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Material Test Procedure 10-2-080
General Equipment Test Activity

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

CONTAINERS, PALLETS, PALLET-CONTAINERS, CONEX CONTAINERS

1. OBJECTIVE

The objective of this document is to set forth the test methodology and testing techniques necessary for determining if palletized and Conex containers meet the technical performance and safety charactistics prescribed in the appropriate Qualitative Military Requirements and Technical Characteristics.

2. BACKGROUND

The concept for future warfare indicates that field armies will possess great mobility in terms of vehicles and aircraft. A more responsive and mobile logistical system is required to complement this improved tactical mobility.

Resupply of forward area units heretofore has been built primarily around the handling of individual packs on trucks. This process requires excessive manpower and occasionally results in supply congestions which severely restrict the capabilities of combat units.

The changing concept of warfare and the development of new equipment, packaging materials and techniques require continuing investigation in an effort to improve tactical mobility.

Development of the consolidated utilized load concept and the advent of various types of special mechanical handling equipment (MHE) has partially solved this problem.

Conex containers normally are used in all areas except in close support of front-line battle. This is due to their cost and size. However, they can be utilized in forward areas.

Conex containers offer several advantages. They are re-usable, offer excellent security against pilferage, provide protection from the elements, and are easy to handle despite their size.

3. REQUIRED EQUIPMENT

3.1 SPECIAL EQUIPMENT USED IN EVALUATING PALLETIZED AND CONEX CONTAINERS

a. Packaging Facilities and Equipment

1) Strapping equipment
2) Heat sealing equipment
3) Fiber board processing equipment
4) Cleaning and preservation equipment
5) Carpenter shop

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6) Assembly lines or areas
7) Drop tester and vibration tester
8) Incline Impact Machine (Rail Humping Test Equipment)

b. Materials Handling Equipment

1) Forklifts
2) Conveyors
3) Cranes
4) Hoisting equipment
5) Port cargo handling equipment

c. Camera and Film
d. Applicable material for packaging

3.2 TEST FACILITIES

a. Environmental Storage

1) Arctic (cold-dry)
2) Temperature (cold-wet)
3) Tropic (hot-wet)
4) Arid (hot-dry)

b. Climatic Chambers
c. Type of Storage

1) Refrigerated
2) Dehumidified
3) Covered
4) Shed
5) Warehouse
6) Improved
7) Unimproved

d. Actual and/or simulated shipping and handling facilities (rail, surface, air, water).
e. Accountability, wholesale and retail issue facilities

3.3 INSTRUMENTATION REQUIREMENTS

Obtained from Material Analysis Facility:

a. Environmental measuring equipment (thermometer, humidity indicator, etc.)
b. Measuring devices (calibrated scales, impactograph)
c. Instrumentation as required in MTP 10-2-500.

4. REFERENCES

A. MS-MIL-B-11856H, Box Metal, Shipping: Reusable, Transporter, Steel, Max Load 9,000 Pounds, 29 June 1964.
B. USATECOM 7-3-0150-03K - Final Report of Engineer Design Test of Containers, Unit Load, Expendable, February 1965.
C. USATECOM 7-3-9908-02-K1 - Final Report of Special Study of Simulated Shipment Methods for Evaluating Military Containers, April 1965.
D. USATECOM 7-6-0727-01 - Final Letter Report, Comparison Test (IC), CONEX, Metal Shipping Container Type II (Category II), April 1966.
E. USATECOM Regulation 385-6, Safety.
F. American Society for Testing and Materials - Standards: Section 15.
G. MIL. STD - 810A (USAF) - Environmental Test Methods for Aerospace and Ground Equipment, 23 June 1964.
H. USATECOM MTP 10-2-500, Physical Characteristics
I. USATECOM MTP 2-2-537, Cargo Loading Adaptability

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following tests conducted on palletized and Conex containers.

a. Pre-Operational Inspection: A study designed to ascertain the arrival condition of the test containers and related parts, and any defects in material and fabrication, and to determine if the test containers meet the required physical dimensions, specifications and material characteristics.

b. Assembling and Packaging: A study designed to determine the ease of assembling and packaging of the various configurations of unit load containers, the condition of the containers at the beginning of the shipping cycle after completion of all repacking and unitizing operations, and weighing the container and its contents.

c. Stacking: A study designed to determine the stacking characteristics and any damage resulting to the container, pallet, or unit load during the test.

d. Shipping and Handling: A study designed to determine the condition of containers during the various phases of the transshipment operations and upon arrival at destination. A diverse shipping combination may be used to obtain maximum exposure to various transportation media and transfer systems.

e. Storage: A study designed to determine the condition of the container and the contents during the storage cycle and at the completion of the test, to evaluate the relative performance of the configurations, to develop data on maintenance, replacement of loose or broken material, or any other repairs occurring during the test.

f. Environmental Tests: A study to determine the capability of the containers to function suitably under various environmental conditions.

g. Vertical Deceleration Test: A test designed to determine failures or distortions in any structural member as a result of shock.

h. Vertical Pull Test: A test designed to determine evidence of

rupture or damage to the welds or deformation of any structural section or lifting lugs as a result of applied tensile loadings.

5.2 LIMITATIONS

Where normal transportation, handling, and storage procedures are used rather than machine or laboratory evaluation, maximum possible control and instrumentation shall be used to assure true findings.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Pre-Test Conditions

Ensure that the test personnel are adequately trained and cognizant of the proper methods of reporting and, when appropriate, evaluating so that the proper data will be recorded.

6.1.2 Pre-Operational Inspection

Perform the following procedures:

6.1.2.1 Arrival Inspection Tests

The test item shall be subject to the following upon its arrival at the test site:

a. Adequacy of packaging - Visually inspect the test item and record the following:

1) Binding deficiencies such as broken straps, seals, etc.
2) Packaging material deficiencies such as cuts, tears, breaks, etc.

b. Test item damages - Visually inspect the test item and record damages such as breaks, cracks, etc.

c. Verification that the test containers comply with Safety Regulation USATECOM 385-6.

6.1.2.2 Physical Characteristics

The test item shall be tested as described in the appropriate paragraphs of MTP 10-2-500 to determine its dimensions, physical specifications, and material characteristics.

