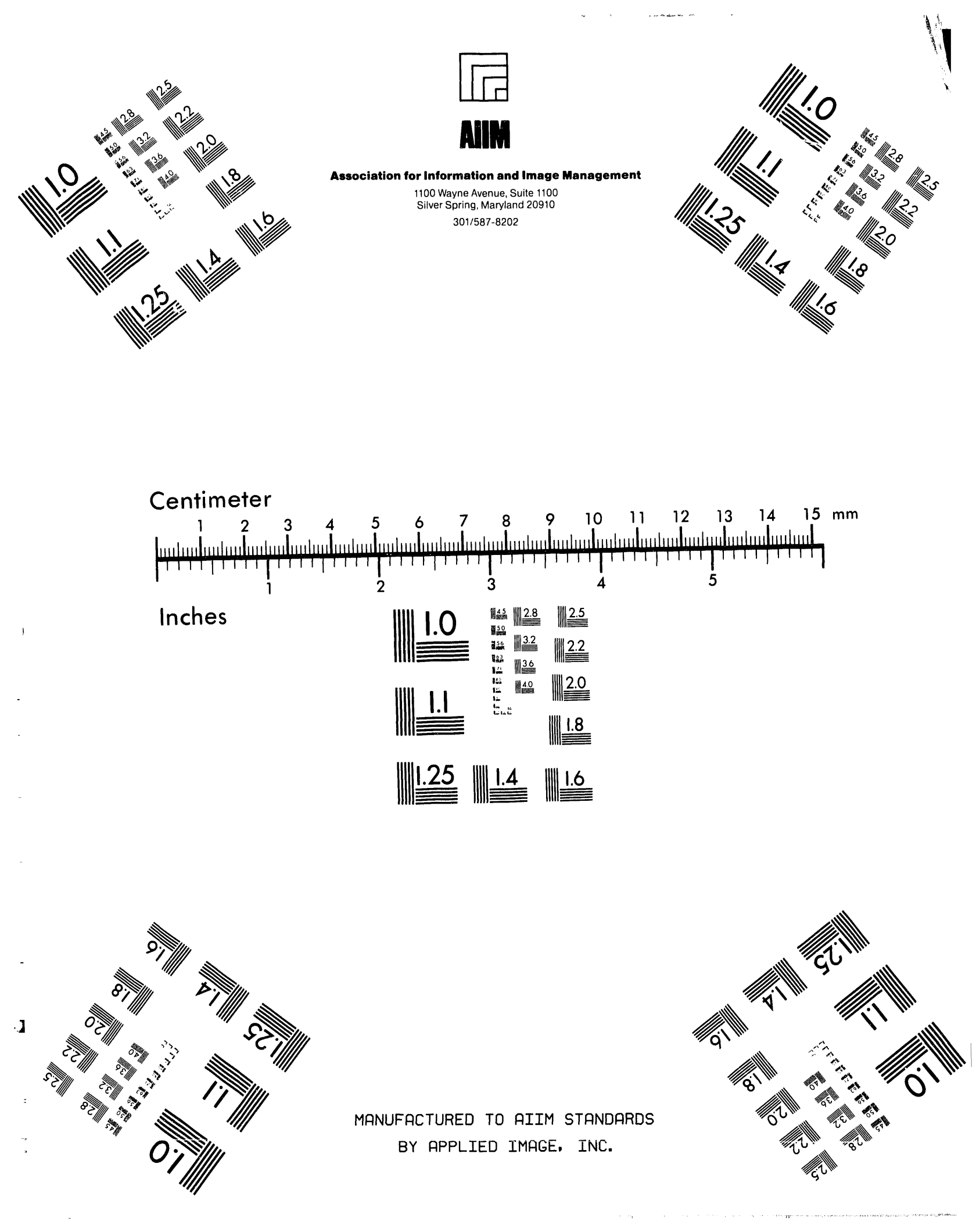
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PNL-SA-22547

