



Making electrotechnology work
for you.

Electrical energy...

the IEC helps keep the power on





The IEC and electrical energy

The IEC international community of experts has accompanied electrical and electronic developments since the very beginning. For energy generation those included first hydro and traditional thermal power sources such as coal, gas, and oil; later nuclear was added and today renewable energy from the sun, wind and water. At every stage the IEC has led the way in establishing International Standards for transmission, connection and use. It provides detailed technical guidance for implementers of emerging systems such as off-grid small-scale sustainable energy initiatives. Its primary drivers are safety, energy efficiency and systems compatibility, thus enabling safe and economic use of electrical and electronic goods and services wherever they are needed.

The IEC also administers Conformity Assessment Systems with thousands of testing laboratories that certify that components, equipment and systems meet its Standards.

The IEC helps keep the power on.

Clean and sustainable energy for the world

Modern life is unthinkable without electricity – it transforms lives. Electricity lights homes, offices and public spaces, underpins information and communication technology, enables financial transactions and powers gadgets and mobile phones.

IEC work covers all facets of energy generation, distribution and use; including manufacturing, Smart Grid, smart cities, smart buildings, and e-mobility. It also embraces the millions of devices that use electricity at home, in the office, in healthcare facilities or public spaces, as well as the components from which they are all built.

As energy consumption is forecast to double between now and 2030 the IEC is working hard to help improve energy efficiency, provide clean energy and to make its work accessible to all countries. Whether for an isolated rural community or in the heart of a metropolis, the greatest source of 'new' power comes from greater efficiency in every step of the process, from generation to consumption.

Countries who want to develop their manufacturing and infrastructure to participate in global trade, or improve education, nutrition and public health need a predictable and adequate supply of electrical power.

The IEC and the thousands of experts who participate in the IEC are committed to bringing reliable and safe electricity to the world, including the 1.3 billion people who most urgently need it.

Generation



Transmission & Distribution



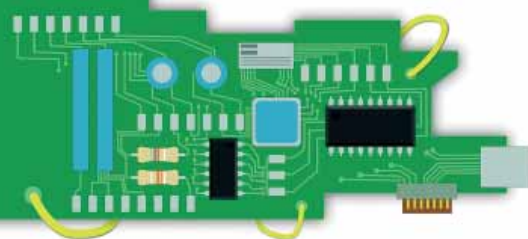
Major Users



Devices



Components



Satisfying future energy needs

IEC work covers all areas of electrical energy from generation to end use. One of the biggest challenges facing us is to increase energy efficiency. Today a 30% increase in energy efficiency is possible with currently available technologies.

However, looking forward, the IEC believes that the whole energy chain will need to be redesigned. The IEC is now putting in place the processes and structures that enable it to support this redesign.



Efficiency gains in thermal power electricity generation

Two thirds of primary energy used in this sector today is lost. Energy-efficient technologies include combined gas and steam turbines (**TC 5: Steam turbines**), CHP (co-generation of heat and power), and fuel cells (**TC 105: Fuel cell technologies**) used in combination with CHP.



Reducing losses in transmission/distribution

Around 9% of generated electricity is lost through transmission and distribution. Upgrading to UHVAC and UHVDC (ultrahigh voltage alternating and direct current) (**TC 22: Power electronic systems and equipment** and soon a new TC) and using superconducting cables (**TC 20: Cables** and **TC 90: Superconductivity**) can greatly reduce this loss.



Redesign of the Grid

In many countries large parts of the existing grid infrastructure date back to the 1960s or even earlier. Redesign of the grid architecture into a responsive electrical infrastructure, or Smart Grid, designed to help lower costs and optimize energy use is essential. The IEC provides the majority of technical International Smart Grid Standards, some of which are essential to any Smart Grid.



Energy efficiency in manufacturing

Industry accounts for over 40% of the world's consumption of electric energy; 2/3 of this electricity is used to drive electric motors. Increasing the efficiency levels of these motors by a few percentage points has a significant impact on overall energy consumption.

TC 2: Rotating machinery prepares International Standards for electric drives used in all industrial sectors and provides a global energy efficiency rating for electric motors, which is in the process of being complemented by a global motor efficiency label.



Lowering electricity consumption in residential and commercial buildings

Residential and commercial buildings consume around 40% of total energy used. The following are just some ways that can reduce power consumption:
 More efficient lighting:
TC 34: Lamps and related equipment.



Heating, ventilation and air conditioning, the use of heat pumps: **SC 61C: Safety of refrigeration appliances for household and commercial use**
 More efficient elevators and escalators:
TC 2: Rotating machinery
 Energy management systems:
TC 57: Power systems management and associated information exchange.



Stand-by power reduction: **TC 59: Performance of household and similar electrical appliances**
 Sensors: **TC 76: Optical radiation safety and laser equipment.**



Improving energy efficiency for industry and consumers

Measuring performance for electric cooking ranges, hobs, ovens and grills for household use is essential for producers and consumers alike.

TC 59: Performance of household and similar electrical appliances and its subcommittees prepare International Standards for clear, complete, reliable and globally recognized energy efficiency guidelines which cover white goods and appliances such as vacuum cleaners.



SC (Subcommittee) 59K: Ovens and microwave ovens, cooking ranges and similar appliances prepares International Standards to measure these appliances' performance levels.



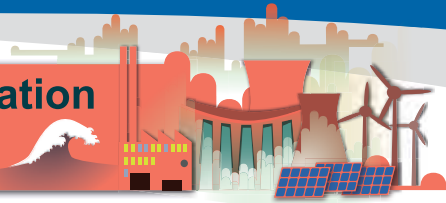
▼
TC 100: Audio, video and multimedia systems and equipment has developed the International Standard for measuring the energy efficiency of the latest generation of television sets, video recording equipment, set top boxes, audio equipment and

multifunction equipment for consumer use. TC 100 and TC 59 have pioneered the measurement and testing methods for stand by power consumption that enabled the global roll out of one watt stand by power regulations.



Generation

Generation



Electricity generation results from the conversion of mechanical or thermal energy from primary sources such as fossil fuels, nuclear or renewable energies into electric energy. The expansion of global electricity-generating capacity and its overall economic impact would not be possible without the multitude of IEC International Standards.



▶ Thermal power plants

Steam and gas turbines dominate electricity generation in coal, gas and oil fuelled thermal power plants worldwide.

TC 5: Steam turbines prepares International Standards for machines used in fossil fuel and nuclear power plants, geothermal and concentrated solar power installations, as well as OTEC (ocean thermal energy conversion).



▼ Nuclear

TC 45: Nuclear instrumentation prepares International Standards for the electronic and electrical functions, associated systems and equipment used in the I&C (instrumentation and control) systems of nuclear energy generation

facilities. This covers nuclear power plants, fuel handling and processing plants, interim and final repositories for spent fuel and nuclear waste.

Renewable Energies

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The share of renewable sources in energy generation is forecast to reach nearly a third of total generation by 2035. The IEC prepares the majority of International Standards for all Renewable Energy sources.



Hydropower

Hydropower is currently the largest source of clean energy in the world – installed in over 160 countries it accounts for 16% of overall electricity generation.

TC (Technical Committee) 4: Hydraulic turbines prepares International Standards on the design, manufacture, installation, testing, operation and

maintenance of hydraulic machines including turbines, storage pumps and pump turbines.

Small, micro- and pico-hydro stations, often important in remote and rural off-grid locations, are also covered by IEC International Standards.



Solar photovoltaic (PV)

TC 82: Solar photovoltaic energy systems prepares International PV Standards for systems that convert solar energy into electrical energy and

for all the elements in the entire PV energy chain, including off-grid lighting systems.



▼ Solar lanterns are important sources of light after dark in rural communities without access to electricity.

IEC has released a new TS (Technical Specification) **IEC/TS 62257-9-5** for solar-powered light-emitting diode (LED) lighting devices, such as solar lanterns. Part of the effort to expand access to modern off-grid lighting among low-income households in developing countries, the new specification represents an important step in aiding governments to harmonize their national standards, paving the way for market expansion for quality-assured devices.

