Discussion of Burnthrough Test Method for Aircraft Thermal Acoustic Insulation Blankets

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Standardization of Burnthrough Test

Objective: Lab-to-lab correlation of test results!

Methodology (1): Ensure proper equipment set-up using standardized tools to allow quick and accurate measurement of critical dimensions and settings.

Methodology (2): Ensure proper calibration and test techniques by visiting labs and witnessing actual calibration and burnthrough tests.

Methodology (3): Prepare and test identical samples (i.e., RR VI)

Special Thanks to:

Scott Anacker

Steve Morgan

For the development of the burner adjustment tools

Methodology (1): Ensure proper equipment set-up using standardized tools to allow quick and accurate measurement of critical dimensions and settings.

Initial Burner Adjustments, General Set-up

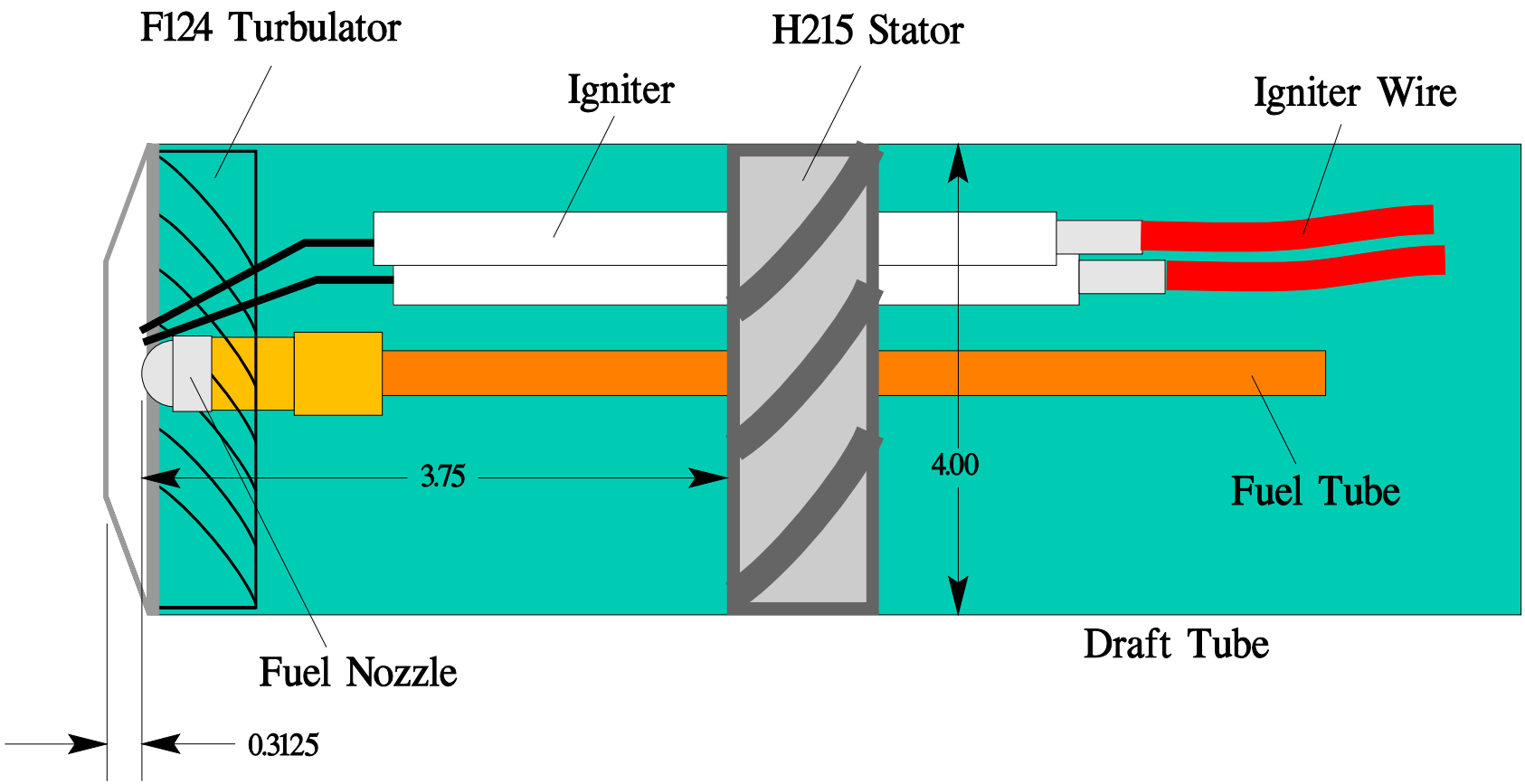
Check:

1. Proper Components (H215 stator, F-124 turbulator, PL fuel nozzle, etc)
2. Test Frame Level
3. 30^{o} Angle for Cone Face, Test Frame, T/C Rake, Calorimeter
4. All Flanges Sealed

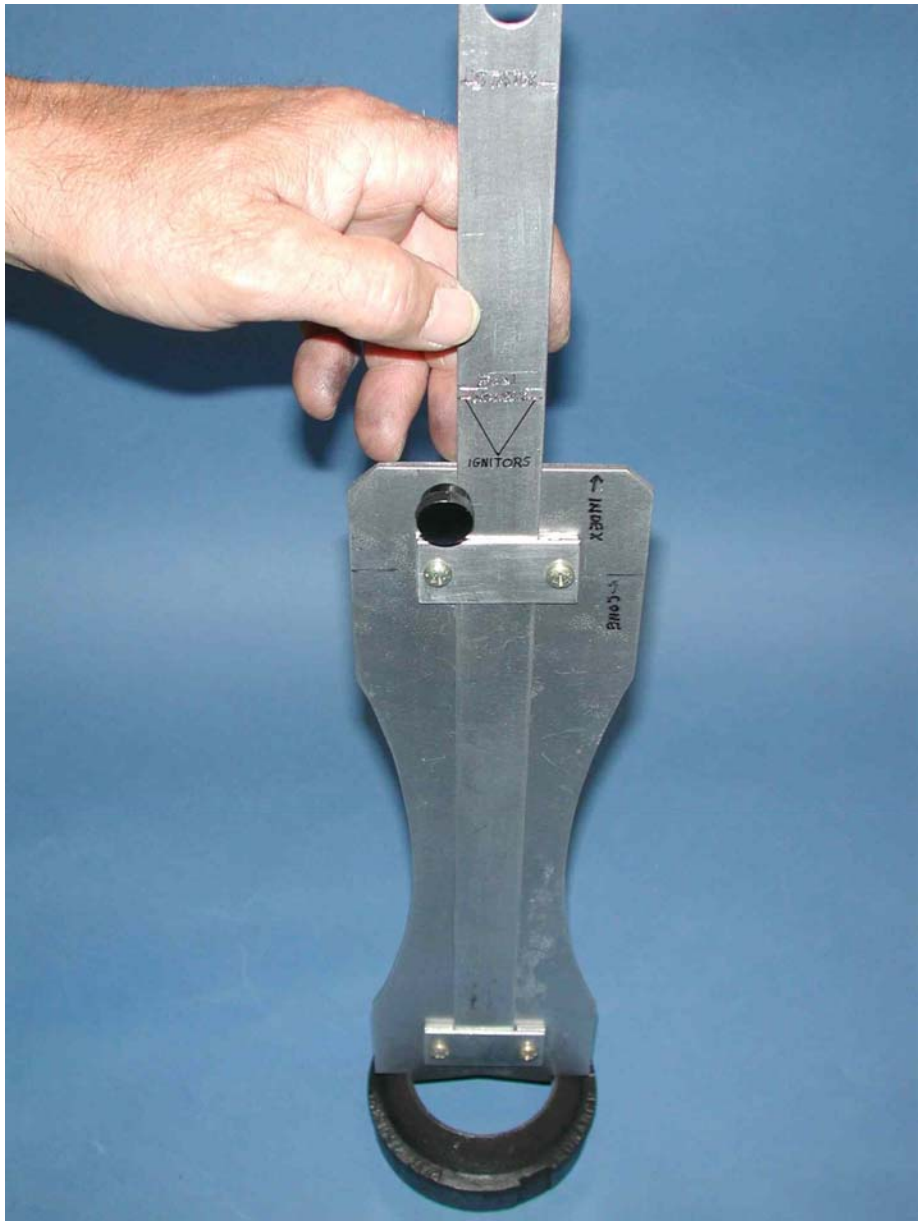
Measure:

1. Burner Cone Protrusion
2. Nozzle Depth
3. Stator Depth
4. Ignitor Depth

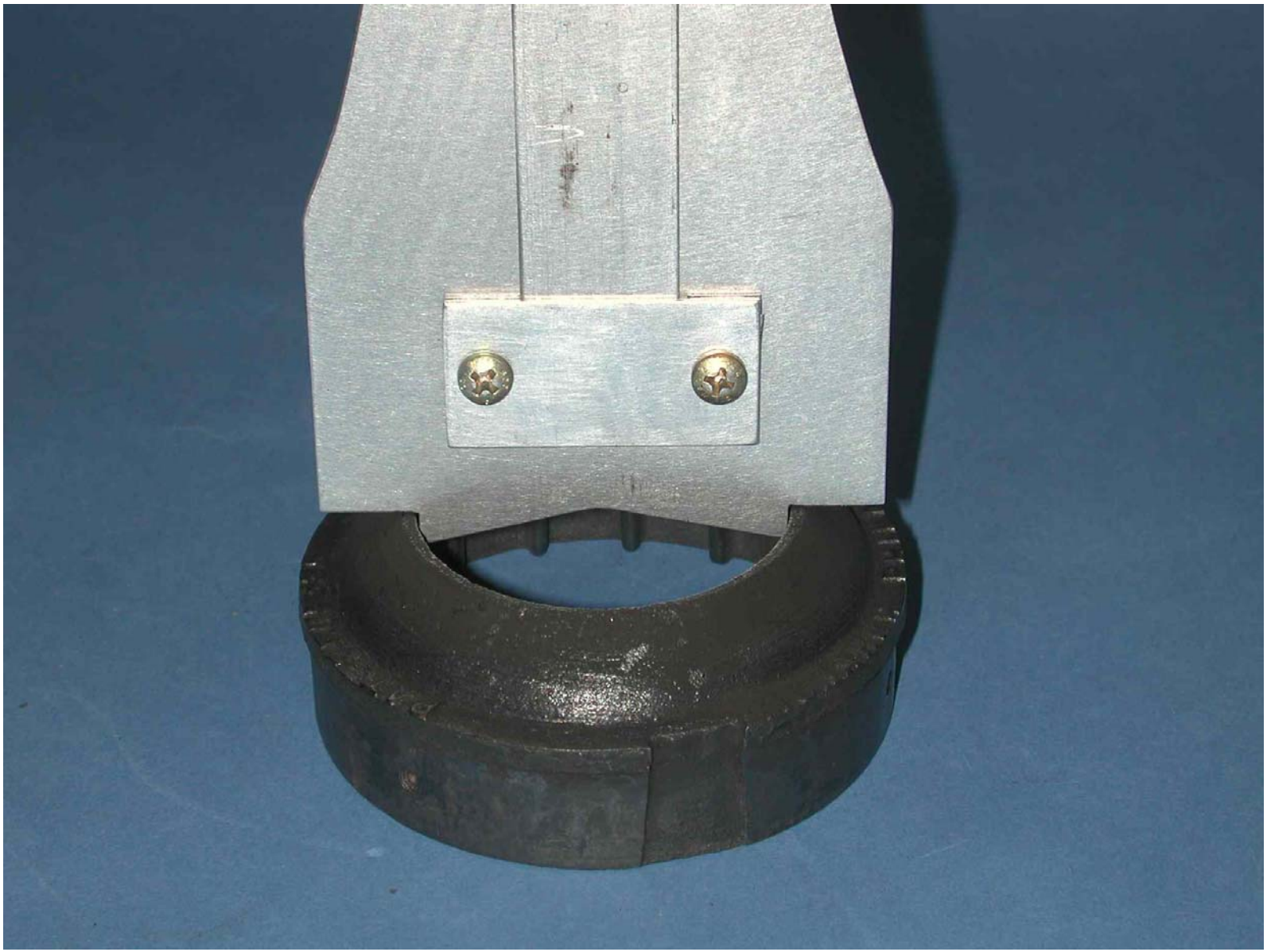
Critical Draft Tube Adjustments



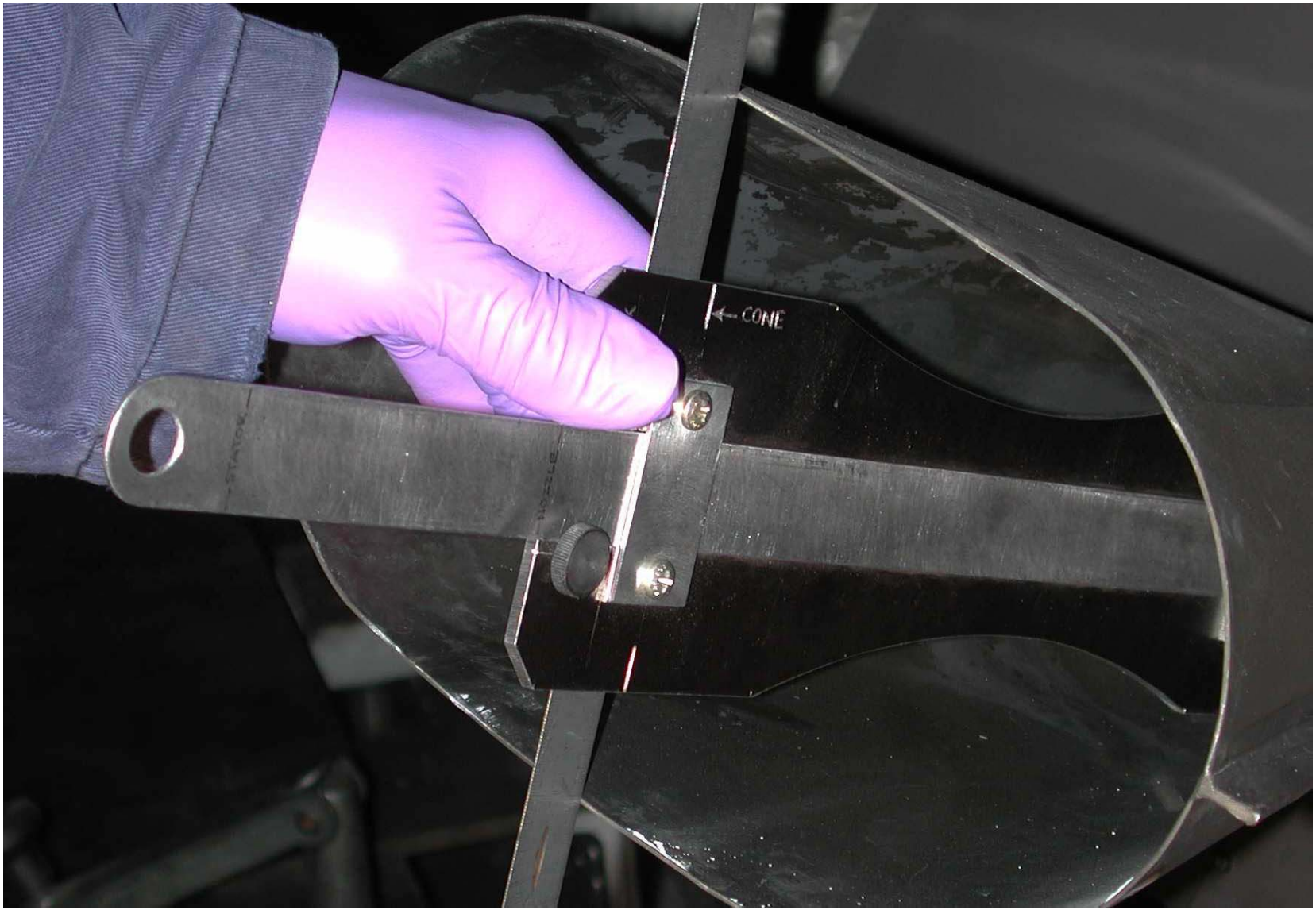
Cone Protrusion/Nozzle Depth/Stator Depth Tool



