International Aircraft Materials Fire Test Working Group Meeting

Task Group Session on New Flammability Test for Magnesium-Alloy Seat Structure

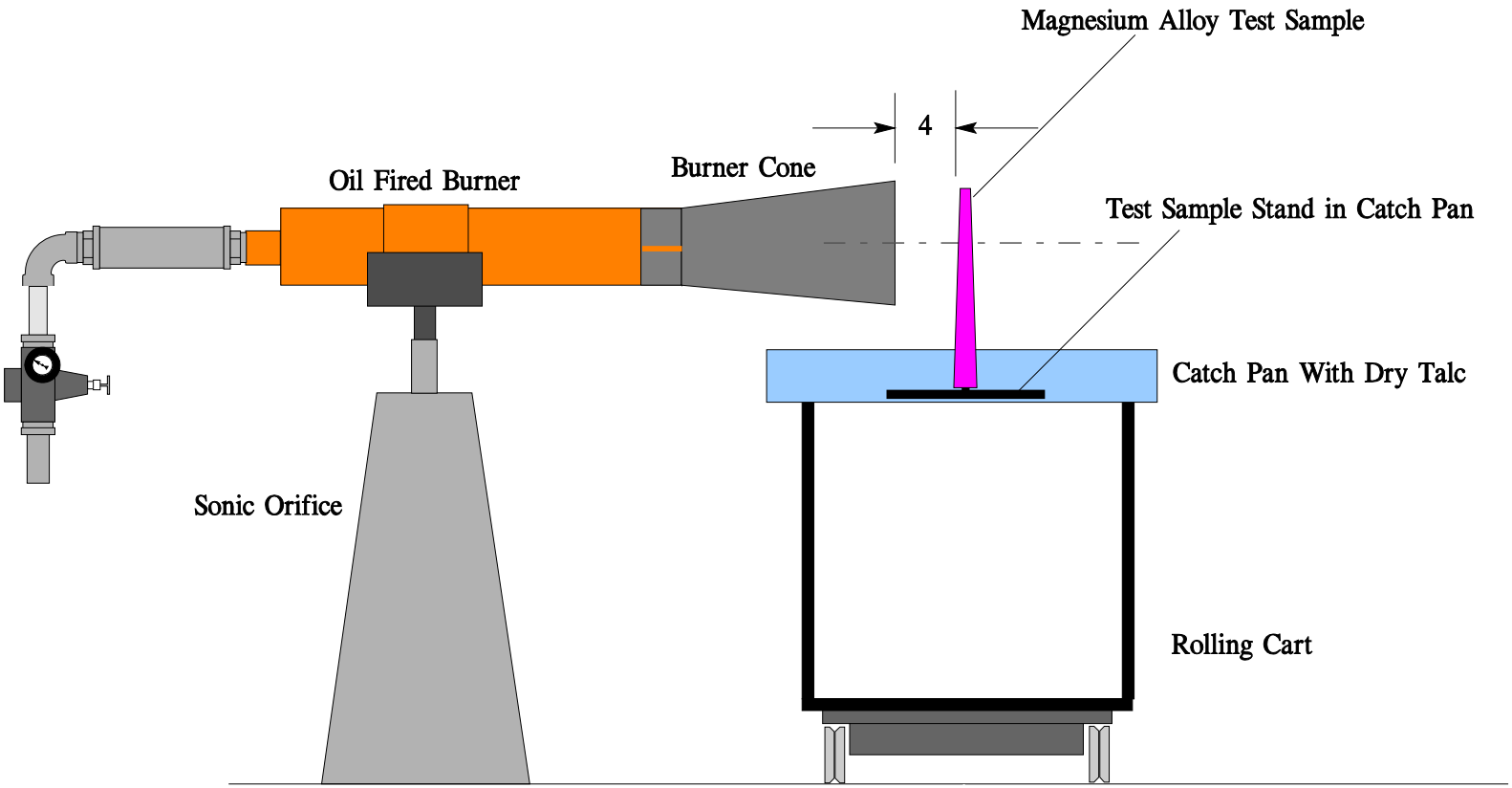
Presented to: International Aircraft Materials Fire Test Working Group, Singapore

By: Tim Marker, FAA Technical Center

Date: February 8-9, 2012

Federal Aviation Administration

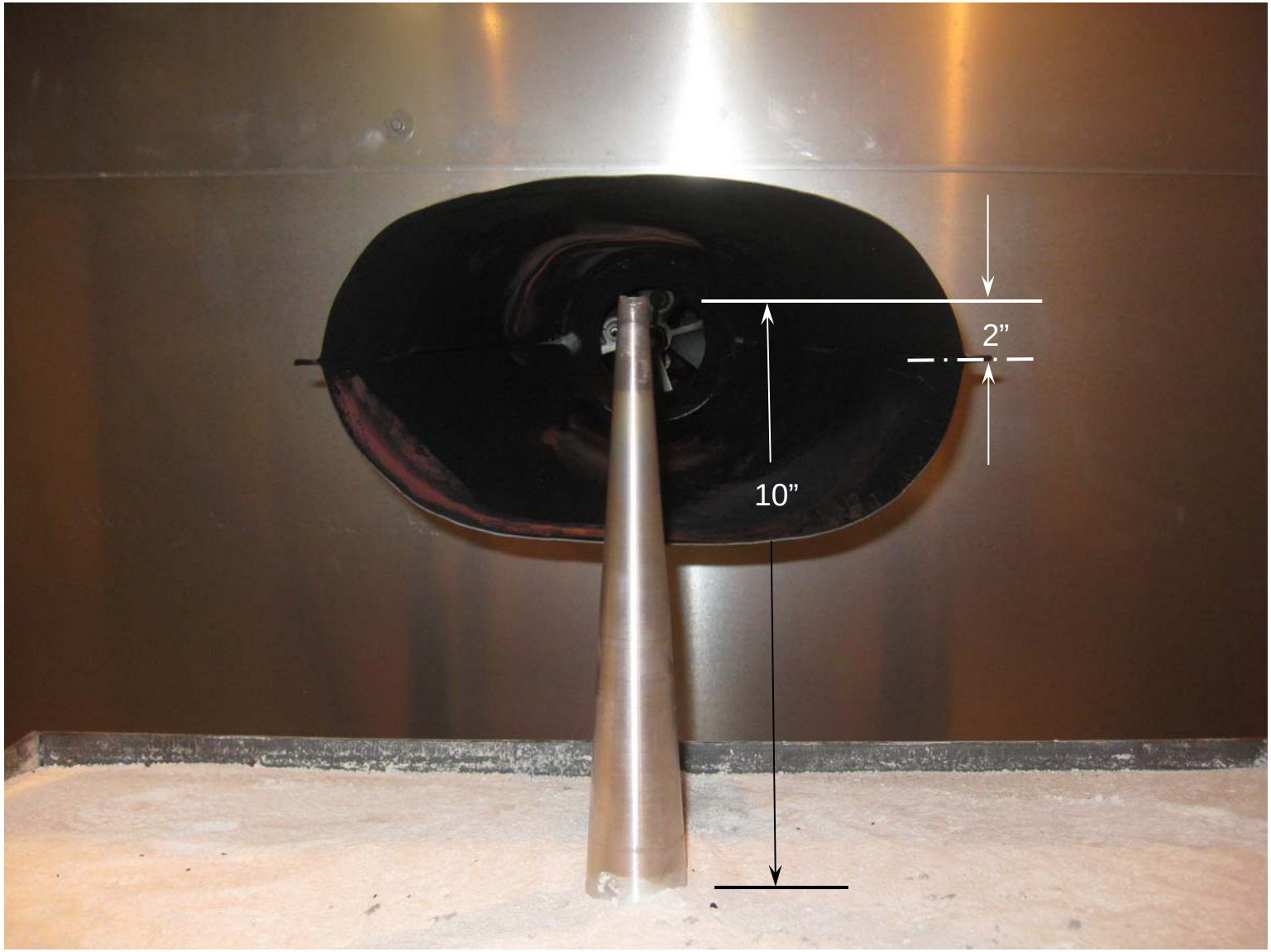
(Original) Proposed Magnesium Alloy Flammability Test



