PAINTING CONTRACTOR CERTIFICATION PROGRAM
TECHNICAL NOTE - CALIBRATION OF INSPECTION & TEST EQUIPMENT

Editorial Note: This version of the documentis split into sections and updated according to NATA requirements Jan 2018

1. SCOPE

This Technical Note details the PCCP requirements for the calibration of inspection and testing equipment (ITE) of protective coatings, floor coatings and pavement markings. The ITE requirements have been developed by considering the order of accuracy required in the inspection and testing plans (ITP) required to achieve optimum performance from the coating systems being applied.

2. AUTHORITY & RESPONSIBILITY

1. The Executive Officer, PCCP (EO) has the authority to implement the requirements of this procedure.
2. The Technical Committee retains the responsibility for the content of the procedure.

3. REFERENCED DOCUMENTS

This procedure makes reference to the following documents;

a) AS 3894 Site testing of protective coatings
b) IEC 60052 Ed. 3.0 Voltage measurements by means of standard air gaps

Australian Standards (AS) and International Electrotechnical Commission (IEC) documents are available for online purchase from SAI-Global at www.standards.org.au

c) NACE SP0188-2006 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NACE documents are available for online purchase from NACE International athttp://www.nace.org

d) NATA Reference equipment – calibration Reference Equipment Table June 2018
e) NATA General Equipment – Calibration and Checks January 2018

NATA documents are available for free download from NATA at http://www.nata.com.au

All PCCP documents and forms are available for free download from the Documents section of the PCCP portal of the APAS website at www.apas.gov.au

4. DEFINITIONS

a) *Calibration* – an operation under specified conditions that establishes a relationship between values and measurement uncertainties.
   - External calibrations are usually carried out by external laboratories complying with ISO 17025 sub-clause 5.6.2.1 and NATA Policy Circular 12.
   - Internal calibrations are carried out in house and are traceable to externally calibrated reference instruments.

b) *Checking* – the measurement of at least one point in a range of an instrument against a known value to confirm that it has not deviated significantly from its original calibrated value. Checks are used to determine if an instrument has changed since its last calibration.
c) *ITE* – Inspection and test equipment used either on the actual job or in the site office or in the main office for the purpose of measuring a particular parameter to determine compliance to specification requirements.
d) *Primary Standards* – reference standards that are maintained and housed under controlled conditions at the principal office of the contractor. Primary Standards are externally calibrated.
e) *Secondary Standards*; working standards generally used in the field and calibrated in house or externally against Reference standards. Organisations performing in house calibrations must be able to demonstrate that they have technical competence to perform the calibration procedures involved.

5. INTRODUCTION

ITE used by a contractor is required to be calibrated and/or checked to ensure that it is capable of the accuracy and precision required. Appropriate handling, preservation, storage and maintenance of such equipment is undertaken to preserve that accuracy.
Inspection & test equipment practices, processes and procedures must:

a) Be documented to ensure requirements and practices are unambiguous and easily understood
b) Describe how the calibration status of infrequently used equipment is ensured
c) Establish calibration and/or checking intervals including "prior to use" where this is appropriate.
d) Establish calibration and/or checking methods such as external or internal calibration or internal checking. ITE may be checked against Primary Standards certified to recognised standards. If no such recognised standard exists, the basis used for the calibration shall be documented.
e) Establish acceptance criteria for internally calibrated or checked ITE.
f) Ensure that all ITE is traceable back to records showing the calibration status at the time of use.
g) Ensure comprehensive records of calibration, checking and maintenance activities are kept and available.
h) All calibration certificates must be reviewed on arrival to check for errors/uncertainties and acknowledged and dated.

6. REQUIREMENTS

6.1 Dry film thickness gauges

a) AS 3894.3 'Site testing of protective coatings - Determination of dry film thickness' details the use and calibration of various instruments used for dry film thickness measurement. The contractor will be required to have a set of Primary Standards and a set of Secondary Standards.
b) Primary (or Master) standards are small panels, each of uniform thickness, covering the appropriate range of film thickness to be measured. Primary (or Master) standards need to be kept secure and away from general access, and are only to be used by the calibrating officer when instrument checking is required.
c) Secondary (or working) standards are usually supplied with the instrument on purchase. Because these secondary standards are used daily, they are subject to wear and tear and need to be checked regularly to ensure continued accuracy.

