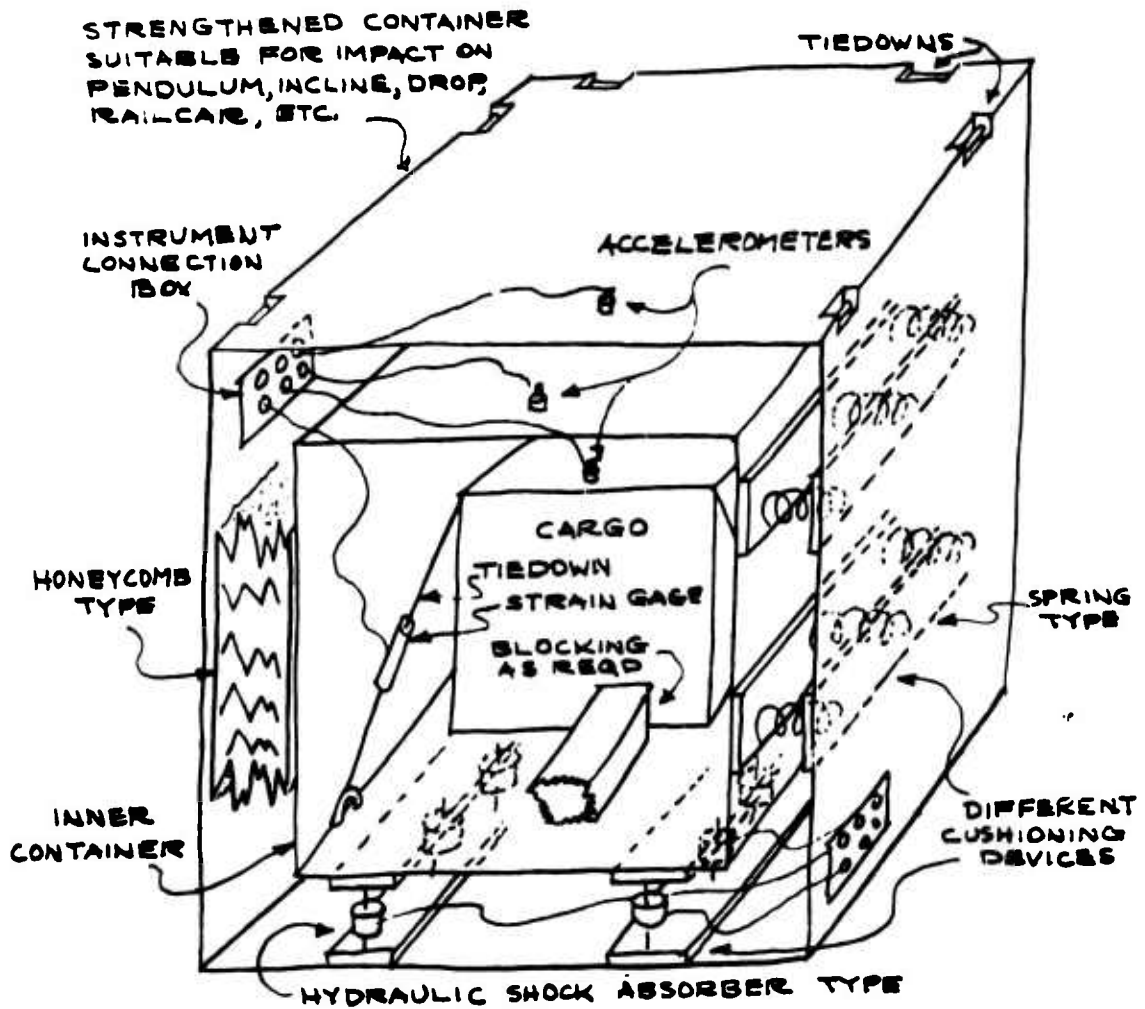


Figure 21. Shock Box.

