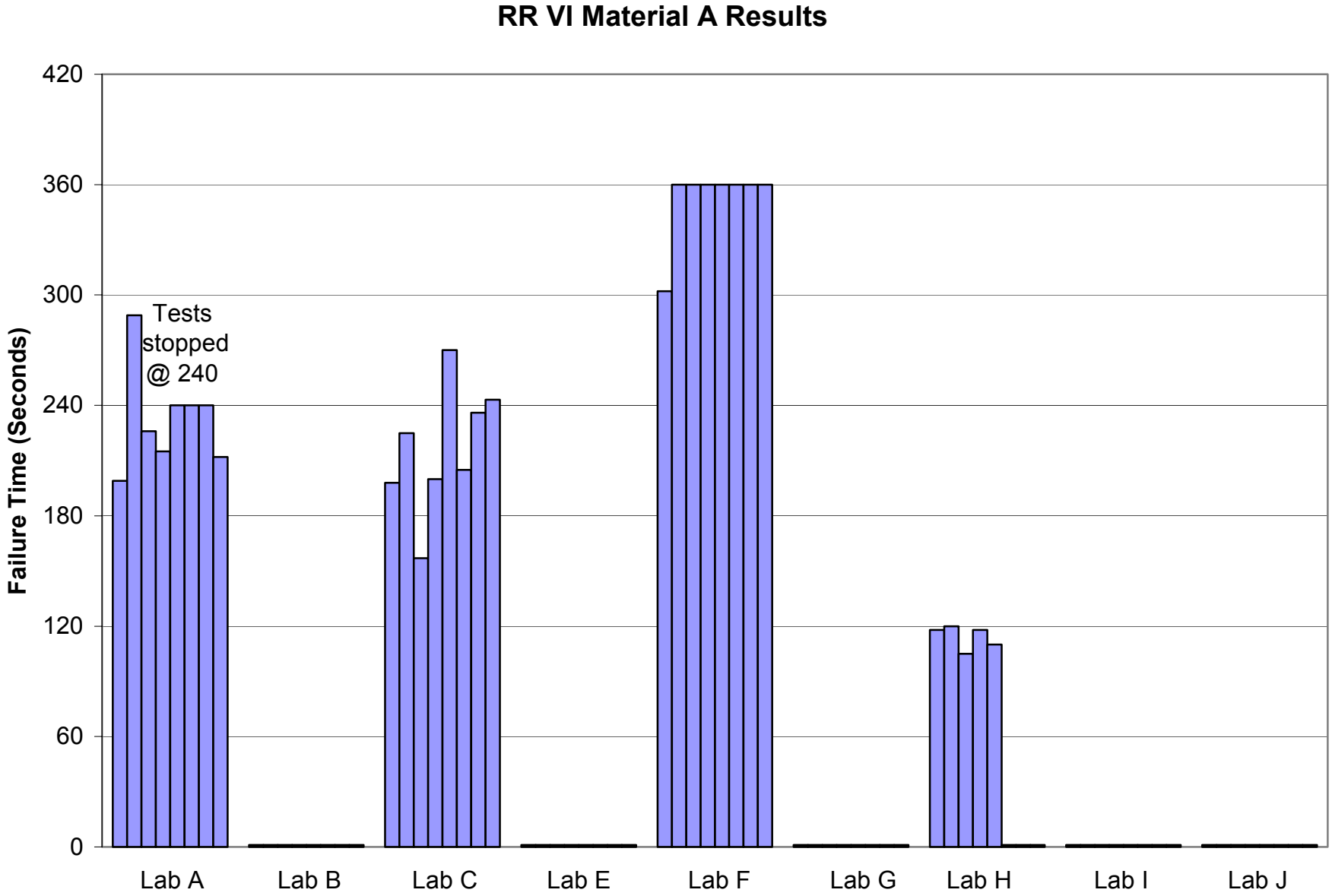
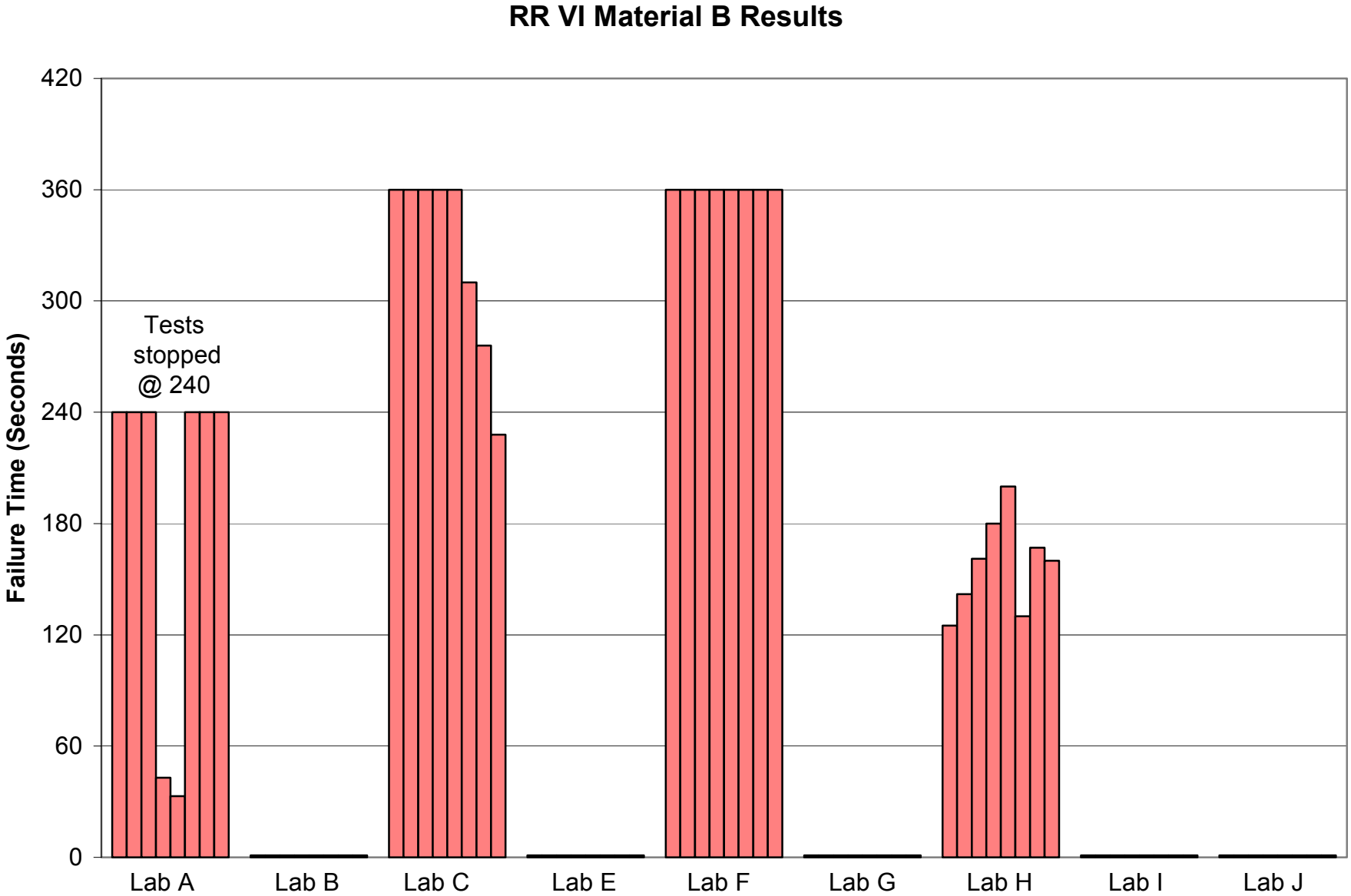
Discussion of Burnthrough Test Method for Aircraft Thermal Acoustic Insulation Blankets