6.2 Thermometers

a) Contractors should have access to, or have purchased, a calibrated reference thermometer with a calibration certificate. As a reference instrument it needs to be kept secure and away from general access, and is only to be used by the calibrating officer when instrument checking is required.
b) The Reference Thermometer Liquid-in-glass will need to be recalibrated externally every 10 years.
c) As externally or internally calibrated infrared thermometers and surface temperature gauges are used daily, they subject to wear and tear and need to be checked regularly to ensure continued accuracy.

6.3 Humidity measurement

a) Calibration requirements are dependent on the type of instrument used. Required calibration frequencies are detailed in Tables 1, 2 and 3.
b) If the whirling hygrometer is to be used, the calibration needs to be in conformance with Appendix B and the frequency of calibration shall be as per Tables 1, 2 and 3.
c) If an electronic hygrometer is to be used, the calibration needs to be in conformance with Appendix B and the frequency of calibration shall be as per Table 1, 2 and 3.

6.4 Pinhole & holiday testing

6.4.1 Low Voltage Wet Sponge Method

The low voltage wet sponge holiday detector is used for testing for pinholes and holidays in non-conductive coatings of thickness up to 250µm. Calibration of these instruments is usually not necessary. If required, NACE SP-0188 describes a procedure. However, verification of proper operation should be carried out prior to use. This is done by touching the damp sponge to a section of bare metal to which the ground wire has been attached.

6.4.2 High Voltage Spark Tester

High voltage spark testers are used to check for discontinuity in thick coatings above 150µm. The test method and calibration requirements are described in AS 3894.1. The voltage is checked using a special high voltage voltmeter (Crest

Meter) which has been calibrated within the last two years by a laboratory certified for that purpose.

6.5 Moisture meters

Concrete floors must be sufficiently dry before the floor covering is installed. Excessive moisture can lead to problems such as adhesive degradation, delaminating floor coverings from the slab and within itself, condensation, blistering, movement, mould and overall deterioration of the covering.

Moisture tester are indicative only. They are usually checked by placing probe in water (not an electronic probe) to check that the reading is high.

7. CALIBRATION FREQUENCY

The frequency and details of the calibration or checking are specified in Tables 1, 2 & 3.

8. ACKNOWLEDGMENT

Referenced documents are acknowledged in Clause 3 of this document.

9. TABLE 1 – CALIBRATION & CHECKING REQUIREMENTS FOR PROTECTIVE COATINGS

Instrument	Calibration and checking method	Calibration Intervals	Checking intervals
A. Dry Film Build measurement			
Reference gauge blocks (Reference shims)	External calibration with supplied certificate.	4 years (initial) then 8 years (subsequent)	N/A
Working gauge blocks (Working shims)	Internal checking against the Reference gauge blocks (reference shims)	N/A	Annually
Electronic DFB gauge	Appendix A	N/A	1 year, against reference shims and Prior to use, against working shims.
Vernier callipers	External calibration with supplied certificate.	2 years	Prior to use, zero point check, correct closure of jaws.
High Voltage Spark tester	External calibration with supplied certificate.	2 years	On use. Touch the damp sponge to a section of bare metal to which the ground wire has been attached.
B. Humidity measurement			
Reference sling psychrometers	External calibration with supplied certificate.	10 years	Prior to use visual check that the liquid column is continuous.
Working sling psychrometers	Internal checking. Refer to Appendix B for Calibration & Checking Methods	N/A	6 months and prior to use visual check that the liquid column is continuous.
Working electronic types	External calibration with supplied certificate & internal checking. Refer to Appendix B for Calibration & Checking Methods.	1 year	6 months
C. Temperature measurement			
Reference thermometer (Liquid-in-glass)	External calibration with supplied certificate.	10 years	Prior to use visual check that the liquid column is continuous
Working thermometer (Liquid–in-glass)	Internal checking. Refer to Appendix C for Calibration & Checking Methods	N/A	6 months and Prior to use visual check that the liquid column is continuous.
Working Infrared (IR) thermometer	Calibration external (with supplier certificate) & internal checking. Refer to Appendix C for Calibration & Checking Methods	2 years	6 months
Working surface (e.g. magnetic) thermometer	Calibration external (with supplier certificate) & internal checking. Refer to Appendix C for Calibration & Checking Methods.	2 years	6 months

