International Aircraft Materials Fire Test Forum Meeting

Development of New Flammability Test for Magnesium-Alloy Cabin Components

Presented to: International Aircraft Materials Fire Test Forum, Virtual Meeting

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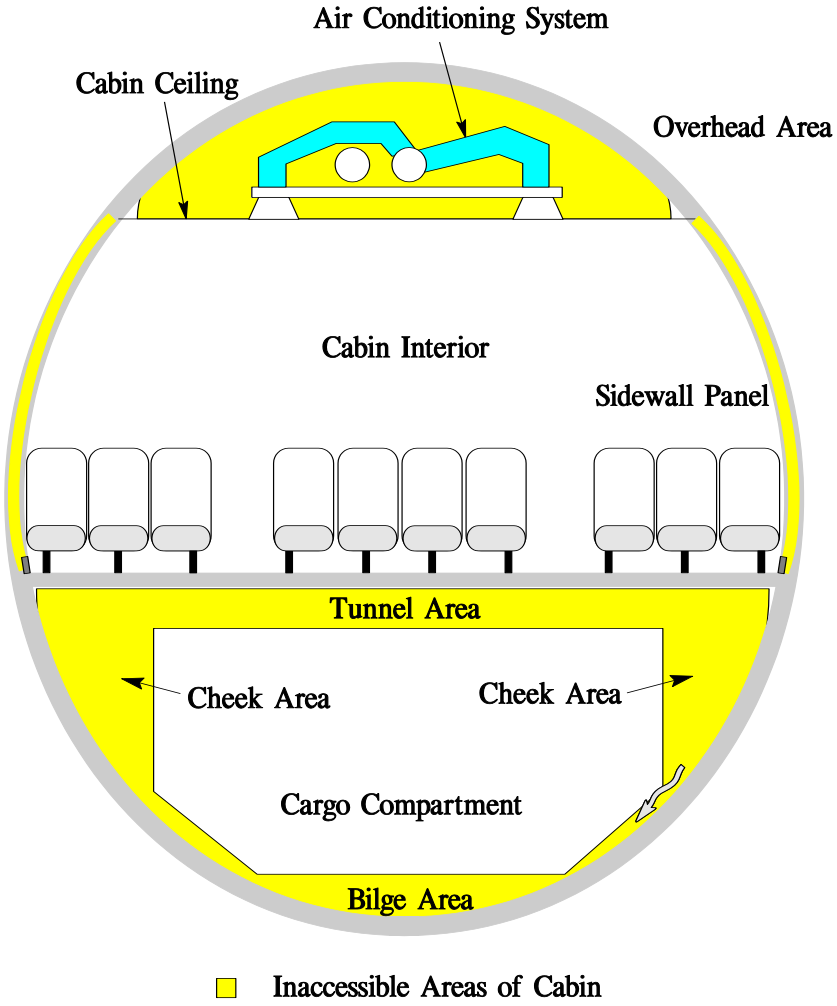
Date: June 8, 2020

Federal Aviation Administration

<u>Objective</u>: Develop a flammability test for magnesium alloy components located in inaccessible areas of the cabin

- *Representative*
- *Repeatable*
- *Reproducible*

Development of Flammability Test for Magnesium Components Used in Inaccessible Areas

