

# DEPARTMENT OF THE NAVY



## CERTIFICATE OF COMPETENCY

### MID-ATLANTIC REGIONAL CALIBRATION CENTER

is recognized by the Joint Naval Audit Certification Team (JNACT) for satisfactory compliance to criteria set forth in the Naval and Marine Corps Calibration Laboratory Audit Certification Manual, NAVAIR 17-35QAC-01B, NAVSEA 04-4734B, and USMC TI-4733-35/23B. These criteria encompass the relevant requirements of the Naval Fleet and Type Commander directives. Certification is issued for specific measurement area and ranges listed on the attached Scope of Competency.

JNACT Document  
S/N 4734.09

By Direction  
NNSY FTSD C/210

Expiration Date:  
21 August 2012

# SCOPE OF COMPETENCY

## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

ELECTRICAL AREA	MEASUREMENT RANGE	
<b>AC CURRENT</b>	<b>RANGE/FREQ UNCERTAINTY(±)*</b>	
5700A/5725A (source)	5 mA to 20 A, 5 Hz to 50 kHz	
Valhalla 2555A (source)	100A @ 1 kHz	
Clamp-on – 5500(coil)(source) with 5520A	1000A @ 60 Hz 390A @ 400 Hz	
A40 shunt (measure)	10mA to 20A @ 400 Hz, 5 kHz, 20 kHz and 50 kHz	
<b>AC VOLTS</b>	<b>RANGE</b>	<b>FREQ</b>
5700A/5725A (source)	.022-220VAC 200-1100VAC	10 Hz to 1 MHz 40 Hz to 100 kHz
Wideband	.0033-3.5Vrms	30 Hz to 500 kHz
5790A AND/OR 4920M (measure)	.0022-70VAC .0022-1000VAC	10 Hz to 1 MHz 10 Hz to 100 kHz
Wideband	.0022-7VAC	10 Hz to 30 MHz
<b>ACOUSTICS (MEASURE)</b>	<b>RANGE</b>	<b>FREQ</b>
Sound Level Meters	(60 to 140) dB from 31.5 Hz to 16 kHz	
<b>ACOUSTICS (SOURCE)</b>	<b>RANGE</b>	<b>FREQ</b>
Sound Calibrators	94,104,114 dB	31.5Hz to 16kHz

\* Expanded uncertainties calculated at k = 2 coverage factor.

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ELECTRICAL AREA	MEASUREMENT RANGE
<b>ATTENUATION – COAXIAL</b>	<b>RANGE/FREQ-UNCERTAINTY(±)*</b>
(8510C ANA)	
TYPE N	0 to -50 dB (0.045 to 18 GHz) (0.048 to 0.083 dB)
APC-7	0 to -50 dB (0.045 to 18 GHz) (0.047 to 0.068 dB)
APC-3.5	0 to -50 dB (0.045 to 26.5 GHz)(0.048 to 0.068 dB)
APC-2.4	0 to -50 dB (0.045 to 50 GHz) (0.028 to 0.11 dB)
<b>ATTENUATION – WAVEGUIDE</b>	<b>RANGE/FREQ-UNCERTAINTY (±)*</b>
(8510C ANA)	
X - BAND	0 to -50 dB (8.2 to 12.4 GHz) (0.066 to 0.15 dB)
P - BAND	0 to -50 dB (12.4 to 18 GHz) (0.042 to 0.29 dB)
K - BAND	0 to -50 dB (18 to 26.5 GHz) (0.042 to 0.63 dB)
R - BAND	0 to -50 dB (26.5 to 40 GHz) (0.044 to 0.28 dB)
Q - BAND	0 to -50 dB (33 to 50 GHz) (0.047 to 0.38 dB)

