IEC e-tech

News & views from the IEC

ISSUE 09/2011

CABLES & CONNECTORS

NEWS & DEVELOPMENTS

Wiring

Durability, compatibility & efficiency

Protection against fire in buildings

CONFORMITY ASSESSMENT

Safety & reliability

Switches and cords

Trace heating cables

INDUSTRY & TECHNOLOGY

Fibre optics

High speed data transmission

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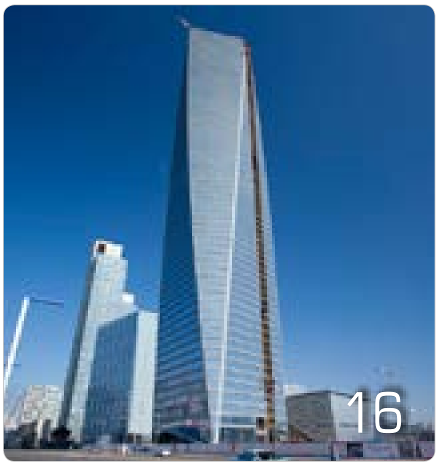

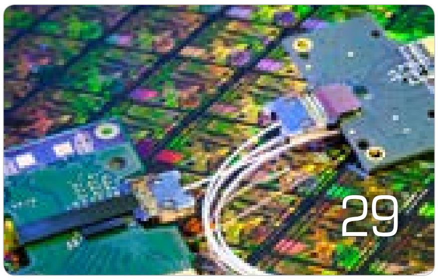

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Focus of the month: Connectors and cables

Components such as cables and connectors are such essential elements of any electrotechnical system that we often take them for granted. Products and systems rely heavily on wiring, relays, fuses, switches and so on in order to function smoothly.

Editorial

Cables and connectors

Philippa Martin-King,
Managing Editor e-tech.

Making the link

Components such as cables and connectors are such essential elements of any electrotechnical system that we tend to take them entirely for granted. All products and systems rely heavily on wiring, relays, fuses, switches and so on in order to function smoothly. In turn, manufacturers and users of these components, sometimes so inconspicuous that they go un-noticed, rely on IEC International Standards to ensure their global safety, durability, compatibility and efficiency. The relevant standards also form the basis of all the testing and certification carried out by the third party institutions who are members of the three IEC Conformity Assessment Systems.

Fundamentally important design and installation

Much today is dependent on correctly designed and installed wiring. The work of IEC TC (Technical Committee) 20: Electric cables, is fundamental to other TCs. Indeed the TC that is responsible for International Standards used for designing, testing and making end-use recommendations for all types of cables and wiring has a Group Safety Function; many other IEC committees are therefore also reliant on its publications. Whether they are used in ships or mega offshore units, or in the thin-film gallium nitride LEDs of experimental piezoelectric materials which require miniscule zinc oxide microwires, wires and cables are essential to charging and for transporting electricity from one place or device to another.

Fire and flame propagation

IEC TC 20's work covers hazards to cables such as fire and the testing of flame propagation. That also extends to fire resistance. Its work encompasses the testing of the optical density of smoke. It also covers corrosion to cables due to reactions with surrounding chemicals or oxidation of the metals that come in contact with one another. The TC was established in 1934, and if, to begin with, its work was restricted to HV (high voltage), it quickly embraced the additional area of low voltage cables. Today, that latter group is still definitely on the increase, particularly for infrastructure demands and in areas such as superconductivity, polymer developments and EV (electric vehicle) charging, together with many others where energy efficiency is at a premium.

Joining the elements of a chain

If cables are important for transmitting and transporting electricity, so too are the connectors that join the elements of the chain together. One of these is the universal serial bus or USB that is now used globally not only as a connector, but increasingly as a means of powering up and charging all types of portable devices.

Fibre optics

Another area, covered extensively by e-tech this month, looks at the important work of IEC TC 86: Fibre optics. Optical fibres are used frequently in telecom applications and for other high-speed interconnecting communication devices. Because of the ever increasing demand for fast and efficient data transmission, both in the private and the commercial sectors, this area is continuing to develop at a tremendous rate.

Special edition for the IEC General Meeting in Melbourne

Following issue 09/2011 of *e-tech*, there will be another publication dealing specifically with some of the sessions and events of the yearly gathering of IEC Executives and Officers at the IEC General Meeting in Melbourne, which was organized this year by the IEC's Australian National Committee.

Getting quality right

The ability to engineer globally and remain relevant locally

IEC Global Visions recently interviewed Dr Kazuo Kyuma, Executive Vice President and Group President Semiconductor & Device, Mitsubishi Electric, about the need to provide optimum quality products to individual markets without developing too many product variations, thereby introducing unnecessary costs. Mitsubishi Electric participates actively in 34 IEC Technical Committees and Subcommittees.

Dr Kazuo Kyuma, Executive Vice President and Group President Semiconductor & Device, Mitsubishi Electric.

How is quality qualified?

Mitsubishi Electric's global *leitmotiv* is quality, of which reliability and safety are key elements. The company believes that quality is always a top priority, even above price or on-time delivery, and that it directly helps the company to grow. However, quality is not a uniform, one-size-fits-all thing: customers in different regions of the world may have dissimilar needs. For example, it would be nonsensical to deliver a product that can withstand high ambient temperatures to customers who live in a cold climate. Likewise, quality requirements in hot, dusty or humid environments may differ substantially. The point is always to deliver the quality that is required to provide optimum performance at an affordable price. Over-engineering can be as detrimental to a company's success as under-engineering.

Born out of necessity

Kyuma believes that one of the reasons for the global success of Japanese products is that Japan is particularly suitable as a testing ground for quality. Most climate types – from cold to humid, from dusty to hot and dry – can be found in the country. Products and infrastructures also need to be able to resist extreme winds, torrential rains and regular earthquakes

Global relevance, taking into account differences

Key elements of Mitsubishi Electric's quality strategy are the use of International Standards and the corporation's participation in IEC work. As Kyuma explains, Mitsubishi as a company needs to grow and succeed in a sustainable way. IEC International Standards take into account global relevance and differences. They are the result of discussions between many people from different companies and backgrounds, who bring the right levels of expertise and experience to the table.

By complying with International Standards, Mitsubishi is able to build and test products that are reliable and safe, and can be sold worldwide. Participating in the standards-setting process allows the company to contribute to technologies, find new ideas and develop innovative products. Kyuma hopes that still more companies will join the process because this further increases the quality of the final standards.

About Mitsubishi

A leader in the manufacture and sales of electric and electronic equipment.

The Mitsubishi Electric Group's corporate statement is, "Changes for the Better", a statement that expresses commitment to continuous adaptation and evolution in the unwavering pursuit of excellence.

International standardization

Cooperation in our DNA

IEC President Dr Klaus Wucherer addresses the ISO General Assembly in New Delhi.

Consensus-based international standardization requires cooperation

Addressing the ISO General Assembly in New Delhi on 21 September, IEC President Dr Klaus Wucherer underlined how cooperation was in the DNA of the two organizations. "As an engineer and industrialist," he said, "I have seen how it can benefit the market. Consensus-based international standardization requires a lot of cooperation. The IEC and ISO have now been working together successfully for over 60 years."

Importance of Joint Project Committee work

Describing some of the work that is being carried out jointly between the two organizations, he underlined the importance of the Joint Project Committee work on specialized and new terminology in the energy field." Representatives of our Strategic Group on energy efficiency and your Strategic Advisory Group on energy are observers in each other's group," he said.

IEC President Klaus Wucherer.

Extending cooperation

President Wucherer added a proposal to extend cooperation in the fields of database standards and academia. As regards the latter, "we need to focus our intentions, goals and resources more clearly," he suggested, "including through our members. Cooperating to encourage and support their initiatives can surely provide synergies with our efforts at international level."

AFSEC

Building capacity in Africa

In collaboration with the IEC, AFSEC (the African Electrotechnical Standardization Commission) organized a training event in electrotechnology for African experts. The capacity building event took place in Kenya, Africa in support of the harmonization of electrotechnical standards to facilitate the interconnection of the African power grid

Experts who presentated at the event.

African region made familiar with processes and tools for international standardization

The capacity-building event was supported by the African Union through its African Energy Commission and held in Nairobi, Kenya on 5-6 September 2011. The two-day workshop was aimed at IEC Members and experts from African countries who are engaged in electrotechnical standardization activities and at making them more familiar with the electronic platform and IEC software such as IEC Collaboration Tools. It was followed by technical meetings. At the request of Evah Oduor of Kenya, who helped organize the event, IEC Affiliate countries that are not yet members of AFSEC were also invited to attend. Oduor is the IEC Affiliate Coordinator for Africa.

Topics that were covered included:

- An introduction to standardization and the organization of work in standardization bodies
- IEC procedures for developing consensus-based standards
- A review of the draft procedures set down by AFSEC for technical committee work
- Mastering principles, techniques and technical committee basics

Mastering principles, techniques and technical committee basics

The IEC Standardization Strategy Manager, Jack Sheldon, gave several presentations that provided guidance and expertise on developing International Standards. He outlined the structure of the IEC and the standardization process under the SMB (Standardization Management Board). He described the types of NC (National Committee) Membership and the scope and role of IEC TCs (Technical Committees) and SCs (Subcommittees). He put standards and standardization into the context of a model technical regulatory system where the government is the supreme legislator in the national territory.

Role of IEC TC/SC officers

Describing the role of the TC/SC secretary, Sheldon underlined the international capacity of the position. In terms of the chairman's role, he pointed out the importance of each committee's SBP (Strategic Business Plan). SBPs, he said, not only describe the scope of each TC/SC and their relationship with business trends, industry, technology and the market, but also with other IEC committees in taking a systems approach. The plans are an important way of attracting other experts to participate in technical work, he added. SBPs also help evaluate the impact of TC/SC standards on the environment for the complete life cycle of products and systems, from procurement to end-of-life.