TC 21: Secondary cells and batteries has prepared IEC 61427-1 covering general requirements and test methods for secondary cells and batteries for renewable energy storage in PV off-grid applications.



▼ **IECEE** (the IEC Conformity Testing and Certification System for Electrotechnical Equipment and Components) is the worldwide exclusive issuer of the **PV Quality Mark and Quality Seal**, ensuring that PV components and products comply with International safety and performance Standards and relevant specifications. The World Bank specifies both the PV Quality Mark and IEC International Standards for tenders, including those for photovoltaic systems.

► **Solar thermal electric plants**

TC 117: Solar thermal electric plants prepares International Standards for Solar thermal electric (STE) plants which concentrate solar power from a wide area to produce heat that drives a heat engine (usually a steam turbine) to generate electricity. This technology is now ready for a broad range of commercial applications.



Wind

Wind energy is set to expand rapidly in the next decades thereby maintaining its position as the leading Renewable Energy source.

TC 88: Wind turbines produces the International Standards that have proven essential for meeting the complex challenges faced by the wind power industry.

The whole industry – buyers, vendors, investors and regulators - uses IEC International wind turbine Standards and terminology to manage expectations in terms of turbine design, efficiency, output and abrasion resistance.



- ▶ Experts from IEC TC 88 and **TC 57: Power systems management and associated information exchange** work together within JWG 25 to develop International Standards for monitoring and control systems and associated information exchange for wind power plants.

The IEC is also putting in place a Conformity Assessment Scheme focused on wind energy installations.



Marine

Marine energy (wave, tidal, river and ocean current, as well as **OTEC** – Ocean Thermal Energy Conversion) is slowly growing in importance. Research has been ongoing for more than 30 years, but many technologies still await broad commercial roll-out.

TC 114: Marine energy - Wave, tidal and other water current converters covers International marine energy Standards for all systems that convert this form of energy into electrical energy.

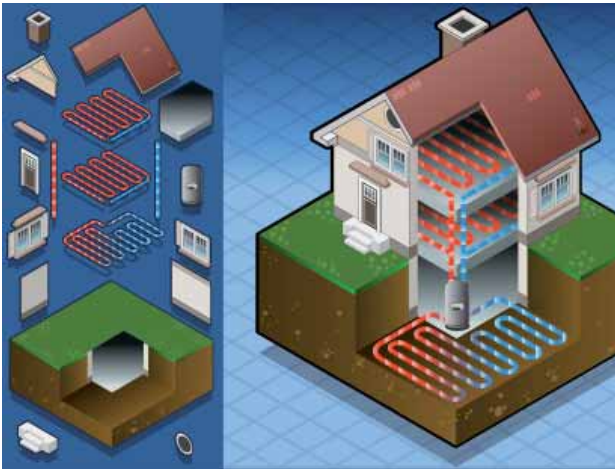
The work of **TC 4: Hydraulic turbines** also relates to marine energy generation through tidal flows as they are found in estuaries.



▼ The IEC **CAB** (Conformity Assessment Board) is evaluating the Conformity Assessment needs of the marine energy industry with a view to establishing a CA Scheme for marine energy converters.

Guidelines for design assessment of OTEC systems ► have been developed by TC 114. OTEC also uses steam turbines (**TC 5: Steam turbines**).





▶ Geothermal

Geothermal heating and cooling uses the energy stored as heat beneath the earth's surface.

Heat pumps are used at depths of up to 400 m to raise the temperature to the level required by the hot water, heating or cooling application.

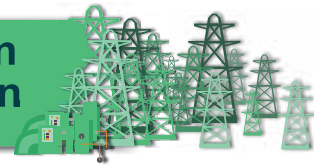
At greater depths, with temperatures from 25-150°C, heat extracted from the ground and groundwater can be supplied to a district heating network, to a CHP installation, or to drive local heat pumps.



▼
TC 5 and **SC 61D** prepare International Standards for the turbines and heat pumps used in solar thermal and geothermal energy systems.

T&D (Transmission & Distribution)

Transmission & Distribution



Power transmission and distribution is another key link in the energy chain. Many IEC TCs prepare International Standards that cover specifications, design and test requirements.



Systems approach to electrical energy supply

TC 8: System aspects for electrical energy supply fosters a systems approach covering the whole electricity supply chain from production to utilization at the customer level. This includes terminology, electrical system reliability, connection practices, operation, operational safety, security, metering, and characteristics of energy supply.



Overhead electrical conductors

TC 7: Overhead electrical conductors prepares International Standards for a wide variety of conductor types, materials and sizes, as well as test methods for performance and other characteristics.



Overhead lines

New overhead lines and the refurbishment, upgrading, or uprating of existing lines on a worldwide basis represents a multi-billion USD market.

TC 11: Overhead lines prepares International Standards for the design and testing of overhead line components (towers, foundations, fittings) not covered by other TCs.



Cables

Electric cables are used throughout the whole chain from supertension transmission cables rated up to 500 kV all the way down to domestic installation wiring and appliance cables.

IEC TC 20: Electric cables prepares International cable Standards for all of these and for the accessories and systems above 1 kV.

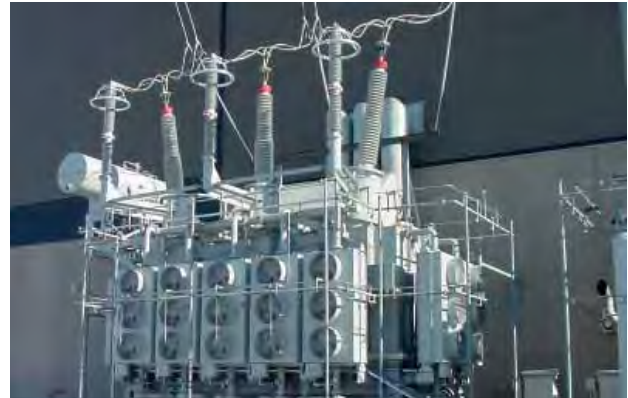
Transmission

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UHVDC (Ultra High Voltage Direct Current) transmission for DC voltages above 800 kV offers important benefits – flexibility, control, cost, and environmental. It brings major advantages for large-capacity power transmission over long distances and for the interconnection of power systems.



▼ The development of a roadmap for standardization of UHVAC (Ultra High Voltage Alternating Current) has been accomplished in the IEC Strategic Group 2: UHV. **TC 115: High Voltage Direct Current (HVDC) transmission for DC voltages above 100 kV** prepares International Standards for HVDC transmission and provides guidelines for the design, operation and maintenance of the HVDC transmission system.



▼ Power transformers

As power transformers are produced and procured across frontiers this trade relies entirely on International Standards.

TC 14: Power transformers prepares International transformer Standards which are adopted as national standards in many countries and used globally by utilities, consultants and project management companies as the basis for the specification, manufacture and testing of power and phase shifting transformers and similar equipment.



▶ Insulators

Insulators are essential for high voltage systems and equipment including overhead lines and substations and their couplings.

TC 36 Insulators prepares International Standards for the components that are used by utilities, electrical equipment manufacturers (e.g. power and instrument transformers, circuit breakers, cables, etc).



Switchgear and control gear

High-voltage switchgear (circuit-breakers, switches, contactors, starters, disconnectors and any switchgear assemblies) often serves as the ultimate safety device in T&D networks.

IEC SC 17A: High-voltage switchgear and controlgear and **SC 17C: High-voltage switchgear and controlgear assemblies** prepare International switchgear and controlgear Standards.



- ▶ **TC 99: System engineering and erection of electrical power installations in systems with nominal voltages above 1 kV AC and 1.5 kV DC** works to ensure the safety of HV installations. TC 99 works in particular on safety aspects for system engineering and erection of electrical power installations in systems with nominal voltages above 1 kV AC and 1.5 kV DC.



