WHC-MR-0423

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SEP 07 1993

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Date Published
July 1993

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

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Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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Printed in the United States of America

DISCLM-1.CHP (1-91)

WESTINGHOUSE HANFORD COMPANY PACKAGE TESTING CAPABILITIES

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INTRODUCTION

The Department of Energy's Hanford Site is a 1,450-km² (560-mi²) installation located in southeastern Washington State. Established in 1943 as a plutonium production facility, Hanford's role has evolved into one of environmental restoration and remediation. Many of these environmental restoration and remediation activities involve transportation of radioactive/hazardous materials. Packagings used for the transportation of radioactive/hazardous materials must be capable of meeting certain normal transport and hypothetical accident performance criteria. Evaluations of performance to these criteria typically involve a combination of analysis and testing. Required tests may include the free drop, puncture, penetration, compression, thermal, heat, cold, vibration, water spray, water immersion, reduced pressure, and increased pressure tests. The purpose of this paper is to outline the Hanford capabilities for performing each of these tests.

FREE DROP/CORNER DROP/IMPACT TEST CAPABILITIES

The Free Drop/Corner Drop/Impact tests include the Type A free drop tests [49 CFR 173.465(c) and 49 CFR 173.466(1)], the Type B free drop tests [10 CFR 71.71(c)(7), 10 CFR 71.73(c)(1)], the Type B corner drop test [10 CFR 71.71(c)(8)], the Special Form impact tests [49 CFR 173.469(b)(1) and 10 CFR 71.77(a)], and the Performance-Oriented Packaging drop test [49 CFR 178.603].

These tests require that the package be dropped onto an unyielding surface. Drop height requirements vary from 0.3 to 9 m (1 to 30 ft). A reinforced concrete pad with a steel cover plate, and a mass ten times that of the package is generally considered to be an

unyielding surface. The Westinghouse Hanford Company (WHC) has full capabilities for this type of evaluation by means of either analysis, or actual testing at any of three separate drop test facilities. The attributes for each of the drop pads are as follows:

The 305 Building test pad is an 11,868-kg (26,165-lb), 2.1-m (84-in) square, indoor test pad consisting of a 5-cm (2-in) thick steel top plate, a 10-cm (4-in) thick steel intermediate plate, and a 61-cm (2-ft) thick reinforced concrete base. The pad is located in a 4.6-m (15-ft) deep pit with a 3.0 by 3.7-m (10 by 12-ft) opening. Packages can be lifted with a 1.8-metric-ton (2-ton) capacity bridge crane, or with either of two 4.5-metric-ton (5-ton) capacity bridge cranes. Maximum lift height is approximately 13.7 m (45 ft) above the pad surface. The release mechanism is a manually operated, quick-release hook. Packages up to 1,179 kg (2,600 lbs) can be drop tested on this pad.

The 200 Area test pad is a 64-metric-ton (71-ton), outdoor test pad consisting of a 2.1 by 3.4-m (84 by 132-in), 38-mm (1.5-in) thick steel top plate, sitting on top of a reinforced concrete base that is 2.4-m (8-ft) wide, 3.7-m (12-ft) long, and 2.9-m (9.5-ft) deep. Packages are lifted with an appropriate capacity crane, and released from a manually operated, quick-release hook. Packages up to 6,441 kg (14,200 lbs) can be drop tested on this pad.

The 300 Area pad is a 118-metric-ton (130-ton), outdoor test pad. The base of this pad consists of a 2.0-m (6.5-ft) thick reinforced concrete structure, comprised of a 1.4-m (4.5-ft) thick bottom section and a 0.6-m (2-ft) thick top section. The 1.4-m (4.5-ft) thick bottom section has a width of 4.1 m (13.5 ft) and a length of 5.6 m (18.5 ft). The 0.6-m (2-ft) thick top section of the concrete base is laterally centered on the bottom section of the concrete base, and is approximately 3.0-m (10-ft) wide and 4.4-m (14.5-ft) long. A 1.6-m (5.4-ft) by 3.2-m (10.4-ft), 22-cm (8.5-in) thick steel target plate has been laterally centered and sunk into the top surface of the concrete base. The remaining surface of the concrete base surrounding the target plate is protected by 25-mm (1-in) thick steel aprons. Packages are lifted with an appropriate capacity crane, and released from a manually operated, quick-release hook. Packages up to 11,793 kg (26,000 lbs) can be drop tested on this pad.