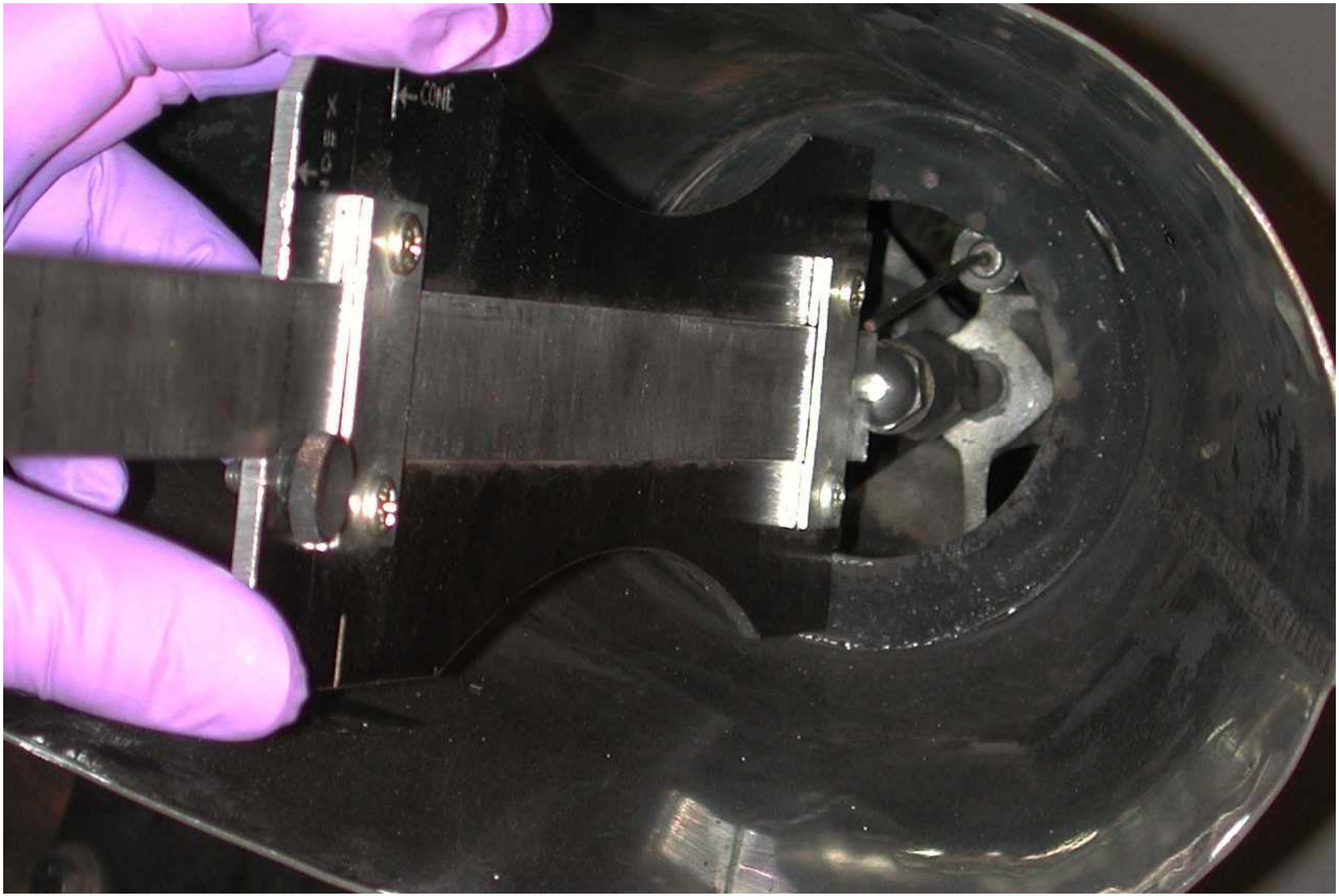
Tool Inserted into Turbulator



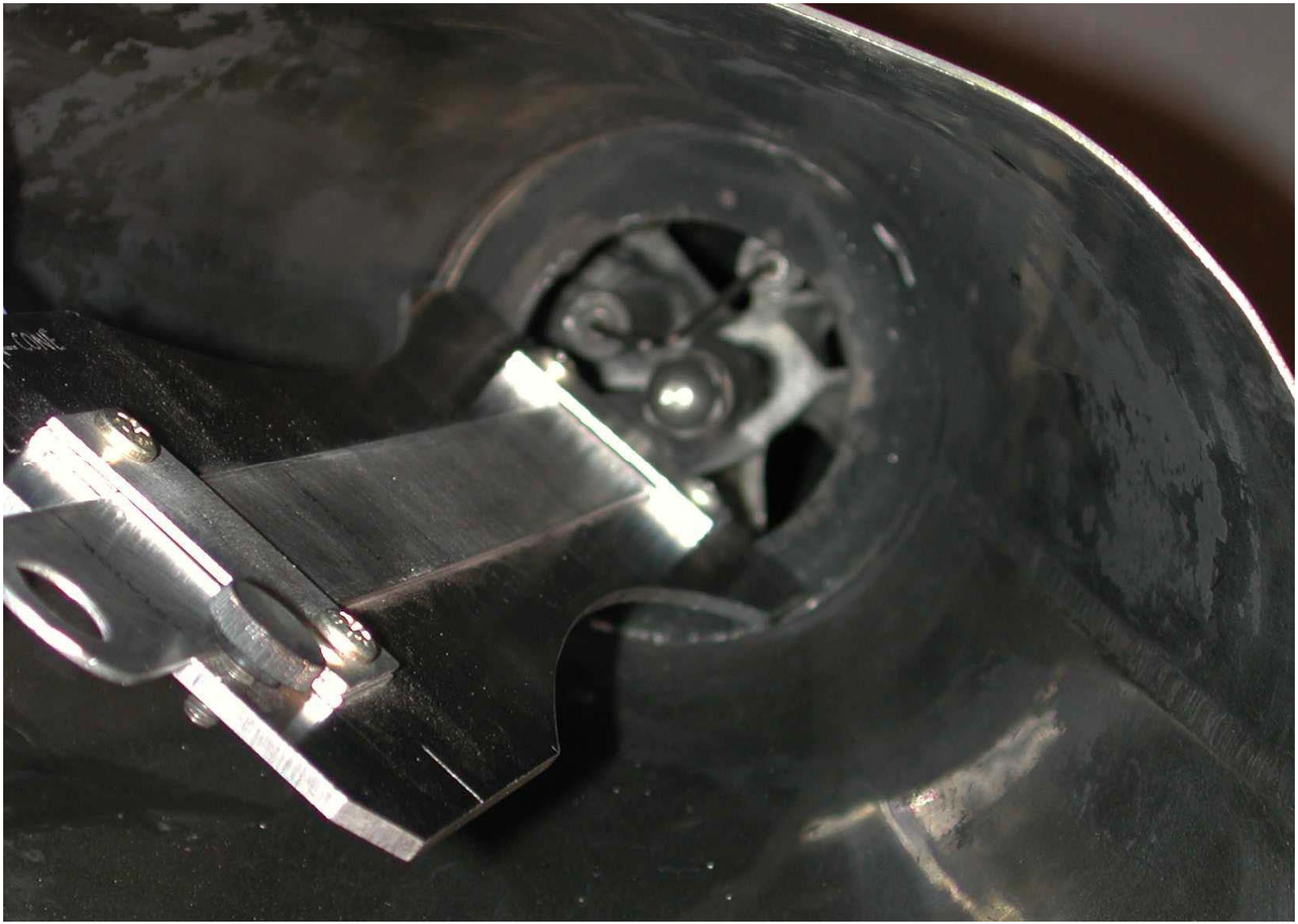
Setting Burner Cone Protrusion



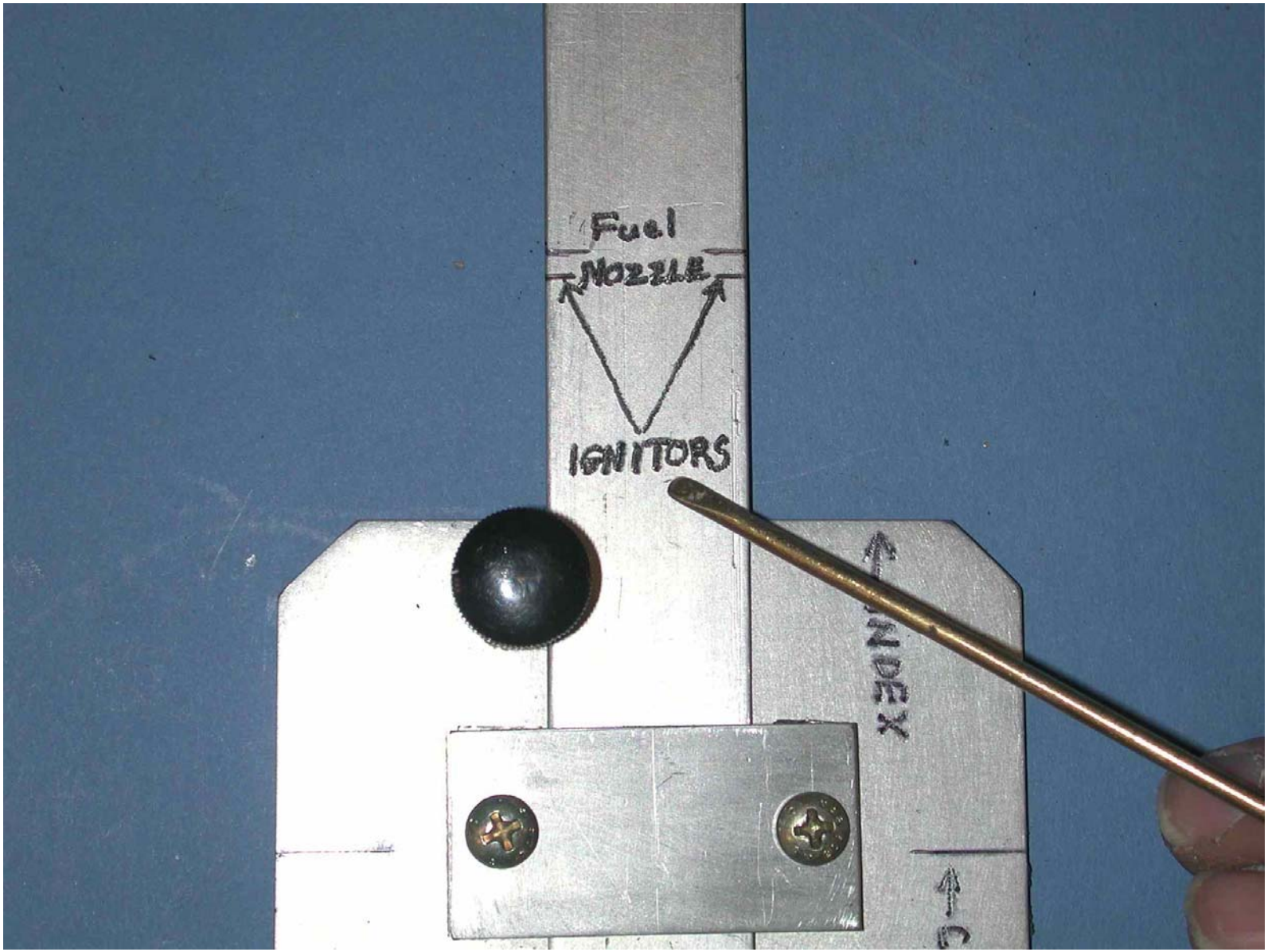
Setting Fuel Nozzle Depth



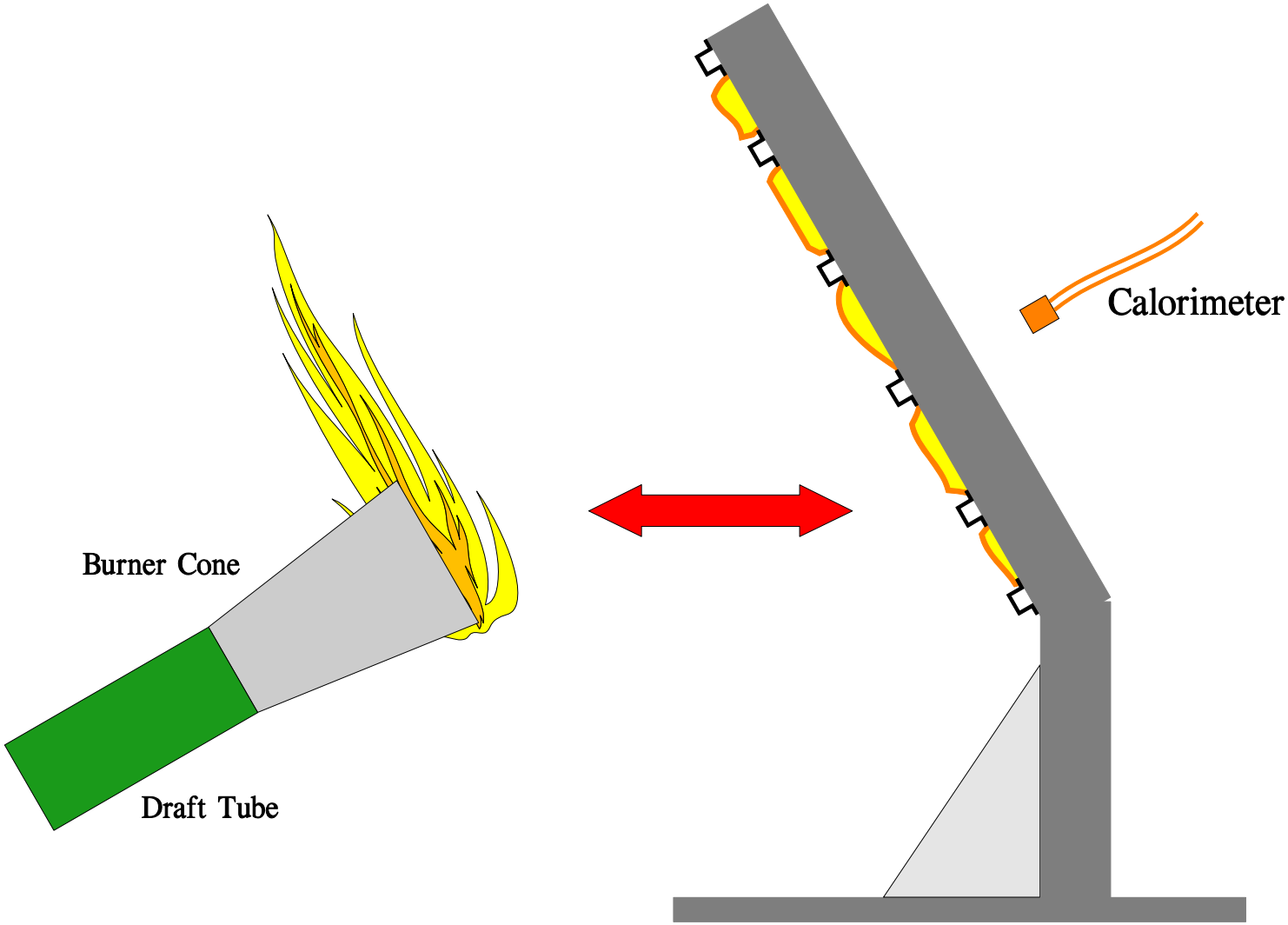
Setting Stator Depth



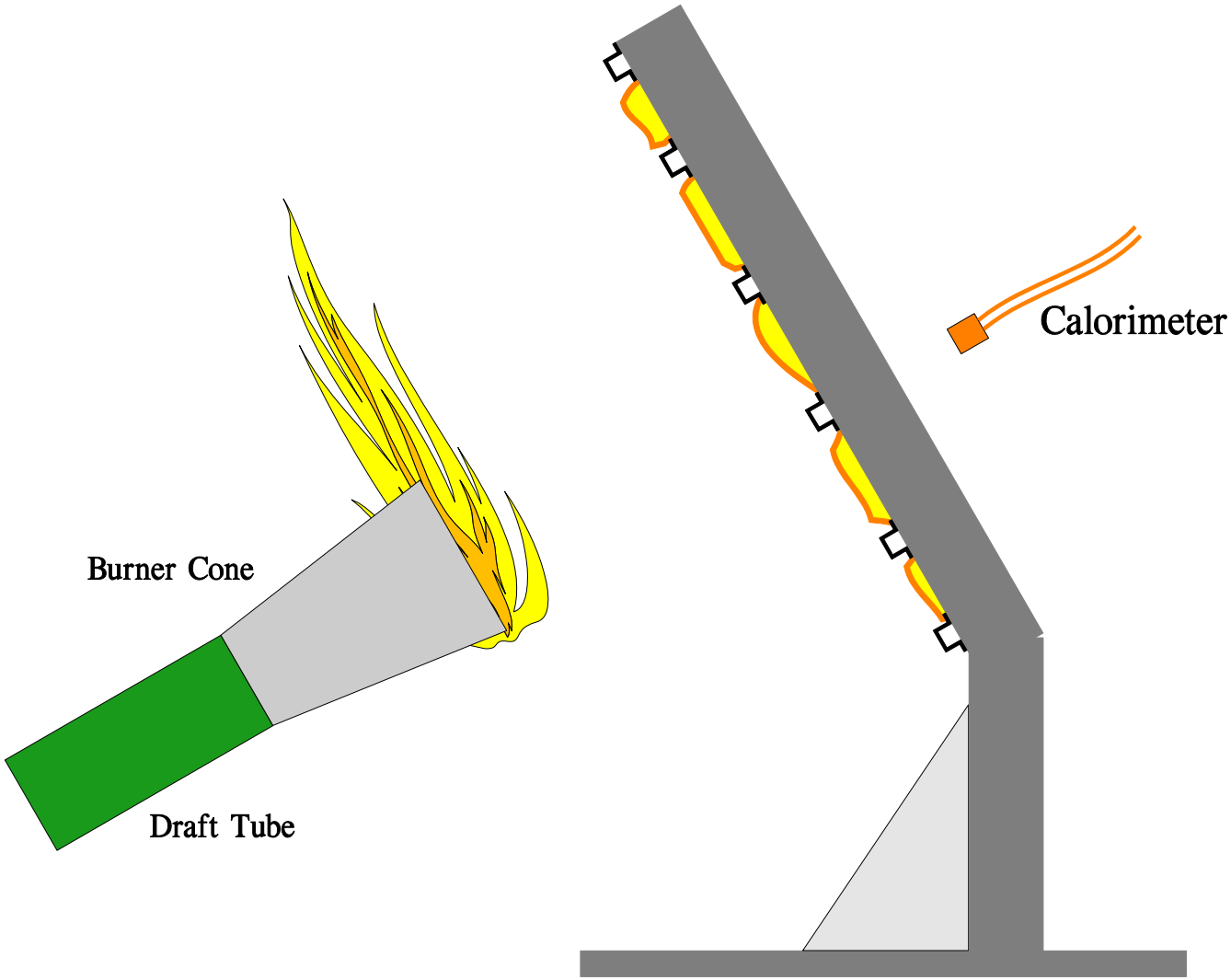