PACKAGE TESTING CAPABILITIES AT THE PACIFIC NORTHWEST LABORATORY

J. M. Taylor

Handout

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Package Testing Capabilities at the Pacific Northwest Laboratory

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INTRODUCTION

The purpose of this paper is to describe the package testing capabilities at the Pacific Northwest Laboratory (PNL). In the past all of the package testing that was performed at PNL was done on prototype or mocked up radioactive material packaging. Presently, we are developing the capability to perform testing on non-radioactive material packaging. The testing on the non-radioactive material packaging will be done to satisfy the new performance oriented packaging requirements (DOT Docket HM-181, 1991). This paper describes the equipment used to perform the performance oriented packaging tests and also describes some testing capability for testing radioactive material packaging.

IMPACT TESTING

A drop pad has been used to test stainless steel canisters containing simulated radioactive high level waste (Olson and Alzheimer, 1989). The drop pad is shown in Figure 1 and listed

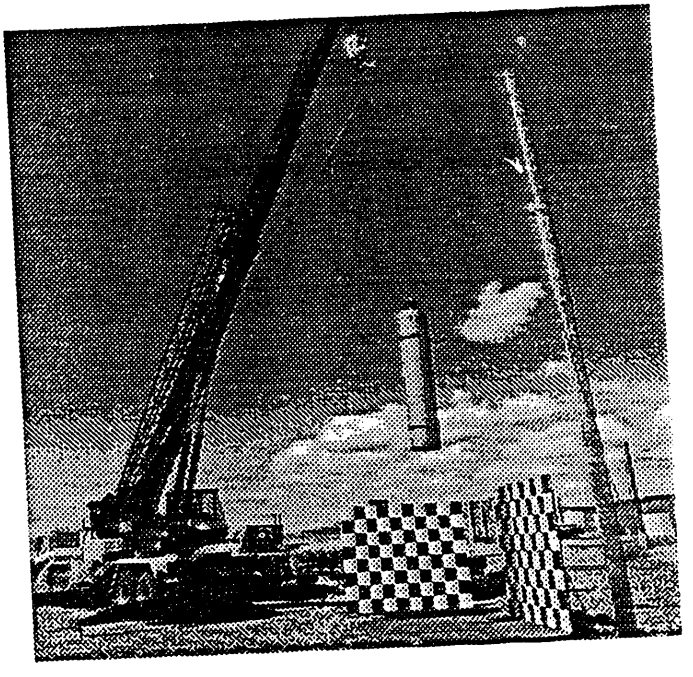

Figure 1. Drop Pad

in Table 1. The drop pad was designed to provide an unyielding impact surface as described in 10 CFR 71, 1992. The drop pad can provide an unyielding surface for objects weighing up to 13 tons. Behind the impact pad are two checkerboard backdrops. Each checkerboard is made up of 1 ft by 1 ft squares. The backdrops are oriented so that the horizontal and vertical lines are at 0° and 90° with the horizon. The second of these checkerboards was installed so that each drop could be recorded by high-speed cameras aimed at each of the backdrops, 90° apart. In this way, the impact angle can be verified exactly, rather than taking pictures in only one direction and assuming that the package orientation was measurable in the single plane.

