H1259 Container Foams: Performance Data on Aged Materials

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ABSTRACT

Samples of the three cushioning foams used in the H1259 weapon storage container were obtained in 1997, 1998, 2000 and 2001 and tested for density, compression set and compressive strength using the same procedures specified for acceptance testing. Foams from six containers, all about 30 years old and located at Pantex, were evaluated. The bottom cushioning foam is a General Plastics polyurethane foam and the two side pads are rebonded polyurethane foams. All the tests were carried out at room temperature.

When compared to the original acceptance requirements the foams were generally in-spec for density and compressive strength at 10% strain and were generally out-of-spec for compression set and compressive strength at 50% strain. Significant variability was noted in the performance of each foam sample and even more in the container-to-container foam performance. The container-to-container variability remains the major unknown in predicting the long-term suitability of these containers for continued use.

The performance of the critical bottom cushion foams was generally more uniform and closer to the specified performance than that of the rebonded foams. It was judged that all the foams were adequate for continued use as storage container foams (not shipping) under controlled conditions to mitigate temperature extremes or high impact.

This archived information is important in evaluations of the continued suitability for weapon storage use of the H1259 containers and other containers using the same foam cushions.
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<th>Page</th>
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Introduction and Procedures

Surplus H1259 storage containers at Pantex are currently planned for refurbishment into H1639 storage containers. Those containers are expected to see continued storage use for additional weapon systems being removed from stockpile. Many of the H1259 containers are already 30 years old. As part of this effort, therefore, the condition of the foams in the containers and any apparent aging trends were evaluated.

Six of the oldest H1259 containers were selected in 1997 for testing and samples of each of the three container foams were removed in 1997, 1998, 2000 and 2001. The identity of the containers is shown in Figure 1 along with a schematic of the three foams and their locations within the containers. Part numbers for the three foams are 272009, 272011 and 320664. The most critical cushion is the bottom cushion, part 272011 (per specification 2170372,) and this was fabricated from virgin polyurethane foam made by General Plastics. The mid (part 320664) and lower (part 272009) side pads (per specification 2170619 in 2170617 thru 2170620) were made from less expensive rebonded polyurethane foams, which generally have poorer and less uniform performance.

The material specs call out the use of test specification 9952033 (Type I) for acceptance testing. These same density, compression set and compressive strength (deflection) tests were used to evaluate the aged foams from Pantex. The results from the four series of tests have been compiled and graphed and are archived in this report. The results from the tests in 1997 and 1998 were also documented in memos from Larry Brown to DOE. All of these results were presented to a December 2001 review of the H1639 storage container program.

Procedures (per 9952033)

After the large foam pieces were received at Sandia, CA they were sent out to Bob’s Foam Factory in Fremont, CA to be cut into test specimens. Three to four specimens measuring 2x2x1 inch and three to four specimens measuring 4x4x1 inch were cut from each piece of foam.

The 2x2x1 inch specimens were used both to measure density and then compression set. The 4x4x1 inch specimens were used to measure compressive strength at 10% and 50% strain. The dimensions of the test specimens were not highly uniform or precise and that variability was one factor contributing to the observed performance variability. In most tests only three specimens were used. All tests were carried out under ambient conditions.

In the density test the dimensions and weight of each specimen were measured and used to calculate a density. Dimensions were measured with either a ruler or micrometer with little difference noted. These individual density values were averaged to give a density for each foam piece in each container. The specified density for the bottom cushion (272011) is 6.5-8.5 pcf (pounds per cubic foot). The specified density for the mid (320664) and bottom (272009) pad rebond foams is 6.75-8.25 pcf.
In the compression set test the height of the specimens was measured with a laser micrometer (Techmet LaserMike Model 183) using the lowest value obtained in four measurements with the sample rotated to a different face before each measurement. The specimens were then placed between steel compression plates and compressed to 0.5 inches using spacers. The compression set plates with the specimens were placed in an oven at 158°F (70°C) for 22 hours. After removing the foam specimens from the plate fixtures they were allowed to cool for about 30 minutes and the height was again measured with the laser micrometer. The compression set percentage is calculated as the difference between the initial and final measured thickness divided by the initial thickness minus the compressed thickness. If the sample does not rebound at all from the compressed thickness the compression set would be 100%. If it completely rebounds the CS% would be 0%. All specimens were compressed to 0.5 inches regardless of their actual height, which varied slightly from the nominal one inch specified. This variability in the actual percent compression, along with the material variability, would contribute to the observed variability in the compression set values. The specified maximum compression set for the bottom cushion (272011) is 8%. The specified maximum compression set for the mid (320664) and bottom (272009) pad rebond foams is 20%.