Ignitor Depth Mark



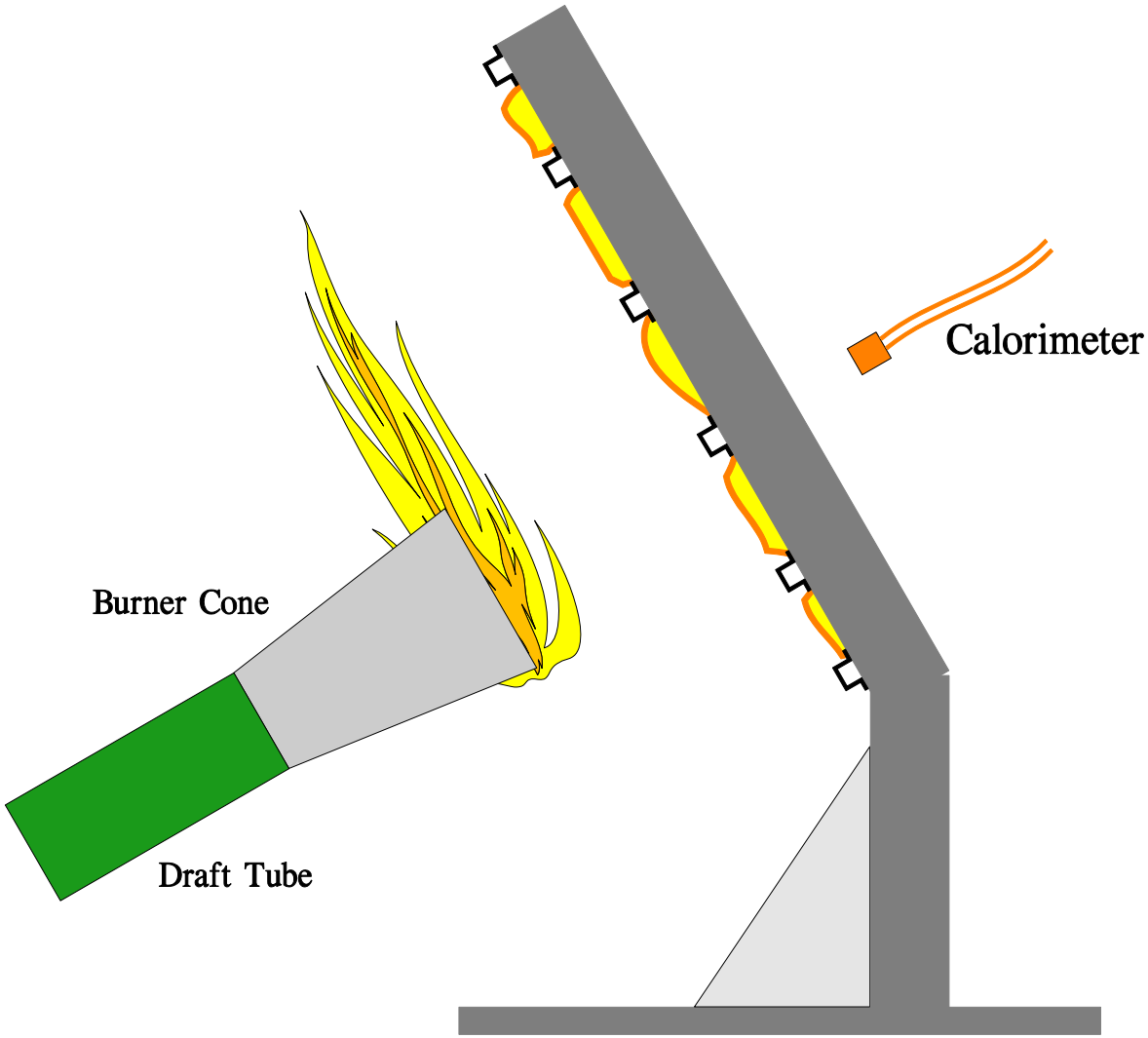
Burner-to-Test-Frame Positioning



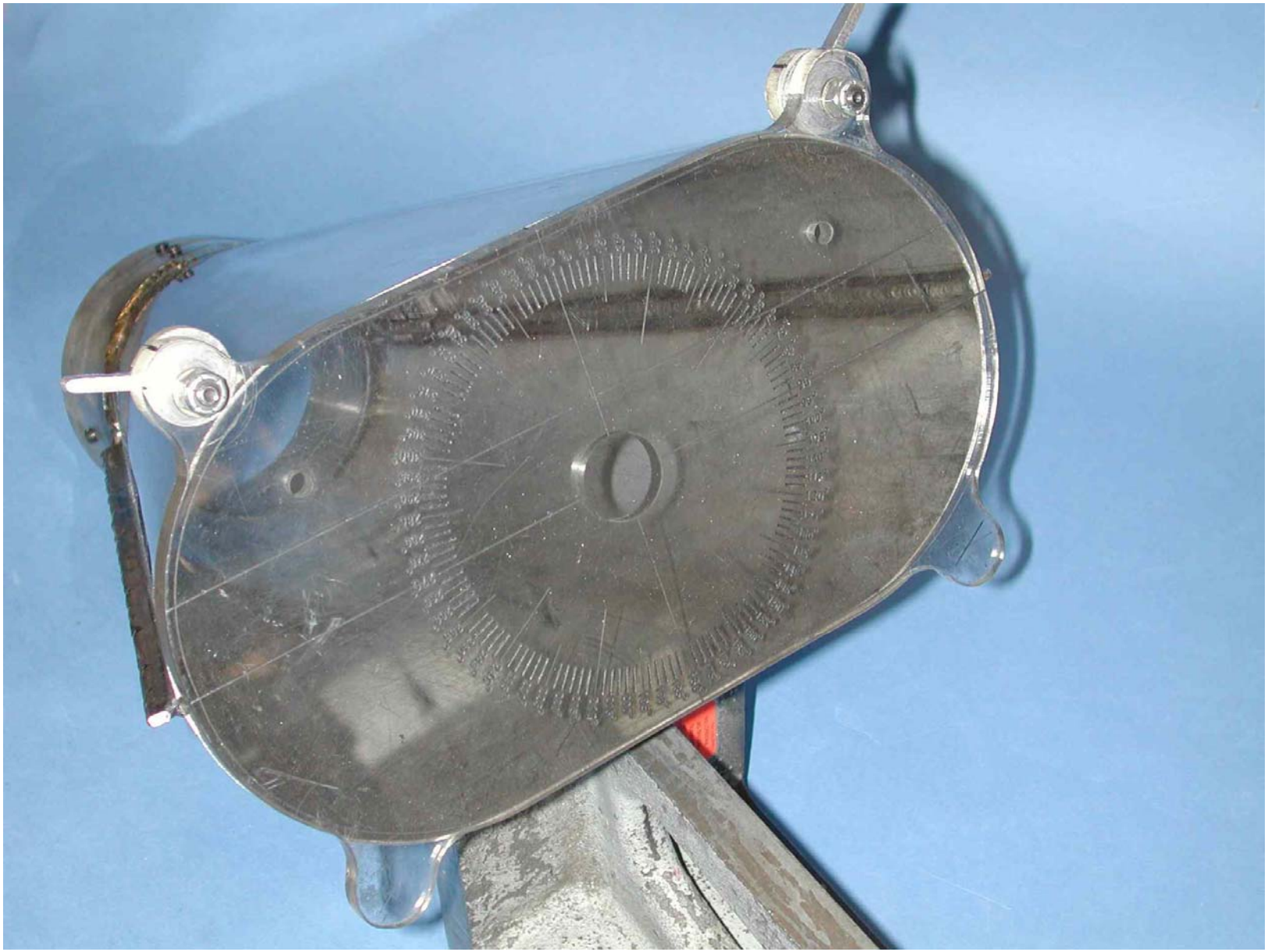
Burner-to-Test-Frame Positioning



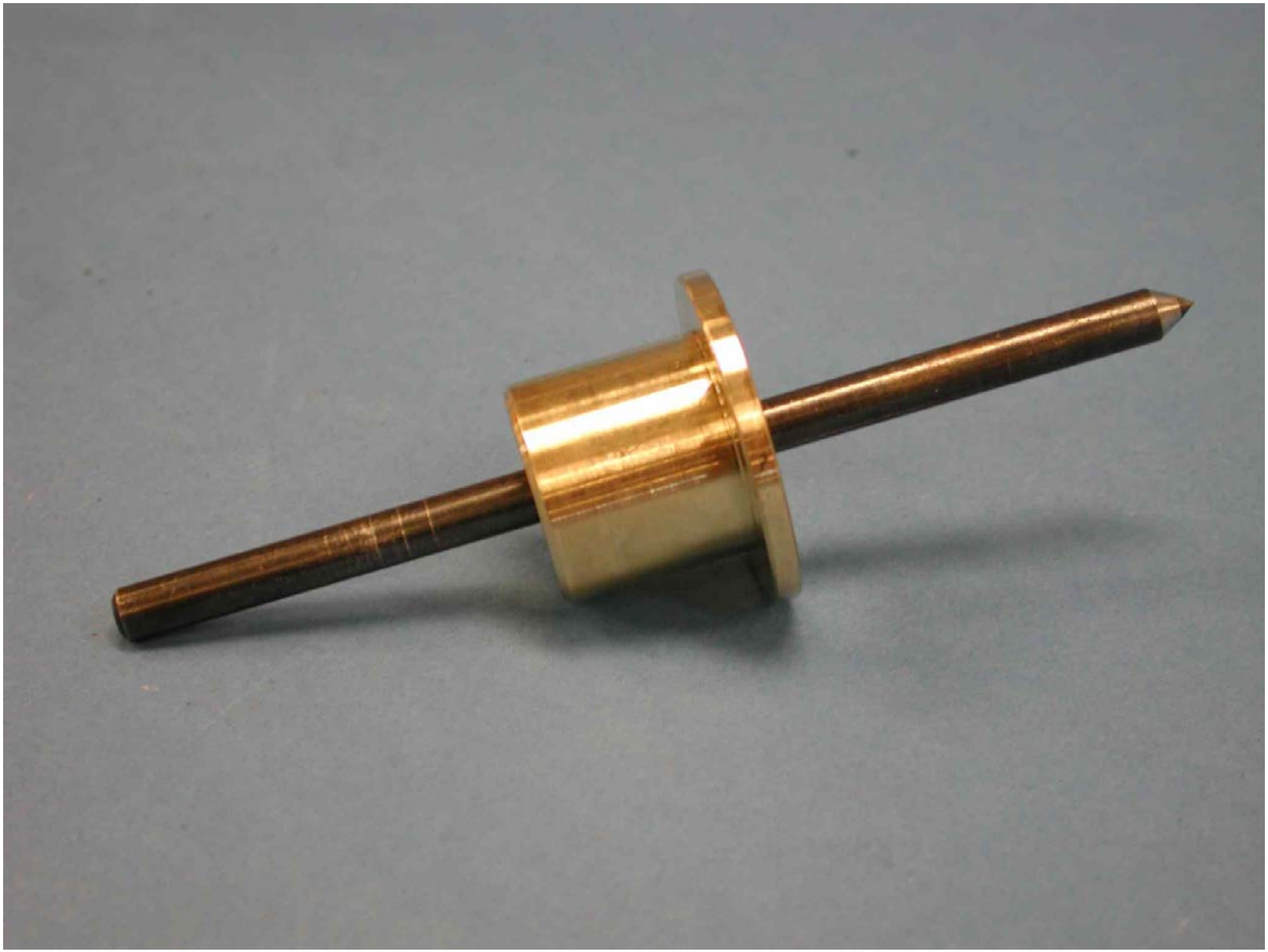
Burner-to-Test-Frame Positioning



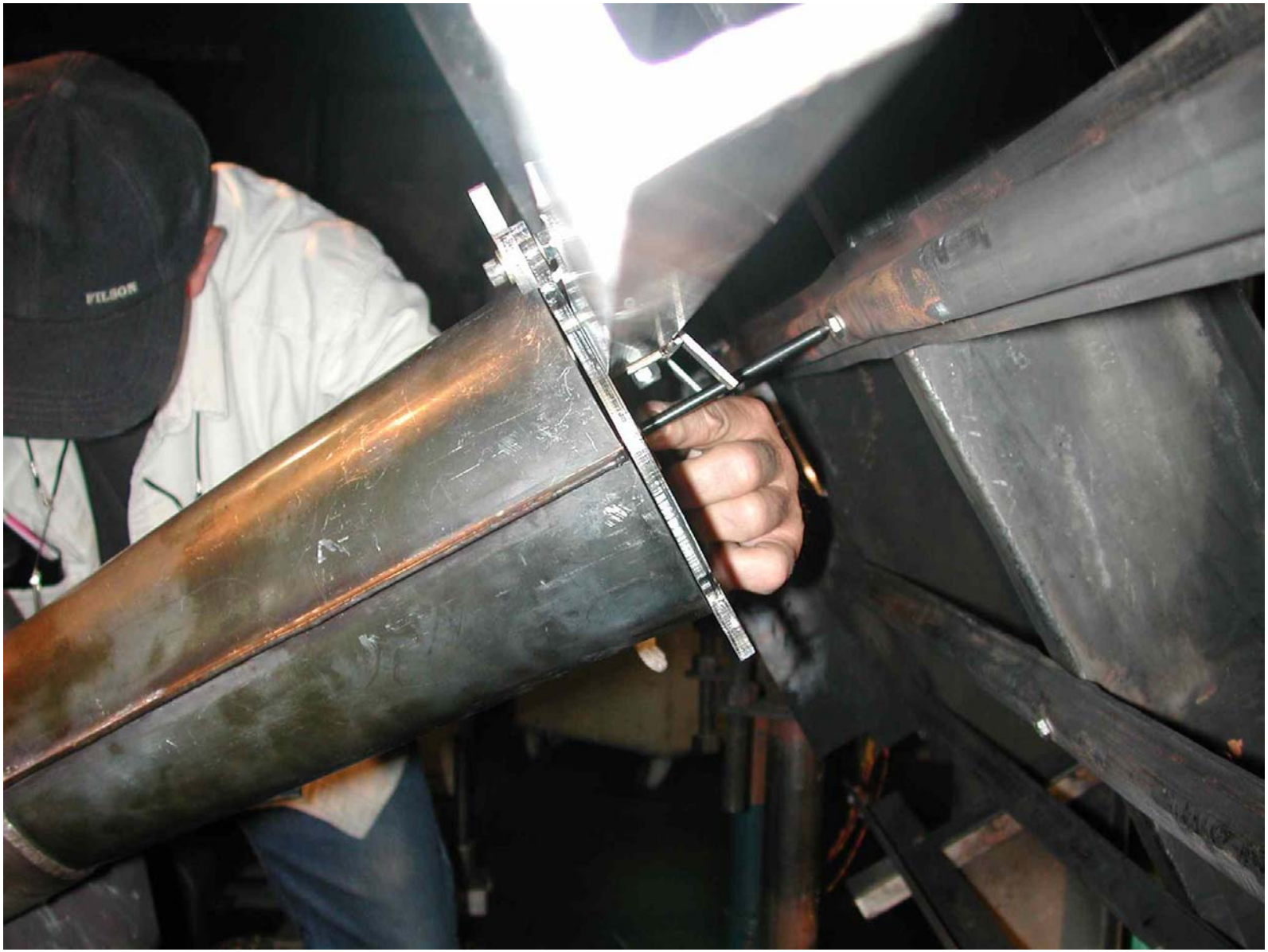
Burner Cone Faceplate Tool Fit Over Cone