In addition to the above regulatory testing, WHC has the capability to perform extra-regulatory drop testing using locally available mobile cranes (from Neil F. Lampson, Inc.) with the ability to lift 1,008-metric-ton (1,111-ton) loads to approximately 46-m (150-ft) high.

PUNCTURE TEST CAPABILITIES

Puncture testing is a required Type B packaging test [10 CFR 71.73(c)(2)].

This test requires the packaging to be dropped 1 m (40 in) onto a 15-cm (6-in) diameter, round post that is mounted on an essentially unyielding surface.

The WHC has full capabilities for this type of evaluation by means of either analysis, or testing using a movable post, which can be placed on an appropriate test pad.

PENETRATION/PERCUSSION/BENDING TEST CAPABILITIES

The Penetration/Percussion/Bending tests include the Type A penetration tests [49 CFR 173.465(e) and 49 CFR 173.466(a)(2)], the Type B penetration test [10 CFR 71.71(c)(10)], the Special Form percussion tests [49 CFR 173.469(b)(2) and 10 CFR 71.77(b)] and the Special Form bending tests [49 CFR 173.469(b)(3) and 10 CFR 71.77(c)].

The Type A and Type B penetration tests require a 32-mm (1.25-in) diameter, 6-kg (13-lb), round steel bar to be dropped 1 m (40 in) onto the packaging that is resting on a rigid, flat, horizontal surface that will not move while the test is being performed.

The Special Form percussion tests and bending tests are essentially variations of the Type A and Type B penetration tests. These variations include the use of a smaller bar [25-mm (1-in) diameter and 1.4 kg (3 lbs)]. Also, for the percussion tests, the test item must rest on a 25-mm (1-in) thick lead surface. Finally, for the bending tests, the specimen is to be securely clamped in a horizontal position so that one half of its length protrudes from the face of the clamp.

The WHC has full capabilities for all the above variations of penetration, percussion, and bending evaluations by means of either analysis, or actual testing.

COMPRESSION/STACKING TEST CAPABILITIES

The Compression/Stacking tests include the Type A compression test [49 CFR 173.465(d)], the Type B compression test [10 CFR 71.71(c)(9)], and the Performance-Oriented Packaging stacking test [49 CFR 178.606].

The Type A and Type B compression tests require uniform loading of the entire top surface of the packaging, using a load that is the greater of either five times the package weight, or 1,300 kg/m² (265 lbs/ft²).

The Performance-Oriented Packaging stacking test requires stacking of equivalent weight packages to a minimum height of 3.0 m (10 ft).

The WHC has full capabilities for both of these types of evaluation by means of either analysis, or actual testing. Testing would typically use dead weights (such as lead bricks); however, for smaller packages, a compression testing press is available. The platens for this press are 76-cm (30-in) square, and can be separated by a distance of 1.3 m (50 in). Maximum load is 90,718 kg (200,000 lbs).

THERMAL/HEAT TEST CAPABILITIES

The Thermal/Heat tests include the Type B thermal test [10 CFR 71.73(c)(3)], and the Special Form heat tests [49 CFR 173.469(b)(4) and 10 CFR 71.77(d)].

The Type B thermal test requires a 30-minute exposure of the specimen to a 800°C (1475°F) environment. This can be accomplished using either a hydrocarbon fuel fire, or can also be accomplished in a furnace/autoclave.

The Special Form heat tests require that the specimen is heated, in air, to a temperature of 800°C (1475°F), held at that temperature for 30 minutes, and allowed to cool. This would typically be accomplished in a furnace.

The WHC has full capabilities for this type of evaluation by means of either analysis, or actual testing. Thermal/Heat tests can be performed on small items using appropriate furnaces/autoclaves [including a heat-treating furnace with a 79-cm (31-in) wide, 76-cm (30-in) tall, and 1.5-m (5-ft) deep cavity that can be heated to 816°C (1500°F)]. Due to environmental constraints, larger items are analyzed in lieu of an actual fire test.

HEAT TEST CAPABILITIES

The heat test is a required Type B test [10 CFR 71.71(c)(1)].

This test requires an ambient temperature of 38°C (100°F) followed by a 12-hour period with insolation up to 800 g cal/cm².

The WHC has full capabilities for this type of evaluation. Packagings are typically analyzed in lieu of actual testing; however, several environmental chambers are available. Typical chamber dimensions are 91 cm (3 ft) on each side. Temperatures of -68 to +177°C (-90 to +350°F) and relative humidities of 20 to 95 percent are achievable.

