



# **Specific Accreditation Guidance**

## **Calibration Reference Equipment Table**

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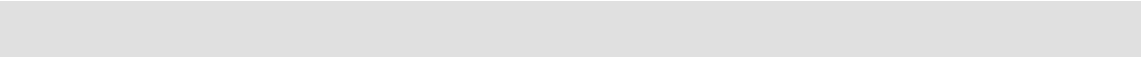
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## **Reference equipment - calibration and checks**

For NATA's requirements on metrological traceability and equipment please refer to NATA's *Metrological Traceability* and NATA's *Equipment assurance, in-house calibration and equipment verification*.

The recommended calibration and checking intervals as presented in this table is to be used in conjunction with the guidance on establishing an equipment assurance program as found in the informative annex of NATA's *Equipment assurance, in-house calibration and equipment verification*.

## General equipment table for reference use

Item of equipment	Calibration interval (years)	Checking interval (months)	General comments and example referenced testing standards
<b>Accelerometers</b>			
Reference	5		
		24	Intercomparison
<b>Acoustic calibrators</b> including Pistonphones and sound sources	1		AS/IEC 60942
		6	Intercompare
<b>Acoustic attenuators</b>	5		
		12	Check 2 ratios
<b>Alignment telescopes</b>	6		
<b>Anemometers</b>	1		Anemometers with rotating parts should be checked regularly for wear, damage and free bearing operation
<b>Angle gauges</b>			
Reference	4 then 8 subsequent		
Working	2 then 4 subsequent		
<b>Attenuators</b>	3		Frequency Response
		12	Check two ratios. Resistance and return loss
<b>Autocollimators</b>	6		EURAMET cg-22
<b>Balances</b>	3		NMI Monograph 4
		12	Service. Where the facility can demonstrate that the balance is used in a suitable environment (e.g. dust free, chemical free) AND results of user checks consistently demonstrate good performance and ability, this requirement may be waived.
		6	Repeatability check NATA's <i>User Checks and Maintenance of Laboratory Balances</i>
		1	One point check NATA's <i>User Checks and Maintenance of Laboratory Balances</i>
		Each weighing	Zero point check
<b>Analogue band pass filters</b> (sound & vibration)			
Octave and fractional	2		AS/NZS 4476, IEC 1260, IEC 61260

<b>Barometers</b>			
Fortin	Initial		
		60	One point check with transfer instrument. NATA's <i>The In-situ Calibration of Barometers</i>
Aneroid	1		
<b>Bridges - manual balance</b>	5		
		12	Check against laboratory standards
<b>Callipers</b>	2		AS 1984
		On use	Zero point, correct closure of jaws
<b>Capacitors</b>	5		
		12	Intercompare
<b>Colorimetric Integrating spheres</b>	1		As long as the coating is in reasonable condition then the absolute reflectance is not critical and recoating is not necessary. Annual recalibration using reference lamp is recommended. More frequent calibration may be required if the sphere is new or in a dusty or humid environment or subject to lamps emitting UV radiation.
		3	Check using working standard lamp
<b>Comparators (dimensional)</b>	3		
<b>Cold reference junctions (ACJC)</b>		12	Check against reference thermometer or comparison at ice point
<b>Current shunts</b>	5		(See entry for shunts)
<b>DC Voltage references</b>	1 to 2		Interval dependent on required uncertainty
		3 to 6	Intercompare
<b>Dimensional Measuring Machines</b>			
Precision scales	5 then subsequent 10		
Geometric tests	5		
Micrometer heads	3		
Coordinate Measuring Machines (CMMs)	2		
		6	Intermediate volumetric check (e.g. ball bar).
<b>Dividing Heads and rotary tables</b>	5 then 10 subsequent	24	
<b>Dry block calibrators</b>	1		EA – 10/13, EURAMET cg-13