► **Other links in the energy chain**

Many more IEC Technical Committees prepare International power generation, transmission and distribution Standards for systems and equipment.

TC 10: Fluids for electrotechnical applications covers liquids used, for instance, as insulators in transformers and lubricants in other equipment;

TC 57: Power systems management and associated information exchange works on Standards that are needed in the planning, operation and maintenance of power systems.



► **TC 28: Insulation co-ordination** for power systems with nominal voltages above 1000 V AC and 1500 V DC;

TC 42: High-voltage and high-current test techniques;

TC 78: Live working prepares International Standards for the tools, equipment and devices used in live working on power lines, substations and other installations.



► Other IEC TCs cover work for systems and installations in residential and other buildings including:

TC 23: Electrical accessories such as cable management systems, plugs, sockets, switches;

TC 32: Fuses;

TC 34: Lamps and related equipment;

TC 47: Semiconductor devices used in integrated circuits and sensors.

These IEC TCs and others work on additional essential aspects found across different systems and devices, such as terminology, safety, interoperability and EMC, which is covered by

TC 77: Electromagnetic compatibility.

Storage

EES (Electrical Energy Storage) will become increasingly important for integrating intermittent renewable energy sources, achieving a better balancing of the grid, reducing total generation cost and limiting investment in new infrastructure. Storage is also an important element in micro-grids and decentralized generation where it permits better planning of local consumption.



Pumped-hydro

This is currently the most used form of energy storage (99% of the total). Electricity can be generated in an instant by allowing water stored at higher altitudes to flow through turbines. This allows utilities to balance the grid without the need for power plants that run empty (spinning reserves), only coming on line when energy demand is high. Pumped storage is under the aegis of **TC 4: Hydraulic turbines.**



Other storage technologies

Other storage technologies include fuel cells and hydrogen accumulators which is covered by **TC 105: Fuel cell technologies**, supercapacitors (**TC 69: Electric road vehicles and electric industrial trucks**), flywheels and others.

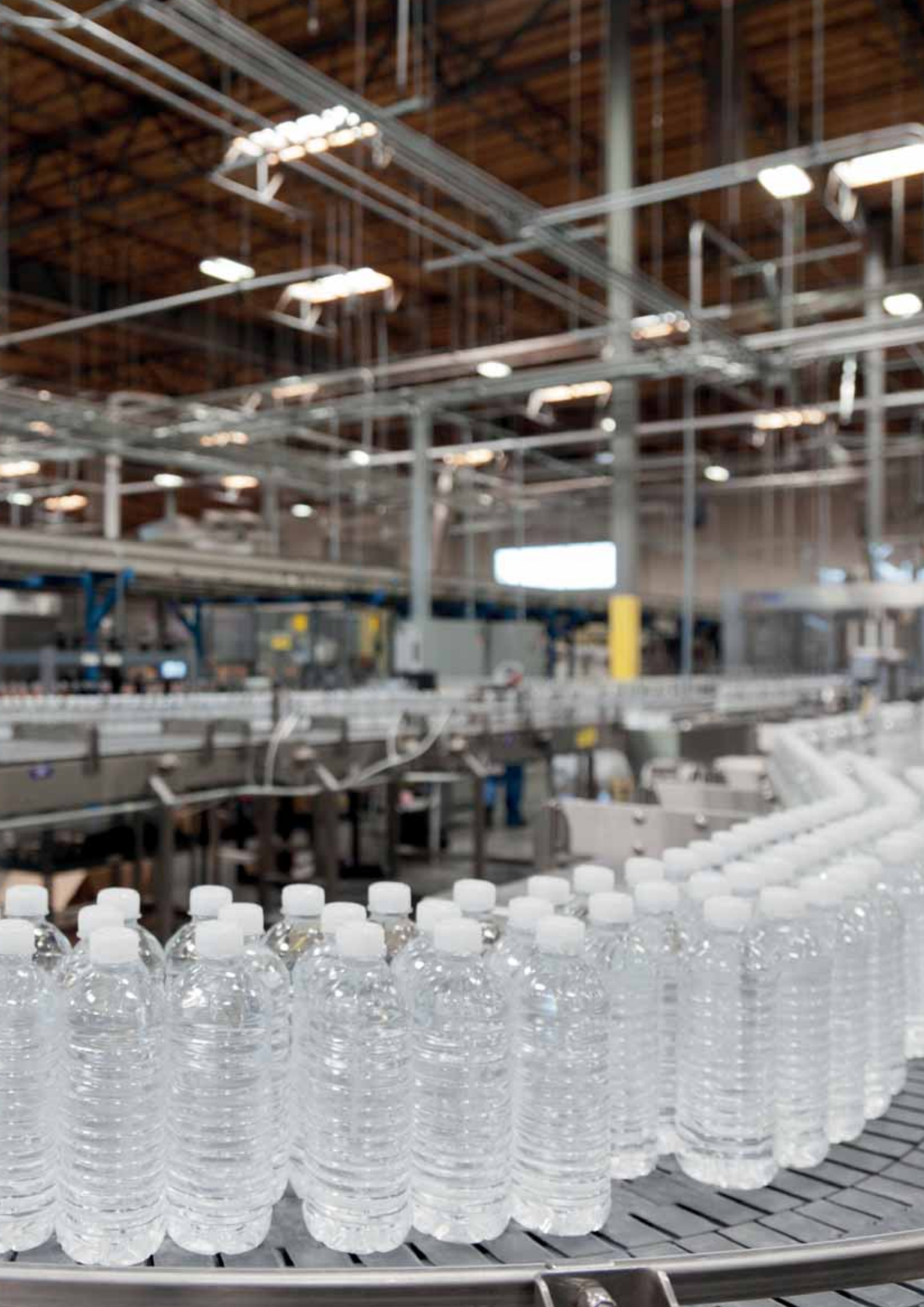


Secondary cells and batteries

Secondary cells and batteries are a mature technology which can be used in stationary applications for mini-grid stabilization. Standardization work is undertaken by **TC 21: Secondary cells and batteries.**



TC 120: EES Systems is a new Technical Committee that aims to accelerate the integration of renewable energy sources and to produce a more reliable and efficient supply of electrical energy.





Manufacturing

Increasingly manufacturers follow International Standards for interoperability among production facilities. With them they are able to streamline investment and facilitate repairs and maintenance. Built-in safety features and environmental considerations make it easier to protect workers, populations and safe guard the environment.

IEC work covers the whole production chain ranging from power generation and distribution to machinery, heating, welding, cooling, ventilation and control systems.



▼ **IECEx** (the IEC System for Certification to Standards relating to equipment for use in explosive atmospheres) ensures that equipment used in explosive areas meets the required

safety standards. The System also certifies the competence of personnel working, maintaining or repairing equipment used in explosive atmospheres.



► Hazardous areas can be found broadly speaking everywhere in manufacturing where flammable gases, liquids or combustible dusts are present – the oil and gas industries, mining, fuel stations, chemical industry, textile mills, saw mills, the printing and paint industry, grain storage and handling, sugar refining, etc.



▶ **Industrial automation**

Today most sectors of industry employ some element of automation to make more efficient use of energy, infrastructure and to lower cost. A number of IEC Technical Committees prepare International industrial automation Standards.

IEC TC 65: Industrial-process measurement, control and automation provides many of the International Standards that are relevant for industry.

IEC TC 17: Switchgear and controlgear

IEC TC 22: Power electronic systems and equipment

SC 22G: Adjustable speed electric drive systems incorporating semiconductor power converters for robots and automated machinery

IEC TC 44: Safety of machinery – Electrotechnical aspects.



▼ **Electroheating and special manufacturing processes**

Electroheating, the high-power heating of material using electrical energy, is widespread in many industrial sectors, accounting for between 20 to 40% of electricity consumed according to UIE (International Union for Electricity Applications). Technologies include arc furnaces, infrared radiation, laser, plasma, induction, radio frequency and microwave. Electroheating is also used in the sterilization of foods, drying of textiles and hardening of ceramic tiles, for example.

