IEC e-tech

News & views from the IEC

ISSUE 07/2011

MANUFACTURING

INDUSTRY & TECHNOLOGY

Sustainability

3-D printing for rapid prototyping
Bright future for aluminium
Banking on the motors

IEC WORLD

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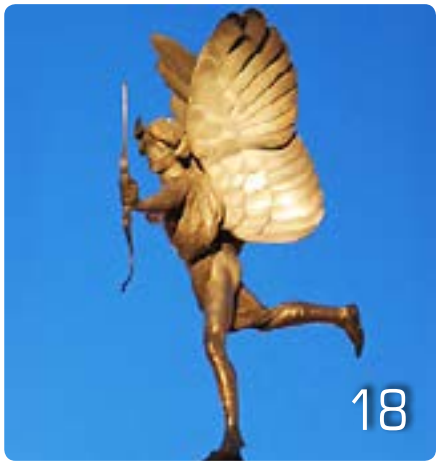
WSC Academic day
World Standards Day poster

CONFORMITY ASSESSMENT

Industrial automation

Certification



Focus of the month: Sustainable manufacturing

Manufacturing is changing and it's harder to remain competitive. The cost of the electrical energy used in production has become an important integral part of a BOM (bill of materials) calculation.

Editorial

Sustainable manufacturing

Philippa Martin-King,
Managing Editor e-tech.

Increasing production efficiency

The face of manufacturing is changing. The Western world is confronted with economic and monetary constraints that make it harder to maintain the production levels of the past few years while the developing world is seeing a rapid increase in output. The result is that for those industrialized countries looking to remain competitive, one element, often neglected in the past, but now an integral part of a BOM (bill of materials) calculation, is the cost of the energy used to produce the goods.

Developing economies account for over 80 percent of global population

Economic activity is the principal driver of demand for energy, according to the IEA (International Energy Agency). Population growth is also an important driver of energy use. In excess of 80 % of the world's population belongs to either developing or emerging economies. These countries make considerable use of raw materials such as steel and copper and emit a great deal of CO_2.

In its 2010 World Energy Outlook projections, the IEA predicts that worldwide electricity demand generation will increase by an average of 2,2 percent per year from 2008 to 2035. By the year 2035, the quantity of electricity used by non-OECD (Organization for Economic Cooperation and Development) countries is expected to rise by 80 %. And, while overall electricity demand diminished in 2009, the IEA projects that growth in demand for electricity will continue to outpace that for all other forms of energy.

Since the industrial sector – which uses between roughly 30 % and 40 % of world energy – is highly sensitive to changing economic conditions, so it follows that cost reduction measures such as those that IEC International Standards enable, and that result in more efficient use of energy, can make a noticeable difference.

The IEC produces International Standards relating to all forms of manufacturing. These include the Smart Grid, energy generation and transmission, electric motors, wiring, cabling, sensors and information technology, to mention just a few. International Standards allow systems to work safely with each other, help improve energy efficiency and lessen CO_2 emissions while reducing costs, opening up greater possibilities within markets and partners and providing faster access to markets.

Issue 07/2011 of *e-tech* looks at some of the ways in which International Standards can help industry achieve its task of becoming more cost efficient, both financially and in terms of cost to the environment.

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1. The industrial sector uses between roughly 30 % and 40 % of world energy.

2. Economic activity is the principal driver of demand for energy.

Reinforcing IEC links with academia

Teaching about standards – the Academic Day in China

The May 2011 *e-tech* gave forward notice of the Academic Day conference being held by the WSC (World Standards Cooperation), a cooperation established in 2001 by the three world-leading standardization organizations IEC, ISO (International Organization for Standardization) and ITU (International Telecommunication Union). Here in retrospect are some of the highlights of the event that was organized in conjunction with the annual ICES (the International Cooperation on Education and Standardization) workshop.

Facilitating contact between learning institutions and industry

The Academic Day, aimed at facilitating contact among academics, industrial leaders, experts and SDOs (Standards Development Organizations), took place in China in Hangzhou on 29 June 2011. It was held in conjunction with the ICES workshop which allowed it to take advantage of synergies that exist between educational institutions and standardization organizations. The two events were hosted by Professor Song Mingshun from China Jiliang University.

ICES – the only association for academics involved in standardization

Commenting on the event, IEC Standardization Strategy Manager, Jack Sheldon, said "This form of cooperation between the WSC (World Standards Cooperation) and ICES is tremendously important. It reinforces links between the IEC and academia and opens up possibilities to make the role of standardization better known among young professionals just starting out in the world of technology and business.

"Holding our Academia day at the same time as the ICES workshop provides us with the possibility to network with a number of key people who are involved in research, business and intellectual property in academic institutions", said Sheldon. "It's really useful, not only for the IEC, but for all organizations involved in international standardization. Indeed, ICES is the only global association that exists for academics connected to the world of standardization."

Held in conjunction with the ICES workshop.

Speaking at the Academic Day.

Standards still not perceived as holding importance

The afternoon session, chaired by John Hill who is a professor at Pennsylvania State University, US (United States), was part of a larger series of discussions covering Standardization Research. One of the speakers, Dong Geun Choi, who is a Senior Researcher at KSA (the Korean Standards Association), pointed out how standardization lends itself to a multi-learning platform that involves both business and engineering. Bruce Harding, a professor from Purdue University, US, and Chairman of ISO/TC 10, Technical product documentation, was quick to point out how standardization was not yet included in courses. "Because it won't make money for them," he said, "it has to be embedded in another course. Standards don't yet have enough importance", concluded Harding.

Insufficient provision made for including standardization in academic programmes

A general overview of the perception of standards within the global academic community shows there are still broad differences between the Western and the Eastern worlds.

Masami Tanaka, who is Vice-president of JISC (the Japanese Industrial Standards Committee) and President of JSA (the Japanese Standards Association), Japan, pointed out how much standardization and IPR (intellectual property rights) material is available in Japan. Indeed, standardization is an integral part of many academic programmes. He asked other attendees how they felt standards were used and implemented in their own parts of the world.

Henk J. de Vries who is a professor at the Dutch Rotterdam School of Management, Erasmus University, and one of the leading Europeans in standardization matters from an academic point of view, commented that standardization tended not to be taught as a single discipline, but be included in other programmes, whether at a national or company level. The Korean Dong Geun Choi corroborated

this saying that standardization lent itself to multi-disciplinary education, whether in engineering or in business. However, in the Western world, as pointed out by Wilfried Hesser, professor and Chair of Standardization and Technical Drawing, Helmut Schmidt University, Hamburg, Germany, standardization is not seen to have economic benefit.

"What we need," said Hill "is a standards model of sufficient impact to help academics demonstrate the strategic value of standards". Tanaka commented that it would take additional research in order to implement this and, furthermore, it would be necessary to make further provision for including Conformity Assessment in a programme.

Small and medium enterprises still don't get it!

The feeling that there is still insufficient teaching about standardization in Europe was summarized by Hesser. "Management in SMEs still don't get it…", he said, "there's a standardization deficit at management level."

Indeed, it can be difficult for senior management to understand the advantages of participating actively in international standardization. Since many top managers have little notion of the positive effect that participating in standards development can have on their business and markets, they often see the cost of involving their own experts as an unnecessary financial burden. "In business, particularly in small and medium enterprises, standards are perceived as being a clerical activity and of little strategic importance. As a result, the subject is rarely taught", commented Hesser.

One of the channels for making these facts better known is through academia. Participants agreed that academics in some countries still need recommendations as to how to go about putting their standardization work into practice. They feel they need more guidance, together with examples of strengthening experiences, the possibility to share materials and cross-referenced resources. Newell Hampson-Jones, from BSI (the British Standards Institute) United Kingdom suggested that social media platforms such as LinkedIn would be a suitable resource for setting up a best practice site where people could share their experiences.

IEC and ISO manage a repository of material for academic institutions

One source of information already exists. It is the repository of material maintained by the IEC and ISO specifically for academic institutions. The online service provides suitable documentation about the benefits of international standardization that can be helpful for teaching purposes and inclusion in course syllabuses. Participants agreed they would continue cooperation between WSC and ICES, choosing locations jointly and establishing a draft programme six months in advance.

Hosted by Jiliang University in China.

IEC - IEEE Challenge

Spread the message in the academic world!

There's a special pre-registration procedure for the IEC-IEEE 2012 Challenge.

Now is the moment to spread the message and let others know about the challenge that carries interesting prize money.

As of 28 October 2011, anyone qualified can show they intend to participate by registering on the Challenge website.

The deadline for pre-registration is 1 March 2012 at 24:00 UTC. The date for final submissions is 28 October 2012.

Next meeting in 2012 in Indonesia

The next ICES meeting is likely to be held in 2012 in Indonesia sometime before the end of May.

The IEC - IEEE 2012 Challenge

The Academic Day was the ideal venue for the IEC to make a pre-announcement about the IEC – IEEE Challenge: an opportunity for academics throughout the world to submit a paper on the impact of electrotechnology on economic, social and environmental development. [See the following article in this month's *e-tech*.]

IEC – IEEE Challenge

A chance for academics

The Academic Day was the ideal venue for the IEC to make a pre-announcement about the IEC – IEEE Challenge: an opportunity for academics throughout the world to submit a paper on the impact of electrotechnology on economic, social and environmental development.

The impact of electrotechnology

The IEC and IEEE are launching the 2012 Challenge, which is open to anyone affiliated to an academic institution. Academics are invited to submit a paper of up to 4 000 words on why and how electrotechnology impacts economic, social and environmental development.

The premise is that broad access to safe and efficient electrotechnology is dependent on universally accepted technical specifications and standards that, in turn, enable interoperability and international trade. It follows that the paper should identify some of the driving forces and prerequisites for achieving successful outcomes anywhere in the world and underline why electrotechnology is able to determine a society's ability to exchange information, develop and prosper.

Subjects that might be considered:

- Energy efficiency and climate change mitigation
- Energy security and public health Roll-out of renewables and Smart Grids
- Waste management and environmental preservation
- Case studies of electrotechnology and standardization helping to solve real-world challenges, including their financial and economic impact
- Laws and regulations
- Safety of populations
- Technology transfer and information exchange
- Corporate efficiency and competitiveness
- Ability to innovate and export…

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The award ceremony will take place in Oslo, Norway, in October 2012.

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IEC-IEEE Challenge Awards

Awards will be presented in October 2012 in Oslo, Norway, during the IEC General Meeting.