<b>Extensometer calibrators</b>	5		AS 2328 and AS 1545
<b>Electrical instruments</b>			
Digital multimeters (DMM), and other types of meters which measure electrical parameters such as volts, resistance, current, capacitance, power, etc...	1		Calibrate over all ranges and parameters of use including calibration across frequency (Hz) of use. NATA Accreditation Guidance Electronic measuring equipment as a reference EURAMET cg-15
		6	Compare with meters of similar resolution
Analogue meters (see above)	1		
		6	Compare with meters of similar resolution
Data loggers/chart recorders (see above)	1		
		6	Check at two points over the range.
<b>Environmentally controlled enclosures</b>			
Temperature-controlled chambers	1		Spatial uniformity, IEC 60068-1; 60068-2-38; 60068-2-39; AS 2853 over 3 points in the temperature working range, EURAMET cg-20
		36	Spatial uniformity in the working zone over 3 points in the temperature working range
Humidity-controlled chambers	1		Humidity distribution in working zone over the operational range. EURAMET cg-20
		12	Spatial uniformity of temperature
CO <sub>2</sub>	On use		Monitor level
Infra Red, Ultraviolet and Visible	1		
		On use	Check operation of the lamps
Pressure / Vacuum	1		Monitor level
<b>Digital signal analysers (sound &amp; vibration)</b>	5		
		12	
<b>Flowmeters</b>			EURAMET cg-19
Differential Pressure meters, orifice meters, venturi meters and Anubar	2	6	Flow or dimensional calibration plus inspection for wear and damage. Associated transducers (temperature, pressure, density) to be calibrated in accordance with that transducer requirement

Electronic Thermal, Mass Flow	1		Where high temperature or corrosive gases are monitored a shorter interval is recommended
Laminar flow meters	2	6	Inspect for damage or contamination
Orifice plates	Initial	6	Visual check for wear and damage
Sonic Nozzle			
Reference 0.1%	3	6	Inspect and clean
Working 0.5%	6	6	Inspect and clean
Soap Film	2		
Positive Displacement Meters	2		
Provers	2	6	Thermometer ice points and pressure readout checks for stability EURAMET cg-21
Rotary meter	2	6	Inspect for contamination or damage
Rotameters Variable area meters	2	3	Visual inspection for damage to float edges or ball float for pitting
Turbine meters	2	6	Inspect for contamination or damage of turbine blades, and free bearing operation
Turbine meters (Pelton Wheel/Miniature)	1	6	Inspect for contamination or damage of turbine blades, and free bearing operation
Vortex shedding	2	6	Inspect for contamination of the bluff body
Wet test meters	2	Before use	Set water level before use
<b>Gauge blocks</b>			
Reference	4 then 8 subsequent		AS 1457 EURAMET cg-02
<b>Glass scale</b> (used as a reference for dimensional comparison)	3 then 6 subsequent		
<b>Haze standards</b>			
Plastic	5		
Glass	10		
<b>Height setting micrometers and riser blocks</b>	3 then 6 subsequent		
<b>Hydrometers</b>			
Reference	5		AS 2026
Working glass	1		
Working metal	6 months		
<b>Hygrometers</b>			
Electronic types (e.g. digital psychrometer)	1		

Digital psychrometers (Aspirated wet and dry- bulb thermometers)	1		
		6	Check against a calibrated thermometer at ambient temperature. Check the wick for contamination and effective wetting and clean or replace if required
Electrical impedance relative humidity sensors	1		Can be 2 yearly if used only under ambient conditions. May need more frequent calibration or checks if used in high humidity environments
Chilled mirror dew or frost point hygrometers	2		Maintain/clean the mirror in accordance with manufacturer recommendations
<b>Inductors</b>	5		
		12	Intercompare
<b>Instrument and ratio transformers</b>	10		Instrument transformers may be extended to 20 years with annual intercomparisons
<b>Instrument transformer test sets</b>	5	12	Compare with a transformer or other known error device. For CT sets every second calibration may be substituted by a test using the NMI/NATA adjustable error current transformer
<b>Laser Power/energy meters</b>	2		
		3	Visual check
<b>Length bars</b>			
Reference	4 then 8 subsequent		AS 1457
Working	2 then 4 subsequent		AS 1457
<b>Levels (precision)</b>	4		
		12	12 monthly single point check for electronic levels
<b>Linear scales (precision)</b>	5 then 10 subsequent		
<b>Load cells</b>			EURAMET cg-04
	2		AS 2193
		On day of use	If amplification is variable perform shunt calibration check
<b>Luminance meters and Illuminance meters</b>			
Digital	1		
Analogue	2		