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ELECTRICAL AREA	MEASUREMENT RANGE	
<b>AVIATION TEST SETS</b>		
General Standards		
<b>CAPACITANCE</b>	<b>RANGE</b>	<b>UNCERTAINTY(±)*</b>
1404A/B/C Reference Standards with 2500A Capacitance Bridge	10 pF @ 1 kHz 100 pF @ 1 kHz 1000 pF @ 1 kHz	8.7 ppm 5.6 ppm 5.6 ppm
General measurements using capacitance bridages & 2500A opt E	0.5aF to 10F @ 12 Hz to 200 kHz	
<b>DC CURRENT</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
Measurements International 6010C System w/extenders	0 to 15 A 15 to 100 A 100 to 400 A	25 ppm 28 ppm 51 ppm
Clamp-On only: 5500 (coil) w/5520A (source)	0 to 1000 A	
<b>DC VOLTAGE - MEASURE</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
Josephson Array Intrinsic Measurement System (Primary Transfer Standard)	10 V 1.018 V	0.43 μV 0.05 μV
<b>DC VOLTAGE – ZENER CALS</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
Automated Zener Reference Measurement System (Secondary Transfer Standard)	10 V 1.018 V	0.70 μV 0.12 μV

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ELECTRICAL AREA	MEASUREMENT RANGE	
<b>DC VOLTS</b>	<b>RANGE</b>	
General Capability (source & measure)	0 to 1000 V	
High Voltage – Fluke 410B w/step-up (source)	0-50 kV	
High Voltage – ESH8 (measure)	0-50 kV	
<b>FREQUENCY AND TIME</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
Various generators w/Cesium timebase (source)	0.001 Hz to 40 GHz	
Various counters w/Cesium timebase (measure)	0.001 Hz to 40 GHz	
Cesium Beam and/or Datum GPS Receiver	1, 5, 10 MHz to 1 PPS	(±3x10e-11)
<b>INDUCTANCE</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
1693 Inductance Bridge	100 µH to 10 H @ 100 Hz	(0.07 to 0.16 %)
1482 Series Reference Standards	100µH to 10 H @ 1 kHz	(0.09 to 0.23 %)
<b>INDUCTIVE VOLTAGE DIVIDERS</b>	<b>RANGE/FREQ UNCERTAINTY (±)*</b>	
Traceable Voltage Dividers @ 400 Hz and 1 kHz	0.001 to 1 Ratio	±6 steps on the 10 <sup>-7</sup> decade

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## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

ELECTRICAL AREA	MEASUREMENT RANGE	
<b>MICROWAVE IMPEDANCE/ COAXIAL TERMINATIONS</b>  (8510C ANA)  TYPE N 14mm APC-7 APC-3.5 APC-2.4	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
	REFLECTION COEFFICIENT   S11	
	(0 to 1) (0.045 to 18 GHz)	(0.0042)
	(0 to 0.2) (0.045 TO 8.5 GHz)	(0.0051)
	(0 to 1)(0.045 to 18 GHz)	(0.0016)
	(0 to 1)(0.045 to 26.5 GHz)	(0.0045)
	(0 to 1)(0.045 to 50 GHz)	(0.0083)
<b>MICROWAVE IMPEDANCE/ WAVEGUIDE TERMINATIONS</b>  (8510C ANA)  X - BAND P – BAND K – BAND R – BAND Q – BAND	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
	REFLECTION COEFFICIENT   S11	
	(0 to 1) (8.2 to 12.4 GHz)	(0.0054)
	(0 to 1) (12.4 to 18 GHz)	(0.0063)
	(0 to 1) (18 to 26.5 GHz)	(0.0062)
	(0 to 1) (26.5 to 40 GHz)	(0.0046)
	(0 to 1) (33 to 50 GHz)	(0.0049)

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ELECTRICAL AREA	MEASUREMENT RANGE
<b>OSCILLOSCOPES</b>	<b>RANGE</b>
9500B/9530 (source)	Rise Time 150 ps @ 2 MHz
54750A/54751A (measure)	17.5 ps @ 20 GHz 28.2 ps @ 12.4 GHz
<b>PHASE</b>	<b>RANGE</b>
2250 Phase Meter (measure)	0 to 360° @ 50 Hz to 50 kHz
5500 Phase Standard (source)	0 to 360° @ 1 Hz to 100 kHz
<b>RF POWER – RELATIVE COAXIAL</b>	<b>RANGE      UNCERTAINTY (±)*</b>
8902S Opt 50 and /or N5531S	(0 to -110 dB) @ 100 kHz to 50 GHz (0.026 to 0.096 dB)
<b>RF POWER – COAXIAL</b>	<b>RANGE      UNCERTAINTY (±)*</b>
Direct Transfer Method Expressed as Cal Factor	1 MHz to 40 GHz @ 10µW & 10 mW      1.6%
<b>RF POWER – WAVEGUIDE</b>	<b>RANGE      UNCERTAINTY (±)*</b>
Direct Transfer Method Expressed as Cal Factor	8.2 to 40 GHz @ 10 mW      1.6%
<b>RF WATTMETERS</b>	<b>RANGE</b>
RFWACS Wattmeter Calibrator System	480 Watts @ 2 to 10 MHz 180 Watts @ 15 to 500 MHz