Pointer Tool



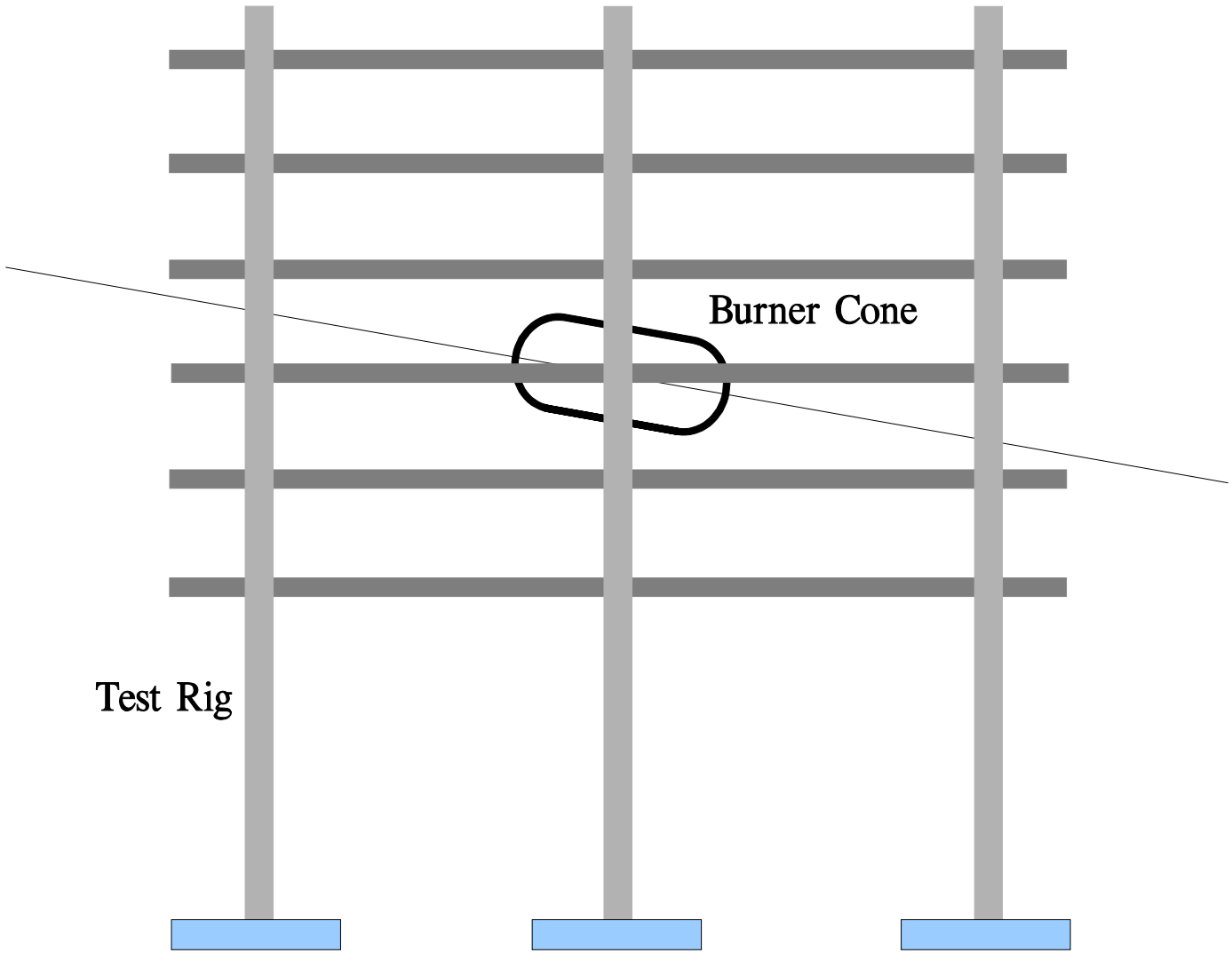
Pointer Tool Used to Check Burner-To-Stringer Alignment

