EXAMINATION OF SHIPPING PACKAGE 9975-2130

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Summary

Shipping package 9975-02130 was examined in K-Area following the identification of a non-conforming condition; the axial gap between the drum flange and upper fiberboard assembly exceeded the maximum allowed value of 1 inch. The average measured axial gap was 1.1 inches. The fiberboard assembly in this package contained moisture levels of ~14 – 24 % wood moisture equivalent (~12 – 19 wt%) This is moderately higher than typically seen in conforming packages, but not as high as seen on most packages which have exceeded the allowed axial gap. Small patches of mold were growing on portions of the lower fiber assembly, but the fiberboard appeared intact and with little apparent change in its integrity.

The lead shield had a heavy layer of corrosion product, some of which flaked off easily. The thickness of several flakes was measured, and varied from 0.0016 to 0.0031 inch. However, additional corrosion product remained on the shield under the flaked regions, so the total thickness of corrosion product exceeds 0.0031 inch.

Background

On June 14, 2010, package 9975-02130 was opened as part of KAMS 9975 field surveillance activities. This package was identified to have an axial gap between the drum flange and upper fiberboard assembly greater than the specified 1 inch maximum, and was placed under an NCR condition (2010-NCR-29-0007). This package was closed up, and moved to another location on July 1, 2010 for further examination. Present at this second examination were J. Murphy, B. Eberhard, W. McEvoy and W. Daugherty, with assistance from D. Holliday (SRNL High Pressure Lab).

Past experience [1 - 3] indicated the possibility that this condition might signal the presence of excess moisture within the fiberboard, and the second examination of each of this package proceeded in a manner similar to that of the previous packages. This report documents the results of the second examination of 9975-02130. The Surveillance Program Authority (SPA) will evaluate the available data and recommend a disposition for the non-conforming axial gap.

Examination Results

During the initial field surveillance, several observations were made specific to this package [4], and are summarized as follows:

- The average axial gap at the top of the package was 1.0565 inch.
- The relative humidity in the top air space was 96.1 %.
- Fiberboard moisture content was measured on the upper assembly and exposed portions of the lower assembly, and varied from 11.6 to 18.6 %WME.
- The upper fiberboard assembly was somewhat darker in appearance on the outer edges than in the center.
- Lead carbonate corrosion product was flaking from the shield.

The following observations were made during the second examination on July 1, 2010. This examination was more extensive in that the shield and lower fiberboard assembly

were removed from the drum. Dimensional, moisture and humidity data are provided in Table 1.

- All 4 caplugs were in place initially. One caplug was removed to record the humidity in the top air space. This caplug was subsequently replaced. The recorded humidity inside the drum was 67.6 %RH at a temperature of 24.8 C. The humidity within the room was 48.8 %RH at a temperature of 23.5 C.
- The drum closure bolts had light superficial rust on top (Figure 1).
- The axial gap between the drum flange and upper fiberboard assembly was 1.099 inch (average of 4 measurements near the edge). The gap at the center was 1.111 inch.
- The package had a moderate musty odor when opened. Numerous regions on the lower fiberboard OD and bottom surfaces assembly had a very light presence of mold. The mold was at an early stage of growth and hard to distinguish from the fiberboard. However, a few locations were more obvious, as illustrated in Figure 2
- The shield had a heavy corrosion layer (Figure 3), which flaked off easily. Much of the corrosion product rubbed off onto the lower fiberboard assembly (or fell to the bottom of the lower fiberboard assembly) as the shield was removed (Figure 4). An additional layer of white corrosion product remained after the outer layer flaked off.
- A few flakes of the shield corrosion product were collected to measure their thickness, which ranged from 0.0016 to 0.0031 inch. This is consistent with previous measurements on other shields [5, 6].
- The drum bottom contained a step (Figure 5), rather than the uniform concave profile seen previously. This created a pronounced compression ring of uniform width on the bottom of the lower fiberboard assembly. Interior to this ring, the lower fiberboard surface held many loose fibers and related debris.
- On the underside of the drum, several spots of corrosion were noted along the bend between the bottom and the lip on which the drum stands (Figure 6).

Package 9975-02130 was leak tested and closed up at RFETS in April 2003. It was transported to KAMS and remained there in storage until the recent field surveillance. Its internal heat load for this 7 year period was approximately 5 watts.