With confidence!

Italian architect wins 2011 competition for World Standards Day poster

Every year in October, the WSC (World Standards Cooperation), which consists of the three international standardization organizations, IEC, ISO (International Organization for Standardization) and ITU (International Telecommunication Union), celebrates World Standards Day. Early this year, the WSC launched a worldwide competition, open to all, to design a poster on the theme of "International Standards – Creating confidence globally".

Online voting proves highly popular

The WSC poster competition was promoted via the social media networks Twitter and Facebook. Out of the entries received, 45 were retained and the WSC selected the finalists and put them up for open vote on its Website. This approach proved to be highly popular, with over 2 000 votes being submitted online – so much so that the competition deadline had to be extended to the end of May.

What is World Standards Day?

Each year, on 14 October, the members of the WSC celebrate World Standards Day. WSC was set up in 2001 in order to strengthen and advance the voluntary consensus-based International Standards systems of the IEC, ISO and ITU.

It is a means of paying tribute to the collaborative efforts of the thousands of experts worldwide who develop the voluntary technical agreements that are published as International Standards.

To reinforce the visual message of the poster, the three partners produce a World Standards Day message.

First prize awarded to Caterina Fiorani of Italy

The winner of the competition, the young Italian architect Caterina Fiorani, is awarded 1 500 Swiss francs for her entry of open hands. An open hand, she explains, has universal recognition. It can be interpreted as a gesture of greeting or welcome; provide peaceful reassurance; or indicate deep confidence in human skills.

Hands wide open

Two open hands suggest honesty. They show willingness to help other human beings and a cooperative attitude in working together towards a common goal. Fiorani, who is an independent architect and planner in Italy's capital, Rome, says that the notion of hands inspired her to illustrate the quest of man and his search for quality in the work he produces. Backed by the helping power of International Standards, he is able to use the tools of his trade to reach a level of excellence.

Dots for equality

Fiorani has represented the world in dots. Dots, she says, are a standardized graphic sign that symbolizes the hope that dignity will be afforded in equal measure to human beings all around the globe.

She has used colours to emphasize local differences that she says are an added value that must never be forgotten.

The runners-up, who each receive 500 Swiss francs, are:

- A French/Germanic team consisting of Alexandra Schoenitz, Eurydice Avoine, Cornell Gorgas and Thibaud Cerdan
- Teguh Pribadi Adi Nugroho from Indonesia
- Eva Kohl from Germany.

Creating Confidence Globally.

Caterina Fiorani.

> ***"Two open hands suggest honesty. They show willingness to help other human beings and a cooperative attitude in working together towards a common goal."***
>
> CATERINA FIORANI,
> Italian architect

GridWeek 2011

The IEC is an endorsing partner organization again

GridWeek 2011 is taking place in Washington DC, US.

For five years now the GridWeek event has had global recognition as an important Smart Grid gathering for policy and decision makers, regulators, technology and service providers, electricity consumer advocates and Smart Grid experts. The IEC will again be present as one of the endorsing partner organizations. GridWeek 2011 takes place on 12-15 September in Washington DC, US (United States).

Attracting wide diversity of Smart Grid stakeholders

One of an impressive panel of Smart Grid experts, Richard Schomberg, Chairman of the IEC Smart Grid Strategic Group, will be speaking on *International Collaboration on Smart Grid Standards,* in a session on Monday afternoon moderated by George Arnold, National Coordinator for Smart Grid Interoperability, NIST (National Institute of Standards and Technology, United States).

The organizers claim that GridWeek is the only event to attract such a wide diversity of global Smart Grid stakeholders. The event explores the Smart Grid's impact on utility infrastructures, consumers, the economy and the environment, while answering the most pressing questions raised by industry.

In the same session, Steve Widergren, 2011 Plenary Chair of the SGIP (Smart Grid Interoperability Panel), will report on efforts to integrate international participation to ensure Smart Grid standards-making is coordinated and harmonized around the world. George Arnold will then moderate panellists from a wide set of countries in discussing progress on developing International Standards for the Smart Grid and the positive impacts these efforts will have on industry, government, and consumers.

Special reduced attendance rate for IEC

There is a special IEC family reduction rate for any person wishing to participate.

To register, simply link through to the customer registration page: www.pointview.com/pv/online/?site=76#register_2851. To receive a 10 % discount, enter the code: MXQMEX

Connecting externally and internally to the Smart Grid.

Industrial automation certified

IECEE responds to market demand

From the wheel that helped transport heavy loads to the fire that provided heat, inventions and discoveries have made life much easier. The advent of electricity was a turning point in the industrial world. Automated operations were introduced that could be performed without the need for human intervention. The development of automation throughout the 20th century brought enormous changes: some jobs disappeared, others underwent major transformations and new ones were created.

Clear advantages of automated processes

The advantages of having automated systems were soon recognized by industry. Human operators can be replaced in tasks that involve hard physical or monotonous work, or those that are performed in hazardous environments such as fires, nuclear facilities, underwater and so forth. Automated systems can also undertake jobs that cannot be performed by human beings because of demands such as speed, size, weight or endurance. Automated processes often result in higher end quality and reliability in the assembly chain.

The automotive industry has been transformed radically by the development of automation, but it is not the only one. Over time, the food industry, pharmaceutical and other manufacturing companies have relied heavily on automation to produce more and at lower cost. Today, it can be said that most sectors of industry use at least some element of automation.

Complex systems

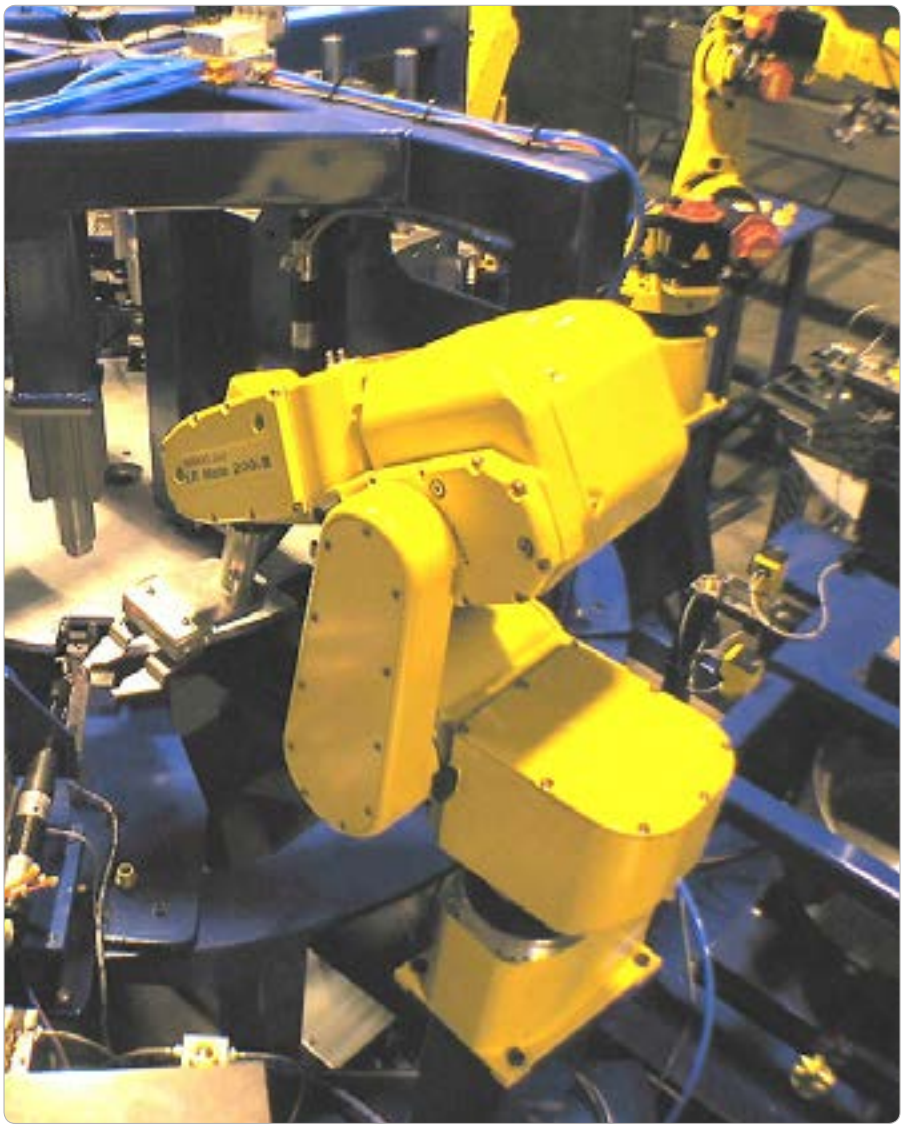
The rapid evolution of IT (information technology) in the second part of the 20th century has also enabled engineers to create more and more complex control systems integrating the factory floor.

IEC support

The IEC has a number of TCs (Technical Committees) that prepare standards that deal with specific areas of industrial automation. IEC TC 65: Industrial-process measurement, control and automation, provides many of the standards that are relevant for industry. IEC TC 17: Switchgear and controlgear, IEC TC 22: Power electronic systems and equipment and IEC TC 44: Safety of machinery - Electrotechnical aspects, all play important roles in this field.

Certification for industrial automation

Most of the standards developed by these IEC TCs are already integrated in



Automation combines the use of control systems and information technology applications to provide solutions to different industrial needs.

Automated production line in solar silicon factory.

Control systems tie together production, material ordering, consumption monitoring, process supervision, costing, maintenance and more.

services provided by IECEE, the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components. However, IECEE WG (Working Group) 2: Business Development, identified a market need for a specific service dedicated to industrial automation and has put in place the development of a new service that will provide manufacturers not only with a list of IEC International Standards that are essential in industrial automation, but also enable them to have their products and systems tested and certified by IECEE TLs (Testing Laboratories) and CBs (Certification Bodies).

Benefits of the IECEE System

The IECEE System is open to any manufacturer anywhere in the world. Today, more than 50 000 manufacturers benefit from the IECEE CB Scheme, enabling them to trade their products on the global market. More than half a million IECEE CB Test Certificates have been issued over the last 10 years.

In most countries IECEE Test Reports and Test Certificates are proof of compliance to regulatory requirements. Retailers, buyers and vendors are happy to import electrical goods that have been tested and certified by the IECEE System.

