

71.35 Package Evaluation

- (a) The G.E. Model 9136 is designed specifically and solely as a single trip package (thus each packaging will be new) consisting of its content, a glove box or fume hood, supported in all directions within an outer wooden container designed and constructed to survive the environment and rough handling tests of Appendix A to Part 71.

The residual radioactive contamination is extremely low level ($< 2 \mu\text{ci}/\text{cm}^2$), isolated within a previously decontaminated hood or glove box, and further immobilized by bonding to the inner surfaces with paint*. This hood or glove box, in effect, is a receptacle or containment device which in turn is carried within a secondary outer wooden container which remains closed under all Appendix A conditions.

It is clear therefore, there will be no release of radioactive material and the effectiveness of the packaging will not be substantially reduced. The bases for this evaluation are set forth in the following treatment of the package under Appendix A conditions.

1. Heat

The outer container is constructed of wood and either painted or coated with Fiberglas. There are no materials on which the structure depends that would be adversely affected by prolonged temperatures up to 130°F.

2. Cold

Similarly, the strength of the wooden packaging is unaffected by temperatures at -40°F.

"Tests of wood conducted at about -300°F show that the important strength properties of dry wood in bending and in compression, including stiffness and shock resistance, are much higher at the extremely low temperature than at normal temperature." (Emphasis supplied). (Wood Handbook, Handbook No. 72, U.S. Department of Agriculture, Washington, D.C. 1955, page 89).

*A metal test specimen was spray painted with Rust-Oleum #964 after the thickness of the bare metal was measured. The paint was applied only until an opaque layer was formed. After drying, the thickness of the specimen was again measured to determine the thickness of the paint required to produce an opaque coating. That thickness is 0.004" and will be used as the criteria for application of paint to the interiors of decontaminated glove boxes and hoods.

The metal specimen was bent into a semicircle with an approximate 5" radius. No spalling or cracking of the painted surface was observed.

71.35 (Continued)

2. Cold (Continued)

Mr. William James of the Forest Products Service of the U.S. Department of Agriculture, Madison, Wisconsin states there is a crude relationship between the toughness of wood and the moduli of elasticity and rupture - properties which are well demonstrated to be superior at colder temperatures. He judges bending and sheer strength most critical to wooden packaging integrity at low temperatures. Bending is evaluated by tests for modulus of rupture which, in turn, correlates to toughness.

In view of these relationships and, since the -40°F minimum temperature is only a fraction of the -300°F temperatures which have shown superior strength in U.S. Department of Agriculture testing, it is concluded that the 9136 packaging meets the requirements of the regulation.

3. Pressure

Since the size and weight of the package precludes consideration of air transport, the package is not likely to encounter pressures lower than about 0.8 of an atmosphere. Nevertheless, both the contents and the outer wooden container will allow enough slow diffusion of air molecules to preclude any possibility of a sudden rupture of a seam or joint.

4. Vibration

The contents are of welded steel and therefore unaffected by vibration. The six faces of the outer wooden box are joined with screw nails, bolts and glue providing structural strength superior to crates used commonly for transport of heavy motors and industrial machinery.

5. Water Spray

A sample package was prepared for the water spray, free drop and penetration tests. The test package included a typical, although non-contaminated glove box prepared as follows:

Since the heaviest piece of equipment to be shipped is 1875 pounds, approximately 680 pounds of sheet lead ballast was installed and rigidly fixed to the interior of the glove box to approximate the weight of the heaviest glove box.

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Windows with glove ports were installed after the lead ballast was fixed in place and all gasket material was caulked on the inside and outside surfaces. All caulking material was sprayed with the red enamel paint. The windows and glove ports were covered with 1/4" plywood. The window covers were fixed to the glove box by steel banding straps and the glove port covers with masking tape.

The glove box was centered within the packaging and anchored to the floor with four 1/4" diameter wire cables crossed over the glove box and attached to eight eyebolts mounted in the floor of the packaging. The glove box was not fixed or restrained by the cribbing support beams and columns of the outer wooden container, but only by the cables tightened by turnbuckles to absorb the energy on impact during the free fall.

The closure (lid), fabricated and reinforced in the same manner as the sides and top of the packaging, was installed and sealed by gluing the lid flange edge to the front framework of the packaging and fastened by bolts and screw nails. Four garden hoses sprayed water uniformly over the sides and top for an hour, producing over 5 inches of water. There were no visible signs of distortion nor other adverse effects.

6. Free Drop

Since the heaviest package will be less than 10,000 pounds, the test drop was designed so that one corner was four (4) feet above the pad to receive all of the initial impact. Also, since this corner included the lid, it is considered to be the area where the maximum impact damage would occur. The most vulnerable point of impact for the 9136 packaging is a corner where the lid is joined to the body. Any other corner would include the thicker floor planking or one with additional internal structural members.

Thus oriented, the assembled package was lifted to the four foot elevation, quick-released and dropped. The test was photographed in video, motion picture and stills.

Upon impact, the package sustained relatively minor damage at the corner of impact and no opening in any part of the entire structure could be found by visual inspection.

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After the box lid was removed by sawing around the edge of the lid, but inside the seal surfaces between the lid and the package frame, no visual evidence of any structural damage was visible within the package at the corner of impact or in any other area. No interior seals sustained damage nor had any water penetrated the seals. The packaging structure withstood the impact with no observed damage that would reduce the effectiveness of the packaging.

Visual inspection of the glove box showed that the wire cables and the eye bolts had absorbed the energy due to impact. The glove box shifted in the direction of impact by 5". The glove box shifted tight against the downside eye bolts and corners were dented by impact with the two eye bolts.

A small spot ($\approx 1/2$ " square area) where impact with one of the eye bolts occurred was chipped in the glove box interior. All other painted surfaces were intact.

No other visible damage had occurred to the glove box. The integrity of bag port, glove port and window seals was maintained.

Some moisture was observed at the impacted end of the packaging and inside the glove box, but later inspection revealed it had entered through a knot in the plywood which had not been thoroughly caulked.

7. Corner Drop Not required. Exceeds 110 pounds.

8. Penetration Test

The packaging was penetration tested by impacting the hemispherical end of a vertical cylinder 1-1/4 inches in diameter and weighing 13 pounds, dropped from a height of 40 inches onto the most vulnerable area of the top of the packaging.

There was a very slight indentation of the surface but there was no puncture or other damage of significance.

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9. Compression - 5 times the Weight of the Package Applied Uniformly Against the Top and Bottom of the Package

A structural analysis was conducted on the package with a uniform load of 2.5 psi applied against the top in the position in which the package normally would be transported.

Horizontal 4" x 4" wood beams and 4" X 4" wood columns were installed within the package to provide support to the top side of the package (see Dwg. 908E617, Rev. 1).

Analyses were made without the glove box providing support to the top side.

Maximum spacing of the support is 29" and the packaging top transmits load through the columns to the heavy (2"X12" planking) wood support base.

Stress on the beams, columns and plywood face are well within the allowable unit stress on the wood - Douglas Fir. See Attachment B, "Stress Evaluation of Model 9136, G.E. Dwg. 908E615, Rev. 1" for details and calculations.

71.35 (a), (b) and 71.36-71.41 Not applicable to this LLS package.