Objective: reproduce results obtained in full-scale tests

WE-43: After several minutes of exposure, remove burner, sample burns for approx 1 minute

Truncated Cone Test Sample of Magnesium Alloy



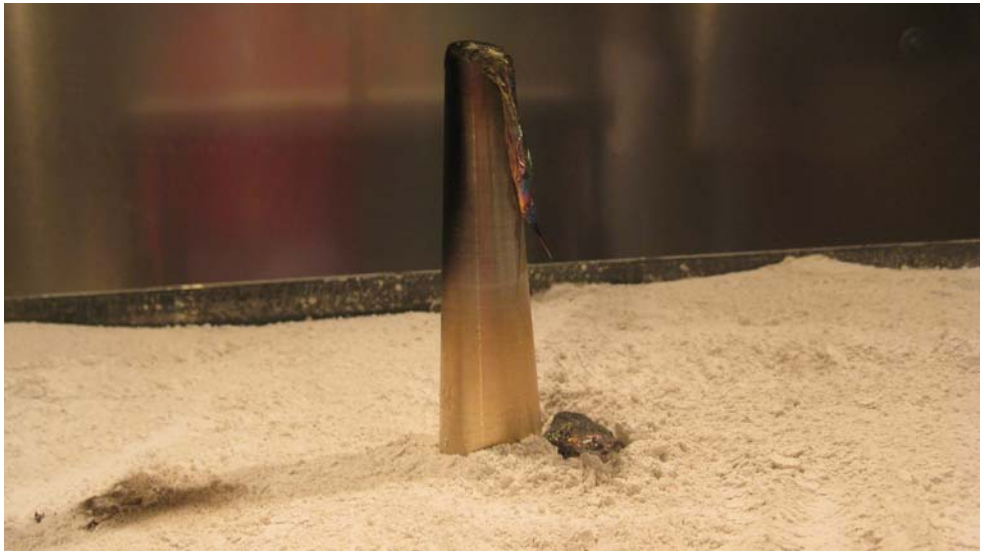
Problems Encountered with Truncated Cone

Repeatability

Molten section of cone falls down into pan, no ignition

Molten alloy creates thin shape which is ignited; ignition stops after short period

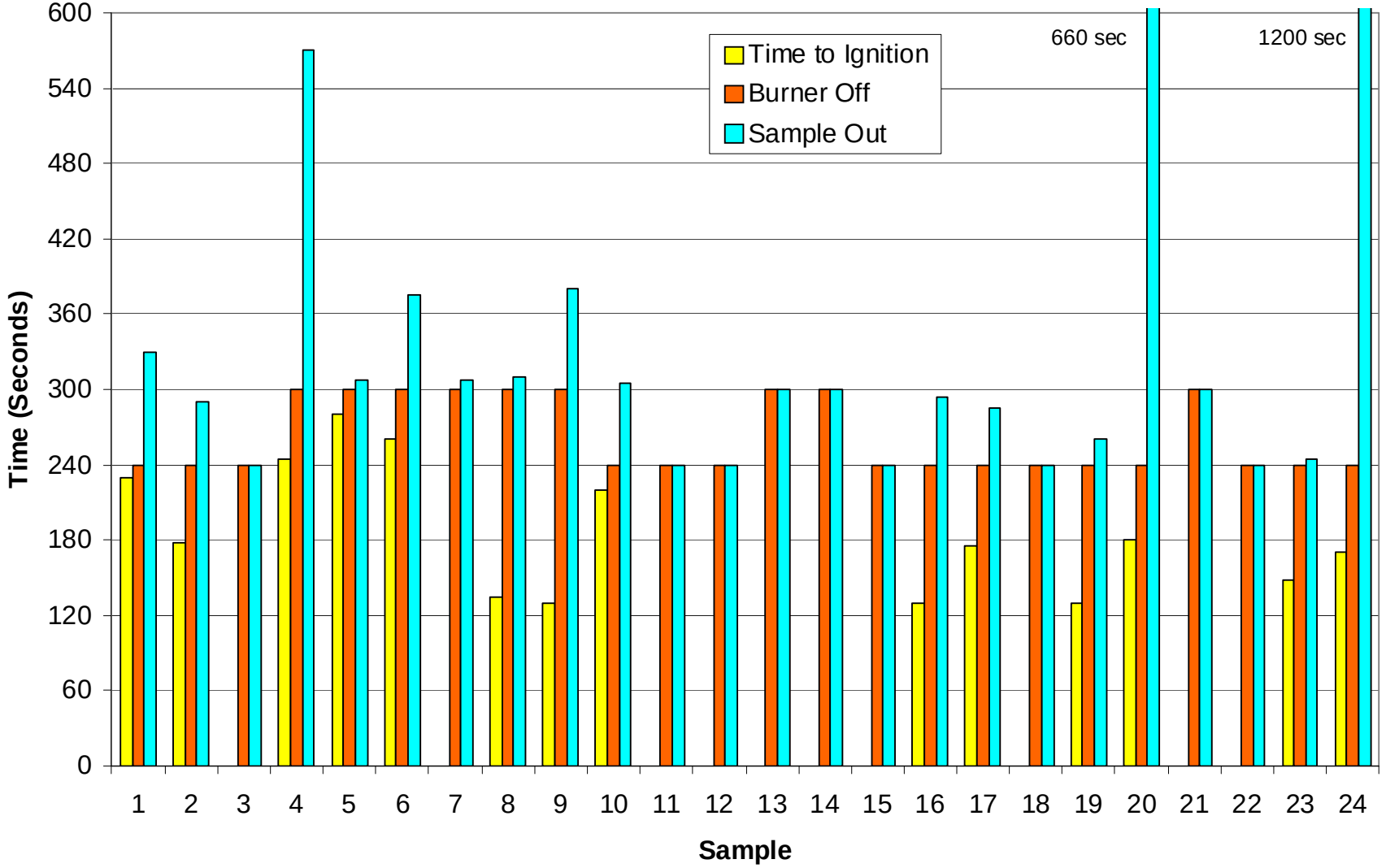
Molten alloy creates shape that ignites; ignition of remaining cone occurs, resulting in extended ignition



