• Bosch: International Standards open up markets
• Training trainers in developing countries
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ISO standards disseminate good practice, facilitate trade and drive innovation. They are valued because they represent an international consensus. However, achieving consensus and avoiding duplication is rarely a simple task. ISO must sometimes resort to innovative solutions and partnerships to best address the current context of the industry. Among the success stories is that of welding, where ISO adopted an approach based on synergy to find the best solution for addressing standardization in this field.

Welding is a horizontal craft, used in almost any product you can think of, from computer chips to cruise ships. “A world of joining experience” is the relevant new tagline of the International Institute of Welding (IIW). IIW was the first of what are now four recognized “International Standardizing Bodies” in the ISO family 1).

In 1984, ISO had concerns about the speed of the standards development process. The ISO Council resolved to create the category of recognized “International Standardizing Body”, where bodies that were similarly constituted could develop ISO standards in a specific technical field.

At that time, ISO/TC 44, Welding and allied processes, was somewhat dormant and there was a growing need to develop standards in the filler metal and resistance welding testing areas. IIW applied and was approved in 1986 as the first recognized International Standardizing Body. After a slow start, IIW developed its first standard in 1990. Since then, 24 International Standards and one technical report have been published, and there are 11 standards projects in the pipeline.

While IIW was gearing up to develop welding standards, CEN/TC 121, Welding, was also becoming active in this area following new mandates from the European Union. Along with the increased activity in IIW and CEN, ISO/TC 44 became re-energized and began to meet more often to address the growing need for welding standards.

As one would imagine, with three organizations now active in the welding standards arena, the potential for conflict was high. Duplication of effort, a limited number of qualified experts, funding for travel to meetings, and ownership of the standards were major concerns. Fortunately, there was some overlap of professionals participating in at least two of the groups, and they decided that, in order to achieve the ends, the means must be resolved.

“The deliverables have been a success and widely accepted by all stakeholders.”

It was recognized that each organization had unique technical expertise in certain areas. As a result, the ISO Central Secretariat assisted in the formation of a coordination committee to facilitate decisions on who should be responsible for which standards. This coordinating committee helped to sort out the politics and procedures so that the resulting standards would be agreeable to all concerned. The Vienna Agreement was also used successfully by all three organizations in order to consistently implement the standards throughout the welding community within Europe and throughout the world.

As the ISO-CEN Vienna Agreement rules evolved to have all subsequent revisions managed by an ISO lead, the operations of the three groups also changed. In 2006, a three-way understanding was established between IIW, CEN/TC 121, and ISO/TC 44 to allow complete transparency of information among the three organizations. Members of the organizations are encouraged to attend meetings of all three, and their documents are circulated amongst them. This also allows for better feedback during the periodic review of ISO standards.

While the journey has not always been smooth, the deliverables have been a success and widely accepted by all stakeholders. Right from the beginning, there was a desire among all parties to find a way to collaborate, achieve consensus, and produce globally relevant standards for the welding community. “Where there is a will, there is a way” and, in the case of welding standards, there was definitely a strong will and ultimately a successful way.

Mechanical innovation thus refers not only to areas where ISO is developing standards that are driving innovation, as shown in the articles in this issue (such as safety for pressure vessels and testing of metallic materials), but also to the innovative approaches and partnerships that ISO is adopting to address the needs of the industry and its stakeholders.

1) The others are the International Commission on Illumination (CIE), International Union of Leather Technologists and Chemists Societies (IULTCS), and most recently the World Maritime Organization (WMO).

H. Glenn Ziegenfuss
Executive Director, Standards Engineering Society and Standards Officer, International Institute of Welding
World Scene

UN Secretary-General warns on food crisis

“The current food crisis threatens to undo all the recent efforts to lift people out of poverty around the world and could spark related economic, social and political crises,” said UN Secretary-General Ban Ki-moon at the inaugural event in April 2008 of the Geneva Lecture series organized by the UN Office at Geneva and the UN Institute for Training and Research.

A step forward for energy management

Another step forward towards an ISO standard on energy management systems (EMS) was taken in April 2008 in Beijing, China, following an experts’ meeting organized by the United Nations Industrial Development Organization (UNIDO) and the Standardization Administration of China (SAC). The meeting brought together representatives of standards authorities, experts, officials of government agencies and Chinese industry.