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ELECTRICAL AREA	MEASUREMENT RANGE	
<b>RESISTANCE</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
Guildline 9520 or 6500 Teraohmmeter	1 T	0.15%
	100 G	0.13%
	10 G	0.12%
Measurements International 6000B System with reference standards	1 G	5.2 ppm
	100 M	5.0 ppm
	10 M	5.0 ppm
	1 M	0.85 ppm
	100 k	0.36 ppm
	10 k	0.36 ppm
Measurements International 6010C System with reference standards	1 k	0.79 ppm
	100	0.74 ppm
	10	0.25 ppm
	1	0.24 ppm
	0.1	0.45 ppm
	0.01	1.4 ppm
	0.001	1.5 ppm
<b>THERMAL VOLTAGE CONVERTERS</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
1395 Direct Transfer	(0.5 to 6) V at 1 MHz	0.06%
	(0.5 to 6) V at 10 MHz	0.12%
	(0.5 to 6) V at 20 MHz	0.23%
	(0.5 to 6) V at 30 MHz	0.23%
	(0.5 to 6) V at 50 MHz	0.58%
	(0.5 to 6) V at 70 MHz	0.58%
	(0.5 to 6) V at 100 MHz	1.12%

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## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

ELECTRO-OPTICS AREA	MEASUREMENT RANGE
<b>FIBER OPTIC DISTANCE</b>  OTDR Calibrations using MM50P STANDARD	<b>RANGE</b>  0 to 5515 meters
<b>NIGHT VISION</b>  Night Vision Test Sets Using a 13335470 Standard Source	<b>RANGE</b>  810 nm wavelength: 5.55 x 10E-11 to 3.03 x 10E-8 W/cm2 steradian  820 nm wavelength: 2.56 x 10E-11 to 3.03 x 10E-8 W/cm2 steradian
<b>OPTICAL POWER 850 and 1300 nm</b>  ML9001A/MA9712A	<b>RANGE</b>  850 nm (-50 to 0 dBm)  1300 nm (-30 to 0 dBm)
<b>PEAK WAVELENGTH AND BANDWIDTH</b>  MS9030A/MS9701A	<b>RANGE</b>  350 to 1750 nm
<b>PHOTOMETRY ILLUMINANCE SOURCE</b>  Standard Lamp/Light Rail (2 to 700 footcandles)	<b>RANGE</b>  Below 10 footcandle 10 to 700 footcandle

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ELECTRO-OPTICS AREA	MEASUREMENT RANGE
<b>RADIOMETRY - IV IRRADIANCE</b>	<b>RANGE</b>
UV Table	0 to 2000 $\mu\text{W}/\text{cm}^2$

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## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

MECHANICAL AREA	MEASUREMENT RANGE	
<b>29° ACME BEST WIRES</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
COMPARISON TO CALIBRATED MASTER WIRES	TPI 1 to 20	7.0 μ in
<b>60° ENGLISH THREAD WIRES</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
COMPARISON TO CALIBRATED MASTER WIRES	TPI 4 to 100	7.0 μ in
<b>CLINOMETERS / INCLINOMETERS / LEVELS</b>	<b>RANGE</b>	
ANGLE GENERATOR / INDEX TABLE	0 to 360°	
<b>DIMENSIONAL (PRODUCTION)</b>	<b>RANGE</b>	
GENERAL COMPLEMENT OF STANDARDS	(0 to 100) in	
<b>DIMENSIONAL (DIAMETER) PLUG GAGES</b>	<b>RANGE</b>	
GAGE BLOCKS AND EXTERNAL COMPARATOR	(0.01 to 12.26) in	

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## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