Discussion

Drawing R-R2-F-0025 [7] 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). The larger vertical dimensions (UH1, LH1 and LH2) are each below the nominal value, after correcting for the air shield thickness. While this suggests an overall vertical shrinkage throughout the assembly, an increase in height generally results from elevated moisture levels. The data do not rule out local regions of compression.

The bottom of the lower fiberboard assembly contained numerous loose fibers protruding from the fiberboard surface within the inner area. This region fit within the step in the bottom of the

drum. The height of these fibers indicates that there was relatively little compression of the bottom layer into the step of the drum bottom. However, there is at least a small amount of compression along the outer ring of the bottom layer where it sits on the drum bottom outside of the step.

Package 9975-02130 has been in storage for 7 years. The overall moisture content of the fiberboard is somewhat higher than typically seen in conforming packages. However, the fiberboard still displays a general overall integrity similar to that expected for undegraded material. Some loss of strength would be expected from the elevated moisture levels, and some long-term degradation would be expected from the mold. However, damage from the mold appears to not be very advanced.

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. SRNL-STI-2010-00233, "Examination of Shipping Packages 9975-01968, 9975-04353 and 9975-06870", W. L. Daugherty and J. L. Murphy, April 2010

4. electronic mail message "NDE Status – 6/14/10 Nights", C. Daley, June 15, 2010

5. WSRC-TR-2006-00162, "Destructive Examination of Shipping Package 9975-00826", W. L. Daugherty, May 2006

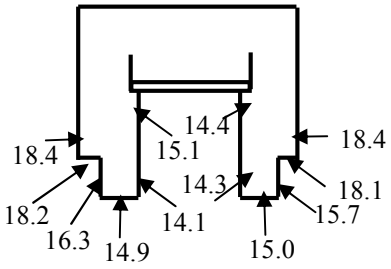
6. WSRC-MS-2005-00406, "Shipping Package 9975-02234 Lead Shield Corrosion Product", W. L. Daugherty, July 5, 2005

7. Drawing R-R2-F-0025, Rev. 2, "9975 Drum with Flange Closure Subassembly and Details", October 29, 2003

Table 1. Detailed data for package 9975-02130

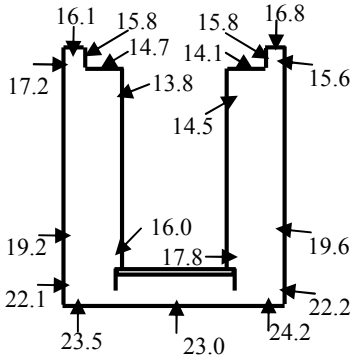
Upper air space RH	67.6% at 24.8 C		
Upper assembly			
Dimension UH1	7.11 inch	Dimension UH3	4.995 inch
Dimension UH2	2.099 inch	Dimension UD2	8.55 inch

Moisture content (%WME)

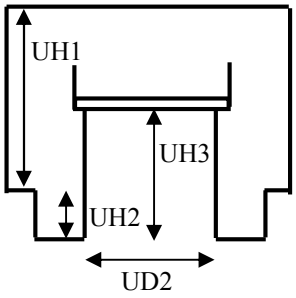


Lower assembly			
Dimension LH1	26.48 inch	Dimension LD1	18.12 inch
Dimension LH2	20.23 inch	Dimension LD2	18.38 inch
Dimension LH3	2.058 inch		

Moisture content (%WME)



Each recorded dimension is an average of 2 or 4 measurements, ~90 or 180 degrees apart. Larger dimensions were read to the nearest 1/32 inch with a tape measure. Smaller dimensions were read to the nearest 0.001 inch with calipers.
Dimension UH1 includes the air shield, which adds ~0.1 inch to the measurement.