Early in 2008, ISO created a project committee (ISO/PC 242) to develop an International Standard on EMS (ISO 50001) expected to be published end 2010. The standard will provide organizations with a practical approach to increase energy efficiency, reduce costs and improve environmental performance.

Pacific area’s strong collaboration with ISO

The Pacific Area Standards Congress (PASC) held its 31st meeting in Shanghai, China, in April 2008. The event – hosted by SAC, ISO member for China and PASC member for the country – was attended by 95 delegates from some 20 countries and a number of international and regional organizations.

In his speech, ISO President Håkan Murby underlined how closely the interests of PASC and ISO coincide, and wished “for a continuing and even stronger collaboration between our organizations”. He gave a number of examples of these common interests (such as energy, environment, and healthcare), and emphasized that the Council’s review of ISO’s regional policy had reaffirmed the importance of cooperation with regional standardization entities.

He added “I am happy to report that the PASC members have been increasing their participation” in ISO’s work. Currently, PASC members hold some 270 technical secretariats, an increase of 11% since 2004.

Attendees also discussed with representatives of the Pacific Area Committee (PAC), an ISO committee developing an ISO standard on energy management systems standard, and PASC members were invited to actively participate.

In its resolutions, PASC reiterated its commitment to cooperate closely with ISO, recognizing the importance of ISO standards for sustainable development and trade, as well as the advantage of twinning for capacity building.

Moving towards e-accessibility for all

As cyberspace and the information highway become the communication tools of choice, concerted action is needed if people with disabilities – thought to represent some 650 million people worldwide, the majority in developing countries – are not to be deprived of access to these vital information channels. Standards are seen as a key first step to facilitating accessibility.

A joint ITU and G3ict forum, “The Convention on the rights of persons with disabilities: Challenges and opportunities for ICT (Information and Communication Technology) standards”, was held in April 2008 in Geneva, Switzerland. The forum brought together an international group of experts from industry, standards development organizations, NGOs, international development institutions, government and academia to examine implications for ICT accessibility standards.

Representatives of two of the ISO committees developing accessibility standards participated in the programme and presented ISO’s work on ergonomics for accessible ICT (ISO/TC 59/SC 4) and new standards and approaches for ICT access by users with disabilities (ISO/IEC JTC 1/SC 35).
Marketing course on ISO standards becomes regular event

The first regular session of the training course on Marketing and Promotion of International Standards took place at the ISO Central Secretariat in Geneva, Switzerland, in March 2008. This event followed four previous training sessions, in Indonesia, Costa Rica, Croatia and Kenya.

Some 19 participants from countries in Africa, Asia and Europe attended the three-day course conducted by Mr. Nicolas Fleury, Director, Marketing and Communication, and Mr. Régis Brinster, Manager, Marketing Services, from the ISO Central Secretariat.

“This yet again successful experience confirms the importance of organizing such training courses on a regular basis”, commented Mr. Fleury. “Not only does the course provide ISO members with practical information, case studies and tools to help them promote standardization in their countries and provide users with an easy access to ISO standards, but it is also a unique opportunity to exchange views and experiences, and reinforce the network of marketing and communication experts in the ISO community.”

The marketing and communication training course on the promotion and marketing of International Standards is part of the ISO Action plan for developing countries.

For more information, see dev-t@iso.org

Russia demonstrates growing interest in ISO


A conference organized on 9 April 2008 was attended by 200 Russian experts involved in ISO standardization. The following day, a conference on the role of international standards to enhance industrial competitiveness gathered some 400 participants from Russian public authorities and industries, among them MM. Alexander Shokhin, President, and Mr. Dimitri Pumpjansky, Vice President, of the Russian Union of Industrialists and Entrepreneurs, and participants from ISO members in neighbouring countries.

ISO Secretary-General Alan Bryden participated in both events. He also met with MM. Sergey Ivanov, Deputy Prime Minister, Victor Khristenko, Minister for Industry and Energy, and the newly created “Russian Technologies” corporation, a conglomerate of some 400 Russian companies investing in modernization and high technologies.

These events highlighted the growing interest of Russian public authorities and industry in ISO and International Standards – a move fully in line with recent national legislative evolutions related to technical regulations and standards, and with the perspective for Russia to eventually join the World Trade Organization.