9. TABLE 2 – CALIBRATION & CHECKING REQUIREMENTS FOR PAVEMENT MARKINGS

Instrument	Calibration and checking method	Calibration Interval	Checking interval
A. Dry Film Build measurement			
Wet Film Build Gauge	Visual for damage and cleanliness.	6 months	Prior to use, visual check for damage.
Vernier Callipers, Micrometer	Against secondary shims	2 Year	Prior to use, zero point check, correct closure of jaws.
Wet Film Build -using Application (on board) Computer read out	Internal calibration of the data inputs to the application computer that are used by the computer to calculate the Wet Film Build readout.	6 months	Regular checks (at least monthly) reconciling the quantity of pavement marking applied quantity material being used.
B. Humidity measurement			
Reference sling psychrometers	External calibration with supplied certificate.	10 years	Prior to use visual check that the liquid column is continuous.
Working sling psychrometers	Internal checking. Refer to Appendix B for Calibration & Checking Methods	N/A	6 months and prior to use visual check that the liquid column is continuous.
Working electronic types	External calibration with supplied certificate & internal checking. Refer to Appendix B for Calibration & Checking Methods.	1 year	6 months
C. Temperature measurement			
Reference thermometer (Liquid-in-glass)	External calibration with supplied certificate.	10 years	Prior to use visual check that the liquid column is continuous
Working thermometer (Liquid–in-glass)	Internal checking. Refer to Appendix C for Calibration & Checking Methods	N/A	6 months and Prior to use visual check that the liquid column is continuous.
Working Infrared (IR) thermometer	Calibration external (with supplier certificate) & internal checking. Refer to Appendix C for Calibration & Checking Methods	2 years	6 months
Smart Phone	Access nearest BOM site	N/A	N/A
D. Linear measurement			
Rulers and Tapes	Visual for damage and cleanliness.	N/A	Prior to use, visual check for damage.
Surveyor's wheel	Visual for damage and cleanliness. Calibration over 10 metre distance	N/A	Prior to use, visual check for cleanliness and damage.
E. Time measurement			
Timing devices	Internal checking against telephone speaking clock or GPS	N/A	6 months
F. Mass measurement			
Balances	External calibrated reference weight close to maximum capacity of the scale	3 years	12 months and Prior to use zero point, tare check and, visual check for damage.
G. Volume measurement			
Graduated Container	Using known weights of water	6 months	Prior to use, visual check

9. TABLE 3 – CALIBRATION & CHECKING REQUIREMENTS FOR FLOOR COATINGS

Instrument	Calibration and checking method	Calibration Intervals	Checking intervals
A. Dry Film Build measurement			
Wet Film Build Gauge	Visual for damage and cleanliness.	6 months	Prior to use, visual check for damage.
Vernier Callipers, Micrometer	Against secondary shims	2 Year	Prior to use, visual check for damage.
Wet Film Build -using calculations	See Appendix D	N/A	N/A
B. Humidity measurement			
Reference sling psychrometers	External calibration with supplied certificate.	10 years	Prior to use visual check that the liquid column is continuous.
Working sling psychrometers	Internal checking. Refer to Appendix B for Calibration & Checking Methods	N/A	6 months and prior to use visual check that the liquid column is continuous.
Working electronic types	External calibration with supplied certificate & internal checking. Refer to Appendix B for Calibration & Checking Methods.	1 year	6 months
Smart Phone	Access nearest BOM site	N/A	N/A
C. Temperature measurement			
Reference thermometer	External calibration with supplied certificate.	10 years	Prior to use visual check that the liquid column is continuous.
Working thermometer (Liquid–in-glass)	Internal checking. Refer to Appendix C for Calibration & Checking Methods	N/A	6 months and Prior to use visual check that the liquid column is continuous.
Working electronic (IR) thermometer	External or internal calibration. Refer to Appendix C for Calibration & Checking Methods	5 years	6 months
D. Linear measurement			
Rulers and Tapes	Visual for damage and cleanliness.	N/A	Prior to use, visual check for damage
Surveyor's wheel	Calibration over 10 metre distance	6 months	Prior to use, visual check for cleanliness and damage.
F. Mass measurement			
Digital Scale	Using secondary 100 gram mass	3 years	6 months and Prior to use zero point, tare check and, visual check for damage.
F. Mass measurement			
Graduated Container	Using known weights of water	N/A	Prior to use, visual check for damage