TC 27: Industrial electroheating and electromagnetic processing prepares International Standards for the many installations used in the sector.



▼ **TC 26: Electric welding, TC 76: Optical radiation safety and laser equipment** and **TC 47: Semiconductor devices** produce International Standards that apply to technology used in special manufacturing processes.



► **Offshore oil and gas extraction**

Safety of offshore installations relies largely on the appropriate and safe interaction of equipment and humans.

TC 18: Electrical installations of ships and of mobile and fixed offshore units and **TC 31: Equipment for explosive atmospheres** prepare International Standards for the industry.



▼ **TC 2: Rotating machinery** prepares International Standards used for oil drilling and mining equipment for onshore installations, including switchgear and controlgear, cables, lights etc.

TC 31: Equipment for explosive atmospheres' International Standards are used across the oil drilling and mining sectors.

International steam turbine Standards prepared by **TC 5: Steam turbines** have also been adopted in other domains such as integrated gasification combined cycle, industrial and petrochemical plants.



▶ **Raw material processing into primary products**

Aluminium production accounts for roughly 3.5 % of global electricity consumption. The generation and distribution of electrical power for aluminium refineries relies on IEC International Standards prepared by **TC 4: Hydraulic Turbines**; **TC 5: steam turbines**, for power generation; **TC 8: System aspects for electrical energy supply** and **TC 14: Power transformers** for regulating supply.



▼ The development and enhancement of energy-efficient production technologies in the aluminium industry is also a priority. The IEC **MSB (Market Strategy Board)** White Paper, “Coping with the Energy Challenge – The IEC’s role from 2010 to 2030”, makes a series of recommendations on electrical energy efficiency measures. “Inert anodes

for aluminium smelters” are identified as a priority technology that requires further development.

TC 65: Industrial process measurement, control and automation, and all its subcommittees; **TC 44: Safety of machinery – Electrotechnical aspects**; and **TC 2: Rotating machinery** cover other aspects of this industry.

Transportation

Safety has always been a major issue in transportation, at the heart of every invention, innovation and technological development over the centuries. Today modern transportation relies heavily on IEC International Standards for safety and reliability.



Rail

Even though rail is more energy efficient than most other forms of transport, energy efficiency can be improved further.

TC 9: Electrical equipment and systems for railways prepares International Standards

that cover aspects such as electric equipment for rolling stock, equipment for signalling and telecommunications, traction transformers and inductors on board rolling stock.



- ▶ The work of this TC also covers capacitors for power electronics, requirements for AC switchgear, urban guided transport management and command/control systems, communication, signalling and processing systems and more.



Road

IEC International Standards apply to all road vehicles, including electric vehicles. The electrical or electronics content today represents more than 50% of the cost of personal vehicles, with nearly 4 km of cables in a single car as well as many monitors, sensors, lights, batteries, switches, etc. Literally dozens of IEC Technical Committees and thousands of engineers work on the electric and electronic infrastructure that allows cars to operate as expected and connect safely to the grid. Thousands of components, switches, connectors, wires; lighting components and displays are built into any modern car.



TC 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories;
 TC 48: Electromechanical components and mechanical structures for electronic equipment;
 SC 34D Luminaires;
 TC 91: Electronics assembly technology.



TC 69: Electric road vehicles and electric industrial trucks provides an overall framework and develops the International EV Standards for all on-board and off-board equipment for the charging of EVs.

TC 21: Secondary cells and batteries ensures the efficiency, performance and safety of the different battery types used in EVs and cars.

TC 32: Fuses.

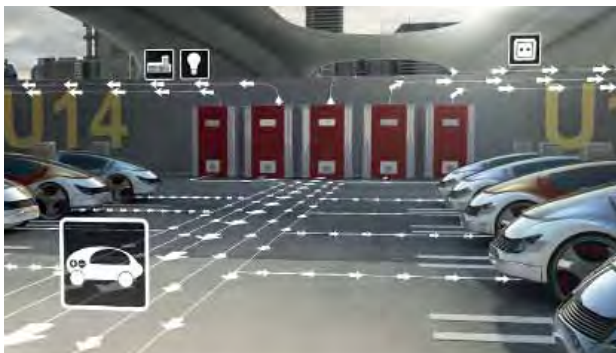


Audio, video, in-vehicle communication & connection:
 ISO/IEC JTC1: Information technology;
 TC 100: Audio, video and multimedia systems and equipment;
 TC 110: Electronic display devices.



▼ Batteries, capacitors and fuel-cells (safety, connectors, dimensions):
TC 8: Systems aspects for electrical energy supply;
TC 21: Safety of batteries
 Connectors and charging infrastructure, electric accessories, inductive charging: **SC 23H: Plugs, socket-outlets and couplers for EVs;**
SC 22E: Stabilized power supplies.

Functional safety of charging stations and vehicles:
SC 65A: Industrial-process measurement, control and automation - Systems aspects
 Overall electrical safety and protection from shocks, overvoltage and fires:
TC 23: Electrical accessories; TC 64: Electrical installations and protection against electric shock; TC 73: Short-circuit currents; TC 112: Evaluation and qualification of electrical insulating materials and systems; and TC 77: Electromagnetic compatibility.



▶ Vehicle to grid communication:
ISO/IEC JTC1 prepares International Standards for interfaces and protocols for vehicle-to-grid communication, IT security and data protection Environment;
TC 111: Environmental standardization for electrical and electronic products and systems.



▶ Shipping

Carrying an estimated 90% of world trade and millions of passengers every year, international shipping represents the life blood of the global economy.

TC 18: Electrical installations of ships and of mobile and fixed offshore units and **SC 18A: Electric cables for ships and mobile and fixed offshore units** prepare International Standards for the maritime sector. TC 18 has a formal relationship with the IMO (International Maritime Organization) to collaborate in the field of electrical systems on ships and offshore units.

TC 80: Maritime navigation and radio communication equipment and systems prepares International Standards covering equipment that may break down, catch fire or explode, and systems enabling a ship's crew to chart its way, minimize the risk of collision, communicate with other vessels and shore and stay informed about weather conditions.



▼ Air

The IEC plays an essential role in ensuring air traffic safety through work from **TC 97: Electrical installations for lighting and beaconing of aerodromes**, **IECQ ECMP** for the management of electronic components used by the industry, **IECEX** for safe refuelling operations and **TC 31: Equipment for explosive atmospheres**.

TC 107: Process management for avionics has a major role to play in developing standard processes to use and manage these components, equipment and systems.



▼ IECQ, the IEC Quality Assessment System for Electronic Components, provides a programme specifically designed for the air transport industry. ECMP (Electronic Component Management Plan) assures industry and regulatory agencies that electronic components in equipment are selected and employed under controlled processes compatible with the relevant safety regulations.

IECEX, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, ensures that fuel storage, transportation and refuelling operations by airlines and oil companies are performed at airports according to highest safety levels. It also certifies the competence of personnel working in these areas.

Smart Grids, Smart Cities, Smart Buildings

In many countries large parts of the existing grid infrastructure date back to the 1960s or even earlier. It is essential to redesign the entire grid architecture into a responsive electrical infrastructure, or Smart Grid, designed to help lower costs and optimize energy use.

Smart Grid

Setting up Smart Grids will be no easy task in many countries as most operators must build on existing legacy systems. The IEC publishes most of the International Smart Grid Standards and is involved in all major Smart Grid projects around the world.



- ▶ **TC 57: Power systems management and associated information exchange; TC 13: Electrical energy measurement, tariff- and load control; and SC 65A: System aspects** are among the dozens of IEC Technical Committees that prepare International Standards relevant to the Smart Grid.



▶ **Smart Buildings, Smart Cities**

Some of the IEC Technical Committees that work in this area include:

- TC 34: Lamps and related equipment** for general, professional and emergency lighting;
- TC 59: Performance of household and similar electrical appliances;**
- TC 47: Semiconductor devices:** elevators and escalators which contain systems and components such as semiconductor devices;
- TC 17: Switchgear and controlgear;**
- SC 22G: Adjustable speed electric drive systems** and countless others.