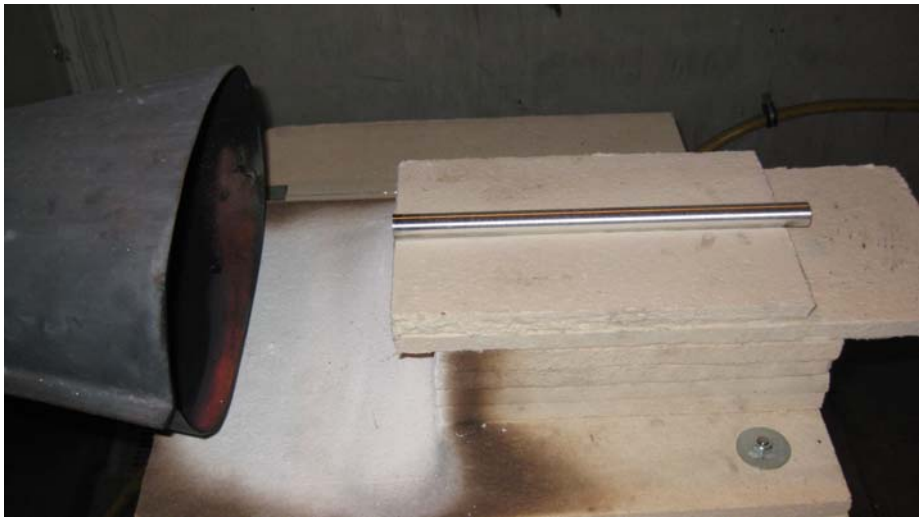
Problems Encountered with Truncated Cone

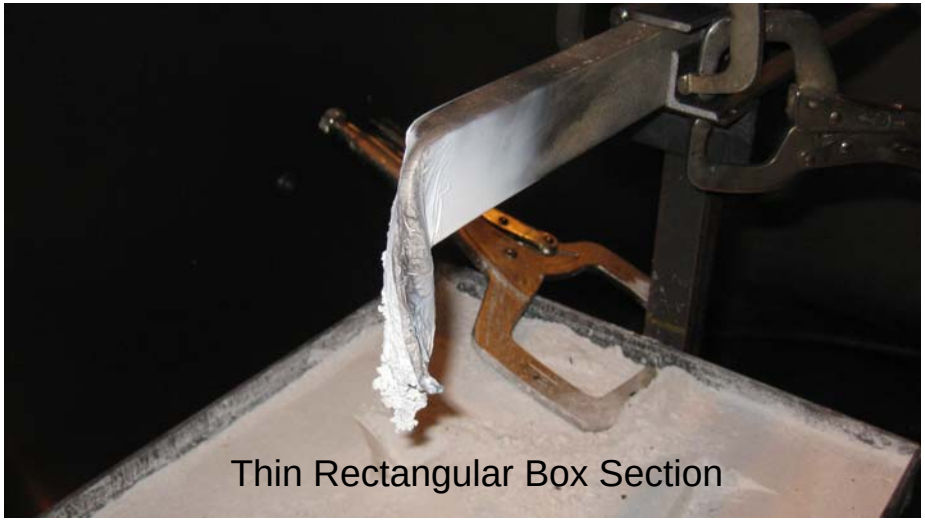
Wide range of test results based on melting process