From left: Sergei Ivanov, First Deputy Prime Minister of Russia; Alan Bryden, ISO Secretary-General; Grigory I. Elkin, Head of GOST-R.

Participants from around the world dedicated to building on solid ground.

Getting the foundation right

The 18th plenary meeting of ISO/TC 195, Building construction machinery and equipment, took place in April 2008 in Chicago, USA.

The meeting was hosted by the Association of Equipment Manufacturers (AEM) with participating experts from around the world: China, Finland, Germany, Italy, Japan, Poland, Sweden and the host country.

To prepare for this event, ISO/TC 195/SC 1 and working groups held discussions on standards covering equipment for concrete work, road building and maintenance machinery, pedestrian controlled compaction equipment, and equipment for aggregates processing.

Among the proposals for new work items were standards for concrete floating machines and self-propelled sweepers and cleaning equipment for road maintenance.

Due to the worldwide concern with standardization on safety requirements for building construction machinery, the committee now has five standards on this topic in preparation. These include: conveying, spraying and placing concrete mix equipment, concrete batching plants, road building and maintenance machinery, pedestrian controlled vibratory plates and rammers, and mobile crushers.

The committee is also preparing a standard on general classification of building construction machinery and equipment.

The Polish Committee for Standardization (PKN), ISO member for Poland, holds the Secretariat of ISO/TC 195, which consists of 14 participating and 17 observer countries.

Water has no borders

Water quality can be a matter of life and death. ISO/TC 147 develops standards that establish reliable test methods to ensure water quality. International Standards in this area are particularly important as water is an element that has no real frontiers. State authorities, industry, laboratories, construction services and ultimately all citizens will benefit from the application of its standards.

Standards Council of Canada hosted in April 2008 the ISO/TC 147 plenary in Niagara-on-the-Lake, Canada. The event was attended by some 55 participants from 15 countries.

Progress was made on a number of projects, including: determination of selenium, antimony or arsenic, cyanide, bromate, volatile lipophilic substances index, mercury, and chloroalkanes.

Niagara Falls provides background for water quality plenary.

Participants learnt about the terminology database that will contain all the terms and definitions related to water quality currently in ISO 6107. Presentations were also made on new projects such as determination of legionella, determination of strontium and uncertainty of measurements.

During the event a certificate of appreciation was given to the Chair of ISO/TC 147, Dr. Sibylle Schmidt, who has been in this position since 1982, for her exceptional commitment.
Siegfried Dais has been Deputy Chairman of the Board of Management of Robert Bosch GmbH since January 2004, and a limited partner of Robert Bosch Industrietreuhand KG since January 2007. He is responsible for the Bosch Rexroth division. In addition, he is responsible for the corporate sectors Research and Advance Engineering and Information Technology, and for product planning and technology in the Automotive Technology, Industrial Technology, and Consumer Goods and Building Technology business sectors.

Dr. Dais was born in Stuttgart, Germany, in 1948. He is married and has three sons. After graduating from high school in 1966 and completing his military service, he studied physics at the University of Stuttgart from 1968 to 1974. He received his doctorate in natural sciences from the Max Planck Institute in 1978, where he then worked as a research scientist before joining Bosch.

“Bosch company standards are based on national and international standards.”

Siegfried Dais: As you rightly guess, Bosch has had company standards for years. The Bosch standards department was established in 1921 in order to compile specifications for materials, parts and tools. The Bosch company standards are based on national and international standards.

Having one single standard worldwide avoids duplication of work and can therefore reduce cost. Standards also allow markets to be opened up, since standardized products offer customers a tangible benefit.

ISO Focus: As an industrial company with a broad portfolio, to what extent does Bosch use an environmental management system based on ISO 14001? How does the portfolio of International Standards supporting environmental protection, carbon emissions credits trading (cf. ISO 14064 and ISO 14065), energy efficiency and renewable sources contribute to Bosch’s vision for responding to climate change and supporting sustainable development?

Siegfried Dais: Our principles of work safety and environmental protection apply to all locations, regional companies, and subsidiaries worldwide. The focal points of our company’s environmental protection concept differ from region to region, but all our locations share the belief that resource-efficient and eco-friendly production makes a crucial contribution to the competitiveness of the Bosch Group and to our social responsibility in all parts of the world.