How the IECEE works

Over 70 NCBs now participate in the IECEE System. More than 370 independent CBTLs (Test Laboratories) and 2 000 MTLs (Manufacturers' Testing Laboratories) test millions of electrical and electronic products, which are commuted into IECEE CB Test Certificates by the IECEE NCBs.

Any CB and testing laboratory can seek IECEE membership. However, they must comply with the strict rules and procedures of the IECEE System and successfully pass the IECEE peer evaluation based on ISO/IEC Guide 65 and ISO/IEC 17025 and specific IECEE procedures. ISO is the International Organization for Standardization.

Examples of products tested include: household appliances, batteries, cables and cords, household equipment, luminaires, office and IT (information technology) equipment, electrical equipment for medical use, electric toys, portable tools, electronics and home entertainment and photovoltaic components, products and systems. The IECEE System also covers switches for appliances, transformers, fuse boards, tests for electromagnetic compatibility, hazardous substances in products and much more.

The way forward

Training Iraqi engineers for major oil production project

In Iraq, one of the world's three leading oil-rich countries, the first signs of economic recovery are in place, but total reconstruction and restoration of existing superstructures and infrastructures is still a long way off.

Participants with Patrick Leroux (front centre).

First signs of economic recovery

In the past couple of years, improved security and an initial wave of foreign investment have helped to spur economic activity, particularly in the energy, construction, and retail sectors. Broader economic improvement and a better standard of living are still dependent on the introduction of major policy reforms and the continued development of Iraq's massive oil reserves.

The Iraqi oil sector provides more than 90 % of government revenue and about 80 % of foreign exchange earnings. Since mid-2009, oil export earnings have returned to levels seen before the Iraqi war and government revenues have rebounded, along with global oil prices.

Recent contracts with major oil companies have the potential to expand oil revenues considerably, but Iraq still needs to upgrade its oil processing, pipeline, and export infrastructure for these deals to reach their potential.

Foreign initiatives

Several projects, driven predominantly by foreign companies and organizations, are being set up to help the country in its efforts to rebuild a sound economy. One such activity covering training activities for Iraqi engineers has been developed by IFP Training, a world leading company in training for professionals from the oil & gas, petrochemical and engine industries.

In July 2011, IFP (Institut français du pétrole) organized a one-month training seminar in Istanbul, Turkey, for 15 Iraqi electrical/instrumentation engineers who work in the oil exploration/production sector for an OPCO (operating company) managed by BP (British Petroleum) in Iraq.

Training Iraqi engineers for major oil production project

This intensive seminar was aimed at preparing these engineers for the development of a huge oil production project in Iraq. After completing the seminar, they will be incorporated into a project team.

The participants, aged between 35 and 50, were all experienced professionals who have had to face extreme work conditions in a war economy – shortage of equipment and spare parts, lack of maintenance, followed by reconstruction. They needed this "refresher" training to be brought up to speed on a variety of aspects and issues pertaining to their area of expertise.

Intensive programme

The seminar programme designed by IFP Training was broken down into four applied and industry-focused modules:

- Oil and gas processing, PID (proportional-integral-derivative) controller and so forth (7 days)
- Metering (4 days)
- Instrumentation and process control, safety systems (5 days)
- Electrical systems (4 days)

Patrick Leroux was one of several experts who served as lecturers for the different modules. He was in charge of the electrical systems design module. Leroux is a consultant for French oil and gas group TOTAL, Chairman of PCIC

An interpreter (right) was present.

Participants during the seminar.

Europe (Petroleum and Chemical Industry Committee) and a long-standing IECEx expert member of various IECEx working groups and committees, including the IECEx Marks Committee.

Two full days were dedicated to electrical equipment, design and construction considerations, regulations and standards in hazardous areas. This was followed by a session on safety and the various types of protection for Ex equipment.

Introducing IECEx

Leroux then spent some time on conformity assessment, introducing IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, and detailing the main characteristics of the three IECEx Schemes:

- the Certified Equipment Scheme,
- the Certified Service Facilities Scheme and
- the Certification of Personnel Competence Scheme.

Benefits of international testing and certification

Leroux drew a comparison between IECEx and ATEX, the European Union Directives on Equipment and protective systems for potentially explosive atmospheres, stressing the benefits of using a truly international system such as IECEx: reduced testing and certification costs to manufacturers, wider acceptance of certificates, faster market access, confidence in the product assessment process and in equipment and services covered by IECEx Certification. One further advantage of the IECEx System is its endorsement by the United Nations, through UNECE (UN Economic Commission for Europe) which recommends the IEC and IECEx as the world's best practice model for the verification of conformity to International Standards.

On the last day, participants completed a quiz that covered all issues addressed during the four-day seminar on electrical systems.

The evaluation sheets they filled in before their departure show that this intensive seminar was greatly appreciated and proved valuable for all attendees.

BP has scheduled similar sessions for other disciplines, such as mechanical engineering, project management, etc. About 100 engineers will be trained by IFP instructors during the next six months.

About IECEx

IECEx is the internationally accepted certification system that covers the installation, production, verification, inspection, maintenance and repair of equipment and systems used in areas where the risk of fire and/or explosions due to flammable gases, liquids and dusts exists (Ex industries). It also allows for the assessment of the competency of personnel carrying out work such as repairs in these industries.

IECEx covers the broad spectrum of devices, systems and services used in explosive environments, and verify their conformity to International Standards such as those prepared by IEC Technical Committee 31. Typical examples include interrupters, lamps, communication equipment and all kinds of instrumentation and rotating machines.

About IFP Training

With 90 full-time lecturers and a network of 600 consultants from the industry, IFP Training offers a wide range of training courses for a large public, from the manager to the technician,as well as Master Degree or Graduate Diploma programs in partnersip with IFP School and consulting related to training.

Keeping electronics safe

IECQ: the best tool for tackling counterfeit and hazardous substances

The global market for electronic components has shown strong growth for many years. This is a real success story, achieved as a result of consistent technological and industrial innovation. In recent years, electronic manufacturers have had to address new concerns: national and regional endeavours to pass legislation restricting or forbidding the use of hazardous substances in components, and the emergence of counterfeit products.

Moving fast

The rapid growth of the electronic components sector comes as no surprise, since the scope of electronics today reaches most consumer goods – from kitchen appliances to computers and entertainment centres – and industrial equipment – telecoms gear, motor vehicles, aerospace goods and instruments.

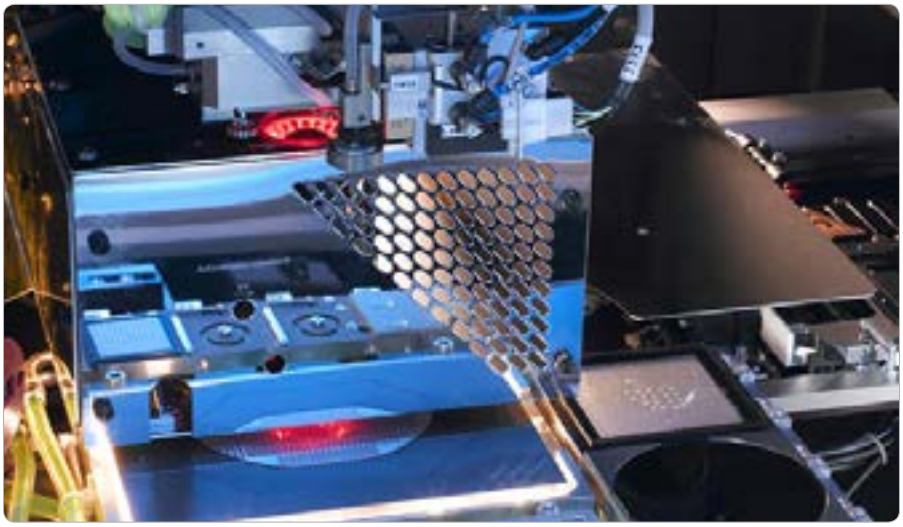
Technology in this field is also moving fast. Components have reduced in size while their performance measures have increased sharply. Manufacturers have had to react quickly and adapt their assembly lines to new designs and specifications provided by their engineers. This is particularly true for complex devices such as printed circuit boards, which may contain several thousand individual components.

Electronic component manufacturers rely increasingly on automation at all stages of the manufacturing process. The size of the components, their sheer complexity and the high production output required make it difficult for human hands to handle them. Highly specialized automated assembly lines, on the other hand, can ensure the utmost accuracy and speed (see *e-tech* July 2011).

New concerns

Today, electronic component manufacturers also have to address the issues of hazardous substances and counterfeit parts. To be considered legitimate and trustworthy, they have to ensure that their products meet the strictest safety and reliability requirements.

To help them react to and solve these problems, the IEC has put in place a conformity assessment system dedicated to the testing and certification of electronic components: IECQ, the IEC Quality Assessment System for Electronic Components.



Wafer assembly line.

IECQ: Testing and certification of all types of electronic components

IECQ is a worldwide approval and certification system that covers electronic components and related materials and processes, providing a business-to-business supply chain management system. It uses quality assessment specifications based on International Standards prepared by the IEC.

IECQ offers a modular approach to its certification schemes to cover electronic components and related processes, for example ESD (Electrostatic Discharge) management, IECQ HSPM (Hazardous Substance Process Management) and IECQ ECMP (Electronic Component Management Plan).

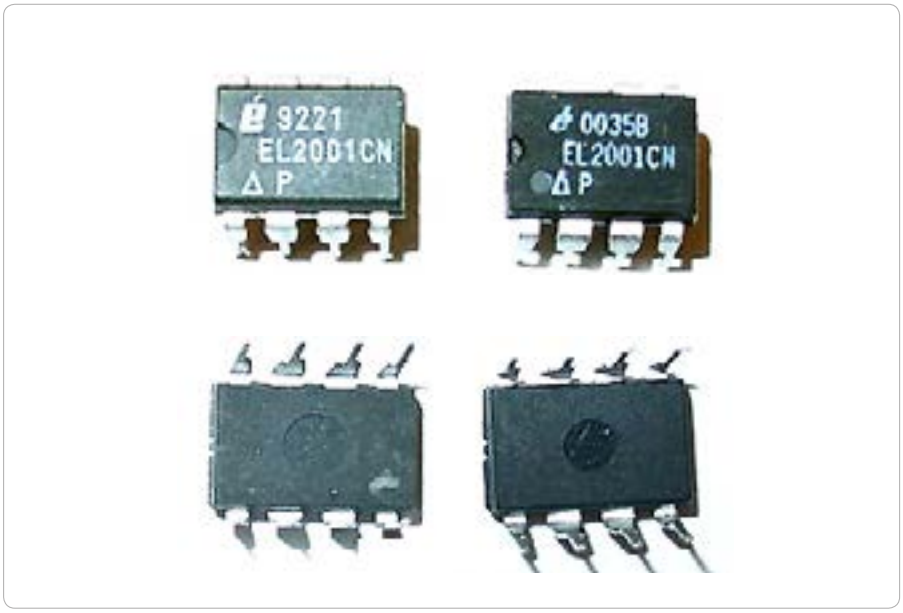
Issue No. 1

One of the issues associated with electronic components is that many of them contain hazardous substances such as lead, cadmium or mercury. Such substances may be dangerous for workers manufacturing the components as well as for end-users.