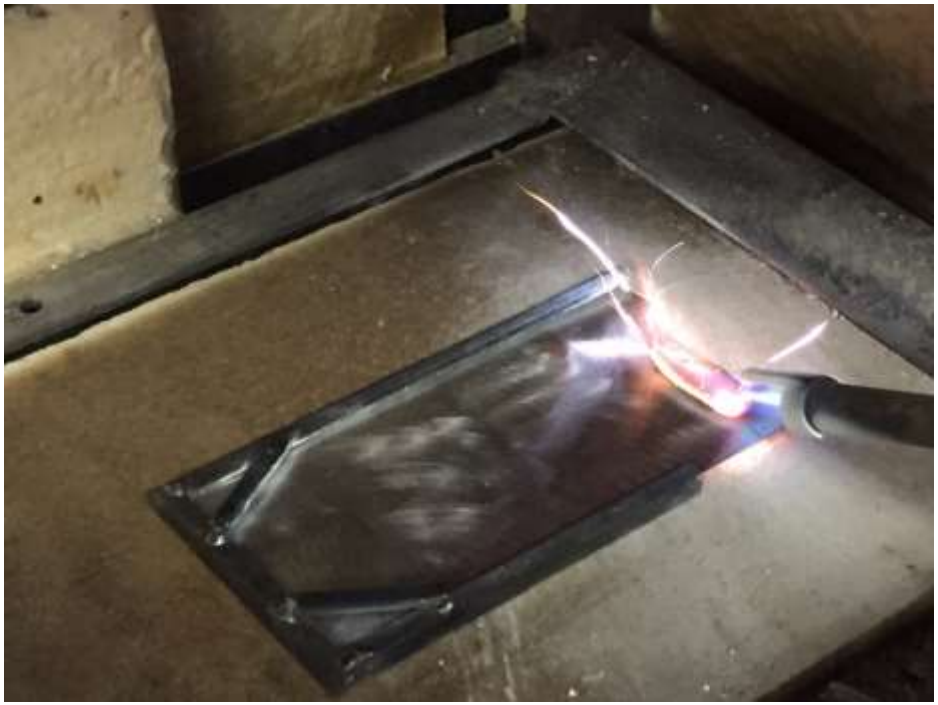


Current Test Parameters

- *Test developed using Radiant Panel Apparatus*
- *3- by 6-inch sample size, 0.025-inch thickness*
- *2-minute pilot ignition*
- *4-minute exposure to radiant heat*
- *Maximum weight loss of 30% (proposed)*

…Test Method inserted as Chapter 26 in current Fire Test Handbook!

Truncated Perimeter Sample Holder



Interlab Study

Prepare identical samples for participating laboratories, to determine lab-to-lab reproducibility:

- *Test materials received from Luxfer (Magnesium Elektron) 2019*
- *Materials were manufactured to 0.125-inch thickness, which were then milled down further to 0.025-inch thickness by FAA for testing*
- *8 laboratories (Airbus, Boeing, Accufleet, DGA, Skandia, FAA, Govmark, Honda)*
- *For first round of testing, 2 types magnesium alloy (EL43, Boeing material "alloy1")*
- *21 samples of EL43, 10 samples alloy1 per lab*
- *Test results compiled by FAA*

*Refine test parameters and pass/fail criteria based on results of interlab study