10. APPENDIX A – CHECKING METHOD FOR ELECTRONIC DRY FILM THICKNESS INSTRUMENTS & WORKING SHIMS

10.1 Scope

Appendix A prescribes a suitable method to be used for checking the accuracy of working gauge blocks (Working shims) and electronic dry film build (DFB) instruments. External calibration by an accredited laboratory is also acceptable; though not necessarily cost effective or timely.

10.2 Apparatus

The following equipment is required to carry out the checking of the DFB instrument.

a) Working gauge blocks (Working shims)
b) Primary gauge blocks (Reference shims)

10.3 Process

A. Check of the electronic DFB instrument – prior to use;

a) Prior to using the electronic DFB instrument, an initial check needs to be undertaken to the manufacturer's working instructions. Checking shall include a zero check and a check against at least one Working shim. Refer to Clause 10.4 for Acceptance Criteria.

B. Check of the electronic DFB instrument – Annual;

a) Condition the Reference shims, working shims and the electronic DFB instrument in a room[1] for 15 minutes. The Reference shims, working shims and the electronic DFB instrument are to be placed next to (but not touching) each other in a location that is not in the direct path of air flow.
b) Zero the instrument using its designated probe.
c) Take one reading on the first Reference shims. Record the reading.
d) Take one reading on the corresponding working shim. Record the reading.
e) Calculate the difference in readings in microns & percent using the formula:

$$100\ (T1-T2)/T1$$

Where T1= thickness of Reference shim and T2= thickness of Working shim.
f) Repeat steps c) to e) for each of the shims
g) Refer to Clause 10.4 for Acceptance Criteria.

Note 1: The room where equipment checking is to be done can be any room inside a building where constant temperature can be maintained.

10.4 Acceptance Criteria

a) Acceptance criteria can be set by the organisation; but criteria greater than ±5% of the gauge block's stated thickness may need to be technically justified to PCCP.

10.5 Actions on non-Acceptance

a) Where an instrument or its shims fail to fall within the organisation's acceptance limits, the Manager responsible for technical matters shall be informed of the outlier check result and a decision on actions to be taken shall be made.

b) Such decisions may include concessional acceptance (where the outlier results are minor deviations), purchase of new shims or instrument.
c) Where new shims are purchased, retirement of the reference shims to working shims is allowed if the newly purchased shims are certified.

11 APPENDIX B – CHECKING METHOD FOR HUMIDITY INSTRUMENTS

11.1 Scope

Appendix B prescribes suitable methods for checking the accuracy of working sling psychrometers and working electronic hygrometers. External calibration by an accredited laboratory is also acceptable; though not necessarily cost effective or timely.

11.2 Apparatus

The following apparatus or equipment is required:
a) A reference thermometer
b) A sling psychrometer
c) A dew point chart

11.3 Process

A. Check of the working sling psychrometer;

The Sling psychrometer consists of two liquid in glass thermometers. These thermometers are checked as if they were working liquid-in-glass thermometers. This is done using the checking method outlined in Clause 12.3 of Appendix C. “Checking the working liquid-in-glass thermometer”. The Sling pyschrometer does not need to be dismantled as the thermometers can be immersed in the water.
The criteria for acceptance for a Sling psychrometer are as follows:
Compare the temperature readings of the sling psychrometer’s thermometers against the reference thermometer at room temperature
The thermometers in the sling psychrometers must be within ± 1°C of the reference thermometer and within ± 0.5°C of one another, this applies to both the ice point test and the one point temperature check.