An additional problem comes at the end of the product life cycle: how to deal with waste. Manufacturers are under great pressure to produce “clean” products in order to comply with legislation that restricts the use of hazardous substances in electronic products and components. The pressure is even greater as the life cycle of electronic components shortens.

Many countries have passed, or are considering, legislation limiting the use of hazardous substances in electrical

Lead-free soldering wire for printed circuit boards.



The original component is on the left, the fake on the right.

and electronic products. The European Union's RoHS (Restrictions of Hazardous Substances) for electrical and electronic equipment and WEEE (Waste Electrical and Electronic Equipment) took effect in July 2006, and a revision of those directives is currently underway.

Solution No. 1: IECQ HSPM

The IECQ HSPM is a technically-based management systems approach to implementing and maintaining hazardous substance-free products and production processes. IECQ HSPM was developed in response to component manufacturers' need for giving suppliers the means to demonstrate, through third-party assessment, that their electrical and electronic components and assemblies meet specific hazardous substance-free local, national and international requirements.

Issue No 2: Counterfeit

Rapid growth of the electronic components market in the past two decades and the increasingly short product life span has led to the emergence of a parallel market, prompting unscrupulous manufacturers and suppliers to make easy money peddling substandard and counterfeit components. Counterfeit integrated circuits, capacitors, batteries, connectors, power-management devices and other electronic parts are making their way into electronic goods, equipment and systems, ultimately endangering the lives of those who use them.

Safety, reliability and performance issues are particularly crucial in transportation where substandard electronics can have dramatic consequences. Malfunctioning, non-responding electronic systems are often responsible for car or train accidents.

The consequences may be even worse for the aerospace industry, which depends heavily on electronics. Electronic components can be found in almost every system, including those that are primarily mechanical, hydraulic or pneumatic.

Solution No. 2: IECQ ECMP

IECQ has a specific scheme for the aerospace industry, IECQ ECMP (Electronic Component Management Plan), covering the component and assembly supply chain for avionics. This allows the aerospace industry to control the quality of the components it uses. IECQ is planning to use this Scheme in other high-reliability sectors such as railway and automotive industries.

Know your sources, have your products tested

The best way to avoid buying substandard parts is to track their production source, make sure they are legitimate and have gone through testing and certification that ensures their quality and safety.

Nominations

Officers of IEC Consultative and Technical Committees

As well as its regular Technical Committees, the IEC has a number of Strategic Groups, Sector Boards and Technical Advisory Committees which report to the SMB (Standardization Management Board). This month, *e-tech* announces various changes and nominations.

ACEA

Advisory Committee on Environmental Aspects

ACEA considers all aspects of the protection of the natural environment against detrimental impacts from a product, group of products or system that uses electrical technology, including electronics and telecommunications. EMC aspects are excluded as they are covered by ACEC (Advisory Committee on Electromagnetic Compatibility).

SMB approved the nomination of Richard Hughes to a second term on ACEA (Advisory Committee on Environmental Aspects). Hughes serves as a member of US TAGs (Technical Advisory Groups) to IEC TC (Technical Committee) 111: Environmental standardization for electrical and electronic products and systems, WG (Working Group) 1: Material declaration for electrical and electronic equipment. The second term runs from 1 August 2011 to 31 July 2014.

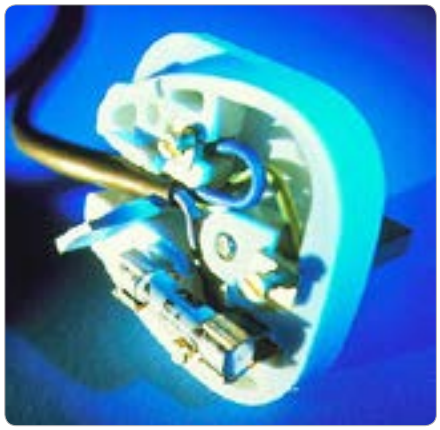
SMB approved the nomination of Bongjin Jung to a first term on ACEA. Jung serves as a member of IEC TC 111/WG 1. The first term runs from 1 July 2011 to 30 June 2014.

ACOS

Advisory Committee on Safety

ACOS deals with safety matters that are not specific to a single TC (Technical Committee). Its task is to guide and coordinate IEC work on safety matters to ensure consistency in IEC safety standards. Reporting to SMB, ACOS assigns horizontal and group safety functions to TCs to ensure this consistency.

SMB approved the nomination of Norbert Bischof to a third term on ACOS (Advisory Committee on Safety). Bischof serves on IEC TC 62: Electrical equipment in medical practice. The third term runs from 1 May 2011 to 30 April 2014.



SMB approved the nomination of Preben Holm to a first term on ACOS as representative of IEC TC109: Insulation co-ordination for low-voltage equipment. The first term runs from 1 May 2011 to 30 April 2014.

TC 39

Electronic tubes

SMB has announced the nomination of Nam Je Koh to a second term as Chairman of IEC TC 39: Electronic tubes. The new term runs from 1 September 2011 to 31 August 2014.

IEC TC 39 prepares International Standards relating to electronic tubes, including integrated components and/or circuits. This also covers accessories with regard to their compatibility aspects. X-ray tubes are excluded.

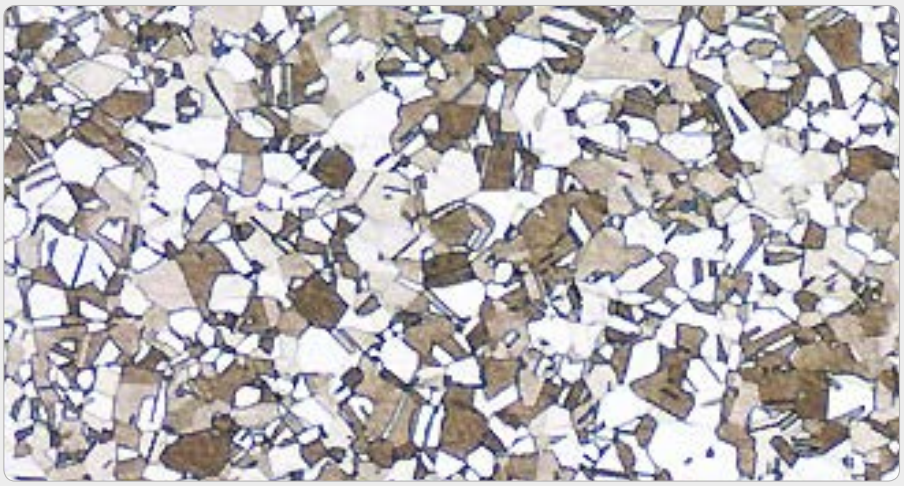
The Committee's scope covers several electronic tube technologies, e.g. receiving tubes, CRTs (cathode ray tubes) and magnetron tubes.

An electronic tube or vacuum tube is a sealed glass or metal-ceramic enclosure used in electronic circuitry to control the flow of electrons between the metal electrodes sealed inside the tubes. The air inside the tubes is removed by a vacuum. Vacuum tubes are used for amplification of a weak current, rectification of an alternating current to direct current (AC to DC), generation of oscillating radio-frequency (RF) power for radio and radar, and so forth.

TC 68

Magnetic alloys and steels

SMB has announced the nomination of Hugh J. Stanbury to a fifth term as Chairman of IEC TC 68: Magnetic alloys and steels. The new term runs from 1 October 2011 to 30 September 2014.



The global magnetics and electrical engineering industries employ soft magnetic alloys and steels which are fundamental to the generation and distribution of electrical power, electrical machine and related technologies. At the other end of the spectrum of magnetic material behaviour are the magnetically hard compounds and alloys which are crucial for a large number of magneto-mechanical applications and some examples of technical energy transformation.

IEC TC 68 develops International Standards that address:

- the classification and specifications of alloys and steels with regard to their magnetic and other physical properties which are relevant to their electrotechnical usage;
- the methods by which those properties are determined, appropriate for practical normative use in industry and test laboratories, i.e. proven to show proper eproducibility and economic efficiency.

IEC Affiliate Country Programme

Welcome Azerbaijan

At the end of June 2011, the IEC Affiliate Country Programme welcomed Azerbaijan as its newest participating country. With its 81 Full or Associate Member countries and 82 developing countries now following the Programme, the IEC Family numbers 163.

IEC Past President visits Central Asia

The June 2011 *e-tech* related the visit in May of IEC Immediate Past President Jacques Régis to Turkmenistan where he was speaking to representatives of the Caucasus and Central Asia regions at EASC, the Euroasian Interstate Council for Standardization, Metrology and Certification. One of the countries present was Azerbaijan.

International Standards and Conformity Assessment important for growth

Régis pointed out how, according to the IMF (International Monetary Fund), the medium-term economic growth prospects in the regions were good, but equally, how countries needed, for prosperity, to be able to look beyond traditional sources of growth in order to get past obstructive import and export barriers. He underlined the importance of International Standards and CA (Conformity Assessment) Systems in this process.

Azerbaijan part of a WTO delegation visit to Geneva

In June 2011, Azerbaijan was part of a WTO (World Trade Organization) delegation visiting IEC Central Office in Geneva. The visit gave Affiliate Country Programme Secretary Françoise Rauser the opportunity to invite Azerbaijan to join the IEC's Affiliate Country Programme. Today, Azerbaijan has already benefitted from its first IEC International Standard under the terms of the Affiliate Country Programme.