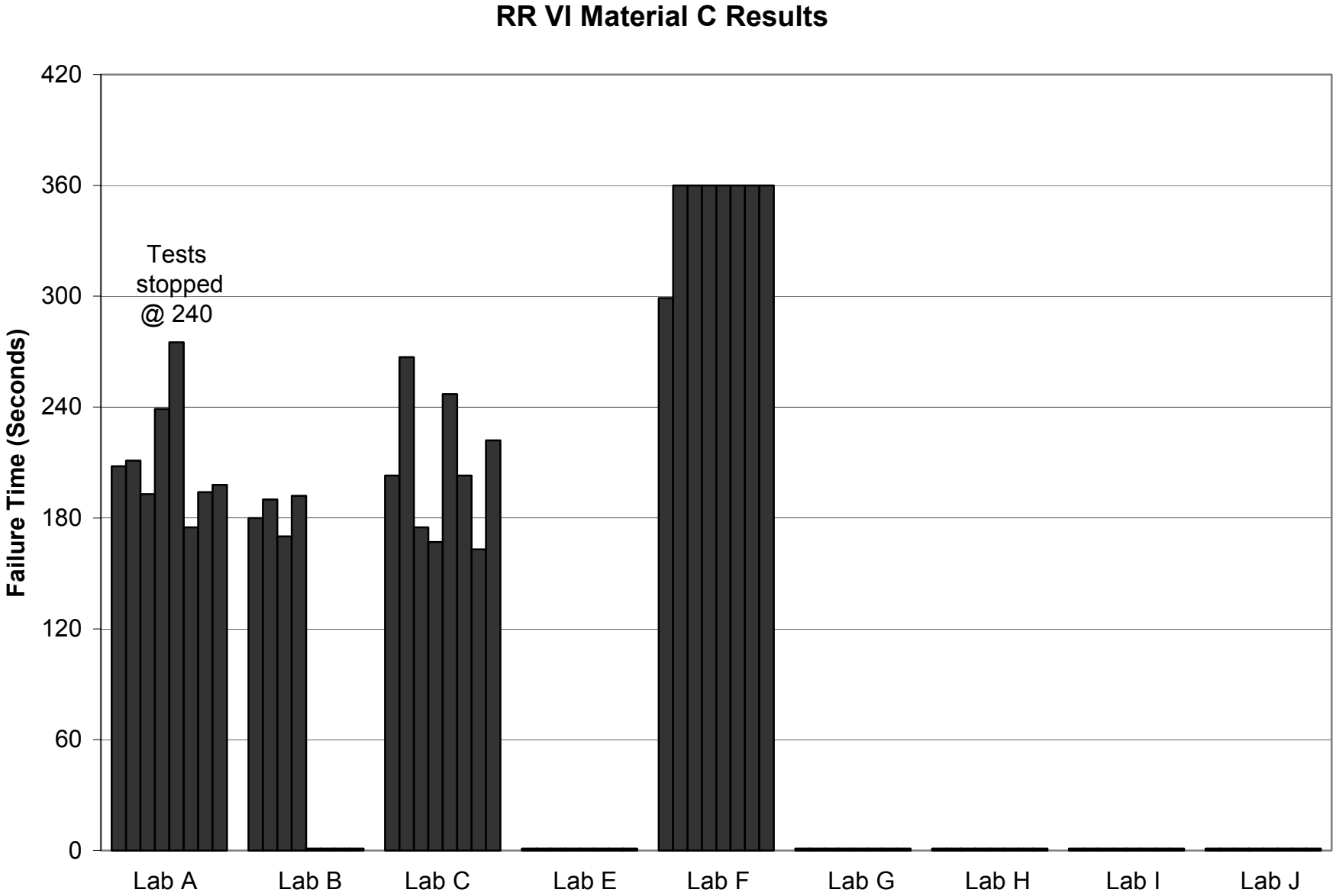
Tim Marker

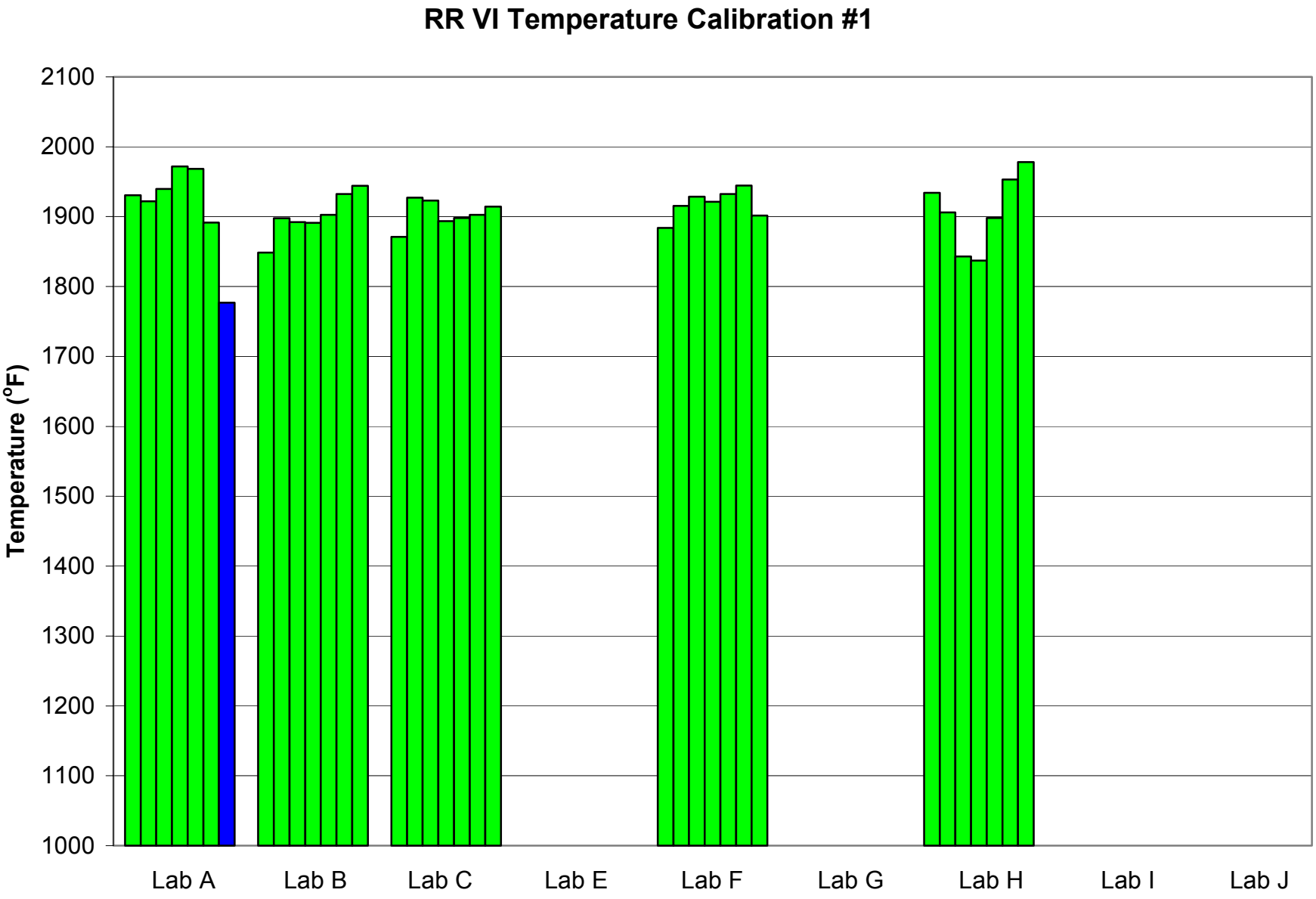
FAA Technical Center

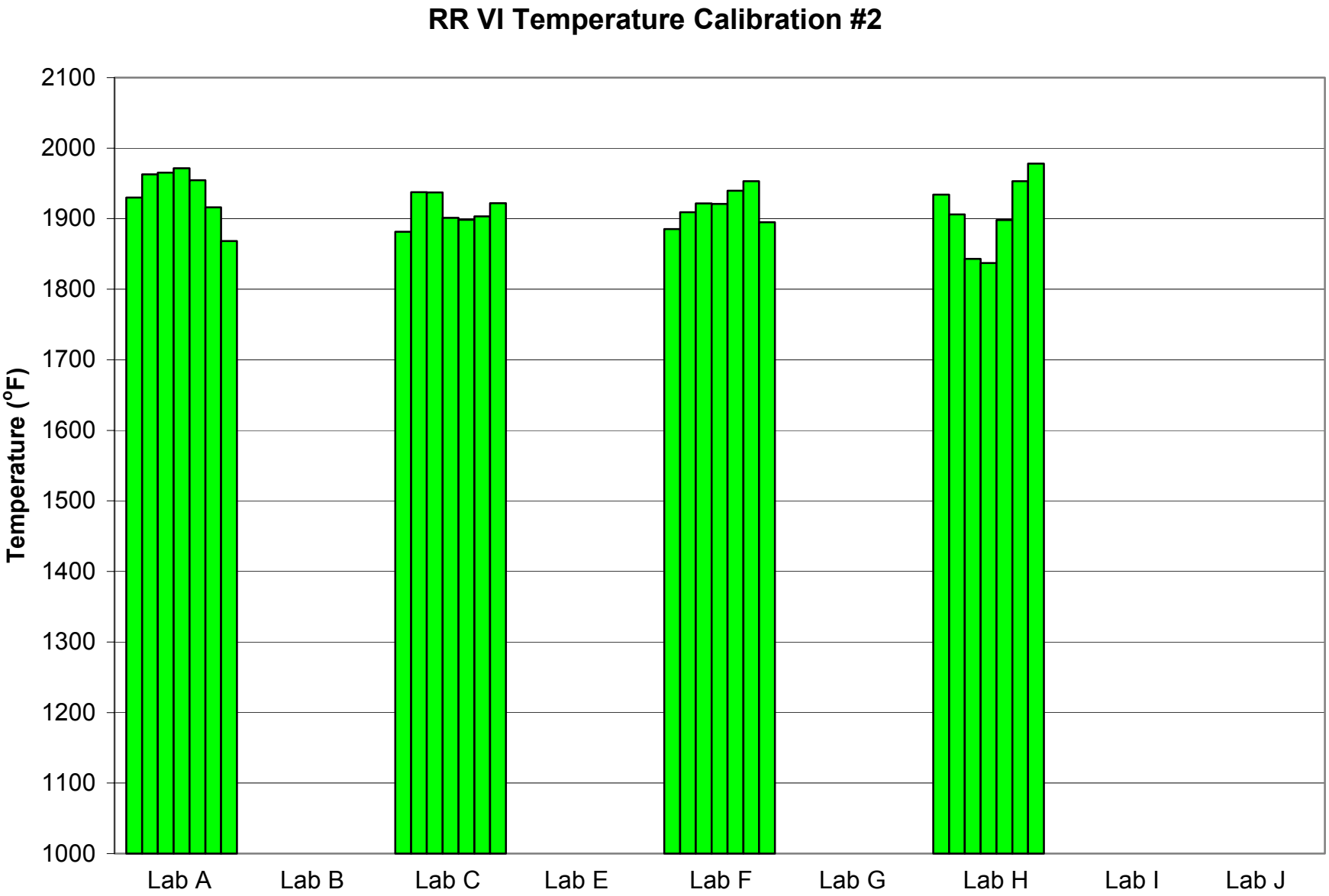
Round Robin VI Data

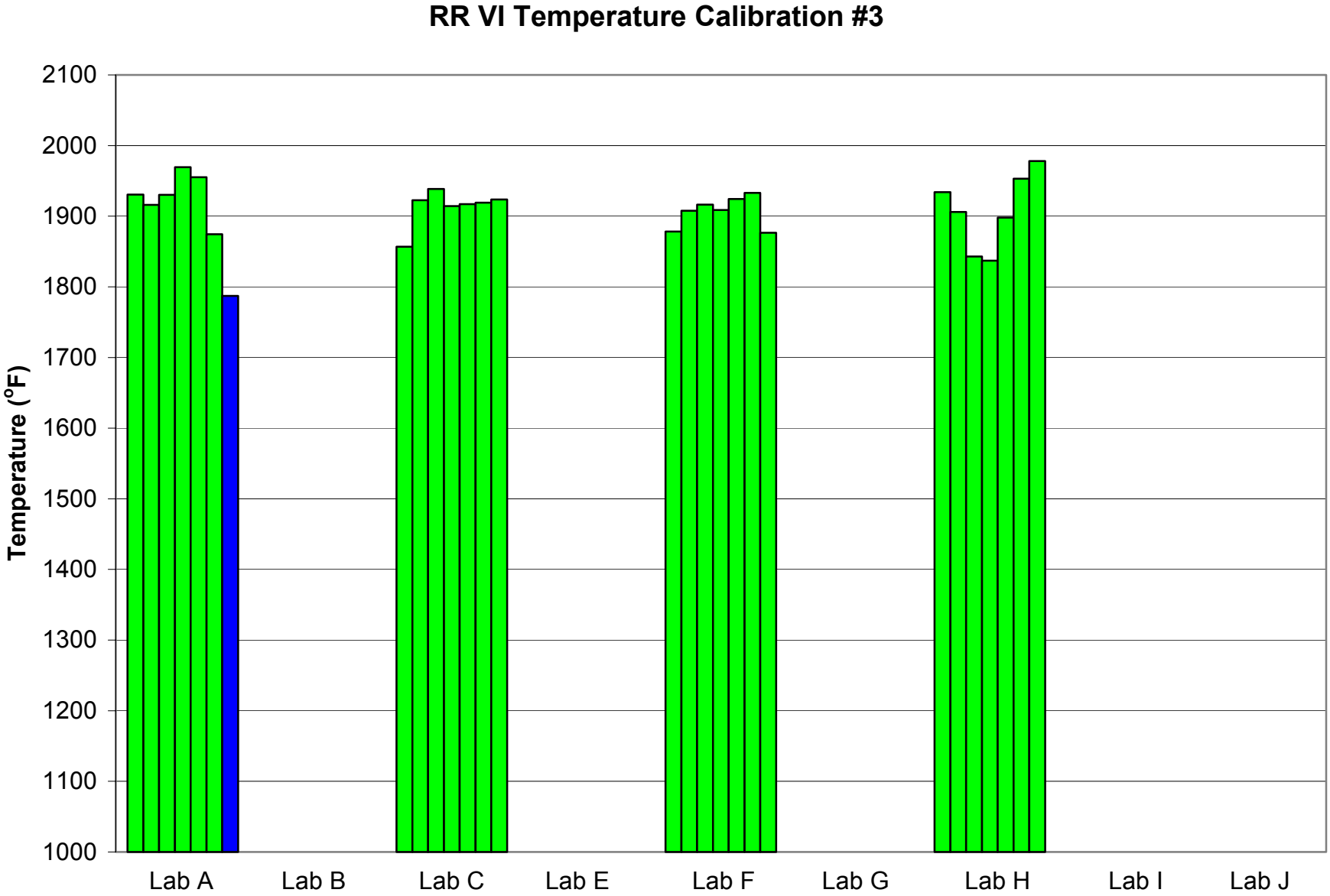

RR VI Material A Results
Failure Time (Seconds)
420
360
300
240
180
120
60
0
Tests stopped @ 240
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

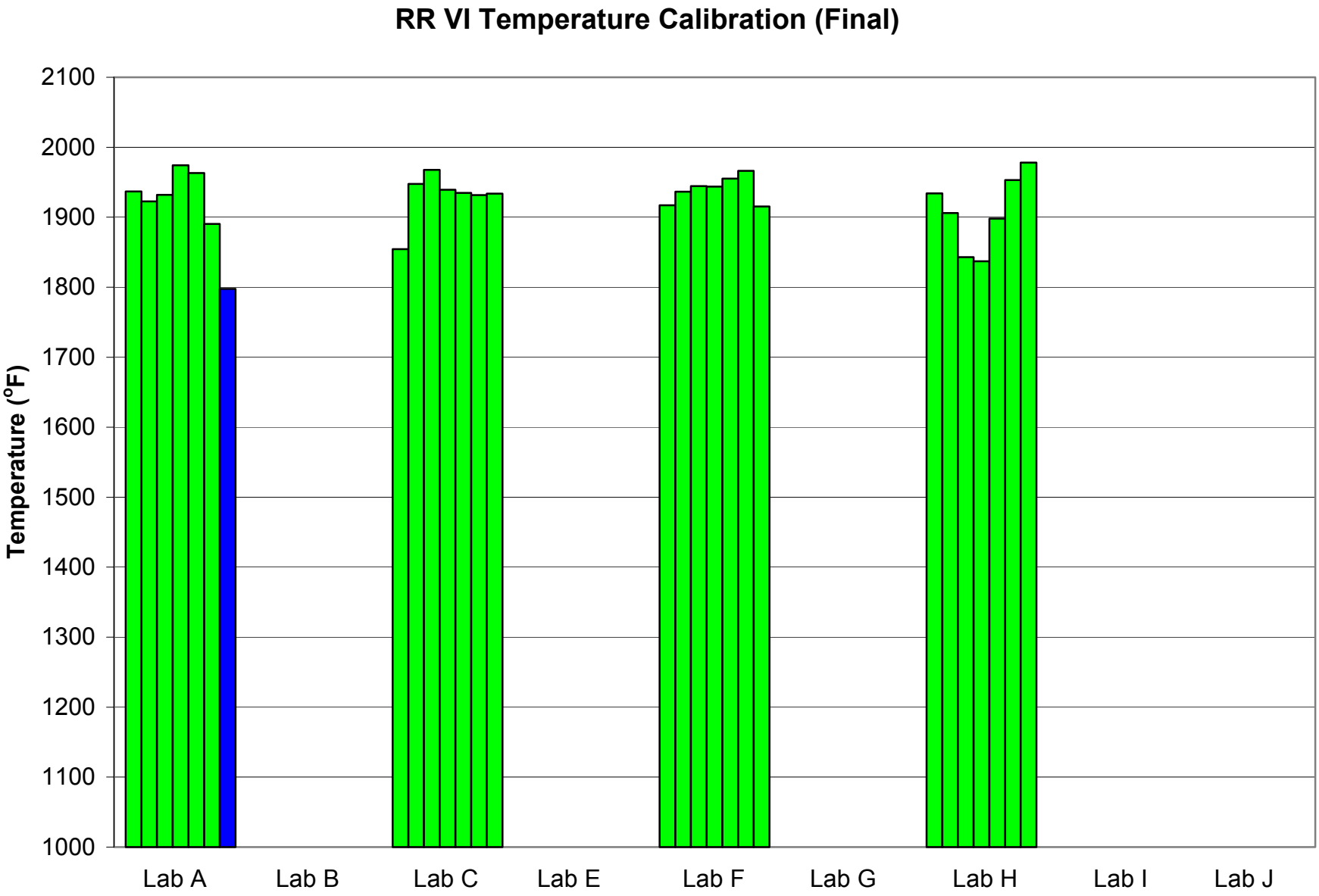

RR VI Material B Results
Failure Time (Seconds)
420
360
300
240
180
120
60
0
Tests stopped @ 240
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

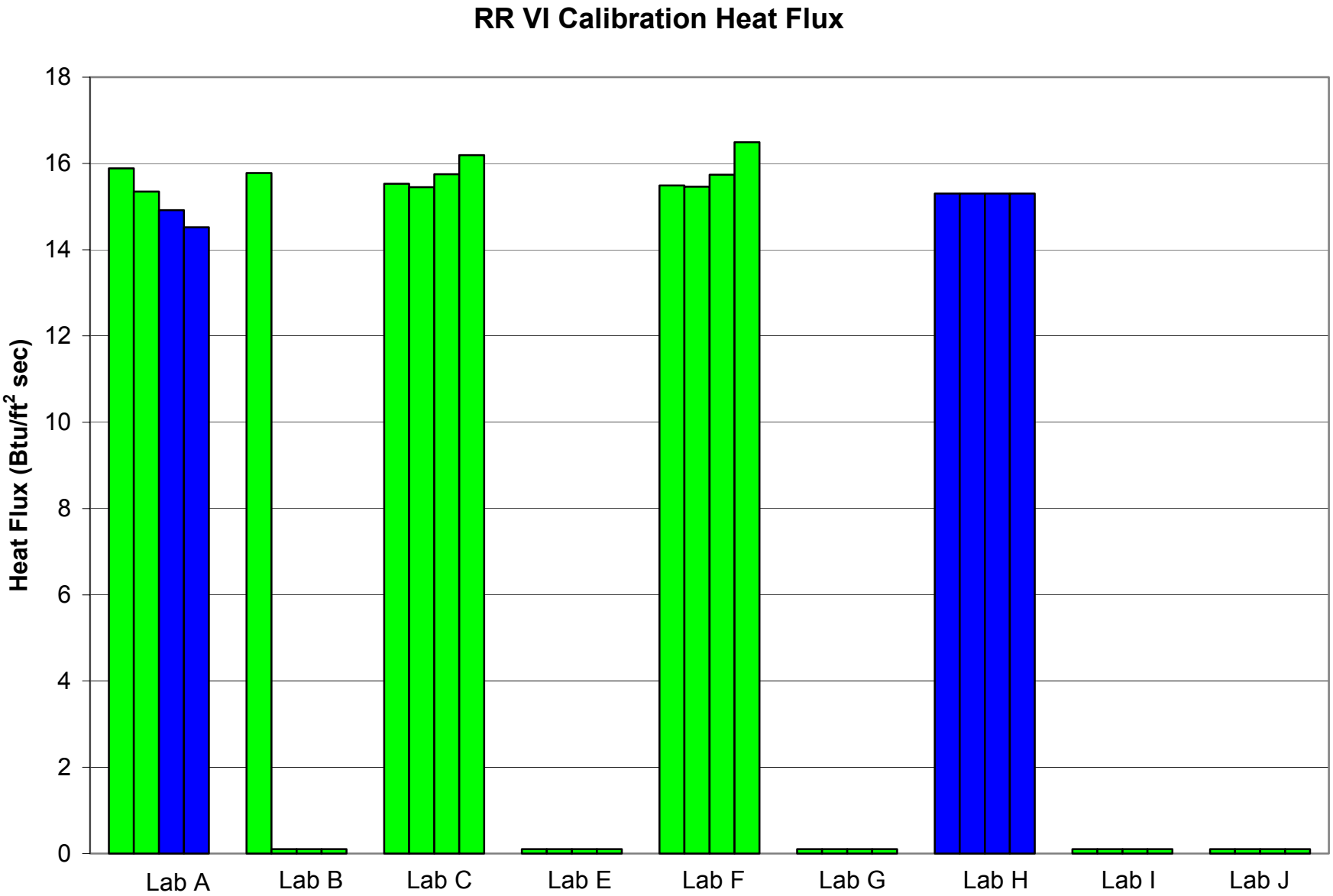

RR VI Material C Results
Failure Time (Seconds)
420
360
300
240
180
120
60
0
Tests stopped @ 240
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J


RR VI Temperature Calibration #1
Temperature (°F)
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

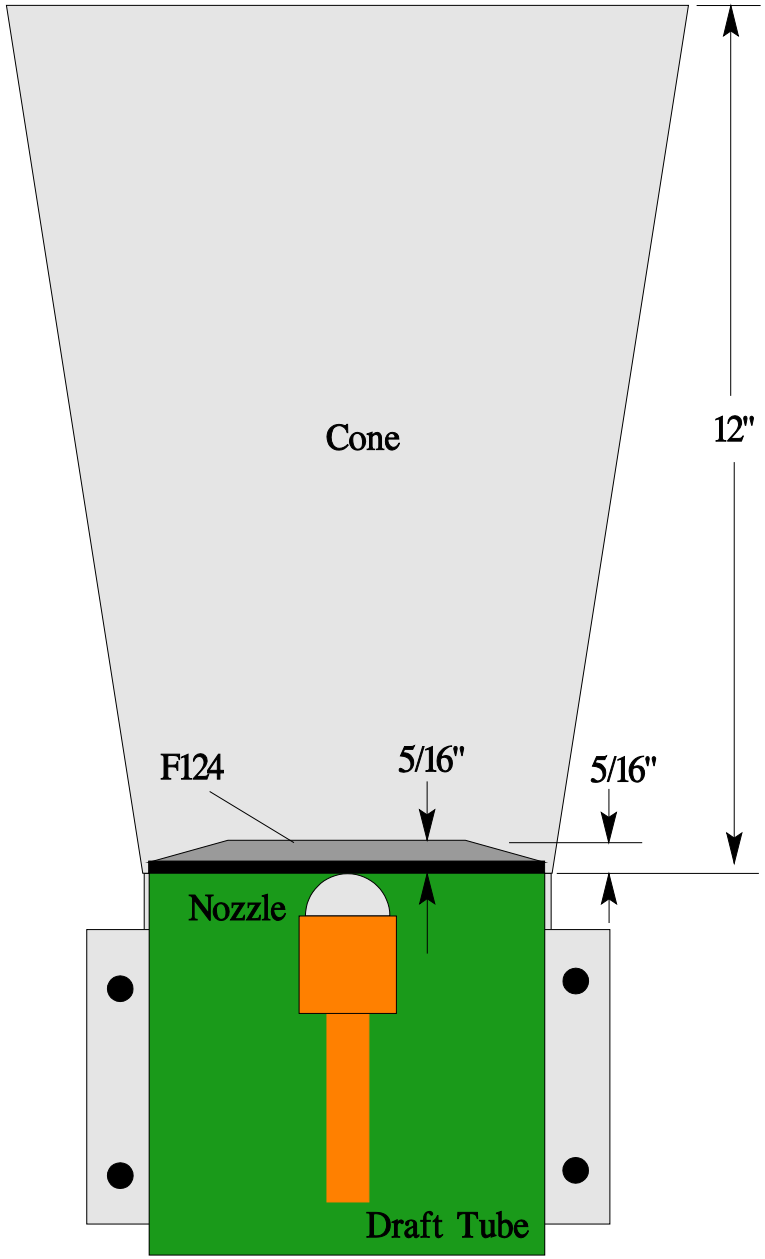

RR VI Temperature Calibration #2
Temperature (°F)
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