In the compressive strength test the specimens were compressed at 2 inches/minute to 60% strain and decompressed three times and then allowed to relax for 5 minutes. The specimens were then compressed a fourth time and the stress measured at 10% and 50% strain. The specified compressive strength for the bottom cushion (272011) is 1.5-3.5 psi at 10% strain and 4.5-7.5 psi at 50% strain. The specified compressive strength for the mid (320664) and bottom (272009) pad rebond foams is 0.7-1.3 psi at 10% strain and 5.0-9.0 psi at 50% strain. The rebonded foams have less strength than the virgin foam at low strains and higher strength at high strains.

It should be noted that any permanent change in the foam dimensions over the 30 years they have been fielded was not captured by the compression set test above. No unusual distortion was noted in the foams, however, and no foam densities above the specified limits were observed. Any significant compression set in the field would be reflected by an increase in the apparent foam density.

**Results and Discussion**

The average test data for all four test series is presented in Table 1 and in Figures 2 through 4. These averages combine the data for each foam in all six containers to provide an overview of the foam performance and any aging trends over the five-year span of the tests. Those table values, which are out-of-spec, are highlighted by shading. As is apparent from the summary table, the two tests with the highest levels of out-of-spec performance are the compression set and the compressive strength at 50% strain.

Table 1 also contains standard deviations, which reflect the container-to-container variability (denoted as SD-C) and the test and material variability (denoted as SD-F). SD-C was calculated from the six test values, one per container, for each foam in a given year where those values (shown in Table 1) were averages of the 3 to 4 specimens tested. SD-F was calculated by averaging the standard deviations found for the 3 to 4 test specimens for that foam type in each
container. Individual test values and standard deviation data for each test are provided in the more detailed test data in the appendix.

Additional figures (5 through 40) depict the average performance of each foam type over the four test series (three plots per page) and also the performance of the foams in each container (six plots per page) over the four test series. These plots enable a more detailed look at the performance of each container and the variability in the container and foam performance.

The performance variability observed is high over the six containers examined and probably reflects variability in the entire population. The container-to-container variability was higher than the test/material variability in all tests except the compressive strength at 10% where they were roughly the same. Because the six containers chosen for this testing were among the oldest, it is presumed that the newer containers may have better performance.

The average foam density has been within specification for all four test series with a few exceptions. The densities have shown little change over the period examined and, as noted above, no exceptionally high densities were noted which might indicate excessive compression set in the field.

The average foam compression set values were slightly over specification for all four test series, but have changed little over the period examined. The highest compression sets, close to 30%, were found in the lower pad rebond foam in container 4, and the lower pad foam generally showed more container-to-container variability than the other foams. The bottom cushion foam, the most important foam, had compression set values above the specified 8% maximum but were generally uniform in performance and ranged from about 8 to 16%. The rebonded foams used in mid and lower pads, are lower performance materials and have a specified compression set maximum of 20%. With the exception of container 4, these compression set values ranged from about 15 to 25%.

A key concern has been the compressive strength at 10% and 50% strain. Changes in the operator, the test hardware and the test software have introduced slight differences in the test methodology from year to year and such changes appear to account for the lower values observed in the 2001 test series. When all these changes are considered there appears to be no significant change in these properties over the period examined. Overall, the compressive strength values at 10% strain are generally within spec with some data above and below the target ranges. The compressive strength values at 50% strain show higher levels of below-spec performance in the two rebond foams (lower and mid pad). The bottom cushion foam shows better performance with most test values within spec.

The foams remain compliant to the touch with no evidence of brittleness and do not look “bad.” The test data discussed above also showed no deterioration trends over the five-year span of these tests, which would suggest that the foams would no longer be usable in the near future.
Summary

The H1259 container foams show reasonably good performance in spite of their age. This performance does vary widely from container to container, however, and worse case scenarios need to be considered in evaluating their suitability for continued use. All the current test data is only suitable for judging the uniformity of the foams and their performance relative to the initial requirements. This data does not measure the foam performance under high strain rates or at different temperatures.