A foot in Europe

The Republic of Azerbaijan lies mainly in South Western Asia, with a foot in Eastern Europe to its north. It is the largest country in the Caucasus region of Eurasia. To its east is the Caspian Sea, the world's largest inland water body. To the north is Russia, with Georgia to the northwest, Armenia and a small 9-kilometre border with Turkey to the west, and Iran to the south. With an electricity consumption of 18 billion kWh, according to 2007 figures, the country exported 786 million kWh of electricity while importing 548 million kWh. The country's population is today verging on 8,4 million.

Running down the length of Azerbaijan to its east, the Caspian Sea is the world's largest inland water body. (Image courtesy NASA).

Azerbaijan has a foot in Europe.

Young woman in traditional wedding dress.

Energy-efficient and cleaner aluminium

Aluminium production is extremely energy-intensive; improving its energy efficiency and cleaning up the process is essential

Primary aluminium production relies entirely on electrical power, from the processing of ore (mainly bauxite) into the alumina (aluminium oxide) needed to make aluminium by electrolysis. Electrical energy costs represent a sizeable proportion of primary aluminium production expenses. The ever-expanding range of products that use or are made of aluminium means that global demand for this metal is constantly rising, pushing producers to seek ways to make its production as energy efficient as possible.

A "young" metal

The processing of raw materials is at the source of any manufacturing activity. The invention of metals, starting with bronze in the 4th millennium BC and followed by iron around 1200 BC, marks a significant milestone in human history. The metals enabled tools and implements to be produced for agriculture and manufacturing.

For its part, aluminium is a "young" metal. Although it is the third most abundant element in the Earth's crust, it is very difficult to produce in a pure form, a step that was only achieved in the mid-1820s. However, until American chemist Charles Martin Hall and French chemist Paul Héroult independently discovered the process for the industrial production of aluminium by electrochemical reduction of alumina in 1886, the global annual production of the metal amounted to just a few hundred kilograms, making it more valuable than gold at the time.

London: on his toes since 1893, Anteros was one of the first statues cast in aluminium

Now, this once rare metal is used for a broad range of applications in many sectors, including transportation, construction, electrical equipment, packaging and medicine.

Energy-intensive and costly production

Aluminium is still produced using the Hall-Héroult process. In this, alumina is dissolved into cryolite, a mineral, in "cells" or "pots" and pure aluminium is extracted by electrolysis using large carbon blocks as anodes, which allows the smelting process to take place. This procedure is very energy intensive: for older smelters, around 15-16 kWh (kilowatt-hours) of energy is needed per kilogram of aluminium produced; 13 kWh or under is required for more modern installations operating at higher current.

Aluminium production accounts for roughly 3,5 % of global electricity consumption. Energy (i.e. electricity) costs represent between 30 % and 40 % of aluminium production expenses. This is the main factor in determining where new smelters can be built: where energy is abundant and relatively inexpensive. Traditionally this is often close to hydroelectric power plants (as in Canada, the US, Norway or Russia) or sources of natural gas (such as in the United Arab Emirates). Easy access to waterways or ports is also important for bringing in ore or alumina to the plants.

The construction of new aluminium smelters, or alumina processing plants, is often accompanied by the parallel construction of dedicated power plants that will sustain their operations. Carbon anodes used in cells represent another significant cost, as they are eroded during the electrolysis process. 400 to 500 kg of carbon anodes are used for each tonne of aluminium produced, releasing CO_2 (carbon dioxide) and requiring regular replacement.

IEC work covers the whole production chain

As aluminium production is entirely dependent on electrical power and systems, from ore processing to finished metal, many IEC TCs (Technical Committees) play a central role in preparing International Standards for the industry. They range from power generation and distribution to machinery, ventilation and control systems and many others.

The generation and distribution of electrical power relies on IEC International Standards prepared by TC 4: Hydraulic Turbines, TC 5: Steam turbines, for power generation, TC 8: System aspects for electrical energy supply and TC 14: Power transformers, for regulating supply.

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

TC 2 prepares International Standards for electric drives used in all industrial

sectors. Its work is essential for aluminium production since much of the machinery used is powered by electric drives. The initial processing of ore uses vibrating screens to sieve bauxite, conveyor belts to transport it or ball mills to grind it into powder for further handling into alumina, which itself requires yet more machines for the final production of aluminium.

Renewable sources for an environmentally-friendly metal

The IAI (International Aluminium Institute), the global forum of the world's aluminium producers, accounts for more than 80 % of world primary aluminium output. It indicates that nearly 55 % of primary aluminium is produced using renewable and environmentally-friendly hydropower. Coal-generated electricity makes up 28 % of the total and natural gas slightly over 13 %. Aluminium producers generate about a third of their electricity needs from hydropower, coal or natural gas.

The share of hydropower usage in the aluminium industry is particularly high in Canada, Norway and Russia - 80 % of Russia's smelters are run on electricity generated by Siberia's hydropower plants.

Aluminium is also an environmentally-friendly material. While requiring a lot of energy to produce (most of it from hydropower), it is also nearly 100% recyclable, and can be recycled indefinitely. About 75 % of the aluminium that has ever been produced is still in use. Secondary (recycled) aluminium needs just 5 % of the energy required for producing the same amount of primary aluminium. In 2000, approximately 36 % of the aluminium supply in the US came from recycled aluminium, a sizeable percentage of it from beverage cans.

Because it is lightweight, aluminium can also help cut the fuel consumption of motor vehicles, aircraft and other means of transportation. Lighter cars or aircraft consume less fuel. It is estimated that every 100 kg of aluminium used in a car saves up to 1 000 litres of fuel per 200 000 km travelled.

Prospects for more efficient and sustainable production

Faced with energy costs that make up a third or more of aluminium production expenses and with the additional expenditure of replacing anodes, aluminium producers are constantly striving to achieve more efficient production methods. Their efforts are focused on the development and enhancement of energy-efficient production technologies and on reducing emissions. Major producers are developing their own processes.

Canadian aluminium producer Rio Tinto Alcan, claims that its AP Technology™ platform is the "world's cleanest aluminium production technology". It aims to "reduce and eventually eliminate emissions, and dramatically reduce energy consumption". The company adds that by operating cells above 400 kA (kiloamperes) – with 600 kA touted as "a realisable goal" – it has achieved a metal output per pot that is 40 % higher than that of existing technologies. Older processes typically use currents of 100 to 200 kA.

Aluminium scrap ready for recycling (Photo: © Norsk Hydro).

Aluminium production at the Wenatchee smelter in Washington state, US (Photo © 2011).

Russia's largest producer, Rusal, makes similar assertions for its own proprietary smelter technologies that also operate at and above 400 kA.

The future is inert

The energy efficiency of aluminium cells has improved significantly as aluminium producers gradually introduce new technologies. A remaining obstacle to further improvement in aluminium reduction, and an additional cost, is the use of carbon anodes that have to be replaced (or constantly topped up), a lengthy and costly procedure as cells have to stop operating during the operation.

For many years the industry has been looking at the possibility of using "inert" anodes made of ceramics, metals or cermets (composites of ceramics and metals). Unlike carbon anodes, inert anodes are not corroded during the aluminium reduction process and will not release CO_2 but pure oxygen.

The IEC is not only preparing International Standards for equipment used in aluminium production, it is also keeping abreast of future technologies, in particular the potential benefits offered by using inert anodes. Its MSB (Market Strategy Board) September 2010 White Paper, "Coping with the Energy Challenge – The IEC's role from 2010 to 2030", makes a series of recommendations regarding measures necessary for EEE (electrical energy efficiency). "Inert anodes for aluminium smelters" are clearly identified as a priority in the list of technologies that require input for further development.

The feasibility of producing inert anodes has long been disputed; however, it seems that this objective is now in sight. Rusal has said that it already has a material for inert anodes. It is currently improving it and retrofitting the cells' structure to suit the new technology. Rusal plans to start operating the first inert anode cells as early as 2015. It claims that inert anodes will allow it to cut operational costs by 10 % through reduced anode and energy consumption and will have considerable environmental benefits too: according to Rusal a single reduction cell will be able to generate the same amount of oxygen as 70 hectares of forest.

Owing to the growing demand for more energy-efficient and environmental-friendly products, aluminium has a bright future. The latest technologies will ensure the whole aluminium production chain will become also more cost effective.

Globalized standards

Here to stay

By Mike Miller, FS TÜV Expert, Global Safety Market Development, Rockwell Automation
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Compliance with international safety standards gives US (United States) machine builders a competitive advantage, while providing manufacturers with more reliable machines.

Machine builder.

Satisfying global customer demands for greater safety and reliability

International safety standards are reshaping how global machine builders approach machine safety system design. Do machine builders in the United States need to comply?

The answer depends on the machine builder's competitive goals and customer

base. For those serving or seeking to do business with global customers, the answer is a definitive "yes". For those aiming to satisfy customer demands for safer, more reliable machinery, the answer also is "yes".

Machine builders who currently serve the needs of North American end users alone should also follow International Standards as a guideline for best practice — not only to gain a competitive edge domestically, but also as a preparatory measure in case they later expand to pursue global customers.

Cutting metal with a high power laser beam.

What are the relevant standards?

Increasingly, global and multinational manufacturers around the world are moving towards following internationally accepted machine-safety system standards to improve flexibility, reduce liability and take advantage of technologies supported by updated standards.

The European Union standards bodies CEN (Comité Européen de Normalisation, the European Committee for Standardization) and CENELEC (Comité Européen de Normalisation Electrotechnique, the European Committee for Electrotechnical Standardization) elected to mandate two of the most rigorous machine safety standards: ISO (International Organization for Standardization) 13849, *Safety of machinery – Safety-related parts of control systems, Part 1: General principles for design,* together with *Part 2: Validation,* and IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems.* This means that any machines shipped into or out of Europe must comply with one of the two standards following the final withdrawal of EN 954-1 in 2011.

This also means the many machine builders in the United States who design machines destined for Europe will need to comply with the European adoption of these International Standards. They also must continue to meet a variety of US standards, such as ANSI (American National Standardization Institute), ASSE (American Society of Safety Engineers), ASME (American Society of Mechanical Engineers) and OSHA (Occupational Safety and Health Association).

Increasingly, manufacturers, especially global ones, are seeking machine builders that understand how to design machines in line with these International Standards. In some cases, it's mandated to do so in order to be able to manufacture in these countries.