6.2 TEST CONDUCT

6.2.1 Assembly and Packaging

6.2.1.1 Assembly

Assemble the test items as specified in the applicable technical manual and record the following:

a. Difficulties in setting up blanks.
b. Difficulties in effecting bottom and top closures, and container sealing and reinforcement where applicable.
c. Method and difficulties encountered in setting up the caps and liners.
d. Any deficiencies concerning the fit of liners with regard to width, height, and length.
e. Difficulties encountered when working with different materials in both containers and liners.
f. Adequacy of the assembly instructions.

6.2.1.2 Packaging

a. Pack each test container with appropriate contents, as specified in the test items technical manual, and record the following:

1) Ease of packing
2) Operability of door latches, hinges, doors, etc., as applicable
3) Adequacy of seal closures, as applicable
4) Ease of capping, strapping, etc., as required

b. Code each container, as appropriate, according to the designated statistical design (See Figure 1).
c. Record the weight of a minimum of one of each type container, and its load, within each unit load, and designate these containers as control containers.

NOTE: These containers shall be used to measure moisture absorption.

d. Attach an impactograph (recording accelerometer) to a minimum of three containers, per type, in each unit load.

6.2.2 Stacking

a. Determine, when applicable, the number of test items that can be stacked by the following procedures:

1) Place a container, and its rated load, on the top of a similar container and examine the lower container top for damage. If no damage has occurred:
2) Increase the load on the container until three loaded containers, or their equivalent weight, have been stacked on the lower container.
3) Examine the top and posts of the bottom container for deformation.

b. Examine the test items during the shipping and handling, and storage portions of the test (paragraphs 6.2.3 and 6.2.4) to determine the following during normal/simulated usage:

1) Compression forces applied to the lower containers.
2) Breakage due to stacking.
3) Effect of time on the ability of the lower container to withstand compressive forces and resulting breakage.
4) Stability of the "stack" under shipping conditions (ability to remain stacked).

6.2.3 Shipping and Handling

The test item shall be subject to the cargo loading adaptability tests of MTP 2-2-537 and the following shipping and handling tests using actual and/or simulated shipping and handling facilities as follows:

6.2.3.1 Vehicle Tests

a. Load the test units aboard vehicles (trucks, trailers, etc.) using normal materials handling equipment (MHE) and the test plans loading schedule and record the following:

1) Type of vehicle
2) Equipment used to load vehicles
3) Difficulties encountered in loading
4) Condition of bracing (if required)
5) Impactograph reading

b. Operate the vehicles, at normal operating speeds, over roads as indicated in the test plan or as follows stopping and restarting a minimum of once every 20 miles:

1) A minimum of 100 miles over a paved highway
2) A minimum of 100 miles over an improved gravel road
3) A minimum of 25 miles over a cobblestone road
4) A minimum of 25 miles over a loose rock road
5) A minimum of 25 miles over a washboard road (minimum of two-inch washboard).

c. Examine the test item at the completion of each road test and record the following, when applicable:

1) Condition of bracing within the vehicle
2) Direction and distance of shifting of:

   a) Load first layer
   b) Load second layer, etc.

3) Damage (amount and type):

a) To containers
b) To binding
c) To packing
d) To container contents

4) Impactograph recording valves

d. Unload the test items from the vehicles and record:

1) Equipment used in unloading
2) Difficulties encountered unloading

6.2.3.2 Rail Tests

a. Load the test items aboard railroad freight cars using the test plans loading schedule and normal MH Equipment and record the following:

1) Equipment used for loading
2) Difficulties encountered loading
3) Impactograph recording readings
4) Condition of bracing

b. Operate the railroad car over a course consisting of level road beds, 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 test items shall be subject to a minimum of 500 miles continuous travel and examined at the completion of the test distance travel.

Record the following:

1) Condition of bracing within the freight car
2) Direction and distance of shifting of:

a) Load first layer
b) Load second layer, etc.

3) Damage (amount and type)

a) To containers
b) To binding
c) To packing
d) To container contents

4) Record impactograph recording valves

c. Unload the test items from the vehicles and record:

1) Equipment used in unloading

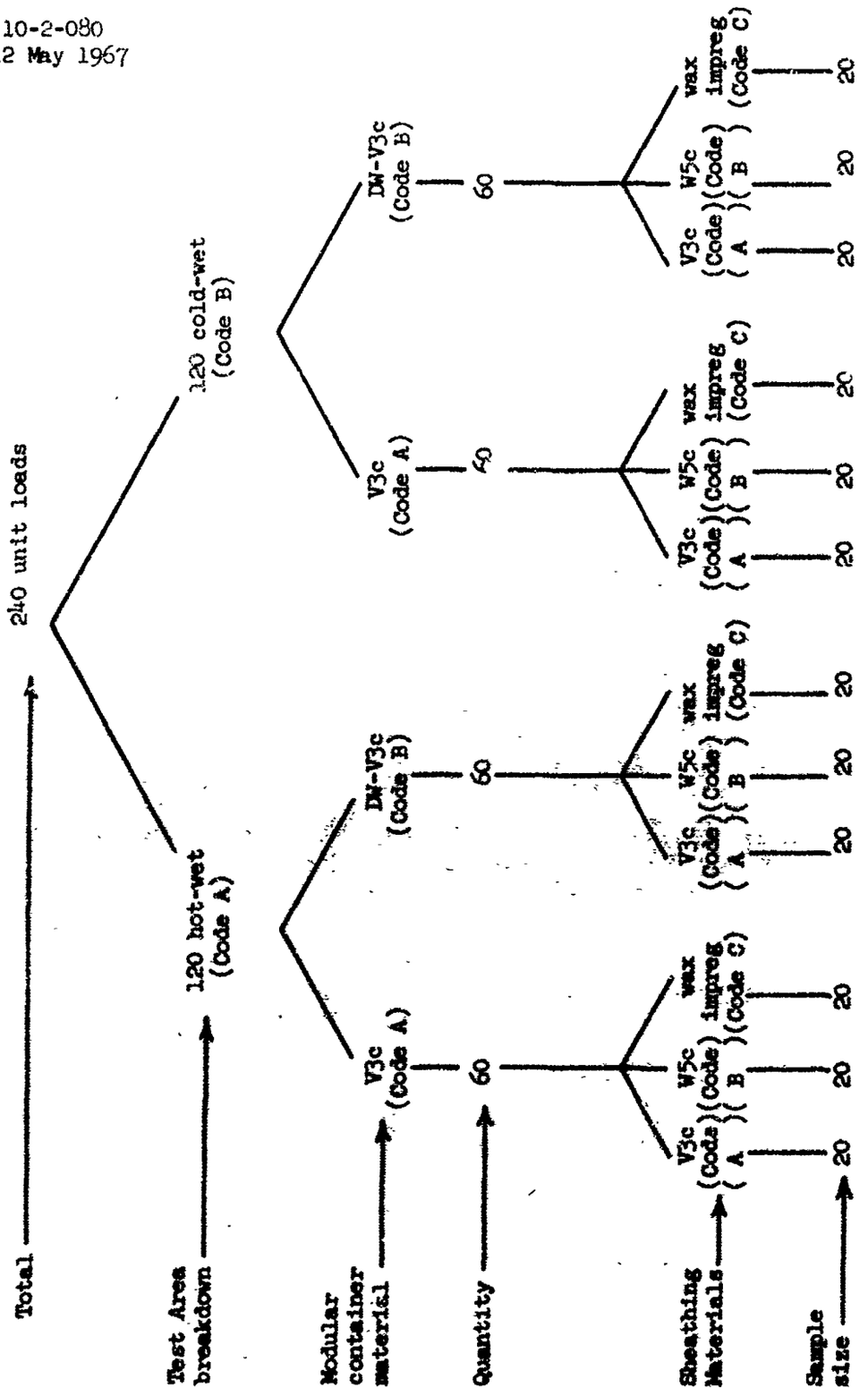

FIGURE 1. TEST DESIGN

2) Difficulties encountered unloading

6.2.3.3 Ship Tests

Load the test items aboard ships, or ship simulating facilities (which are capable of simulating an actual ship in loading methods, hold and/or deck space, and ships pitch and roll) as indicated in the test plan loading schedule using normal MH Equipment and record the following:

a. Ship facility - real or simulated
b. Type of ship used/simulated
c. Equipment used for loading
d. Location of storage
e. Difficulties encountered while loading:

1) In the ship's hold
2) On ship's deck, if applicable

f. Broken stowage space in wings between decks (distance from top of container load to ceiling
g. Condition of bracing and or tie-down
h. Impactograph recording values

6.2.3.3.1 Actual Ship Test - Attempt to have the ship proceed through rough waters (Beaufor Scale 6 wind - State 5 sea: 10-18 ft. waves; 28.75 mph wind) and record the following:

a. Sea states encountered
b. Duration of sea states
c. Impactograph recording values
d. Condition of bracing and/or tie-down
e. Direction and distance of shifting of:

1) Load first layer
2) Load second layer, etc.

f. Damage (amount and type)

1) To container
2) To binding
3) To packing
4) To container contents

6.2.3.3.2 Simulated Ship Test - Apply a roll of 30°, at a frequency of 15 seconds, and a pitch of 5° at a frequency of 20 seconds for a minimum of one hour and record the following:

a. Duration of pitch and roll motion
b. Impactograph recording values
c. Condition of bracing and/or tie-down

d. Direction and distance of shifting of:

1) Load first layer
2) Load second layer, etc.

e. Damage (amount and type):

1) To container
2) To binding
3) To packing
4) To container contents

6.2.3.3.3 Unloading - Unload the test items from the ship/simulator and record:

a. Equipment used for unloading
b. Difficulties encountered while unloading from:

1) Ship's hold
2) Ship's deck, if applicable

6.2.3.4 Air Tests

a. Load the test items aboard aircraft, or aircraft simulated facilities as indicated in the test plan loading schedule using normal MH Equipment and record the following:

1) Type of aircraft used/simulated
2) Equipment used for loading
3) Difficulties encountered while loading
4) Condition of tie-down
5) Impactograph recording values

b. Unload the test items from the aircraft/simulated aircraft and record:

1) Equipment used in unloading
2) Difficulties encountered while unloading

6.2.4 <u>Storage</u>

The test items shall be stored, for a period of not less than six months, in open fields, sheds, and warehouses, under the following environmental conditions, or in test chambers capable of simulating the following meteorological conditions and with 50% of the control containers appropriately loaded.

a. 120°F air temperature, solar radiation of 36- BTU/ft^2 hr (145° ground temperature) and a maximum relative humidity of 15%.
b. 120°F air temperature, solar radiation of 360 BTU/ft^2 hr (145° ground temperature) and a minimum relative humidity of 80%.

c. 0°F under snow and ice conditions.
d. 65°F and dry.

6.2.4.1 Open Field Tests

The test items shall be stored in the open on both improved and unimproved sites, subject to the temperature/humidity conditions of paragraphs 6.2.4.a through 6.2.4.d, directed by the test plan, and subject to the following checks:

a. Record the weight of the control containers and individual loads prior to testing.
b. All containers, subject to a given storage condition, shall be examined for exterior damage every two weeks. Record any damages observed.
c. One-sixth (1/6) of the control containers shall be weighed, then opened and their contents examined for damage every month. Record any damage.

NOTE: Until the completion of the test no container shall have been opened and examined more than once.

d. At the completion of testing:

1) Examine the exterior of all test items and record any damage observed.
2) Weigh the control containers and:

a) Open the containers and examine and weigh the contents
b) Determine the compatability of the various materials, when the container is made of dissimilar materials.

3) Determine the compatability of the strapping and bonding material with the container material.

e. Repeat steps a through d with the test items covered with a tarpaulin or equivalent.

6.2.4.2 Shed Tests

The test items shall be stored in sheds, as directed by the test plan, on both improved and unimproved land, without heat, air conditioning, or dehumidification, with the ambient (outside) temperature/humidity conditions as described in paragraphs 6.2.4.a through 6.2.4.d. The test items shall be subject to the checks of paragraph 6.2.4.1.