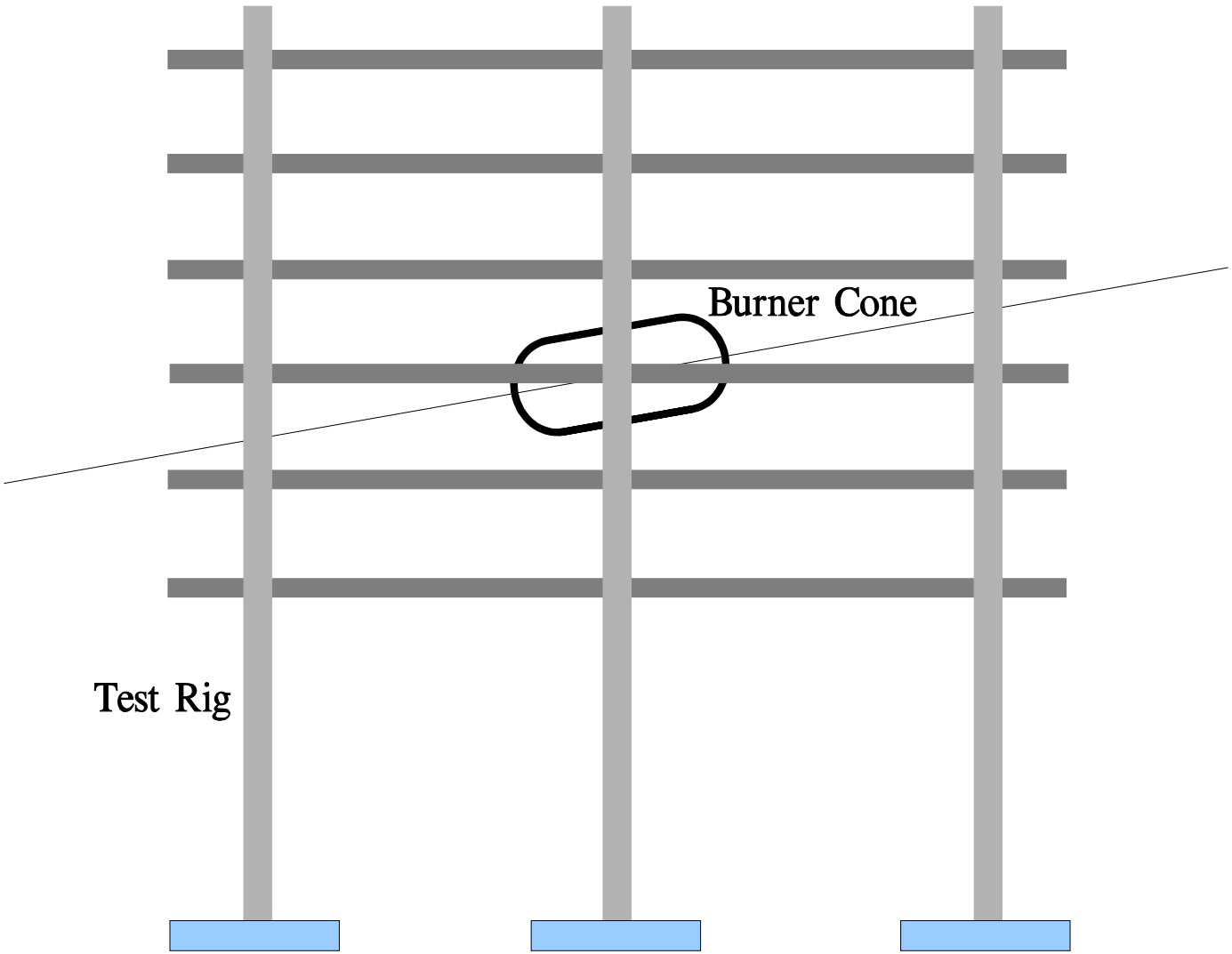


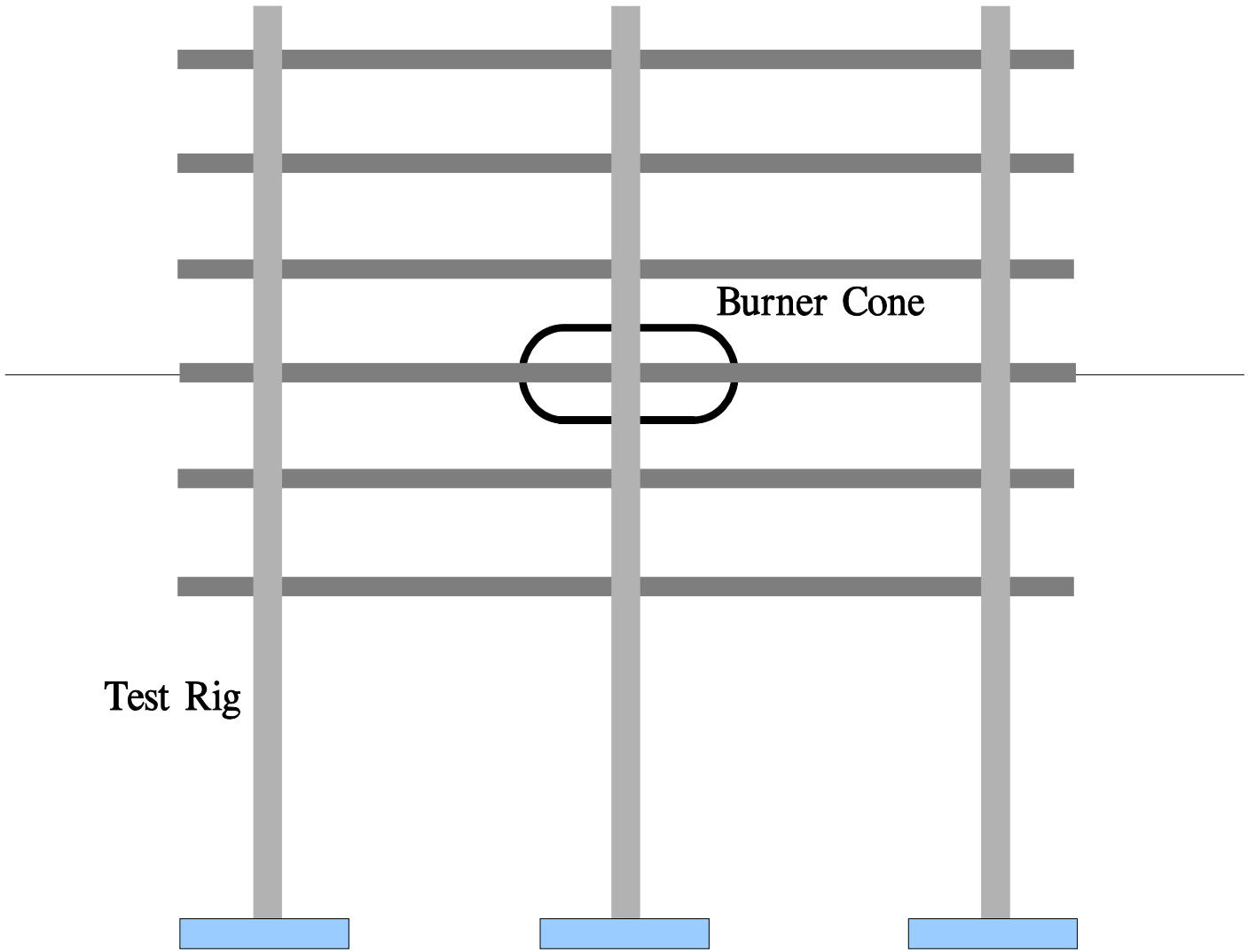
4-Inch Angles on Outer Formers

Adjusting Cone Rotation by Measuring Vertical Distance to Centerline

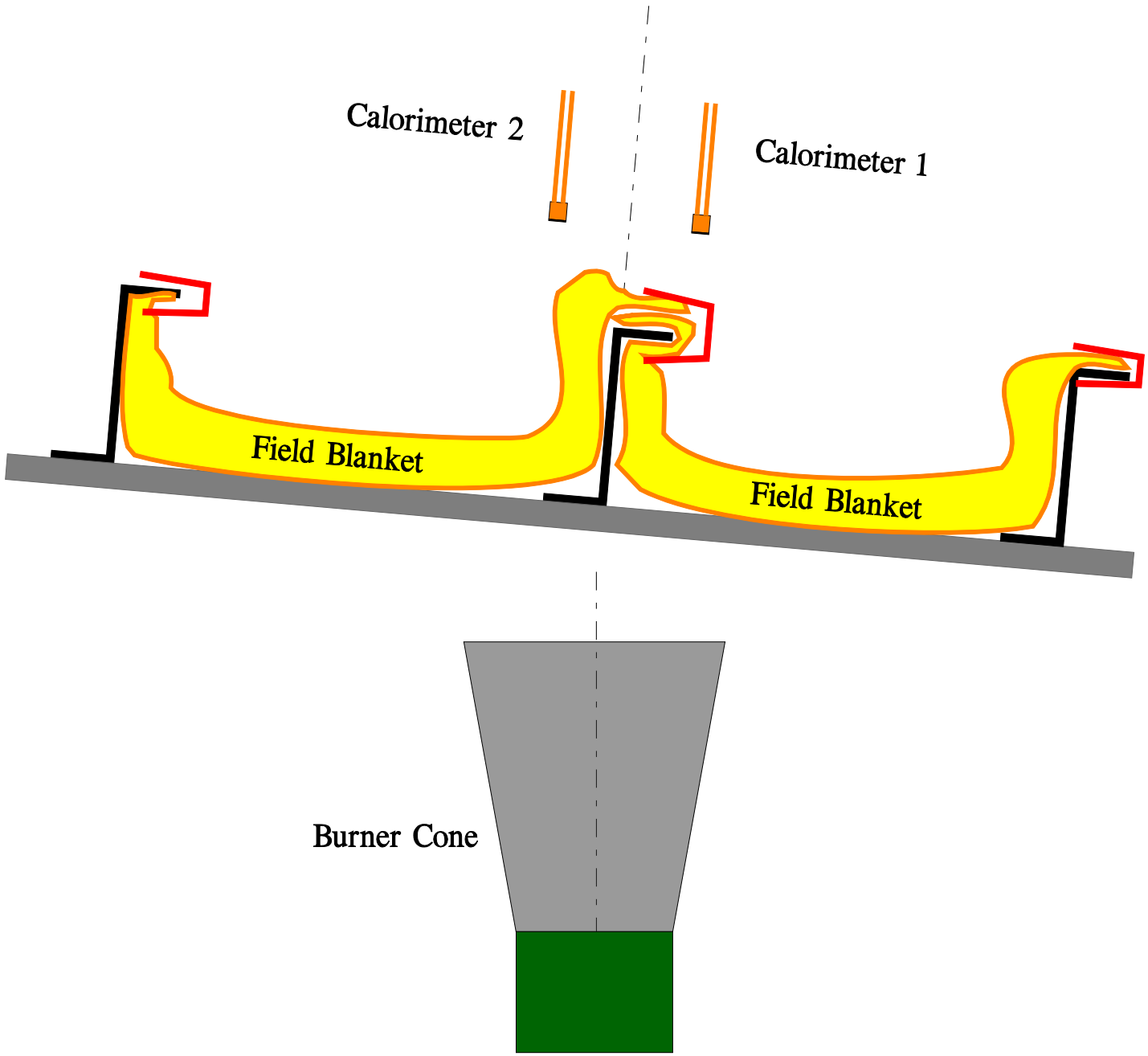
Angle attached to faceplate

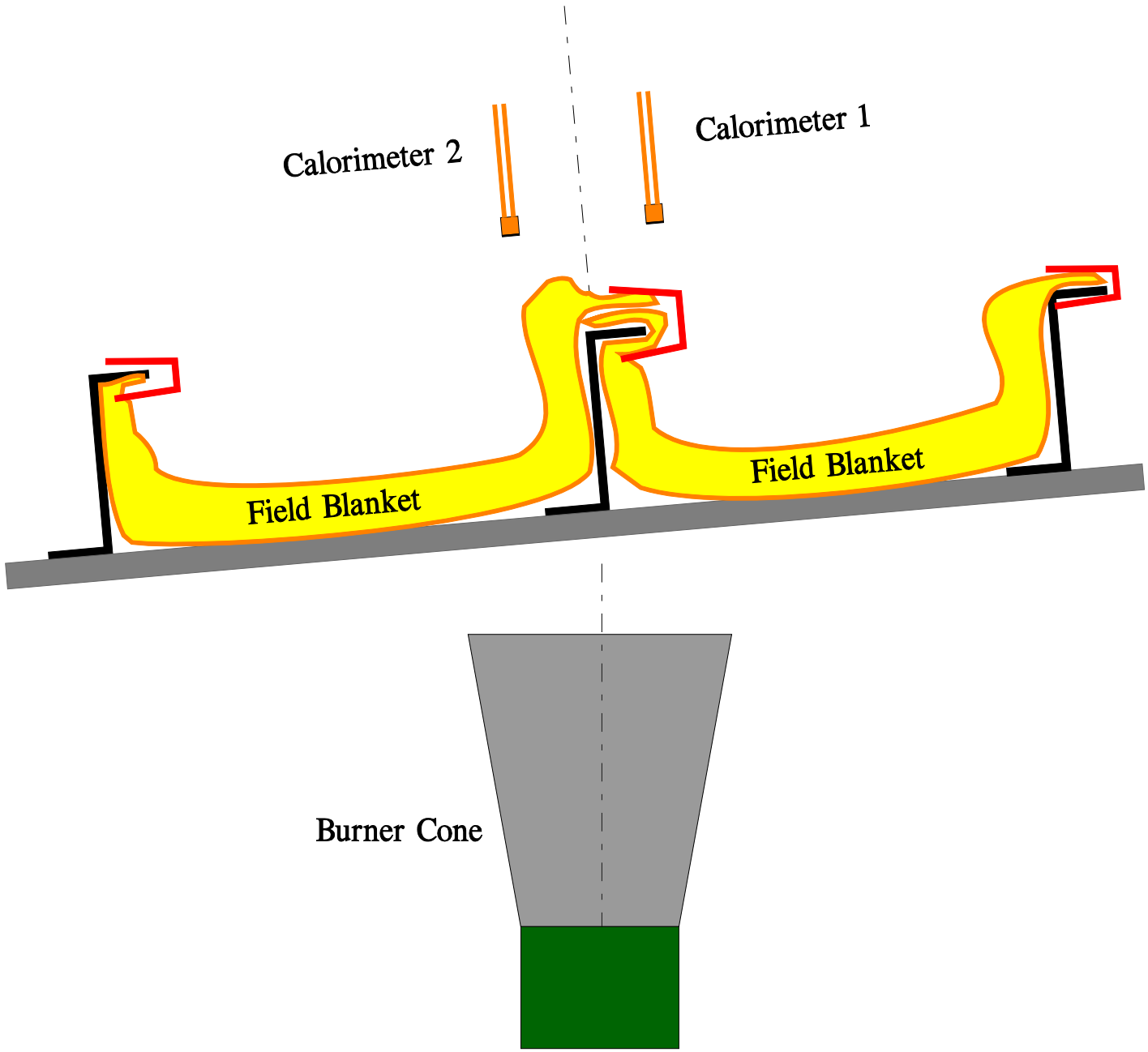

Burner Cone
Test Rig

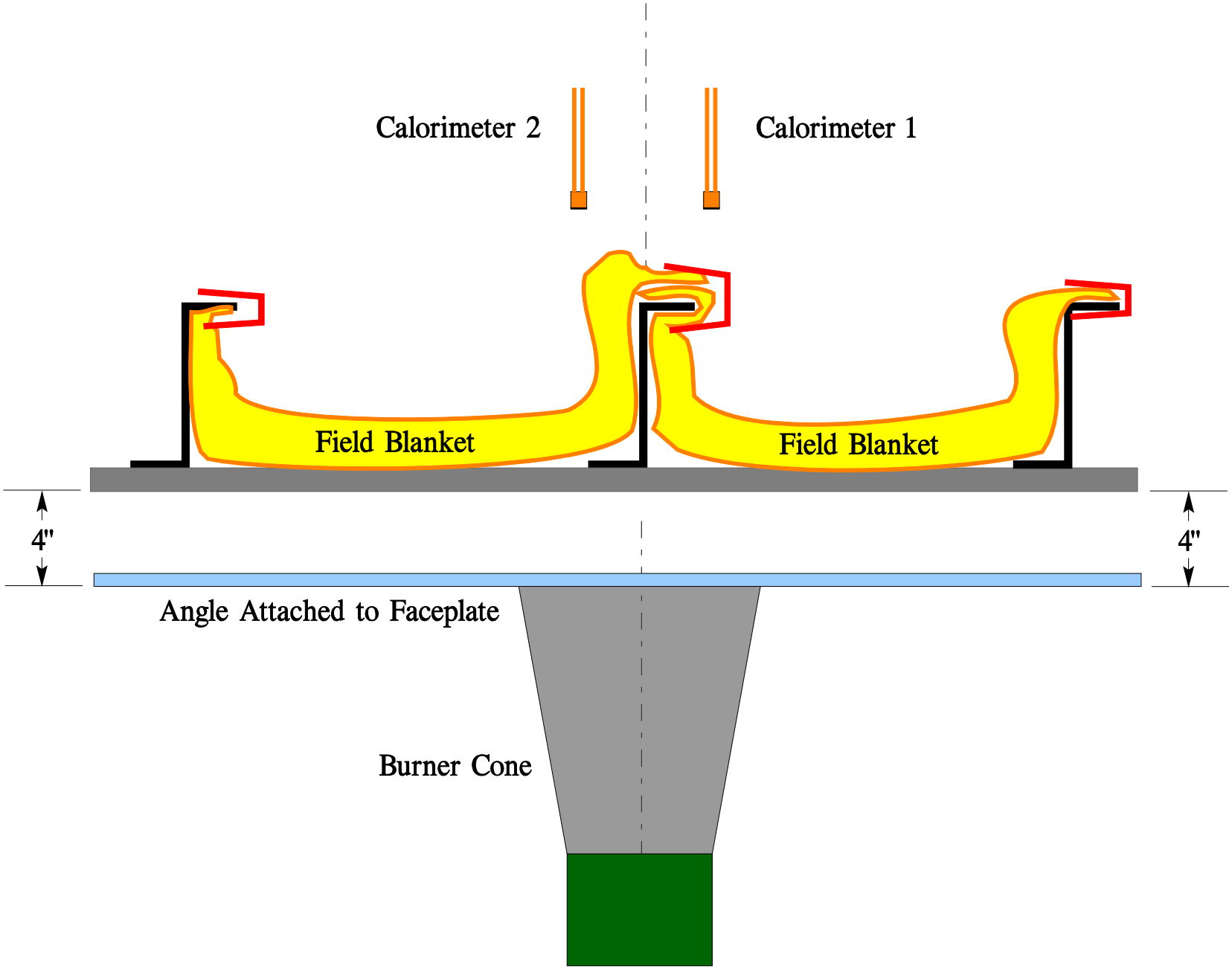

Burner Cone
Test Rig


Burner Cone
Test Rig

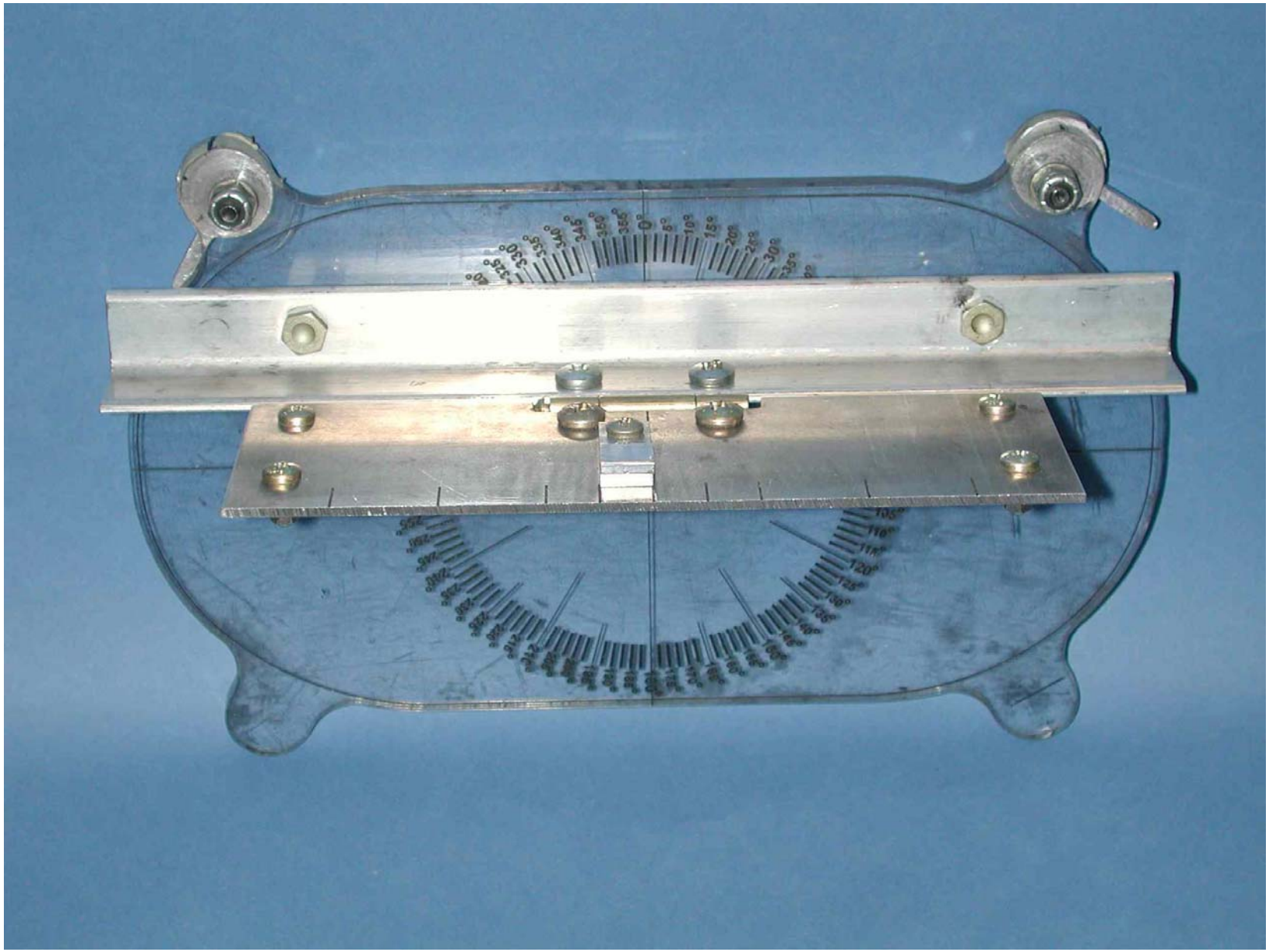
Adjusting Frame Position to Ensure Perpendicular to Cone Centerline


Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
Burner Cone


Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
Burner Cone


Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
4"
4"
Angle Attached to Faceplate
Burner Cone