More and more, manufacturers follow internationally accepted standards to provide streamlining of their global plants. Such manufacturers can be assured they're investing in safe machinery that helps protect workers and equipment and that displays excellent reliability. They understand the business value inherent in investing in contemporary machine safety systems and standardizing their plants worldwide. These upfront investments help reduce incidence, minimize training and maintenance costs, and often increase productivity.

"As a global manufacturer with over 180 locations worldwide, we focus on international safety standards to ensure that machine operators in all locations have the same level of confidence in the machine's safety system," says Mike Douglas, General Motors' senior manager and consultant, Global Health & Safety, Design, Standards and Technologies.

"International safety standards represent the highest confidence level in achieving machine safety, resulting in more predictable, reliable machines," he notes.

New elements of time and risk help justify costs

Historically, machine control-system safety standards were prescriptive in nature, simply providing guidance on the structure of control systems to help ensure safety requirements were met. The newer international safety system standards are more rigorous in their design requirements and provide a more quantifiable methodology to help ensure overall safety system performance and integrity.

The International Standards add two very important elements to the definition of the reliability of the machine's safety function: time and risk. These two elements help machine builders take advantage of a more methodical approach to safety system design.

Both International Standards require machine builders to identify and document the potential hazards

Sensor over a conveyor belt in a factory.

associated with a machine and the risk levels the hazards present to users.

The safety system is then designed to the level of risk associated with the hazards present on the machine. This allows the machine designer to design the safety system to the correct functional level.

Appropriate documentation proves a machine's level of safety, designers can better justify a need for a safety system upgrade, and operators can be more confident in the reliability of a machine's safety system.

ISO 13849-1

To comply with ISO 13849-1, a machine builder is required to define and document the statistical probability of an unwanted occurrence or dangerous failure, or MTTFd (the calculated mean time to dangerous failure). A machine builder must also define and document the machine's structure, or hardware configuration (often called categories), and its ability to detect dangerous failures, called diagnostic coverage.

Each component in a safety system must have an assigned probability of, or mean time to, dangerous failure. By adding the "time" element and the ability to detect dangerous failures to the existing safety structure approach, the ISO 13849-1 standard forces the designer to validate that the control system does what is required of it.

This standard applies beyond electric/electronic systems to include mechanical, hydraulic and pneumatic safety-related parts of the control systems.

IEC 62061

To comply with IEC 62061, a machine builder is required to describe the amount of risk to be reduced and the ability of a control system to reduce that risk in terms of SIL (safety integrity level).

The machinery sector uses three SILs; SIL 1 is the lowest and SIL 3 is the highest. A SIL applies to a safety function. The subsystem making up the system that implements the safety function must have an appropriate SIL capability. Conducting a risk assessment helps a designer define the amount of risk to be reduced and the SIL claim limit that safety-related control function must meet.

Both the documentation process and the performance-based approach help make it easier for designers to quantify and justify the value of safety.

Previously, a designer might have had difficulty understanding – or explaining – why a costly or seemingly sophisticated safety system was needed for a particular application. Now, with the ability to quantify circuit reliability through specific performance and system integrity calculations, the designer can show the value in terms of actual risk reduction and thereby more easily justify the value of safety.

Furthermore, machine designers can leverage the required documentation to cost-justify a system upgrade that includes a more effective safety solution.

Requiring designers to document risks and the control system's ability to reduce those risks also increases a machine builder's confidence in the reliability of the safety components. Because the standards are designed to assess risk over a prolonged period, a machine's safety system can be more predictable in the long term. This can help enhance a machine operator's confidence while operating a machine and, in turn, can help increase protection and productivity on the job.

Ultimately, a more predictable machine is a safer machine, and a safer machine is a more productive machine.

Help from automation suppliers

In support of the industry's move toward internationally accepted standards, automation suppliers are taking measures to help machine builders understand fully the benefits and to meet the requirements of machine safety control systems standards. These include getting safety products certified and offering education, training programs and tools.

For example, Rockwell Automation provides a product library file designed for use with the SISTEMA calculation tool from Germany's IFA, and a PDF file designed for manual calculation. Functional safety data, including the SISTEMA calculation tool and library, can be downloaded at the Rockwell Automation Safety Solutions Portal.

Also available on the Rockwell Automation Safety Solutions Portal are white papers, animations on safeguarding techniques and technologies, and archived versions of a functional safety webinar series.

Global standardization is here to stay

The machine safety world continues to change, and the European Union's mandate of rigorous international safety standards represents the global trend toward standardization. Ultimately, this will provide more flexibility to achieve and cost-justify designs, safer machine control systems and more consistency across plants.

While machine builders who plan to serve the needs of North American end users alone don't need to comply with the requirements of International Standards, they should consider following International Standards as a guideline for best practice, enabling them to gain a competitive edge domestically.

The 3D printing manufacturing revolution

From mass production to mass customization with additive manufacturing

3D printing, also known as AM (additive manufacturing) or RM (rapid manufacturing), was introduced more than two decades ago in the form of RP (rapid prototyping). As it enters mainstream manufacturing, AM signals a move from mass production to mass customization and personalization in the creation of many goods. It could also herald more energy-efficient and cleaner manufacturing processes, and significant changes in manufacturing.

Mass production

Manufacturing, as we know it today, dates back to the late 1890s and early 1900s. It is essentially based on the mass and efficient production of large volumes of goods, resulting in economies of scale and cheaper products. Return on capital investment is a determining factor. Most modern manufacturing is still firmly anchored in this model.

Mass production is often based on subtractive manufacturing, where the production methods dictate the design of products for optimal workflow. Inputs, such as metals or plastics, are processed and shaped into oversized products through moulding, pressing or die-casting before layers of excess material are removed by machining (drilling, trimming, etc.) or other methods to get a finished result. Modern manufacturing, using CNC (computer numerical control) machine tools, has greatly improved the efficiency of such "destructive" processes, but it still produces large amounts of waste material that need recycling, and require cleaning and replacement of machining equipment.

Fresh solutions drawing on new technologies are needed to face current and future industrial and economic challenges.

From making models to manufacturing

There is a prototype behind every manufactured product. From concept to function, models are needed to define the shape, feasibility, functionality and other parameters of a product, and to test potential customers' reactions.

The introduction of CAD (computer-aided design), in the mid-1960s, followed by CAM (computer-aided manufacturing), and their use with CNC machine tools, greatly enhanced and speeded up the design and production of prototypes, and ultimately of manufacturing.

A new process for making prototypes comparatively cheaply emerged in the late 1980s. Taking data from three-dimensional CAD drawings, a machine lays down very thin coats of material, usually plastics, in powder, liquid or resin form and hardens them to create a model rapidly, earning this technology the name of rapid prototyping. RP enabled companies to send designs of parts to their subsidiaries in different countries and continents instantly and have the parts reproduced locally, rather than having to ship them.

Within a few years RT (rapid tooling) was introduced to create moulds quickly or to fabricate tools for a limited volume of prototypes. The first RT machines were expensive but cut down on the cost and time spent on making moulds, preparing tools or finishing incomplete models.

This additive method eventually led to AM, enabling objects to be produced following the same process: adding nanometre-thick layers of various materials and using lasers to fuse them (a process also called sintering) or UV (ultraviolet) light to cure certain resins.

International Standards central to future of AM

IEC International Standards will be essential to the expansion of additive manufacturing. One area likely to expand is that of 3D printers: systems that use a wide array of electric and electronic components, including switches, relays, servo motors, ultraviolet lights and different types of lasers. Amongst the many IEC TCs (Technical Committees) preparing International Standards for such components is TC 76: Optical radiation safety and laser equipment. This is the leading body on laser standardization, including for high-power lasers used in industrial and research applications, and will play an important role in AM's expansion here.

Multiple benefits

3D printing/AM opens up new perspectives in manufacturing, in particular the cost-

Swirler (fuel injection nozzle) for gas turbines (Photo: Morris Technologies, Inc.).

Anyone for Rubik's cube? 3D printing designs from Meffert's Challenge

effective production of high-tech items or very complex products in relatively low volumes in a single process and not requiring long lead times. Another area lies in the costly manufacture and assembly of different parts which are often very small and made up of different materials. This is an important consideration in new technology sectors, such as aircraft or satellite production, where some parts are not needed in large volumes and have to be manufactured in complex steps.

"ATKINS: Rapid Manufacturing a Low Carbon Footprint", a Zero Emission Enterprise Feasibility Study from Loughborough University, UK (United Kingdom), gives several examples of potential environmental and economic benefits. For instance, it is not unusual to find 15 kg of expensive alloys being used to produce just 1 kg of high-value aerospace components. Excess material must be recycled and waste and chemicals, such as shavings, contaminated lubricants and slurries produced in the machining process, have to be treated at substantial additional cost, consuming still more energy.

By contrast, in a single procedure and using only the raw material needed, RM can produce highly complex items. These may include latticed microstructures and variable density surfaces or cavities. When the process is complete, the part is removed, excess material that has not been sintered is cleaned and can be reused almost entirely (in the case of metal sintering) or partially (in the case of polymer sintering). The volume of waste residue is cut drastically.

AM metal hinge for aircraft engine covers (fore): 50 % lighter than the conventional model.

Unlike conventional manufacturing, in which a multitude of machines and processes are required to cast, press, shape, trim and polish products, AM can create a wide assortment of items from the same device when similar material is employed – machines used for metal sintering cannot process plastics, for instance. No retooling is needed between tasks, only new 3D CAD data, resulting in much shorter lead times and significant production savings.

Hi-tech quickly at relatively low-cost

Complex parts, such as a swirler (fuel injection nozzle) for gas turbines, have been produced in a single manufacturing step from a cobalt chrome alloy using a DMLS (direct metal laser-sintering) system from EOS (Electro Optical Systems). In spite of its complexity, the 10-15 cm swirler was made in a single manufacturing step and did not require complicated and costly machining or the welding of some 10 separate parts, always a potential source of weak spots and cracks. Aircraft manufacturers, such as Boeing or EADS (European Aeronautic Defence and Space), routinely use AM to manufacture more reliable aircraft parts and drastically cut production cost and weight.

Scientists and students from Southampton University, UK, designed and made a 1,2 metre wingspan UAV (unmanned aerial vehicle) using 3D printers. SULSA (Southampton University Laser Sintered Aircraft), which has a range of 45 km and can fly at up to 140 kph, was designed in two days and printed in five. This short lead time between design and manufacturing allows designers to test out new ideas and prototypes quickly. Some of the benefits mentioned by the SULSA team are complete structural freedom for the designer at no cost and where the complexity of the design has no impact on manufacturing costs; a parametric design that can be stretched or resized and a complete separation of design and construction with "print where you need" possibility.