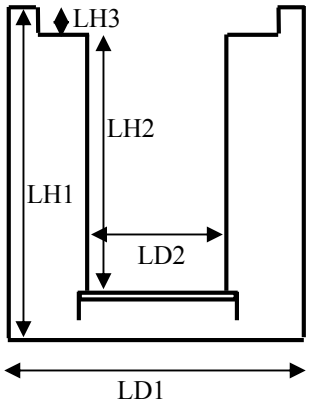


Figure 1. Superficial corrosion on the drum closure bolts. (Photograph by B. Eberhard, NMM)

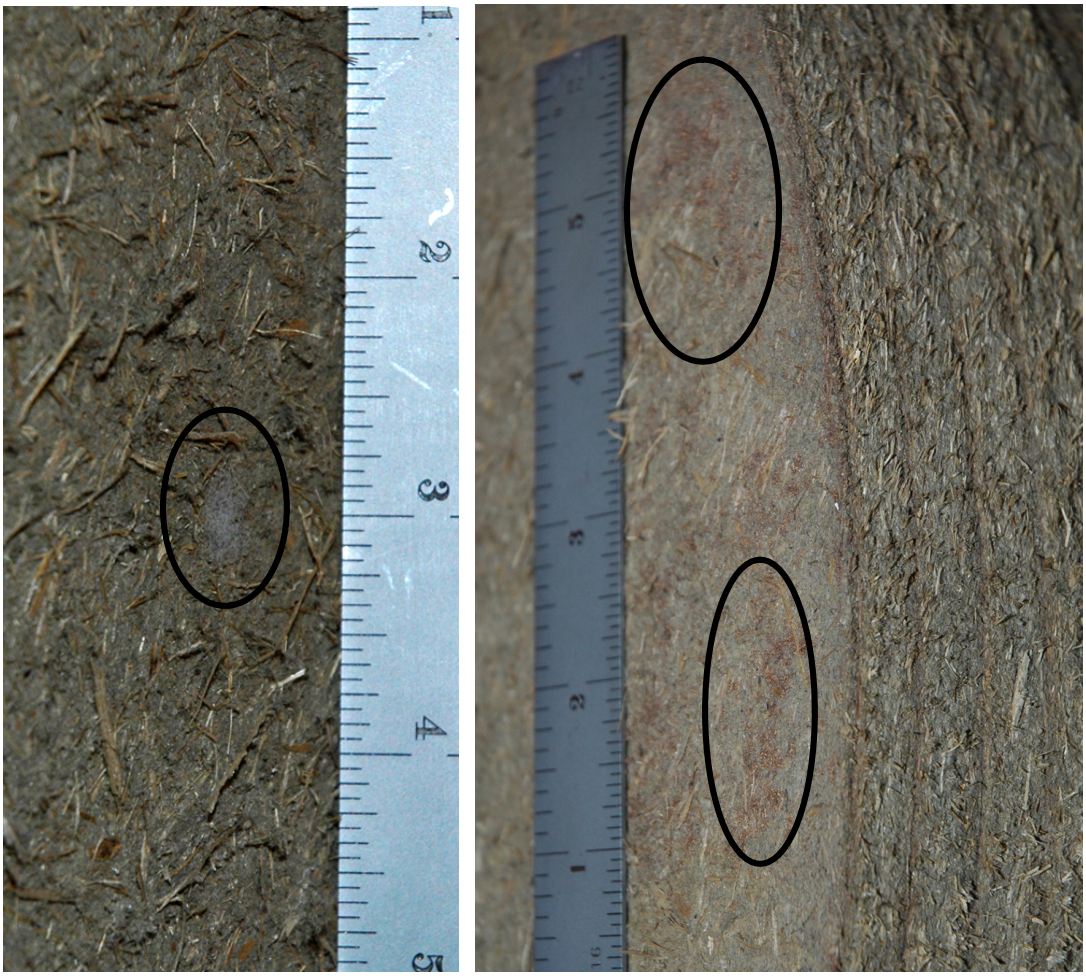


Figure 2. Regions of mold (circled) on the lower assembly bottom. (Photographs by B. Eberhard, NMM)