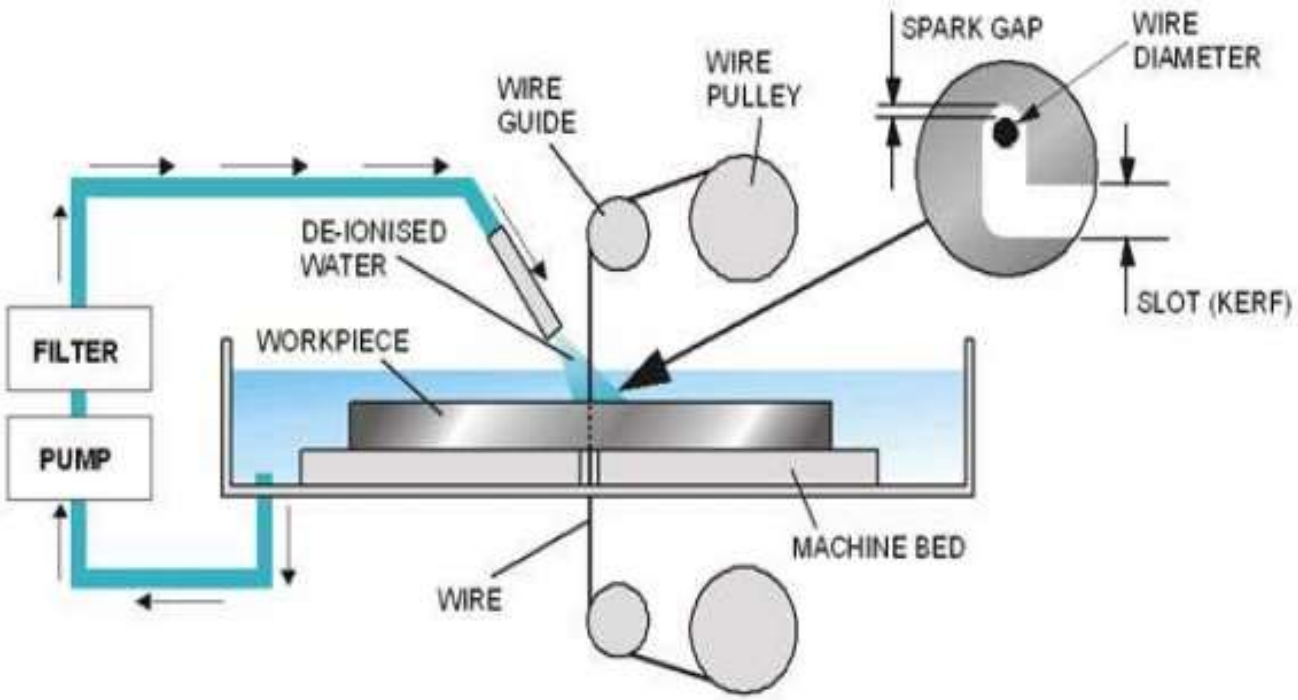
EDM Electrical Discharge Machining

FAA contracted US company to mil samples down from 0.125-inch supplied thickness to specified 0.025-inch thickness for testing.

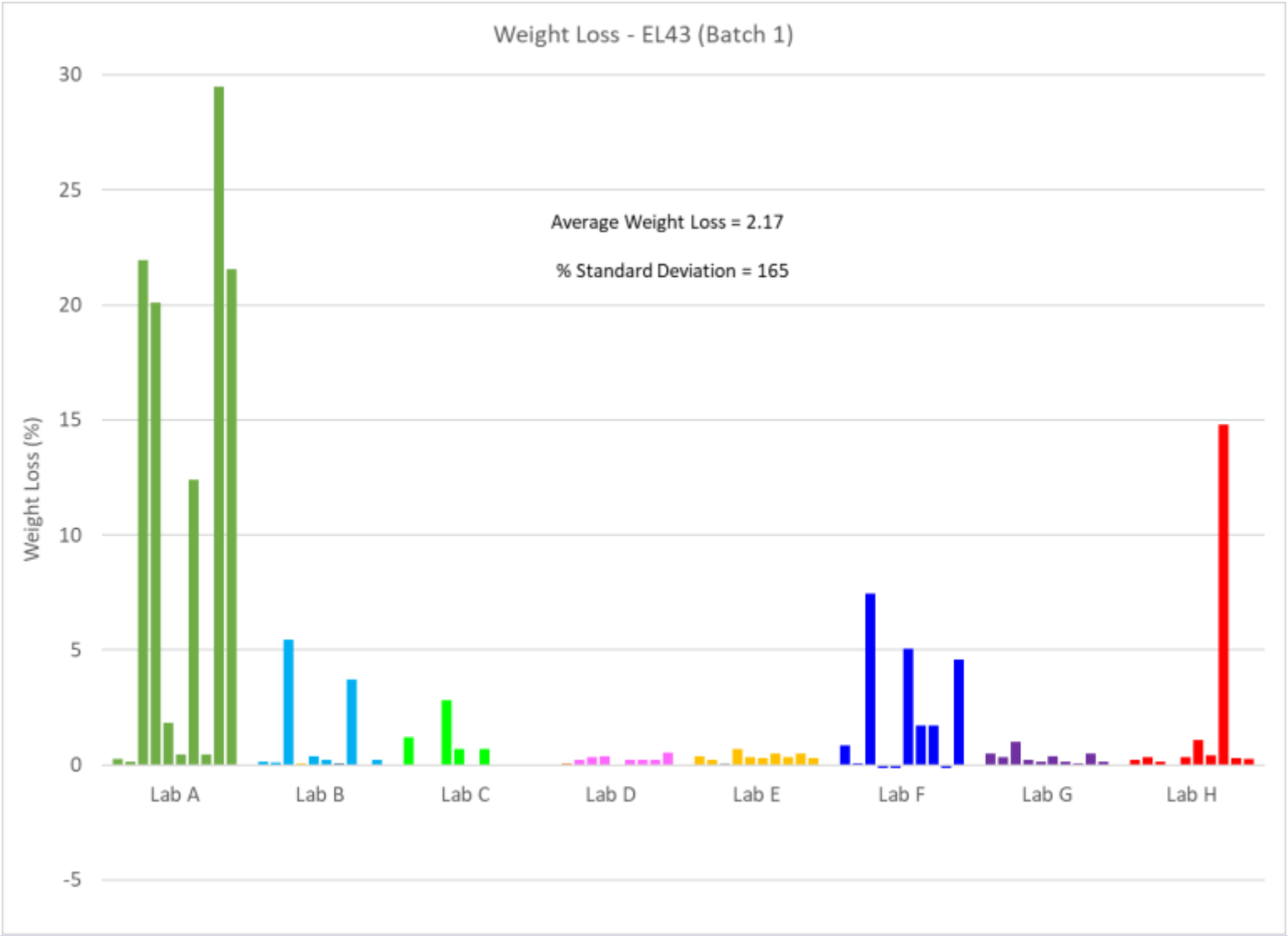
Wire EDM is an electro thermal manufacturing process where components are made using electrical discharges. A thin strand of metal wire accompanied by de-ionized water allows the wire to cut through metal just from the heat of the sparks.