6.2.4.3 Warehouse Tests

a. The test items shall be stored in warehouses, as directed by the test plan, which have the following characteristics, and are subject to stipulated meteorological conditions:

1) Warehouses lacking in heating, refrigerating and dehumidify-

ing capabilities and subject to the meteorological conditions of paragraph 6.2.4.a through 6.2.4.d.

2) Warehouses capable of maintaining a temperature of 0°F or higher when exposed to -65°F and minimal humidity.
3) Warehouses capable of maintaining a temperature of 32°F or higher when exposed to ice/snow conditions and temperatures below 0°F.
4) Warehouses capable of dehumdifying air having a minimum relative humidity of 80% and a temperature of no less than 85°F.
5) Warehouse capable of cooling and/or dehumidifying air having a temperature of 125°F or higher and a humidity varying from 0 to 100%.
6) Warehouses capable of refrigerating air having a temperature range of from 50°F to 125°F down to 20°F.

b. The test items shall be subject to the checks of paragraph 6.2.4.1.

6.2.5 Environmental Tests

In the event that the test items cannot be subject to the various environmental conditions stipulated during storage (paragraph 6.2.4) a minimum of three test items of each type shall be subject to the following:

6.2.5.1 Elevated Temperature Tests

a. Test items shall be subject while in a test chamber, to a temperature of 160°F for a minimum of 48 hours.

b. Record the duration of temperature exposure and the following as applicable:

1) Differential expansion of dissimilar metals
2) Non-metallic discoloration, cracking, bulging, checking or grazing
3) Melting or adhering of closure and sealing strips.

6.2.5.2 Low Temperature Tests

a. Test items shall be subject while in a test chamber, to a temperature of -80°F for a minimum of 48 hours.

b. Record the duration of temperature exposure and the following as applicable:

1) Differential contraction of dissimilar metals
2) Loss of resiliency of packings and gaskets
3) Cracking of seals and closure strips

6.2.5.3 Humidity Test

a. Assemble and weigh loads for two-thirds (2/3) of the test items

to be tested and load them into the containers.

b. Weigh the test items

c. Insert test item into a test chamber having a temperature between 68°F and 100°F and uncontrolled humidity and be subject to the following temperature humidity cycling:

1) Raise the chamber temperature and relative humidity to 160°F and 95% RH over a period of two hours and maintain this condition for a period of 6 hours.
2) Maintain the chamber relative humidity at 95% while reducing the chamber temperature to between 68°F and 100°F over a period of 16 hours.

d. Repeat steps (c.1) and (c.2) for ten (10) continuous cycles.

e. Record the following at the completion of testing, as applicable:

1) Corrosion of test item metallic material
2) Swelling of test item non-metallic material
3) Loss of physical strength of non-metallic material
4) Weight of the test items
5) Weigh and inspect the container loads

6.2.5.4 Sand and Dust Tests

a. Insert closed (sealed) test items into a chamber having a sand and dust density of 0.25 gram per cubic foot and a maximum relative humidity of 30%.

NOTE 1. See paragraph 6.2.5.4.1 for the sand and dust specifications.
NOTE 2. The density shall be measured at a minimum of three different locations, within the test chamber, utilizing collection devices such as impinger flasks.

b. Maintain a temperature of 77°F for a minimum period of 2 hours with an air velocity of 100 to 500 feet per minute.

c. Raise the chamber temperature to 160°F and maintain it for a minimum period of 2 hours.

d. Remove the test item from the test chamber and examine it for the following:

1) Exterior damage
2) Difficulties in opening the test items
3) Presence of sand and dust within the test items

6.2.5.4.1 Sand and Dust Characteristics - The sand and dust used during this procedure shall be of angular structure and conform to the following specifications:

a. 100 percent of the sand and dust shall pass through a 100-mesh screen, U. S. Standard Sieve Series

b. 98 ± 2 percent of the sand and dust shall pass through a 140-mesh screen, U. S. Standard Sieve Series.

c. 80 ± 2 percent of the sand and dust shall pass through a 200-mesh screen, U. S. Standard Sieve Series.

d. 75 ± 2 percent of the sand and dust shall pass through a 325-mesh screen, U. S. Standard Sieve Series.

e. Chemical analysis of the dust shall be as follows:

SUBSTANCE	PERCENT OF WEIGHT
SiO_2	97 to 99
Fe_2O_3	0 to 2
Al_2O_3	0 to 2
TiO_2	0 to 2
MgO	0 to 1
Inorganic Losses	0 to 1

6.2.5.5 Water Resistance Tests

a. Place closed (sealed) test items on a flat surface and subject them to a spray of water for 10 minutes applied simultaneously through eight shower heads spray nozzles located as indicated in paragraph 4.3.1.1 of reference 4A and with a flow rate as indicated in the same paragraph.

b. Record any damage done to the test item and the presence of water within the test containers.

6.2.6 Vertical Pull Test - Lifting Attachments

Determine the ability of lifting attachments, both permanently and temporarily attached, to withstand excess pull without damage or destruction as follows:

a. Restrain a minimum of three test containers so that a force applied to the lifting attachments shall be evenly distributed against the restraining units.

b. Subject the lifting attachments to the load indicated in the test plan or a load equal to twice the weight of the test container and its rated load.

c. Record the load applied and damages incurred, if any.

6.2.7 Shock Tests

The test specimen shall be shock tested, under various conditions, as follows:

6.2.7.1 Vertical Deceleration Test (Drop Test)

a. Install an evenly distributed appropriate load, within a minimum of three test containers.

b. Secure the load, within the container, when applicable, with

timber bracing.

c. Subject the test containers, using a drop testing machine, to the drop(s) specified in the test plan or as indicated in Table I and described below:

TABLE I

Drop Test

Gross Weight Not Exceeding	Dimensions on Any Edge or Diameter Not Exceeding	Free Fall Drop Test (Height of Drop)	Edgewise Drop Test (Height of Drop)	Cornerwise Drop Test (Height of Drop)
Pounds	Inches	Inches	Inches	Inches
50	36	30	--	--
100	48	21	--	--
150	60	18	--	--
200	60	16	--	--
600	72	--	36	36
3000	No Limit	--	24	24
No Limit	No Limit	--	12	12

d. Drop tests of Table I shall be performed as follows:

1) Free fall drop test: The packaged test item of the applicable gross weights and dimensions specified in Table I shall be dropped cornerwise onto a hard, level, concrete floor or equal surface on each of its eight corners, falling freely through the vertical distances specified in Table I. Prior to each drop, the package shall be suspended with its center of gravity vertically above the striking corner.