<b>Manometers</b>			
Reference and Working, liquid (mercury based)	10		Periodically check the cleanliness of the fluid and the cleanliness, shape and freedom of movement of the Hg meniscus. (Changes in the shape of the meniscus as it moves indicates dirty mercury or glass)
		36	Check the cleanliness of the fluid
Reference and Working, liquid (liquid other than mercury)	3		Periodically check the cleanliness of the fluid and the cleanliness, shape and freedom of movement of the Hg meniscus
		18	Check the cleanliness of the fluid
Electronic	1		
<b>Masses</b>			
Reference – integral stainless steel or nickel chromium alloy	3 then 6 subsequent		Verifying Authorities request 3 then 5 subsequent
Working - stainless steel, nickel chromium alloy	3		
Working - other alloy and iron Class III	2		
<b>Mass comparators</b>		6	Repeatability checks at full, half and minimum scale
<b>Metals – Temperature reference</b>			
Freezing fixed point	5		Calibration every 5 years.
<b>Micrometers</b>	5		AS 2102
		1	Zero, one point (against gauge block) and condition of anvils.
<b>Micrometer setting gauges</b>	3 then 6 subsequent		
<b>Microphones (measuring)</b>	2		
		3	Check frequency response and sensitivity
<b>Microphone amplifiers</b>		12	Check frequency response and meter accuracy
<b>Noise analysers</b>			
Integrated in firmware	Initial		No requirement where the analyser has already been type approved. Initial calibration required where instrument has not been type approved, or where firmware changes are made.
<b>Optical flats</b>	3 then 6 subsequent		

<b>Optical parallels</b>	3 then 6 subsequent		
<b>Optical projectors</b>	5		
<b>Orifice plates</b>	Initial	6	Visual check for wear and damage
<b>Oscilloscopes</b>		24	Time base and voltage scale accuracy
<b>Photodetectors</b>			
Silicon cells	3		Linearity and spectral
Others	5		Or when filter transmittances change significantly
		12	Check spectral response with colour filters
		6	Check linearity of response
<b>Photometric Integrating spheres</b>	1		As long as the coating is in reasonable condition then the absolute reflectance is not critical and recoating is not necessary. Annual recalibration using reference lamp is recommended. More frequent calibration may be required if the sphere is new or in a dusty or humid environment or subject to lamps emitting UV radiation.
		3	Check using working standard lamp
<b>Photometric test plate for luminance</b>			
Ceramic or enamel	10		
Others	5		
All		36	Visual inspection
<b>Pitch diameter reference discs</b>	4 then 8 subsequent		
<b>Polygons (precision)</b>	5 then 10 subsequent		
<b>Verification plates for plate readers</b>	10		See photometric test plates
<b>Polilight (Or light source used with specific wavelength filters)</b>		On use	Checked against reference material
<b>Process Instrument Calibrators</b>	1		Initial calibration should include an ACJC check at typical field use ambient temperatures
<b>Pressure balances</b>			EURAMET cg-03
Dead weight testers with accuracy < 0.01%	3		
		12	Spin time and fall rate
Dead weight testers with accuracy > 0.01%	5		

		12	Spin time and fall rate
<b>Pressure equipment</b>			Metrology Society of Australia publication MSA 1 and MSA 2
Mechanical gauges	1		MSA 2
Digital pressure gauges	1		MSA 1
Pressure transducers	1		MSA 1
Pressure transmitters	1		MSA 1
Calibrators	1		MSA 1
<b>Quartz control plates</b>	Initial		
<b>Disappearing filament pyrometers</b>	3		
<b>Radiation thermometers including visible and infrared pyrometers</b>	2		Initial test of target size dependence should be performed Initial calibration should include sufficient points to confirm linearity
		12	Check at one point in range or at ice point
Black body sources	2		Either calibration of the measured radiance temperature in a specified waveband, or, calibration of the monitor sensor together with blackbody cavity uniformity assessment.
<b>Pyrgeometers</b>	3		
<b>Pyrheliometers</b>			
Reference	3		
Working		6	Check against reference
<b>Quartz control plates</b>	Initial		Visual check before use
<b>Radioactive reference material</b>			
Neutron, X-rays, Gamma	5	12	
<b>Radioactive reference material</b>			
Neutron, X-rays, Gamma	5	12	
<b>Radiometers (Thermal)</b>	2 or after 100 tests		
		3	Against know radiant heat source
<b>Reference ballasts</b> Lighting tests	5		
<b>Refractometers</b>		On use	Check against distilled water
<b>Reference glass filters,</b> spectrophotometry, colourimetry, luminous transmittance, neutral density,	10		