Our “BeQIK” mission, which addresses quality, innovation, and customer orientation, applies equally to environmental management. At all locations, environmental management systems have been developed according to a mandatory milestone plan. The systems are reviewed in an internal audit process, and in isolated cases
by an external certification agency. Continuous improvement is a defining characteristic of the environmental management systems which we began to establish at our production sites in 1996. Since then, 145 of our 264 sites have been certified to ISO 14001.

A few Bosch locations are involved in the Europe-wide trading of emissions certificates adopted at the start of 2005. As part of their CO₂ reduction plans, the four German sites in Bamberg, Hildesheim, Schwieberdingen, and Reutlingen, which have large furnaces and kilns, are taking a number of steps to reduce their CO₂ emissions. In Reutlingen, for example, a membrane degassing plant is being used to replace the vacuum degasser. This significantly reduces the energy required for ultrapure water treatment and will result in an annual saving of some 800 metric tons of CO₂ a year.

Many appliances, systems and components from Bosch contribute directly to protecting the environment by reducing the demand for energy, using renewable energies, avoiding energy waste, allowing the use of alternative fuels, and reducing emissions. Any Bosch product whose operation involves the consumption of raw materials is continuously developed further so that it gets by with less material, energy, and water. We regard the excellent environmental benefit of our products as vital for securing our long-term position in the world market.

"Standards allow markets to be opened up."

ISO Focus: Bosch is a partner with the Global Reporting Initiative and the UN Global Compact. What added value would you see in the International Standard giving guidelines on social responsibility being developed by ISO (cf. ISO 26000)?

Siegfried Dais: Organizations around the world, as well as their stakeholders, are becoming increasingly aware of the need for socially responsible behaviour.
Robert Bosch (1861-1942) created values that still apply in the company today. For him, success did not just mean economic growth and good earnings, but also encompassed an improvement of working and living conditions, both for his workforce and for the community.

We have therefore always been aware of the challenges involved in balancing economic and social responsibility. As interpretations of social responsibility can vary, an internationally accepted standard may be of benefit in helping the global business community to achieve a common perspective and understanding of the principles and practices of social responsibility.

The aim of social responsibility is to contribute to sustainable development, health and the welfare of society. More than ever, the way an organization relates to the social environment in which it operates, and its impact on the natural environment, are now major criteria for measuring its overall performance and its ability to continue operating effectively.

The Bosch Group is a leading global supplier of technology and services. In the areas of automotive and industrial technology, consumer goods and building technology, some 271,000 associates generated sales of EUR 46.3 billion in fiscal 2007. The Bosch Group comprises Robert Bosch GmbH and its more than 300 subsidiaries and regional companies in roughly 50 countries. This worldwide development, manufacturing, and sales network is the foundation for further growth. In 2007, Bosch spent roughly EUR 3.6 billion for research and development, and applied for just under 3,300 patents worldwide. The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as the “Workshop for precision mechanics and electrical engineering”.

The new International Standard will provide guidance to all organizations on the integration of socially responsible behaviour into existing organizational strategies, systems, practices and processes, with an emphasis on results and improvements in performance. The standard will help companies to achieve this objective by providing guidance on the underlying principles of social responsibility, on the core subjects and issues pertaining to social responsibility, and on ways of promoting socially responsible behaviour within an organization.

Last but not least, organizations that pro-actively engage in and support sustainable activities will not only have a competitive advantage, but also improve their chances of establishing good long-term relationships with their associates.

**ISO Focus: The incorporation of patented technologies in standards is becoming increasingly important, and ISO, IEC and ITU have now a common policy on this matter. What are...**
Mechanical inno

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your views on the Common Patent Policy as a mechanism that balances the interest of patent holders while facilitating access to technology for end users? What do you see as the benefits of sharing your proprietary technology through ISO standards that are implemented worldwide?

Siegfried Dais: We believe that the Common Patent Policy provides a fair balance between the interests of the patent holder on the one hand and those of the user of a technology on the other. In particular, as it gives patent holders the option of licensing on reasonable terms and conditions, it provides an incentive for the research and development activities that are needed to generate technically advanced solutions in the first place.