2) Edgewise drop test: The packaged test item of the applicable gross weight specified in table I shall be tested as follows: One end of the base of the package shall be supported on a sill 5 to 6 inches in height. The opposite end shall be raised and allowed to fall freely to a hard level concrete floor or equal surface from the height of drop specified in Table I. The test shall be applied once to each end of the package. If the size of the package and the location of the center of gravity are such that this drop cannot be made from the prescribed height, the greatest height attainable shall be submitted.

3) Cornerwise drop test: The packaged test item having the applicable gross weight specified in Table I shall be tested as follows: One corner of the base of the package shall be supported on a block approximately 5 inches in height. A block nominally 12 inches in height shall be placed under the other corner of the same end. The opposite end of the package shall be raised and allowed to fall freely to a hard

level concrete floor or equal surface from the heights specified in Table I. This test shall be applied once to each of two diagonally opposite corners of the base. If the size of the package and the location of the center of gravity are such that this drop cannot be made from the prescribed height, the greatest height attainable shall be substituted. When the proportions of width and height of the package are such to cause instability in the cornerwise drop test, edgewise drops shall be substituted. In such instances two edgewise drops in each corner shall be conducted.

NOTE: Alternate methods of performing drop tests are continued in procedures D775, D997, D1083 and D1185 of reference 4F.

e. Record the distance dropped and G's attained.
f. Record any damage that occurs to the test item or its contents.

6.2.7.2 Rail Humping or Inclined Plane Tests

a. Install an evenly distributed load within a minimum of three test containers.
b. Secure the load, within the container, when applicable, with timber bracing.
c. Tie-down the test items on a carriage mounted on an inclined plane having a maximum slope of 20 degrees, being a minimum of 10 times the length of the carriage and having a barrier at the bottom of the decline.
d. Release the carriage at the top of the slope and record the impact when the carriage hits barrier.
e. Record damage incurred to the test item or its contents.

6.3 TEST DATA

6.3.1 Pre-Operational Inspection

Record the following:

a. Adequacy of packing (loose bindings)
b. Container damages (breaks in material)
c. Compliance with Safety Regulation USATECOM 385-6
d. Physical Characteristics data as collected in MTP 10-2-500:

1) Dimensions
2) Specifications
3) Material Characteristics

6.3.2 Assembly

Record the following:

a. Difficulties in setting up banks.

b. Difficulties in effecting bottom and top closures, and container sealing and reinforcement, where applicable.

c. Method and difficulties encountered in setting up caps and liners.

d. Deficiencies concerning the fit of liners with regard to width, length and height.

e. Difficulties encountered when working with different materials in both containers and liners.

f. Adequacy of assembly instructions.

6.3.3 Packaging

Record the following:

a. Ease of packing
b. Operability of door latches, hinges, etc., when applicable
c. Adequacy of seal closures
d. Ease of capping, strapping, etc.
e. Weight of control containers, in pounds

6.3.4 Stacking

Record the following:

a. Compression forces applied to the bottom containers, in psi when:

1) One container is loaded onto a second.
2) Three containers, or equivalent, are loaded onto a container.

b. Roof and/or post deformation, if applicable.

6.3.5 Shipping and Handling

6.3.5.1 Cargo Adaptability Tests

Data shall be recorded and collected as described in MTP 2-2-587.

6.3.5.2 Vehicle Tests

Record the following:

a. Vehicles used (trucks, trailers, etc.)
b. Materials handling equipment used (fork trucks)
c. Difficulties encountered while loading
d. Bracing required, if any
e. Impactograph reading, in G's
f. Type of road (paved highway, washboard road, etc.)
g. Post-test condition of the following as applicable:

1) Bracing
2) Direction (forward, left) and distance, in inches of each

container stack shift.

3) Damage to:

a) Container
b) Binding
c) Packing
d) Container contents

h. MH Equipment used in unloading
i. Difficulties encountered while unloading

6.3.5.3 Rail Tests

Record the following:

a. MH Equipment used in loading
b. Difficulties encountered while loading
c. Impactograph readings, in G's
d. Condition of bracing
e. Post test condition of the following, as applicable:

1) Bracing
2) Direction (forward, left) and distance, in inches of each container stack shift
3) Damage to:

a) Containers
b) Binding
c) Packing
d) Container contents

f. MH Equipment used in unloading
g. Difficulties encountered while unloading

6.3.5.4 Ship Tests

Record the following:

a. Facility used (real or simulated ship)
b. Type of ship simulated (transport)
c. MH Equipment used for loading
d. Location of storage (3rd deck, hold)
e. Difficulties encountered while loading
f. Distance from container tops to ceiling, below decks, in feet
g. Condition of bracing and/or tie-down
h. Impactograph values, in G's

6.3.5.4.1 Actual Ship Tests - Record the following when checking the test items on ships:

a. Sea states encountered (1, 5, etc.)

b. Duration of sea state, in hours
c. Maximum impactograph readings, in G's
d. Condition of bracing and/or tie-down
e. Direction (aft, port) and distance, in inches, of each container stack shift
f. Damage to:

1) Container
2) Binding
3) Packing
4) Container contents

6.3.5.4.2 Simulated Ship Tests - Record the following when checking the test items on ship simulating equipment:

a. Duration of pitch and roll motion, in hours
b. Impactograph values, in G's
c. Condition of bracing and/or tie-down
d. Duration (aft, port) and distance, in inches, of each container stack shift
e. Damage to:

1) Container
2) Binding
3) Packing
4) Container contents

6.3.5.4.3 Ship Unloading Tests - Record the following:

a. MH Equipment used for unloading
b. Difficulties encountered while unloading from:

1) Ship's hold
2) Ship's deck, if applicable

6.3.5.5 Air Tests

Record the following:

a. Aircraft used or simulated
b. MH Equipment used for loading
c. Difficulties encountered while loading
d. Condition of tie downs
e. Impactograph values, in G's
f. MH Equipment used for loading
g. Difficulties encountered while unloading