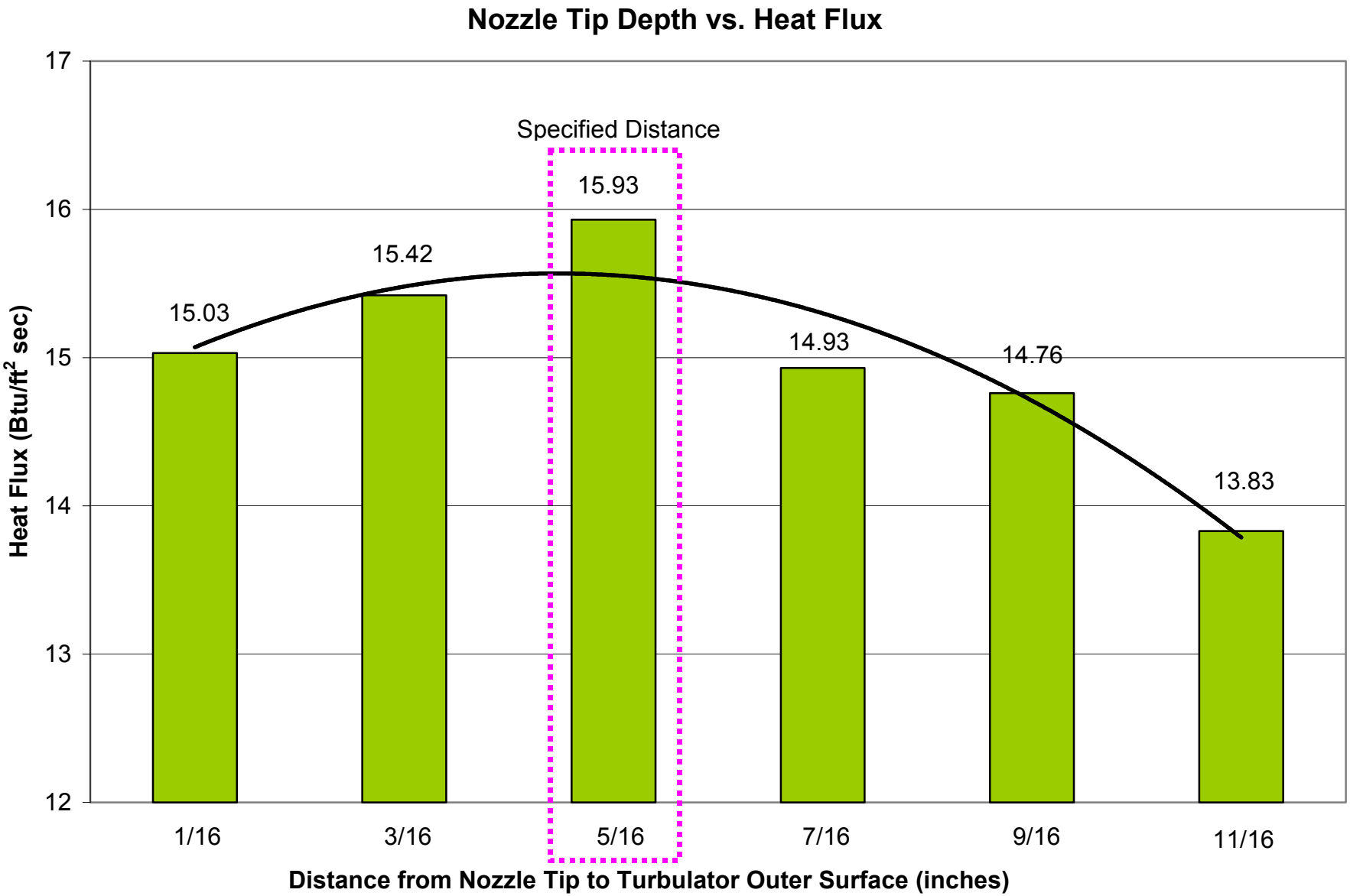

RR VI Temperature Calibration #3
Temperature (°F)
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J


RR VI Temperature Calibration (Final)
Temperature (°F)
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

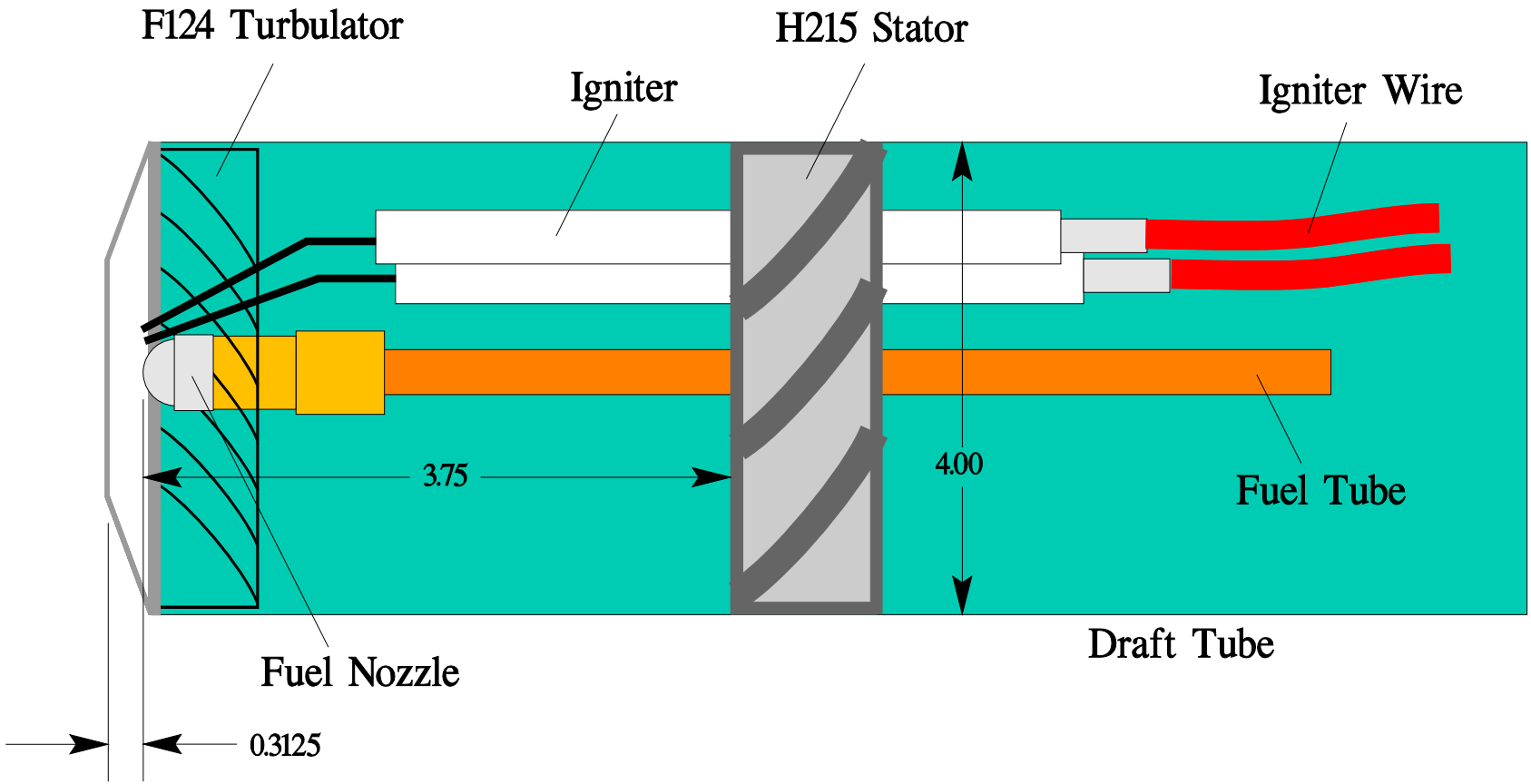

RR VI Calibration Heat Flux
Heat Flux (Btu/ft2 sec)
18
16
14
12
10
8
6
4
2
0
Lab A
Lab B
Lab C
Lab E
Lab F
Lab G
Lab H
Lab I
Lab J

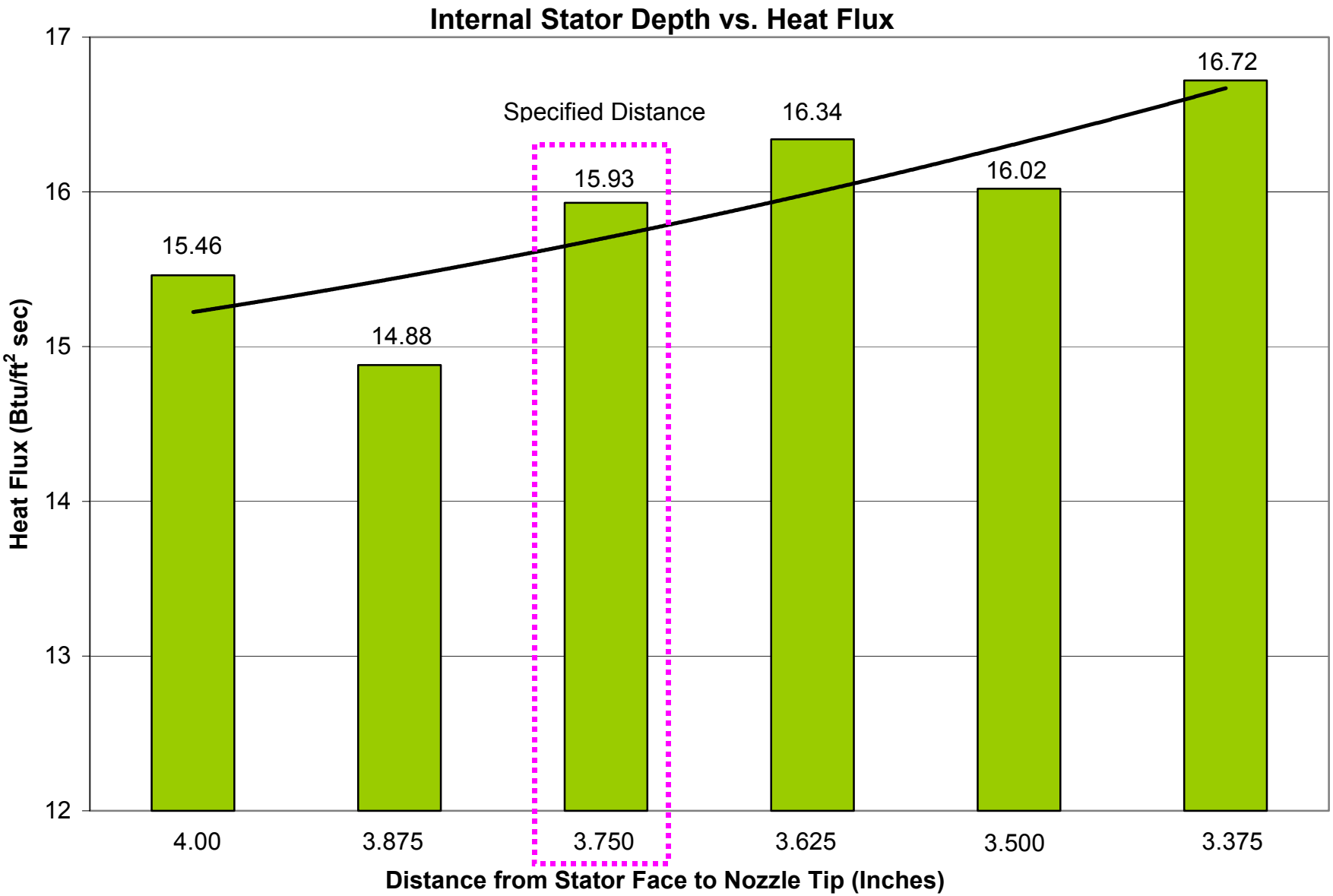
Current Specification for Nozzle Depth

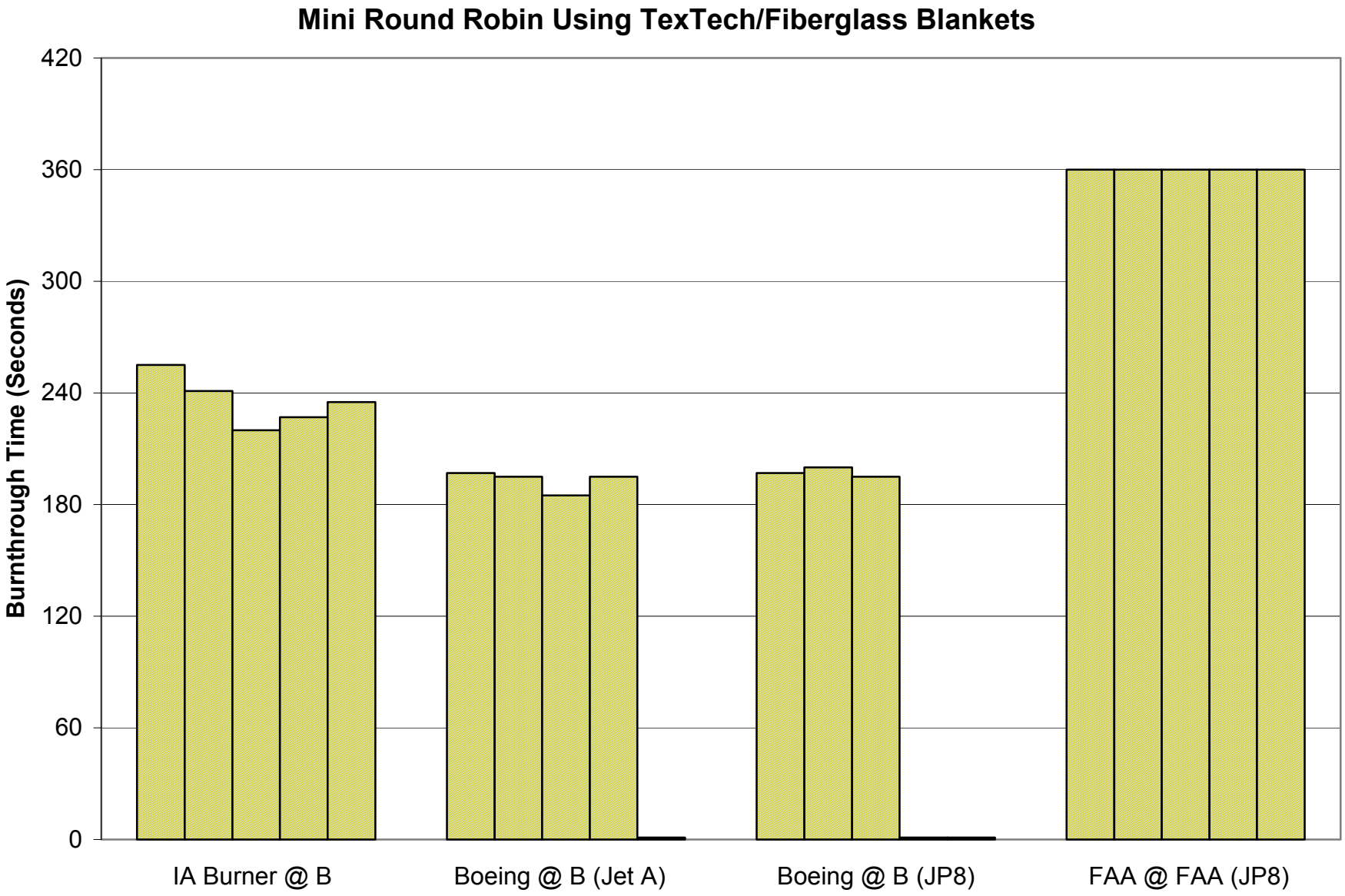



Nozzle Tip Depth vs. Heat Flux
17
16
15
14
13
12
Heat Flux (Btu/ft2 sec)
Specified Distance
15.03
15.42
15.93
14.93
14.76
13.83
1/16
3/16
5/16
7/16
9/16
11/16
Distance from Nozzle Tip to Turbulator Outer Surface (inches)