For us, the main advantage of sharing our technologies in the standardization process is that it will allow technological developments to be speeded up. If patented technologies are shared among the pioneers in the respective fields, products can be brought to market more quickly, to the benefit of consumers and producers alike. One good example of sharing technologies under ISO standards that comes to mind is the CAN (controller area network) protocol, which has been standardized under the multipart standard ISO 11898, Road vehicles – Controller area network (CAN).

ISO Focus: Every day, the many Bosch scientists, engineers and technicians around the world are involved in the development of new products and systems, as well as of innovative manufacturing processes. What is the role of standards for the successful dissemination of innovation? To what extent does Bosch support the use of international standards to open up global markets for innovative products?

Siegfried Dais: In general, we welcome standards that give people, the environment and market participants a real benefit. Ideally, these standards meet our Bosch slogan “safe, clean and economical”.

Nevertheless, the accelerating competition between standardization organizations is something that worries us. It is a big waste of resources, and endangers the acceptance of the international standardization system. One example is the growing tendency of organizations other than ISO to develop standards for the automotive industry. Agreements between ISO and these organizations either appear not to exist or, if they do, to be simply ignored. We would like ISO to negotiate with these competing standardization organizations, in order to clarify who is responsible for what.

Also, the unresolved dispute between ISO and SAE concerning intellectual property (IP) rights is hindering a timely development of standards, and creating uncertainty for the experts developing the standards. This dispute must be resolved fast, with a clear result, such as a shared IP agreement. As a matter of principle, we would like to see more common (shared) standards between SAE and ISO so as to avoid duplication of efforts.

ISO Focus: What new International Standards would Bosch like to see coming out of ISO and, more generally, what are your expectations on the international standardization system?

Siegfried Dais: Organizations around the world ... are becoming increasingly aware of the need for socially responsible behaviour.”

Siegfried Dais: Standards mirror the acknowledged state-of-the-art, as well as channel and document innovation. International standards are frequently referred to in legislation, which can be necessary to either allow innovative products to be used or, in some cases, even to mandate their installation.

ISO Focus: What new International Standards would Bosch like to see coming out of ISO and, more generally, what are your expectations on the international standardization system?
Throughout the ages, the art of metalworking has been inextricably linked to copper, bronze and iron, and the ability of smiths to work the then-newfound materials into inventions. When we consider the Copper Age, the Bronze Age and the Iron Age against the framework of human history, we tend to view these as evolutionary scales in our ancient civilizations. But are they really that long ago?

Imagine for a moment that all the iron, copper and bronze that are part of modern daily life were to be removed from every object around you. Your car, kitchen appliances, home computers, office machines, mobile phones, and thousands of other “things”… all of these are gone. So, while we live today in a knowledge-based and entertainment-driven world, the reign of metals has not really disappeared. Instead, they are enablers, playing a central role in enriching our lives at work and play.

This art of shaping and joining metals that we know as welding does not receive much attention – and precious little credit – for any of the benefits that technology has given society over the centuries. Advances that have revolutionized the face of our planet would simply have been impossible without the arc, torch and helmet or, travelling back in time, the hammer, forge and anvil.

Beyond the forge

Yet, welding has now progressed beyond the days of forge welding, a process that attempts to join metals through heating, pounding and striking. Today, metal joining can be performed in almost any environment, from the depths of underwater oceans to the...
distant reaches of space. Housing, communications, transportation, manufacturing – welding has been instrumental in advancing all areas of life.

Imagine for a moment that all the iron, copper and bronze that are part of modern daily life were to be removed from every object around you.

More than ever before, patients today feel the influence of welding in the medical, pharmaceutical and dental professions, as hip and knee implants, pacemakers and braces are becoming routine procedures the world over. Some of the new methods in welding innovation for the medical industry involve ultrasonic assembly, hot plate welding for medical applications, vibration welding, spin welding and laser welding.

"Imagine for a moment that all the iron, copper and bronze that are part of modern daily life were to be removed from every object around you."

### About the author

**Vivek Vaidya, M. Eng. P. Eng.**

Vivek Vaidya, M. Eng. P. Eng., is Director, Welding Technology and Business Development, for Air Liquide Canada and is a Group Senior Expert in the application of Welding Technology and Services for Air Liquide.

