

**EXAMINATION OF SHIPPING PACKAGES 9975-01968, 9975-04353
AND 9975-06870**

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AND 9975-06870**

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Summary

Three 9975 shipping packages were examined to investigate the non-conforming condition of an axial air gap greater than 1 inch. This condition typically indicates the presence of excess moisture in the fiberboard overpack, and may be accompanied by degradation in the fiberboard properties. In the case of these three packages, no excess moisture was present, and the fiberboard was not visibly degraded. However, the lower fiberboard assembly from 9975-06870 was separated into two pieces.

The lead shield from 9975-04353 was heavily corroded, while the shield from 9975-01968 had very little corrosion. In the case of 9975-06870, the shield was covered by a stainless steel sleeve, and the condition of the lead was not observed. No other conditions of concern were observed in these three packages.

Background

On April 13, 2010, three 9975 packages (-01968, -04353 and -06870) were examined in K Area by J. Murphy, B. Hackney and W. Daugherty, with assistance from C. Allen and G. Sides (SRNL High Pressure Lab). Each of these packages had been identified in violation of the 1 inch maximum axial gap between the drum flange and top of the upper fiberboard assembly. Past experience [1, 2] indicated the possibility that this condition might signal the presence of excess moisture within these packages, and examination of each of these packages proceeded in a manner similar to that of the previous packages. This report documents the results of the examination.

Examination Results

General notes on each package are summarized below. Dimensional, moisture and humidity data are provided in Table 1.

Package 9975-06870

The axial gap in this package ranged up to 1-1/8 inch. The fiberboard moisture content was drier than normally observed (8.4 %WME and less). The lower fiberboard assembly separated approximately 3.5 inches above the bottom (Figure 1). This separation did not appear to be associated with a glue joint. Otherwise, the softwood fiberboard appeared undegraded. The axial gap was reported on nonconformance report 2010-NCR-29-0005. K-Area will be requested to update the nonconformance report for the fiberboard separation.

Package 9975-04353

The axial gap in this package barely exceeded 1 inch at the center, and was 1 inch or less elsewhere. The lower fiberboard assembly could not be removed from the drum, due to a tight fit at the top of the drum. In regions accessible for measurement, the fiberboard moisture content (8.8 – 11.8 %WME) was consistent with other conforming packages. The cane fiberboard was in good shape and appeared undegraded (Figure 2). Heavy corrosion of the lead shield was observed, with local nodules of corrosion in several areas (Figure 3). K-Area will be requested to initiate a nonconformance report for the excessive axial gap condition.

Package 9975-01968

The axial gap in this package barely exceeded 1 inch at the center, and was 1 inch or less elsewhere. The fiberboard moisture content (10.0 – 14.2 %WME) was consistent with other conforming packages. The cane fiberboard was in good shape and appeared undegraded (Figure 4). Very little corrosion of the lead shield was observed (Figure 5). The axial gap was reported on nonconformance report 2010-NCR-29-0004.

Discussion

Drawing R-R2-F-0025 [3] recognizes that the axial gap dimension may vary over time due to variation in the fiberboard properties. An increase in the gap could result from axial shrinkage of the fiberboard (possibly as a result of moisture loss) or from compression of fiberboard layers (possibly as a result of local regions of elevated moisture). Some of the fiberboard dimensions measured (see Table) fall outside drawing tolerances. This generally occurred with dimensions LH1 and LH2 (refer to sketch). Both dimensions are consistently below nominal in these packages, even where only 1 of them is below the minimum tolerance. This suggests a general shrinkage throughout the assembly, although it does not rule out local compression.

Dimension UH1 varied among the three packages. However, this dimension was measured to include the air shield, which can create significant variation. Therefore, the data are indeterminate with regards to dimension UH1 meeting drawing tolerances.

Two observations are offered with regards to measuring the 1 inch axial gap.