Sheldon gave step-by-step hints on using the IEC's Collaboration Tools, the electronic platform that is used by TC (Technical Committee) and SC (Subcommittee) experts to produce, comment and revise their standardization work. He covered all the main areas of the application, from log-in to downloading attachments, from the discussion forum to task creation and status changing.

In session.

Protection against electric shock

Other IEC Officers accompanying him included Etienne Tison, the Chairman of IEC TC 64: Electrical installations and protection against electric shock. Tison outlined the role of the IEC TC 64 BSP (Basic Safety Publications), and TC 64's responsibilities in ACOS (Advisory Committee on Safety) before describing in further detail the role of TC 64 in protecting against electric shock, both for people and livestock, through the various International Standards and TS (Technical Specifications) that the committee maintains.

Electromagnetic compatibility

Hervé Rochereau, Secretary of IEC SC (subcommittee) 77A: Low frequency phenomena, focused on the role of the committee in EMC (Electromagnetic Compatibility), low frequency emission, high frequency phenomena and PQ (power quality). The description of PQ, he said, does not necessarily fit in with the needs of a product committee when developing EMC immunity requirements. For this reason, immunity requirements have to be based on EMC basic publications that are part of the IEC 61000-2 series, not on PQ requirements.

Power systems

Don Taylor, an expert from South Africa and member of IEC TC 57/WG (working group) 14: System interfaces for distribution management (SIDM), concentrated on the control equipment for power systems and other systems including EMS (Energy Management Systems) that are used in the planning, operation and maintenance of power systems.

Measuring electrical energy

Another IEC expert, Roland Hill, is Chairman of the South African mirror committee TC 13: Electrical energy measurement, tariff- and load control. [Note that a mirror TC is set up and

AFSEC group photo.

functions at a national level in the same manner as its international IEC counterpart]. He explained how, since the 1920s, IEC TC 13 has been responsible for electrical energy measurement and electricity tariffs and load control. TC 13 standards are used in power stations, within transmission, distribution and supply networks and by industrial, commercial and residential customers. He pointed out Africa's past contributions to IEC TC 13 and the future objectives of AFSEC TC 13.

AFSEC mirror committees

Together these five speakers represented the five technical fields that AFSEC originally selected for its initial work and for which it has set up its own regional mirror committees to carry out work at a national level:

- IEC TC 8: Systems aspects for electrical energy supply
- IEC TC 13: Electrical energy measurement, tariff- and load-control
- IEC TC 57: Power systems management and associated information exchange
- IEC TC 64: Electrical installations and protection against electric shock
- IEC TC 77: Electromagnetic compatibility

After the workshop, from 7-8 September, AFSEC experts held the inaugural meetings of their own five regional mirror committees, nominating their chair people and secretaries. They prepared strategic business plans that were presented to the AFSEC management committee for its approval.

About AFSEC

The African Electrotechnical Standardization Commission was established in 2005 through the collaborative effort of its stakeholders. This was supported by a declaration at the Conference of African Ministers of Energy held in Algiers on 17 February 2008.

The IEC and AFSEC have a cooperation agreement that covers a number of areas, particularly cross representation and exchange of technical information in the fields of standardization and the development of electrotechnology.

In Africa, AFSEC is responsible for:

- identifying existing standards and prioritizing standardization needs in the fields of electricity, electronics and related technologies
- harmonizing existing standards, either by adopting International Standards, or, where necessary, adapting them to African conditions
- identifying the need to draft standards for adoption by AFSEC members
- recommending harmonized standards for application by the appropriate bodies of the African Union.

2012 Marcomm Forum

Third ISO-IEC Marketing & Communications announcement

The date for the joint 2012 ISO-IEC Marketing & Communications Forum has now been confirmed.

Third ISO-IEC Marketing & Communications Forum

Following the success of the second ISO-IEC Marketing & Communications Forum in December 2009, we are pleased to announce that the dates for a third joint event, the 2012 *ISO-IEC Marketing & Communications Forum*, have now been confirmed.

Two years ago, over 100 marketing and communications specialists from some 60 standardization organizations around the world attended the forum. The 2012 event will be held again in the CICG (Centre International de Conférence de Genève), the international Geneva conference centre which is situated within walking distance of the IEC Central Office, on 22 and 23 February 2012.

Register now for the forum
The final forum programme with details of speakers and the relevant registration forms will be made available by 12 December 2011. In the meantime, you should save the date!

Since the places are limited and will be distributed on a first-come, first-served basis, you can already make your pre-registration requests by emailing IEC Communications.

CICG International Conference Centre Geneva.

The second event focused on social media.

The 2nd Forum was a tremendous success.

Switched on to safety

IECEE helps build strong consumer confidence

When buying a new electrical appliance, who pays much attention to the cable – or to the control switch, for that matter? Customers tend to focus on the design, the look, the size, the price or the overall performance of the product. They are likely to overlook other aspects and see the cable and the switches as necessary appendages that don't merit close examination. They usually take it for granted that the device they acquire is safe and reliable, and will perform without any problems.

Maximum and minimum water levels are indicated on electric kettle.

Strict safety requirements are in place

And in most cases, they are right. Their confidence in the high quality of the product they buy may be intuitive but it is not misplaced. It is intuitive because, more often than not, they do not know what is involved in the manufacture of consumer goods. They may not be aware of the fact that electrical appliances are built according to very strict requirements and then tested to make sure that they are safe and reliable in use. Cords and switches are inherent parts of any electrical device and are treated in the same way as any other element of the product.

Take an electric kettle for example. It is designed to heat water at a certain temperature and will stop automatically if the device is overheating. It can't be switched on if the water level is too high or if it is completely empty. The cable is well insulated and its wiring is correctly colour-coded. All this doesn't happen by chance.

Built to standards...

Manufacturers rely on standards, IEC International Standards in particular, to design and build their products. The IEC has an array of standards that deal exclusively with electrical household appliances – the IEC 60335 series – and a number of specific standards that cover cables and cords.

Automatic electrical controls for household and similar use are covered in the IEC 60730 series of International Standards.

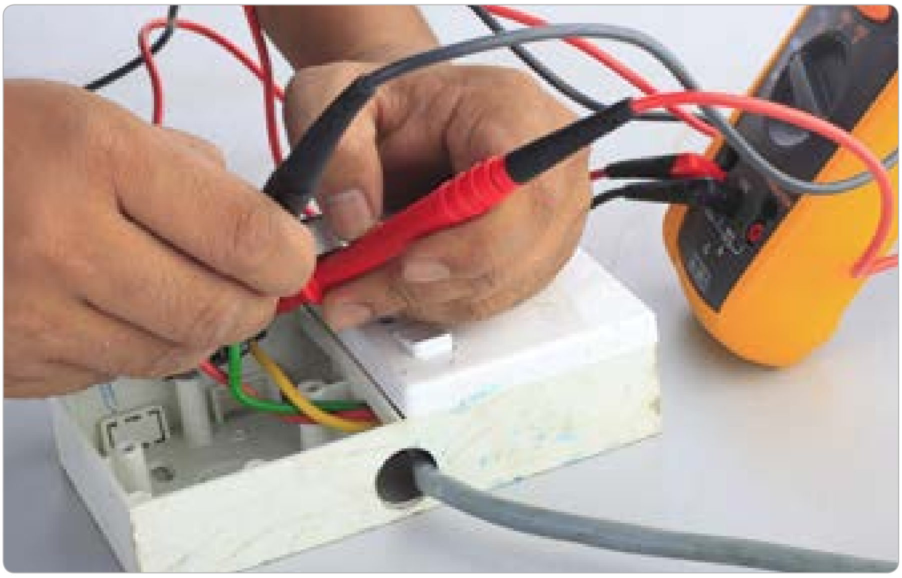
...and thoroughly tested

Manufacturing products to standards is only the first step. To make sure their products are safe, reliable and perform according to the requirements specified in the standards, manufacturers then have to have them tested and certified.

Worldwide recognition through IECEE

This is where the IECEE, the IEC System of Conformity Testing and Certification for Electro-technical Equipment and Components, comes into play. The IECEE CB Scheme provides the assurance that tested and certified products meet the strictest levels of safety, reliability and performance as stipulated by the relevant IEC International Standards. It helps reduce costs and time to market, eliminates duplicate or multiple testing and offers a high level of confidence for manufacturers, retailers and consumers alike.

The CB-FCS Scheme for Mutual Recognition of Conformity Assessment Certificates for Electrotechnical Equipment and Components is an



Man using insulation tester to socket outlet.

Defective plug.

extension of the IECEE CB Scheme that also includes factory surveillance. This scheme goes beyond product testing. It covers Type Test and regular surveillance at the factory that manufactures the relevant certified product. This is of value to manufacturers who need to provide proof that products manufactured in a given factory offer a consistent level of quality over time.

CB-FCS includes product sampling, testing, assessment and surveillance of assembly lines and management processes and surveillance, regular sampling and retesting of products at the factory and/or in the marketplace.

Huge benefits for manufacturers...

For manufacturers, the benefits of having their products tested and certified to IECEE Schemes are manifold. Products tested and certified in one country will be accepted in all other IECEE member countries. Even better, global acceptance of the CB Scheme through the CB Test Certificates and associated CB Test Report is also effective in countries that are not part of the IECEE community. A CB Test Certificate is a global passport for the product. Because it takes national differences into account, it ensures easier and more rapid access to international markets and reduces the costs involved in a global product roll-out

...and consumers

Although most consumers are not aware of the behind-the-scene steps that make a product safe and reliable, they implicitly give it their vote of confidence.

Freeze protection

IECEx certifies trace-heating cables

Pipelines, tanks and vessels that store or transport potentially explosive substances are frequently subjected to extreme climatic conditions and huge temperature variations. Confronted with the problem of protecting equipment from freezing or ensuring that products were stored at the correct temperature, engineers were quick to find a solution: electric trace-heating cables.