6.3.6 Storage Tests

Record the following for all tests, as applicable:

a. Weight and type of the control container loads
b. Weight of control containers, in pounds prior to testing
c. Type of tect site (test chambers or actual locale)
d. Simulated meteorological condition in °F and % R.H., if applicable
e. Actual meteorological conditions, if applicable, per week as follows:

1) Test week number (1, 5, etc.)
2) Temperature in °F

a) Weekly average
b) Weekly maximum
c) Weekly minimum

3) Relative humidity in %

a) Weekly average
b) Weekly minimum
c) Weekly maximum

4) Presence of precipitation:

a) Amount
b) Duration

6.3.6.1 Open Field Tests

Record the following:

a. Ground condition (improved or unimproved)
b. Coverage applied (none or tarpaulin)
c. For all containers every two weeks:

1) Week number (1, 5, etc.)
2) External condition of the test items

d. For control containers each month:

1) Month number (1, 5, etc.)
2) Weight of control containers being examined, in pounds
3) Condition of container contents
4) Weight of control container contents, in pounds

e. At the completion of testing:

1) External condition of the test items
2) Weight of all control containers, in pounds
3) Condition of all control container contents
4) Weight of control container contents, in pounds

5) Compatibility of various materials when container is made of dissimilar materials
6) Compatibility of strapping and bonding material with the container.

6.3.6.2 Shed Tests

Record the following:

a. Ground condition (improved or unimproved)
b. For all containers every two weeks:

1) Week number (1, 5, etc.)
2) External condition of the test items

c. For control containers each month

1) Month number (1, 5, etc.)
2) Weight of control containers being examined, in pounds
3) Condition of container contents
4) Weight of control container contents, in pounds

d. At the completion of testing:

1) External condition of the test items
2) Weight of all the control containers, in pounds
3) Condition of all control container contents
4) Weight of control container contents, in pounds
5) Compatibility of various materials when container is made of dissimilar materials
6) Compatibility of strapping and bonding material with the container

6.3.6.3 Warehouse Tests

Record the following:

a. Type of warehouse (refrigeration, air conditioned, etc.)
b. For all containers every two weeks:

1) Week number (1, 5, etc.)
2) External condition of the test items

c. For control containers each month:

1) Month number (1, 5, etc.)
2) Weight of control containers being examined, in pounds
3) Condition of container contents
4) Weight of control container contents, in pounds

d. At the completion of testing:

1) External condition of the test item
2) Weight of all the control containers, in pounds
3) Condition of all control container contents
4) Weight of control container contents, in pounds
5) Compatibility of various materials when container is made of dissimilar materials.
6) Compatibility of strapping and bonding material with the container.

6.3.7 Environmental Tests

6.3.7.1 Elevated Temperature Tests

Record the following for each test container:

a. Container number (1, 2, etc.)
b. Duration time of exposure, in hours
c. Differential expansion of dissimilar metals, as applicable
d. Non-metallic discoloration, cracking, etc., as applicable
e. Melting or adhering of closure and sealing strips, as applicable

6.3.7.2 Low Temperature Tests

Record the following for each test container:

a. Container number (1, 2, etc.)
b. Duration time of exposure, in hours
c. Differential contraction of dissimilar metals, as applicable
d. Loss of resiliency of packings and gaskets, as applicable
e. Cracking of seals and closures, if applicable

6.3.7.3 Humidity Test

Record the following for each test container:

a. Container number (1, 2, etc.)
b. Weight of test items, in pounds
c. Weight and type of container load, in pounds
d. For post-testing:

1) Corrosion of test item metallic material
2) Swelling of test item non-metallic material
3) Loss of physical strength of test item non-metallic material
4) Weight of test item, in pounds
5) Weight of test item load, in pounds
6) Condition of the container loads

6.3.7.4 Sand and Dust Tests

Record the following for each test container:

a. Container number (1, 2, etc.)
b. Air velocity in feet per minute
c. Exterior damage
d. Difficulties in opening the test item
e. Presence of sand and dust within the test item

6.3.7.5 Water Resistance Tests

Record the following for each test container:

a. Container number (1, 2, etc.)
b. Visible damage to the test item
c. Presence of water within the test item

6.3.8 Vertical Pull Test - Lifting Attachments

Record the following for each test container:

a. Container number (1, 2 etc.)
b. Type of lifting attachment (permanent or temporary)
c. Load applied, in pounds
d. Damage incurred, if any

6.3.9 Shock Tests

6.3.9.1 Vertical Deceleration Test

Record the following for each test performed:

a. Test performed (Free fall, edgewise, corner)
b. Container number (1, 2, etc.)
c. Container point of impact (top right corner, end, etc.)
d. Distance item was dropped, in inches
e. Acceleration obtained, in G's
f. Damage which occurred:

1) Container
2) Contents

6.3.9.2 Rail Humping Test

Record the following:

a. Container number (1, 2, etc.)
b. Slope angle in degrees
c. Length of inclined plane, in feet
d. Damage:

1) Container
2) Contents

6.4 DATA REDUCTION AND PRESENTATION

Data shall be summarized to reveal significant deficiencies in construction, handling, shipping, storage and stacking of the test containers, and presented in chart, tabular form or graphic form as applicable.

6.4.1 Pre-Operational Inspection

Summarize the adequacy of packaging and test item damages for each type of container.

6.4.2 Assembly and Packaging

Tabulate the difficulties encountered assembling each type of container, indicating the total number of each type container, and the number of each type giving specific problems.

6.4.3 Stacking

a. Indicate by similar containers and weight the number of containers that can safely be stacked.

b. Prepare a graph, if applicable, obtained from storage data which will show the effects of time on stack loads which meet the requirements of "a" above.

6.4.4 Handling and Shipping

a. Indicate the type of damage, for each type of container and method of shipping as indicated in Appendices A and B.

b. Tabulate the loading and unloading difficulties encountered with each type of container, shipping vehicle, and loading/unloading equipment.