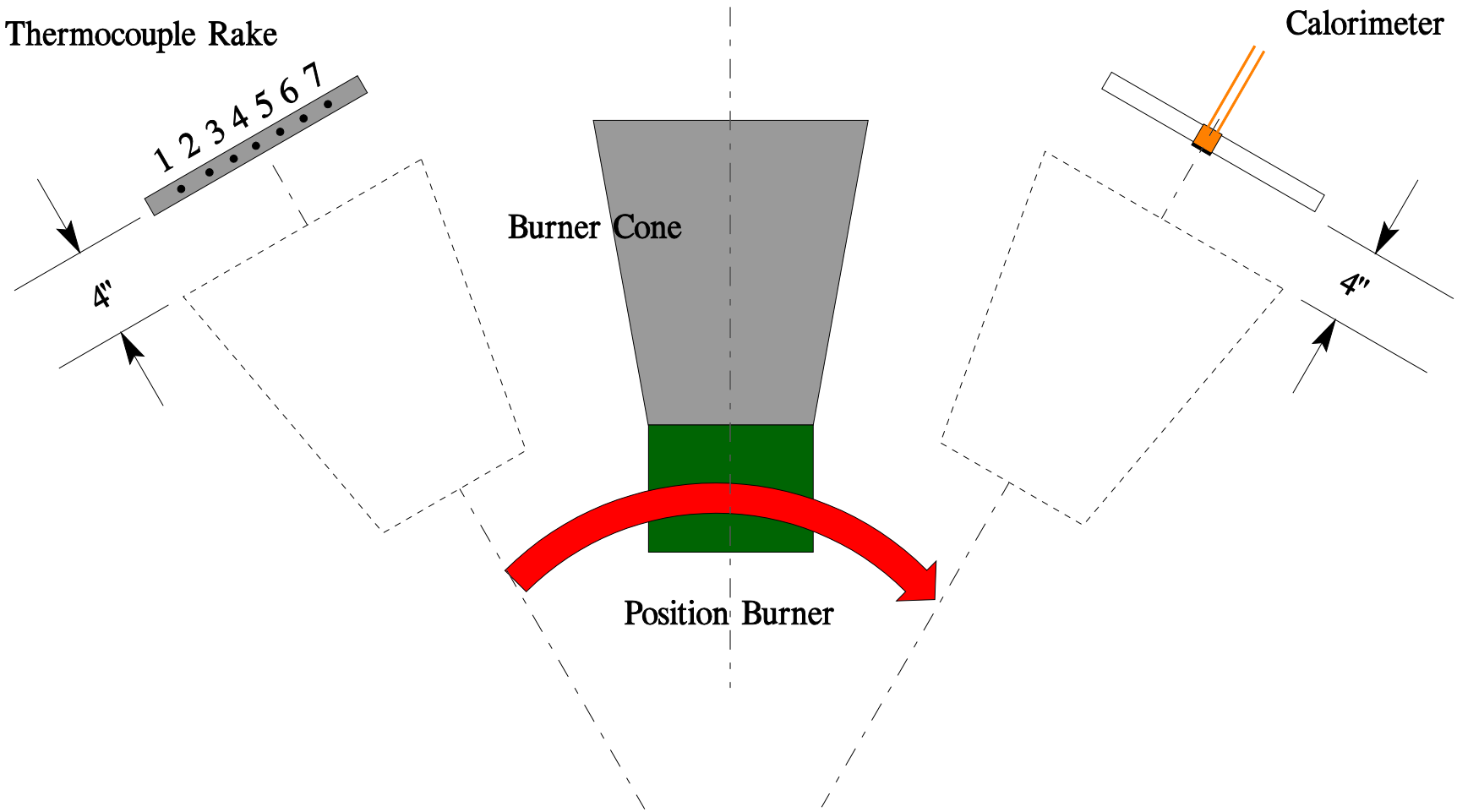
Current Specification for Stator Position



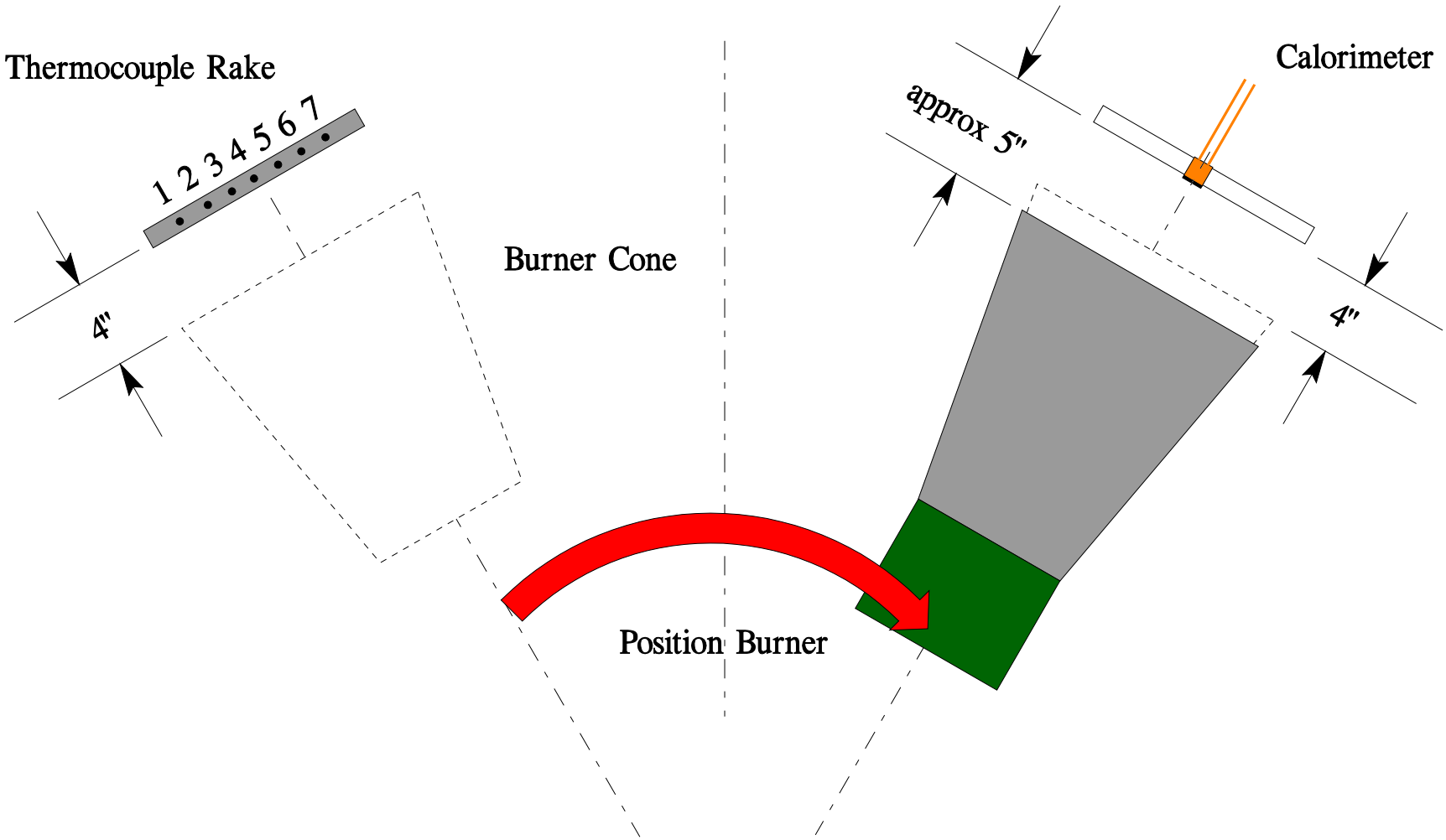

Internal Stator Depth vs. Heat Flux
Heat Flux (Btu/ft2 sec)
17
16
15
14
13
12
15.46
14.88
Specified Distance
15.93
16.34
16.02
16.72
4.00
3.875
3.750
3.625
3.500
3.375
Distance from Stator Face to Nozzle Tip (Inches)


Mini Round Robin Using TexTech/Fiberglass Blankets
Burnthrough Time (Seconds)
420
360
300
240
180
120
60
0
IA Burner @ B
Boeing @ B (Jet A)
Boeing @ B (JP8)
FAA @ FAA (JP8)

Boeing Burner at FAA Lab



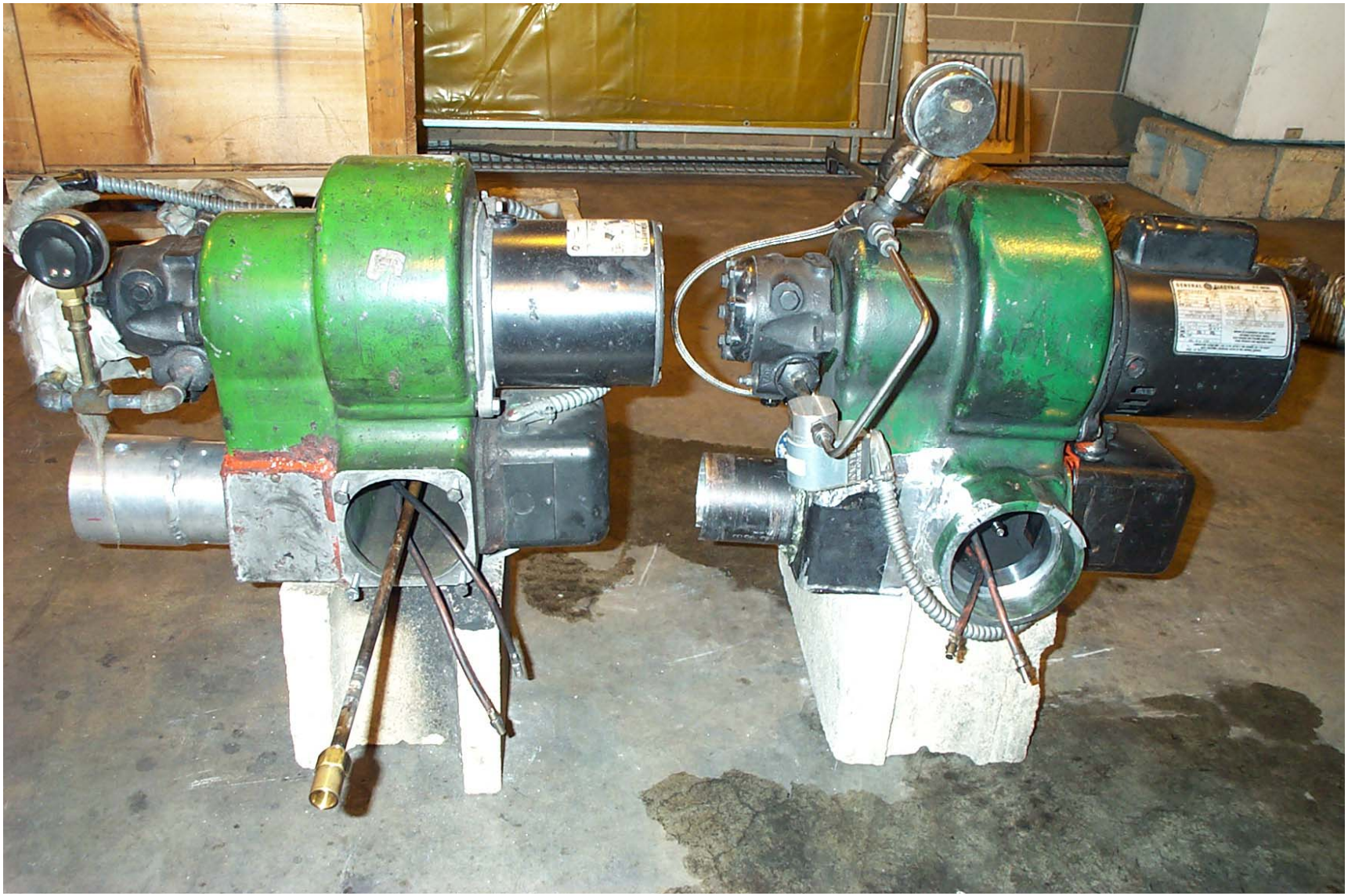
Boeing Burner at FAA Lab



	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

Effect of Different Draft Tube?