Vertically-Oriented Solid WE-43 Cone Test Results

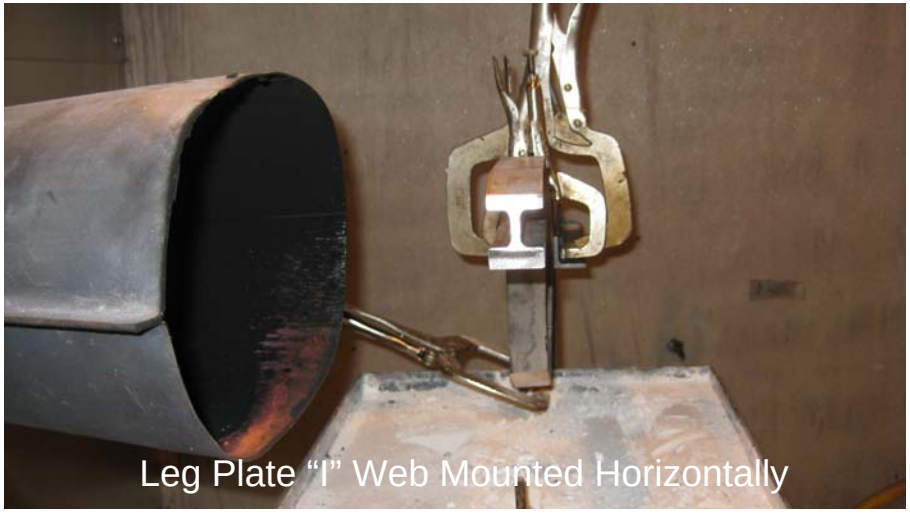


Various Sample Configurations Tested





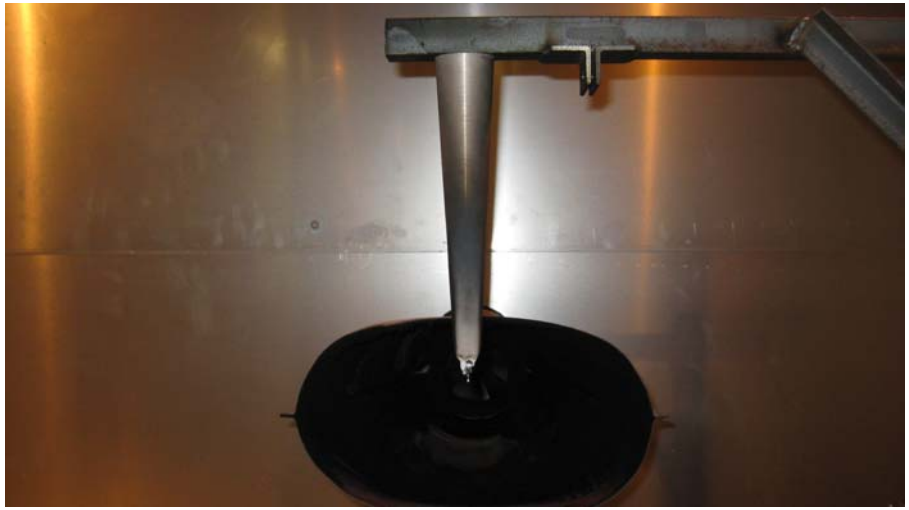
Various Sample Configurations Tested


Leg Plate “I” Web Mounted Horizontally


“T” Web Machined from Leg Post

“T” Web Machined from Leg Post, Mounted Horizontally

Inverted Cones of AZ-31, Suspended Vertically

Circular Tube WE-43, Mounted Horizontally

Test 1

Circular Tube WE-43, Mounted Horizontally

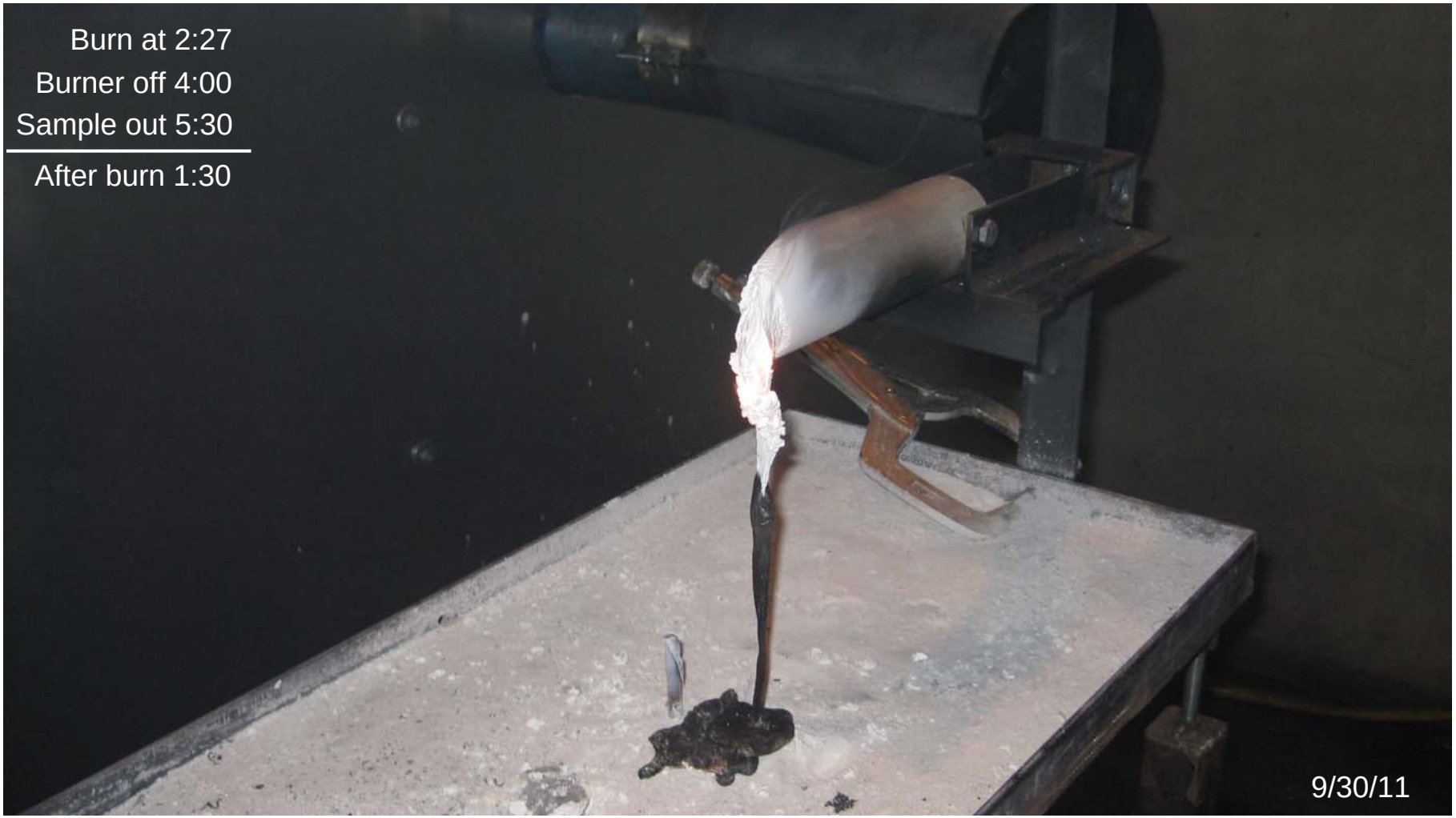
Test 1

Circular Tube WE-43, Mounted Horizontally

Test 2

Circular Tube WE-43, Mounted Horizontally

Test 2



Circular Tube WE-43, Mounted Vertically

Test 1

Circular Tube WE-43, Mounted Vertically

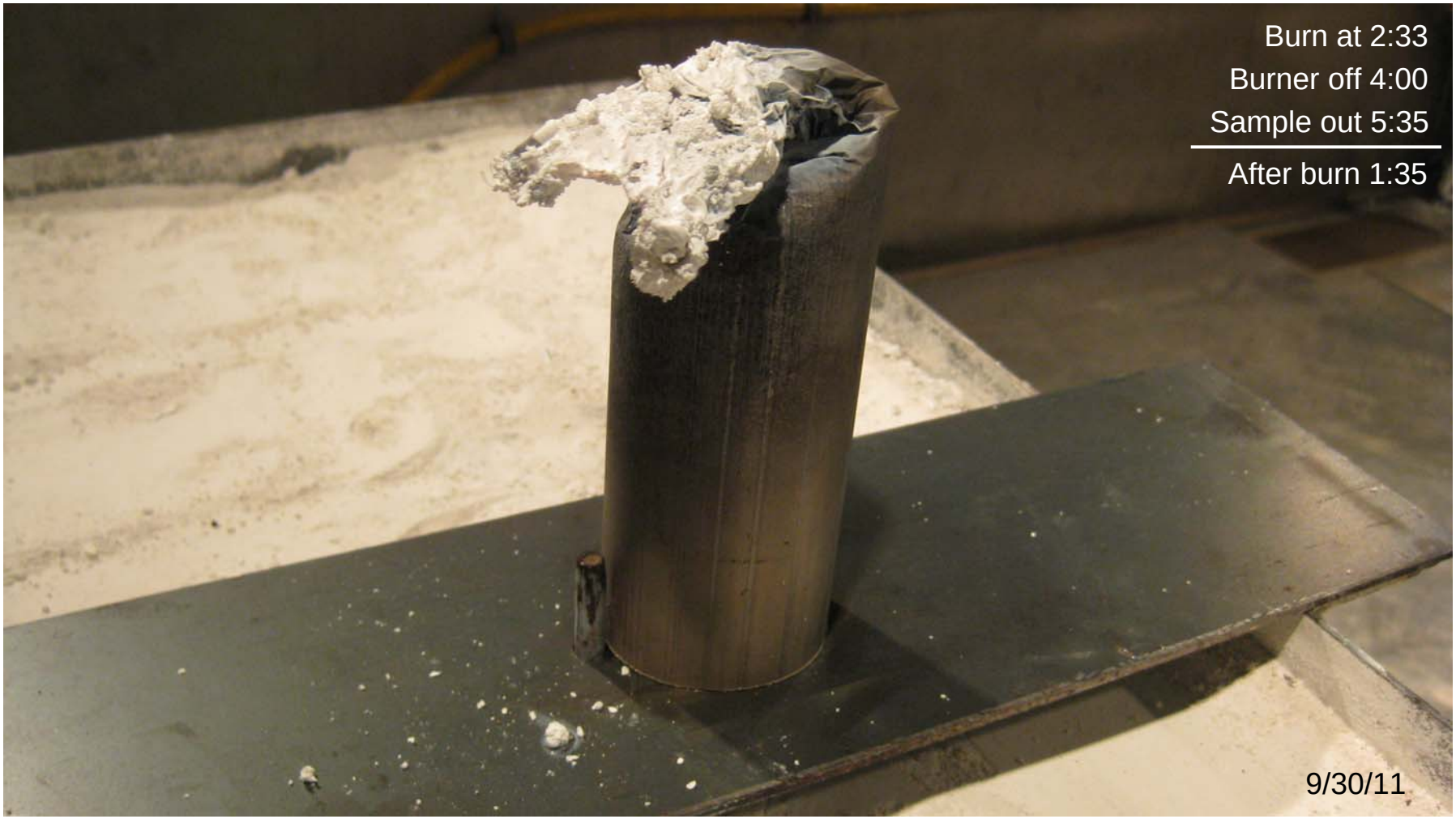
Test 1

Circular Tube WE-43, Mounted Vertically

Test 1