Mr. Vaidya is the chair of the Canadian Standards Association (CSA) Strategic Steering Committee (SSC) on Welding and Structural Materials, which oversees all welding standards in Canada, and a voting member of ISO/TC 44, representing the SCC, Canada. Mr. Vaidya is an active member of the American Welding Society, Society of Manufacturing Engineers, and Canadian Welding Society, and is actively involved with applying Lean to Welding practices.

### Welding in medicine

Yet, there is virtually no limit to the potential reach of welding into non-traditional areas. For example, biomedical micro-electromechanical systems are microscopic medical devices that can deliver medicine directly to the site of a disease. Joining such devices without clogging the tiny channels presents a challenge that could only be met with welding.

Electrical outlets, mobile phones, transport systems – we live in a world of standards. As welding becomes more entrenched in our activities, there is a growing need for standardization to promote safety and reliability in global markets. This important task is the mandate of ISO/TC 44, the ISO technical committee on welding and allied processes.
ISO/TC 44 and its subcommittees are involved in the global standardization of welding, including areas such as terminology, symbols, equipment, consumables and electrodes, welder qualifications, welding procedures, and health and safety. Delegates from 33 countries participate in the work of ISO/TC 44 (plus 38 observers), and more than 270 ISO standards have been produced under the guidance of ISO/TC 44. France currently holds the chair.

An ancient heritage
Modern welding technology owes its heritage to those who made welding and the world of metals what they are today – the ancient smiths, the sculptors, the alchemists, the gold and silver-smiths of antiquity, the physicists, the metallurgists and the engineers. And the world of welding today is dramatically different than yesteryear, as it likely will be in the future. Electronics, intelligent robots, lasers and hybrid processes are on the verge of revolutionizing the metal fabrication industry. This means new welding processes, metal joining techniques and innovations in real-world applications will emerge out of the need for continuous improvement.

“More than ever before, patients today feel the influence of welding in the medical, pharmaceutical and dental professions.”

As the most cost-effective manufacturing method to join metals for structural integrity, welding will enjoy a healthy future, with growth in alternative materials such as plastics, composites and new alloys. Perhaps the increased use of automation in welding operations will also leave its mark as an important growth sector within the welding industry. Welding will continue to thrive as a horizontal process, almost as a necessity of invention; cutting across market segments to positively impact our lives in many significant ways.

destructive testing, but mostly depends on validation, verification, documentation and control of the welding processes themselves.

Qualification of welding procedures and welders is recognized as a key issue for the safety and quality of tanks, pipelines, boilers, pressure vessels, aircraft, trains, ships, metallic engineering and a wide range of other equipment.

Specific rules have existed for this purpose for many years at national and regional levels. However, the global market, the exchange of finished products between countries, the installation of production plants for the same company in different locations – in other words, multinational transactions – drive the industry to call for qualification certificates recognized everywhere in the world, and harmonization of practices through international standards.
It has been an essential challenge of ISO/TC 44 to follow the global relevance in order to harmonize the different approaches and develop International Standards that can be locally applied.

**Independent technical rules**

The technical report ISO/TR 15608, published in 2005, establishes a uniform system for the grouping of materials for welding purposes. The major elements of welding standards are based on this grouping system, which takes into consideration the following materials: steel; aluminium and its alloys; nickel and its alloys; copper and its alloys; titanium and its alloys; zirconium and its alloys; cast iron. This grouping system may also be applied to other purposes such as heat treatment, forming and non-destructive testing.

The International Standards for qualification of welders provide a set of technical rules independent of product type, location and examiner or examining body. The basic philosophy is the same: welders must pass a test demonstrating that they can deposit sound weld metal, and perform welding processes under conditions that are at least as challenging as the conditions encountered in production welding.

When qualifying welders, emphasis is placed on the welder’s ability to manually manipulate the welding torch and thereby produce a weld of acceptable quality.

The welding processes referred to in these standards include those fusion welding processes which are designated as manual or partly mechanized welding.

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**Table 1**

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<th>Process</th>
<th>Arc welding</th>
<th>Gas welding</th>
<th>Electron beam welding</th>
<th>Laser beam welding</th>
<th>Resistance welding</th>
<th>Stud welding</th>
<th>Friction welding</th>
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<td>ISO 15609-5</td>
<td>ISO 14555</td>
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</tr>
</tbody>
</table>

**Table 1** – Details of the standards dealing with specification and approval of welding procedures
They are not intended to qualify fully mechanized and automated welding processes.

