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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: *Aluminum Alloy 6061*

FINAL REPORT
Consisting of 4 Pages

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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 28, 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 E136-19 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 $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($73\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) and $50\% \pm 5\%$ 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 $60\text{ }^{\circ}\text{C}$ 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.

Material ID	Description of Material	Tested Nominal Dimensions*	Average Tested Mass*	Nominal Density	Color
<i>Aluminum Alloy 6061</i>	Labeled 6061	$38 \times 38 \times 50\text{ mm}$	198.66 g	2.7 g/cm^3	Gray

* Measured by SwRI personnel.

4.0 TEST RESULTS

Testing was conducted on April 28, 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 *Aluminum Alloy 6061* meets the requirements of the ASTM E136-19 standard.

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ASTM E 136 TEST DATA SHEET

Client: The Aluminum Association
 Operator: Nathan W.
 Test Date(s): April 28, 2020
 Material ID*: Aluminum alloy 6061
 Description*: Labeled 6061

Receipt Date: April 13, 2020
 Color: Gray*
 Average Sample Mass: 198.66 g

* Information/instructions provided by the Client

RESULTS

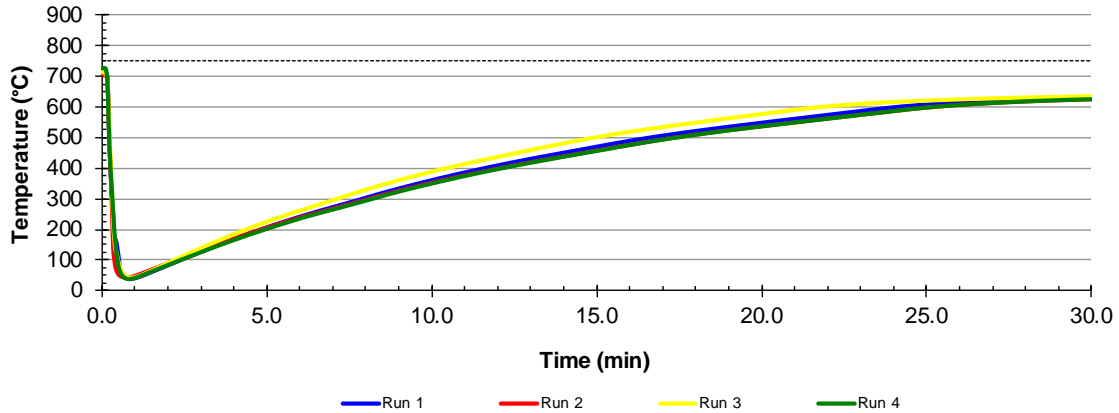
Run	Initial Mass (g)	Final Mass (g)	Percent Mass Loss	Specimen Center				Specimen Surface			
				Stabilized (°C)	Maximum (°C)	Δ T (°C)	Criteria* ΔT < 30 °C	Stabilized (°C)	Maximum (°C)	Δ T (°C)	Criteria* ΔT < 30 °C
1	197.41	197.40	0%	749	717	-32	Pass	749	724	-25	Pass
2	199.90	199.88	0%	748	710	-38	Pass	748	724	-24	Pass
3	204.06	204.04	0%	749	713	-36	Pass	749	724	-25	Pass
4	208.21	208.20	0%	748	727	-21	Pass	748	717	-31	Pass

*Criteria for when percent mass loss < 50%

TEST OBSERVATIONS

Run	Insertion Time (s)	Ignition Time (min:s)	Flameout (min:s)	Duration of flaming (min:s)	Criteria: No flaming after first 30 s	Observed Smoke (min:s)	Observed Soot (min:s)	Total Test Time (s)
1	42	-	-	-	Pass	No	No	1800
2	31	-	-	-	Pass	No	No	1800
3	39	-	-	-	Pass	No	No	1800
4	29	-	-	-	Pass	No	No	1800

Center Temperature Graph



Surface Temperature Graph