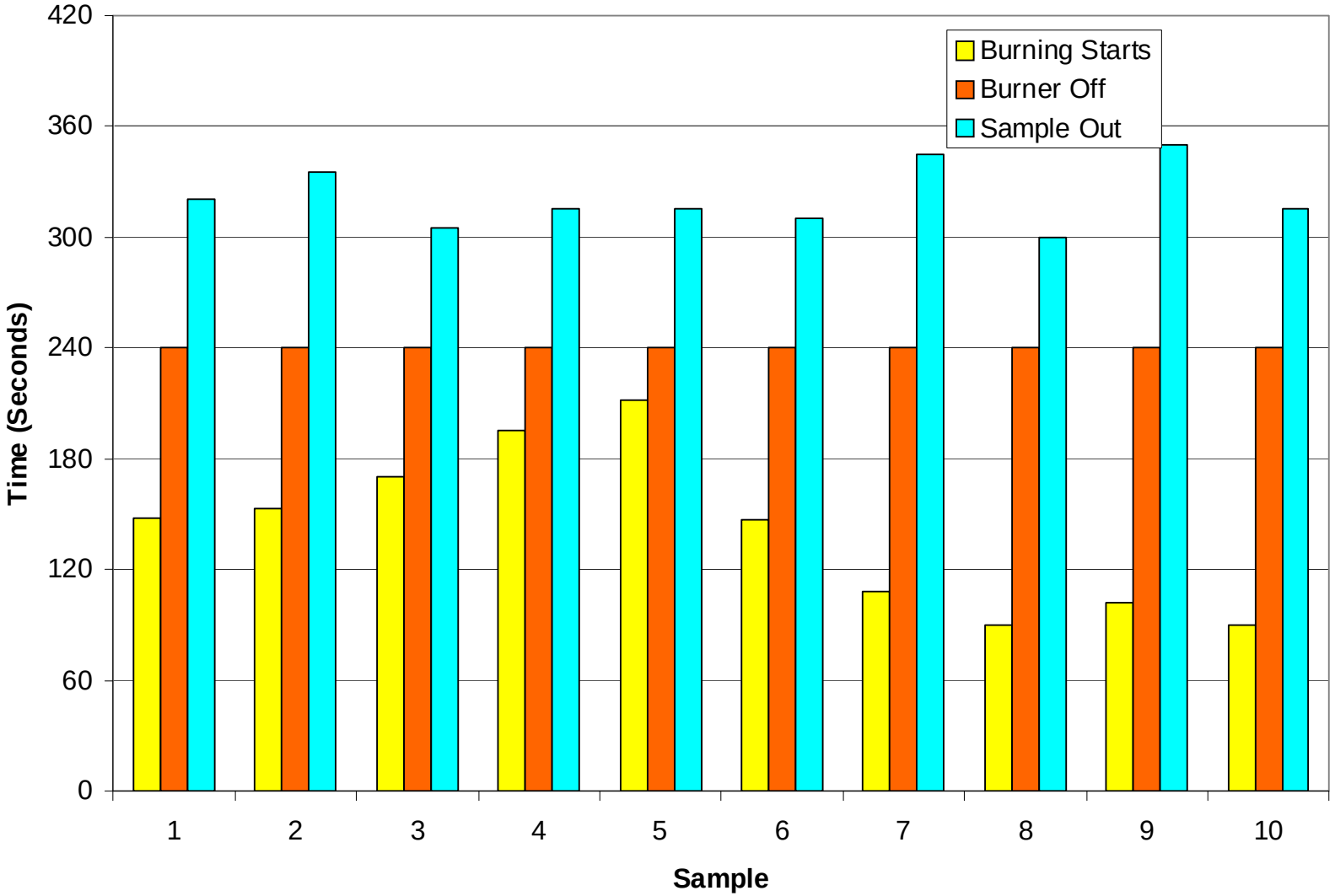
Circular Tube WE-43, Mounted Vertically

Test 2



Circular Tube WE-43, Test Results

Vertically-Oriented WE-43 Hollow Cylinder Test Results



Circular Tube Aluminum, Mounted Vertically

…for comparison to mag-alloy samples

Test 1

Circular Tube Aluminum, Mounted Vertically

…for comparison to mag-alloy samples

Circular Tube Aluminum, Mounted Vertically

…for comparison to mag-alloy samples

Rectangular Box Section WE-43, Mounted Vertically

Rectangular Box Section WE-43, Mounted Vertically

Rectangular Box Section WE-43, Mounted Vertically (rotate 90º)

Rectangular Box Section WE-43, Mounted Vertically (rotate 90º)

Summary of Results

Truncated cone sample suffered from repeatability issues:

- Time of ignition dependent on resulting molten shape