These containers are already certified for storage only, not for transportation use. While technically out-of-spec in many cases, the foams appear to be suitable for such continued benign use, particularly if care is taken to minimize exposure to extreme temperatures and to mitigate conditions that might result in high impacts.
Six older containers were selected at Pantex, two from inside storage and four from the Bull Barn area, and marked as “Engineering Evaluation Unit.” During each test cycle, a single large sample was cut from the three foams in each container, bagged and marked with the foam part and container serial numbers. The remaining foams were returned to each container for storage. Desiccant was added to one drum stored inside and two stored in the bull barn. At SNL/CA each sample was cut into 3 to 4 pieces measuring 2x2x1 inches and 3 to 4 pieces measuring 4x4x1 inches for testing. All units had foams with apparent water stains except Unit 1. Unit 3 was an unbolted “Training Only” unit moved to the Bull Barn from outside storage.
### Table 1. Summary Table of H1259 Container Foam Properties

**Summary of H1259 Storage Container Foam Properties (individual values are the average of measurements on 3-4 foam samples.)**

Test procedures as per 49CFR303.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Foam</th>
<th>Density (lbs/cubic foot)</th>
<th>Compression Set Percentage</th>
<th>Strength at 10% Compression (psi)</th>
<th>Strength at 50% Compression (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>272009</td>
<td>7.64 7.43 7.35 7.30</td>
<td>12.2 20.18 20.2 18.9</td>
<td>1.77 0.84 1.14 0.81</td>
<td>1.94 4.39 6.25 4.85</td>
</tr>
<tr>
<td>2</td>
<td>272011</td>
<td>7.80 7.80 7.80 7.80</td>
<td>12.7 15.24 15.3 14.6</td>
<td>1.73 2.55 3.23 2.48</td>
<td>5.84 6.62 7.97 6.62</td>
</tr>
<tr>
<td>3</td>
<td>320664</td>
<td>6.77 6.80 6.80 6.80</td>
<td>12.8 23.7 23.7 22.6</td>
<td>1.53 2.79 3.14 2.36</td>
<td>5.84 6.63 7.52 6.54</td>
</tr>
<tr>
<td>4</td>
<td>272009</td>
<td>7.64 7.43 7.43 7.43</td>
<td>15.4 22.5 22.5 20.5</td>
<td>0.96 0.91 1.28 0.86</td>
<td>6.07 5.42 6.44 5.32</td>
</tr>
<tr>
<td>5</td>
<td>272011</td>
<td>7.80 7.80 7.80 7.80</td>
<td>14.3 23.7 23.7 22.6</td>
<td>0.79 0.68 1.04 0.74</td>
<td>4.93 4.73 5.02 4.53</td>
</tr>
<tr>
<td>6</td>
<td>320664</td>
<td>6.77 6.80 6.80 6.80</td>
<td>16.3 23.0 23.0 21.2</td>
<td>0.51 0.52 0.78 0.55</td>
<td>3.88 3.28 4.27 3.58</td>
</tr>
<tr>
<td>7</td>
<td>272009</td>
<td>7.64 7.43 7.43 7.43</td>
<td>16.3 23.0 23.0 21.2</td>
<td>1.00 2.14 2.25 1.83</td>
<td>4.15 4.45 4.87 4.40</td>
</tr>
<tr>
<td>8</td>
<td>272011</td>
<td>7.80 7.80 7.80 7.80</td>
<td>16.3 23.0 23.0 21.2</td>
<td>0.89 1.17 1.12 0.85</td>
<td>4.50 4.84 6.14 4.40</td>
</tr>
<tr>
<td>9</td>
<td>320664</td>
<td>6.77 6.80 6.80 6.80</td>
<td>16.3 23.0 23.0 21.2</td>
<td>0.78 0.90 1.20 0.82</td>
<td>4.25 5.32 6.38 5.02</td>
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<tr>
<td>10</td>
<td>272009</td>
<td>7.64 7.43 7.43 7.43</td>
<td>16.3 23.0 23.0 21.2</td>
<td>1.00 2.14 2.25 1.83</td>
<td>4.15 4.45 4.87 4.40</td>
</tr>
<tr>
<td>11</td>
<td>272011</td>
<td>7.80 7.80 7.80 7.80</td>
<td>16.3 23.0 23.0 21.2</td>
<td>0.89 1.17 1.12 0.85</td>
<td>4.50 4.84 6.14 4.40</td>
</tr>
<tr>
<td>12</td>
<td>320664</td>
<td>6.77 6.80 6.80 6.80</td>
<td>16.3 23.0 23.0 21.2</td>
<td>0.78 0.90 1.20 0.82</td>
<td>4.25 5.32 6.38 5.02</td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td>7.64 7.35 7.30 7.30</td>
<td>17.8 21.2 21.2 19.5</td>
<td>1.00 2.14 2.25 1.83</td>
<td>4.15 4.45 4.87 4.40</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>2.02 2.02 2.02 2.02</td>
<td>10.8 10.8 10.8 10.8</td>
<td>0.45 0.61 0.61 0.61</td>
<td>2.98 3.29 3.68 3.59</td>
</tr>
</tbody>
</table>