Prevent heat loss

Pipe and vessels are subject to heat loss when their temperature is above ambient temperature. Thermal insulation reduces the rate of heat loss but does not eliminate it. Trace heating is used to replace the heat that is lost to the atmosphere. If the heat replaced matches the heat lost, temperature will be maintained.

Trace heating consists of an electrical heating element run in physical contact along the length of a pipe, tank or vessel. Heat generated by the element maintains the temperature. The object must be covered with thermal insulation to minimize heat losses.

Historical background

Electric trace heating began in the 1930s. While at the time there was no dedicated equipment available – mineral insulated cables were run at high current densities to produce heat – the technology evolved rapidly. Mineral-insulated resistance heating cables and parallel-type heating cables that could be cut to length were introduced in the 1950s. The 1970s saw the introduction of proper control systems while networked computerized controls were developed in the 1990s.

A wide range of applications

Trace heating is widely used both in hazardous and non-hazardous

Trace heating cables are used in pipelines, here the Trans-Alaskan pipeline...

environments. Applications can be found in many industrial sectors: oil and gas, chemical, petrochemical, pharmaceutical, food processing, refineries, pulp and paper. Nuclear power plants also make use of the technology. Trace heating is most commonly used as protection against freezing and maintenance of temperature.

IEC International Standards...

As part of its IEC 60079 series of International Standards on explosive atmospheres, IEC TC (Technical Committee) 31: Equipment for explosive atmospheres, has developed two standards that cover general and testing requirements and provide guidance for the design, installation and maintenance of electrical resistance trace heating in potentially hazardous areas.

...and Conformity Assessment for trace heating in Ex areas

Trace-heating cables, as specified in IEC 60079-30-1 and IEC 60079-30-2, are the only type of cables tested and certified by IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres.

Any other type of electrical cable used in Ex areas is not considered a part of the Ex equipment and is not covered by the IECEx Certified Equipment Schemes. This is why it is all the more important to entrust electrical installations in hazardous locations to highly skilled and trained staff who are aware of the specific aspects linked to explosion protection.

Highly skilled staff

To assess and certify individuals working in potentially hazardous areas, IECEx has developed the IECEx Certification of Personnel Competence Scheme.

The IECEx CoPC (Certificate of Personnel Competence) provides companies with independent proof that the certificate holder has the required qualifications and experience necessary to work on electrical equipment located in hazardous areas and can implement IEC International Standards covering explosive atmospheres. This can be especially important for contracting staff.

For the CoPC, competence is defined as "the ability to apply knowledge" rather than simply assessing knowledge. In this sense the assessment of persons includes assessing their ability to perform certain Ex-related tasks.

To obtain a CoPC, a person submits an application to an approved IECEx Certification Body. Regular re-assessment also ensures that the certified person maintains these competencies. The certificate is personal, non-transferable and is valid across international borders.

All IECEx Certificates are issued via the IECEx "On-Line" certificate System. Full public view is available on the IECEx website at www.iecex.com

...offshore oil platforms... (Troll A platform, Statoil / Photo Øyvind Hagen).

...or storage tanks (Photo: Statoil).

Speedy delivery

IECQ certification ensures high quality of components used in fibre optics

Fibre optic lines have revolutionized communications, from long-distance phone calls to cable TV and Internet. Business and industry have used fibre optic technology for years to move large amounts of data quickly. Fibre-based communication is expected to grow tremendously in years to come.

Coming home

More recently, FTTH (Fibre-to-the-Home) has brought the technology to the home Internet user. In FTTH, fibre optic cables are installed from the telephone exchange to deliver communications such as broadband, digital TV and telephone to private homes.

Fibre optic cables offer much faster speeds and much higher bandwidth than copper wires were ever able to cope with. The multimedia and telecommunications sectors rely more and more on fibre optics for instantaneous data transmission.

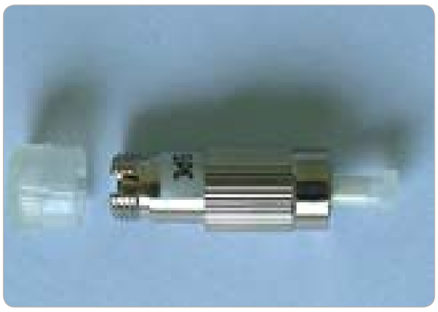
Complex components

Fibre optic components are used to form the fibre optic networking system. Because the fibre system is much more complicated than the former copper wired system, components needed for these optical networks are also extremely sophisticated.

Typical fibre optic components include transceivers, optical amplifiers, couplers/splitters, WDM (wavelength-division multiplexing) multiplexers and demultiplexers, filters, isolators, circulators, attenuators, optical switches, wavelength converters and various function modules. The entire range of components can be classified in one of two ways: passive or active type. Passive fibre optic components work without external power, while active fibre optic components need external power to operate.

Reliability is essential

To ensure the quality and reliability of the components used in optical fibre assemblies, manufacturers and suppliers have a powerful tool at their disposal. IECQ, the IEC Quality Assessment System for Electronic Components, provides certification at the international level for a wide variety of electronic components, including those found in fibre optic systems.



Fibre optic attenuator

The System offers immediate international recognition. One test and one certificate issued in one country means acceptance on a global basis, even in countries that are not IECQ members.

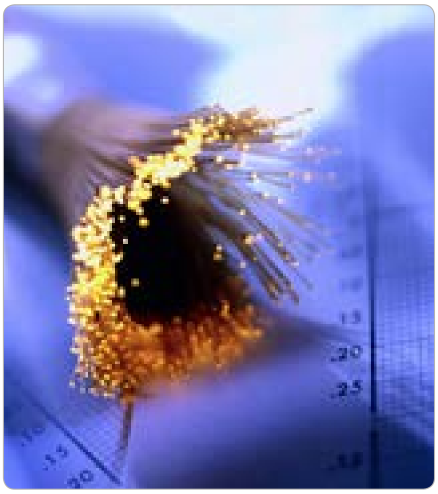
Reducing the use of hazardous substances

Nowadays, electronic component manufacturers who have had their products tested and certified by IECQ also request IECQ HSPM (Hazardous Substance Process Management) certification to demonstrate that their products are produced under controlled conditions to provide assurance that they meet hazardous-substance-free specific local, national and international requirements.

This is of particular importance for fibre optics as networks extend across borders. This means that they will have to comply with different national regulations that may restrict or prohibit the use of such substances in components.

The IECQ System provides all players in the ever expanding fibre optic market with the certainty of using electronic components that meet the strictest requirements and are of the highest quality.

For more on fibre optics, see also *Shifting signals delivery from copper to optical fibre* in this issue.



Fibre optic network.

Fibre optic cables.

Nomination

IEC Technical Committee Officer

This month, *e-tech* announces the nomination of an IEC TC (Technical Committee) Officer.

IEC TC 117 Solar thermal electric plants

SMB (Standardization Management Board) has approved the nomination of Amnon Mahalalel as Chairman of IEC TC 117: Solar thermal electric plants. He is the first Chairman of this new Committee; this first term runs from 1 November 2011 to 31 October 2017.

Mahalalel is International Marketing Manager/Standards and Regulations Manager in the Energy Sector, Renewable Energy Division of Siemens AG, Israel.

After more than two decades of testing, the generation of electricity from STE (Solar Thermal Electric) plants is now moving on from the research phase to industrial deployment. International Standards will be essential to ensure that the transition to this new stage is successful. The SMB approved the creation of the new IEC TC 117 in April 2011, to draft International Standards in this field at system and component levels, including measurement standards for performance tests.

The TC 117 secretariat was allocated to the Spanish NC (National Committee). Within the committee, three WGs (Working Groups) will be set up to cover the main needs for standardization: plant, components and storage.

PS10 CSP Power Plant near Seville (Spain)

CSP solar trough collector.

SES “Sun Catcher” Dish-Engine (US), Photo: SES.

Twenty thousand cables under the sea

Power and telecommunication cables expand their scope

Electrical power generation and the primary sources used to produce electricity and their environmental impact, attract a lot of attention. Yet, one key element of power distribution to users is often overlooked. This oversight is equally applicable in the communication domain. The missing – but essential – link is the cables and wires sector. Submarine cables used to transmit power or to exchange electronic data or voice represent a particularly interesting and fast expanding segment of this market.

Section of hybrid power / optical fibre submarine cable (Photo: ZTT)

A significant market

According to a recently-published report by the US (United States) market research company BCC Research, the global cable market was valued at some USD 127 billion in 2010. This market is expected to increase at 9,4 % CAGR (compound annual growth rate) to reach nearly USD 200 billion in 2015.

Power cables will continue to make up the bulk of demand for cable, accounting for more than three-quarters of the market. Their share was valued at nearly USD 98 billion in 2010 and is expected to increase at 9 % CAGR to reach more than USD 150 billion by 2015.

The telecom cables market is limited to the ICT (information, communications and technology) arena. It was valued at USD 29 billion in 2010 and is expected to increase at 11 % CAGR to reach USD 49 billion by 2015.

Wide range of materials

Telegraph cables, the first cables to transport a very small amount of electric power, appeared in the first half of the 19th century. Conductors were made out of copper and different materials were used to protect, insulate and allow them to cope with the environments in which they were installed, which were initially in the ground. The first submarine cable was laid between England and France in 1850.

Today, cables used for the transmission of telegraph, radio signals or data services are made of copper and optical fibres.

Power cables appeared later, in the second half of the century, with the first distribution system, installed by Thomas Edison in New York in 1882, actually using copper rods rather than cable. Nowadays cables used for power distribution are made of copper or aluminium. Of late they have also started to incorporate carbon-fibre core conductors.

The range of materials used to insulate and protect the various cables is extensive, as they must ensure proper operation in a multitude of physical environments, temperatures or under a variety of mechanical constraints.

A long history

Submarine cables were introduced shortly after the first telegraph cables were created.