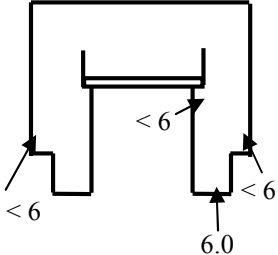
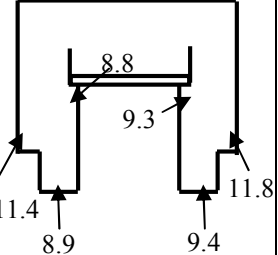
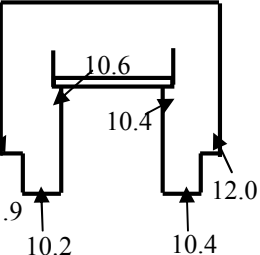
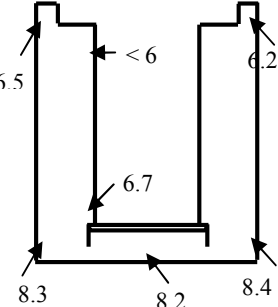
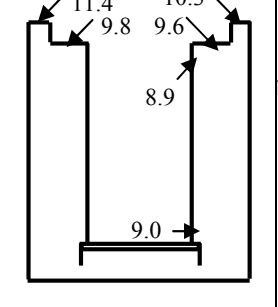
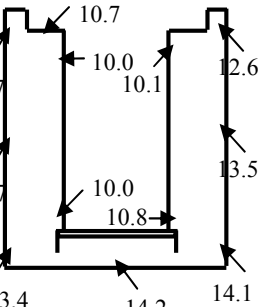
- When the package is fabricated, the fiberboard assembly is placed in the drum, and its height is adjusted to obtain the specified axial gap. Since the bottom of the drum is dished, the bottom of the fiberboard assembly will compress around the outside edge once it is weighted down (with the shield, containment vessels and/or a 3013 payload). If this weight is not included during the sizing step at the manufacturer, then compression of the fiberboard during subsequent assembly and operation will increase the axial gap beyond its initial value.
- There are different protocols in use for measuring the axial gap. For example, the High Pressure Lab compares the largest gap measured at any location to the 1 inch criterion. In contrast, an average of 4 readings is compared to the criterion during K Area field surveillance. Other protocols might be used elsewhere. A consistent approach would be desirable.

In the case of these three packages, the fiberboard was not visibly degraded (apart from the separation in 9975-06870). However, other packages have been examined in which an axial gap slightly greater than 1 inch was associated with regions of excess fiberboard moisture and/or mold. If any changes are considered in the way the gap is measured or the 1 inch criterion, the incidence of missing a degraded package should be weighed against the incidence of rejecting an otherwise acceptable package.

References

1. SRNL-STI-2009-00240, "Examination of Fiberboard from Shipping Package 9975-01819", W. L. Daugherty, April 2009
2. SRNL-STI-2009-00742, "Examination of Shipping Packages 9975-01818, 9975-01903 and 9975-02287", W. L. Daugherty, November 2009
3. Drawing R-R2-F-0025, Rev. 2, "9975 Drum with Flange Closure Subassembly and Details", October 29, 2003

Table 1. Detailed data for each package

	9975-06870	9975-04353	9975-01968
Upper air space RH	45.9% at 19.1 C	51.9% at 18.9 C	51.0% at 20.2 C
Upper assembly			
Dimension UH1	7 1/16 inch	7 1/8 – 7 3/16 inch	7 1/8 – 7 1/4 inch
Dimension UH2	2 inch	2 1/16 inch	2 1/16 – 2 1/8 inch
Dimension UH3	5 inch	5 inch	5 inch
Moisture content (%WME)			
Lower assembly			
Dimension LH1	26 3/8 – 26 1/2 inch	NA	26 1/2 - 26 9/16 inch
Dimension LH2	20 3/8 inch	20 5/16 – 20 3/8 inch	20 1/4 - 20 5/16 inch
Dimension LH3	2 inch	2 inch	2 inch
Moisture content (%WME)			

Each dimension was measured twice, ~180 degrees apart. Dimensions were read to the nearest 1/16 inch.