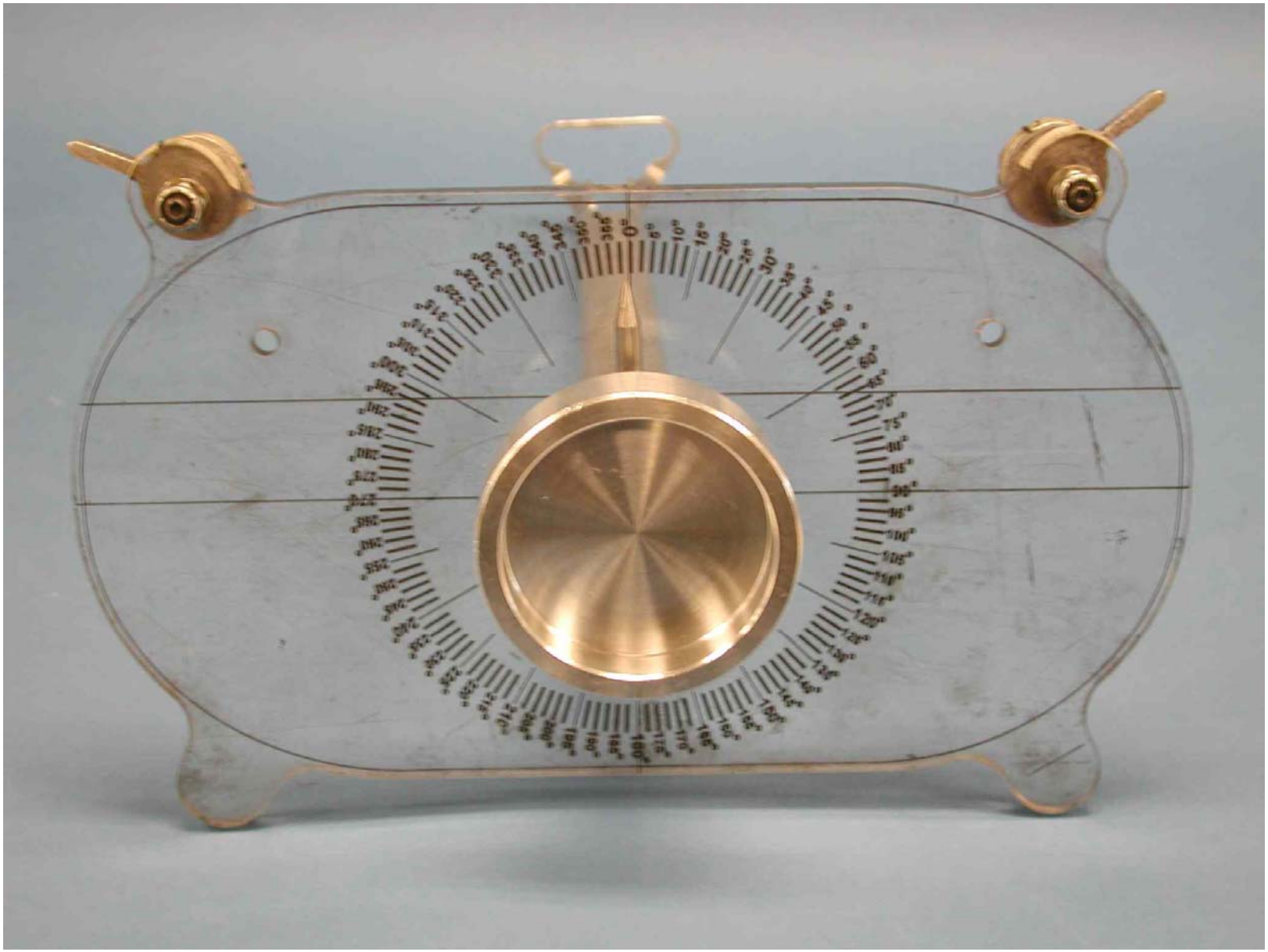
Burner Faceplate Tool w/Drop-Down



Aligning Burner with Center Former Using Drop-Down Tool

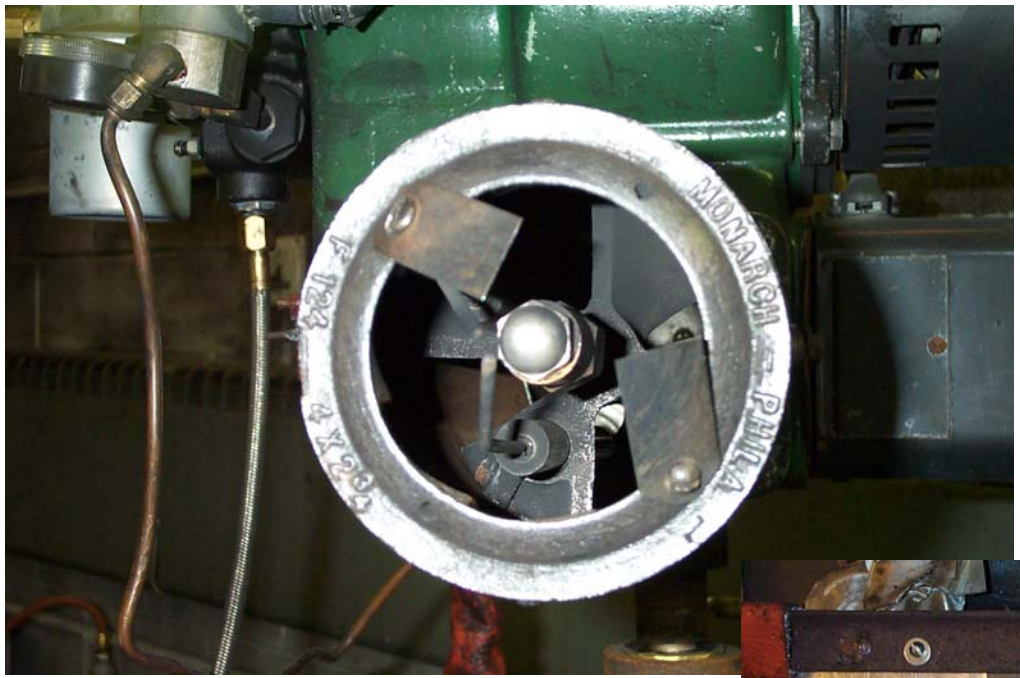
Adjustment of Stator Rotation

Ignitor/Stator Clocking Tool



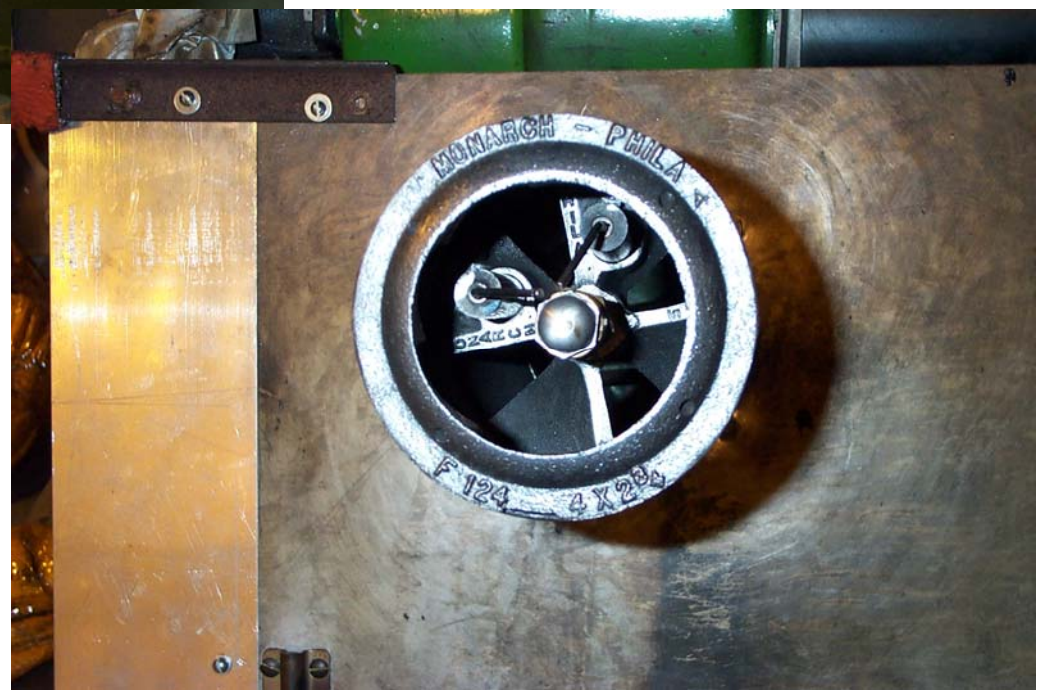
Adjustment of Turbulator Rotation

Differences in Turbulator Position

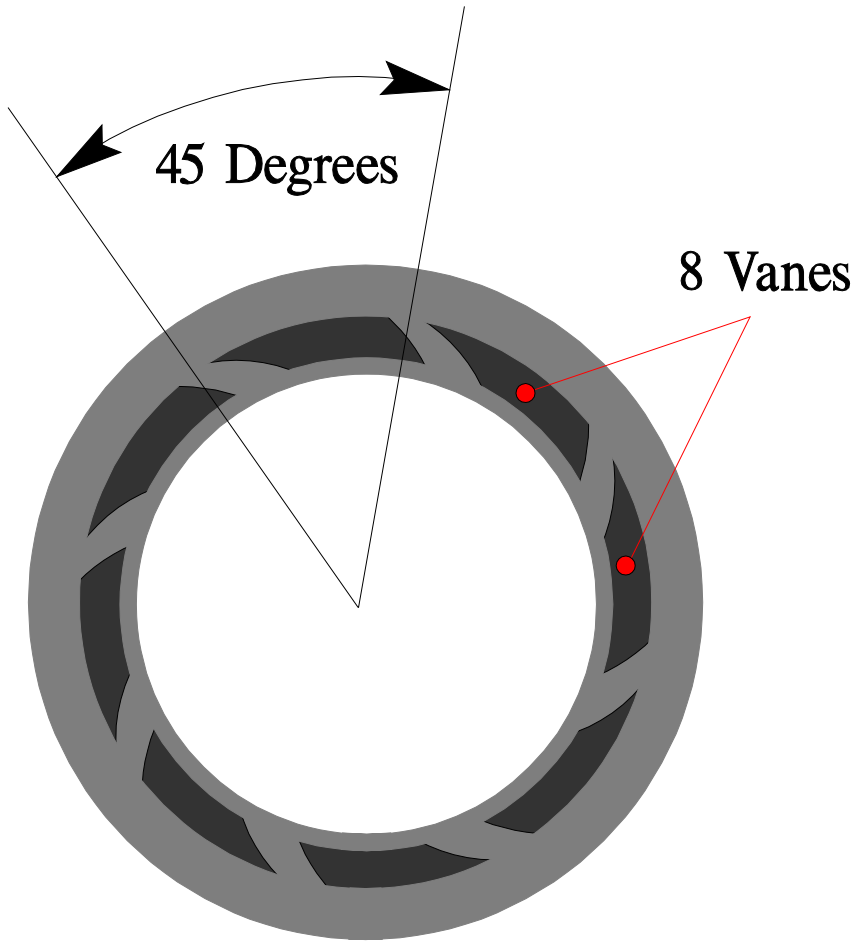


Seat Test

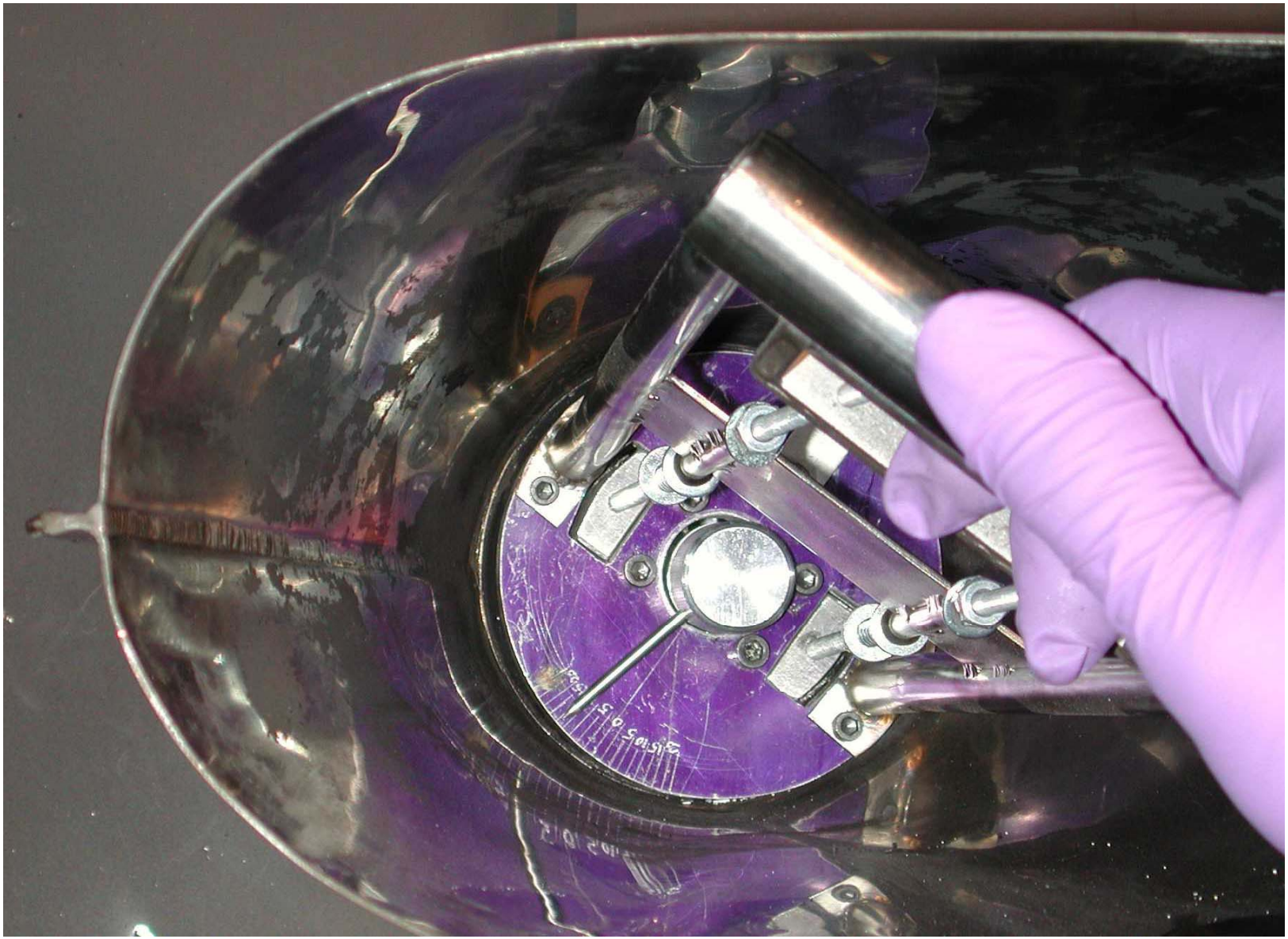
Burnthrough Test



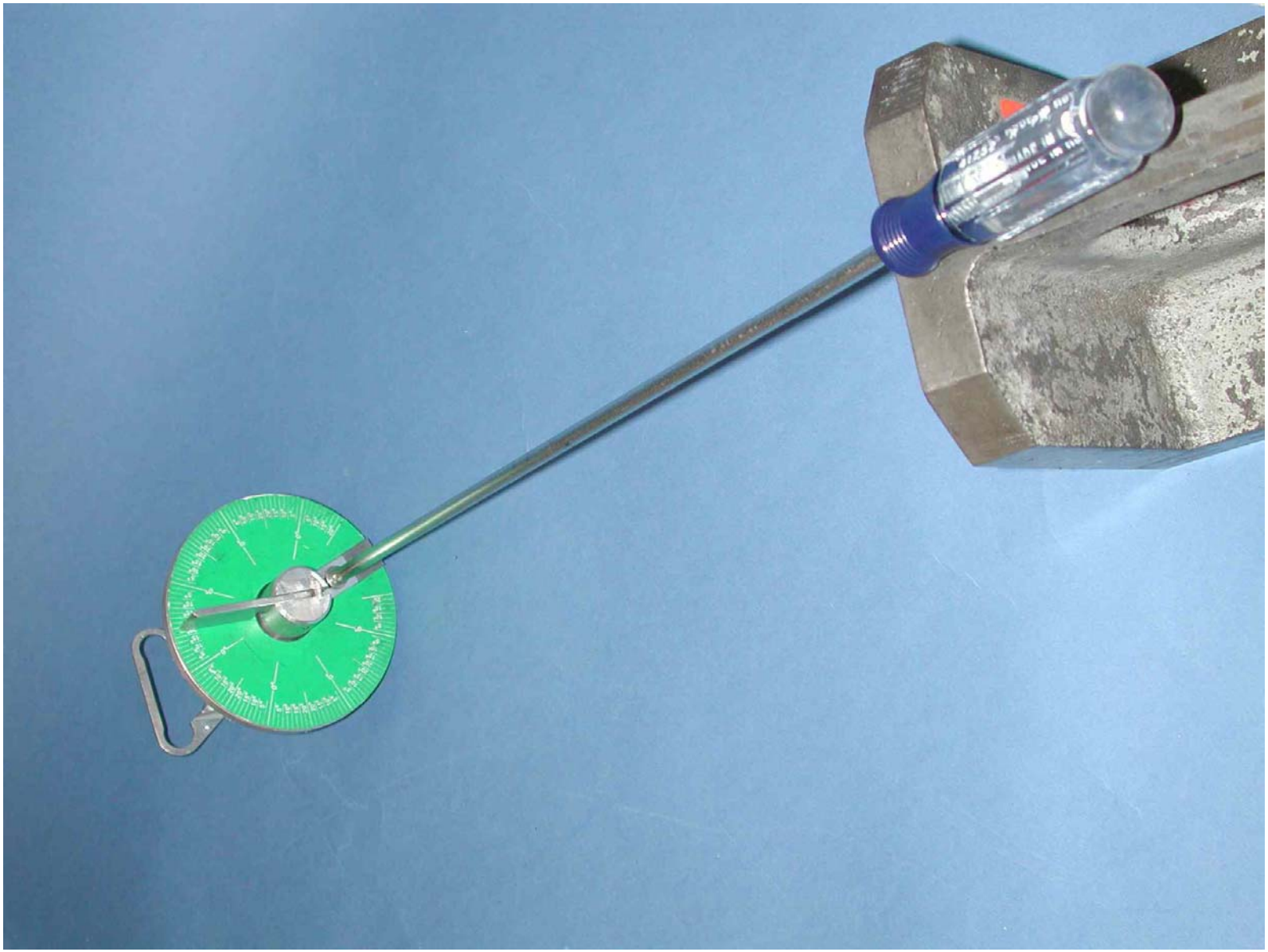
Turbulator



Turbulator Clocking Tool

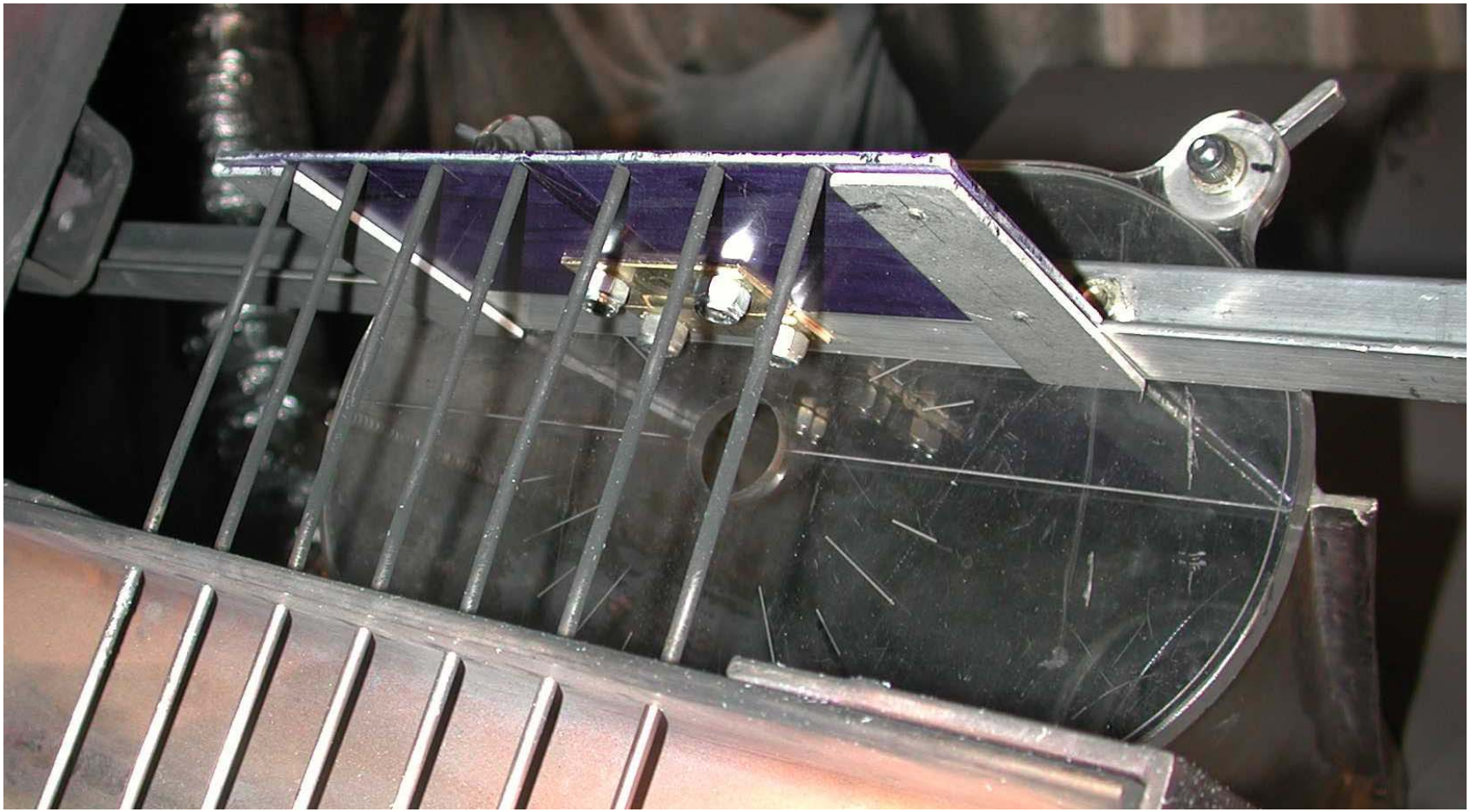


Alternate Turbulator Clocking Tool



Adjustment of Thermocouple Rake Position W-R-T Burner

Setting Thermocouple Rake Position Using Drop-Down Tool



Adjustment of Calorimeter Position W-R-T Burner

Aligning Calorimeter Using Scribes on Drop-Down Tool

Methodology (2): Ensure proper calibration and test techniques by visiting labs and witnessing actual calibration and burnthrough tests.

Lab 1

Igniter flange not sealed

Fuel rail too short, preventing proper nozzle depth

Thermocouple rake and calorimeter rake not properly oriented, resulting in burner cone at obscure angle when performing calibration

Poor burner mounting, producing instability

Center of test frame not aligned with center of burner cone

Test frame formers reversed

Direct visual observation of blankets not possible

Lab 2

Rear faceplate not sealed

Shutter-style air damper installed on end of intake hose; OEM damper removed

Top of center vertical former cut on angle, not square

Lab overall very organized