- Duration of burning following burner flame removal also dependent on resulting molten shape

Hollow cross-sections demonstrated better ignitability than solid cross-sections

- Thinner wall has tendency to ignite simultaneous to melting
- Thick cross sections melt into complex shapes prior to ignition, reducing repeatability

Hollow cylinder test sample demonstrates good repeatability

- Time of ignition and duration of after flame very consistent
- Resulting molten shape also very repeatable, demonstrating test robustness

Planned Activities (from October 2011)

Continue with testing of hollow cylinders to further define repeatability

Experiment with smaller diameter hollow cylinders to determine repeatability

Problem with samples??

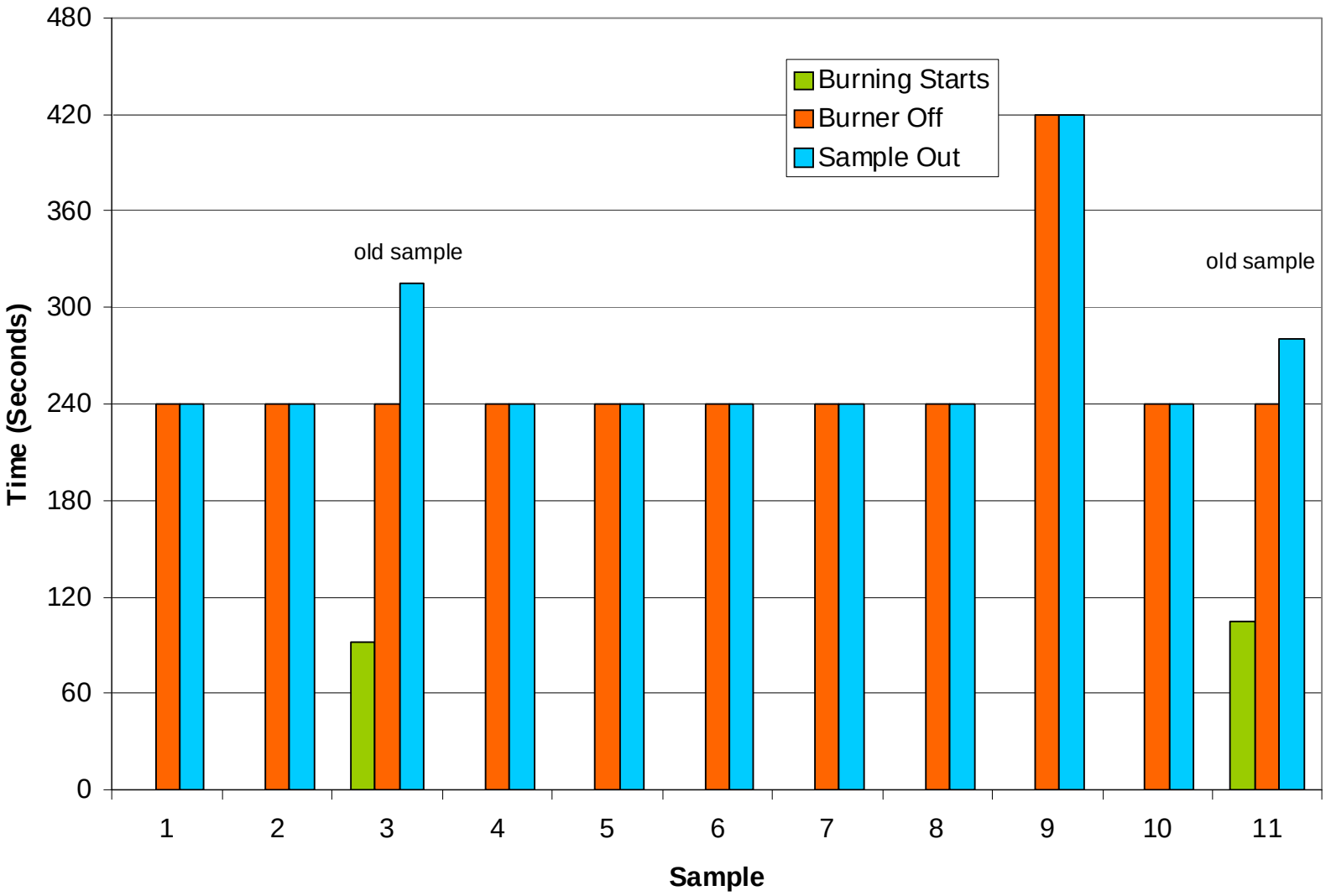
Experiment with hollow cylinders in other mag-alloys?