Minigrids and microgrids

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Minigrids, small clusters of loads and generators linked together and sharing one point of connection to the wider grid, provide potential advantages such as enhanced reliability of supply, lower costs in remote locations and better environmental performance. Microgrids represent an entirely new way of powering remote or rural communities.

IEC work covers many connecting devices and other systems used in mini and microgrids. This is in addition to International Standards for all categories and technologies of renewable energies, as well as for cables, transformers, and DC/AC converters.



Minigrids

About 1.3 billion people do not have access to electricity as they live in remote or rural areas, or on islands not connected to the main grid. Minigrids offer a means of providing them with electricity from renewable and other sources.

They are expected to supply 40% of new capacity by 2030. Minigrids can also be on standby in case regional or national grids go down.

Backup options for minigrids may include batteries, fuel cells or generators, for which International Standards are prepared by a number of IEC TCs (see energy generation section)

Following various disasters and significant damage delaying recovery in many countries, the IEC's **MSB** (Market Strategy Board) in cooperation with Australia's CSIRO (Commonwealth Scientific and Industrial Research Organisation) has started to prepare a White Paper on MDR (Microgrid for disaster recovery). Publication is planned for October 2013.



Microgrids

It is not uncommon now to find microgrids in operation with more than 50 % of the electrical load being supplied from renewable generation.

From the IEC Smart Grid Roadmap developed by **SG** (Strategic Group) **3: Smart Grid**, Microgrids are placed within DER (Distributed Energy Resources). Guidelines for the General Planning and Design of Microgrids have been submitted as new work proposals in **TC 8: Systems aspects for electrical energy supply**. TC 8 also prepares International systems Standards for equipment, protection schemes, and communication systems.

Individual devices for the home, office, healthcare facilities

Devices



Millions of devices and systems in the home, office, public spaces and healthcare facilities use electricity and are designed, built and tested with the help of IEC International Standards.



▼ The **IECEE Conformity Assessment System** helps verify safety, efficiency and performance of all products used in these spaces.

The **IECEE RSHS (Reporting Service for Hazardous Substances)** helps to clearly determine the presence and exact content of hazardous substances in materials and components.



▼ Domestic appliances and office equipment

Microwaves, ovens, juicers, fridges, washing machines...computers, printers, space heaters: most electrical devices used in the home or office are based on IEC work. All major manufacturers participate in the IEC.

TC 59: Performance of household and similar electrical appliances works on the performance of appliances, including the measurement of standby power.



▼ Lamps

CFLs (Compact Fluorescent Lamps), LEDs (Light-Emitting Diodes), Halogen, and luminaires come

within the remit of **TC 34: Lamps and related equipment** and its Subcommittees.



▼
Entertainment and ITC equipment

International Standards for electric and electronic systems/components used in home entertainment and IT devices, e.g. semiconductors, cables, connectors, fuses, switches, cells and batteries, are developed by:

TC 100: Audio, video and multimedia systems and equipment

TC 110: Electronic display devices including OLEDs

TC 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology

TC 119: Printed Electronics.



▼
TC 116: Safety of motor-operated electric tools develops International Standards for tools used by tradesmen and households.

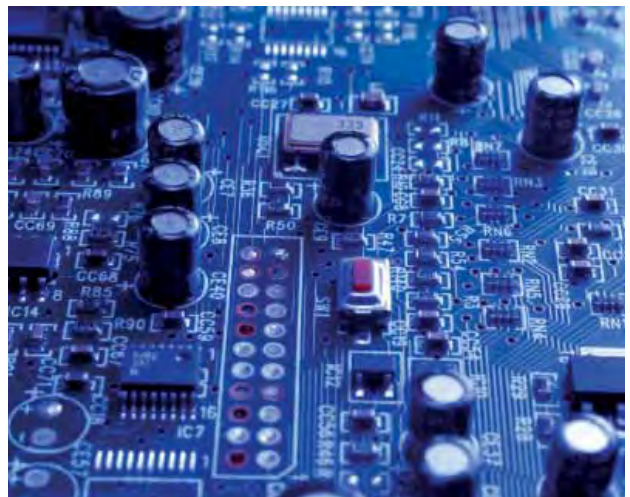
Other TCs that are important in this area are:

TC 20: Electric cables; SC 23F: Connecting devices; SC 23G: Appliance couplers; SC 23J: Switches for appliances; and TC 72: Automatic controls for household use.



▼
TC 61: Safety of household and similar electrical appliances prepares International safety Standards to protect users of such equipment from a wide range of hazards. Appliances for outdoor use such as gardening tools and swimming pool equipment are also covered.

TC 64: Electrical installations and protection against electric shock and **SC 34D: Luminaires** also protect the home environment.



▼
 Consumer electronics and smart appliances wouldn't exist without electronic components. Sensors, connectors, resistors, capacitors, semiconductors, LEDs, MEMS (micro-electromechanical systems) are just some of the many components that are widely used.

SC 47E: Discrete semiconductor devices and **SC 47F: Micro-electromechanical systems** prepare International Standards that facilitate the design and manufacture of sensors and MEMS.

Medical

The medical sector is probably one of the most challenging environments for risk management owing to its complexity, the multiplicity of stakeholders and large number of systems and individuals involved. The IEC has been directly involved in developing International EMD (Electric Medical Devices) Standards for decades.



▼ **TC 62: Electrical equipment in medical practice** works on International Standards that ensure the safe operation of EMDs. However, many other TCs are also working on International safety Standards that ensure, directly or indirectly, the operation of electrical equipment used in the health-care environment.