**Verifying skills to instil confidence**

The principle of these standards is that a qualification test should qualify the welder not only for the procedures used in the test, but for all joints intended for welding, on the assumption that the welder has received a particular training and/or has industrial practice within the range of qualification.

By following the guidelines of these standards, it is possible to verify the skill of welders and, provided they have passed the test, award them the relevant designation and qualification. At the same time, it is intended to instil confidence that qualified welders – who must be able to follow verbal and written instructions, and demonstrate their ability to manually manipulate the relevant welding tools – will be skilled in handling the products, ensuring that they meet their company production quality standards. Their welding skills are essential to avoid unnecessary wastage, recalls and expensive production downtime.

**Qualification backbone**

ISO 9606, *Approval testing of welders – Fusion welding*, is the backbone of the qualification scheme for fusion welding. This standard, specifying the approval testing of welders, is used for steel (Part 1), aluminium and alloys (Part 2), copper and alloys (Part 3), nickel and alloys (Part 4) and titanium and alloys, and zirconium and alloys (Part 5).

Following an unsuccessful attempt to revise ISO 9606-1 in 1998, the ISO/TC 44 Chair decided to create a specific task force directly under the responsibility of the technical committee. By the end of 2007, this task force had succeeded in producing a draft International Standard (DIS). The different stakeholders are now confident in the future publication of a globally relevant standard.

ISO 15618, *Qualification testing of welders for underwater welding*,
was developed for qualification testing of diver-welders for underwater wet and dry welding. To these publications has been added ISO 14731, Welding coordination – Tasks and responsibilities, published in 2006.

Welding consumables

Like standards for the qualification of welding procedures, welding consumable standards are built in a scheme according to the welding process and the material to be welded (see Table 2).

In the field of resistance welding, no less than 53 ISO International Standards have been published, along with another 22 standards for gas welding equipment, cutting and allied processes. Standards on friction stir welding are under development.

Importance of health and safety

Another important aspect of the work of ISO/TC 44 is health and safety.

The purpose of ISO 15011, Health and safety in welding and allied processes – Laboratory method for sampling fume and gases generated by arc welding, is to determine fume emission chemical composition data for use in health and safety applications. Clear instructions and supporting informative guidance are provided to ensure that the welding conditions used are carefully selected according to a standardized procedure.

“A significant portion of metallic products and structures includes at least one weld.”

ISO 15012, Health and safety in welding and allied processes – Requirements, testing and marking of equipment for air filtration, deals with the significant hazards caused by the emission of welding fume particles. This document specifies safety requirements concerning the separation of welding fumes and describes a method for determining the particle separation efficiency of welding fume extraction devices.

A history of commitment to welding

ISO/TC 44, Welding and allied processes, produces standards in the field of welding, by all processes, as well as allied processes. These standards include terminology, definitions and the symbolic representation of welds on drawings, apparatus and equipment for welding, raw materials (gas, parent and filler metals) welding processes and rules, methods of test and control, calculations and design of welded assemblies, welders’ qualifications, as well as safety and health.

Electrical safety matters related to welding are excluded from the scope of ISO/TC 44, since they fall under the responsibility of the International Electrotechnical Commission (IEC). However, ISO/TC 44 and the IEC committee, IEC/TC 26, Electric welding, are in liaison to ensure harmonization of their work.

ISO/TC 44 is responsible for standardization concerning an industrial field which cannot be considered alone, but must always be considered in close liaison with the needs expressed by other industrial fields which use the techniques defined above. It is positioned between the work of “upstream” technical committees, such as base material or non-destructive testing methods, and the work of “downstream” product technical committees (also called user committees), such as pressure vessels.

First created in 1938, ISA 44 held its first meeting in Berlin. Since its creation, the Chair and Secretariat have been held by France.

The work of ISO/TC 44 results from the active participation of 33 countries from a balanced regional distribution: Europe, North America, Asia/Oceania, Middle East and Africa.