COLD TEST CAPABILITIES

The cold test is a required Type B test [10 CFR 71.71(c)(2)].

This test requires exposure of the packaging to a temperature of -40°C (-40°F), in still air, in the shade.

The WHC has full capabilities for this type of evaluation. Packagings are typically analyzed in lieu of actual testing; however, several environmental chambers are available. Typical chamber dimensions are 91 cm (3 ft) on each side. Temperatures of -68 to +177°C (-90 to +350°F) and relative humidities of 20 to 95 percent are achievable.

VIBRATION TEST CAPABILITIES

Vibration tests include the Type B vibration test [10 CFR 71.71(c)(5)], and the Performance-Oriented Packaging vibration test [49 CFR 178.608].

The Type B vibration test requires exposure of the package to vibration normally incident to transportation.

The Performance-Oriented Packaging vibration test requires placing the samples on a vibrating platform that has a vertical or rotary, double amplitude (peak-to-peak displacement) of 25 mm (1 in).

The WHC has full capability for this type of evaluation by means of either analysis, or by actual testing using a vibration table. Several vibration tables are available, including one of the largest, that has a 137 by 145-cm (54 by 57-in) table. Frequency is adjustable from 3 to 25 hertz, with a maximum double amplitude of 32 mm (1.25 in), adjustable from vertical to horizontal. The table is capable of testing at accelerations up to five times gravity for specimens 227 kg (500 lbs) or less, decreasing linearly to 1.4 times gravity for a maximum specimen weight of 4,536 kg (10,000 lbs).

WATER SPRAY TEST CAPABILITIES

The water spray tests include the Type A water spray test [49 CFR 173.465(b)], and the Type B water spray tests [10 CFR 71.71(c)(6)].

These tests require exposure of the package to a water spray of 5-cm (2-in) per hour for one hour.

The WHC has full capabilities for this type of evaluation by means of either analysis, or actual testing.

IMMERSION TEST CAPABILITIES

The immersion test is a required Type B test [10 CFR 71.73(c)(5)].

This test requires exposure of the packaging to a water pressure corresponding to immersion depths from 0.9 to 15 m (3 to 50 ft).

The WHC has full capabilities for this type of evaluation. Test items are analyzed in lieu of an actual immersion test.

REDUCED EXTERNAL PRESSURE/LEAKPROOFNESS TEST CAPABILITIES

Reduced external pressure/leakproofness tests include the Type A reduced external pressure test [49 CFR 173.412(i)], the Type B reduced external pressure tests [10 CFR 71.71(C)(3)], and the Performance-Oriented Packaging leakproofness test [49 CFR 178.604].

The Type A and Type B reduced external pressure tests require reduction of the absolute external pressure to 2,461 kg/m² (3.5 psi), and can be simulated by increasing the internal gauge pressure to 7,874 kg/m² (11.2 psi).

The Performance-Oriented Packaging leakproofness test requires that the internal gauge pressure be increased to 2,109 or 2,812 kg/m² (3 or 4 psi), depending on the packing group.

The WHC has full capabilities for this type of evaluation by means of either analysis, or actual testing (including helium leak testing). Increased internal pressures can be achieved using an appropriately constructed test rig. Reduced external pressures can be achieved using an appropriately sized vacuum chamber.

INCREASED EXTERNAL PRESSURE TEST CAPABILITIES

The increased external pressure test is a required Type B test [10 CFR 71.71(c)(4)].

This test requires increasing the absolute external pressure of the packaging to 14,061 kg/m² (20 psi).

The WHC has full capabilities for this type of evaluation by means of either analysis, or actual testing. A 1.4-m³ (49.4-ft³) vacuum/pressure chamber is available that is capable of applying an absolute pressure of over 35,153 kg/m² (50 psi).

HYDROSTATIC PRESSURE TEST CAPABILITIES

The hydrostatic pressure test is a required Performance-Oriented Packaging test [49 CFR 178.605].

This test requires pressurizing a liquid inside of the package. Test pressures depend on vapor pressure of the payload, although minimum gauge pressure is 10,546 kg/m² (15 psi).

The WHC has full capabilities for this type of evaluation by means of either analysis, or actual testing using an appropriately constructed test rig.

SUPPORT CAPABILITIES

In addition to the above testing capabilities, the WHC has a full complement of support capabilities, including a wide spectrum of test instrumentation with calibrations traceable to the National Institute of Standards and Testing, numerous computer analysis techniques (including supercomputer capability), still photography, video, and high-speed photography, and full non-destructive test capabilities.

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