IMPACT PROPERTIES OF ALUMINUM ALLOY – BETA SILICON CARBIDE WHISKER COMPOSITES

To

Melpar, Inc.
(USAF Contract No. F33615-68-C-1064)
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\(^1\) Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D. C. 20234.

\(^2\) Located at Boulder, Colorado 80302.

\(^3\) Located at 5285 Port Royal Road, Springfield, Virginia 22151.
IMPACT PROPERTIES OF ALUMINUM ALLOY – BETA SILICON CARBIDE WHISKER COMPOSITES

By
I. J. Feinberg
Engineering Metallurgy Section
Metallurgy Division

To
Melpar, Inc.
(USAF Contract No. F33615-68-C-1064)

IMPORTANT NOTICE

Approved for public release by the Director of the National Institute of Standards and Technology (NIST) on October 9, 2015.
Impact Properties of Aluminum Alloy - Beta Silicon Carbide Whisker Composites

Material: Thirty-one subsize Charpy V-notch impact test specimens were submitted by the Materials Laboratory, Melpar, Incorporated for tests. The test material included specimens machined from extruded 2024, 6065, and 7075 aluminum alloy blanks and specimens machined from extruded 2024, 6065, and 7075 aluminum alloy - silicon carbide composites.

Test Specimens: Figure 1 shows the configuration of the subsize impact test specimen and contains pertinent dimensions.

Test Procedure and Equipment: All specimens were conditioned at room temperature (70° F) for at least one-half hour before testing. They were broken in a Baldwin 2 foot pound capacity impact tester. This machine has a C-type pendulum. The striker is rounded to a radius of 0.125 inches and the points of specimen support are 1.78 inches apart. Figure 2 is a view of the impact tester with a test specimen in place for testing.

Test Results: Table 1 gives the test results.
Table 1. Charpy Impact Properties of Aluminum Alloy Blanks and Aluminum Alloy - Beta Silicon Carbide Whisker Composites

<table>
<thead>
<tr>
<th>Melpar Specimen Identification</th>
<th>Energy Absorbed Foot Pounds</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Al 2024 Blanks, IHTB 31</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. 1</td>
<td>0.250</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.235</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.256</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.236</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.244</td>
<td></td>
</tr>
<tr>
<td><strong>Al 2024 Composites, VHTL 42</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. 1</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.019</td>
<td>Some cladding</td>
</tr>
<tr>
<td>4</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td><strong>Alloy 889 (Al 97 1/2% - Si 2 1/2%) Blanks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. 1</td>
<td>0.572</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.531</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.527</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.606</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.559</td>
<td></td>
</tr>
<tr>
<td><strong>Alloy 889 (Al 97 1/2% - Si 2 1/2%) Composites, VSSL 43</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. 1</td>
<td>0.0440</td>
<td>0.121 in. notch depth,</td>
</tr>
<tr>
<td>2</td>
<td>0.0380</td>
<td>0.151 in. square.</td>
</tr>
<tr>
<td>3</td>
<td>0.0320</td>
<td>0.115 in. notch depth,</td>
</tr>
<tr>
<td>Avg.</td>
<td>0.0380</td>
<td>0.143 in. square.</td>
</tr>
<tr>
<td><strong>Alloy 889 (Al 97 1/2% - Si 2 1/2%) Composites, VSSM 44</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. 1</td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.026</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.031</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.028</td>
<td></td>
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</table>
Table 1. Continued

<table>
<thead>
<tr>
<th>Melpar Specimen Identification</th>
<th>Energy Absorbed (Foot Pounds)</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td><strong>Al 7075 Composites, VHTB 32</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. A</td>
<td>0.250</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0.190</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.255</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>0.238</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.233</td>
<td></td>
</tr>
<tr>
<td><strong>Al 6061 Composites, VHTM 45</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. 1</td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.031</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.033</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td><strong>Al 7075 Composites, VHTL 41</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. A</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0.016</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>0.018</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>0.014</td>
<td></td>
</tr>
</tbody>
</table>
Remarks: With only one exception, specimen C, Al 7075 Composite, VHTL 41, test results showed little scatter. Shear lips indicative of good ductility were observed on the fracture surfaces of all of the aluminum alloy blank specimens. The fracture surfaces of the composite specimens were generally flat indicating embrittlement.
FIGURE 1. SUBSIZE IMPACT SPECIMEN
MELPAR TESTS

DIMENSION            INCHES            TOLERANCE
A - Center to End     1/2 B              0  0.05
B - Length            2.56              0.001  0.001
C - Cross Section (Depth)  0.150          0.001  0.001
D - Notch to Base     0.125              0.001  0.001
E - Cross Section (Width)  0.156          0.001  0.001
F - Radius of Notch   0.010              0.001  0.001
G - Angle of Notch    45°               Plus or Minus 1°
Suggested out of Square (of Cross Section)  0.15° (9 min.)
Figure 2. Baldwin Impact Tester - 2 foot pound capacity.