Table 1. Listing of Package Test Equipment

Test Equipment	Test Capability	Test Condition Requirement
Drop Pad (See Figure 1)	Impact surface: Steel plate 10.4 ft x 5.4 ft x 8.5 in thick. Backup pad: Reinforced concrete 18.5 ft x 13.5 ft x 5.8 ft thick Max. Impact load: 13 ton	10 CFR 71.73
Drop Tester (See Figure 2)	Test Load: 160 lbs Max. Package Dim. 40"H x 48"W x 48" L	49 CFR 178.603
Shock Tester (See Figure 3)	Payload cap.: 200 lbs Max. Acceleration (g): 3000 Carriage size: 16" x 16"	
Compression Tester (See Figure 4)	200,000 pounds capacity platen dimensions: 30" x 30" max. space between platens: 50" Constant rate between 0 to 6"/min Constant load capability	49 CFR 178.606
Vibration Table (See Figure 5)	Payload capacity 400 lbs. Acceleration rating (g): 1.25 Freq. range: 2.5 - 5 Hz Table size: 40" x 34"	49 CFR 178.608
Vibration Table (See Figure 6)	Payload capacity: 1500 lbs Acceleration rating (g): 3.2 Freq. range: 8 - 60 Hz Table size: 48" x 66"	49 CFR 178.608
Environmental Chamber (See Figure 7)	Temperature range: -68°C to 177°C Humidity range: 5 - 95% RH in temperature range from 27°C to 82°C Internal dim: 3 ft x 3 ft x 3 ft	49 CFR 178.602 IATA 6.2.13
Pressure/Vacuum Chamber (See Figure 8)	Pressure range: 200 to 2800 mm Hg Internal volume: 1.4 m^3	49 CFR 178.605 ICAO 4.5.1
Heat Treating Furnace (See Figure 9)	Temperature range: ambient to 1500°F Heating Rate: maximum 500°/hr. Internal dim. 31" W x 30" H x 60" L	10 CFR 71.73

The light weight drop tester shown in Figure 2 is a commercial unit that was designed to drop test small packages. The drop tester can handle packages that weigh up to 160 pounds and can drop them from heights up to 6 feet. The tester has the capability to drop rectangular shaped packages from different orientations, such as on the edge or corners of the package. The impact surface is a 0.75" steel plate that is anchored to a 8" thick concrete floor.

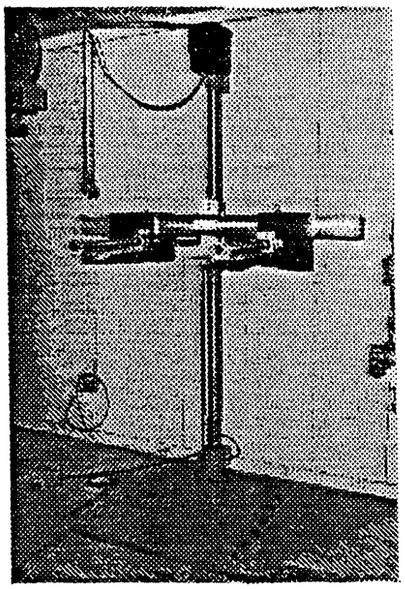

Figure 2. Drop Tester

Shock testing of packages is performed with a commercial shock tester. The unit shown in Figure 3 can handle components up to 200 pounds. The acceleration rating (g) loading on the packaging can vary depending on the drop height of the platen or the resilience of the bottom impact pad. The component tested is subject only to one bounce. The platen after impact makes one rebound and then is captured to prevent further rebounds. The shock tester provides a means to assess the ability of the package to withstand shock (deceleration) without experiencing deformation. Depending on the structural make-up of the package, a shock test can in some cases be more severe than a drop test on an unyielding surface.

COMPRESSION TESTING

Compression tests are done on packaging to satisfy the stacking test requirements as required by the Department of Transportation (49 CFR 178.606). A universal compression testing machine is available for these tests. The machine is shown in Figure 4. It has a 200,000 pound load capacity. The surface area of the platens are 30" x 30" and the space between the upper platen and lower platen can be adjusted up to a maximum of 60". The testing machine is instrumented so that the load and the deformation of the package under the