Dimension UH1 includes the air shield.

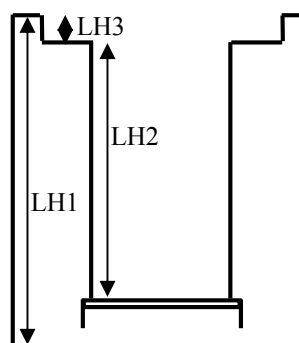
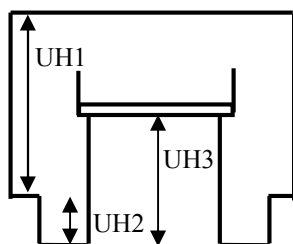




Figure 1. Separation of 9975-06870 lower fiberboard assembly.

(a) Both pieces of lower assembly separated



(b) Lower separated piece (in upright position) on top of inverted larger section



(c) Lower piece inverted and placed on upper piece. (The entire lower assembly is inverted in this view.)



Figure 2. Fiberboard assembly from package 9975-04353

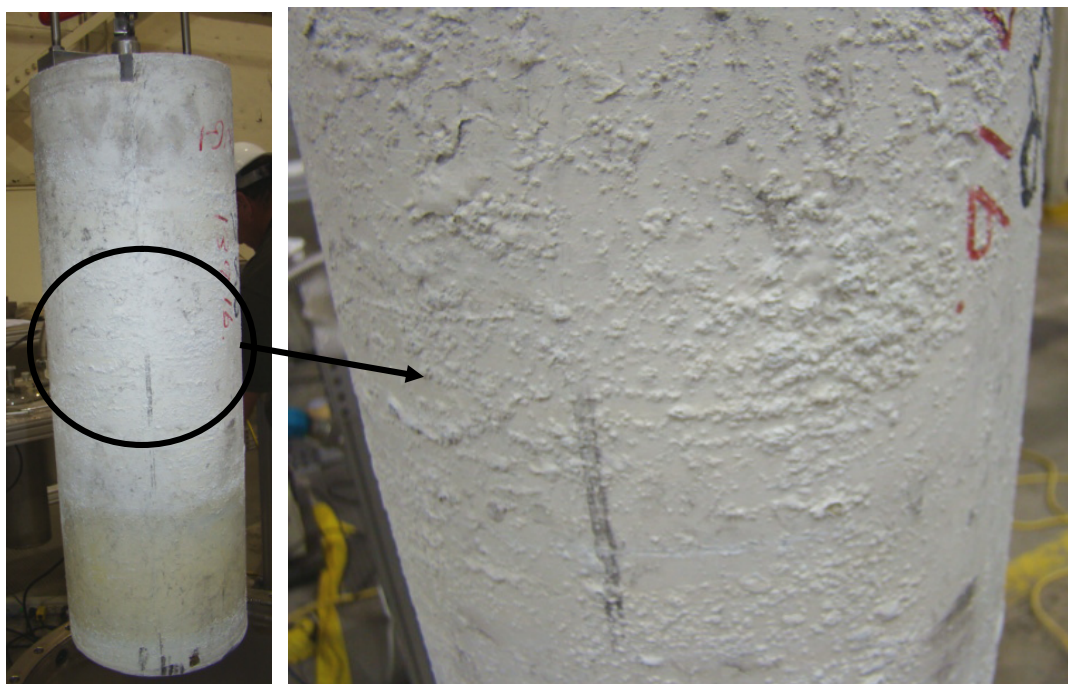


Figure 3. Lead shield from 9975-04353 showing heavy corrosion



Figure 4. Fiberboard assembly from package 9975-01968



Figure 5. Lead shield from 9975-01968 showing light corrosion

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