From the outset, the production of submarine cables was a complex operation: many layers were required so as to protect the conductors from water ingress, mechanical and friction damage and rupture. Laying submarine cable was also an operation fraught with difficulty and beset by unknown issues.

The first transatlantic cable was laid between Newfoundland (Canada) and Ireland, a distance of some 4 000 kilometres, in 1858.

The rapid development of submarine telegraphic cable is evidence of the importance attached to this technology that has been instrumental in expanding global trade and allowing near instant communication. In 1914, more than 595 000 kilometres of submarine cables linking all continents had been laid, just 64 years after the first link between England and France was established.

Submarine power cables were introduced much later than their telegraphic counterparts, owing to the far more complex technical issues involved. Until recently they made up an insignificant share of the overall power cable sector and were used mainly to bring power to islands or offshore installations.

If submarine power and telecom cables still represent a relatively small share of the global cable market, they are set to expand considerably in the future.

Power cables

An October 2011 report by Pike Research, a firm that provides in-depth analysis of global clean technology markets, forecasts a more than five-fold increase in submarine power cable projects, from just over 60 worldwide in 2011 to more than 350 by 2020. The main drivers for this growing global demand will be:

- the quest for new renewable energy sources, such as offshore wind and marine wave farms that need connecting to grids;
- grid operators turning to submarine power transmission cables to help supplement or replace aging and inadequate grid infrastructures;
- the planned interconnections between countries with spare renewable energy capacities, such as Iceland or Norway, and those in need of additional power, such as the United Kingdom or Germany;
- the replacement of local power generation on offshore oil and gas platforms with power fed from the mainland.

Europe will lead the expansion for submarine power transmission deployments, with nearly three-quarters of all projects by 2020. From 2011 to 2015, purchasers and developers have proposed to install an additional 14 000 kilometres of HV (high-voltage) submarine cables in 53 separate projects in Europe – nearly three times the total in the last 11 years.

Data and content transmission

Nowadays, the massive expansion of the transmission of data required by the ICT sector is causing unprecedented growth of the global submarine cable network.

Special vessels are needed to lay submarine cables, a very complex operation (Photo: ABB).

ACE (Africa Coast to Europe) is one project that demonstrates this admirably. Extending over 17 000 km from Penmarch in Brittany, France, to Cape Town in South Africa, this USD 700 million high-bandwidth system will be ready in 2012. Optical fibre cables, laid at depths close to 6 000 metres below sea level, will give this network a potential capacity of 5,12 TBps (terabytes per second) and help reduce the North-South digital divide.

For some installations, such as offshore wind and tide generation farms or oil and gas platforms, combined power and optical fibre cables can be fitted in the same casing.

Early IEC involvement in kind…

Work by IEC first President, William Thompson, Lord Kelvin, was essential to the successful introduction of submarine telegraph cables. Thompson was knighted in recognition of his work on the transatlantic telegraphic cable project.

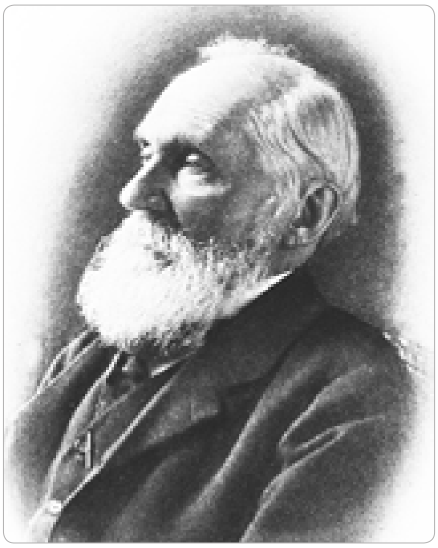
He invented the Mirror galvanometer in 1858. This was the first instrument that allowed the operation of long submarine cables and made it possible to realise transmission speeds five or six times those achievable with any other instrument.

In 1870 he devised the Siphon recorder, the first instrument used on long cables that recorded the received signals.

Thompson also designed the first modern deep-sea sounding machine for assessing the depth of water, an essential piece of equipment when laying submarine cables. His Kelvite Mark IV Sounding Machine, developed with the Royal Navy between 1903 and 1906, was still being produced with only minor modifications in the 1960s.

…continuing today

Work to prepare International Standards for cables and related systems and for



Pioneer of submarine cables: IEC first President Lord Kelvin

testing these is not new. A number of IEC TCs (Technical Committees) and SCs (Subcommittees) have been created for this purpose.

SC 18A: Electric cables for ships and fixed offshore units, brings together technical experts from 20 countries to prepare standards for testing methods or the production of certain elements such as cable sheathing and insulation.

TC 20: Electrical cables prepares International Standards for the design, testing and end-use recommendations (including current ratings) for insulated electrical power and control cables, their accessories and cable systems, for use in wiring and in power generation, distribution and transmission.

TC 86: Fibre optics, prepares standards for cables used to transmit data and voice, which are increasingly widely deployed in submarine environments.

That major submarine power cable and optical fibre producers and suppliers mention compliance of their products with IEC International Standards in their trade publicity material attests to their belief that these are essential and a true mark of quality.

Electric cables

Wired up to go

A surprising number of fires are caused by electrical faults that are associated with wiring or wiring devices. In the United States, fixed wiring heads the list of causes of ignition in home fires. There are more fires due to wiring than there are fires caused by cords and plugs, light fixtures, switches, receptacles, outlets, lamps or light bulbs. It's not that wiring is inherently unreliable and thus causes greater problems. No, it's simply that you can't have a building without electricity and if you want the electricity to be distributed it has to go through the relevant wiring which, by following the guidance of IEC TC (Technical Committee) 20 and testing regularly, should be safe.

Where electric defects are the most common cause of fire, overheated wires tops the list.

Wired to reduce fire hazards

Electrical fire data for 2010 put together by the European agency Leonardo Energy shows that residential dwellings are ageing and that their renovation rate is slow. However, at the same time, the use of electricity is increasing and with it the danger of fires due to faults in the wiring. Where electric defects are the most common cause of fire, overheated wires come top of that list. With age, electrical installations wear, cable insulation hardens, contacts become loose or corrode. In the UK, says Leonardo Energy, one third of the 9 000 fires each year are caused by inadequate wiring.

According to Underwriters Laboratories, over one third of all US housing is more than 50 years old. Put in the context of a typical situation today where wiring and circuitry are overloaded, it is quite likely that the wires become heated and where cabling has deteriorated and crumbled, so it is unable to insulate efficiently, a fire may follow.

IEC 60364-1, *Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions,* deals with electrical installations for buildings. It specifies that wiring should be verified every ten years to ensure there is no overheating, that the switchgear is suitable, the earthing adequate and so on; however this is not mandatory in many countries.

The most important test is that of measuring the insulation resistance of cables. If the insulation resistance is low, there's a risk of current leakage. If the earthing is not correct there's a potential danger of electric shock to humans or animals – and a leakage current of 500 mA can generate enough heat to cause a fire. IEC 60364-6, *Low-voltage installations – Part 6: Verification*, provides guidance for carrying out periodic verification of this element.

Fire Statistics in the United Kingdom was published in November 2010 by the Fire and Rescue Services. Figures show that the "majority of fire-related deaths occur in dwelling fires (three quarters in 2008)". More than half (54 per cent) of those accidental fires in homes arose from cooking. Other common sources of ignition were: electrical appliances (13 per cent), smokers' materials (7 per cent), electrical distribution (7 per cent) and space heating appliances (4 per cent).

In certain highly populated urban areas of the world, people today are housed and work in high-rise blocks and towers. As well as the obvious structural and geotechnical challenges of such buildings, there is a high additional risk attached to evacuating inhabitants in case of fire. Often these residential tower blocks have been built in areas that needed low cost housing and where there were already other social problems to contend with. As a result, it is highly likely that maintenance of the electrical system will not always have been carried out correctly; the risk of fire is therefore proportionately higher.

Statistically speaking, says the US Department of Homeland Security, when a residential building catches fire, what ignites first is not the structural framing of the construction (17 %), wall covering, insulation, panelling and so on (18 %), but the insulation around the wiring (30 %).

International Standards for testing and assessing wiring and cabling

IEC TC 20: Electric cables, prepares International Standards that are used in designing and testing insulated electrical power and control cables, their accessories and cable systems. End-user recommendations (including current ratings) are also issued for wiring and for use in power generation, distribution and transmission applications.

Test houses and conformity among the largest users

As a result, many of the main users of TC 20's publications are the test houses and conformity assessment organizations that are responsible for checking and testing wiring and cabling. Installations range from those in the domestic sector right up to superconducting transmission cables rated at up to 500 kV in the large installations currently being constructed to deal with UHV (ultra high voltage) power transmission or offshore connections. Other evolving markets include charging stations for EVs (electric vehicles) and dealing with renewable energy generation across the Smart Grid. The number of countries involved in manufacturing cables – currently around 80 – is growing, particularly for the lower voltage cables used in basic infrastructure.

Not only testing but better efficiency

Since wiring has resistance, it uses energy and very often loses it too. Energy efficient cabling therefore offers great possibilities for future development and new areas of standardization. A reduced carbon footprint and significant energy savings are demonstrated by cabling that has been designed to reduce transmission losses and heating effects. TC 20 is now working on a new version of its energy efficiency publication, IEC 60287-3-2, *Electric cables – calculation of the current rating.*

IEC TC 20: Electric cables, first met as an AC (Advisory Committee) in 1934. Today the focus is as much on the economic aspects of cabling as the technical ones. By considering globalization and the rationalization of cables, the International Standards that TC 20 produces will enable their users to better address the issue of electrical energy efficiency.

TC 20 is divided into four WGs (Working Groups) that deal with:

The Northeast Asia Trade Tower is presently the tallest high-rise building in South Korea.

- WG 16: High voltage cables (1 kV and above), their accessories and cable systems
- WG 17: Low voltage cables (below 1 kV)
- WG 18: Burning characteristics of cables
- WG 19: Current ratings and short circuit limits.