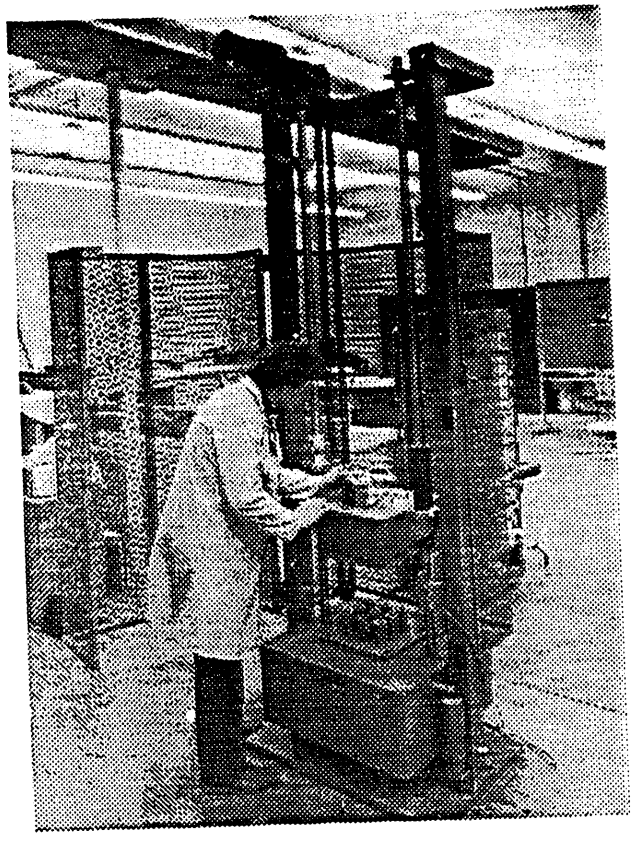

Figure 3. Shock Tester

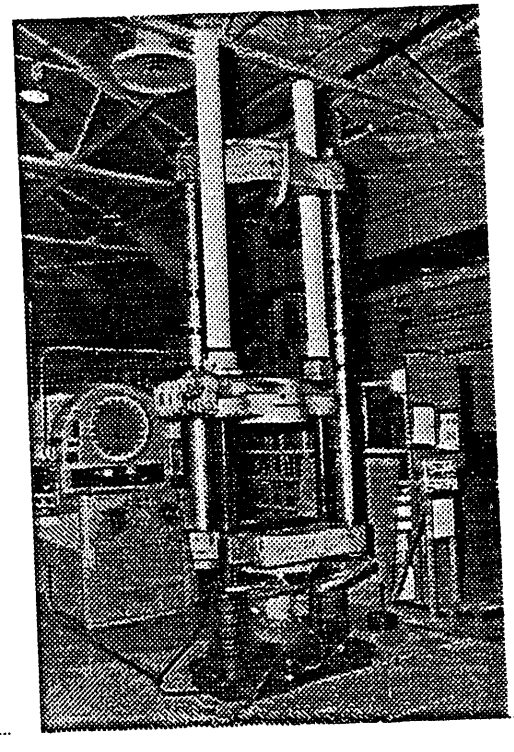

Figure 4. Compression Tester

load can be recorded. A constant load regardless of the deformation can be maintained on the package. Also a constant strain rate from 0 to 1" per minute can be applied to the package to determine the ultimate load the package can withstand.

VIBRATION TESTING

The new performance oriented packaging rules require that assembled packages be subjected to a vibration test. The test standard requires that the test platform have a vertical double-amplitude (peak to peak displacement) of one inch. In addition, the frequency must be sufficient to raise the test package high enough that a piece of material of approximately 0.063" thickness can be passed between the bottom of the package and the platform. In other words, the vibration test stand must provide a 1 g load to the package. The two vibration test machines listed in Table 1 and shown in Figures 5 and 6 are capable of providing the displacement and the g loading required. The machines vary in their frequency range, g loading and load capacity. The machines are equipped with instrumentation capable of reading and recording the g load and frequency of the test by means of accelerometers, X-Y and strip chart recorders.