**Average** and **Range**: The average and range of the values were calculated for each container. This is an indication of the container-to-container variability. 

**SD-C**: The spread of (high to low) value of the average values measured for each container. This is the container-to-container range.

**SD-F**: The average of the six standard deviations for that foam type. Three to four test specimens were cut from each container foam sample. This is an indication of the material and test variability.

**Density spec.** | **CS spec.** | **10% Comp. spec.** | **50% Comp. spec.**
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>6.75-8.25 pdf</td>
<td>20%</td>
<td>6.75-8.25 pdf</td>
<td>20%</td>
</tr>
<tr>
<td>6.50-6.50 pdf</td>
<td>8%</td>
<td>6.50-6.50 pdf</td>
<td>8%</td>
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<tr>
<td>6.75-8.25 pdf</td>
<td>20%</td>
<td>6.75-8.25 pdf</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Unit 1**: JAW-2770
**Unit 2**: MBZ-RA-B78
**Unit 3**: JAW-1133

**Unit 4**: JAW-2627
**Unit 5**: JAW-1334
**Unit 6**: JAW-1521
Figure 2-4. Overall Average H1259 Container Foam Properties vs. Sample Year

Overall Average Foam Density (pcf)

- 272009 Density (pcf)
- 272011 Density (pcf)
- 320664 Density (pcf)

Overall Average Compression Set Values (percent)

- 272009 Compression Set Percentage
- 272011 Compression Set Percentage
- 320664 Compression Set Percentage

Overall Average Foam Compressive Strength Values (psi)

- 272009 Average Strength at 50% Compression (psi)
- 272011 Average Strength at 50% Compression (psi)
- 320664 Average Strength at 50% Compression (psi)
- 272009 Average Strength at 10% Compression (psi)
- 272011 Average Strength at 10% Compression (psi)
- 320664 Average Strength at 10% Compression (psi)
Figure 5 - 7. Average Foam Densities

Lower Pad Rebond Foam (272009) Average Foam Densities

Bottom Cushion GP Foam (272011) Average Foam Densities

Mid Pad Rebond Foam (320664) Average Foam Densities
Figure 8-13. Individual Container Foam Densities

Drum 1 (JAW-2770) Average Foam Densities

Drum 2 (M822-878) Average Foam Densities

Drum 3 (JAW-1133) Average Foam Densities

Drum 4 (JAW-2627) Average Foam Densities

Drum 5 (JAW-1134) Average Foam Densities

Drum 6 (JAW-1521) Average Foam Densities
Figure 14 - 16. Average Foam Compression Set Values

Lower Pad Rebond Foam (272009) Average Compression Set Values

Bottom Cushion GP Foam (272011) Average Compression Set Values

Mid Pad Rebond Foam (320664) Average Compression Set Values
Figure 17-22. Individual Container Compression Set Averages
Figure 23 - 25. Average Foam Compressive Strength Values at 10% Strain

Lower Pad Rebond Foam (272009) Avg. Compressive Strength at 10% Strain

Bottom Cushion GP Foam (272011) Avg. Comp. Strength at 10% Strain

Mid Pad Rebond Foam (320664) Avg. Compressive Strength at 10% Strain
Figure. 26-31. Individual Container Compressive Strength Values at 10% Strain