Disruptive potential

AM is still a nascent technology, used mainly in high-tech or niche environments, for the low-volume production of small to medium size and complex parts, for which it is cost-effective. However, AM will find its way into mainstream manufacturing and will lead to mass production, giving way to mass customization and on-demand production in many domains.

AM could herald another industrial revolution. Speaking to the BBC in July 2011, Neil Hopkinson, a senior lecturer in the Additive Manufacturing Research Group at Loughborough University, said that AM "could make off-shore manufacturing half way round the world far less cost effective than doing it at home. Rather than stockpile spare parts and components in locations all over the world," he argued, "the designs could be costlessly stored in virtual computer warehouses, waiting to be printed locally when required."

Exceptional growth

Evidence of the growing success of AM can be found in a May 2011 report by Wohlers Associates, an independent consulting firm on new developments and trends in additive manufacturing. Wohlers indicates that "the compound annual revenue growth rate produced by all AM products and services was an impressive 26,2 % for the industry's 23-year history." Wohlers Associates conservatively forecasts industry-wide revenues to grow from USD 1,3 billion in 2010 to USD 3,1 billion in 2016. The report also predicts the industry will ship 15 000 3D systems a year by 2015. The relatively low and falling price of RM equipment (sales are largely driven by machines selling for between USD5 000 and USD25 000) means the return on large capital investments is no longer the constraint it is in traditional manufacturing.

Although 3D printers are relatively small – EOS' largest DMLS system, the EOSINT M 280, has a footprint of 2,4 m² and weighs 1 250 kg – advanced AM machines are not yet "just round the corner at a 3D print shop on the high street", as Hopkinson is forecasting they will be.

George Devol: Father of industrial robots

George Devol (1912-2011): Father of industrial robotics and tireless inventor

George Devol, the man who has been called the father, grandfather and even great grandfather of industrial robotics and who died on 11 August 2011 at the age of 99, filed his last patent when he was… 98! The legacy of Devol, who once described himself as "the perpetual Don Quixote. Always flailing my arms", will be ever-felt at the IEC where many IEC Technical Committees prepare International Standards for systems he invented and that are part of our lives.

ABB robot successor of Devol's Unimate robotic arm (Photo: ABB).

Father of industrial robots…

Devol was best known as the "father of industrial robots" after inventing the first programmable industrial robot, which was introduced 50 years ago. Since then robots have been part of manufacturing throughout the world, in the automotive industry where they started as well as in nearly all other industrial activities.

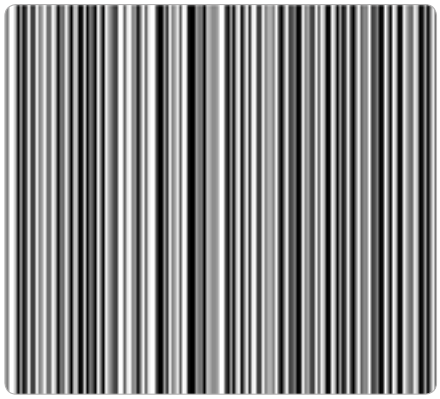
By the mid-1950s, Devol, who had already developed many inventions that are omnipresent in modern life, noted that tooling was regularly being scrapped as product designs changed increasingly rapidly. Inspired by books about robots by science-fiction author and fellow scientist Isaac Asimov, Devol reflected that automation would allow tooling to adapt to product changes through reprogramming, and to perform tasks, including difficult and repetitive ones, with precision and endurance. He patented a device that could do this.

After years of development, which included designing a digitally-controlled system, a solid-state memory system, servo controllers and special hydraulic and electrical power supplies, Universal Automation or "Unimation, Inc." created its first robotic arm, Unimate. The device was installed at a GM (General Motors) plant in New Jersey, US (United States), in 1961. This first Unimate was used to move hot metal for die-casting and to perform spot-welding on cars. Unimation, Inc. soon began full scale production, expanding to include robots that could weld, print, and assemble.

"I just can't understand America"

The introduction of robots to US industry was initially met by scepticism from managers – GM avoided publicity when it installed the first Unimate – and hostility from unions and workers who saw it as threatening jobs. In fact it emerged later that the jobs eliminated by the advent of robotics were unskilled or semi-skilled, whilst those created required a significant technical background.

Japan, realizing that it would face a labour shortage in the medium term, and looking to improve the quality of its products, was quick to introduce Unimate robots to manufacturing and beyond the automotive sector. Kawasaki Heavy Industries licensed its first hydraulic robot from Unimation and manufactured its first Unimate in 1969, opening the way to the automation of Japanese industry, allowing it to overtake its US counterpart in many domains, in particular the automotive sector. Devol deplored the US losing the initiative in robotics: "We're handing it to the Japanese on a platter," he told The Washington Post in 1983. "I just can't understand America."



Devol developed a simple bar code system.

Modern microwave oven (Photo: Panasonic).

… father of automatic doors, bar code readers and more

If Devol is best known for his pioneering work in the domain of industrial robotics, many of his other inventions from the 1930s, that use sensors and photoelectric switches, have become part of our daily lives.

One of his first inventions was the automatic photoelectric door. The company he set up, United Cinephone, licensed it to Yale & Towne, which manufactured and sold it under the name "Phantom Doorman". This system is the precursor of the automatic doors we see every day, everywhere, in shops, offices and many other places.

Devol also created the first photo-electronic entrance counter, which was first demonstrated in New York at the 1939 World Fair. The device counted visitors automatically, replacing the turnstile.

International Standards for photoelectric detectors, used in such doors and systems, are prepared by IEC SC (Subcommittee) 47C: Optoelectronic, display and imaging devices, part of IEC TC (Technical Committee) 47: Semiconductor devices.

ISO (International Organization for Standardization) and the IEC have established JTC (Joint Technical Committee) 1/SC 31: Automatic identification and data capture techniques, preparing International Standards for bar code systems.

> ***"Devol's patent for the first digitally-operated programmable robotic arm represents the foundation of the modern robotics industry (…) today, industrial robots have transformed factories into safer places and improved products with precision and consistency."***
>
> US NATIONAL INVENTORS HALL

Devol experimented with microwave technology and, in 1946, developed the "Speedy Weenie", a vending machine that cooked and dispensed hot dogs on demand. Speedy Weenies were installed in several locations including railway stations in New York.

Microwave ovens have now entered many households in developed countries and IEC SC 59K: Ovens and microwave ovens, cooking ranges and similar appliances, prepares International Standards for such appliances.

Late recognition

Devol was inducted into the US National Inventors Hall of Fame in March 2011. The citation read: "Devol's patent for the first digitally-operated programmable robotic arm represents the foundation of the modern robotics industry (…) today, industrial robots have transformed factories into safer places and improved products with precision and consistency".

In 2005, the Popular Mechanics magazine selected Unimate as one of the top 50 inventions of the last 50 years, together with such ubiquitous devices and products as the television remote control, the microwave oven and the jet airliner.

Devol, the tireless inventor who received his final patent when he was 98, regretted that the US had failed to benefit fully from his robotics work in spite of his efforts: "How can we afford to let a country as big as this one go down the drain in manufacturing capability?" he told the Miami Herald in a 1984 interview, adding, "I'm the perpetual Don Quixote. Always flailing my arms".

Sustainability

Banking on the motors

By Philippa Martin-King

When the going gets tough, a customary fiscal reaction of many states is to print additional national currency. As the millions of fresh banknotes roll off the printing press, how many of us stop to think of the many processes involved in their manufacture? Or of the number of efficiently run motors required to produce the simple piece of paper that represents so much, both culturally and financially? A banknote has that dual role. Graphically, it depicts national pride, history. Financially, through its many security printing and manufacturing technologies, it ensures that the note retains its face value. Each of the manufacturing efforts involved is wholly dependent on the efficiency and reliability of its own machinery.

Industry still consumes over a third of the world's total electricity

Industry is one of the areas that has made the greatest efforts to curb use of electricity. Its share of world electricity consumption fell from 53,4 % in 1973 to 41,7 % in 2008. Yet 2010 figures show that industry is still consuming over a third of the world's total electricity requirement, with some 60 % of that powering electric motors. The top four of the greatest energy users are the chemical, bulk refining, paper and mining industries. All four industries form an essential part of the banknote manufacturing chain in supplying pigments, inks, resins, high-technology chemistry and substrates for printed currencies. It follows that if the efficiency of the motors used in the manufacturing process can be enhanced even fractionally, then there are substantial economies to be made, both in terms of manufacturing costs and also of CO_2 emissions.

> ***"When you next take a banknote out of your wallet, take a second to admire the final product of so many steps of machining and think of all those finely tuned motors that provide the reassurance automatically associated with currency."***
>
> PHILIPPA MARTIN-KING, MANAGING EDITOR, *e-tech*

An IEC International Standard, IEC 60034-30, *Rotating electrical machines - Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)*, specifying efficiency classes for relevant 50 Hz and 60 Hz motors, has been adopted by leading manufacturers of industrial motors around the world. This IEC International Standard classifies motors into three levels depending on how efficiently they convert electricity into mechanical energy: IE1 is the base standard for efficiency, IE2 stands for high efficiency and IE3 for premium efficiency. The standard also mentions a future level of products above IE3, not yet commercially available, which will go by the name IE4 super premium efficiency.

The classification system has stimulated competition among motor manufacturers and generated massive technology improvements. Although IEC International Standards are voluntary, the EU (European Union) has adopted the IEC classification system and issued a Commission Regulation (EC) 640/2009, which came into effect on 16 June 2011. Now, only motors that meet or exceed IE2 energy efficiency levels are allowed to be sold and installed in the EU.

In a second stage, from January 2015, all motors will need to reach IE3 efficiency levels (or IE2 combined with variable speed drives). Generally referred to as

50 USD intaglio – colour change from gold to green.

EU MEPS (Minimum Energy Performance Standard), the requirement covers most two, four and six pole motors in the power range of 0,75 to 375 kW (kilowatt) for alternating current (AC) power supply frequencies of 50 and 60 Hz (Hertz).