The group WG 18 holds a group safety function for "Fire hazard testing on cables" that consists of:

- flame propagation tests
- fire resistance tests
- smoke optical density tests
- corrosivity tests

Basic, group and product safety standards

Safety has to be a fundamental consideration wherever electricity is involved. The IEC publications that deal with safety therefore tend to be horizontal in nature. Rather than expecting each IEC TC to repeat or re-describe safety information, some of the IEC publications are destined to apply to entire aspects of safety that cover many products. These are known as *basic safety publications.* Others apply to the safety aspects of a specific group of products within the scope of two or more product TCs. These are known as *group safety functions*. This is the role that WG 18 plays in relation to cable fire hazard testing.

Reciprocal arrangements with other TC/SCs

IEC TCs/SCs do not work in total isolation but maintain liaisons with a number of other TCs/SCs and sometimes external organizations that are dealing with matters common to the work of each. In exchanging information they ensure that their committees remain effective and that their work is not duplicated or repeated. In this respect, TC 20 maintains liaisons with:

- **IEC TC 10:** Fluids for electrotechnical applications
- **IEC TC 27:** Industrial electroheating
- **IEC TC 36:** Insulators
- **IEC SC 36A:** Insulated bushings
- **IEC SC 46A:** Coaxial cables
- **IEC SC 46C:** Wires and symmetric cables
- **IEC SC 86A:** Fibres and cables
- **IEC TC 89:** Fire hazard testing
- **IEC TC 97:** Electrical installations for lighting and beaconing of aerodromes
- **CIGRE:** International Council on Large Electric Systems
- **CIGRE/SC B1:** Insulated cables

Clamp meter.

Shifting signals from copper to fibre

The distribution of radio frequency signals is experiencing rapid changes

RF or r.f. (radio frequency) signals, used to carry multimedia, voice or data content, may reach end-users through cable or over the air via electromagnetic wave propagation or satellite reception. Yet they rely primarily on cables for distribution from source to transmitters and antennas and final connection to receiving equipment. RF signals can be transmitted electrically or optically via coaxial cable or optic fibre; sometimes both approaches are used together in integrated networks.

Coaxial cables

A coaxial cable is an electric cable that acts as a waveguide for RF signals. It consists of an inner conductor (single solid or stranded wires), surrounded by a dielectric (non-conducting) insulator that separates it from an outer metallic conductor made up of metal tubing or braided strands. The outer conductor acts as a shield, preventing external and internal leakage of electromagnetic signals and interference. These elements are contained within an outer sheath that protects them from the environment; they all share the same axis, hence the term coaxial.

Coaxial cables are used in many areas, such as mobile and microwave communication, wireless broadcasting and radar systems in aviation and marine.

Multiple types, multiple standards

A wide variety of coaxial cables enables specific frequency bands to be catered for as well as the multitude of applications and environments in which the cables are used. The most familiar coaxial cable is the flexible sort found in the home environment for bringing analogue TV signals from antennas or cable networks to sets.

Other types of cables, including hard line, semi-rigid and rigid are used in domains such as broadcasting or two-way telecommunication and data transmission. They have to meet stringent technical criteria to prevent external interference and protect them against environmental hazards. As many cannot be bent, they also need special connectors.

Many International Standards are required to set the electromagnetic and physical characteristics of coaxial cables and associated components. Preparing these is the task of IEC SC (Subcommittee) 46A: Coaxial cables. SC 46A "is responsible for standardization activities related to coaxial cables used primarily in ICT (Information and Communications Technology), microwave and multimedia distribution networks and systems".

Armoured optical fibre cable

To leak or not to leak

The purpose of the shielding layer is to prevent leakage; that is, the passage of signals from and into the inner conductor.

Defective shielding may let unwanted signals penetrate the conductor and weaken or interfere with the RF signals it transmits. Conversely, external leakage of the signal carried by a coaxial cable results in a poorer RF signal and possible electromagnetic interference that can disrupt nearby devices or signals.

However, a certain type of coaxial cable is specifically designed to leak signals, both from and to the cable. These so-called "leaky" or "radiating" cables have slots cut into their shield that enable them to act as both antenna and feeder cables by allowing signals to be sent or received. These cables are mainly used for wireless communication systems in long, narrow and enclosed areas that cannot be covered effectively by conventional antenna signals – for example, elevator or mine shafts, or tunnels, like those of London Underground, which uses this type of cables.

SC 46A has published a specific standard for "leaky" cables. IEC 61196-4, *Coaxial communication cables – Part 4: Sectional specification for radiating cables.* This standard "covers the requirements for flexible and semi-flexible radiating coaxial communication cables (…) specifies preferred ratings and characteristics (…) and enables selection of the appropriate tests and performance levels (…)"

Coaxial cables: slots in shielding of leaky cable (right) allow signal to be received/sent.

Light at the end of the cable

For many applications, metal wires such as coaxial cables have been replaced by optical fibres for the transmission of RF signals for multimedia services or ICT data.

Optical fibre-based systems present many benefits as they allow very large amounts of data to be transmitted over long distances almost instantaneously. Their widespread introduction has made possible the rapid and extensive development of the information society.

Optical fibres are made up of a transparent core surrounded by a transparent but less refractive material that keeps light in the core, allowing it to act as a waveguide.

Electrical signals, such as RF signals, are changed into optical signals using an electrical to optical fibre converter. They are then transmitted down optical fibres. If required, repeaters are used to regenerate the signal over distance.

Hundreds of fibres can be bundled in a single cable, allowing large amounts of data to be transmitted simultaneously at great speed. This makes fibre an ideal medium for multimedia, telecommunication and ICT applications.

In addition to these applications, the introduction of Smart Grids is expected to create an additional demand for fibre-based networks.

Optical fibres are highly adaptable: they can be fitted nearly anywhere indoors or outdoors. They may be laid in ducts, sewer networks, water pipes, high-pressure gas pipes, along or inside power cables. They can be buried in the ground, in the pavement, used in self-supporting cables or submerged in the sea…

The fibre optic market is expanding rapidly. IEC TC 86 and its SCs prepare International Standards for fibre optic-based systems. This TC and its SCs are very active, preparing and releasing many International Standards.

Multimedia world

One sector that relies extensively on both coaxial and fibre optics is the broadcast industry, from content production to signal distribution via satellite, terrestrial broadcast or cable networks.

The dramatic rise in the number of TV channels has driven the need for increased transmission capacity. The number of national channels in Europe had swollen from 47 in 1990 to 9 800 by 2010, a trend also observed elsewhere in the world. The introduction of interactive and data services, of HDTV (high-definition television) and 3D TV has further increased the search for even higher capacity.

The signal distribution infrastructure in satellite ground stations and CATV (cable TV) head-ends still relies heavily on coaxial cables.

HFC (hybrid fibre-coaxial) networks, employing a combination of optical fibre and coaxial cable, have been widely deployed for broadband networks by CATV operators since the early 1990s.

According to the German DEV Systemtechnik GmbH company, only about a quarter of all satellite communication and CATV installations currently use optical transmission and distribution of RF signals. The need for reliable and larger capacity solutions for signal transport and distribution at RF installations means that fibre-based systems are set to become ever more present in this sector.

TC 86 and its SCs are well prepared to support this expansion with their extensive work on International Standards for optic fibre-based systems.

Uplink dish for broadcasting (Photo: SES S.A.)

Connecting the world

Through thick and thin

Connectors play a vital role in any device. Yet they rarely attract much attention because the focus is generally on the device itself, be it a computer, telephone, photovoltaic module, or life-saving machine in a hospital. Connectors are simply expected to enable the effortless operation of the system in which they are installed. They are inconspicuous, yet must be both easy to access and to handle.

When the weakest element becomes the strongest

Traditionally a connector has often been the weakest point of any installation, since over and above the electrotechnical role it plays in connecting and transmitting electricity from one source to another, it has to put up with being pulled, pushed and twisted. It often suffers unusually rough treatment in its everyday use. As a result, designers of connectors have come up with some ingenious approaches to ensure that their system will withstand harsh treatment and last as long as the appliance itself or at least have a very long life.

Worldwide adoption of USB

The most popular and successful connector in the world is the USB (universal serial bus) device. According to ElectronicsWeekly, there are over 6 billion units installed worldwide with an adoption rate of virtually 100 % in PCs and peripherals. High-speed USB 2.0 running at 480Mbit/s meets many needs of consumers. Yet the rising demand for high-definition video and faster downloading of digital-media files has led to the creation of SuperSpeed USB 3.0.

USB connectors have been purposely designed to be robust. While many previous connector designs were fragile, with pins that were so delicate that they would easily bend or break, the USB connector was designed from the outset to withstand much more wear and tear. The electrical contacts in a USB connector are protected by an adjacent plastic tongue, and the entire connecting assembly is usually enclosed in a protective metal sheath. USB was originally a way of connecting PCs to peripherals, and OTG (on-the-go) was invented for situations when two devices, neither of which was a PC, needed to be connected together – for example, a camera and a printer.

Use extended to charging

Now, the use of USB connectors has been extended. One example is to act as battery charging devices – connecting battery-powered products to the USB port of a computer, for example.

IEC TC (Technical Committee) 100 has several ongoing projects that cover various possible device interfaces based on USB connectors.

One of the aims of TC 100 has been to standardize a universal power adapter and charger solution for mobile terminals and other ICT (information and communication technology) devices. This will enable interoperability between a common EPS (external power supply) and a data-enabled mobile telephone. At present, this is one of the solutions adopted globally by manufacturers in an effort to reduce waste and to create a single standard battery-charging solution for mobile phone manufacturers. In creating a common EPS, EU consumers are able to re-use the same single external power supply with a variety of phones made by different manufacturers.

The resulting economies of scale imply fewer external power supplies will need to be manufactured and supplied with every phone sold. Lower production quantities

USB is used increasingly to charge devices.

mean less raw material is used. Shipping costs are lower, warehouse storage space is reduced and there are fewer chargers that need to be disposed of at the end of the phone's useful life. It's an entirely win-win situation, not only for the consumer and the manufacturer, but for the environment too.