PRESSURE/VACUUM/ENVIRONMENTAL CHAMBERS

General pre-testing or conditioning of the packages is required before the performance tests. All paper or fiberboard packaging must be preconditioned for 24 hours in an atmosphere maintained within certain temperature and relative humidity. If plastic containers are used

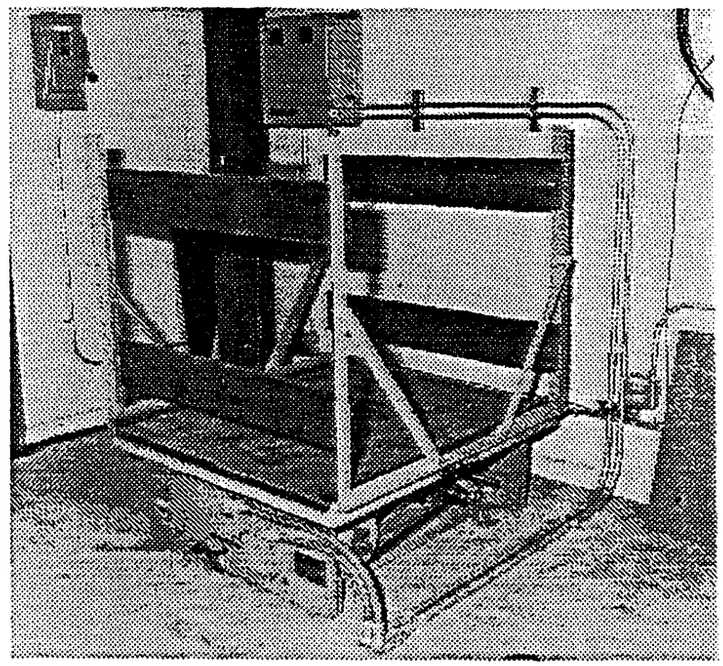

Figure 5. Vibration Table

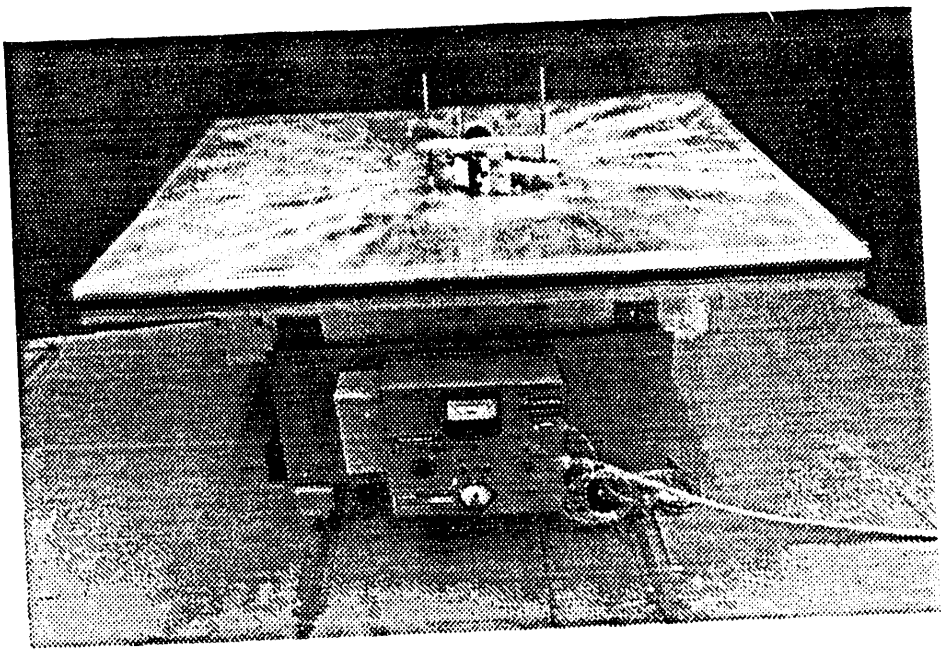

Figure 6. Large Capacity Vibration Table

they must be either subjected to temperature and relative humidity tests or the container and its contents must be lowered to 0°F prior to the test. The environmental chamber (Figure 7, Table 1) has a wide range of temperature and humidity settings that can satisfy the requirements of conditioning packages.