The ZVEH (Zentralverband der Deutschen Elektro- und Informationstechnischen Handwerke, the central association of the German electrical and information technology industries) has calculated that this regulation will affect some 30 million old industrial motors in Europe alone. As they are gradually replaced, the resulting energy savings are estimated to be roughly 5,5 billion kilowatt hours of electricity each year with a corresponding reduction of 3,4 million tons of CO_2. Proof that energy efficiency measures can be profitable for the environment and for the investor is the fact that investment replacement payback can be achieved in one to three years (and in under one year when combined with variable speed controls).

Other countries not affected by EU MEPS, which covers only European Union markets, have already implemented similar energy efficiency schemes and are active participants in the IEC. They include Australia, China, Brazil and Canada. In the US, the NEMA (National Electrical Manufacturers Association) motor energy efficiency programme follows closely the IEC energy classifications. For instance, the NEMA Premium is identical to IE3 and NEMA motors have to be tested in accordance with the IEC testing protocol contained in IEC 60034-2-1.

50 Euros with silkscreen – colour change from magenta to green.

Feel the raised intaglio printing on the 100 CHF.

So when you next take a banknote out of your wallet, take a second to admire the final product of so many steps of machining. From the substrate, made of strong pure cotton to withstand all the wear and tear of being handled multiple times in particularly dry or humid or salty climates, to the elements printed using intaglio or silkscreen methods with their exceptional colour-changing Optically Variable Ink, think of all those motors finely tuned and set up and providing the reassurance that is automatically associated with currency.

Turning the motors to produce currency

Historically, banknotes involved a number of manual processes. Today, all stages of manufacturing are controlled by motors that run the sophisticated machinery.

Substrate – engineered to perfection

Most banknotes are made of cotton, rolled and processed to a particular thickness and tolerance, with additives that give them the colour, and visual security elements such as threads and watermarks, that each citizen associates with his or her currency. Some notes are printed on plastic substrates that have their own particular needs as far as ink adherence is concerned.

Pigments – grinding with finesse

All inks contain pigments which provide them with their unique colour. Pigments can be made of a variety of organic or inorganic materials, each with their own specific properties. They need to be ground to a fine powder with the utmost precision and care, to ensure that they will bind accurately with the resins and other chemical substances used.

Inks – crucial manufacturing for high security

There are inks for every printing process, whether offset, intaglio, silkscreen, letterpress, serigraphy, flexography or gravure. Each has to be carefully manufactured with the correct mixture of pigment and binding substances that correspond to the printing method and to ensure its successful transfer from press to substrate. The binding resinous substance is particularly crucial: it has to be manufactured taking account both of the printing process, and the range of use that the note may encounter later on in its everyday life.

One particularly notable ink is OVI® (Optically Variable Ink). Its colour-shifting properties make it an excellent and highly visible anti-counterfeiting measure. Manufactured in Switzerland, it shows one colour when viewed at arm's length from waist height and another when looked at close-to at eye level. That enables it to provide attractive colourful design features and makes it particularly good as a security feature, since a colour photocopier or scanner is incapable of reproducing both colours. As a result, forged notes can be detected easily. OVI can be applied either using silkscreen or intaglio processes, which opens up endless possibilities from the point of view of design.

Offset – rolling off the dots with applied chemistry

The classic printing technology consists of a series of dots that, to the naked eye, combine to give the impression of blocks of colour. It uses chemical technology that makes ink adhere to the various parts of the different plates from which it is transferred to the substrate, or, using the opposite approach, prevents the ink from transferring from the rollers that come into contact with the plate, so as to create blank areas on the paper. Each colour is dealt with separately, using a different plate, although certain specialist banknote printers have developed special techniques to apply more than one colour at a time.

Intaglio – machine-engraving and applied pressure and heat

The intaglio process is the one that supplies the typical tactile effect so often associated with banknotes. The raised effect is due to the thickness of the ink that is left on the substrate on which it is printed. Originally intaglio printing used a hand-engraved plate as the basis for its design. Nowadays these are produced by motor-driven machines. The viscous ink is spread on the engraving where it sinks into every line and hollow of the design. Having wiped the plate's surface, the only ink left is in the etched part. To transfer it to the substrate requires significant pressure and high temperatures. A roller presses the substrate into the recesses of the plate, leaving a positive, raised image of ink.

Silkscreen and its relevant drying equipment

Silkscreen printing now no longer uses silk to create the printed designs, but a mesh of other fibres through which the inks are pushed in a sieve-like manner. Parts of the mesh are blanked out so that the ink is only transferred to the substrate where the screen is left open. Silkscreen printing needs a particularly efficient drying system. That calls on yet another set of motors to operate the heated ventilation and corresponding airing systems.

The euro banknotes are printed on sheets that are cut into individual notes, counted and prepared for packaging. Source: Bundesdruckerei.

Manufacturing 2B information exchange

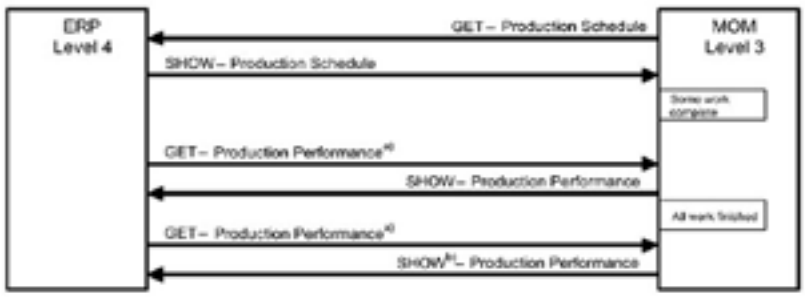
Manufacturing to Business and Business to Manufacturing information exchanges

Information exchanges within enterprises and between manufacturers and businesses are essential for the whole production process to proceed as efficiently as possible. The latest instalment in a multi-part International Standard, which defines the interfaces making such transactions possible between enterprise activities and control activities, is now available.

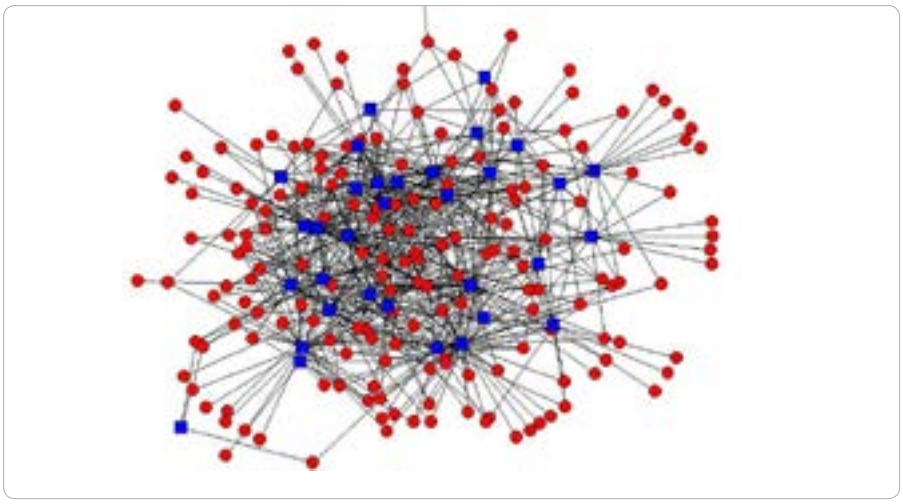
Pull, push or publish...

Information exchanges take place at all levels within an enterprise and between it and its partners. They are intended to enable information collection, retrieval, transfer and storage in support of control system integration. International Standard IEC 62264-5, *Enterprise-control system integration – Business to manufacturing transactions,* focuses on the information interface between the manufacturing systems and the enterprise systems.

It defines transactions in terms of information exchanges between applications performing business and manufacturing activities and retains three different transactions: a pull, a push and a publish model.



Pull model – Production schedule and production performance (IEC).



Information exchange.

This part of IEC 62264 prepared by IEC SC (Subcommittee) 65E: Devices and integration in enterprise systems, of TC (Technical Committee) 65: Industrial-process measurement, control and automation, was published earlier this year.

It completes the IEC 62264 series, outlining protocols for business-to-manufacturing and manufacturing-to-business transactions, defined as information exchanges. It is based on IEC 62264-1, *Models and terminology,* IEC 62264-2, *Object model attributes* and IEC 62264-3, *Activity models of manufacturing operations management* that describes object and activity models of manufacturing operations.

In the pull model users request data from the provider; the push model, requires an action (processing, changing or cancelling) by users. As for the publish model the data provider or owner publishes it for users (subscribers).

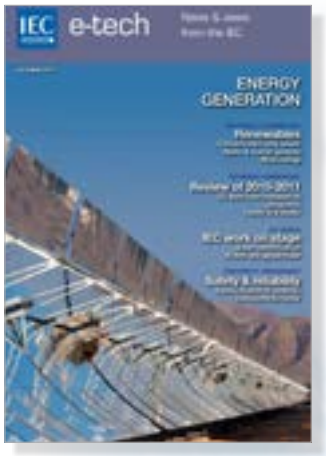
The first model is used for query/reporting, the second for transaction processing and the last one for data synchronization.

Transaction models and business scenario examples

This part of the 62264 standard describes the structure, areas and syntax (verbs and nouns to be used in the messages) necessary for the exchanges to take place.

It provides various transaction models and business scenario examples for exchanges between ERP (Enterprise Resource Planning) and MOM (Manufacturing Operations Management) for the push, pull and publish models.

This standard, essential to determine the degree of completeness, compliance and conformance of applications, is now available from the IEC webstore.



Energy generation

Issue 08/2011 of *e-tech* will be distributed to all attendees at the IEC General Meeting in Melbourne, Australia. It takes a look back over some of the previous year's events and highlights in terms of technical developments, TC activities and strategic meetings.

Summary articles cover important TC work in areas as diverse as e-books, standby and performance and ultrasonics, EVs, medical risk management, fuel cell technologies, domestic household appliances, elevators and escalators, sensors, robots, access and accessibility.

At the same time, with global energy needs on the rise and a diminishing supply of fossil fuels, awareness of environmental issues and safety concerns is increasing. The October *e-tech* contains articles on renewable energies, wind, water and particularly the sun, the focus of the IEC's latest Technical Committee, TC 117: Solar thermal electric plants, set up in 2011.

The IEC General Secretary and CEO, Ronnie Amit, in a pre-announcement about the publication of the Masterplan, talks of the IEC's clear vision and mission in spreading the word about standardization and the strategic advantage of active participation in IEC work.

e-tech

News & views from the IEC

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