In January 2011, IEC TC 100, in collaboration with GSMA (the GSM Association that represents the interests of the worldwide mobile communications industry), announced IEC 62684, *Interoperability specifications of common external power supply (EPS) for use with data-enabled mobile telephones.*

Micro USB plug specifications

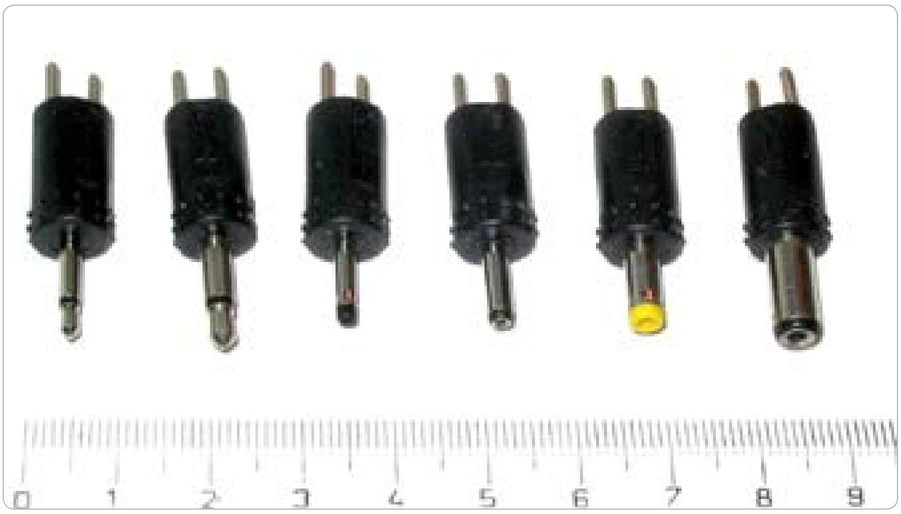
At the heart of the standard are the micro USB plug specifications issued by the USB-IF (Implementers Forum), with which the IEC has signed an MoU (Memorandum of Understanding).

In March 2011, TA (Technical Area) 1 produced the International Standard IEC 62637-1, *Battery charging interface for small handheld multimedia devices - Part 1: 2 mm barrel interface,* and IEC 62637-2, *Battery charging interface for small handheld multimedia devices - Part 2: 2 mm barrel type interface conformance testing.*

Barrel type battery charging interfaces are, as the name suggests, cylindrical. They have the advantage of being much lighter than transformer-based chargers and typically are used within the OMTP (open mobile terminal platform) for charging systems such as mobile phones. Gradually their use has become more widespread and they are increasingly popular. Today, there is a tremendous market of mobile devices, from cameras and telephones to tablets and homing devices. Systems can be recharged or connected simply using a standard USB plug on one end of a cable with a micro- or mini-USB or barrel plug on the other. One end connects to the computer or power adapter, the other, to the mobile terminal.

TA 14 works on device interfaces and methods of measurement for personal computing equipment. One of its PTs is working on another International Standard, IEC 62680, *Battery charging interface for small handheld multimedia devices - Part 3: Micro USB battery charging interface.*

At the end of October, IEC SC 48B: Connectors, a Subcommittee of TC 48: Electromechanical components and mechanical structures for electronic equipment, announced a pre-release version of the International Standard IEC 60511-1-100, *Connectors for electronic equipment – Tests and measurements – Part 1-100: General – Applicable publications.* Now at FDIS (Final Draft International Standard) stage, it is available for sale during the voting period. The new edition of the publication provides a listing of the 60512 series for carrying out specific tests on connectors. It particularly addresses new technical developments such as lead-free soldering which operates at different temperatures and is being used in a move towards more environmentally-friendly manufacturing.



Barrel type interface is 2 mm.

Source: Digital Photography Review.

Relays

Using electricity to switch

Relays are electromechanical devices. That is an area for which the experts in IEC TC (Technical Committee) 17 are responsible.

Sending the signals to the heavy load circuit

When a high-power system needs to handle a large number of amps because of the current it's drawing, a traditional hand-operated on-off switch with its direct connection doesn't serve much purpose. Temperatures can rise to such a level that the wiring inside simply is not able to handle the power and will melt!

A relay is an electromechanical remote control switch that turns on or off using electricity. Inside the relay, instead of wires, there's a small electromagnet or other system that activates a contact to make or break the circuit. A relay is able to control an output circuit of higher power than the input circuit, which means that it doesn't need to be wired to support a heavy load. Instead, it acts a bit like an automated electrical amplifier, sending out its on-off signals to the heavy load circuit.

Dating back to the 1830s

The first relays were developed by Joseph Henry in his studies of electromagnetism. It is he who devised the first electromagnetic telegraph in 1836. It was later adapted by Samuel Morse and used for his Morse code. That was several years before the IEC came into being in 1906. Relays were used extensively from then on in the first telephone exchanges and early computers to perform logical operations. Henry was also responsible for developing the first electric motor. And, although today in many modern circuits, solid-state devices with semiconductors have replaced relays, these switches are still used in a high proportion of motors and heavy load applications.

IEC TC 17 established in 1927

IEC TC (Technical Committee) 17: Switchgear and controlgear, was formed in 1927. The committee prepares International Standards that specify circuit-breakers, switches, contactors, starters, disconnectors, busbars and other types of switchgear assemblies – with the exception of those destined for domestic use. TC 17 is divided into four SCs (Subcommittees) that cover both high- and low-voltage switchgear and controlgear, together with assemblies and their associated control and/or power equipment, measuring and signalling equipment.

Work continues to be important for safety and reliability today

TC 17 work is vitally important today where switchgear and controlgear are heavily dependent on standardization to ensure the safety of those people who are involved in high-voltage transmission and distribution networks, in setting up electric power systems and so on. This is particularly the case in industrializing and developing countries where often workers lack training and experience. The TC 17 publications act as guides in passing on information and providing planning outlines.

Low-voltage switchgear assemblies are taking on greater significance too as buildings and factories are automated, and complementary functionality – e.g. integrated sensors – is added to the original equipment. At the same time, the markets are changing and becoming more global and deregulated. There are also moves to increase energy efficiency. Often, in an aim to reduce operational costs and increase output, a high degree of automation is involved, with switchgear and controlgear playing a major role. The reliability and dependability of systems are all-important.

Recent publications released in 2011
In August 2011, IEC SC 17A released a consolidated version of IEC 62271-1, *High-voltage switchgear and controlgear – Part 1: Common specifications.* This part of the IEC 62271 series [see the separate e-tech article on some of the new publications available from the IEC Webstore], applies to a.c. switchgear and controlgear designed for both indoor and outdoor installations with frequencies of up to 60 Hz and voltages above 1 000 V.

Another publication, to be read in conjunction with IEC 62271-1, is IEC 62271-200, *High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.* It is the responsibility of IEC SC 17C: High-voltage switchgear and controlgear assemblies; the second edition was released at the end of October 2011.

IEC 62271-200 specifies requirements for prefabricated metal enclosed switchgear and controlgear for alternating current of rated voltages above 1 kV and up to and including 52 kV for indoor and outdoor installation, and for service frequencies up to and including 60 Hz. Enclosures may include fixed and removable components and may be filled with fluid (liquid or gas) to provide insulation.

This second edition of IEC 62271-200 has introduced more precise definitions, classifications and test procedures. It includes specific ratings for parameters such as fault level to earth; describes optional rating “cable test voltage” type tests and gives internal arc classification test guidance regarding the test arrangement, room simulation and arc initiation.

Master mariners need standards too

Ensuring the safety of ships and offshore units

The safety of ships, of mobile and fixed offshore units and of their crews, is of prime concern and is largely dependent on the reliable operation of electrical installations, of cables in particular.

IEC standards for mobile and fixed offshore units are recognized by the IMO (photo: Norcowe)

Safety at sea – an ancient concern

Electrical installations on board ships and offshore units are subjected to, and must be capable of enduring, very harsh conditions and environmental or chemical hazards – yet still continue operating. This means that they must meet very stringent standards. The need for the latter was identified at an IEC Committee of Action meeting in Bellagio (Italy) in 1927, when it was decided to establish a specific Advisory Committee for questions relating to the standardization of electrical installations in ships.

Multilateral environment, global adoption

IEC TC (Technical Committee) 18: Electrical installations of ships and of mobile and fixed offshore units, prepares International Standards for the maritime sector; its SC (Subcommittee) 18A deals specifically with standards for electric cables. TC 18 has established a formal relationship with the IMO (International Maritime Organization) to collaborate in the field of electrical systems on ships and offshore units.

Standards for the shipping industry are adopted by a limited number of large bureaus or registers of shipping, such as the ABS (American Bureau of Shipping), Bureau Veritas, DNV (Det Norske Veritas), Lloyd's Register, the Korean Register of Shipping and the Russian Maritime Register of Shipping, to name just a few.

Most of these authorities rely on IEC International Standards as their preferred choice rather than opting to develop their own standards. The IEC 60092, *Electrical installations in ships,* series is referenced in the IMO's SOLAS (Safety of Life at Sea) Convention, which applies to all commercial seagoing ships of 500 gross tonnes and above; thus all the standards in the series are used extensively at a global level.

Where offshore units are concerned, the IEC 61892, *Mobile and fixed offshore units - Electrical installations,* series is a referenced document in the IMO MODU Code (Code for the construction and equipment of mobile offshore drilling units).

Both series of standards are implemented worldwide by naval architects, marine engineering design and consulting companies, and all industries involved in the ship-building and related sectors.

Covering all applications and installations

SC 18A International Standards cover all types of cables, including armoured or unarmoured, flame retardant and flameproof. These cables are used for multiple applications to transport energy, signals and data for power supply or instrumentation control. Adopting IEC International Standards for ships, mobile and fixed offshore units, greatly facilitates the interchangeability of parts and eases the selection and procurement of equipment for ships at a global level.