MECHANICAL AREA	MEASUREMENT RANGE	
<b>DIMENSIONAL (DIAMETER) RING GAGES</b>	<b>RANGE</b>	
GAGE BLOCKS AND INTERNAL COMPARATOR	(0.125 to 13.25) in	
<b>DIMENSIONAL (LENGTH)</b>	<b>RANGE</b>	<b>UNCERTAINTY (<math>\pm</math>)*</b>
MASTER GAGE BLOCK COMPARATOR AND MASTER GAGE BLOCK STANDARDS	STEEL (0.01 to 4.0) in (4.0 to 20.0) in	(0.48*L) +3.62 $\mu$ in (0.81*L) +5.48 $\mu$ in
	CHROMIUM (0.05 to 4.0) in	(0.46*L) +3.32 $\mu$ in
<b>DIMENSIONAL (THREADS)</b>	<b>RANGE</b>	
SIP-305M MAJOR, MINOR AND PITCH DIAMETERS	(0.06 to 6) in	
<b>DIMENSIONAL (THREADS) CONTOUR</b>	<b>RANGE</b>	
STARRETT HB 400	20 PITCH AND COARSER  (20 to 40) PITCH  40 PITCH AND FINER	

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MECHANICAL AREA	MEASUREMENT RANGE	
<b>DIMENSIONAL (THREADS) LEAD AND HELIX ANGLE</b>  SIP-305M	<b>RANGE</b>  (2 to 56) PITCH	
<b>END STANDARDS</b>  STANDARD MEASURING MACHINE AND SUPER MICROMETER	<b>RANGE</b>  (1 to 72) in	
<b>FLOW – AIR VELOCITY</b>  TRANSDUCER PITOT TUBE/DIGITAL INDICATOR	<b>RANGE</b>  (0 to 1000) fpm (1000 to 1500) fpm (1500 to 2000) fpm (2000 to 6000) fpm	
<b>FLOW – GAS FLOW RATE</b>  BELL PROVERS	<b>RANGE</b>  (0.25 to 10) cfm (10 to 40) cfm	<b>UNCERTAINTY (±)*</b>  0.033 cfm 0.034 cfm
<b>FLOW – LIQUID FLOW RATE</b>  FLOW CALIBRATORS STANDARD TURBINE FLOWMETER	<b>RANGE</b>  (0.01 to 2100) gpm (0.01 to 250) gpm	<b>UNCERTAINTY (±)*</b>  0.25% i.v. 1% i.v.

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## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

MECHANICAL AREA	MEASUREMENT RANGE	
<b>FORCE</b>  DMP 40 LOAD CELLS WITH INDICATOR	<b>RANGE</b>  (1 to 300,000) lbf	
<b>GAS DETECTION</b>  CALIBRATION OF MONITORING DEVICES USING CERTIFIED STANDARD GAS MIXTURES	<b>RANGE</b>  FREON OXYGEN COMBUSTIBLE GASES HELIUM	
<b>HUMIDITY (DEW POINT)</b>  GENERAL EASTERN M3 DEWPOINT MONITOR	<b>RANGE</b>  (-65 to 35) °C	
<b>MASS</b>  COMPARISON TO STANDARD WEIGHTS	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
	20 kg	23 mg
	10 kg	11 mg
	5 kg	5 mg
	3 kg	5 mg
	2 kg	4 mg
	1 kg	0.36 mg
	500 g	0.35 mg
	300 g	0.35 mg
	200 g	0.35 mg
	100 g	0.08 mg
	50 g	0.08 mg
	30 g	0.070 mg
	20 g	0.007 mg
	10 g	0.006 mg
	5 g	0.005 mg

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## MID-ATLANTIC REGIONAL CALIBRATION CENTER (MARCC)

MECHANICAL AREA	MEASUREMENT RANGE	
MASS (CONTINUED)	RANGE	UNCERTAINTY ( $\pm$ )*
COMPARISON TO STANDARD WEIGHT	3 g	0.004 mg
	2 g	0.004 mg
	1 g	0.004 mg
	500 mg	0.002 mg
	300 mg	0.002 mg
	200 mg	0.002 mg
	100 mg	0.001 mg
	50 mg	0.001 mg
	30 mg	0.001 mg
	20 mg	0.001 mg
	10 mg	0.001 mg
	5 mg	0.001 mg
	3 mg	0.001 mg
	2 mg	0.001 mg
	1 mg	0.001 mg
	50 lb	76 mg
	30 lb	38 mg
	20 lb	31 mg
	10 lb	16 mg
	5 lb	7 mg
	3 lb	5 mg
	2 lb	3.65 mg
	1 lb	0.36 mg
	8 oz	0.35 mg
	4 oz	0.08 mg
	2 oz	0.08 mg
	1 oz	0.08 mg
	½ oz	0.009 mg
	¼ oz	0.007 mg
	1/8 oz	0.005 mg
	1/16 oz	0.003 mg
	1/32 oz	0.002 mg