<b>Reference tiles</b>			
Plastic and PTFE	3		
Ceramic	10		
Gloss - glass, ceramic	10		
<b>Reference Haze standards</b>			
Plastic	5		
Glass	10		
<b>Refractive index standards</b>			
Liquid	5		
		Before use	Check for contamination
Solid	Initial		
		Before use	Visual examination
<b>Resistors</b>	5		
		12	Intercompare
<b>RF power meters</b>	3		
		6	Intercompare Check VSWR
<b>RF thermister mounts and thermal converters</b>	3		
		6	Intercompare
<b>Rollers and balls</b>	4 then 8 subsequent		
<b>Roughness standards</b>			
Metal	4		
		12	Microscopic inspection
Glass	Initial		
		12	Microscopic inspection
<b>Roundness standards</b>	5 then 10 subsequent		
<b>Screw check plugs for ring gauges</b>	3 then 6 subsequent		EURAMET cg-10
<b>Screw pitch reference standards</b>	3 then 6 subsequent		EURAMET cg-10
<b>Screw thread measurement cylinders and vee pieces</b>	Initial		EURAMET cg-10
		12	Visual inspection
<b>Secondary standard dosimeters (Ionising Radiation)</b>	3	Before use	

<b>Setting cylinders</b>	3 then 6 subsequent		EURAMET cg-06
<b>Setting rings</b>	3 then 6 subsequent		
<b>Shunts</b>	5		
		12	Intercompare
<b>Signal generators</b>	1		When used in isolation to provide reference signals
<b>Sine bars, centres and tables</b>	3 then 6 subsequent		
<b>Sound level meter and Noise dosimeters</b>	2		.
		On use	Check against acoustic calibrator or pistonphone
<b>Sound power source</b>	5		
<b>Spectrophotometers</b>		6	Wavelength accuracy, bandpass, absorbance, stray light error, linearity of response, repeatability and matching of cells.
		On use	A blank and at least 2 points on the calibration curve must be checked
<b>Spectroradiometers, scanning</b>		6	Wavelength accuracy, bandpass, stray light error, linearity of response, repeatability
<b>Spectroradiometers, array</b>	Initial		Wavelength accuracy, bandpass, stray light error, spectral responsivity, linearity of response, repeatability
		6	Wavelength accuracy, spectral responsivity, linearity of response, repeatability
<b>Spectroradiometers, all types</b>		On use	If not calibrating prior to use, a check on a working standard lamp is recommended. Additional checks may be required if the input geometry has been changed
<b>Spectrum and harmonic analysers</b>	1		Parameters to be calibrated dependant on use
<b>Squareness testers</b>	3 then 5 subsequent		
<b>Squares</b>			
Try squares	2 then 5 subsequent		
Block squares	4 then 8 subsequent		
Straightedges, steel/cast iron	3 then 6 subsequent		

Granite	4 then 8 subsequent		
<b>Standard lamps, incandescent</b>			
Luminous flux, Luminous intensity, Illuminance	5		Or after each 20 hours burning period, whichever comes first
Spectral radiance, irradiance, relative measurements	10		Or after 50 hours burning period, whichever comes first
Spectral radiance, irradiance, absolute measurements	5		Or after 20 hours burning period, whichever comes first
Distribution temperature	10		Or after 50 hours burning period, whichever comes first
<b>Standard lamps, LED</b>			
Luminous flux, Luminous intensity, Illuminance	1		Calibration interval may be increased based on stability after several repeat calibrations
<b>Surface plates</b>			
Cast iron	3 then 6 subsequent		
Granite	4 then 8 subsequent		
<b>Thermocouples</b>			EURAMET cg-08
'Base metal' type, sheathed	2		For use up to 400°C. It is not recommended to recalibrate thermocouples used above 400 °C
'Base metal' type, wire	2		For use up to 300° C. Replace if used above 300° C
Stored reels	10		Reel of wire – 4 samples of wire from end points and middle of reel
'Rare metal' type	3		3 years or after 100 hours above 500° C whichever is sooner