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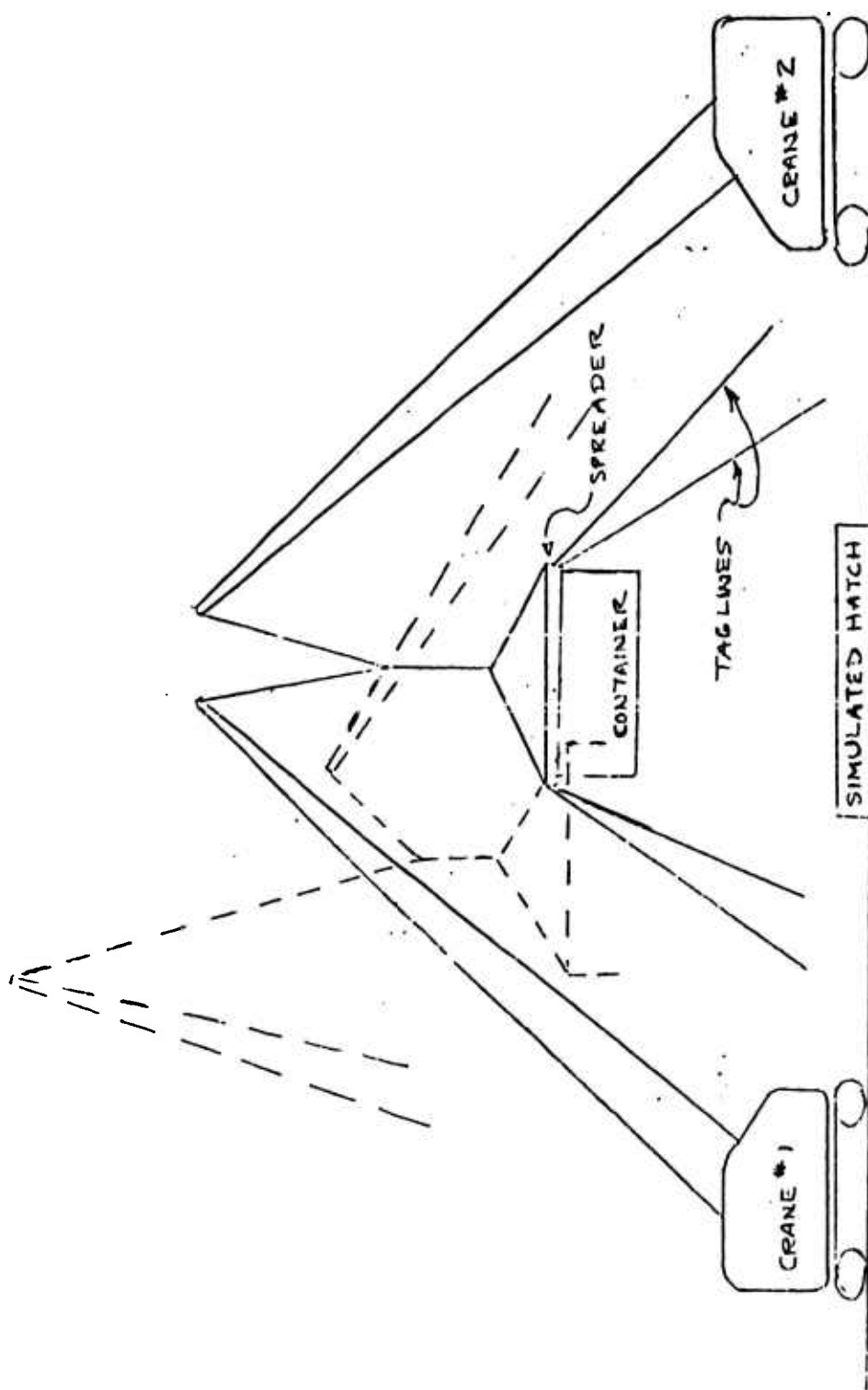


Figure 22. Lift Station Showing Container in Position Over Ship's Hatch.