The safety and control of ships depends on cables (Photo: Australian Maritime College)

This is an important factor if one considers the extent of the worldwide market for electrical equipment and installations. Excluding cables for ships and offshore units, it was estimated at around USD 25 billion in 2008, with the cable market valued at more than USD 1,1 billion.

Safe cables are vital for ships transporting oil or gas, such as the Arctic Princess (photo: Statoil)

The ship-building industry is characterized by regional concentration: bulk carriers, oil and LNG (liquid natural gas) tankers or offshore platforms are mainly built in China, Japan and Korea, whilst most passenger ships are manufactured in Europe. Some countries produce special craft, such as offshore supply vessels (Norway). In spite of these regional differences and the varying types of products, most electrical components in ships and offshore units meet common standards, thanks to the world-wide adoption of IEC International Standards.

TC 18's work programme covers all aspects of electrical installations in ships and offshore units, from system design, control and automation or equipment, to propulsion systems or EMC (electromagnetic compatibility). To cut pollution when ships are in port, TC 18 is also preparing standards for HV (high-voltage) shore supply, in cooperation with ISO (International Organization for Standardization) and IEEE (Institute of Electrical and Electronics Engineers).

More standards needed for future systems and new sources of energy

As the power requirements of modern ships and offshore units continue to increase, there is a trend to introduce more electrical and electronic equipment, including computers and monitoring systems, electrical propulsion and machinery auxiliaries.

The expansion of offshore-based power generating installations, such as wind farms and wave or tidal current converters means that other types of cables will be needed to supply HV to these installations and to connect them to onshore grids. There will be a commensurate need for new standards.

Technological advances and the growing range and requirements of systems and devices installed on ships and offshore units, mean that TC 18 and SC 18A will be very active preparing new standards and maintaining existing ones in the foreseeable future.

Keeping copper in the loop

RF systems are 'live wires'

RF (radio frequency) equipment is widely used for the distribution and transmission of data, voice and multimedia content in the telecom, broadcast, ICT (Information and Communications Technology) and other sectors. As copper cable technology has evolved to meet increased requirements and stay at the cutting edge of technology, IEC TC (Technical Committee) 46 and its Subcommittees and various working groups prepare and update standards for RF cables, connectors and other components to ensure they remain effective and relevant for the industry.

RF cables and connectors are widely used in radio broadcasting, such as for this longwave antenna

LNB (low-noise block) downconverters for satellite reception use RF coaxial cables and connectors

Wide scope

Although the distribution and transmission of various kinds of content have moved to some extent from RF systems to new carriers such as fibre optics-based systems, RF gear, which covers a wide range of components, is still irreplaceable in many domains – for instance, connecting TV sets to antennas or cable networks in broadcasting, or for a number of ICT uses. Its performance must be maintained and even improved to ensure it remains relevant in the future.
This task is entrusted to TC 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories, its SCs (subcommittees) and various WGs (Working Groups) and MTs (maintenance teams).

Subcommittees for specific areas

SC 46A is responsible for the preparation and maintenance of standards for the coaxial cables used in analogue and digital transmission systems. Currently these are cables of rigid, semi-rigid and flexible construction that are used on transmission lines and in cabled distribution and other similar systems. The subcommittee's WG3 focuses specifically on coaxial cables for ICT and multimedia distribution networks and systems.

SC 46C prepares and maintains standards for wires and symmetric cable pairs and quads in analogue and digital transmission systems and for equipment used in communications and signalling. This work may include general cable construction; electrical, transmission, mechanical and environmental characteristics; related test methods and requirements, as well as quality assessment procedures.

SC 46F prepares standards concerning the specifications, requirements and measuring methods for RF and microwave passive components used in networks and cabling. Given the range of components used in RF systems, this SC produces and maintains a large number of International Standards.

Tight network of liaisons

TC 46 and its SCs act as suppliers or consumers of standards with other IEC TCs, such as:

- **TC 20:** Electric cables
- **TC 100:** Audio, video and multimedia systems and equipment, and in particular its TA (Technical Area) 5: Cable networks for television signals, sound signals and interactive services
- **TC 103:** Transmitting equipment for radiocommunication SC 65C Industrial networks.

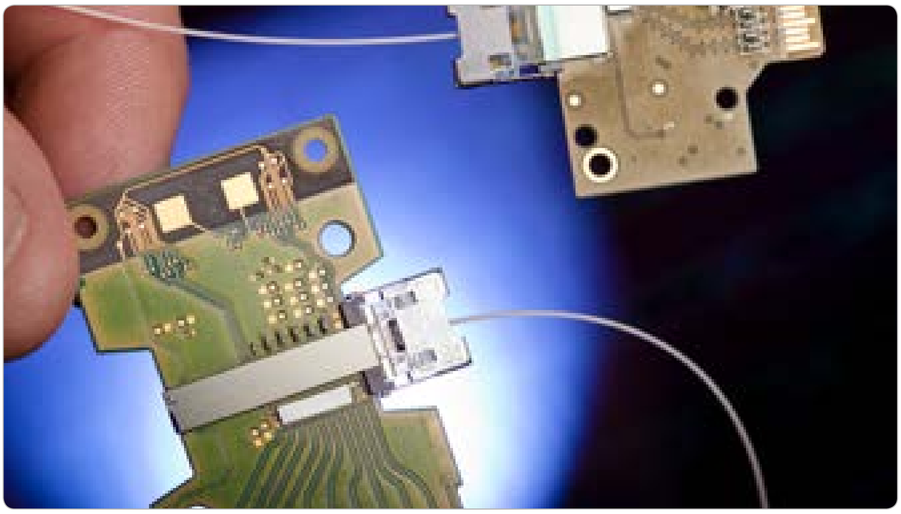
As the distribution of data, voice, telecom and multimedia content is often entrusted to both RF and optical fibre networks, TC 46 and TC 86: fibre optics, and their SCs, work together to define component specifications to ensure interoperability between RF and fibre optic-based systems. TC 46 also liaises with ISO/IEC JTC (Joint Technical Committee) 1/SC 25: Interconnection of information technology.

Since RF represents a key element in the distribution of radio and telecommunications signals, TC 46 also works closely with the ITU (International Telecommunication Union) through its ITU-R (Radiocommunication Sector), and ITU-T (Telecommunication Standardization Sector). As demand and need for access to greater content keeps growing, and with RF still providing an essential link in the distribution chain, TC 46 and its SCs are set to be highly active, preparing and maintaining International Standards for the foreseeable future.

A guiding light in fibre optics

Maintaining the signal

Ever since the invention of the first low-loss optical fibre in 1970 and the initial installation of optical fibre networks in the early 1980s, the market for fibre optic-based components and systems has been expanding globally. International Standards prepared by IEC TC (Technical Committee) 86, Fibre optics, and its SCs (Subcommittees) have been instrumental in this development by ensuring the industry has been able to roll out new products and develop the performance of the various components and systems that underpin it.



Faster computing will be possible thanks to optical transmitters (Photo: Intel Corp)

An expanding market

The actual value of the fibre optics market is assessed using physical as well as financial indicators: the demand for optical fibre itself is measured in thousands (or millions) of kilometres. The global demand for optical fibre grew from around 60 million kilometres in 2002 (down 50 % on 2001, following the so-called dot-com bubble burst) to 184 million in 2009. A slowdown resulting from the financial crisis and ensuing recession followed, before a steady growth returned.

Where the value of metal-based cables is linked closely to highly volatile global prices for copper and aluminium, that of optical fibre cables is dependent on glass, a raw material whose price tends not to fluctuate widely. Improving manufacturing processes, a somewhat inelastic supply chain and a fairly stable demand in recent years (owing to a rather global sluggish economic situation) have led to stable and even lower prices for optical fibres over the years.

Optical fibre GBIC (gigabit interface converter) for networking equipment

Components-driven growth

According to a report by GIA (Global Industry Analysts, Inc.) the fibre optic components and assemblies market is forecast to reach USD 31,3 billion by 2015. Demand is driven by continued migration from copper to fibre networks, in particular for the so-called FTTx (Fibre to the x), the replacement of metal local loops for the "last mile" connection to nodes, homes or businesses. TC 86 and its SCs are closely involved in the preparation of standards and testing procedures for all these components and subsystems.

In fibre optic transmission, the signal, in the form of light produced by optical transmitters such as LEDs (light-emitting diodes) or semiconductor lasers, loses its intensity over distance, a loss measured in dB/km (decibels per kilometre). Great advances have been made in the quality of fibres and performance of optical transmitters that produce the initial signal, thus cutting significantly this loss. However amplifiers of various kinds are still needed along the cables to ensure the maintenance of good signal quality over very long distances.

Other components and subsystems with a central role to play in transmission and connection are chromatic compensators, regenerators, transponders, attenuators and various interfaces and connectors, to name just a few.

Healthy prospects

According to TC 86 Secretary Steve Swanson the following trends will drive growth in the sector:

- worldwide development of FTTx (Fibre to the premises, in any configuration), calling for new products/new (improved) solutions to ease installation and reduce deployment costs;
- bandwidth demands are going up exponentially and expected to be four times larger in 2015 than in 2010, resulting in deeper penetration of communications and data transmission-related applications that use fibre optic technology;
- short reach communication on optics more important today and into the future – optical backplane inevitable for next generation switches and routers.

This growth will in turn drive demand for new / improved products in particular for FTTx, such as:

- new fibre and new cable types, specifically designed for in-the-premises application and deployment;
- new passive components, for the improved performances of NGANs (next generation access networks) optical access systems (in close cooperation with ITU-T);
- new fibre development, especially in the field of multi-mode fibres, which had been completely neglected in public NGAN applications.