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MECHANICAL AREA	MEASUREMENT RANGE	
<b>ON-SITE PRODUCTION</b>  GENERAL CAPABILITIES	<b>RANGE</b>	
<b>OPTICAL FLATS</b>  PLANO-INTERFEROMETER MODEL D-309-L	<b>RANGE</b>  (1 to 5) in	
<b>PRESSURE (PRODUCTION)</b>  STANDARD CALIBRATORS	<b>RANGE</b>  (0 to 10,000) psi	
<b>PRESSURE AND VACUUM</b>  SCHWIEN PRECISION MERCURY MANOMETER  DEAD WEIGHT TESTER HYDRAULIC	<b>RANGE</b>  (ABS OR DIFF) (0.5 to 10) in Hg (10 to 50) in Hg (50 to 110) in Hg (0.25 to 54) psi  (8.0 to 40,000) psig	<b>UNCERTAINTY (±)*</b>      60 ppm

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MECHANICAL AREA	MEASUREMENT RANGE	
<b>PRESSURE STANDARDS (FCA)</b>	<b>RANGE</b>	
CALIBRATION AND REPAIR OF STANDARD MODELS 1127 AND 3666 AND MODEL 3731's	(0 to 30) in Hg (0 to 10,000) psi	
<b>ROTATION</b>	<b>RANGE</b>	
STROBOSCOPE AND TACHOMETER TESTER	(0 to 40,000) rpm	
<b>SPECIFIC GRAVITY</b>	<b>RANGE</b>	
STANDARD HYDROMETERS	0.6700 to 2.000 s.g.	
<b>TEMPERATURE</b>	<b>RANGE</b>	
TEMPERATURE CALIBRATORS	(-38 to 500) °C	
<b>TEMP-RESIST THERMOMETRY</b>	<b>RANGE</b>	<b>UNCERTAINTY (±)*</b>
ITS 90 CALIBRATION OF AL, ZN, SN, H2O, HG FIXED POINTS AND COMPARISON METHOD AT BP OF LIQUID N2	-195.8 °C	12.8 mK
	-38.8 °C	0.6 mK
	0.01 °C	1.9 mK
	231.9 °C	3.0 mK
	419.5 °C	3.2 mK
	660.3 °C	9.5 mK

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MECHANICAL AREA	MEASUREMENT RANGE
<b>THERMOCOUPLES AND PYROMETER INDICATORS</b>  PRT COMPARISON AND STANDARD THERMOCOUPLE COMPARISON	<b>RANGE</b>  (0 to 1100) °C
<b>TOOLMAKERS FLATS</b>  PLANO-INTERFEROMETER MODEL D-309-L	<b>RANGE</b>  (3 to 6) in
<b>TORQUE</b>  AKO AND CDI SYSTEMS	<b>RANGE</b>  (0 to 12,000) lb.-ft.
<b>TORQUE ARMS</b>  TORQUE STANDARDS IN ACCORDANCE WITH NAVAIR 17-20MU-24 AND NAVAIR 17-20MU-62	<b>RANGE</b>  (2.5 to 120) in
<b>VACUUM</b>  MKS BARATRON PRESSURE MEASUREMENT SYSTEM	<b>RANGE</b>  (0.001 to 760) torr
<b>VACUUM (PRODUCTION)</b>  1127 CALIBRATOR	<b>RANGE</b>  (0 to 30) in Hg

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<b>VIBRATION</b>  UNHOLTZ-DICKIE 680 SYSTEM  Acceleration:  Velocity:  Displacement:	<b>RANGE</b>  up to 20 g's peak  up to 12 in/sec peak  up to 750 mils p-p
<b>VISCOSITY</b>  EFFLUX TIME IS MEASURED WITH AN ELECTRONIC COUNTER	<b>RANGE</b> <b>UNCERTAINTY (±)*</b>  (0.5 to 1000) Centistokes      0.19% i.v. (1000 to 7000) Centistokes      0.40% i.v.

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