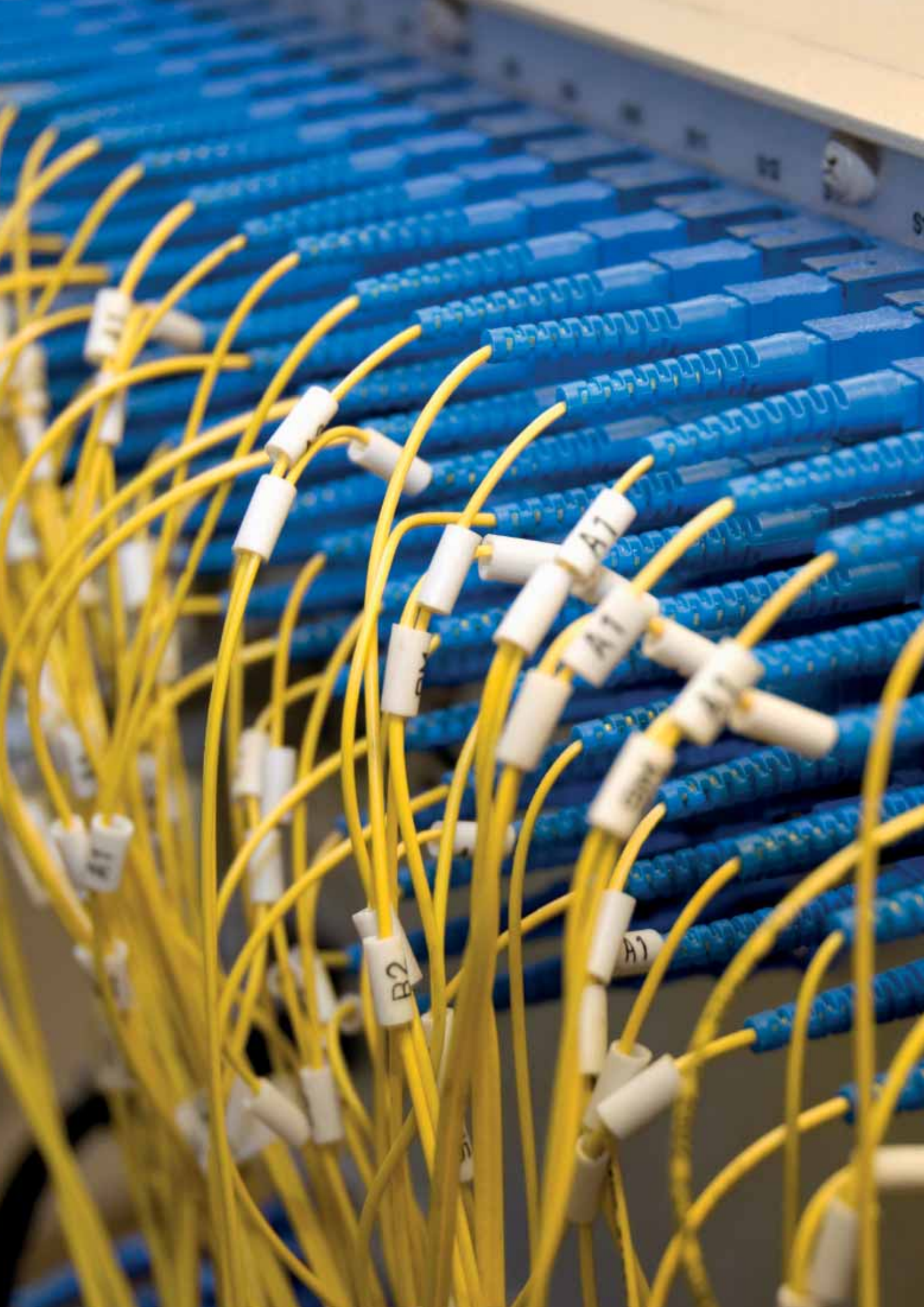


▼ **Safe and reliable electrical equipment**

IECEE (the IEC System of Conformity Testing and Certification for Electrotechnical Equipment and Components), ensures that electrical products and equipment are reliable and meet expectations in terms of performance, safety, durability and other criteria. This includes not only medical electrical equipment, but also risk hazards for patients, operators such as doctors and nurses, and maintenance personnel.

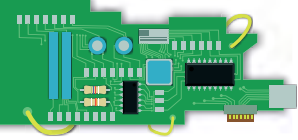


▼ **IECQ** measures the safety, reliability and performance of components that are used in the manufacture of electronic devices in the medical sector, which is crucial because lives are at stake.



Components, connectors, cables and switches

Components



Electronic components are needed to build devices that are part of our everyday lives and are often the unseen enablers of electrical devices and equipment. Without switches and cables very little can be charged or connected.



Connectors

SC 48B: Connectors prepares International Standards for electric connectors, component devices and value added devices.



Connectors and interfaces are central to computer and multimedia devices, allowing them to communicate and exchange all forms of data and content. With a total installed base now in excess of 10 billion units, the USB (Universal Serial Bus) is by far and away the most successful interface. **IEC TC 100 - TA (Technical Area) 14: Interfaces and methods of measurement for personal computing equipment** prepares International USB device Standards.



Switches

SC 23B: Plugs, socket-outlets and switches prepares International Standards for electronic switches, time-delay switches, remote control switches, isolating switches and for switches and related accessories for use in Home and Building Electronic Systems (HBES). SC 23B also prepares International Standards for plugs, fixed and portable socket-outlets, fused plugs, socket-outlets for appliances, and switched socket-outlets.



TC 17: Switchgear and controlgear

TC 17: Switchgear and controlgear prepares International Standards that establish specifications for circuit-breakers, switches, contactors, starters, disconnectors, busbars and other types of switchgear assemblies. Its four Subcommittees cover both high- and low-voltage switchgear and controlgear, together with assemblies and their associated control and/or power equipment and measuring and signalling equipment.

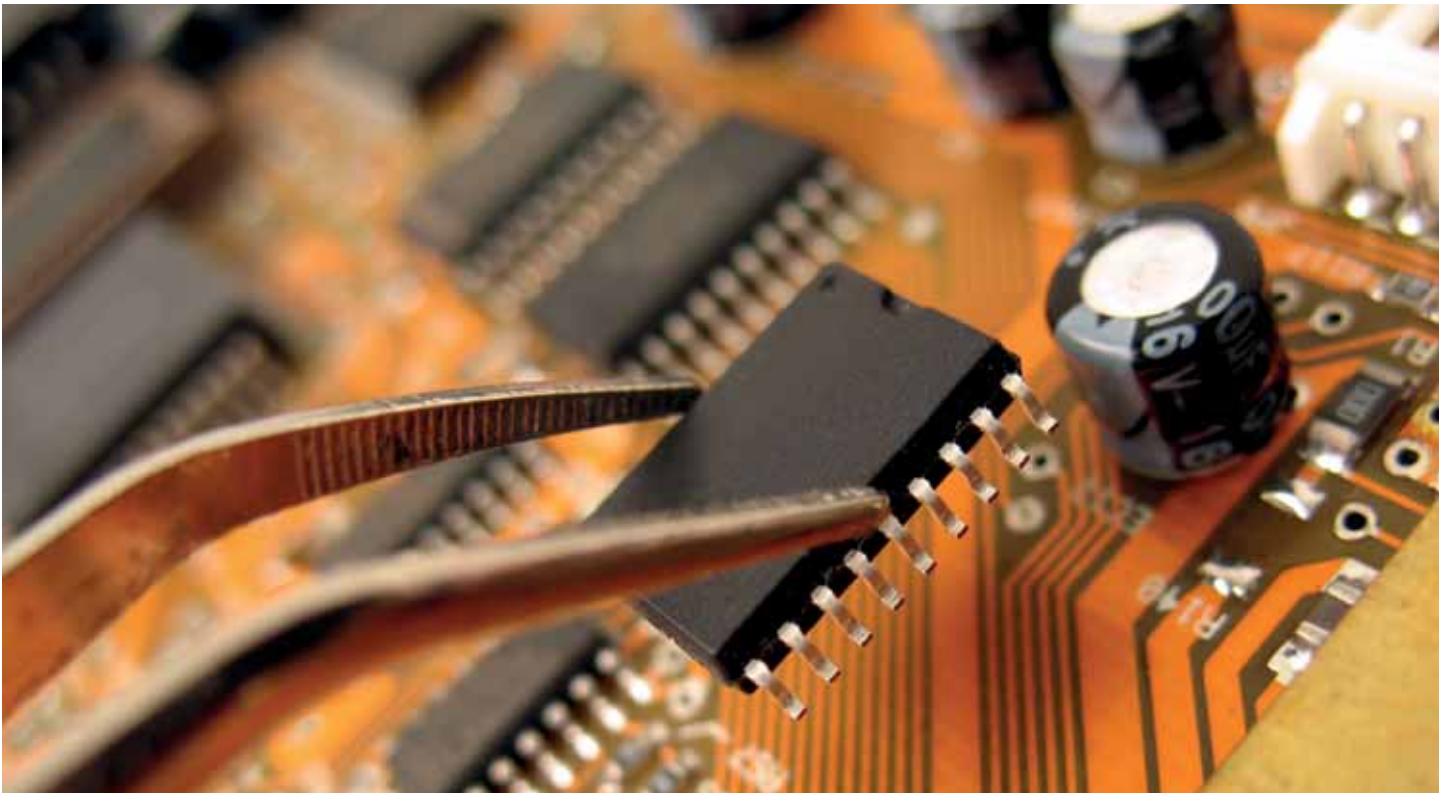


Cables

TC 20: **Electric cables** covers the design, testing and end-use recommendations for insulated electrical power and control cables, their accessories and cable systems, for use in wiring and in power generation, distribution and transmission.



ISO/IEC JTC 1/SC (Subcommittee) 25: **Interconnection of information technology equipment** has developed an International generic cabling Standard for ICT, BCT (Broadcast and Communications Technologies) and CCCB (Commands, Controls and Communications in Buildings) for homes.