Flanged vs. Socket Type Housing



FAA Burner

Flanged-Type

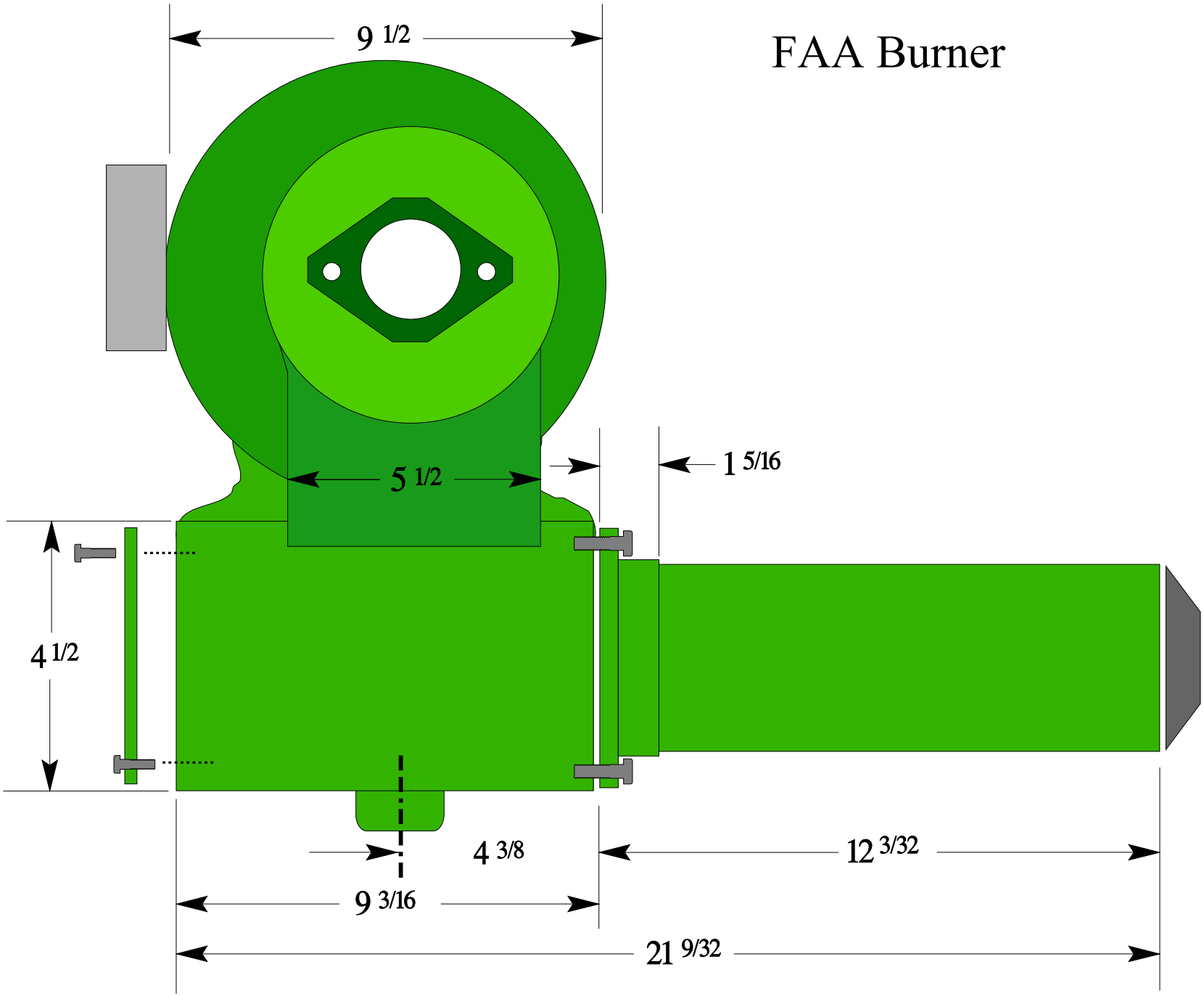
Boeing Burner

Socket-Type

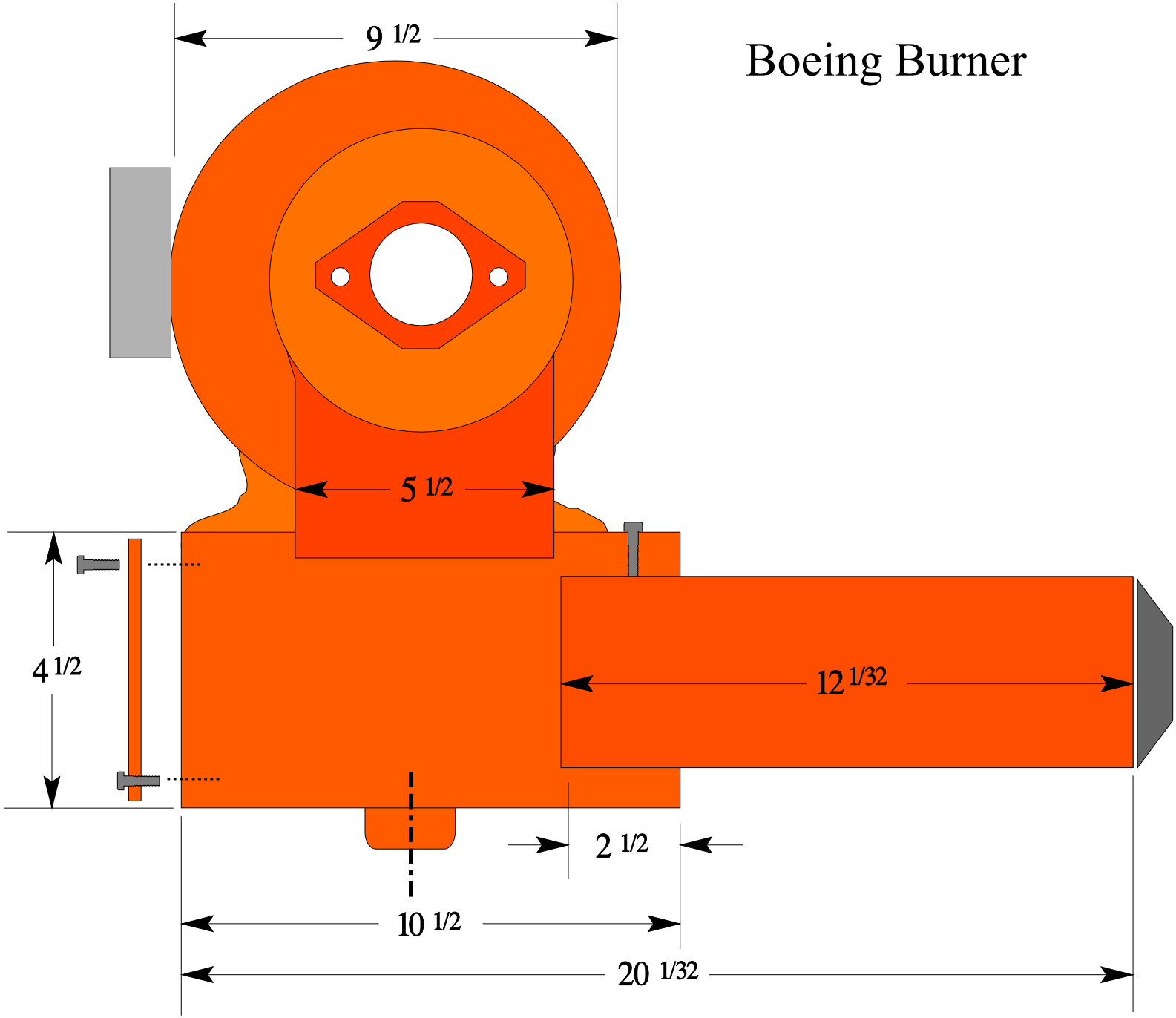
Burner Type

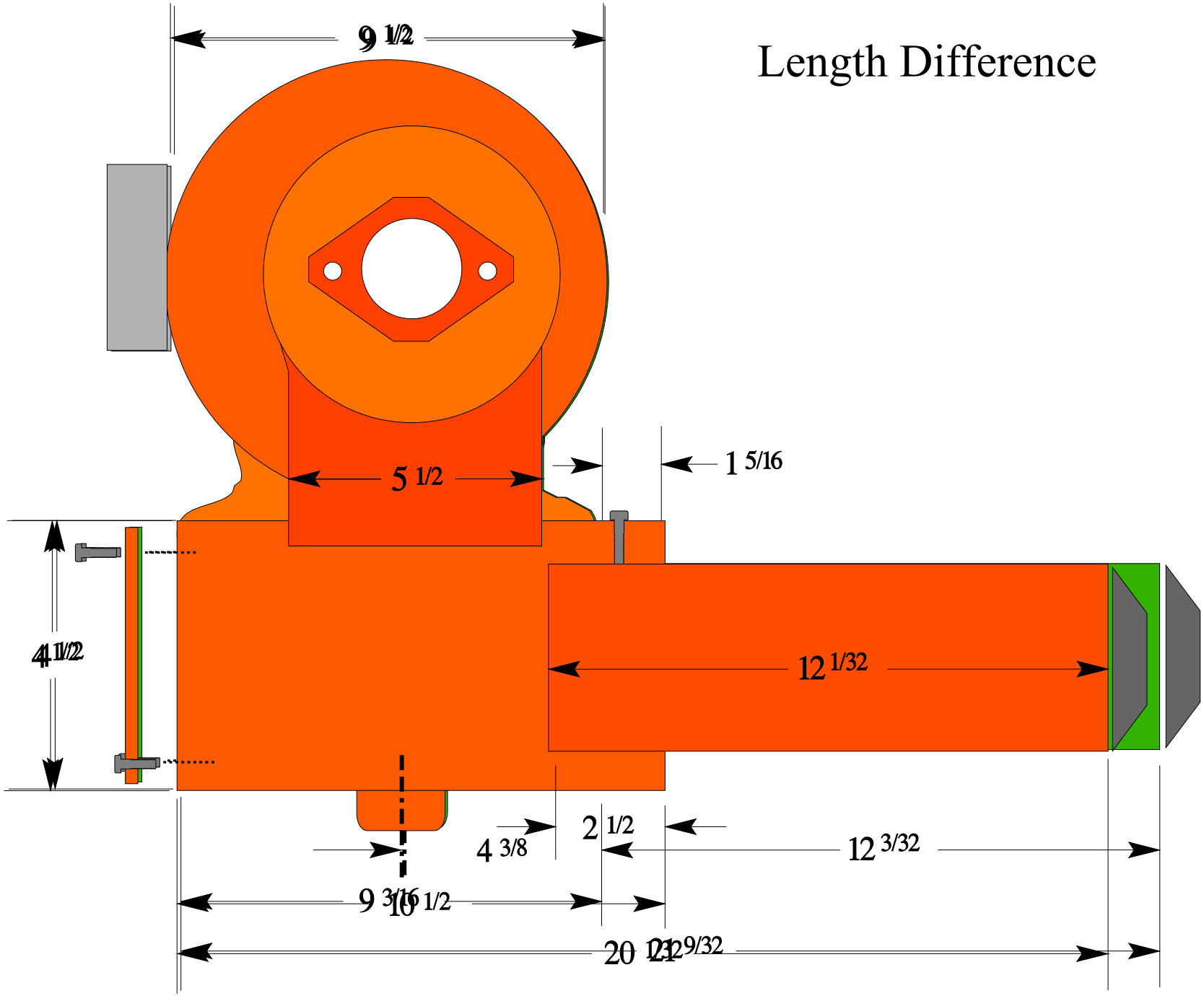
Lab A	Lab B	Lab C	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
Flanged-Type with re-manufactured H215 stator	Socket-Type with re-manufactured H215 stator	Socket-Type with re-manufactured H215 stator	Flanged-Type with re-manufactured H215 stator	Flanged-Type with original H215 stator	Flanged-Type with re-manufactured H215 stator	?	Socket-Type with re-manufactured H215 stator	Socket-Type with re-manufactured H215 stator

FAA Burner

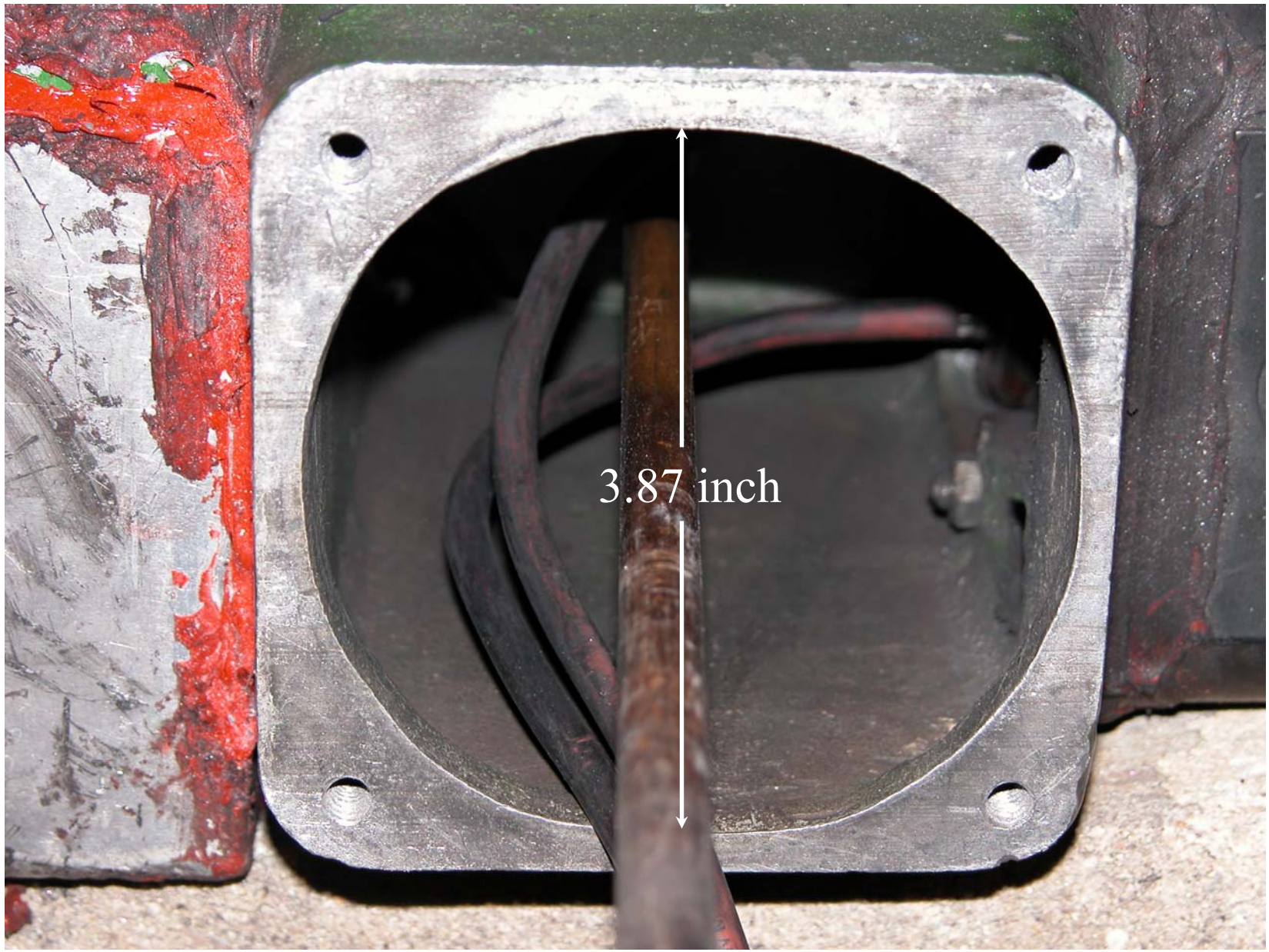


Boeing Burner

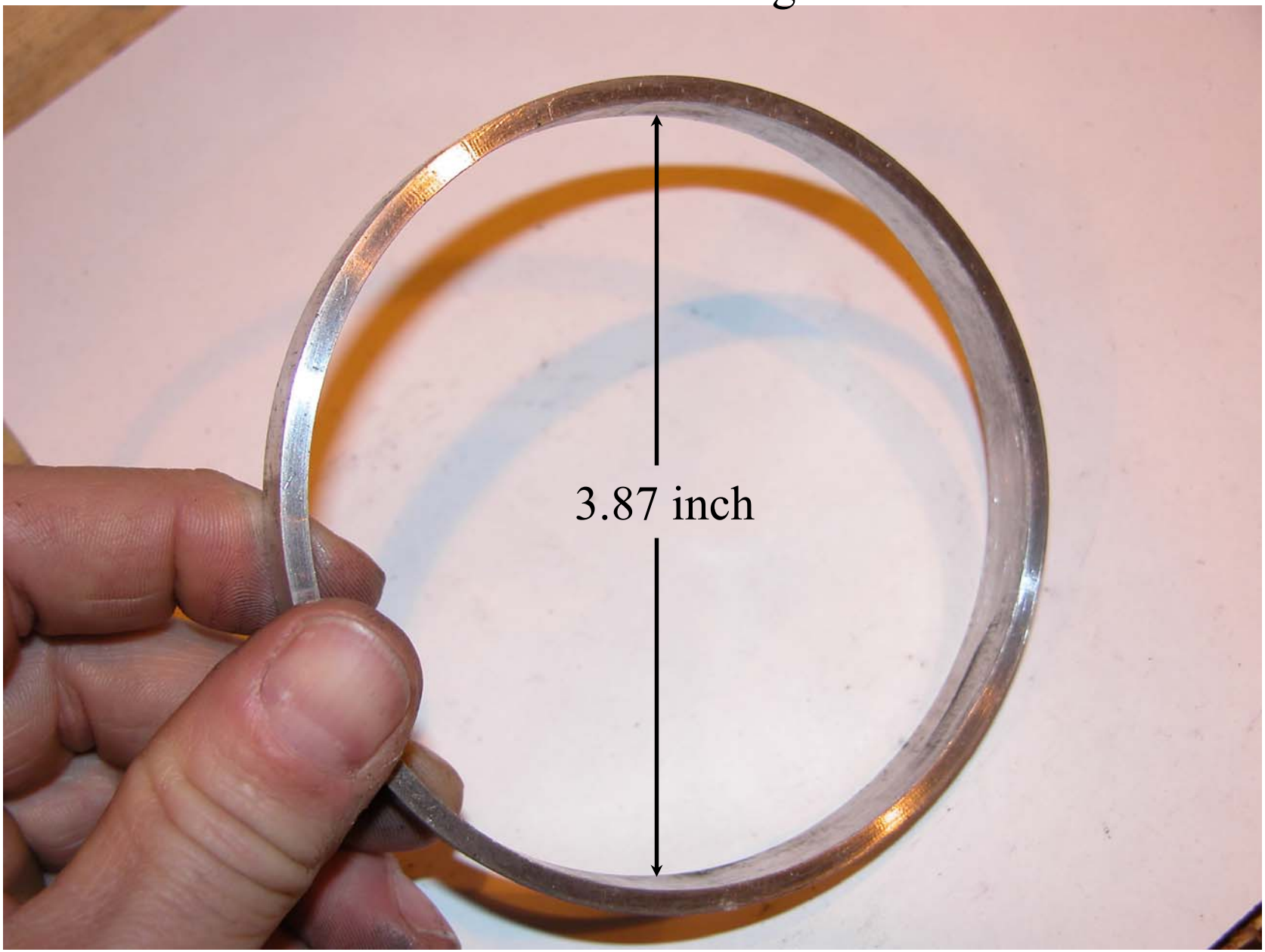



Length Difference
9 1/2
5 1/2
1 5/16
4 1/2
12 1/32
4 3/8
2 1/2
12 3/32
9 3/16
10 1/2
20 23 9/32

