PERFORMANCE ORIENTED PACKAGING TESTING
OF
SIX-FOOT FLEXIBLE LINEAR SHAPED CHARGE BOX
FOR PACKING GROUP II HAZARDOUS MATERIALS

BY:
KERRY J. LIBBERT
MECHANICAL ENGINEER

Performing Activity:
Crane Division
Naval Surface Warfare Center
Crane, Indiana 47522-5000

OCTOBER 1992
FINAL

DISTRIBUTION STATEMENT A
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED.

Sponsoring Organization:
Naval Weapons Station Earle
Program Management Office - Code 50
Colts Neck, New Jersey 07722-5000
**Performance Oriented Packaging Testing of the Six-Foot Flexible Linear Shaped Charge Box for Packing Group II Hazardous Materials**

Kerry J. Libbert  

**Compliance**  

Performance Oriented Packaging standards specified by the Code of Federal Regulations, Title 49 CFR, Parts 107 through 178, dated December 31, 1991. The box was tested with a gross weight of 14 kilograms and met all the requirements.

**Abstract**  

The wood box (Drawing 53711-6665109) for six-foot flexible linear shaped charges was tested for conformance to Performance Oriented Packaging standards specified by the Code of Federal Regulations, Title 49 CFR, Parts 107 through 178, dated December 31, 1991. The box was tested with a gross weight of 14 kilograms and met all the requirements.
The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to stay within the lines to meet optical scanning requirements.

**Block 1**  
Agency Use Only (Leave blank).

**Block 2.**  
Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

**Block 3.**  
Type of Report and Dates Covered.  
State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

**Block 4.**  
Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

**Block 5.**  
Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:
- C - Contract
- G - Grant
- PE - Program
- TA - Task
- WU - Work Unit

**Block 6.**  
Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

**Block 7.**  
Performing Organization Name(s) and Address(es). Self-explanatory.

**Block 8.**  
Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

**Block 9.**  
Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

**Block 10.**  
Sponsoring/Monitoring Agency Report Number (If known)

**Block 11.**  
Supplementary Notes. Enter information not included elsewhere such as:
Prepared in cooperation with...; Trans. of...; To be published in... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

**Block 12a.**  
Distribution/Availability Statement.  
Denotes public availability or limitations. Cite any limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

- DOD - See DoDD 5230.24, "Distribution Statements on Technical Documents."
- DOE - See authorities.
- NTIS - Leave blank.

**Block 12b.**  
Distribution Code.

- DOD - Leave blank.
- DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
- NASA - Leave blank.
- NTIS - Leave blank.

**Block 13.**  
Abstract. Include a brief (Maximum 200 words) factual summary of the most significant information contained in the report.

**Block 14.**  
Subject Terms. Keywords or phrases identifying major subjects in the report.

**Block 15.**  
Number of Pages. Enter the total number of pages.

**Block 16.**  
Price Code. Enter appropriate price code (NTIS only).

**Blocks 17-19.**  
Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (e.g., UNCLASSIFIED). If form contains classified information, stamp classification: at the top and bottom of the page.

**Block 20.**  
Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.
INTRODUCTION

This Performance Oriented Packaging (POP) test was performed to ascertain whether the shipping and storage container for the Six-Foot Flexible Linear Shaped Charge meets the Packing Group II requirements specified by the Code of Federal Regulations, Title 49 CFR, Parts 107 through 178, dated 31 December 1991. The objectives were to evaluate the adequacy of the container in protecting the hazardous materials.

The container is a wood box with cavities cut into the bottom part to hold the charges. The open empty container is shown in Figure 1. Figure 2 shows the container closed and banded for shipment, as it was tested.

TESTS PERFORMED

1. Drop Test

   This test was performed in accordance with Title 49 CFR, Part 178, Subpart M, Sec. 178.603. One container was used for each drop orientation. The drop height was 1.2 meters and the drop sequence was as follows:

   a. Flat on Bottom
   b. Flat on Top
   c. Flat on Long Side
   d. Flat on Short Side
   e. One Corner

   The test was performed at ambient temperature (70°F ± 20°F). The contents of the container should be retained within its packaging and exhibit no damage liable to affect safety during transport.

2. Stacking Test

   This test was performed in accordance with Title 49 CFR, Part 178, Subpart M, Sec. 178.606. Three different containers were used, each with a stack weight of 3000 pounds. The test was performed for 24 hours. After the allowed time, the weight was removed and the container examined. Any leakage, deterioration, or distortion which could adversely affect transport or reduce its strength or cause instability in stacks of packages is cause for rejection.

3. Base Level Vibration Test

   This test was performed in accordance with Title 49 CFR, Part 178, Subpart M, Sec. 178.608. Three sample containers were loaded with steel rods to simulate the charges and closed as for shipment. Each container was placed on a vibrating platform that had a vertical double-amplitude (peak-to-peak displacement) of one inch. The packages were constrained horizontally to prevent them from falling off the platform, but were free to move
vertically, bounce and rotate. The test was performed for one hour at a frequency that caused each point of the container bottom to be raised from the platform 1.6 mm. A 1.6 mm thick metal strip was passed between the bottom of the container and the platform.

PASS/FAIL

1. Drop Test

The criteria for passing the drop test is outlined in Title 49 CFR, Part 178, Subpart M, Sec. 178.603(f): A package is considered to successfully pass the drop test if for each sample tested, no rupture occurs which would permit spillage of loose explosive substances or articles from the outer packaging.