EDM Electrical Discharge Machining

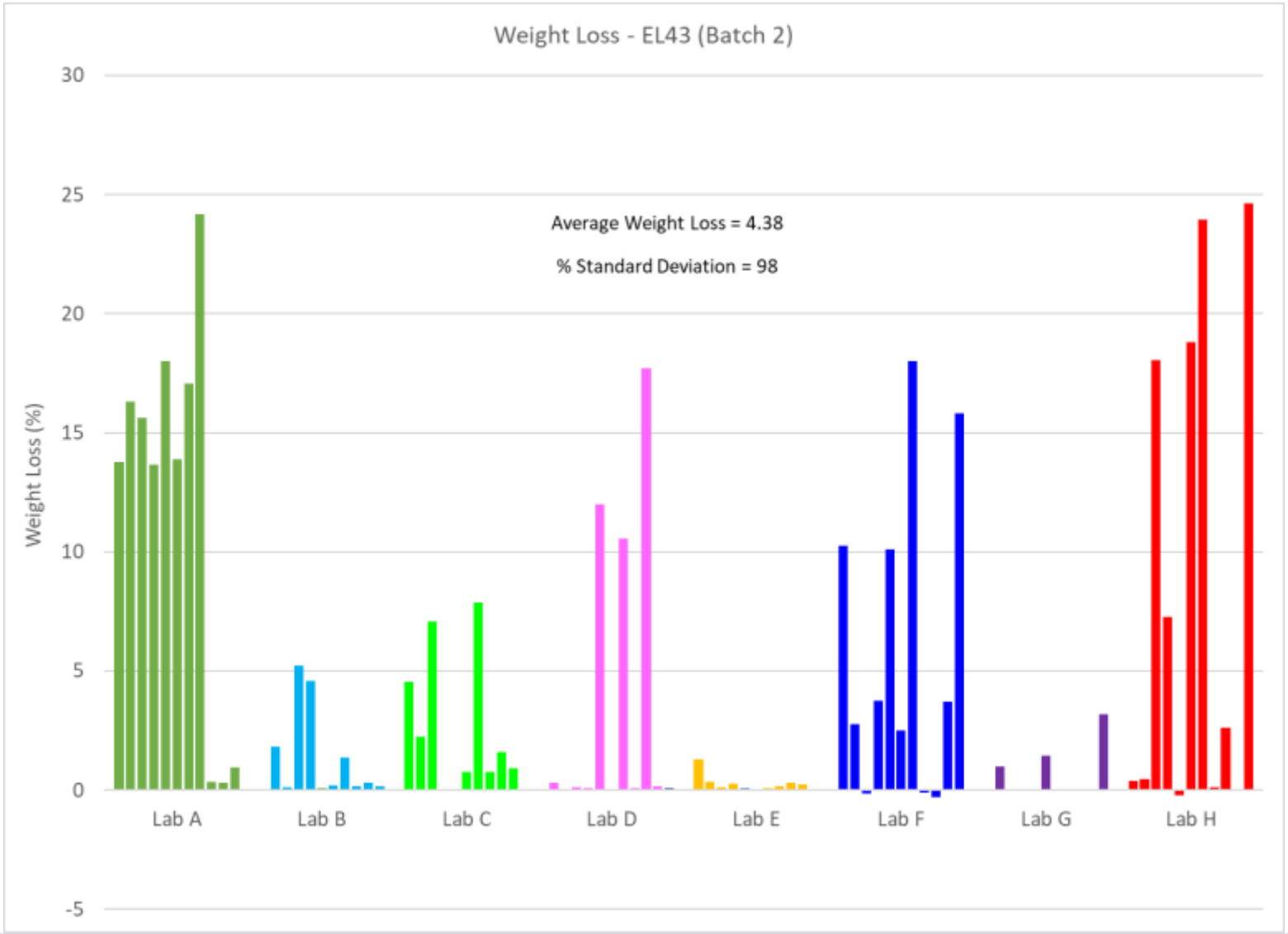
EDM Wire cutting



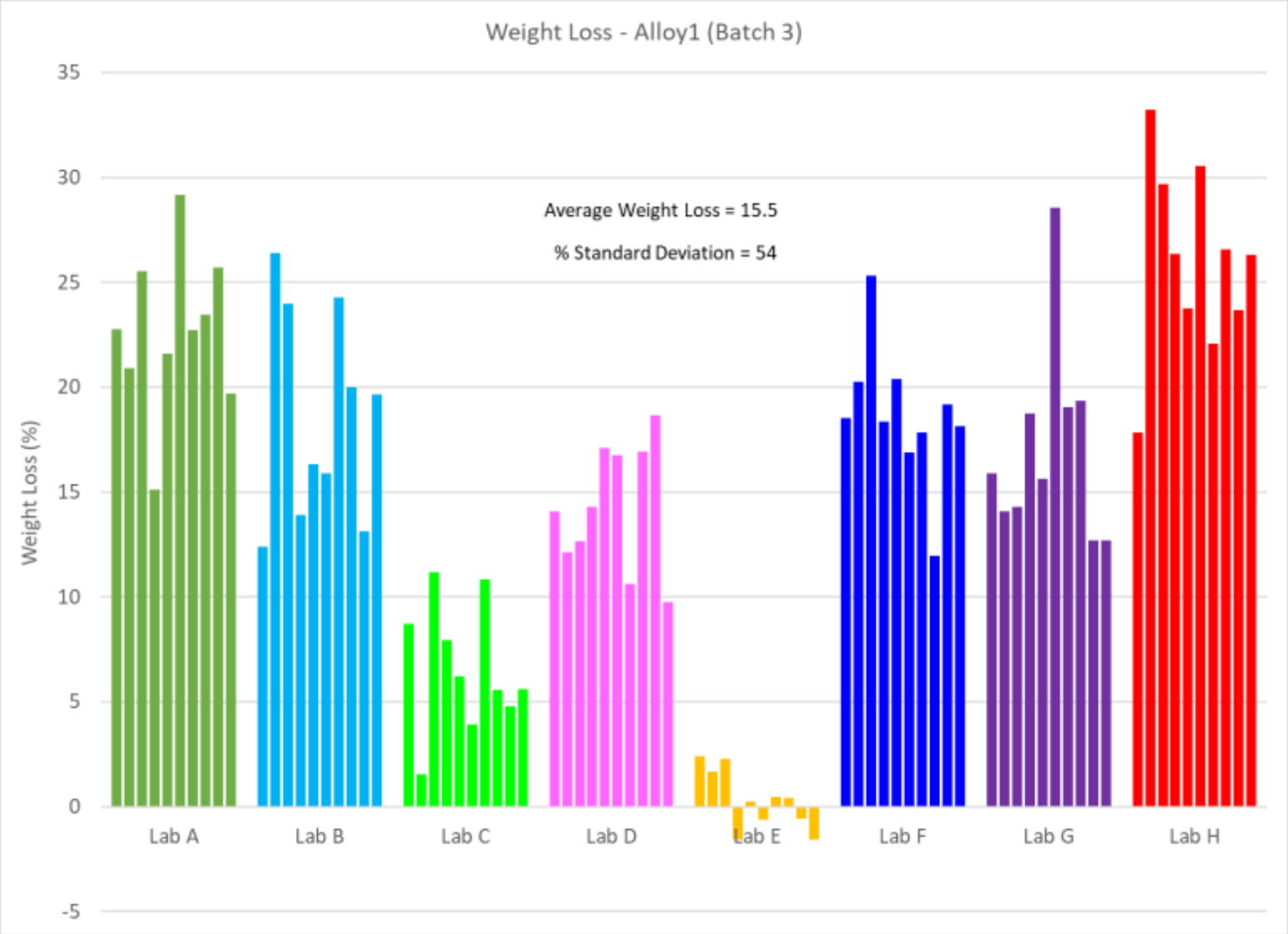
Interlab Study Results



Interlab Study Results



Interlab Study Results



Lab A Test Configuration

Interlab Study Observations

EDM samples in Batch 1 and Batch 2 were very inconsistent in terms of thickness, which likely played a role in the weight loss results.

Pre-heating of samples may produce more consistent results. Update procedure accordingly, conduct additional study.

Lab H Results on Batch I Samples

Lab H Results on Batch II Samples

Lab H Results on Batch III Samples

Summary of Task Group Discussion from 3/10/2020

Interlab Study Discussion:

- *Need for consistently-manufactured test samples*
- *EDM-produced samples were not consistent. Difficulties in mounting the thin samples*
- *More favorable samples would result from EDM process using thicker initial stock*
- *Oxidized surface of EDM samples may have contributed to poor results*

Test Method Discussion:

- *Task Group participants unanimously agree the test is easy to conduct, not time consuming*
- *Determine Impact of backer board on results (i.e., void in material allows air under sample)*
- *Need additional language in Chapter 26 to address this (frequency of replacing backer board)*

Summary of Task Group Discussion from 3/10/2020

Test Method Discussion (con't):

- *Reports of negative weight loss (i.e., weight gain) in several instances*
- *Measured weights are very low; possibility of HVAC air currents impacting sensitive scales?*
