FIRE PERFORMANCE EVALUATION IN ACCORDANCE WITH
ASTM E136-19, STANDARD TEST METHOD FOR BEHAVIOR OF
MATERIALS IN A VERTICAL TUBE FURNACE AT 750 °C

MATERIAL ID:  Commercially Pure Aluminum P1020A

FINAL REPORT
Consisting of 4 Pages

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Report Date: May 15, 2020

Prepared for:

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1.0 INTRODUCTION

This report describes a small-scale fire test conducted on a material in accordance with ASTM E136-19, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 °C, for The Aluminum Association located in Arlington, Virginia. Testing was conducted on April 30, 2020, at the Fire Technology Department of Southwest Research Institute (SwRI), located in San Antonio, Texas.

The results presented in this report apply specifically to the specimens tested, in the manner tested, and not to the entire production of these or similar materials, nor to the performance when used in combination with other materials.

2.0 DESCRIPTION OF TEST APPARATUS AND PROCEDURE

The ASTM E136-19 hot-air ignition furnace consists primarily of an electrical heating unit and specimen holder. The furnace tube is a vertical tube, with an inside diameter of 100 ± 5 mm and a length of 230 ± 20 mm, made of ceramic that will withstand at least 750 °C. The inner ceramic tube, with an inside diameter of 75 ± 5 mm, a length of 230 ± 20 mm, and a thickness of approximately 3 mm, is placed inside the furnace tube and positioned 20 ± 2 mm above the furnace floor on spacer blocks. The test apparatus is shown in Figure 1.

The air temperature inside the furnace is stabilized to 750 °C prior to testing. Sheathed thermocouples are used to measure the temperature of the furnace air (T_2), specimen surface (T_4), and specimen center (T_3). The duration of flaming is recorded during the test, and specimen mass loss is determined based on weight measurements before and after testing. ASTM E 136-19 requires that a series of four tests be conducted for each sample.

A material passes if at least three of the four specimens tested meet the following criteria (The three specimens do not need to meet the same condition):

1. When the weight loss is 50% or less:
   a. The recorded temperatures of the surface and interior thermocouples do not at anytime during the test rise more than 30 °C (54°F) above the stabilized furnace temperature measured at T_2 prior to the test.
   b. No sustained flaming after the first 30 s of the test.

2. When the weight loss is 50% or more:
   a. The surface and interior thermocouples cannot exhibit any temperature rise from the stabilized temperature measured by the interior thermocouple before testing.
   b. No flaming at any time during the test.
3.0 DESCRIPTION OF TEST SPECIMENS

The test samples were received by SwRI on April 13, 2020. The samples were placed in a controlled environment maintained at 23 °C ± 2 °C (73 °F ± 5 °F) and 50% ± 5% relative humidity from the time they were received. Prior to testing, the specimens were prepared according to the ASTM E136 standard and then placed in an oven at 60 °C for 24 h, then placed in a desiccator to cool at room temperature. A more detailed description of the material can be found in Table 1.

Table 1. Test Sample Description.

<table>
<thead>
<tr>
<th>Material ID</th>
<th>Description of Material</th>
<th>Tested Nominal Dimensions*</th>
<th>Average Tested Mass*</th>
<th>Nominal Density</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercially Pure Aluminum P1020A</td>
<td>Labeled P1020A</td>
<td>38 × 38 × 50 mm</td>
<td>209.42 g</td>
<td>2.7 g/cm³</td>
<td>Gray</td>
</tr>
</tbody>
</table>

* Measured by SwRI personnel.

4.0 TEST RESULTS

Testing was conducted on April 30, 2020. Tabular test data and graphs of the measured temperatures plotted with respect to time are presented at the end of this report.

5.0 CONCLUSIONS

The material identified as Commercially Pure Aluminum P1020A, meets the requirements of the ASTM E136-19 standard.
**ASTM E 136 TEST DATA SHEET**

**Material ID**: Commercially Pure Aluminum P1020A

**Description**: Labeled P1020A

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**RESULTS**

<table>
<thead>
<tr>
<th>Run</th>
<th>Initial Mass (g)</th>
<th>Final Mass (g)</th>
<th>Percent Mass Loss</th>
<th>Specimen Center Stabilized Maximum</th>
<th>Specimen Surface Stabilized Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-T&lt; 30 °C (°C)</td>
<td>-T&lt; 30 °C (°C)</td>
</tr>
<tr>
<td>1</td>
<td>210.21</td>
<td>210.20</td>
<td>0%</td>
<td>749 723 -26 Pass</td>
<td>749 719 -30 Pass</td>
</tr>
<tr>
<td>2</td>
<td>208.62</td>
<td>208.60</td>
<td>0%</td>
<td>748 720 -28 Pass</td>
<td>748 717 -31 Pass</td>
</tr>
<tr>
<td>3</td>
<td>198.72</td>
<td>198.71</td>
<td>0%</td>
<td>749 706 -43 Pass</td>
<td>749 729 -20 Pass</td>
</tr>
<tr>
<td>4</td>
<td>202.24</td>
<td>202.22</td>
<td>0%</td>
<td>750 726 -24 Pass</td>
<td>750 722 -28 Pass</td>
</tr>
</tbody>
</table>

**Criteria for when percent mass loss < 50%**

- **Total Test Time** (s): 1800
- **Duration of flaming (min:s)**:
  - Run 1: 0 - 0
  - Run 2: 0 - 0
  - Run 3: 0 - 0
  - Run 4: 0 - 0
- **Observed Smoke (min:s)**:
  - Run 1: No
  - Run 2: No
  - Run 3: No
  - Run 4: No
- **Observed Soot (min:s)**:
  - Run 1: No
  - Run 2: No
  - Run 3: No
  - Run 4: No

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**TEST OBSERVATIONS**

<table>
<thead>
<tr>
<th>Run</th>
<th>Insertion Time (s)</th>
<th>Ignition Time (min:s)</th>
<th>Flameout</th>
<th>Duration of flaming (min:s)</th>
<th>Criteria: No flaming after first 30 s</th>
<th>Observed Smoke (min:s)</th>
<th>Observed Soot (min:s)</th>
<th>Total Test Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Pass</td>
<td>No</td>
<td>No</td>
<td>1800</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Pass</td>
<td>No</td>
<td>No</td>
<td>1800</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Pass</td>
<td>No</td>
<td>No</td>
<td>1800</td>
</tr>
<tr>
<td>4</td>
<td>39</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Pass</td>
<td>No</td>
<td>No</td>
<td>1800</td>
</tr>
</tbody>
</table>

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**Center Temperature Graph**

**Surface Temperature Graph**