Drum 1 (JAW-2770) Avg. Compressive Strength at 10% Strain (psi)

Drum 2 (MSZ-878) Avg. Compressive Strength at 10% Strain (psi)

Drum 3 (JAW-1133) Avg. Compressive Strength at 10% Strain (psi)

Drum 4 (JAW-2872) Avg. Compressive Strength at 10% Strain (psi)

Drum 5 (JAW-1334) Avg. Compressive Strength at 10% Strain (psi)

Drum 6 (JAW-1521) Avg. Compressive Strength at 10% Strain (psi)
Figure 32 - 34. Average Foam Compressive Strength Values at 50% Strain

Lower Pad Rebond Foam (272009) Avg. Compressive Strength at 50% Strain

- Drum 1
- Drum 2
- Drum 3
- Drum 4
- Drum 5
- Drum 6

272009 spec: 5.0-9.0 psi

Bottom Cushion GP Foam (272011) Avg. Comp. Strength at 50% Strain

- Drum 1
- Drum 2
- Drum 3
- Drum 4
- Drum 5
- Drum 6

272011 spec: 4.5-7.5 psi

Mid Pad Rebond Foam (320664) Avg. Compressive Strength at 50% Strain

- Drum 1
- Drum 2
- Drum 3
- Drum 4
- Drum 5
- Drum 6

320664 spec: 5.0-9.0 psi
Figure 35 - 40. Individual Container Compressive Strength Values at 50% Strain

Drum 1 (JAW-2770) Avg. Compressive Strength at 50% Strain (psi)

Drum 2 (MBZ-078) Avg. Compressive Strength at 50% Strain (psi)

Drum 3 (JAW-1123) Avg. Compressive Strength at 50% Strain (psi)

Drum 4 (JAW-3627) Avg. Compressive Strength at 50% Strain (psi)

Drum 5 (JAW-4334) Avg. Compressive Strength at 50% Strain (psi)

Drum 6 (JAW-1521) Avg. Compressive Strength at 50% Strain (psi)
Appendix

The following tables provide detailed test information, which has been summarized in the Table and Figures in the report body. The original data from the 1997 and 1998 density tests could not be located.
### Container Foam Densities: 2000 Data

<table>
<thead>
<tr>
<th>Unit</th>
<th>Foam No</th>
<th>2000 Polyurethane Foam Densities (using 2 x 2 x 1 inch compression set samples)</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>Foam No</td>
<td>Wt-1</td>
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<tr>
<td>1</td>
<td>272009</td>
<td>8.66</td>
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<tr>
<td>1</td>
<td>272011</td>
<td>9.27</td>
</tr>
<tr>
<td>1</td>
<td>320664</td>
<td>7.48</td>
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<tr>
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<td>272009</td>
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<tr>
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<td>272011</td>
<td>8.74</td>
</tr>
<tr>
<td>6</td>
<td>320664</td>
<td>7.44</td>
</tr>
</tbody>
</table>

| Avg, 272009 | Container to container | 0.78 | 6.85 | 0.10 |
| Avg, 272011 | standard | 0.46 | 7.76 | 0.09 |
| Avg, 320664 | deviations | 0.52 | 9.95 | 0.17 |

272009 = Robond Foam, Lower Pad
272011 = Virgin Foam, Bottom Cushion
320664 = Robond Foam, Mid Pad
1 = JAW 2770 F71
4 = JAW 2627
2 = MBZ-R/A-B78
5 = JAW-1334-F0 (MBZ-R/A-C71)
3 = JAW-1153-00 (MBZ-R/A-C71)
6 = JAW-1521-H0 (MCA-R/A-B71)
## Container Foam Densities: 2001 Data

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- Avg. 272009: Container to container 0.68 6.89 0.14
- Avg. 272011: standard deviation 0.42 7.62 0.12
- Avg. 320664: deviations 0.49 6.88 0.18

272009 = Rebound Foam, Lower Pad
272011 = Virgin Foams, Bottom Cushion
320664 = Rebound Foam, Mid Pad
1 = JAW-2770-F71
4 = JAW-2827
2 = MBZ-R/A-878
5 = JAW-1334-F0 (MBZ/R/A-C71)
3 = JAW-1133-00 (MBZ/R/A-C71)
6 = JAW-1521-H0 (MCA/R/A-B71)
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| Avg. |    | Container to container | 19.7 | 6.1 | 0.4 |
|      |    | standard deviations | 13.0 | 3.1 | 1.7 |
|      |    | deviations | 22.7 | 2.5 | 2.0 |

Heights measured on laser micrometer using lowest cross-section height obtained on four faces.