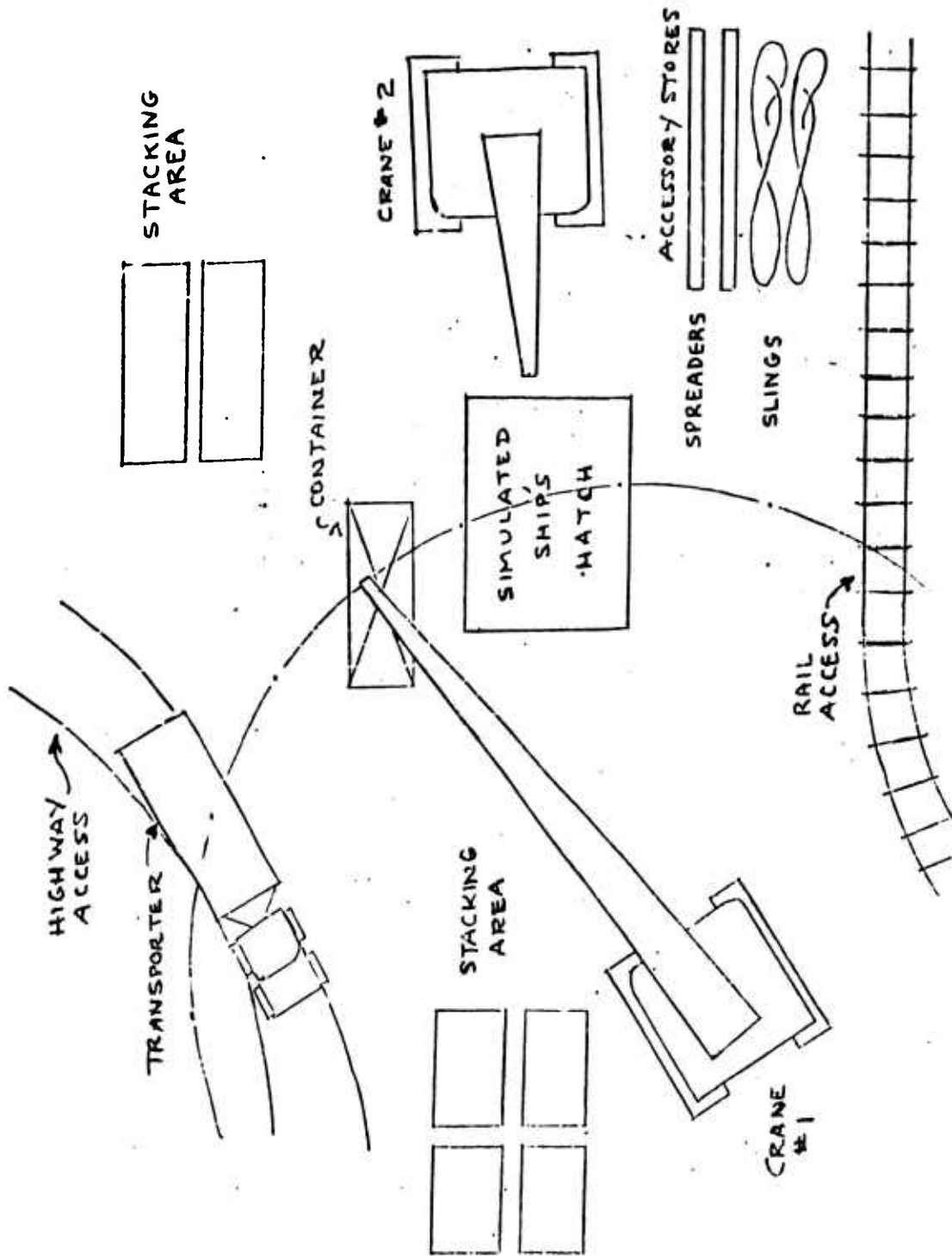


Figure 22 (Cont). Lift Station Layout.

APPENDIX F  
SAFETY

1. Oversized intermodal containers present special safety problems due to size and weight, lack of integral wheels (thus the need for externally applied lifts and movements), strict reliance on tiedown and lift provisions, and a wide variety of interfaces with differing modes and media of transportation.