6.4.5 Storage

Indicate the type of damage for each type of container, type of storage condition, and each environmental condition as follows:

a. Damage (type and percent) as depicted in Appendix C.
b. Category of damage (major or minor) as depicted in Appendix D.
c. Condition of test item contents as depicted in Appendix E.
d. Percentage change in weight for control containers and their contents as depicted in Appendix F.

6.4.6 Environmental Tests

6.4.6.1 All Tests

Indicate the type of damage, for each type of container and each

environment as depicted in Appendix G.

6.4.2 Humidity Tests

Indicate the following:

a. Condition of test item contents as depicted in Appendix E.
b. Percentage change in weight for the containers and their contents as depicted in Appendix F.

6.4.6.3 Water Tests

Summarize the amount of water within the container by container type.

6.4.6.4 Sand and Dust Tests

Summarize the amount of sand and dust within the container by container type.

6.4.7 Vertical Pull Test - Lifting Attachments

Summarize the amount of pull the various types of lifting attachments can be subject to without damage.

6.4.8 Shock Tests

Summarize the shock (g forces) each type of test item can be exposed to without sustaining damage.

APPENDIX A

TYPE OF DAMAGE OCCURRING DURING SHIPMENT

	Type Damage		Motor Vehicle						Rail						Ship					
			AA	AB	AC	BA	BB	BC	AA	AB	AC	BA	BB	BC	AA	AB	AC	BA	BB	BC
No. Loads	No crushing or bulging		19	19	16	20	18	17	18	16	12	19	15	12	4	2	6	11	7	9
	Bulging slightly		6	1	2	0	2	3	0	4	5	0	4	3	4	9	4	7	9	7
	Bulging badly		0	0	1	0	0	0	0	0	1	0	0	0	10	7	10	2	4	0
	Crushed slightly		1	1	4	0	1	2	2	2	4	1	2	5	4	7	4	1	2	2
	Crushed badly		0	0	0	0	0	0	0	0	0	0	0	1	9	6	5	2	1	1
	No. straps (5 straps per load)	Loose	3	1	24	5	12	12	11	6	17	4	12	26	94	95	96	94	96	97
		Broken	0	0	0	0	1	0	6	4	4	5	4	3	6	4	4	6	4	3
		Missing	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
No. Loads with Sheathing Damage	Holes and tears	Scoreline	0	0	4	1	3	1	1	2	5	2	6	9	5	5	11	1	0	9
		Walls	1	1	5	1	4	3	3	5	9	3	9	9	3	6	14	4	6	14
		Load contents	0	0	0	0	0	0	1	2	2	1	0	2	0	0	1	0	1	0
	Crushing	Corners	0	1	1	0	1	1	1	2	2	0	1	4	10	7	6	2	4	2
		Walls	0	1	5	0	2	1	1	2	5	0	5	5	12	10	8	2	5	3
		Scorelines	0	0	3	0	3	2	1	1	3	0	4	7	7	4	6	0	2	1
	Cause of sheathing damage	Pallets scraping, weight on top	-	-	4	-	-	1	2	-	7	1	1	7	5	8	4	2	1	2
		Settling, handling	-	-	-	-	-	-	-	-	-	-	-	-	3	6	6	1	5	6
		Forklift	1	1	3	1	4	3	2	5	7	1	9	5	-	-	-	-	-	-
		Weather	-	-	-	-	-	-	-	-	-	-	-	-	3	2	11	4	6	11
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Straps cut walls	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	-
No. of Loads with Pallet Damage	1 to 3 Deck Board	Torn loose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Split or Broken	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
		Pulled loose from Stringer	0	0	0	0	0	0	1	1	1	0	1	0	2	2	0	0	2	0
	1 Stringer split or broken		0	0	1	0	0	0	0	0	1	0	0	0	0	0	2	0	1	0

APPENDIX B

OVERALL CONDITION OF EXPENDABLE UNIT LOADS BY LOAD TYPE DURING SHIPMENT

		Motor Vehicle						Rail						Ship					
		AA	AB	AC	BA	BB	BC	AA	AB	AC	BA	BB	BC	AA	AB	AC	BA	BB	BC
Good general condition, no visible damage		19	19	15	19	[illegible]	17	13	11	8	14	11	10	0	0	0	2	0	5
Minor Damages	Good condition, shows minor damage	1	1	5	1	4	3	6	6	9	3	5	2	6	8	8	13	11	7
Minor Damages	Damaged, contents unaffected, can ship further	0	0	0	0	0	0	1	3	3	3	4	8	6	8	8	4	5	7
Minor Damages	Damaged, should repair, contents possibly damaged	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	1	4	1
Major Damages	Damaged unit load and contents, required repairs	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	0	0	0
Major Damages	Damaged, would prevent further shipment	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Note: Unit loads may have been damaged by one or more types of damage and may be listed in the above table more than once.

APPENDIX C

PERCENT AND TYPE OF CONTAINER DAMAGE BY THE SIX BASIC LOAD TYPES COMBINED BY THE TWO CONTAINER AND THREE SHEATHING MATERIAL TYPES

Storage Area	Damage Description	Percent of Containers Damaged										
		Unit Load Type						Container Type		Sheathing Type		
		AA	AB	AC	BA	BB	BC	Single Wall	Double Wall	V3C	W5C	Wax
Open Field 0°F - wet 20 containers examined in each unit Load type	Holes/Tears	10	15	0	10	0	10	8	7	10	8	5
	Crushing	10	10	15	0	0	5	12	2	5	5	10
	Bulging	10	5	10	0	10	5	8	5	5	8	8
	Staining	30	25	20	5	40	25	25	23	18	32	22
	Any of Above types of damage, excl. staining	15	15	15	10	10	15	15	12	12	12	15
Open Field 125°F-85% RH - 240 containers examined in each unit load type	Holes/Tears	2	1	2	1	2	2	2	2	1	1	2
	Crushing	20	14	13	5	6	2	16	4	12	10	8
	Bulging	19	17	16	6	5	3	17	5	12	11	9
	Staining	1	2	5	0	0	4	3	1	1	1	4
	Any of above types of damage, excl. staining	22	20	19	7	7	5	21	6	15	14	12