The pressure/vacuum chamber (Figure 8, Table 1) can be used to perform the leakproof test. A glass viewing port in the chamber allows for visual observation during evacuation. Bubble testing can be performed by observing containers immersed in baths under vacuum. Packages can also be subject to external pressures up to 3.6 atmospheres inside the chamber.

THERMAL TESTING

The heat treating furnace shown in Figure 9 has been used to "fire test" specification packages such as the DOT-6M and 6L containers. The furnace is equipped with a circulating air fan to maintain a uniform temperature within the furnace. The maximum operating temperature for the furnace is 1500°F. Temperature measurements are obtained with thermal couples that can be attached to the package being heated and read with a multi-input temperature recorder.

SUMMARY

A full range of test equipment is available to perform the required tests to satisfy the performance oriented packaging tests to meet the new DOT HM-181 requirements. Facilities are also available to perform drop test and thermal testing as required for testing packaging designed for containing radioactive material.

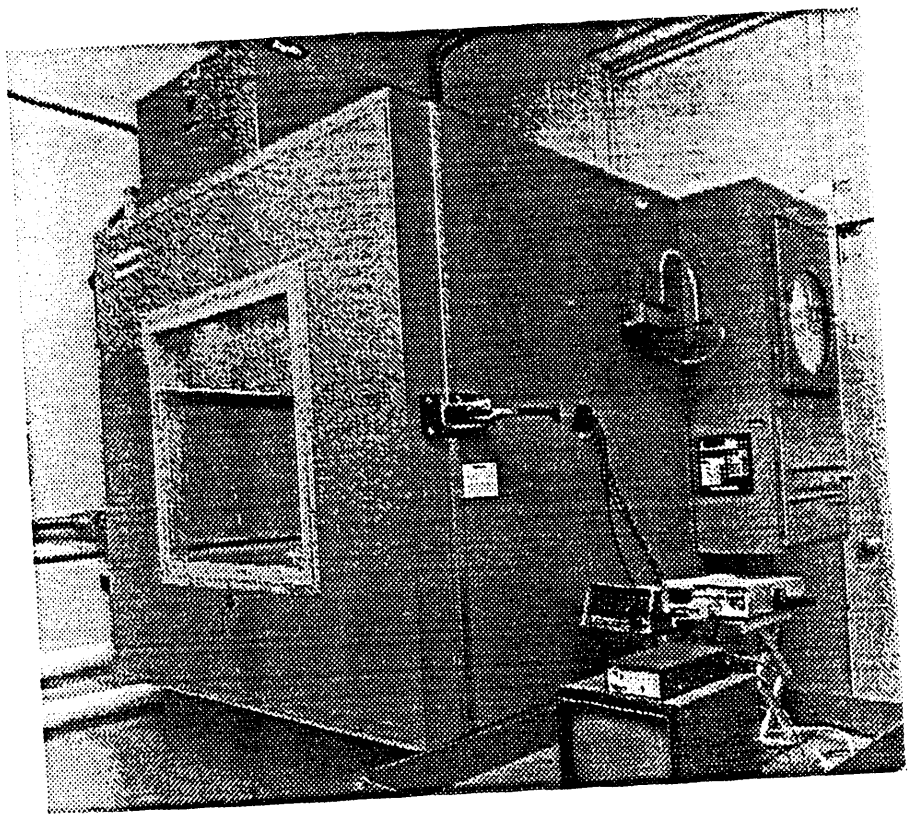

Figure 7. Environmental Chamber

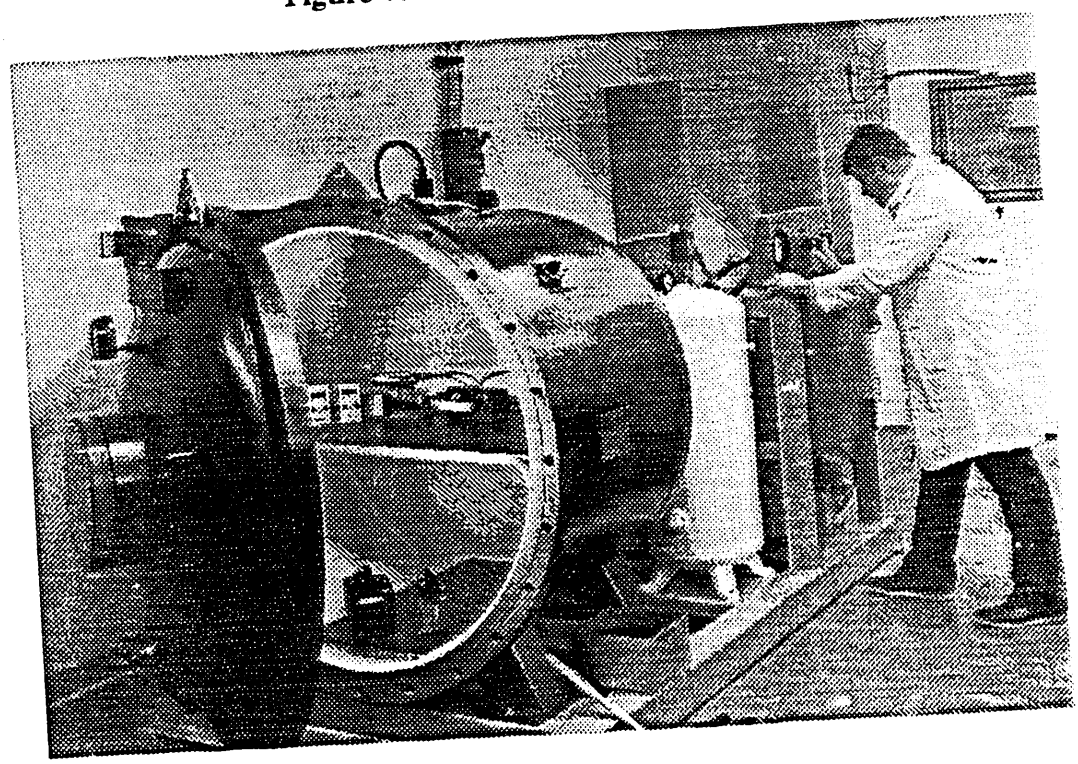

Figure 8. Pressure/Vacuum Chamber

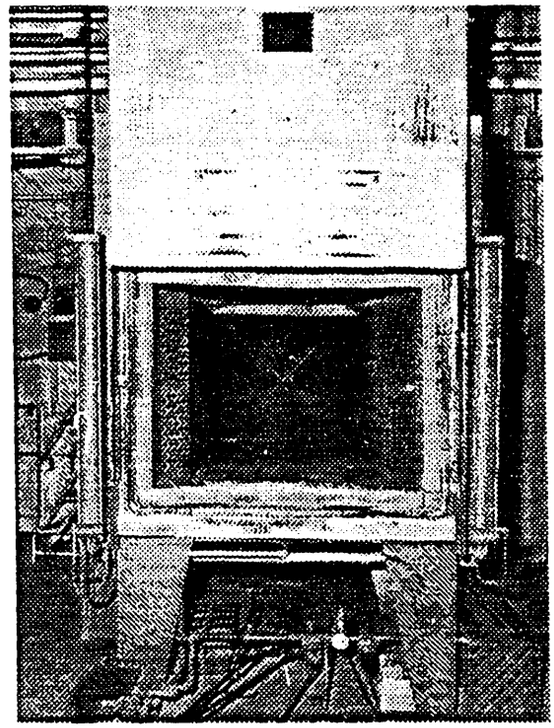

Figure 9. Heat Treating Furnace

ACKNOWLEDGEMENT

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