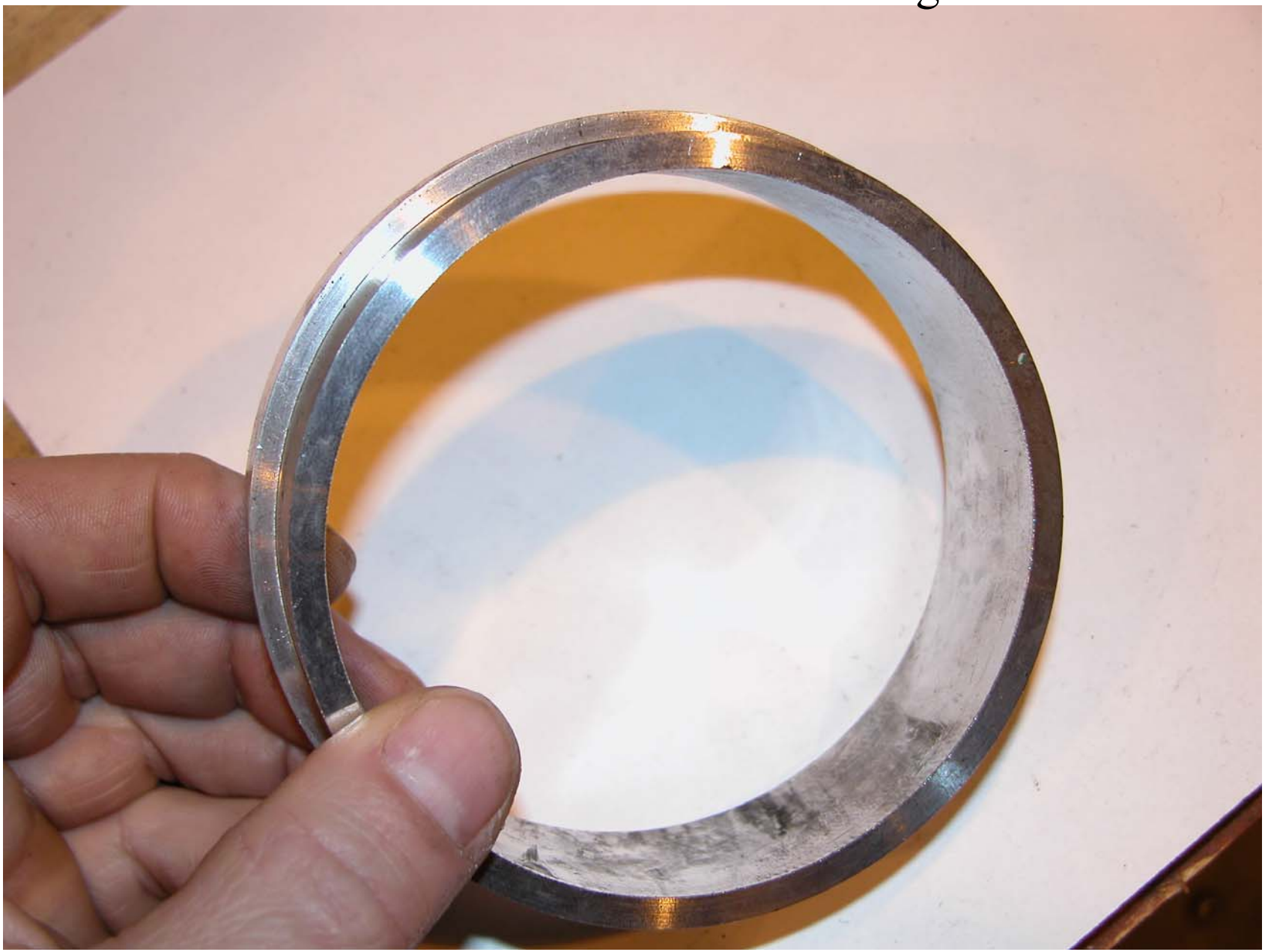
Oval Opening in Flanged Burner



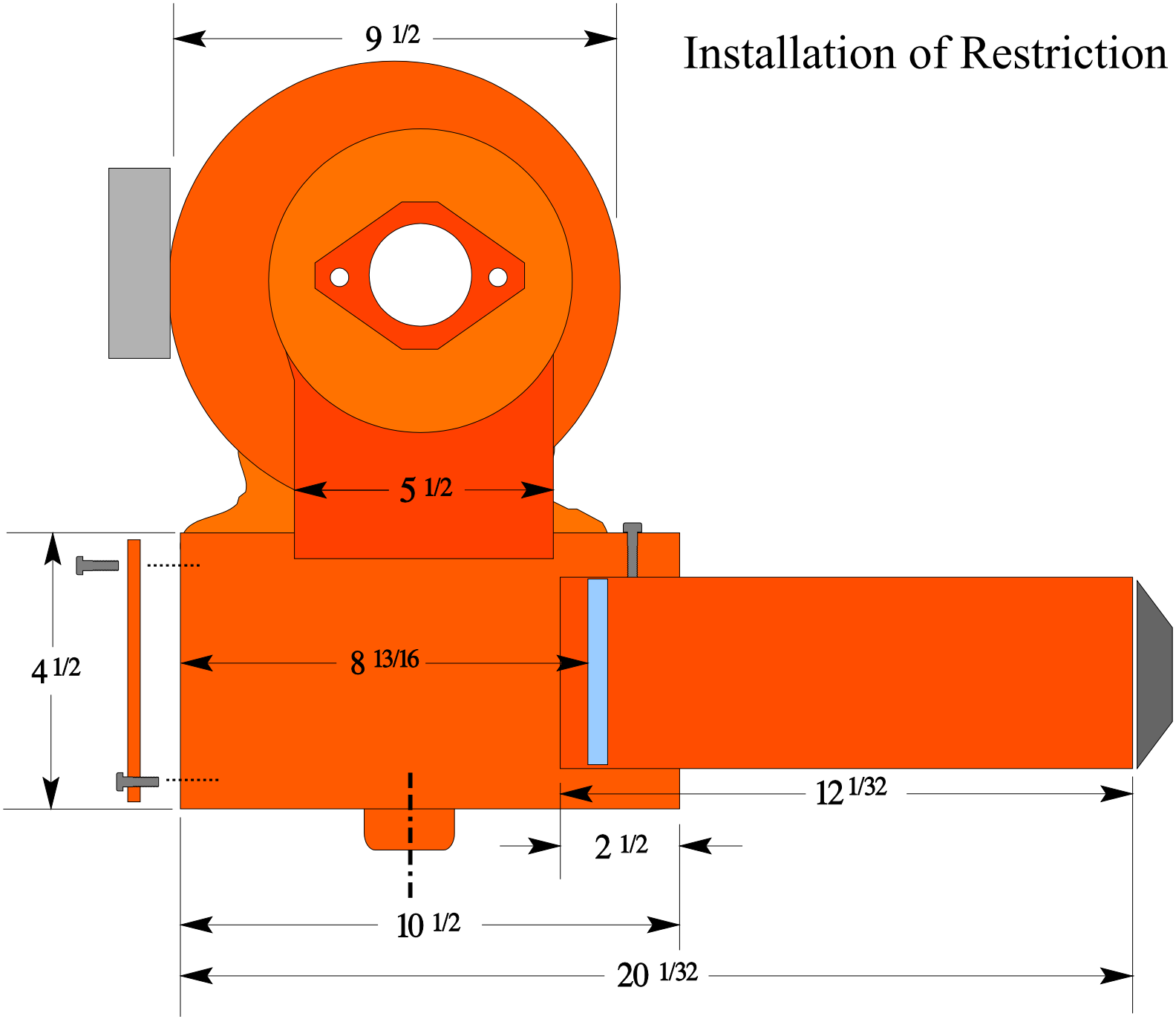
Restriction Ring



Smaller I.D. Restriction Ring

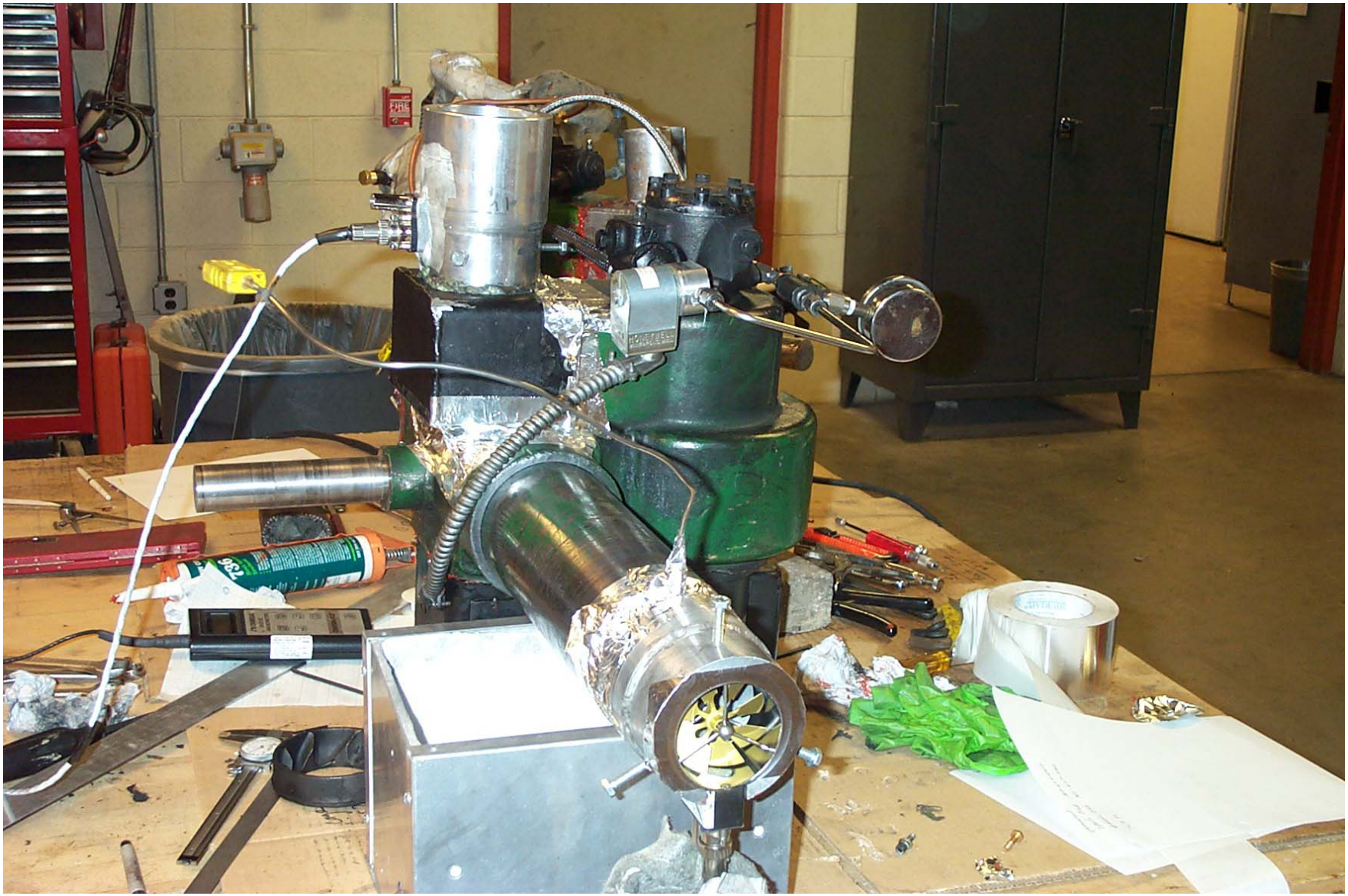


Installation of Restriction Ring



Installation of Restriction Ring

Intake vs. Outlet Air Velocity Measurements



	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
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28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