Central role and full agenda for IEC TC 86 and its SCs

The IEC's involvement in the preparation of International Standards for fibre optics systems dates back to the late 1970s when its SC 46E was tasked with preparing "International Standards intended for application in telecommunication equipment and in devices employing similar techniques". At its first meeting in 1978, SC 46E set up a number of WGs (Working Groups) to assist in the preparation of these standards.

TC 86: Fibre optics, was established in December 1984 from SC 46E. Today TC 86 has three SCs, 12 WGs and numerous project teams and coordination groups. Some 250 experts from 26 countries are active participants in the work covered by TC 86.

TC 86 and its three SCs – SC 86A: Fibres and cables; SC 86B: Fibre optic interconnecting devices and passive components and SC 86C: Fibre optic systems and active devices – prepare International Standards for devices and tests in their respective domains.

Swanson lists the following as the main focus areas for TC 86 and its SCs currently:

- integration of optical components: optical circuit boards, optical backplanes, combining active and passive optics;
- high density low-cost components: cables and components minimizing first installation costs in FTTx applications, multi-fibre connectors, bend resistant fibres;
- dynamically-adaptive components;
- fibre optic sensors;
- collaboration with other TCs.

With over 440 International Standards covering test methods, interface and performance standards, specifications and technical reports currently available, and 109 active work projects, this TC and its SCs are particularly productive, their agenda shows this will remain the case in the future.

MultiDyne fibre-optic transceiver/receiver solution for the transmission of TV signals (Photo: MultiDyne).

IEC Webstore

Dynamic moves for customer satisfaction

The IEC Webstore is structured so as to allow users to purchase IEC publications directly in either electronic or paper format. It also provides access to a broad range of additional information on International Standards for electrical, electronic and related technologies. The free preview function and advanced search tools make the IEC Webstore the ideal place for anyone who is looking for material on a set subject, needing to search for the latest publication concerning a particular technology, for a standard produced by a specific TC (Technical committee) or for information linked to ICS Codes, publication date references and so on.

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Recent Tweet concerns high-voltage switchgear and controlgear

On 24 October 2011, the IEC Webstore released the new edition of IEC 62271-200, *High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*. This is a particularly popular publication that specifies requirements for prefabricated metal enclosed switchgear and controlgear. Enclosures may include fixed and removable components or be filled with fluid (liquid or gas) to provide insulation.

This latest publication includes changes to definitions and classifications and more precise testing procedures. Specific ratings related to fault level to earth have been introduced. There's now an optional rating "cable test voltage" included together with the associated requirements and type tests. Solid insulated high-voltage parts are no longer considered on their own so more specific guidance is given as to the test arrangement, room simulation and arc initiation for testing internal arc classifications, including single phase to earth ignition.

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IEC standards' series have always been extremely popular; some of them feature regularly on the list of bestselling publications. Indeed, customers who purchase IEC standards that are part of a series tend to buy more than one publication in that specific series, or, in many cases, the complete collection of publications.

Always at the forefront of developments in a rapidly and constantly evolving IT environment, the IEC Webstore responds to feedback from its community, customers and experts alike. Since there is a real market need behind the trend for series of publications, the IEC offers some of its bestselling series of standards as packages. Purchasing the whole collection is a one-click affair: quick, simple and cost-effective.

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Bright future for fibre optic standards

Lighting the way ahead

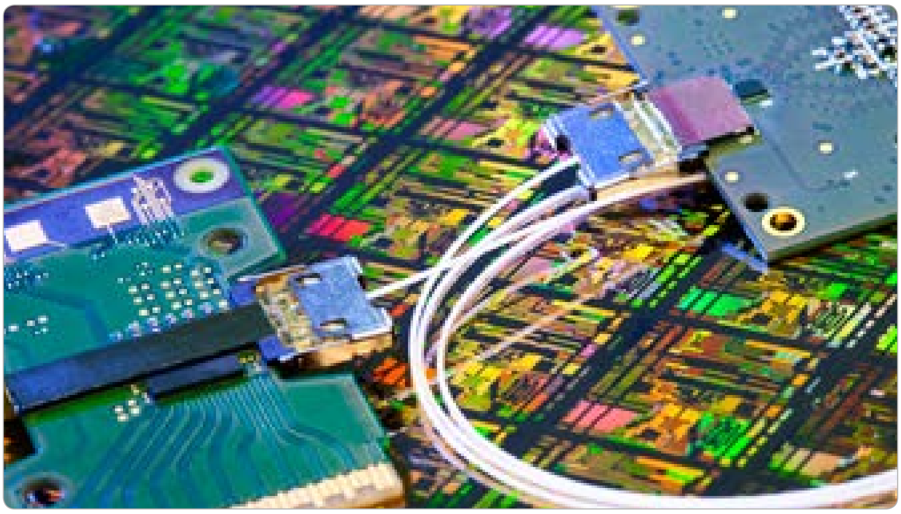
Fibre optic-based systems, which were first introduced in the late 1970s, are behind the spectacular expansion of the telecommunication, broadcast, entertainment and ICT (information and communications technology) industries of the last decades, given their ability to transmit voice, data or multimedia content.

Standards helping fibre optics sector expansion

TC (Technical Committee) 86: Fibre optics, and its SCs (Subcommittees) have been central to the development of the entire fibre optics sector. Their work on International Standards for fibres, cables and modules, devices and components such as connectors and interfaces is needed by all systems and networks.

Interoperability and reliability first

International Standards are essential to ensure that all of the components in fibre optic systems are both interoperable and reliable. Owing to the fast-moving pace of the sector, TC 86 and its SCs are constantly preparing new International Standards, or updating existing ones. November has proved a particularly busy month in terms of publications from SC 86B:



Fibre optics-based «Silicon Photonics» will replace copper connections in computers (Photo: Intel Corp.).

Fibre optic interconnecting devices and passive components.

This Subcommittee has just released the following International Standards:

- IEC 60874-1-1 Ed. 3.0, *Fibre optic interconnecting devices and passive components – Fibre optic fan outs – Part 1-1: Blank details specifications.* This document is not of itself a specification, but is a blank worksheet with instructions for preparing detailed specifications for fibre optic fan-outs. These are multiple cables designed for patch panels or cable ducts where saving space is a key requirement.
- IEC 61274-1-1 Ed. 3.0, *Fibre optic interconnecting devices and passive components – Adaptors for fibre optic connectors – Part 1-1: Blank detail specification.* This part of the IEC 61274 series concerns fibre optic adaptors for all types, sizes and structures of optical fibre connectors. It includes adaptor requirements and quality assessment procedures.
- IEC 61314-1-1 Ed.3.0, *Fibre optic interconnecting devices and passive components – Fibre optic fan-outs – Part 1-1: Blank detail specification.*
- IEC 61300-3-39 Ed. 2.0, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-39: Examinations and measurements – Physical Contact (PC) optical connector reference plug selection for return loss measurements.* The objective of this part of IEC 61300 is to select non-angled physical contact optical connector plugs used as reference plugs when making return loss measurements and to define an acceptance return loss value for use in plug acceptance testing.

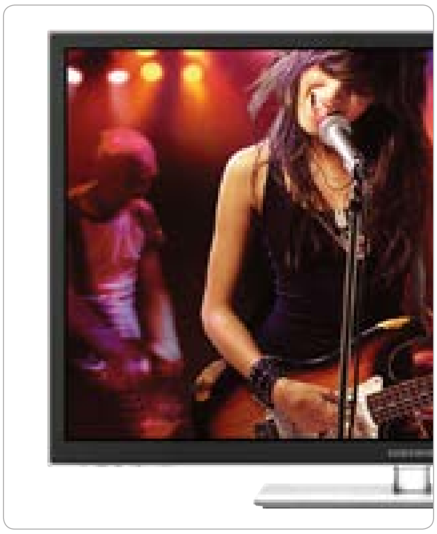
SC 86B also pre-released the following International Standard as FDIS (Final Draft International Standard) in August of this year. The final version will be released this month:

- IEC 60874-1 Ed. 6.0, *Fibre optic interconnecting devices and passive components – Connectors for optical fibres and cables – Part 1: Generic specification.* This part of the IEC 60874 series applies to fibre optic connector sets and individual components (adaptors, plugs, sockets) for all types, sizes and structures of fibres and cables. It includes requirements that have to be met by these regarding classification, IEC specification system, materials, quality, performance, etc.

Growing demand for standards

The introduction of fibre optic-based components, such as circuit boards, into other equipment, such as computers, control and monitoring systems, and the constant need for greater capacity in networks, means that new standards will be needed to enable all of the systems that are reliant on fibre optics technology to operate seamlessly with one another. As a result, TC 86 and its SCs are likely to remain very active for the foreseeable future.

Optical fibre cable.



Optical fibre networks help feed demand for multimedia content (Photo: Samsung).

Lighting

Lighting is central to our lives; in our homes, at work, when we shop or travel it ensures we do so comfortably and safely.

In the residential environment energy-efficient bulbs, in the form of CFL (compact fluorescent lamps) and LED (light-emitting diode) based lamps, are fast replacing the older incandescent bulbs as these are being phased out. Using up to 80 % less electricity when turning energy into light, they also last much longer and significantly reduce carbon dioxide emissions over their lifetime. They also help cut households' electricity bills.

In transport there are few areas where lighting plays a more important role than in aviation. AGL (airfield ground lighting) is a crucial element of day-to-day air traffic operations. It constantly provides crucial and safe information about an aircraft position in the air or on the ground to pilots and ground crews. After years of gradual improvements AGL is now on the threshold of a revolution with the introduction of LED-based fittings for all installations.

In both domains several IEC TC work to ensure manufacturers have access to the latest standards to make the best possible products for the benefit and safety of all users.

GM Special

Issue 10/2011 of *e-tech* will also summarize much of the 2011 IEC General Meeting proceedings in Melbourne, Australia, covering the activity report by the IEC General Secretary, management meetings, the Young Professionals and the Industrializing Country Workshops as well as a photo gallery of the event.

e-tech

News & views from the IEC

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