Title of TC  
Industrial electroheating and electromagnetic processing

A Background

IEC Technical Committee 27 was established in 1937 to prepare international standards for characteristics, safety requirements and test methods for industrial electroheating installations. TC 27 standardization work actually begun in the 1960s. Its first standards such as IEC 60239, which deals with dimensions of graphite electrodes for arc furnaces, were published in 1967. The TC’s portfolio now consists of 30 publications.

The scope of TC 27 now covers all industrial electroheating (EH), including electroheat-based surface treatment technologies, and their combinations as well as electromagnetic processing of materials (EPM). Specific aspects of electromagnetic compatibility (EMC) and electromagnetic fields (EMF) are addressed, too.

One of TC 27’s main objectives is to provide the market with relevant safety requirements, along with test and measurement methods, which also take into account the impact of industrial equipment and installations for EH and EPM on the environment, people and the electric supply network.

B Business Environment

B.1 General

In general, EH is used in the following generic industrial operations: fluid and solids heating, drying, sterilization, annealing, metal and non-metal melting, smelting/agglomeration, curing and forming, to name the most important. EPM processes can be thermal or non-thermal, they rely on magnetic or electric forces and may further employ very high pressures including compression waves. Examples are induced change of crystal orientation, separation processes, stirring of liquids and high pressure sterilization. Such technologies are used for producing or processing many different materials, that range from metals to glass, natural fibres to polymers but also paper and foodstuffs.

Standardization in industrial EH and EPM is of great importance for manufacturers of equipment and installations, being mainly small or medium-sized enterprises, and their "products" are usually individually designed and custom engineered according to specific needs of end users. Establishing common international standards with safety requirements and other characteristics that may vary is rather difficult, but supports global harmonization and reduction of trade barriers.

End-users of TC 27 publications are customers coming from various industrial sectors

- basic material industry like iron, steel or non-ferrous metal, cement, glass, ceramics and chemical;
- industry manufacturing industrial machinery and equipment, photovoltaic cells, batteries;
- industry manufacturing products for the end user, like automotive, food, paper and print, items made from plastic including fiber reinforced plastics.

EH technologies cover a large percentage of industrial electricity consumption. In the European Union it is estimated to range from 20 % to 40 %.

B.2 Market demand

There is an increasing need for international standards dealing with safety requirements, test and measurement methods of relevant equipment as industrial EH and EPM installations with their various techniques become more and more widespread.

A growing number of heating installations use electric heating rather than fossil fuel. The market recognizes that industrial EH equipment offers a significant opportunity to enhance industrial
productivity, energy efficiency and global competitiveness. The technical, economic and environmental advantages of EH in comparison with heating processes powered by fossil fuels are for example:

- fast heating, excellent temperature accuracy and instant on-off operation;
- high quality of final products,
- high production capacity at comparably low production cost and cost of ownership;
- high safety, efficiency and reliability provided through simple process control and monitoring;
- possible full automatisation of electroheating processes and small-scale commercial production runs;
- low to no critical emissions at the production plant;
- good working conditions and safety for personnel;
- safety advantages over fuel combustion energy use, due to the hottest object typically being the workload itself;
- fully operational with non-fossil and renewable energy sources.

B.3 Trends in technology

Equipment and installations covered by the TC 27 scope are used in various industrial processes, e.g. for direct and indirect resistance heating, induction heating, melting and stirring, arc heating and melting, electroslag remelting, plasma heating, microwave heating, dielectric heating, electron beam heating, infrared radiation heating, laser heating and EH surface treatment.

The equipment offers an extremely wide scope of processing methods at ranges of power and frequencies that are unusual for other electrical equipment. An important incentive for development is the search for adapted methods of processing and very precise heating in emerging technologies, such as nanotechnology, biotechnology, optoelectronics and printed electronics, photo voltaic and re-processing of waste and dangerous products.

Development of new materials for construction and advances in computer aided engineering (CAE) enable new generations of EH or EPM equipment to be manufactured. Industrial EH and EPM are also considered as fields with tremendous potential for the application of power electronics (converters and digital control systems), which could help to achieve significant energy savings, enhanced productivity and improved quality.

Advanced technologies offer considerable industry-wide cost savings and high performance efficiencies – the energy consumption could be reduced by 5-25 % over the next 10 years. It is envisioned that advancements in EH and EPM will make significant contributions to achieving set targets regarding safety, energy efficiency and environmental performance.