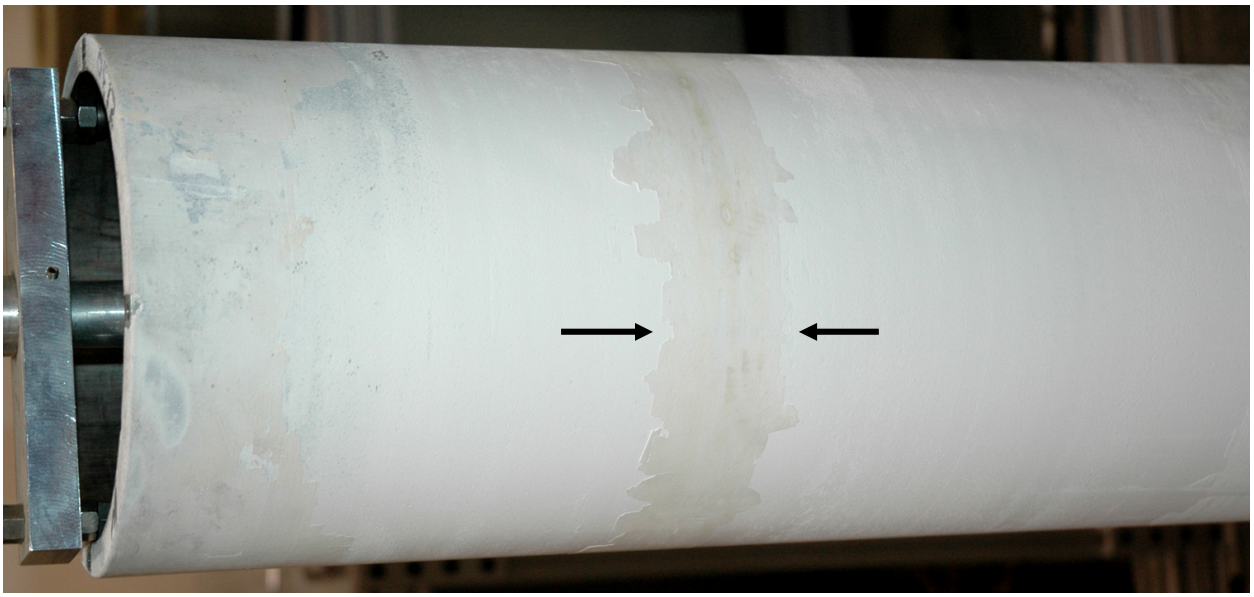
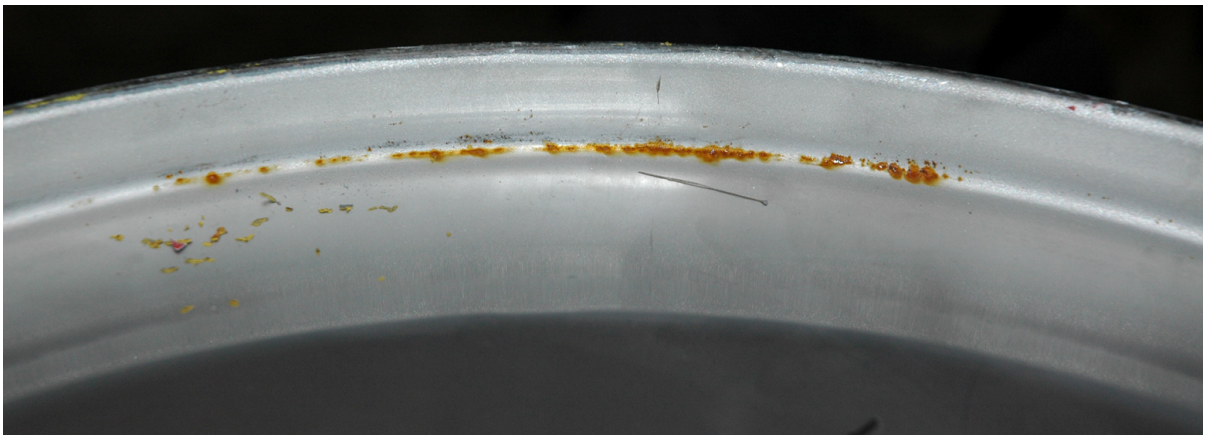


Figure 3. Corrosion on lead shield. Corrosion product in the central band (between arrows) has not yet flaked off. Corrosion product has flaked off above and below this band. (Photograph by B. Eberhard, NMM)

Figure 4. Lead carbonate corrosion product from the shield which remained on/in the lower fiberboard assembly after the shield was removed. (Photographs by B. Eberhard, NMM)

Figure 5. Bottom of drum, showing step profile. (Photograph by B. Eberhard, NMM)



(a)

(b)

Figure 6. Two of the heavier regions of corrosion on the drum bottom, along the edge of the lip the drum stands on. (Photographs by B. Eberhard, NMM)

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