CS = (100 x avg. height diff.)/(init. height-0.5). This is equivalent to averaging three separate CS values.

<table>
<thead>
<tr>
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<tr>
<td>Unit 1: JAW-2770</td>
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## Container Foam Compression Set Values: 1998 Data

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<th>Init.-3</th>
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<th>Final-2</th>
<th>Final-3</th>
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<th>Diff.-2</th>
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<th>CS No.3</th>
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</tbody>
</table>

Heights measured on laser micrometer using lowest cross-section height obtained on four faces.
CS = (100 x avg. height diff.)/(init. height-0.5). This is equivalent to averaging three separate CS values.

### Spec. Maximum

<table>
<thead>
<tr>
<th>Unit 1: JAW-2770</th>
<th>Unit 4: JAW-2627</th>
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<th>20%</th>
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<tbody>
<tr>
<td>Unit 2: MBZ-R/A-B78</td>
<td>Unit 5: JAW-1334</td>
<td>272011 = GP Foam, Bottom Cushion</td>
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<tr>
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<td>Unit 6: JAW-1521</td>
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### Container Foam Compression Set Values: 2000 Data

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<th>Init.-3</th>
<th>Final-1</th>
<th>Final-2</th>
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<th>Diff.-1</th>
<th>Diff.-2</th>
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Heights measured on laser micrometer using lowest cross-section height obtained on four faces.

CS = \(100 \times \text{avg. height diff.} / (\text{init. height} - 0.5)\). This is equivalent to averaging three separate CS values.

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<td>272011 = GP Foam, Bottom Cushion 8%</td>
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## Container Foam Compression Set Values: 2001 Data

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Heights measured on laser micrometer using lowest cross-section height obtained on four faces.

CS = (100 x avg. height diff.)/(init. height-0.5). This is equivalent to averaging three separate CS values.

Std. Dev.  
Avg. 272009  Container to container 22.1 6.1 1.4  
Avg. 272011  standard 10.6 3.7 0.8  
Avg. 320664  deviations 23.0 3.8 1.1

Spec. Maximum

| Unit 1: JAW-2770 | Unit 4: JAW-2627 | 272009 = Rebond Foam, Lower Pad 20%  
| Unit 2: MBZ-R/A-878 | Unit 5: JAW-1334 | 272011 = GP Foam, Bottom Cushion 8%  
| Unit 3: JAW-1133 | Unit 6: JAW-1521 | 320664 = Rebond Foam, Mid Pad 20%  

### Container Foam Compression Set Values: Standard Deviations

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(Values above are averages of the 1997 to 2001 averages.)

Std. Dev.(1) is the standard deviation of the 3 specimens cut from and tested for each foam sample. This is the material/test variability.

Std. Dev.(2) is the standard deviation of the average compression set calculated from the values obtained for each container. This is the container to container variability and is clearly higher than the material variability.

Spec. Maximum

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## Container Foam Compressive Strength Properties: 1997 Data

### 1997 Polyurethane foam specimens

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### Unit Specifications
- **Unit 1**: JAW-2770
- **Unit 2**: MBZ-RA-878
- **Unit 3**: JAW-1133
- **Unit 4**: JAW-2627
- **Unit 5**: JAW-1334
- **Unit 6**: JAW-1521

### 10% Comp. spec.: 0.7-1.3 psi
- **Unit 4**: 0.7-1.3 psi
- **Unit 6**: 0.7-1.3 psi

### 50% Comp. spec.: 5.0-9.0 psi
- **Unit 2**: 5.0-9.0 psi
- **Unit 3**: 5.0-9.0 psi
- **Unit 5**: 5.0-9.0 psi
## Container Foam Compressive Strength Properties: 1998 Data