2. Various safety factors may be involved and should be considered in respect to the specific item under investigation:

a. Safety and protection of the handling personnel, including procedures to follow in dangerous situations such as the handling of tag-lines during marine loading/unloading operations.

b. Need for special protective clothing or gear such as gloves, hard hats, protective shoes, life jackets, etc.

c. Safety and protection of the contained cargo, including proper internal blocking, bracing, tiedown, dunnage at floor or end walls, or particular protective linings provided by the container.

d. Protection against loss of cargo or damage through pilferage or sabotage; need for escort.

e. Dangers due to the hazardous nature or type of cargo carried. Specific regulations apply for different cargoes (3 below).

f. Adequacy of seals, ports, and closures not only to protect contents against ingress of contaminants, but also to indicate potential danger from leakage of cargo (liquids or odors).

g. Hazards existing on the carrier during transport, such as ignition, grounding, or exhaust hazards of vehicles.

h. The need for special protection provision for a particular cargo mix.

i. Center of gravity and distribution of internal load which, when subjected to shifting of the cargo/lading, may affect carrier stability.

j. Particularly dangerous operational situations pertaining to: stacking, where level-surface, inter-container mating and stack heights and aisles may be critical; and sling lifting, where pendulation may result in excessive and uncontrolled forces and motions.

k. Severity of the safety environment which is directly relatable to the transportability environment, as in adverse marine or logistics-over-the-shore operations.

1. Special actions or training that may be required in the event of accidents, such as for fire, explosion, collision, wrecks, gas leakage, traffic obstruction, etc.

m. Situations that may require specialized conveyance inspection or certification such as required by ABS or FAA.

3. Numerous references exist for guidance in planning safety tests. Representative documents are listed below. Those related to the specific item or test situation should be sought, however.

#### Container Safety References

DOD Reg 4500.32-R, "Military Standard Transportation and Movement Procedures."

AR's:

- 55-38, "Reporting of Transportation Discrepancies in Shipments."
- 55-55, "Transportation of Radioactive and Fissile Materials Other than Weapons."
- 55-56, "Transportation of Dangerous or Hazardous Chemical Materials."
- 55-162, "Permits for Oversize, Overweight, or Other Special Military Movements on Public Highways in the United States."
- 55-203, "Movement of Nuclear Weapons, Nuclear Components and Related Classified Nonnuclear Materiel."
- 55-228, "Transportation by Water of Explosives and Hazardous Cargo."
- 55-355, "Military Traffic Management Regulation."
- 380-55, "Safeguarding Classified Defense Information in Movement of Persons and Things."
- 385-10, "Army Safety Program."
- 385-14, "Accident/Incident Report - Shipments of Conventional Explosives and Dangerous Articles by Commercial Carriers."
- 385-30, "Safety Color Code Markings and Signs."
- 385-40, "Accident Reporting and Records."
- 700-53, "Report of Packaging and Handling Deficiencies."

DA Pam 55-1, "Transportation - Railway Service."

MTMTS (Military Traffic Management and Terminal Service Agency) Pams:

- 55-2, "Guidelines on Stuffing Containers."
- 55-3, "Transportability Guidelines for Military Cargo in LASH Lighters and SEABEE Barges."

TM's:

- 38-250, "Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft."

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55-602, "Movement of Special Freight."

AMCR 385-100, "Safety Manual."

MIL-STD-1458, "Radioactive Materials, Marking and Labeling of Items, Packages and Shipping Containers for Identification in Use, Storage and Transportation."

CFR (Code of Federal Regulations):

Title 10, CFR 71, "Packaging of Radioactive Material for Transport."

Title 10, CFR 70, "Special Nuclear Material."

Title 10, CFR 20, "Standards for Protection Against Radiation."

Title 14, CFR 103, "Transportation of Dangerous Articles and Magnetized Materials."

Title 46, CFR 146, "Transportation or Storage of Explosives or Other Dangerous Articles or Substances and Combustible Liquids on Board Vessels."

Title 49, CFR 171-179, "Transportation of Explosives and Other Dangerous Articles," published by Agent T. C. George's Tariff No. 23.

Official Air Transport Restricted Articles Tariff No. 6-Series, Agent C. C. Squire, General Manager.

United Nations International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials:

Safety Series No. 6

Notes on Certain Aspects of the Regulations, Safety Series No. 7.