Lab 3

Incorrect fuel nozzle (previous to inspection)

Incorrect blower fan (previous to inspection)

Incorrect internal stator

Incorrect warm-up/calibration procedure (must be 2 individual events)

Igniter flange not sealed

Direct visual observation of blankets not possible

Excessively long igniter wires, wrapped around fuel rail

Overall lab very organized, equipment in excellent condition

Lab 4

Poor burner mounting, producing instability

Incorrect location of test stand, calorimeter, and thermocouple rake with reference to burner

No detents on rotation mechanism; proper position with regard to test frame, thermocouples, and calorimeter not possible

Loose thermocouple mounting bracket; impossible to properly set thermocouple location

Test frame welded together, not bolted, resulting in severe warpage

Incorrect fuel nozzle

Incorrect fuel flowrate

Lab 4 (con't)

Calorimeter face carbon build-up, resulting in incorrect readings

Test chamber crosswind

Incorrect warm-up/calibration procedure (must be 2 individual events)

Backface calorimeters not perpendicular to test frame

Intake hose coiled up, possibly affecting accuracy of intake air measurement

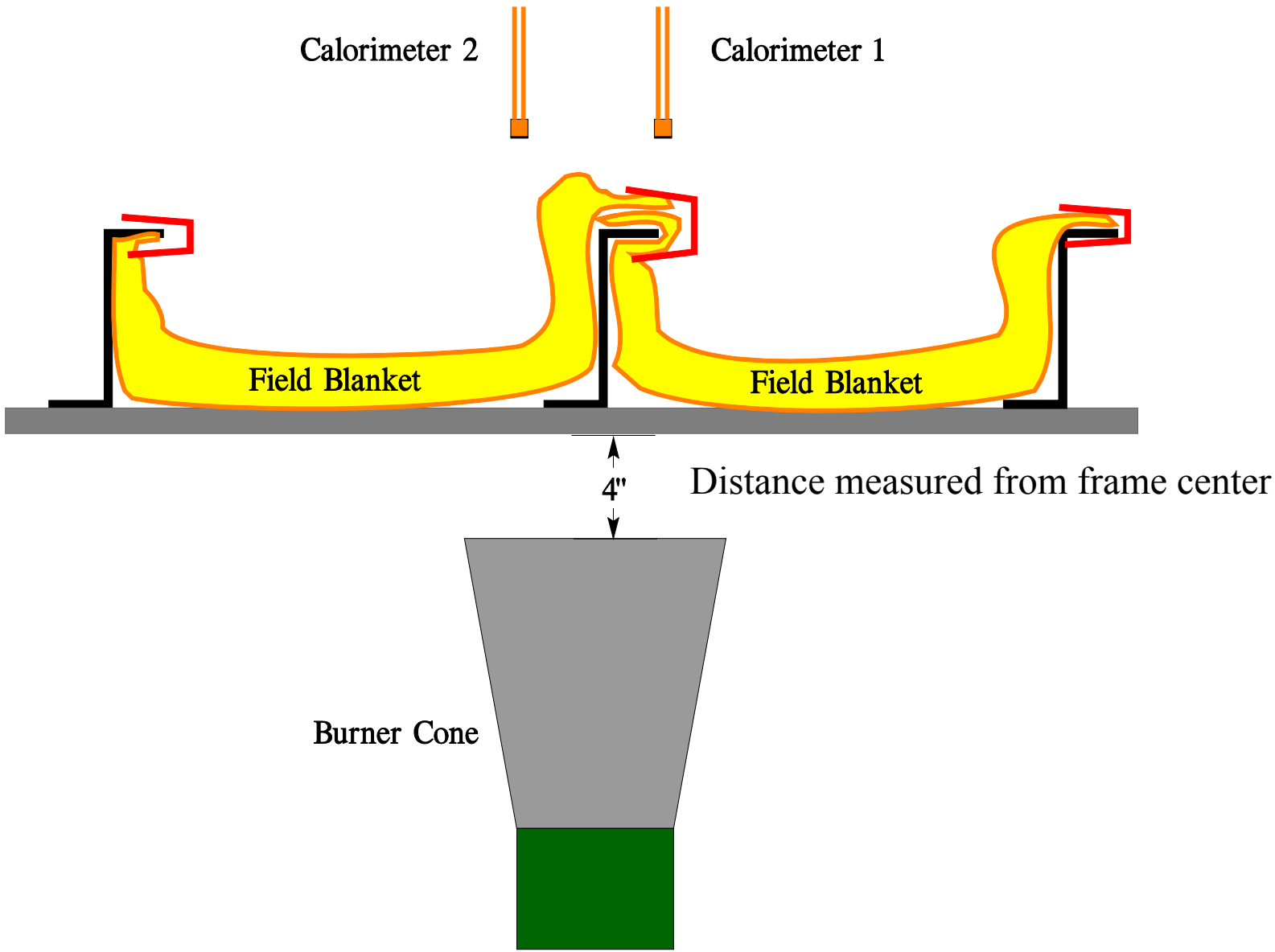
Direct visual observation of blankets not possible

No fuel filter

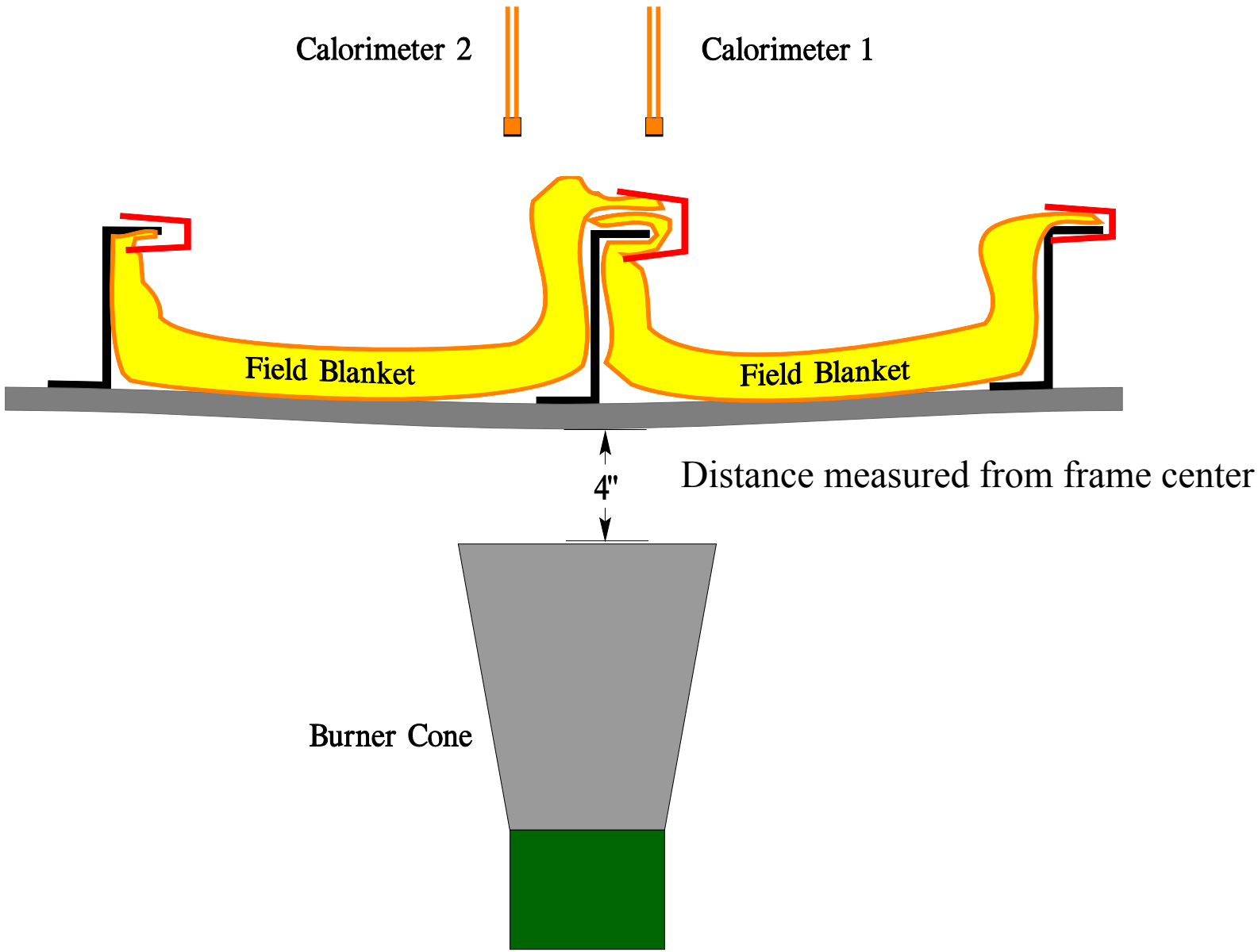
FAA Lab

Incorrect location of test stand, calorimeter, and thermocouple rake with reference to burner

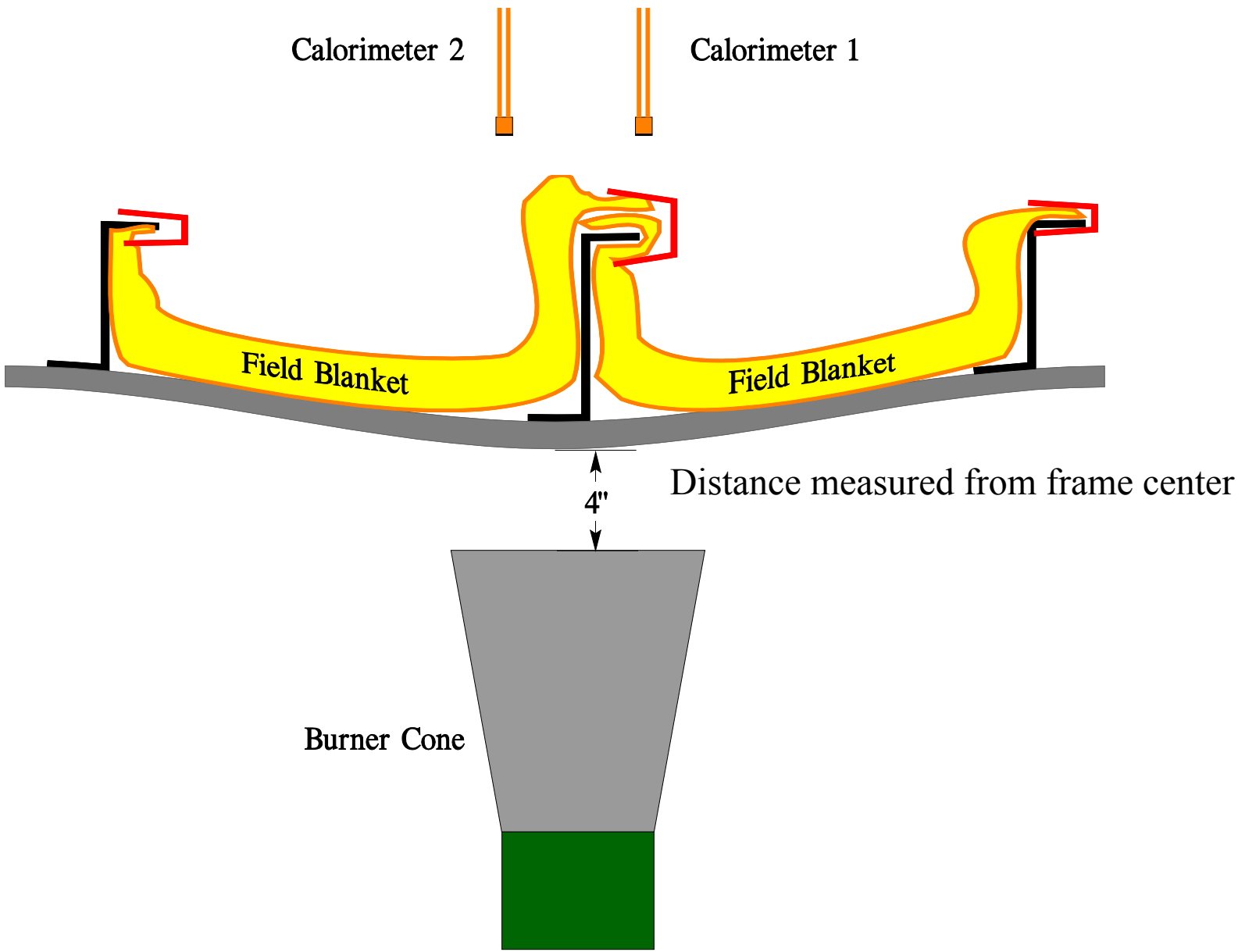
FAA Lab


Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
4"
Distance measured from frame center
Burner Cone