- *Documentation of tests was helpful to testers; FAA only received limited photos of tests*
- *FAA recommends photo and/or video overage of tests*

Pre-Heating of Samples Discussion:

- *Conditioning temperature → Pre-heat temperature → Actual test temperature*
- *Large tolerances on temperatures could impact results*
- *FAATC has experimented with pre-heating for 1 minutes, which has produced excellent results*
- *FAATC plans to monitor the surface temperature of the samples to determine time required to reach steady state conditions*

Summary of Task Group Discussion from 3/10/2020

Test Method Robustness Discussion:

- *What is impact of current heat flux tolerance on test results?*
- *FAATC to conduct tests at low and high ranges of heat flux to determine impact*

Randomization of Samples Discussion:

- *During collaborative effort between FAATC/Boeing on HR2, Boeing developed randomization process. The process would prevent certain parameters from influencing test results.*
- *Boeing has offered to assist in the randomizing effort for future interlab studies on magnesium*

Discussion Items for Task Group

Discuss the key elements of the new flammability test for components located in inaccessible areas:

- *Time until ignition (cannot be less than 30 seconds)*
- *Should there be a limit on self extinguishment? (currently not required)*
- *Discuss sample milling options for next interlab study*

Discuss any other items related to the use of magnesium alloy in either seats or other cabin components

Questions?