With **IECQ HSPM** certification, electronic component manufacturers and suppliers can demonstrate that their electrical and electronic

components and assemblies meet hazardous-substance-free specific local, national and international requirements.

Interoperability

Interoperability refers to the ability of two or more devices from the same vendor (or different vendors) to exchange information and use that information to co-operate correctly.



▶ Universal power charger for mobile phones

A major international achievement of **TC 100: Audio, video and multimedia systems and equipment** has been to standardize a universal power adapter and charger solution for mobile terminals and other ICT (information and communication technology) devices to enable interoperability between a common EPS (external power supply) and a data-enabled mobile telephone.

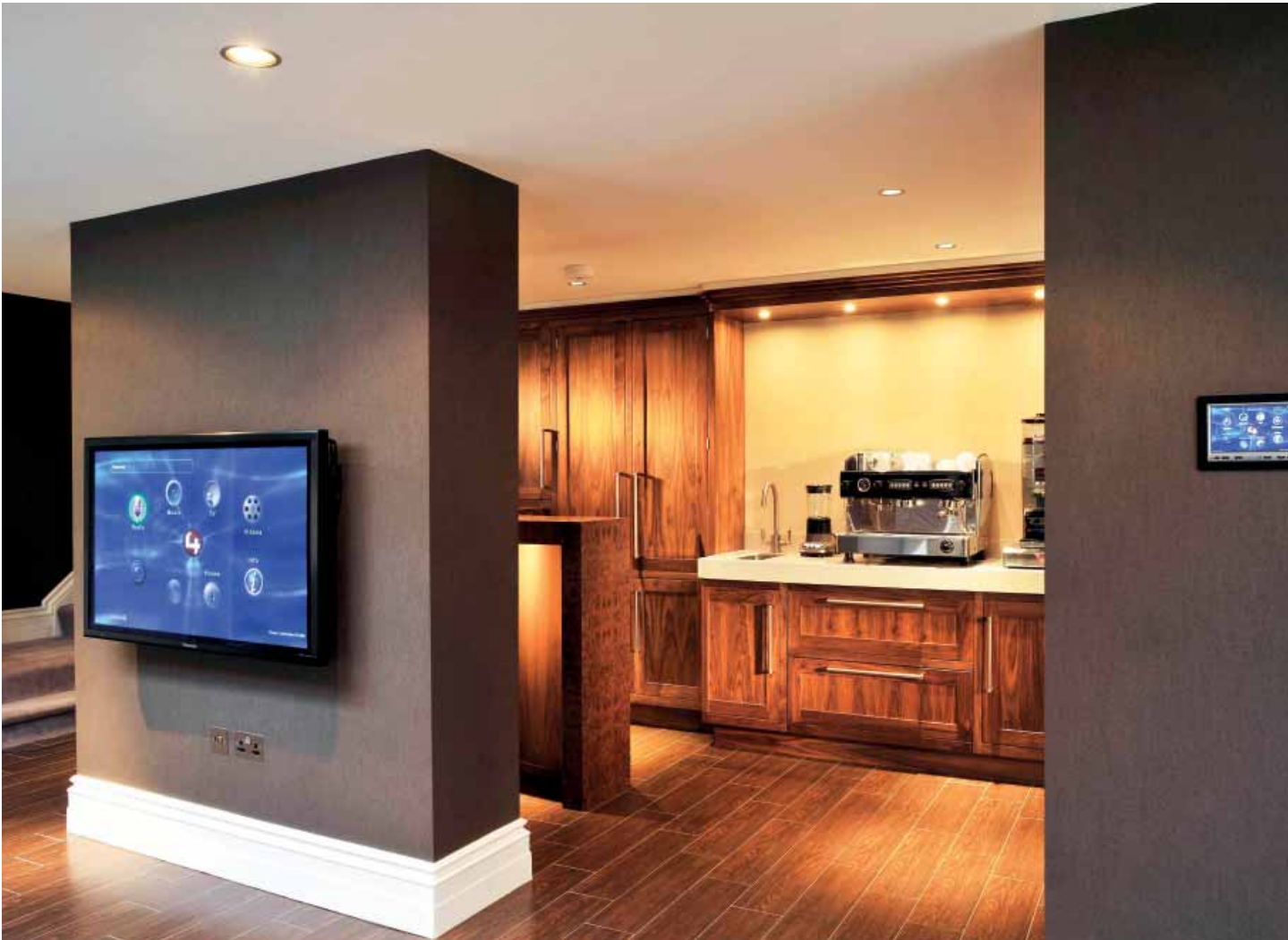


▼ Multimedia production and transmission

Multimedia signal production has shifted from analogue to digital sources and optical fibre-based systems, with International Standards ensuring that equipment from different manufacturers can be interconnected and work seamlessly with the right interfaces and connectors.

Some of the IEC Technical Committees working in this area are:

TC 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories; TC 86: Fibre optics; SC 86B: Fibre optic interconnecting devices and passive components.



▼ UPnP (Universal Plug and Play) technology allows devices to cross multivendor and multi-technology networks seamlessly. The International UPnP Standard was developed by the IEC and ISO

within joint technical committee **ISO/IEC JTC 1/ SC (Subcommittee) 25: Information technology – Interconnection of information technology equipment.**



▶ **ISO/IEC JTC 1/SC 17: Cards and personal identification** develops International Standards for Registration authority procedures in interoperability authentication protocols.

Safety

When it comes to electrical energy, governments want to protect their populations from unnecessary risks. Buyers want proof about a product or system's safety, performance and reliability. Consumers want to be able to trust the products or services they are purchasing.



▶ The IEC helps protect human lives and reduce liability risks for manufacturers by producing International safety Standards which take into account the integrity of installations and systems and by operating CA (Conformity Assessment) Systems.

The assignment of horizontal safety functions and group safety functions is the responsibility of the IEC ACOS (Advisory Committee on Safety), subject to confirmation by the IEC SMB (Standardization Management Board).

Functional Safety

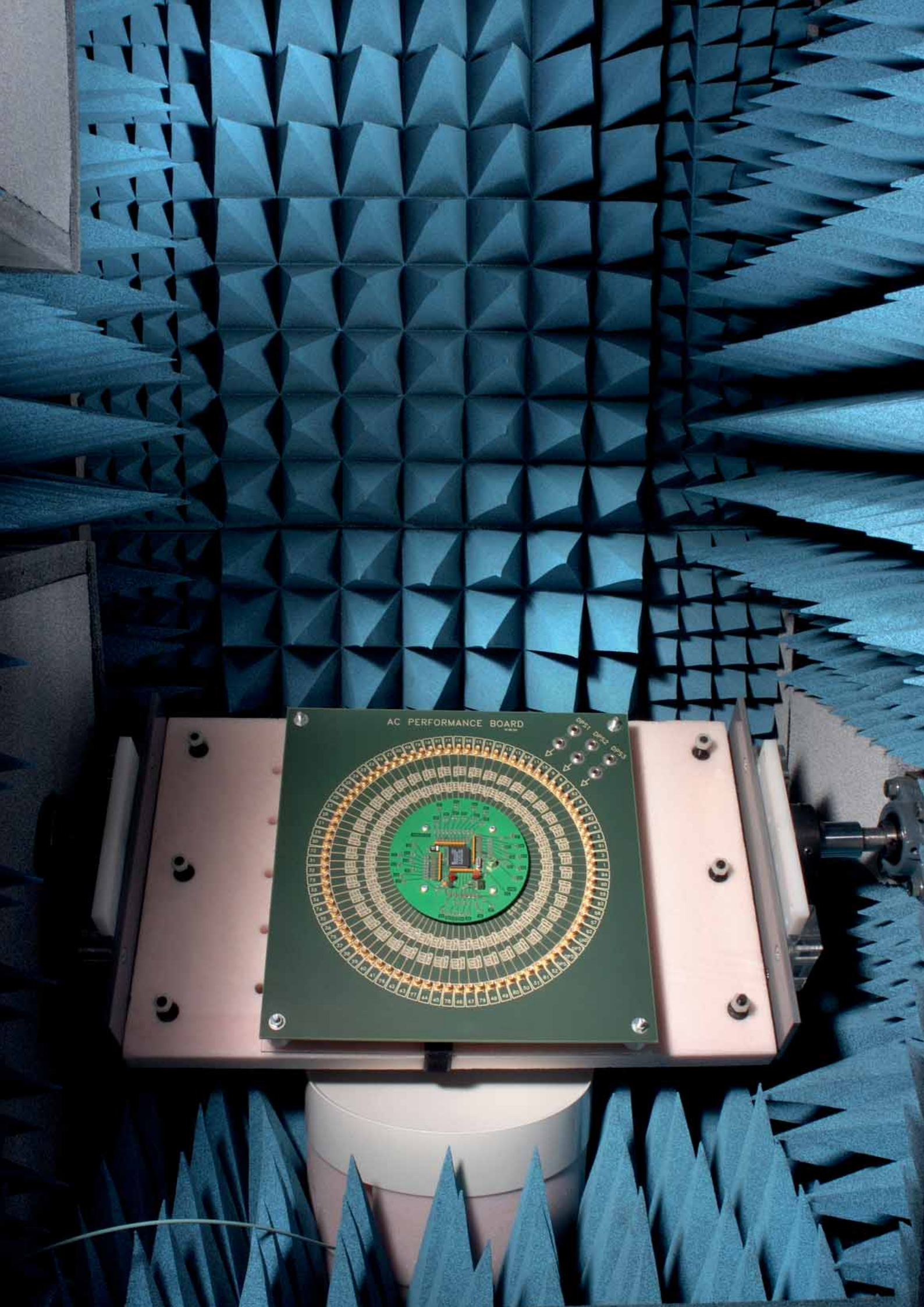
Functional safety is fundamental to enable the complex technology used for safety-related systems. It provides the assurance that these systems will offer the necessary risk reduction required to ensure safe operation of the equipment.