Note: Loads may have had more than one type of damage

APPENDIX D

TOTAL NUMBER OF LOADS DAMAGED BY CRUSHING AND BULGING BY LOAD TYPE DURING A SEASONAL PERIOD OF OPEN STORAGE IN VARIOUS ENVIRONMENTS

Load Type (20 each)	Cold-Wet (0°F-Snow)		Hot-Wet (125°F - 85% RH)	
	Minor Damage	Major Damage	Minor Damage	Major Damage
AA	12	4	5	11
AB	12	7	7	11
AC	17	1	10	8
BA	9	0	11	4
BB	13	2	9	5
BC	11	1	10	2
Total	74	15	52	41

APPENDIX E

CONDITION OF THE LOAD CONTENTS AFTER STORAGE IN HOT-WET AND COLD-WET ENVIRONMENT WHEN COMBINED BY CONTAINER AND SHEATHING TYPE MATERIAL

		Hot-Wet (125°F-85% RH)					Cold-Wet (0°F - Snow)				
		Container		Sheathing			Container		Sheathing		
		Single Wall	Double Wall	V3C	W5C	Wax	Single Wall	Double Wall	V3C	W5C	Wax
Number of Containers	Inspected	60	60	40	40	40	60	60	40	40	40
	With Mildewed Rags	7	3	5	4	1	1	0	0	0	1
	With Faded Rags	0	0	0	0	0	1	0	0	0	1
	With Wet Rags	2	0	1	1	0	1	1	0	0	2
	With Termite Rags	13	7	7	7	6	0	0	0	0	0
	With Evidence of Rust	5	4	3	4	2	9	8	4	6	7
Number of Rolls of Toilet Tissue	Inspected	2562	2549	1705	1756	1650	2526	2463	1670	1659	1660
	Not Usable	7	0	4	3	0	17[A]	0	0	0	17[A]
Number of Cans	Inspected	1908	1870	1262	1262	1254	1941	1896	1309	1264	1264
	With Loose Labels	0	0	0	0	0	54[B]	3	1	3	53[B]
	With Illegible Labels	0	1	0	1	0	0	0	0	0	0
	Ruptured (Not Usable)	2	1	3	0	0	18	35	8	27	18
	Too Rusty to Use	0	0	0	0	0	5	8	3	6	4
Percent of Cans Not Usable		0.1	0.1	0.2	0	0	1.2	2.3	0.8	2.6	1.7

[A]All (17) of these were in one Container.

[B]Of these, (50) were in one Container.

APPENDIX F

PERCENTAGE CHANGE IN WEIGHT COMBINED BY THE TWO CONTAINERS AND THREE SHEATHING TYPES FOR THE LOADS AND CONTENTS

ITEM	INSPECTION NUMBER	Hot-Wet (125°F - 85%)					Cold-Wet (0°F and Wet)				
		CONTAINER		SHEATHING			CONTAINER		SHEATHING		
		SINGLE WALL	DOUBLE WALL	V3C	W5C	WAX	SINGLE WALL	DOUBLE WALL	V3C	W5C	WAX
CONTROL CLOTH	1	-0.7	0.8	2.8	0.4	3.0	4.6	0	4.6	0	0
	2	3.8	4.0	5.8	0	4.0	1.9	0	0	0	3.8
	3	3.8	4.1	8.2	0	3.8	4.6	3.9	3.1	5.2	4.4
	4	4.2	4.5	3.8	3.7	6.5	6.2	1.3	2.0	3.1	4.0
	End of Test	3.7	3.8	7.4	1.9	1.8	2.9	1.6	-0.5	1.8	5.5
TOILET TISSUE	1	1.8	3.3	2.6	3.1	1.8	7.7	5.3	8.8	7.1	3.4
	2	2.8	4.9	0.8	3.0	7.6	4.2	1.8	1.7	3.2	4.2
	3	-1.4	2.6	-1.0	3.2	-0.4	-1.3	3.2	1.3	0.4	1.1
	4	3.8	3.9	5.1	2.5	3.9	0.2	3.6	2.2	1.4	2.0
	End of Test	4.6	4.2	4.2	5.0	4.0	5.5	5.1	7.0	4.4	4.4
EMPTY CONTAINER	1	6.3	0.3	6.7	2.0	1.2	-22.2	-16.6	-20.2	-26.2	-11.8
	2	7.9	5.6	6.8	9.0	4.5	3.9	4.4	2.3	0.3	9.8
	3	7.7	7.0	6.0	6.9	9.2	-4.1	-2.9	-4.3	-5.5	-0.7
	4	3.9	2.2	6.1	2.8	0.2	-7.1	-3.2	4.9	-8.4	-11.9
	End of Test	11.8	9.2	12.6	11.0	7.8	4.0	-2.4	2.5	0.9	-0.9
PACKED CONTAINER	1	1.3	1.5	0.3	2.7	1.2	0.7	-0.7	-0.4	0	0.4
	2	1.0	1.0	1.1	0.7	1.2	0.1	0.3	0	0	0.6
	3	0.4	0.8	0.6	0.5	0.5	0.3	1.1	0	0.4	1.6
	4	0.5	0.8	1.0	0.4	0.4	0.2	0.2	0.2	0.3	0.1
	End of Test	1.2	1.2	1.4	1.2	0.8	1.0	0.4	0.5	1.0	0.8

APPENDIX G

TYPE AND PERCENT OF CONTAINER DAMAGE BY LOAD DURING ENVIRONMENTAL TESTS

ENVIRONMENT	DAMAGE DESCRIPTION	PERCENT OF CONTAINERS DAMAGED		
		Unit Load Type AA AB AC BA BB BC	Container Type Single Wall Double Sall	Sheathing V3C W5C WAX
HIGH Temperature (24 containers examined in each Unit Load)	Expansion of Dissimilar Metals			
	Non-Metallic Discoloration Cracking, etc.			
	Melting or adherence of closure and sealing strips			
LOW Temperature (24 containers examined in each Unit Load)	Contraction of Dissimilar Metals			
	Loss of Non-Metallic Resiliency			
	Cracking of Seals			
HUMIDITY (30 containers examined in each Unit Load)	Metal Corrosion			
	Container Swelling			
	Loss of container physical strength			
	ETC.			