**1998 Polyurethane foam specimens**

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### Container to Container

- **Standard Deviations**
  - Unit 1: JAW-2770
  - Unit 2: MBZ-RVA-878
  - Unit 3: JAW-1133
  - Unit 4: JAW-2627
  - Unit 5: JAW-1334
  - Unit 6: JAW-1521

### 10% Comp. Spec.

- 0.7-1.3 psi

### 50% Comp. Spec.

- 5.0-8.0 psi
## Container Foam Compressive Strength Properties: 2000 Data

### 2000 Polyurethane foam specimens

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**Avg.**

- Unit 272009: Container to container - 0.303, 1.190, 0.127
- Unit 272011: Standard deviation - 0.439, 2.730, 0.151
- Unit 320664: Standard deviation - 0.178, 0.976, 0.075

**Out-of-spec values**

- Container to container - 1.344, 6.062, 0.353
- Standard deviation - 1.139, 7.230, 0.287
- Deviations - 0.737, 4.928, 0.279

**10\% Comp. spec.**

- Unit 1: JAW-2770
- Unit 4: JAW-2627
- Unit 5: JAW-1334
- Unit 6: JAW-1521

**50\% Comp. spec.**

- Unit 1: JAW-2770
- Unit 4: JAW-2627
- Unit 5: JAW-1334
- Unit 6: JAW-1521

---

Unit 1: JAW-2770
Unit 2: MBZ-R/A-B78
Unit 3: JAW-1133
Unit 4: JAW-2627
Unit 5: JAW-1334
Unit 6: JAW-1521

272009 = Rebound Foam, Lower Pad
272011 = GP Foam, Bottom Cushion
320664 = Rebound Foam, Mid Pad

0.7-1.3 psi
1.5-3.5 psi
0.7-1.3 psi
5.0-9.0 psi
4.5-7.5 psi
5.0-9.0 psi

---

30
# Container Foam Compressive Strength Properties: 2001 Data

## 2001 Polyurethane foam specimens

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<th>4th Compression: Strength at 50% (psi)</th>
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**Unit 1: JAW-2770**
**Unit 4: JAW-2627**

272009 = Rebond Foam, Lower Pad
272011 = GP Foam, Bottom Cushion
320664 = Rebond Foam, Mid Pad

**Unit 2: MBZ-JIA-B78**
**Unit 5: JAW-1334**

272009 = Rebond Foam, Lower Pad
272011 = GP Foam, Bottom Cushion
320664 = Rebond Foam, Mid Pad

**Unit 3: JAW-1133**
**Unit 6: JAW-1521**

272009 = Rebond Foam, Lower Pad
272011 = GP Foam, Bottom Cushion
320664 = Rebond Foam, Mid Pad

**10% Comp. spec.**
0.7-1.3 psi
1.5-3.5 psi
0.7-1.3 psi

**50% Comp. spec.**
5.0-9.0 psi
4.5-7.5 psi
5.0-9.0 psi
## Container Foam Compressive Strength Properties: Standard Deviations

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Distribution

Honeywell FM&T
Milt Bryan
D/ME2
PO Box 419159
Kansas City, MO 64141-6159

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D/465
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1 MS 0637 G. E. Dahms, 12336
1 MS 0645 C. G. Stayner, 2913
1 MS 0958 R. L. Myers, 14172
1 MS 1411 R. A. Assink, 1811
1 MS 9013 V. L. Harwood, 8231
1 MS 9013 C. M. Hinckley, 8231
1 MS 9013 S. B. Johnson, 8231
1 MS 9013 C. A. Lari, 8231
1 MS 9013 D. R. Walker, 8231
1 MS 9014 P. K. Lari, 2255
1 MS 9014 M. B. Loll, 2255
1 MS 9035 K. E. Carbiener, 8234
1 MS 9035 T. R. Harrison, 8234
1 MS 9035 M. C. Higuera, 8234
3 MS 9035 G. E. Simpson, 8234
1 MS 9042 R. D. Gilbert-O’Neil, 8727
1 MS 9108 B. E. Oden, 8243
1 MS 9106 C. Jackson, 8215
1 MS 9401 J. M. Hruby, 8702
1 MS 9402 K. L. Wilson, 8701
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