▼ **SC 65 A: Industrial-process measurement, control and automation - Systems aspects** develops International functional safety Standards. Information on the preparation and use of basic safety publications and group safety publications can be found in IEC Guide 104. This guide should be used in conjunction with ISO/ IEC Guide 51.



▼ The IEC CA (Conformity Assessment) Systems help to ensure that a product or system meets the relevant IEC International Standard, that means it will be safe to use anywhere in the world.



EMC (Electromagnetic compatibility)

EMC describes the ability of electronic and electrical systems or components coexist without causing interference to one another when they are close together.



▼ The IEC's approach to EMC standardization is based on achieving compatibility between controllable emissions and the immunity of equipment. International Standards are prepared with the design stage in mind rather than waiting for the point at which problems have arisen and need to be solved.



▼ **IEC TC (Technical Committee) 77: Electromagnetic compatibility** and its SCs prepare International EMC Standards to ensure designers and engineers have access to reference material such as specifications and technical reports from the very beginning of the design cycle.

Terminology

The establishment of a comprehensive and consistent terminology is a prerequisite for the development of International Standards and for their understanding and implementation by end users.



▶ **IEC TC 1: Terminology** sanctions the terms and definitions used in different electrotechnical fields and determines the equivalence of the terms used in different languages. It prepares the IEV (International Electrotechnical Vocabulary) for standardizing and co-ordinating the terms relating to electrical sciences and techniques for use in technical language and literature, in technical specifications and in commercial exchanges, and in giving their equivalents in different languages. Terminology can be an important tool in managing market expectations and ensuring that different stakeholders understand each other. In the wind industry for example common terminology allows buyers, investors and vendors to understand turbine performance, wind classes and abrasion resistance making it easier to compare different designs with one another.



Environment and hazardous substances

All IEC International Standards and CA (Conformity Assessment) activities work toward minimizing the effect on the environment and optimizing the use of resources.



▼ **TC 111: Environmental standardization for electrical and electronic products and systems** works on International Standards that contribute to the harmonization of market and regulatory requirements around the world at the technological level. IEC TC 111 deals with generic aspects of environmental issues applicable to all electrotechnical products.



▼ Environmental concerns are covered by a number of other TCs:

IEC TC 100: Audio, video and multimedia systems and equipment established TA (Technical Area) 13 to deal with environmental issues.

ISO/IEC JTC 1 (Joint Technical Committee) created **JTC 1/SC 39: Sustainability for and by Information Technology** to cooperate closely with TC 111 and other standardization organizations in order to avoid overlap.

Emerging issues

National and regional legislation restricting or forbidding the use of hazardous substances in components and the emergence of counterfeit products pose new challenges for manufacturers of electronic components.



▶ Counterfeit integrated circuits, capacitors, batteries, connectors, power-management devices and other electronic parts are making their way into electronic goods, equipment and systems, ultimately endangering the lives of those who use them.

The IEC has put in place a conformity assessment system dedicated to the testing and certification of electronic components: **IECQ**, the (IEC Quality Assessment System for Electronic Components).



▼ **IECEX** launched a new scheme. **CoPC** (IECEX Certificate of Personnel Competence) provides companies with independent proof that a person has the required competence and capability (based on qualifications, experience and demonstrated

ability) to implement International Ex Standards and to work on, or repair, equipment located in hazardous areas.

IECEX certification for lighting fixtures for hazardous areas ensures that these risks are suitably managed.



► **IEC SC** (Subcommittee) **65B: Measurement and control devices** has prepared the IEC 61207 series of International Standards for gas analyzers, which are used to identify certain constituents in gaseous mixtures.

International Standards in perspective

The IEC is the global organization that publishes International Standards for the majority of electrical and electronic components, devices and systems used in homes, offices, healthcare facilities, factories, public spaces, both in developed and in developing countries around the world. The IEC is also the key partner for all actors of the energy sector, providing most of the International technical Standards for power generation, transmission and distribution, including for Smart Grids and Smart Cities.

The IEC Family comprises 164 countries; 82 are Members and 82 are developing countries, which participate free of charge in the IEC Affiliate Country Programme. Together they represent 98% of world population and 96% of the world's electric energy production. IEC International Standards allow millions of components, devices and systems that use or produce electricity or contain electronics to work safely with one another everywhere in the world and to support all forms of conformity assessment. An IEC International Standard represents a global consensus on the state of the art in the subject matter to which the standard applies.

The IEC is unique in that it also administers third party Conformity Assessment Systems that bring together several thousand testing laboratories. These Systems are the world's largest working multilateral agreement based on one-time testing of products on a global basis and they have issued over 1 million certificates to date that are accepted and used by nearly all countries in the world (www.iec.ch).

IEC and its partners

One of the IEC's principal partners is the WTO, whose 160 central government members recognize, through their TBT (Technical Barriers to Trade) Agreement that International Standards and conformity assessment play a critical role in improving industrial efficiency and helping to develop world trade.

The IEC also works closely with ISO (International Organization for Standardization) and ITU (International Telecommunication Union).

It has cooperation agreements with international organizations, including UNECE (United Nations Economic Commission for Europe), IEA (International Energy Agency), WHO (World Health Organization), ILO (International Labour Office), IMO (International Maritime Organization), OIML (International Organization of Legal Metrology) and many more.

The IEC encourages industrializing nations to share in the benefits of joining in its work and liaises closely with the IMF (International Monetary Fund), EBRD (European Bank for Reconstruction and Development), the World Bank and the UNDP (United Nations Development Programme).

At the regional level, in 1996 the IEC and CENELEC (European Committee for Electrotechnical Standardization) ratified a cooperation agreement known as the Dresden Agreement. It relates to common planning of new work and parallel IEC/CENELEC voting and seeks to avoid duplication of efforts, speed up the preparation of standards and to ensure that the best possible use is made of the available resources.

In addition, the IEC participates in the UN Foundation Energy Access Practitioner Network which addresses market barriers to achieve universal energy access, as part of the global initiative on SE4ALL (Sustainable Energy for All).

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