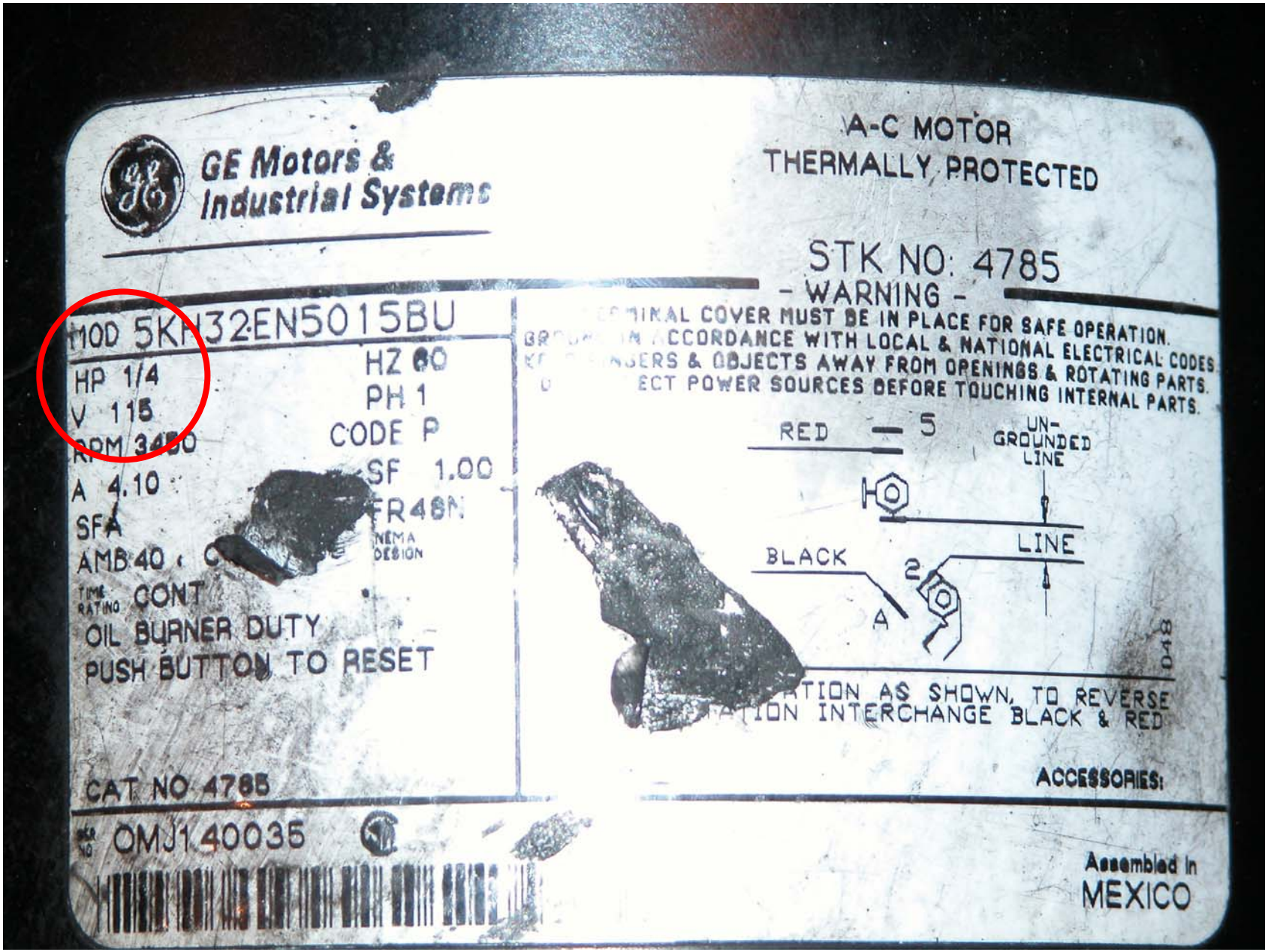
FAA Motor

1/4 Horsepower

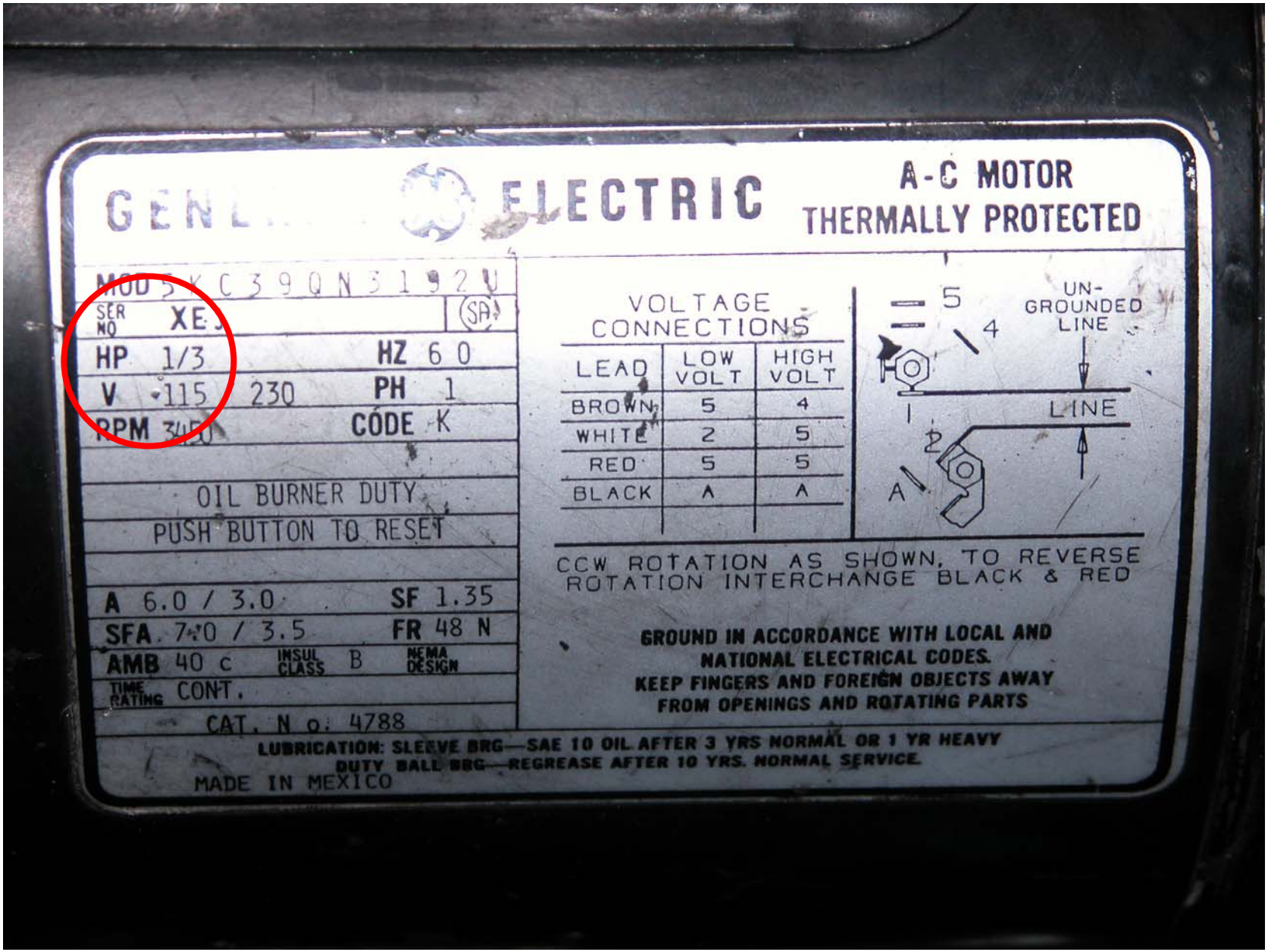
Boeing Motor

1/3 Horsepower

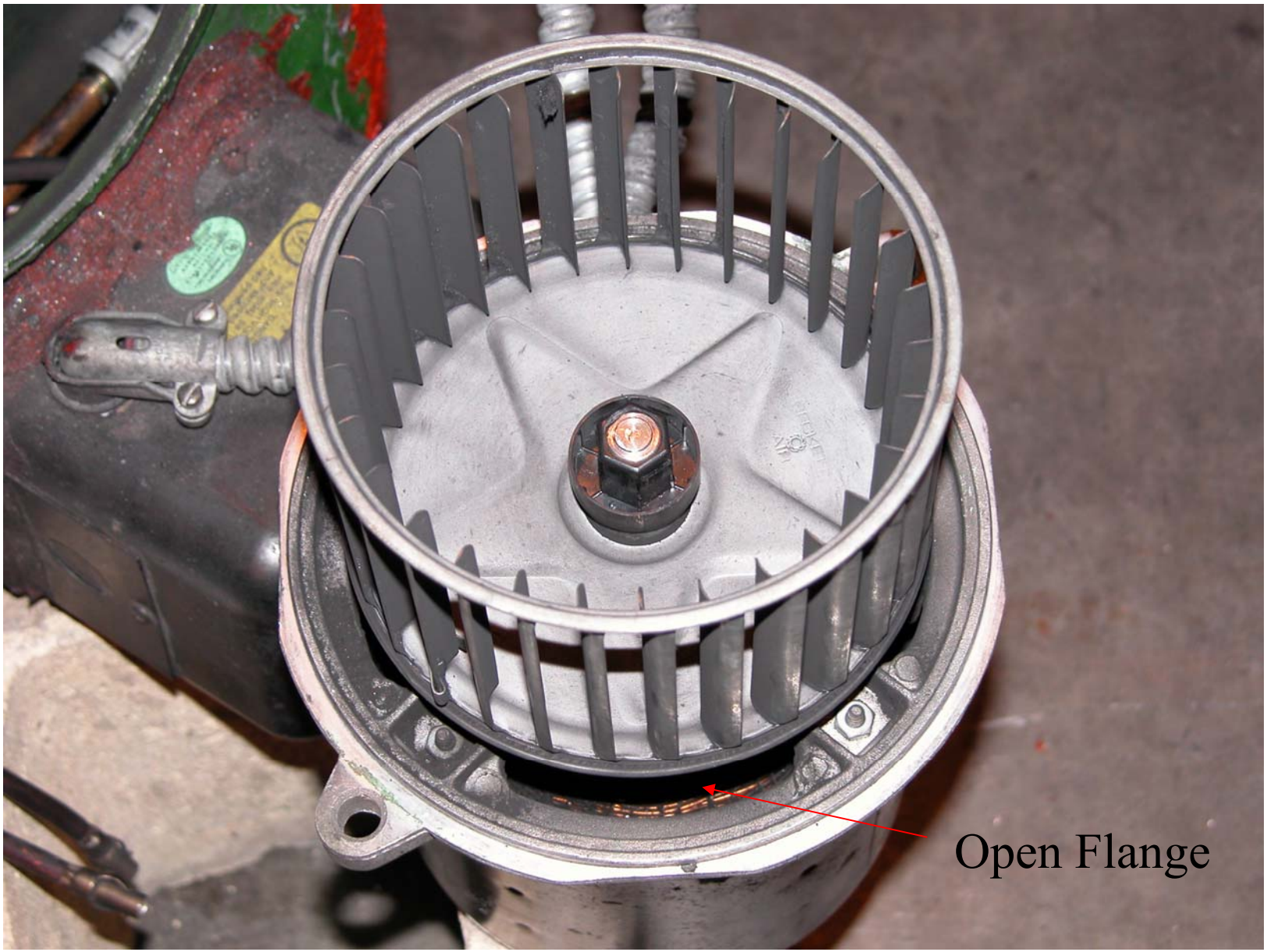
FAA Motor


GE Motors &
Industrial Systems
A-C MOTOR
THERMALLY PROTECTED
STK NO: 4785
- WARNING -
MOD 5KH32EN5015BU
HP 1/4
V 115
A 4.10
SFA
AMB 40 °
TIME RATING CONT
OIL BURNER DUTY
PUSH BUTTON TO RESET
HZ 60
PH 1
CODE P
SF 1.00
FR48N
NEMA DESIGN
CAT NO 4785
OMJ140035
ACCESSORIES:
Assembled in
MEXICO
RED
5
UN-
GROUNDED
LINE
LINE
BLACK
2
A
ACCORDANCE WITH LOCAL & NATIONAL ELECTRICAL CODES.
ECT POWER SOURCES BEFORE TOUCHING INTERNAL PARTS.
INTERCHANGE BLACK & RED

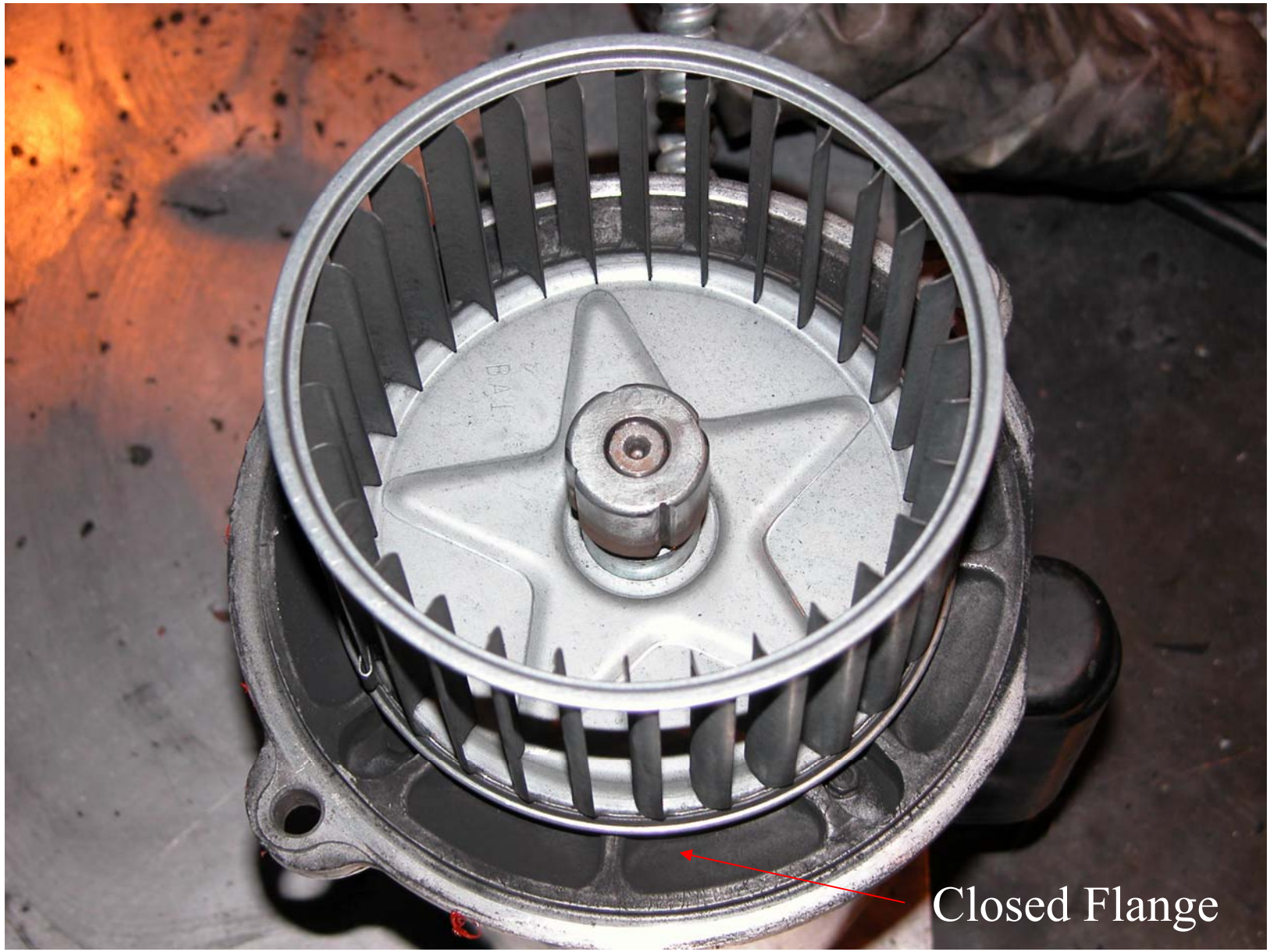
Boeing Motor



FAA Motor



Boeing Motor



	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
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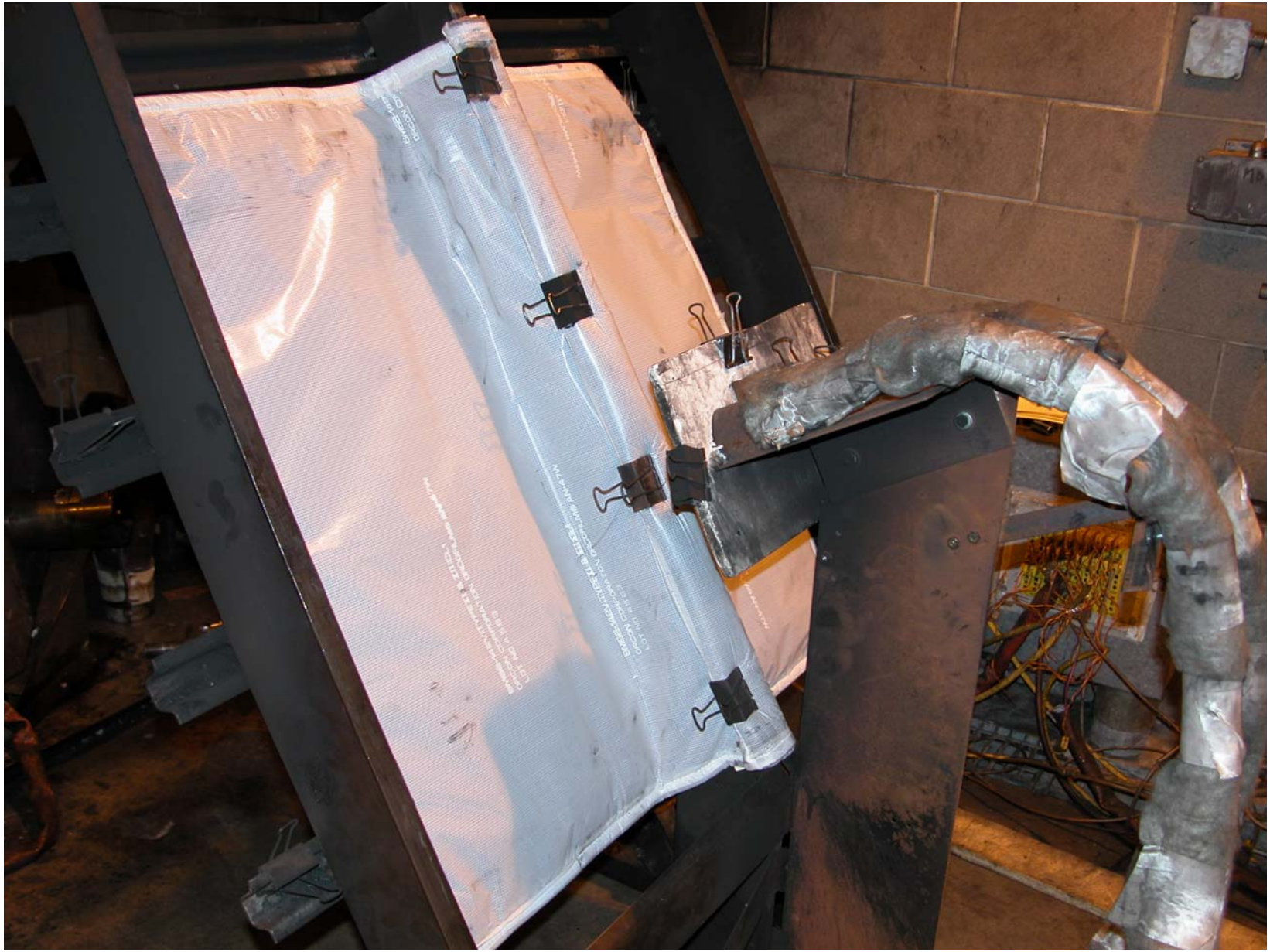
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

Horizontal Installation of Small Blanket

Vertical Installation of Small Blanket



	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

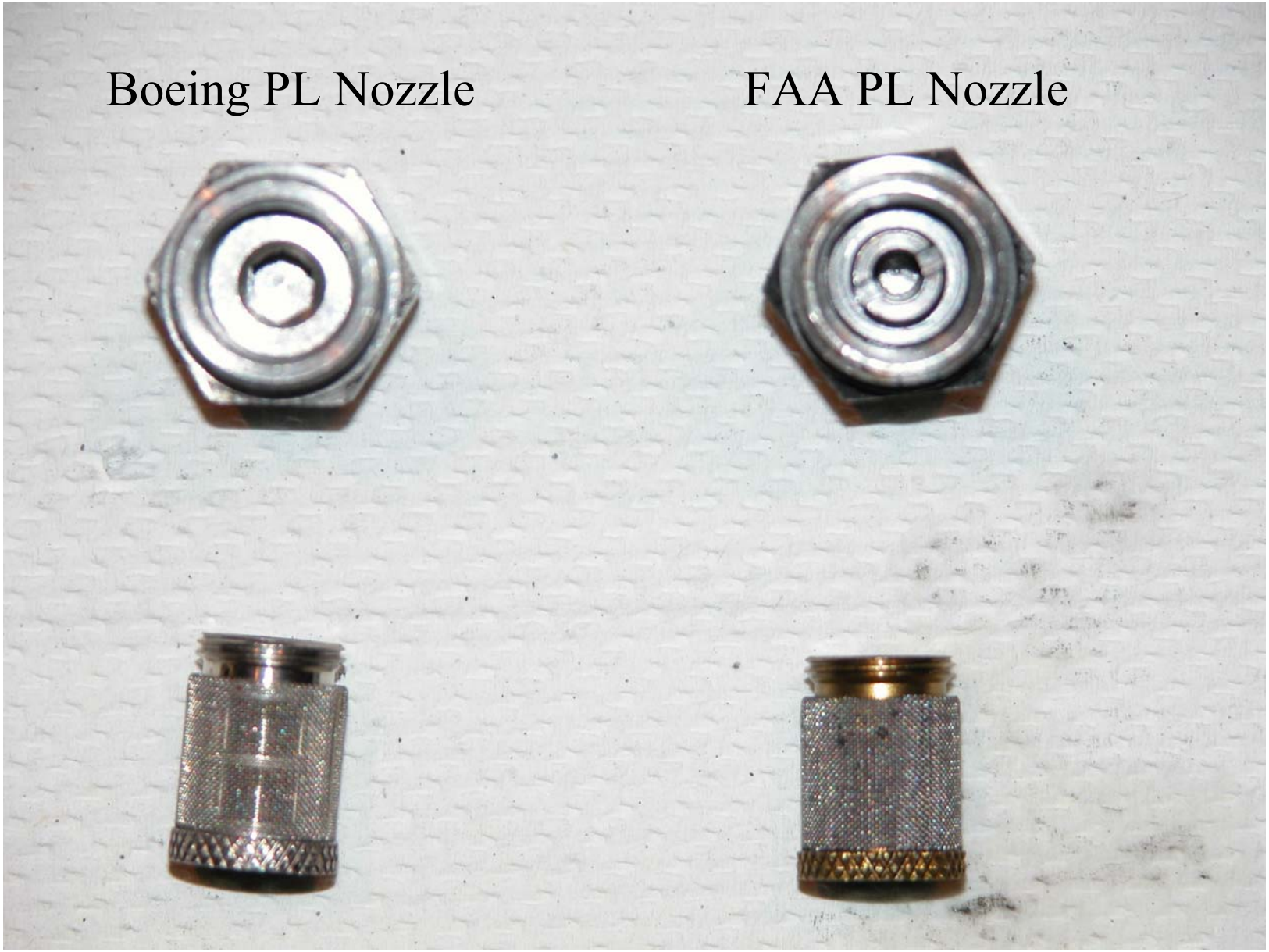
	Housing	Stator	Turb	Motor (HP)	Fuel Nozzle	Heat Flux	Test Result	Comments
1	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.74	X	Boeing burner @ FAA lab using Boeing settings
2	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:00	Boeing burner @ FAA lab using Boeing settings
3	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.23	X	Move Boeing draft tube out approx 1 inch
4	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 4:15	Move Boeing draft tube out approx 1 inch
5	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.12	X	Boeing burner @ FAA lab using FAA settings
6	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Boeing burner with FAA air velocity meter
7	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 0.4-inch wide draft tube restriction ring
8	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install 1-inch wide draft tube restriction ring
9	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.30	X	Install smaller I.D. restriction ring in draft tube
10	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.50	X	Increase air velocity to 2400 fpm
11	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	13.60	X	Increase air velocity to 2600 fpm
12	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	X	TTFG B/T @ 3:00	premature burnthrough
13	Socket	H215 replicate	F124	1/4	Monarch PL (Boeing)	13.30	X	Install FAA motor on Boeing burner
14	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.30	X	Re-install FAA burner using FAA settings
15	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	SampleX B/T @ 1:45	Same as previous result
16	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:00	Blankets horizontal
17	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG no B/T	Blankets Vertical
18	Flange	H215 original	F124	1/3	Monarch PL (FAA)	15.63	X	Install Pat's Flanged burner using FAA settings
19	Flange	H215 original	F124	1/3	Monarch PL (FAA)	16.27	X	Install Pat's Flanged burner using FAA settings
20	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
21	Flange	H215 original	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 2:00	Same result as FAA burner
22	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.23	X	Pat's burner w/Boeing stator and ignitors
23	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.12	X	Pat's burner w/Boeing fuel nozzle
24	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.33	X	Pat's burner w/Boeing fuel nozzle
25	Flange	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.21	X	Pat's burner w/Boeing fuel nozzle
26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
27	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.06	X	Pat's burner w/FAA fuel nozzle
28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle

Boeing PL Nozzle

FAA PL Nozzle

Boeing PL Nozzle

FAA PL Nozzle



Boeing PL Nozzle

FAA PL Nozzle

26	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	15.81	X	Pat's burner w/FAA fuel nozzle
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28	Flange	H215 replicate	F124	1/3	Monarch PL (FAA)	16.22	X	Pat's burner w/FAA fuel nozzle
29	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.77	X	Boeing burner w/Boeing fuel nozzle*
30	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.79	X	Boeing burner w/Boeing fuel nozzle*
31	Socket	H215 replicate	F124	1/3	Monarch PL (Boeing)	14.96	X	Boeing burner w/Boeing fuel nozzle*
32	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	16.17	X	Boeing burner w/FAA fuel nozzle
33	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	16.30	X	Boeing burner w/FAA fuel nozzle
34	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	16.45	X	Boeing burner w/FAA fuel nozzle

1 week later…

35	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	15.61	X	Boeing burner w/FAA fuel nozzle
36	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	16.14	X	Boeing burner w/FAA fuel nozzle
37	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 1:00	Quicker burnthrough than FAA burner
38	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	SampleX B/T @ 1:00	Quicker burnthrough than FAA burner
39	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	TTFG no B/T	Same result as FAA burner
40	Socket	H215 replicate	F124	1/3	Monarch PLP	13.99	X	Boeing burner w/PLP fuel nozzle
41	Socket	H215 replicate	F124	1/3	Monarch PLP	14.15	X	Boeing burner w/PLP fuel nozzle
42	Socket	H215 replicate	F124	1/3	Monarch PLP	14.27	X	Boeing burner w/PLP fuel nozzle

new batch of blankets…

43	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	TTFG B/T @ 4:45	Quicker burnthrough than previous
44	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	TTFG B/T @ 5:40	Quicker burnthrough than previous

reinstall original FAA burner…

45	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.60	X	Re-install FAA burner using FAA settings
46	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:55	Same result as Boeing burner
47	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 5:50	Same result as Boeing burner

* FAA burner cone, FAA air velocity meter, fuel nozzle cleaned, ignitor box sealed

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1 week later…

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42	Socket	H215 replicate	F124	1/3	Monarch PLP	14.27	X	Boeing burner w/PLP fuel nozzle

new batch of blankets…

43	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	TTFG B/T @ 4:45	Quicker burnthrough than previous
44	Socket	H215 replicate	F124	1/3	Monarch PL (FAA)	X	TTFG B/T @ 5:40	Quicker burnthrough than previous

reinstall original FAA burner…

45	Flange	H215 original	F124	1/4	Monarch PL (FAA)	15.60	X	Re-install FAA burner using FAA settings
46	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 4:55	Same result as Boeing burner
47	Flange	H215 original	F124	1/4	Monarch PL (FAA)	X	TTFG B/T @ 5:50	Same result as Boeing burner

* FAA burner cone, FAA air velocity meter, fuel nozzle cleaned, ignitor box sealed

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1 week later…

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new batch of blankets…

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reinstall original FAA burner…

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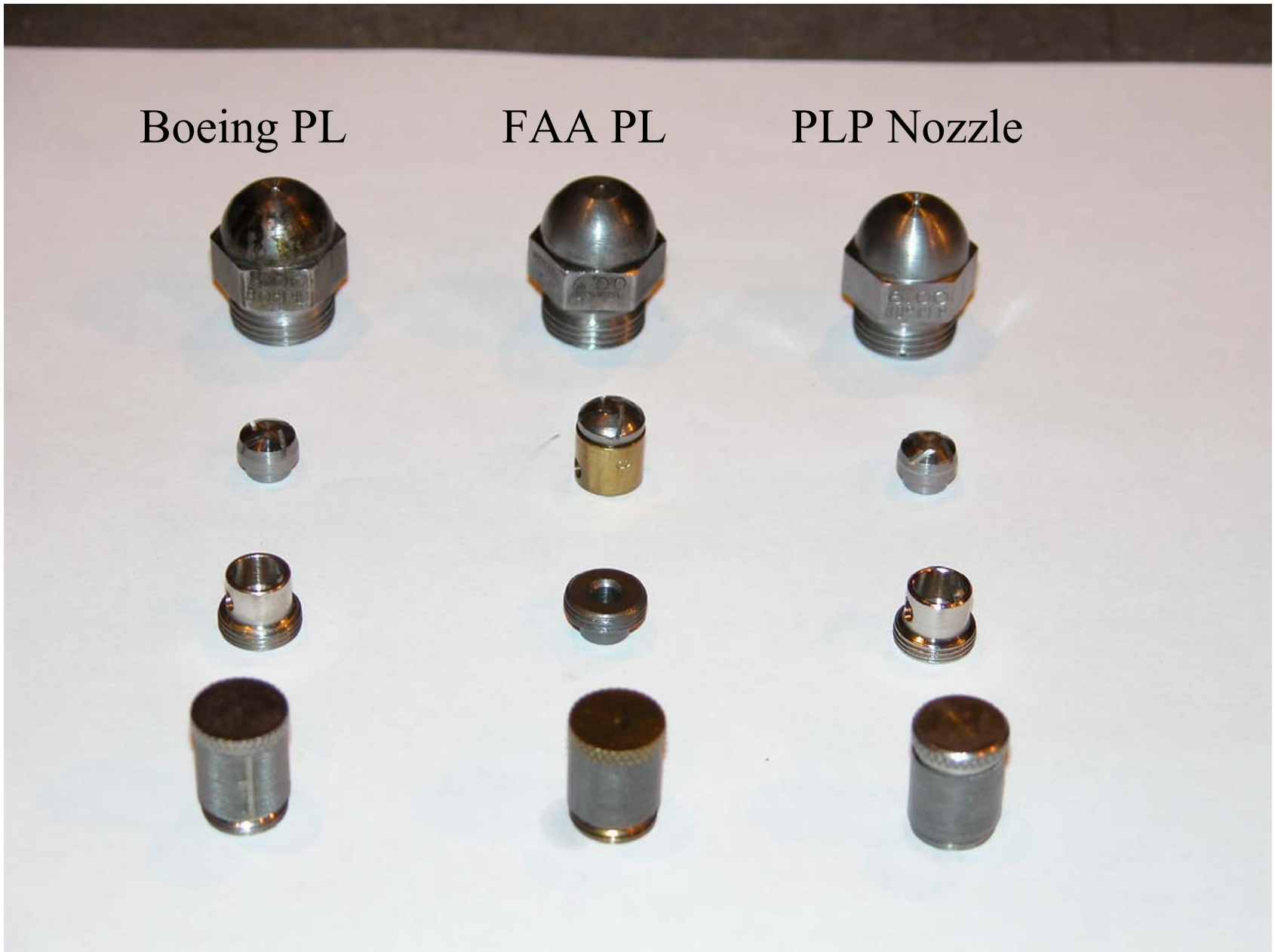
* FAA burner cone, FAA air velocity meter, fuel nozzle cleaned, ignitor box sealed


Boeing PL
FAA PL
PLP Nozzle


Boeing PL
FAA PL
PLP Nozzle

Boeing PL

FAA PL

PLP Nozzle

CC Nozzle

PLP Nozzle

Discussion with Monarch

Early nozzles inscribed with “F-80” (generic drawing description)

Discussion with Monarch

Late 1980's, change from "F-80" to "MTD-92" (material tolerance description)

Discussion with Monarch

Early 1990's no inscription, but rather a production number (for example "9 7")

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new batch of blankets…

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new batch of blankets…

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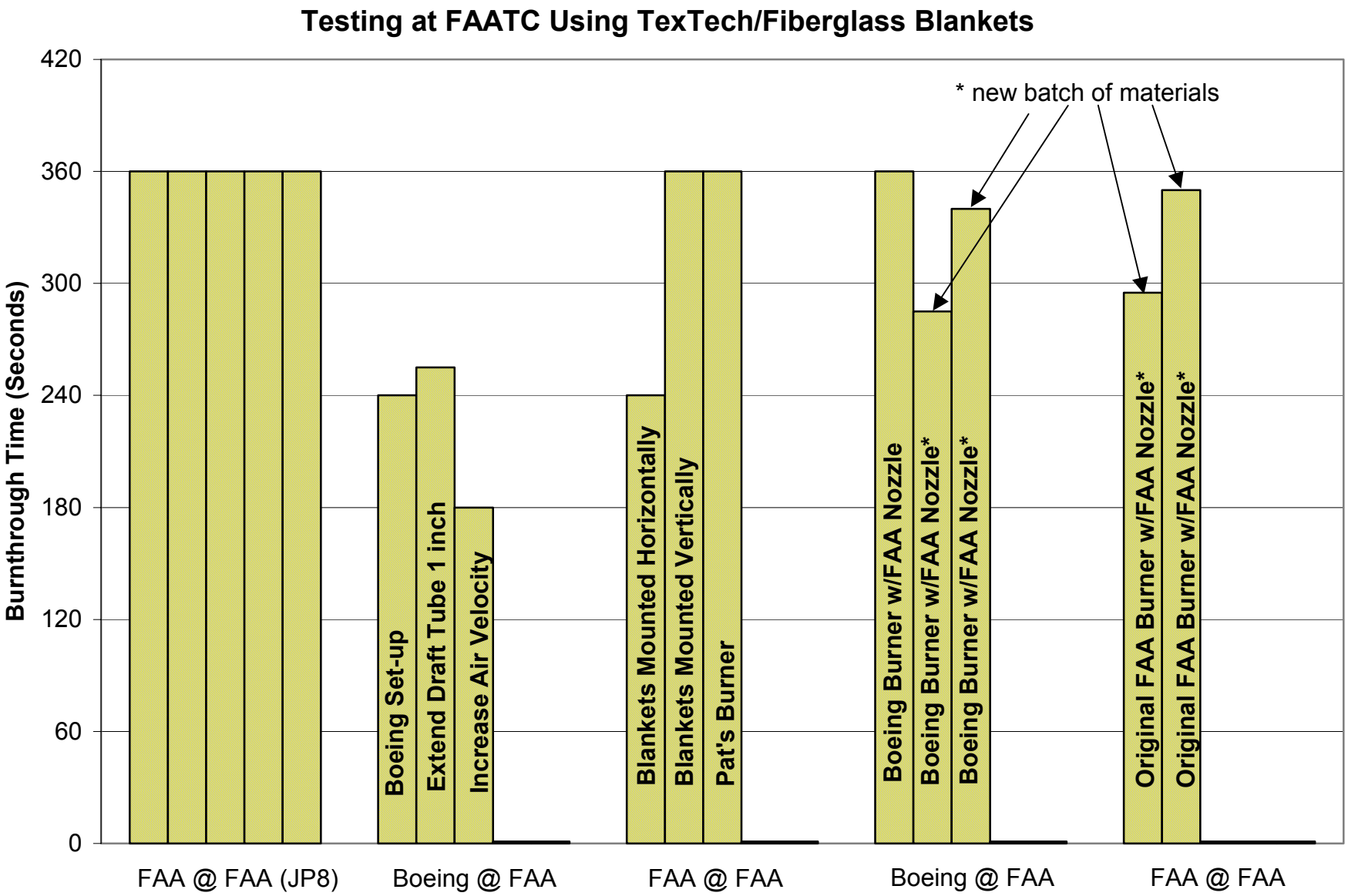
Summary of Tests



Conclusions

Various types of motors do not impact heat flux or burnthrough times.

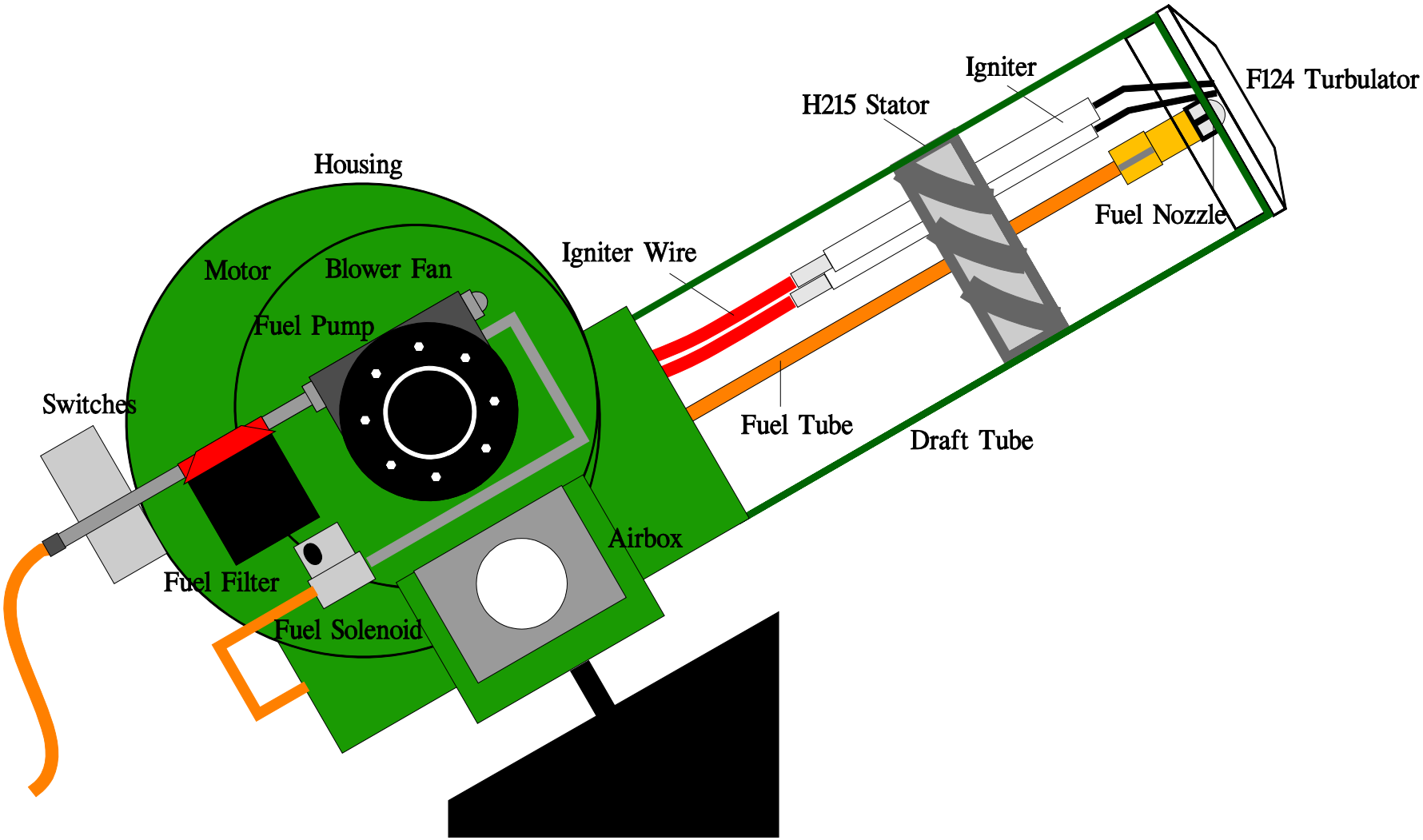
Replicate stator does not impact heat flux or burnthrough times.

Difference in housing does not impact heat flux, but may impact burnthrough time.

Difference in fuel nozzle impacts both heat flux and burnthrough times.

Development of a “Non-Park” Oil Burner for Testing

Current Park Oil Burner Used for Testing



Future Oil Burner Used for Testing

Igniter
H215 Stator
F124 Turbulator
Fuel Nozzle
Igniter Wire
Fuel Tube
Draft Tube
Venturi Tube
Regulator
Fuel Pump
Fuel Tank