B. Check of the working digital/electronic hygrometer

a) Condition the reference sling psychrometer (with wick wet) and digital/electronic hygrometer a room[1] free of drafts for 15 minutes.
b) Use the reference psychrometer to determine and record the % Relative Humidity.
c) Read and record the %Relative Humidity displayed on the digital/electronic hygrometer
d) Whirl the sling psychrometer in the room for 3 minutes. From the Dew Point Chart, determine the relative humidity.
e) Compare the relative humidity result determined by the Sling psychrometer to that displayed by the digital/electronic hygrometer.
f) Refer to Clause 11.4 for the Acceptance Criteria.

11.4 Acceptance Criteria

a) Acceptance criteria can be set by the organisation; but criteria greater ± 5% RH variance between the working and reference hygrometers may need to be technically justified to PCCP.

11.5 Actions on non-Acceptance

a) Where an instrument fails to fall within the organisation's acceptance criteria, the Manager responsible for technical matters shall be informed of the outlier check result and a decision on actions to be taken shall be made.
b) Such decisions may include concessional acceptance (where the outlier results are minor deviations), or the purchase of new equipment.

12. APPENDIX C – CHECKING METHOD FOR THERMOMETERS

12.1 Scope

Appendix C prescribes suitable methods for calibrating and checking the accuracy of working Thermometers used for air or surface temperature measurement.
External calibration by an accredited laboratory is also acceptable; though not necessarily cost effective or timely.

12.2 Apparatus

The following apparatus is required:

a) Reference thermometer for calibrating the working thermometer.
b) An insulated plastic container, coffee cup size approximately 11cm high and 7 cm in diameter.
c) An in calibration working thermometer for calibrating the infrared thermometer.
d) Distilled water.
e) Ice made from distilled water.
f) A weathered steel plate; of minimum dimensions 100 mm. x 100 mm. x 4mm.

12.3 Process

A. Checking the working liquid-in-glass thermometer

Visual Inspection
Inspect both the Reference and working thermometers for cleanliness. The thermometers must be clean and dry, any contamination can affect the checking results especially the ice point. Check the liquid columns are continuous (the liquid must be continuous for the thermometer to measure the correct temperature).
Ice Point Check
The ice point check is a quick and convenient way to spot check the accuracy of a liquid-in-glass thermometer. The ice point test is a good test method to monitor any problems with a liquid in glass thermometer. The temperature of the distilled ice is 0.00ºC ±0.01ºC.

a) Fill the container about a quarter with cold distilled water and then add crushed ice made from distilled water to fill the container. Mix and allow to mixture stand for 5 minutes.
b) Immerse the Reference and Working thermometers in the container making sure that they do not make contact with each other or the wall or bottom of the container. After 5 minutes check and record the thermometer readings.
c) The ice point reading of both thermometers must be within ± 1°C of 0°C. If not repeat the check. If the working thermometer still does not meet this criteria it should be replaced.

One Point Temperature Check
The working thermometer is checked at a temperature that is commonly used, say at 20 ºC to 30 ºC for a working thermometer used to measure ambient temperatures.

a) Fill the container with water at the checking temperature (20 ºC to 30 ºC) and immerse both

b) Immerse the Reference and Working thermometers in the container making sure that they do not make contact with each other or the wall or bottom of the container. After 5 minutes check and record the thermometer readings.
c) The reading of both thermometers must be within ± 1°C of each other

B. Check of the working Infra-Red thermometer

a) Place the reference or working thermometer on the piece of steel in a room free of drafts and have the Infrared thermometer in the same room and leave them to stabilize for 30 minutes
b) Record the reading on the reference or working thermometer.
c) Use the infrared thermometer to take three readings on the steel block near to the bulb of the reference or working thermometer and record the readings. Calculate and record the average reading.
d) Calculate the difference between the reading on the reference or working thermometer and the average of the infrared thermometer readings.
e) The reading of both thermometers must be within ± 2°C of each other.

C. Check of the working Magnetic surface thermometer

a) Place the Reference or Working thermometer and the magnetic surface thermometer on the piece of steel in a room free of drafts and leave them to stabilise for 30 minutes
b) After 30 minutes record the readings on the two thermometers.
c) The reading of both thermometers must be within ± 2°C of each other**.**

12.4 Acceptance criteria

a) Acceptance criteria unless specified in the checking method can be set by the organisation; but criteria greater than ± 2°C variance between the working and reference thermometers may need to be technically justified to PCCP.