<b>Thermometers</b>			
Reference, liquid-in-glass	10		
		Before use	Before use check at ice point. NATA's <i>Liquid-in-Glass Thermometers - Selection, Use and Calibration Checks</i>
Liquid-in-glass	5		
		6	Check at ice point. NATA's <i>Liquid-in-Glass Thermometers - Selection, Use and Calibration Checks</i> OR against reference thermometer at 1 point in range
Resistance			NMI Monograph 11 Platinum Resistance Thermometry
-40°C to 250°C	5		
		6	Check resistance at ice point
<-40°C and >250°C	2		
		6	Check resistance at ice point
Measuring instrument AC Bridge type	5		
Measuring instrument DC Bridge type	2		
		6	Check at ice point
Reference, digital indicating systems, with or without a temperature/humidity sensor, hand held or bench type, single and multichannel	Initial		Calibrate against a reference temperature measuring system. For thermocouple type devices check efficacy of automatic cold junction compensation with the temperature sensor at ice point.
	1		Calibrate against a reference measuring system
		6	Check at ice point
<b>Time interval and frequency standards</b>			
Caesium and Rubidium			Calibration regime dependent on type and accuracy required. This may be as frequently as daily if needed
Other oscillators			Calibration regime dependent on type and accuracy required
Counters	1		
GPS receivers			See Calibration guide in Calibration Electrical Metrology Annex
<b>Torque</b>			ISO 6789 EURAMET cg-14

Standards – beams and masses	4 then 8 subsequent		
Transducers	1		
		6	In house cross check of overlapping ranges
<b>Transfer standards AC-DC</b>			
	1 to 5		If only one is available. Interval dependent on established history and required uncertainty
		6 to 12	Intercompare with appropriate level digital instruments, compare adjacent ranges and self-check
	4 to 8		If two are available. Interval dependent on established history and required uncertainty
		12	Intercompare
<b>Tricolorimeters</b>		12	Check against calibrated colour filters or surfaces
<b>Vibration calibrators</b>	2		
<b>Velocity transducers</b>	3		
		24	Check frequency response and sensitivity
<b>Vibration calibrators</b>	2		
<b>Voltage dividers</b>	5		
<b>Volt ratio boxes</b>	5		
		12	Intercompare
<b>Ultraviolet lamps</b>		During use	Monitor irradiance level
<b>Viscometers</b>			
<b>U-tube viscometers</b>			
Reference	Initial	120	Against reference oils ASTM D2162
Working	Initial		Using quality oils against reference tubes or using reference oils
		24	ASTM D2162/D445; IP 71
<b>Other viscometers</b>			
Brookfield	Initial, then every 2		Against reference oils. <b>Note:</b> As well as the spindle number, laboratories need to report the temperature of the test and the revolution per minute
		1	Against quality (ie. manufacturers') oils.
Ferranti	Initial	3	Against reference oils



Zahn	Initial	12	Against reference oils
<b>Wathour and VAR-hour references</b>			
Electronic	1 to 2		Interval dependant on required uncertainties and instrument history.
		3	Intercompare

## REFERENCES

This section lists publications referenced in this document. The year of publication is not included as it is expected that only current versions of the references shall be used.

### Australian Standards

AS 1349	Bourdon tube pressure and vacuum gauges
AS 1457	Geometrical Product Specifications (GPS) - Length standards - Gauge blocks
AS 1545	Methods for the calibration and grading of extensometers
AS 1984	Vernier callipers (metric series)
AS 2001.1	Methods of test for textiles - Conditioning procedures
AS 2026	Laboratory glassware - Density hydrometers
AS 2102	Micrometer callipers for external measurement
AS 2193	Calibration and classification of force-measuring systems
AS 2328	Micrometer heads - Metric series
AS 2360.1.5	Measurement of fluid flow in closed conduits - Pressure differential methods - Measurement using orifice plates, nozzles or Venturi meters - Pulsating flow, in particular sinusoidal or square wave intermittent periodic-type fluctuations
AS 2853	Enclosures - Temperature-controlled - Performance testing and grading
AS 4476	Acoustics—Octave-band and fractional-octave-band filters
AS IEC 60942	Electroacoustics - Sound calibrators
AS IEC 61672.1	Electroacoustics - Sound level meters - Specifications
AS IEC 61672.2	Electroacoustics - Sound level meters - Pattern evaluation tests