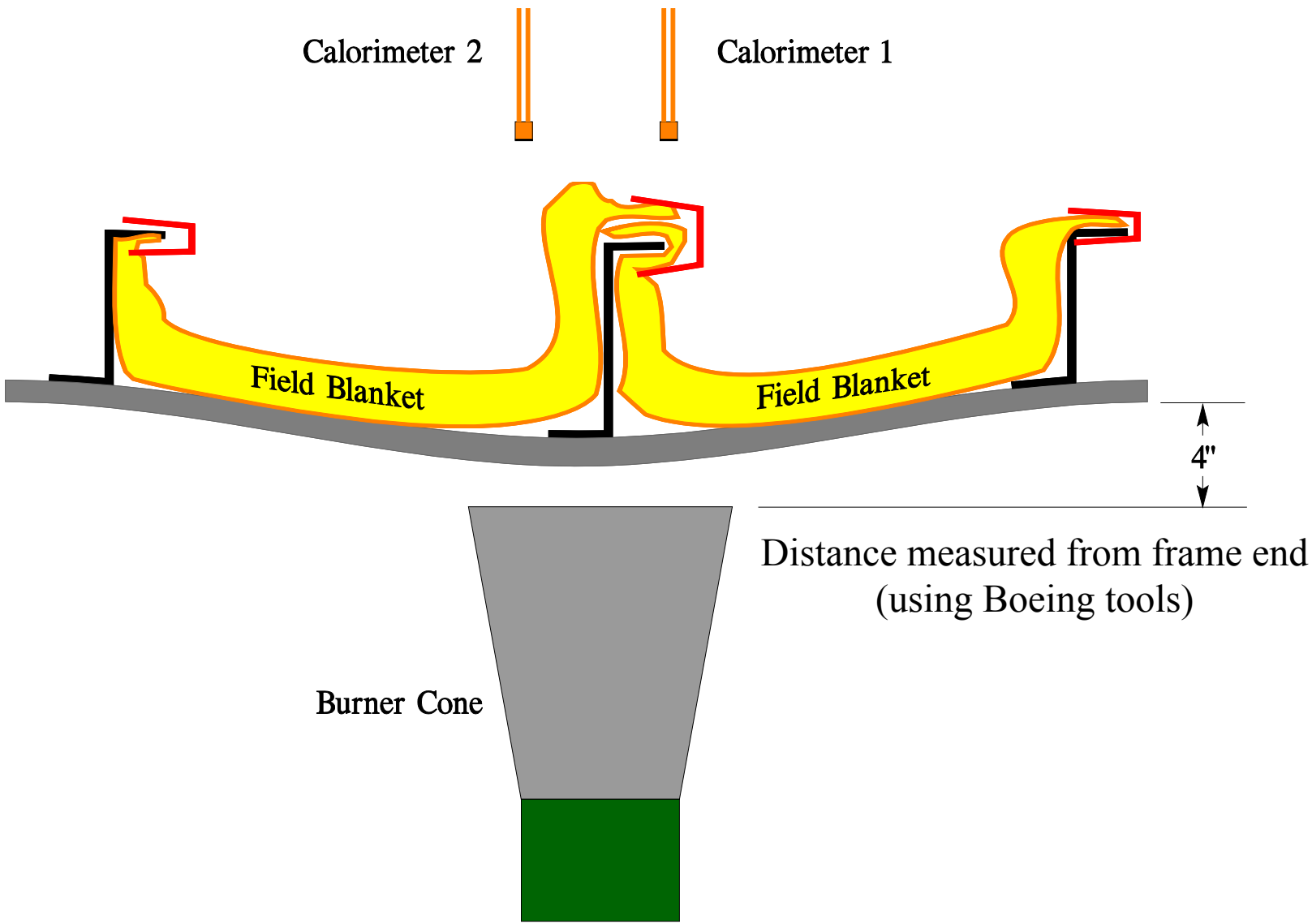
FAA Lab


Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
4"
Distance measured from frame center
Burner Cone

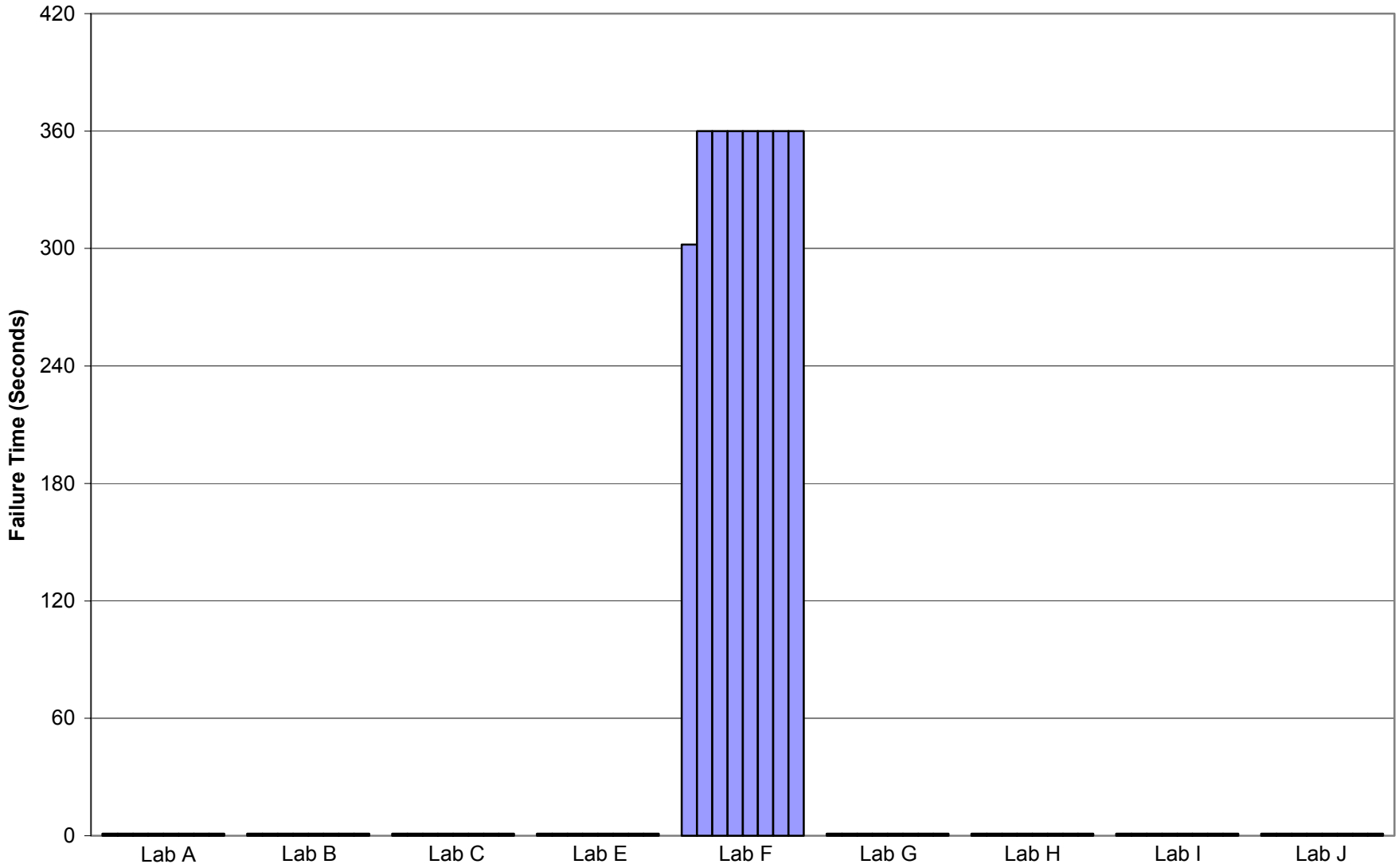
FAA Lab

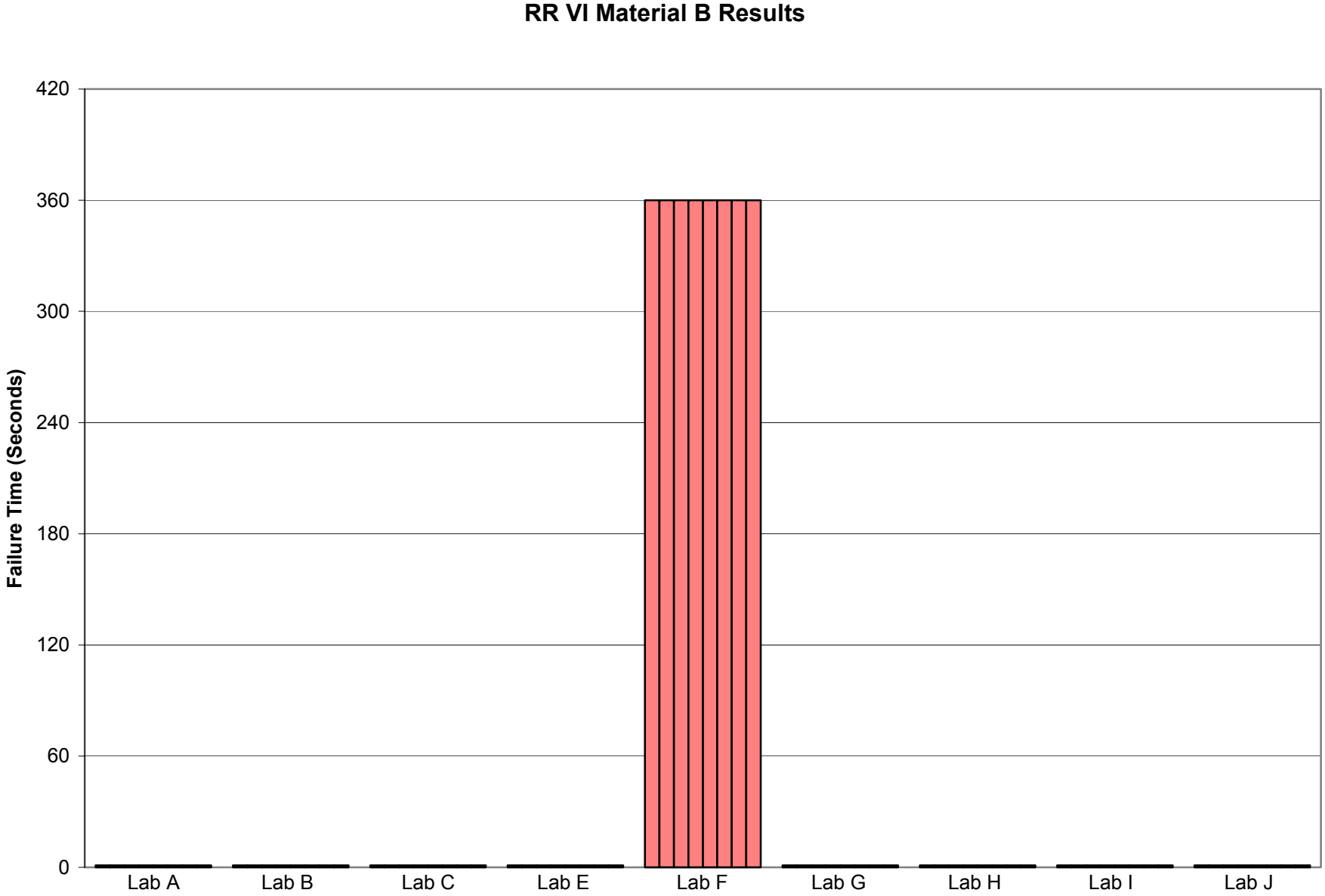

Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
4"
Distance measured from frame center
Burner Cone

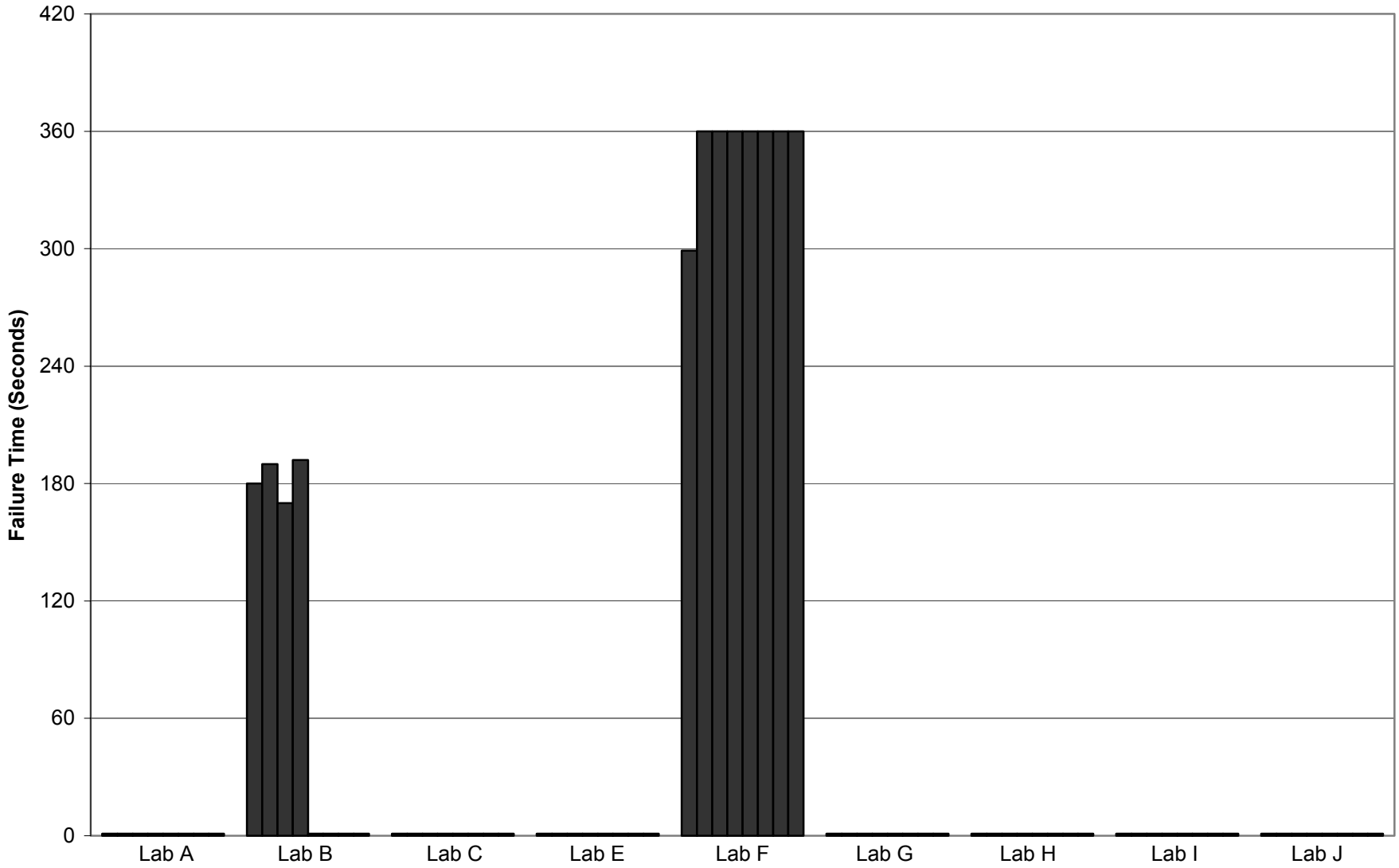
FAA Lab


Calorimeter 2
Calorimeter 1
Field Blanket
Field Blanket
4"
Distance measured from frame end
(using Boeing tools)
Burner Cone

Methodology (3): Prepare and test identical samples (i.e., RR VI)


RR VI Material A Results
Failure Time (Seconds)
420
360
300
240
180
120
60
0
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J


RR VI Material B Results
Failure Time (Seconds)
420
360
300
240
180
120
60
0
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J


RR VI Material C Results
Failure Time (Seconds)
420
360
300
240
180
120
60
0
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

Summary

Specialized tools extremely helpful in properly setting up equipment.

Several labs still have additional work to bring their equipment into compliance.

Better analysis to be made once all RR data is in.

FAA and Boeing Lab still not equal in terms of burnthrough times.

Draft Tube Differences??

Igniter Wire Impact??