12.5 Actions on non-acceptance

a) Where an instrument fails to fall within the organisation's acceptance limits, the Manager responsible for technical matters shall be informed of the outlier check result and a decision on actions to be taken shall be made.
b) Such decisions may include concessional acceptance (where the outlier results are minor deviations), or the purchase of new equipment.

13. APPENDIX D – CALCULATING QUANTITY OF MATERIAL FOR FLOOR APPLICATION

13.1 Scope

Appendix D prescribes suitable methods to achieve optimum in service performance from a floor coating manufacturers Data Sheets that specify how the floor coating should be applied to achieve this optimum performance.

13.2 Process

One of the most important items specified is the Application (Spreading) Rate or the Film Build. Applying and achieving to the correct Film Build is not only important for maximising the in service performance of the floor coating but also insures that dollars are not wasted in applying an excess amount of coating.

The following procedure can be used to determine the quantity of a floor coating required to uniformly cover a measured area of a smooth floor surface at a specified Application Rate or Film Build. Allowances have to be made when the floor surface being coated is textured, porous or has surface imperfections. Any wastage or losses during application process must also be considered.

13.3 Equipment required

A Data Sheet from the manufacturing of the floor coating recommending or specifying the Application Rate or Film Build or an ITP or Specification from the client.
A tape measure and calculator, or a laser measuring device is used to measure the dimensions of the floor and to calculate the area.

13.4 METHODS

METHOD NUMBER 1

USING THE SPECIFIED APPLICATION (or SPREADING) RATE
This method is used where the floor coatings manufacturer recommends or specifies a rate of application in either Square Metres per Litre or Square Metres per Kilogram.

Measure the dimensions of the floor to be coated and calculate the surface area in Square Metres.
Determine the spreading rate specified or recommended in the floor coating manufacturers Data Sheet.

Use the following formulas to calculate the Quantity of surface coating required to uniformly coat the measured floor area at the specified application rate.

Calculation where the application rate is specified in Square Metres per Litre

$$\text{Quantity in Litres} = \frac{\text{Floor Area in Square Metres}}{\text{Application Rate in Square Metres per Litre}}$$

Calculation where the application rate is specified in Square Metre per Kilograms

$$\text{Quantity in Kilograms} = \frac{\text{Floor Area in Square Metres}}{\text{Application Rate in Square Metres per Kilogram}}$$

METHOD NUMBER 2

USING THE SPECIFIED WET OR DRY FILM BUILD
This method is used where the floor coatings manufacturer recommends or specifies the WET or DRY Film Build.

Measure the dimensions of the floor to be coated and calculate the surface area in square metres.
Determine Wet or Dry Film Build specified or recommended in the floor coating manufacturers Data Sheet.
The film thicknesses used in the calculations below are in mm. **Note:** Where the Film thickness is quoted in microns or µm it must be first converted to mm before using the formulas below. One mm equals 1000 microns. A micron is also known as a micrometre (one millionth of a metre) and is represented by the symbol µm.
Then use the following formulas to calculate the Quantity of floor coating required to uniformly coat the measured surface area at the specified application rate.

Calculation where the WET Film Build is specified in millimeters (mm)

Quantity in Litres = WET Film Thickness (mm) X AREA (Square Metres)

Calculation where the DRY Film Build is specified in millimeters (mm)

Where a DRY Film Build is specified it is necessary to first calculate the corresponding WET Film Build as follows. **Note:** in cases where the Volume Solids of the surface coating is 100% then the WET and DRY film builds can be regarded as the same.

$$\text{WET Film Build in mm} = \text{DRY Film Build in mm} \times \frac{100}{\%\text{VOLUME SOLIDS}}$$

Then perform the calculation using the Wet Film Thickness in mm.

RECONCILIATION AFTER APPLICATION

When the application is complete, and the quantity of uniformly applied floor coating and the floor area to which it has been applied are both known, then the formulas above can be used to calculate the applied film build.
This is often referred to as a Reconciliation Method, and is used not only as a Quality Control check, but also check on the quantities of floor coating materials being consumed.