Begin to refine test parameters (i.e., time to ignition, exposure time, after-flame duration)

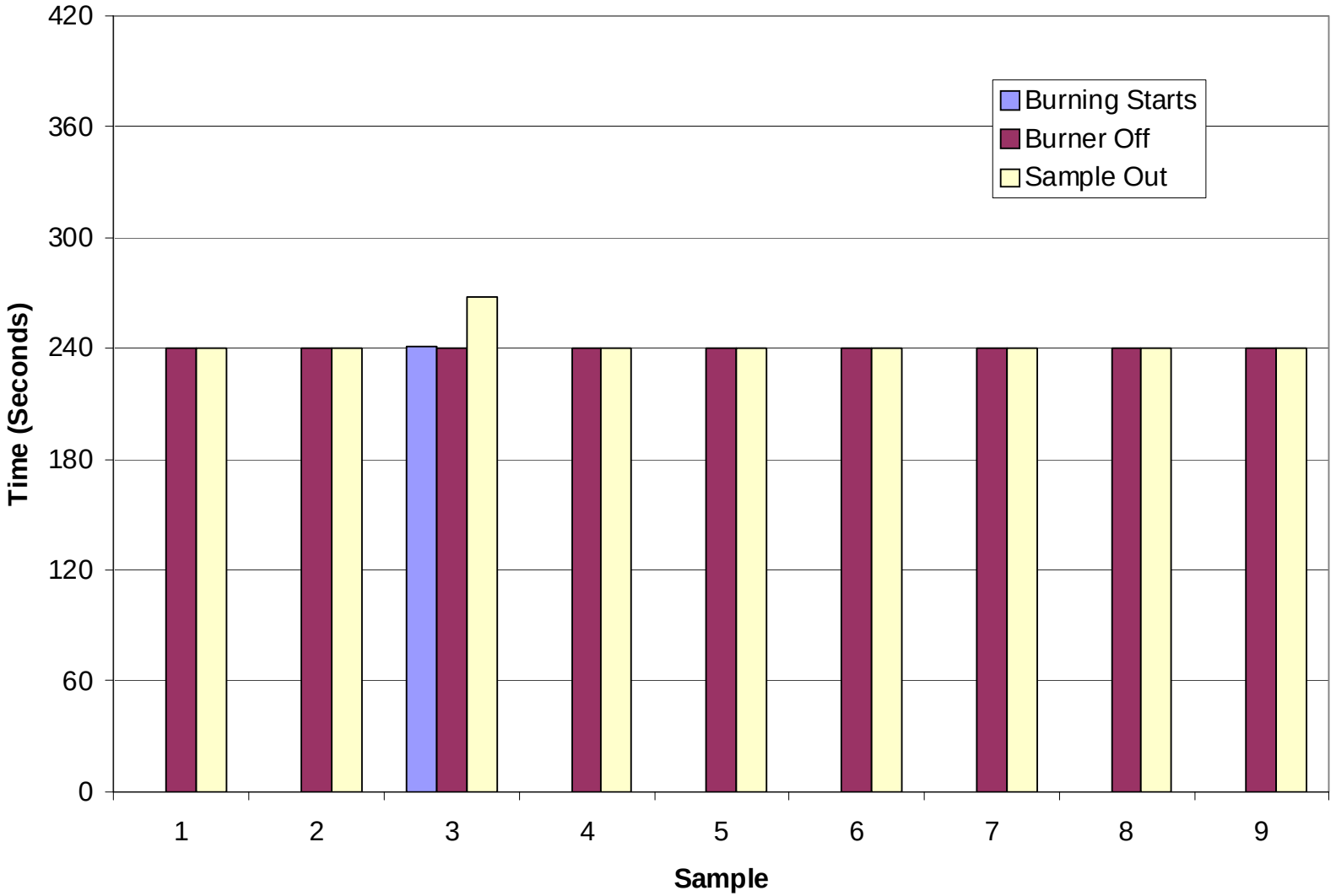
Additional Hollow Cylinder Testing (since last meeting)

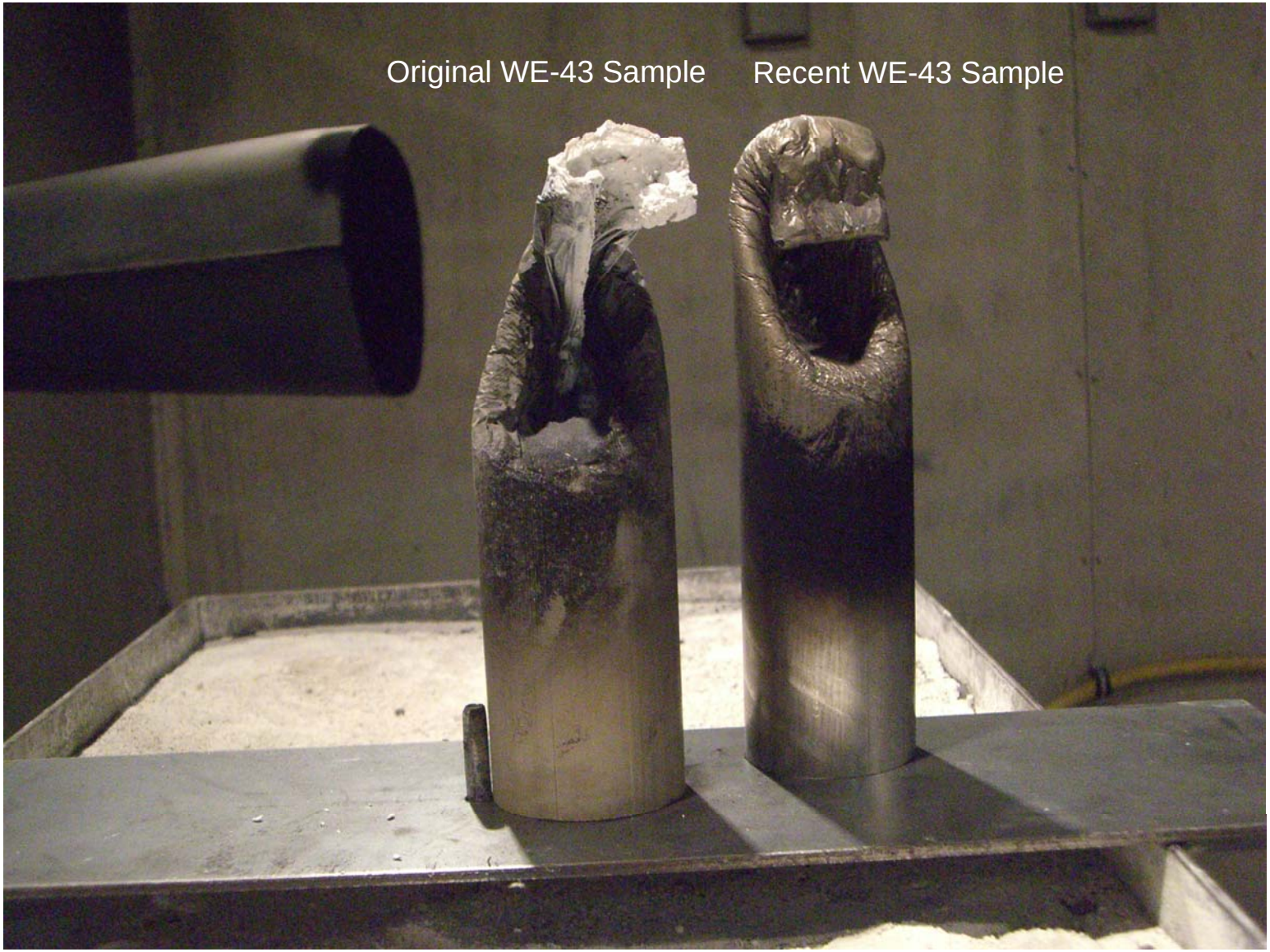
Newer samples of WE-43 that were difficult to ignite