2. Stacking Test

The criteria for passing the stacking test is outlined in Title 49 CFR, Part 178, Subpart M, Sec. 178.606: No test sample may show any deterioration which could adversely affect transportation safety or any distortion likely to reduce its strength, cause instability in stacks of packages, or cause damage to inner packagings likely to reduce safety in transportation.

3. Base Level Vibration Test

The criteria for passing the Base Level Vibration Test is outlined Title 49 CFR, Part 178, Subpart M, Sec. 178.608: Immediately following the period of vibration, each package must be removed from the platform, turned on its side and observed for any evidence of leakage. A packaging passes the vibration test if there is no rupture or leakage from any of the packages. No test sample should show any deterioration which could adversely affect transportation safety or any distortion liable to reduce packaging strength.

TEST RESULTS

1. Drop Test
   Satisfactory.

2. Stacking Test
   Satisfactory.

3. Base Level Vibration Test
   Satisfactory.
DISCUSSION

1. Drop Test

After each drop the container was inspected for any damage which would be cause for rejection. Final inspection revealed some small cracks in the bottom parts of the containers at the ends, but the simulated charges were contained.

2. Stacking Test

Three containers were individually tested. Each container was visibly inspected after the 24-hour period was over. There was no leakage, distortion, or deterioration to the container as a result of this test.

3. Base Level Vibration Test

Immediately following the vibration test, each container was removed from the platform, turned on its side and observed for any evidence of leakage. All latches and bands remained fastened and there was no evidence of leakage of contents.

REFERENCE MATERIAL


DISTRIBUTION LIST

Commander
Crane Division
Naval Surface Warfare Center
Code 4045 and Code 4033
Crane, IN 47522-5000

Commanding Officer
Naval Weapons Station Earle
Code 50 and Code 50232
Colts Neck, NJ 07722-5000

Defense Technical Information Center (2 copies)
ATTN: DTIC/PDAC (Virginia Guidi)
Bldg. 5, Cameron Station
Alexandria, VA 22304-6145

Commander
U.S. Army Armament, Research, Development and Engineering Center
SMCAR-ESK
Rock Island, IL 61299-7300

Defense General Supply Center
DDRV-TMPA (Dave Gay)
Richmond, VA 23297-5000
DATA SHEET

CONTAINER: POP MARKING:
Wood Container for the 4C1/Y14/S/** Flexible Linear Shaped Charge

4C1/14/S/**
USA/DOD/NAD

Type: 4C1 UN Code: 1.1D

Specification Number: Material:
None Natural Wood

Capacity: Dimensions:
14 kg 1.85m L x .14m W x .05m H
(30.8 pounds) (72.88" L x 5.50" W x 2.06" H)

Closure (Method/type): Tare Weight:
Latches (3 ea.) 6.04 kg
1/4" steel banding (4 ea.) (13.3 pounds)

Additional Description: Box was constructed in accordance with Drawing 53711-6665109.

PRODUCTS:
Linear Flexible Shaped Charge, see Table I

Proper Shipping Name: Charges, Shaped, Flexible, Linear

United Nations Number: 0288

United Nations Packing Group: N/A

Physical State: Solid

Amount Per Container: See Table I

Gross Weight: See Table I

TEST PRODUCT:
Name: Steel rods
Physical State: Solid

Size: 1.83m L x .01m Dia
(72"L x .50"Dia)

Quantity: 3

Dunnage: Foam polyethylene, PPP-C-1752
Gross Weight: 14 kg (30.8 lbs.)
<table>
<thead>
<tr>
<th>DODIC</th>
<th>NSN</th>
<th>ITEM (FLSC GR/FT)</th>
<th>PACKING DRAWING</th>
<th>#/CNTR</th>
<th>GROSS WT (KG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM41</td>
<td>1375-01-318-8571</td>
<td>30</td>
<td>6665108</td>
<td>6</td>
<td>7.41</td>
</tr>
<tr>
<td>MM42</td>
<td>1375-01-318-9821</td>
<td>40</td>
<td>6665108</td>
<td>6</td>
<td>7.66</td>
</tr>
<tr>
<td>MM43</td>
<td>1375-01-319-0940</td>
<td>60</td>
<td>6665108</td>
<td>6</td>
<td>8.06</td>
</tr>
<tr>
<td>MM44</td>
<td>1375-01-318-9822</td>
<td>75</td>
<td>6665108</td>
<td>6</td>
<td>8.71</td>
</tr>
<tr>
<td>MM45</td>
<td>1375-01-319-0941</td>
<td>125</td>
<td>6665108</td>
<td>6</td>
<td>9.06</td>
</tr>
<tr>
<td>MM46</td>
<td>1375-01-318-0754</td>
<td>225</td>
<td>6665108</td>
<td>3</td>
<td>9.93</td>
</tr>
<tr>
<td>MM47</td>
<td>1375-01-318-0753</td>
<td>400</td>
<td>6665108</td>
<td>3</td>
<td>10.46</td>
</tr>
<tr>
<td>MM48</td>
<td>1375-01-319-9184</td>
<td>600</td>
<td>6665108</td>
<td>3</td>
<td>11.78</td>
</tr>
</tbody>
</table>