### Other Standards

ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ASTM D2162	Standard Practice for Basic Calibration of Master Viscometers and Viscosity Oil Standards
EA-10/13	EA Guidelines on the Calibration of Temperature Block Calibrators
IEC 1260	Electroacoustics - Octave Band and Fractional Octave Band
IEC 60068-1	Environmental testing. Part 1: General and guidance;
IEC 60068-2-38	Environmental testing - Part 2-38: Tests - Test Z/AD: Composite temperature/humidity cyclic test;
IEC 60068-2-39	Environmental testing - Part 2: Tests. Test Z/AMD: Combined sequential cold, low air pressure, and damp heat test;
ISO 6789	Assembly tools for screws and nuts -- Hand torque tools -- Part 2: Requirements for calibration and determination of measurement uncertainty

- IP 71: Kinematic Viscosity of Transparent & Opaque Liquids  
ISO/IEC Guide 99 International vocabulary of metrology -- Basic and general concepts and associated terms (VIM)  
ISO/IEC 17025 General Requirements for the competence of calibration and testing laboratories

### **NATA Publications**

#### General Accreditation Criteria

Metrological Traceability

Equipment assurance, in-house calibration and equipment verification

#### General Accreditation Guidance

The in-situ calibration of Barometers

User Checks of Balance Calibration

Liquid-in-Glass Thermometers – Selection, Use and Calibration Checks

Electronic measuring equipment as reference standards

### **Other Publications**

NMI Monograph 11 *Platinum Resistance Thermometry*

NMI Monograph 4 *The Calibration of Weights and Balances* EC Morris and KMK Fen

*Calibration of Pressure Calibrators, Indicators and Transducers* Metrology Society of Australia MSA Test Method 1 - 2008

*Calibration of Pressure Gauges* Metrology Society of Australia MSA Test Method 2 - 2008

### **EURAMET calibration guides**

- EURAMET cg-15 Guidelines on the Calibration of Digital Multimeters  
EURAMET cg-19 Guidelines on the Determination of Uncertainty in Gravimetric Volume Calibration  
EURAMET cg-21 Guidelines on the Calibration of Standard Capacity Measures using the Volumetric Method  
EURAMET cg-02 Calibration of Gauge Block Comparators  
EURAMET cg-06 Extent of Calibration for Cylindrical Diameter Standards  
EURAMET cg-10 Determination of Pitch Diameter of Parallel Thread Gauges by Mechanical Probing  
EURAMET cg-22 Guidelines on the Calibration of Autocollimators  
EURAMET cg-23 Guidelines on the Calibration of Angular Encoders  
EURAMET cg-03 Calibration of Pressure Balances  
EURAMET cg-04 Uncertainty of Force Measurements  
EURAMET cg-14 Guidelines on the Calibration of Static Torque Measuring Devices  
EURAMET cg-08 Calibration of Thermocouples  
EURAMET cg-11 Guidelines on the Calibration of Temperature Indicators and Simulators by Electrical Simulation and Measurement

EURAMET cg-13 Guidelines on the Calibration of Temperature Block Calibrators

EURAMET cg-20 Guidelines on the Calibration of Temperature and / or Humidity Controlled Enclosures

## Amendment Table

The table below provides a summary of changes made to the document with this issue.

Section or Clause	Amendment
All parts	Update and minor editorials
Additions	<p>The following items have been added;</p> <ul style="list-style-type: none"> <li>• LED Standard lamps</li> <li>• Spectroradiometers, scanning</li> <li>• Spectroradiometers, array</li> <li>• Spectroradiometers, all types</li> <li>• Glass scale</li> </ul>
Deletions	<p>The following items have been removed as they are considered not appropriate to use as reference standards/instruments;</p> <ul style="list-style-type: none"> <li>• Assmann and sling psychrometers</li> <li>• Power meters electro-mechanical type</li> <li>• Thermometers 'working type'</li> <li>• Pressure gauges, non standard types</li> <li>• Network analysers</li> <li>• Neutral density filters</li> <li>• Acoustics, Impedance matching networks</li> </ul>
Variations	<p>The following items have had changes to the guidance;</p> <ul style="list-style-type: none"> <li>• Precision scales</li> <li>• Dividing heads</li> <li>• Digital psychrometers</li> </ul>
All	Addition of the EURAMET guides as example reference standard