1.75-Inch O.D. (New Samples 12/2011)



1.25-Inch O.D. (New Samples 12/2011)




Original WE-43 Sample
Recent WE-43 Sample

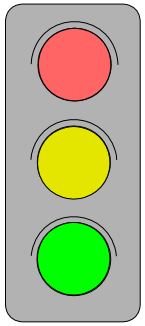
Planned Activities

Determine fix for “non-burning” WE-43 samples

Original and recent WE-43 samples sent to Magnesium Elektron for analysis

Analysis revealed no chemical differences, possible structural differences?

Possible to replicate original samples for testing purposes

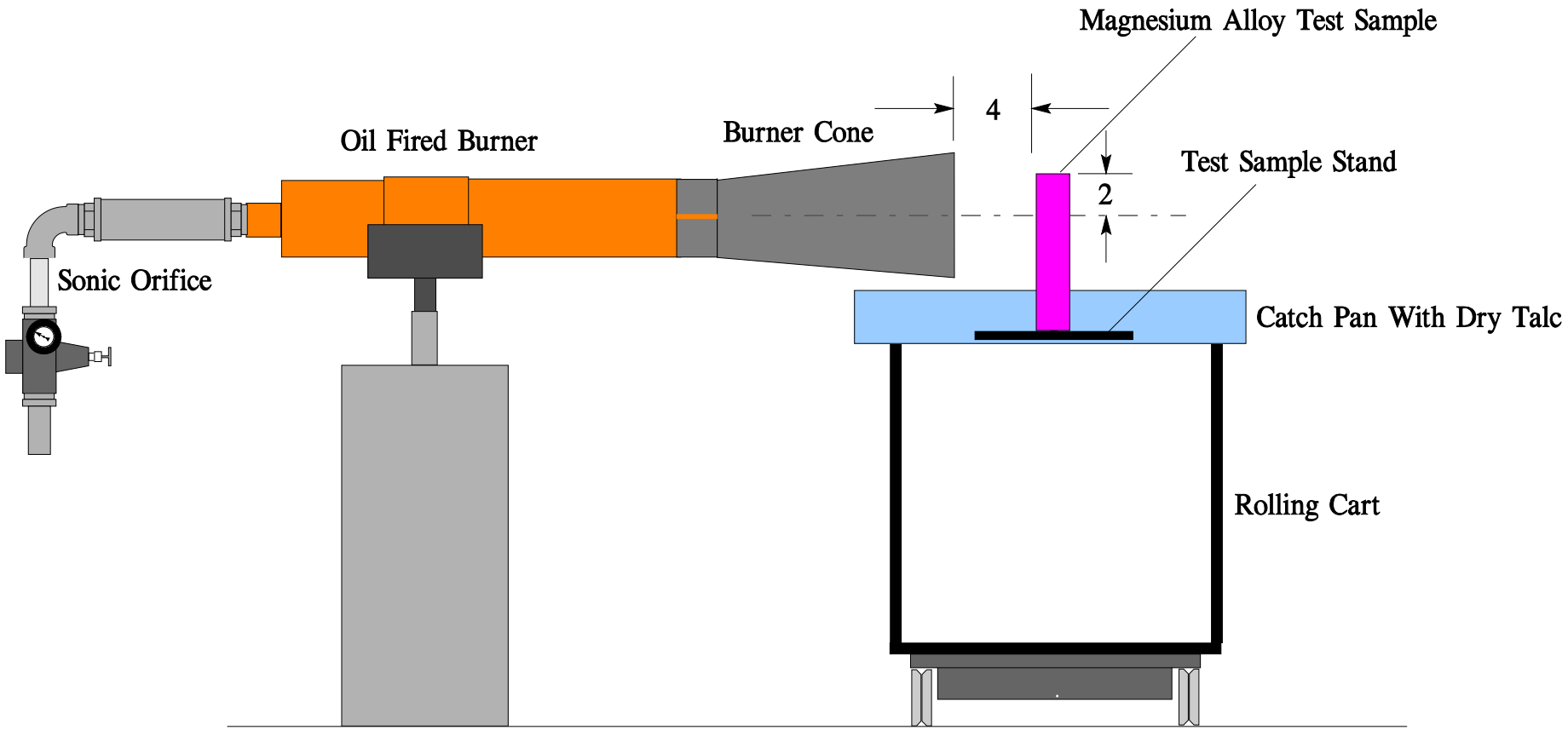


Experiment with hollow cylinders in other mag-alloys

Finalize test parameters (i.e., time to ignition, exposure time, after-flame duration)

Experiment with photocell to determine ignition and extinguishment times?

Proposed Magnesium Alloy Flammability Test



Proposed Magnesium Alloy Flammability Test

2-minute warm-up

Expose sample for 4 minutes

Sample can not ignite prior to 90 seconds

Sample must not continue to burn for more than 90 seconds after burner off at 4:00

Once finalized, can we include this test method in the existing (old) Handbook??