

The Technical Committee for Electricity and Magnetism (TC-EM) of EURAMET is in charge of scientific, technical and organizational issues related to electromagnetic metrology.

TC-EM areas of development include:

- Realization of the SI units of electromagnetism;
- Determination of electromagnetic constants and fundamental tests;
- Quantum electrical metrology;
- DC voltage, resistance, and current;
- AC resistance, capacitance, inductance;
- AC voltage, current, power and energy; power quality;
- High voltage and current;
- Other DC and low frequency measurements, including electric charge, phase angle, current and voltage waveform,
- Electric, magnetic, and electromagnetic fields;
- Radio frequency and microwave measurements;
- THz metrology;
- Electromagnetic properties of materials, including electrical conductivity, dielectric and magnetic properties;
- Electrical and magnetic measurements at the nanoscale.

TC-EM is responsible for the execution of the activities required by EURAMET as Regional Metrology Organisation (RMO) for the fulfilment of the Mutual Recognition Arrangement of the International Committee of Weights and Measures (CIPM-MRA), including the management of the Calibration and Measurement Capabilities, the organisation of Comparisons, the maintenance of Guide of Comparisons in the field.

TC-EM contributes to the elaboration and execution of EURAMET Strategy and EURAMET Metrology Research Programmes (at the present time, EMRP and EMPIR).

TC-EM organizes a Contact Person Meeting annually, and other meetings devoted to specific matters (e.g., participation to Metrology Research Programmes).

TC-EM Chair reports to EURAMET through an Annual Report and the participation to EURAMET TCC and General Assembly.

Chairmanship and membership to TC-EM is regulated by the EURAMET Rules of Procedure [present version G-PRM-ROP-010, version v4.0 24 may 2016, Sec. IX]





The Technical Sub-Committees (SC) of TC-EM further develop the discussion of technical issues related to electrical metrology, the organization of Comparisons and Pilot Studies, the proposal and maintenance of the Calibration Guides. The established SCs of TC-EM are:

- SC DC and Quantum Metrology (SC-DC&QM);
- SC Low Frequency (SC-LF)
- SC Radiofrequency and Microwave (SC-RF&MW)
- SC Power and Energy (SC-P&E)

TC-EM can establish Working Groups and Task Forces dedicated to specific activities and to address particular problems. The Task Forces in particular are intended to have temporary nature.

TC-EM Subcommittee DC and Quantum Metrology (SC-DC&QM)

The Subcommittee covers the following topics:

- Quantum standards (JAVS, QHE, SET)
- Metrological triangle and fundamental tests
- Classical standards of voltage, current and resistance
- Spintronics, nanomagnetism
- New developments in quantum metrology

In the CCEM Classification of Services [Version No 7.6, 2011.03.17], SC-DC&QM deals with the following branches:

1. DC voltage;
2. DC resistance;
3. DC current;
4. Impedance - *if based on quantum standards, together with SC-LF*
5. AC voltage (up to the MHz range) - *if based on quantum standards, together with SC-LF*
- 9.1 Electric charge - *not including partial discharge measurements.*

TC-EM Subcommittee Low Frequency (SC-LF)

The Subcommittee covers the following topics:

- AC/DC transfer
- AC voltage and current, waveform metrology
- Impedance (R, L, C)
- Electric and magnetic fields (low frequency)
- Measurement on materials (low frequency)

In the CCEM Classification of Services, SC-LF deals with the following branches:

4. Impedance (up to the MHz range);
5. AC voltage (up to the MHz range);
6. AC current;
- 9.2 Phase angle; (*together with SC-P&E, depending on the application*)
- 9.3 Current and voltage waveform; (*together with SC-P&E, depending on the application*)
- 10.1 Electric fields below 50 kHz; (*when not related to P&E applications*)
- 10.2 Magnetic fields below 50 kHz; (*when not related to P&E applications*)
- 12 Measurements on materials; (*low-frequency*)

TC-EM Subcommittee Radio Frequency and Microwave (SC-RF&MW)

The Subcommittee covers the following topics:

- RF and MW metrology
- Time domain and frequency domain measurements
- EM fields
- Electromagnetic compatibility
- THz metrology

In the CCEM Classification of Services, SC-RF&MW deals with the following branches:

- 10.3 Electromagnetic fields above 50 kHz;
- 11 Radio frequency measurements; (*including microwaves*)
- 12 Measurements on materials; (*at RF&MW frequencies*)

TC-EM Subcommittee Power and Energy (SC-P&E)

The Subcommittee covers the following topics;

- Power and energy (*excluding RF&MW topics*)
- High voltage and current transducers, instrument transformers;
- Magnetic measurements

In the CCEM Classification of Services, SC-P&E deals with the following branches:

- 7. AC power;
- 8. High voltage and current;
- 9.1 Electric charge; (*when related to partial discharge measurements*).
- 9.2 Other DC and LF measurements: phase angle; (*together with SC-LF, depending on application*)
- 9.3 Current and voltage waveform; (*together with SC-LF, depending on the application*)
- 10.1 Electric fields below 50 kHz; (*when related to P&E applications*)
- 10.2 Magnetic fields below 50 kHz; (*when related to P&E applications*)
- 12 Measurements on materials; (*ferromagnetic transformer cores*)

The present TC-EM Working Groups and Task Forces are:

Working Group on Strategic Planning (WGSP);
Comparison Task Force.

Working Group on Strategic Planning (WGSP)

The objective of the Working Group for Strategic Planning is to propose plans for the future activities of the TC-EM.

The main tasks are:

- to collect information regarding the long-term development of metrology in electricity and magnetism (EM);
- to identify future needs for metrology in the EM field and to identify opportunities for collaboration;
- to support and to act for the appropriate participation of the EM community in the Metrology Research Programmes;
- to review the organisation and the activities of the TC-EM and to propose plans for its future development;
- to review the status of the EURAMET TC-EM key and supplementary comparisons and to plan future comparisons.

Organisation

The members of the WGSP are:

- the acting and the immediate past TC-EM chairpersons
 - the subcommittee conveners
 - up to 4 additional members of the TC-EM. Any member of the TCEM may be nominated as a member of the WGSP by addressing the chairperson. The TCEM Chair appoints the additional members after consultation with the WGSP. The term of office is 6 years, reappointment is possible.
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- The WGSP is chaired by the TC-EM chairperson;
 - The WGSP attempts to meet on a yearly basis, usually in connection with TC-EM meetings;
 - Guests may be invited to the WGSP meeting;
 - Information is exchanged among members via email and the WGSP website; this is available on the restricted part of the EURAMET TC-EM website.

Comparison Task Force

The objective of the Comparison Task force is to constitute and maintain a comparison toolbox which will be helpful for both the pilot laboratory and the associated support group in the complete process of the comparison they are involved. The task force can be asked to intervene in the frame of an on-going comparison to solve difficult technical issues, particularly in the analysis of data.

The main tasks are:

- to establish and maintain a set of documents (official documents, templates for protocol, letters, audit pack, reports, uncertainty budget ...) and materials for data analysis (list of references and of good examples, Mathematical background summary, software tools, analysed test cases ...) which will constitute a comparison toolbox;
- to update the comparison toolbox when necessary;
- to help occasionally the comparison pilot and the associated support group for technical issues which asked other expertise, for example in statistics for the analysis of set of complex data;

The task force has a coordinator and a defined set of participants, which are nominated by the TC-EM Chair. An updated list can be found in the dedicated section of the EURAMET website.