CMC Review Protocol for Humidity Generators

1. Scope: To provide a method of reviewing CMC's on humidity generators (Service Categories 4.1 to 4.4 and 5.1) for acceptance in Appendix C of the KCDB.

The CMC review protocol described in this document is primarily designed for use during the RMO review of the CMC's by the RMO CMC review committee. After the RMO review, the CCT inter-RMO CMC review committee shall review only those CMC entries that are labelled "under review" from the RMO CMC review process. After the CMC review process is completed, the CMC's are submitted for general acceptance to the JCRB.

The review process according to this protocol is presented graphically in appendix A.

2. Acceptance Criteria for Service Categories 4.1 to 4.4 and 5.1

2.1 In the whole claimed operating range, the measurand is within the range of NMI's accepted CMCs in the relevant Hygrometers service category (Service Categories 3.1 to 3.4).

2.2 In the whole claimed operating range, the claimed uncertainties are not smaller than NMI's accepted CMCs in the relevant Hygrometers service category (Service Categories 3.1 to 3.4).

2.3 In the whole claimed operating range, the relevant specific criteria in Sections 3 and 4 are met.

2.4 If the criteria 2.1, 2.2 and 2.3 are fulfilled, then the uncertainty is deemed acceptable.

If the CMC fulfils the criteria 2.1 and 2.2 but not the criterion 2.3, then the uncertainty claim requires scrutiny by the NMI's RMO.

3. Specific Acceptance Criteria for Service Category 4.1 to 4.4

3.1 Criteria for calibrations carried out in terms of dew-point temperature within Service categories 4.1, 4.3 and 4.4

The NMI should provide an uncertainty budget for the whole claimed operating range showing that at least the following components are included:

- Reference hygrometer[1]:
  - Calibration of the reference hygrometer

[1] If more than one reference hygrometer, reference thermometer or humidity generator is used then the corresponding uncertainty budget entries are required.

  - Drift of the reference hygrometer since the last calibration against the NMI's reference generator and during the customer calibration
  - Stability of the measured values
  - Repeatability/reproducibility of the reference hygrometer
  - Resolution of the reference hygrometer (or uncertainty of the measurement of the output signal)
  - Effect of flow rate deviations on the performance of the hygrometer
  - Uncertainty of pressure correction between the measuring head and the reference pressure measurement point.
  - Non-linearity
- Measurements against the generator under test
  - Stability of the measured dew-point temperature values
  - Repeatability and reproducibility of the measured dew-point temperature with the same settings of the generator under calibration
  - Variation and instability of gas flow through the generator
  - Variations in the saturator water level in the generator
  - Uncertainty of pressure correction between the output pressure gauge and the reference pressure measurement point (if relevant)
  - Hysteresis

3.2 Criteria for calibrations carried out in terms of relative humidity and gas temperature within Service category 4.2 (relative humidity generators)

The NMI should provide an uncertainty budget for the whole claimed operating range showing that at least the following components are included:

- Reference hygrometer:
  - Calibration of the reference hygrometer
  - Drift of the reference hygrometer since the last calibration against the NMI's reference generator and during the customer calibration
  - Repeatability/reproducibility of the reference hygrometer
  - Resolution of the reference hygrometer (or uncertainty of the measurement of the output signal)
  - Effect of flow rate deviations on the performance of the hygrometer
  - Non-linearity
  - If the reference hygrometer uses an impedance-type sensor,
    - Temperature dependence of the relative humidity indication
    - Hysteresis

    - If the reference hygrometer uses a condensation-type sensor (e.g. a chilled-mirror sensor, or chilled surface-acoustic-wave sensor) :
        - Uncertainty of pressure correction between the measuring point and the dew-point sensor.
        - Uncertainty in relative humidity associated with frost-dew ambiguity
- Reference thermometer (integrated in the reference thermohygrometer probes or separate thermometer):
    - Calibration of the reference thermometer
    - Drift of the reference thermometer since the last calibration
    - Repeatability/reproducibility of the reference thermometer
    - Resolution of the reference thermometer (or uncertainty of the measurement of the output signal)
    - Effect of flow rate deviations on the performance of the thermometer [i.e. thermal dissipation error]
    - Effect of heat flow along the thermo(hygro)meter probes [i.e. immersion error]
    - Hysteresis
    - Non-linearity
    - Stability of the measured values
- Measurements against the generator under test
    - Stability of the measured values
    - Repeatability and reproducibility of the measured relative humidity and gas temperature with the same settings of the generator under calibration
    - Variation and instability of gas flow through the generator
    - Variations in the saturator water level in the generator
    - Water vapour gradients in the measurement volume
    - Gas temperature gradients in the measurement volume
    - Effect of loading
    - Effect of thermal radiation (if relevant)
    - Hysteresis
    - Non-linearity (if relevant)
    - Resolution (if relevant)
    - Response time

4. Specific Acceptance Criteria for Service Category 5.1

4.1 Criteria for calibrations carried out in terms of relative humidity and gas temperature within Service category 5.1 (salt solution generators)

The NMI should provide an uncertainty budget for the whole claimed operating range showing that at least the following components are included:

- Reference thermohygrometer:
    - Calibration of the reference thermohygrometer

  - Drift of the reference thermohygrometer since the last calibration against the NMI's reference generator and during the customer calibration
  - Repeatability/reproducibility of the reference thermohygrometer
  - Resolution of the reference hygrometer (or uncertainty of the measurement of the output signal)
  - Effect of gas flow on the performance of the thermohygrometer (static vs. dynamic)
  - Effect of heat flow along the thermohygrometer probes
  - Temperature dependence of the relative humidity indication
  - Hysteresis
  - Non-linearity
  - Response time
- Reference thermometer (integrated in the reference thermohygrometer probe or separate thermometer)
  - Calibration of the reference thermometer
  - Drift of the reference thermometer since the last calibration
  - Repeatability/reproducibility of the reference thermometer
  - Resolution of the reference thermometer (or uncertainty of the measurement of the output signal)
  - Effect of flow rate deviations on the performance of the thermometer [i.e. thermal dissipation error
  - Effect of heat flow along the thermo(hygro)meter probes [i.e. immersion error]
  - Hysteresis
  - Non-linearity
  - Stability of the measured values
- Measurements against the generator under test
  - Stability of the measured values
  - Repeatability of the measured relative humidity and gas temperature with the same salt solution in the generator under calibration (only for saturated salt solutions)
  - Reproducibility of the measured relative humidity and gas temperature when changing the salt solution in the generator under calibration
  - Water vapour gradients in the measurement volume
  - Gas temperature gradients in the measurement volume
  - Effect of loading
  - Effect of salt solution quality
  - Response time

APPENDIX A: DIAGRAM SHOWING THE CMC REVIEW PROCESS