B.4 Market trends

Due to the increasing demand for energy savings, product quality and environmental protection EH and EPM methods are becoming increasingly challenging but essential for industry.

Industry demands increasingly compact equipment, higher throughput, higher flexibility in materials processing and advanced control over product characteristics.

Reducing the carbon footprint of industry will have a major impact on development and application of industrial EH and EPM. New applications substituting conventional heating techniques will be instrumental for creating global sustainable energy usage.

B.5 Ecological environment

TC 27 is not directly concerned with the environmental aspects of manufacturing products. However, it pays attention to potential hazards, which may have a harmful impact on the environment. In general, EH and EPM equipment is environmentally friendly as during its operation there is no or only minimum emission of NOx, SOx, CO2, black carbon and of hazardous substances. Another advantage is the possibility of containment of hazardous substances during processes.

Industrial electroheating and electromagnetic processing equipment is used in re–processing of waste and dangerous products.

C System approach aspects
Subject area

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D Objectives and strategies (3 to 5 years)

TC 27 plans to revise the whole standard series IEC 60519 (13 publications) dealing with safety of EH and EPM installations. The objective of this revision work, starting with Part 1, is to develop a consistent series of standards for industrial equipment and installations for EH and EPM covering all safety aspects – electrical and non-electrical hazards.

It is expected that additional parts covering particular industrial equipment or installations for EH and EPM will be added in the near future.

Revision work will also be undertaken with regard to the large series of test methods standards, which should be updated having in view technological developments, energy efficiency considerations and market needs.

In the coming years, TC 27 will start work on new standards while amending the existing publications to address:

- electrical energy efficiency (EEE) issues, following guidelines of IEC/TS 62796 for the classification of equipment/installation allowing for the determination of the performance / efficiency of a given system and comparison with other systems of that category;
- EMC and EMF issues (for instance in liaison or co-operation with IEC TC 26, TC 64, TC 77, TC 106 or CISPR, as relevant);
safety and test methods for different equipment or installations for EH and EPM, in particular new ones or which are not covered by existing standards;

- safety and reliability aspects of combining heavy current equipment with sophisticated digital control methods.

If there is no specific standard for components particularly used in industrial EH or EPM installations, TC 27 will also consider the development of the relevant specifications.

TC 27 work on EEE issues will take account of performance aspects of components of the installation given in other TC/SC standards.

Taking into account the predicted long-term evolution of the electroheating and electromagnetic processing technologies, TC 27 should undertake new projects aiming at development of safety and test methods standards concerning:

- plasma arc furnace installations;
- new casting systems;
- electromagnetic processing of materials;
- crystal growth and orientation;
- ultrasonic heating;
- spark erosion.

To broaden resources of specialists who prepare these diverse standards, TC 27 recognizes the need to collaborate with the International Union for Electricity Applications (UIE) and other international and regional industrial societies, as well as with technical committees of the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN) dealing with thermoprocessing equipment (TPE).

TC 27 will cooperate with its liaison partner ISO/TC 244 (Industrial furnaces and associated processing equipment) aiming at:

- aligning the safety standards of the committees;
- increasing mutual understanding of respective roles and responsibilities as well as needs of the market;
- enabling joint projects in the future.

**E Action plan**

1. Revise the IEC 60519 series of standards and publish new editions:

   - Part 1/Ed. 5 - at the beginning of 2015;
   - Parts 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 21 - new editions basing on future Part 1/Ed. 5 to be published according to Stability Dates of current editions.


3. Revise particular test methods standards (according to their Stability Dates) in connection with future IEC 60398/Ed. 3.

4. Develop a test method standard for infrared emitters (IEC 62798) by the 4th quarter of 2014.

5. Continue maintenance work on IEC 60050-841 *International Electrotechnical Vocabulary - Part 841: Industrial electroheat* (revision to be made according to the new database procedure).

6. To broaden the resources, TC 27 will further develop co-operation with UIE, ISO/TC 244 and CEN/TC 186, and will establish working contacts with other international and regional partners from industry and academia.

**F Useful links to IEC web site**

[TC 27 dashboard](http://www.iec.ch) giving access to Membership, TC/SC Officers, Scope, Liaisons, WG/MT/PT structure, Publications issued along with their Stability Dates, Work Programme and similar information for SCs, if any.
Name or signature of the secretary

Dr. Piotr Ostrowski