*International Federation of the National Standardizing Associations, which officially ceased to exist in 1942.*

**About the author**

Frédéric Lobinger is a qualified welding engineer, who has been involved in standardization for many years and is active in numerous international and national organizations. In addition to being Chair of ISO/TC 44, he is a member of the Board of the American Society of Mechanical Engineers (ASME), Chair of the French national committees on welding and pressure vessels, and Chair of the Technical committee of the French manufacturer association, SNCT.

**Worldwide implementation**

Most countries and regions have recognized the quality and the importance of the International Standards developed by ISO/TC 44, and have decided to adopt them as national and regional standards. Europe, for instance, has chosen this direction, and the Vienna Agreement is applied whenever it is suitable. Because European standards supersede the national standards of 30 countries, a wider public is being made aware of normative documents, regardless of origin.
Main Focus

Safety valves – Vital protection against excessive pressure

by Martin Bayart, Chair of the French national committee UNM/763, Safety devices against excessive pressure

On the Mississippi river, on 27 April 1865, the steam boilers of the overcrowded steamboat “Sultana” exploded, wrecking the ship and killing more than 1 700 American Civil War veterans who were sailing home. This event initiated the eventual establishment of the Boiler Code1, setting safety rules for pressure equipment.

But the Boiler Code could not prevent a serious mishap on 28 March 1979, when a pressurized water nuclear reactor at Three Mile Island in the US state of Pennsylvania partially melted down following a loss of coolant. The accident was caused by a pressure relief valve stuck in the open position, followed by a failure to reseat due to a false reading of the valve disc position.

The Three Mile Island accident revealed the hazards associated with the operation of pressure-relieving devices and had a tremendous impact on the development of nuclear reactors around the world over several decades.

Stabilizing hazardous processes

The task of protecting against the risk of bursting due to the over-pressurization of vessels and tanks has been addressed by a number of standardization committees, and has become ever more critical in certain inherently hazardous processes, particularly in the nuclear field.

Pressurized systems are normally protected against excessive pressure by some type of safety valve. ISO 4126-1:2004, Safety devices for protection against excessive pressure – Part 1: Safety valves, defines it as a:

“valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges a quantity of fluid to prevent a predetermined safe pressure from being exceeded, and which is designed to re-close and prevent further flow of fluid after normal pressure conditions of service have been restored.”

The user may require additional functions or characteristics of the safety valve, such as:

• remaining tight under maximum service conditions; and
• having stable, consistent operation (no vibration, no chatter, accurate opening and closing pressures).

When “nuclear” enters the scene

In the nuclear field, and more specifically for the protection of the primary or secondary circuits, the safety valve will be expected to meet additional requirements:

• providing real-time, reliable information on its position (open or closed);
• being able to protect the core vessel at a lower pressure during the warm-up process of the reactor, to prevent the risk of brittle fracture; and
• being a relief point in case of a “feed and bleed” procedure in accidental conditions (core heat removal by circulation of water), and in the case of remaining wide open for several days under severe accident conditions.

Customized safety

When considering types of safety valve for protecting nuclear-related circuits, other criteria must also be taken into account. For example, there is the direct loaded safety valve, defined in ISO 4126-1 as:

“safety valve in which the loading due to the fluid pressure underneath the valve disc is opposed only by a direct mechanical device such as a weight, lever and weight, or a spring”.

However, this specification cannot handle the critical features of size, pressure and weight.

There is also the controlled safety pressure relief system (CSPRS), defined in the standard on CSPRS, ISO 4126-5:2004, as:

“system consisting of a main valve in combination with control units. On reaching the set pressure, the controlling forces on the main valve are, by means of the control unit, automatically applied, released or so reduced that the main valve discharges a specified quantity of fluid”.

But this system requires an external power source.

Fail-safe

An important feature for safety valves is the “fail-safe” concept. Traditionally, it was considered that the “fail-safe” position of a safety valve was the open position (which prevented the tank from bursting). This is usually what happens, for instance, with a direct acting safety valve in case of spring failure.

With nuclear reactors, two critical situations can arise which a “fail-safe” position can prevent:

• a safety valve fails to open, and the pressure exceeds safety limits leading to a risk of rupture of the circuit; or
• a safety valve fails to reseat following a relieving cycle.

Both situations can lead to a loss of coolant accident (LOCA), which is what happened at the Three Mile Island incident – in that case, there was no such thing as a “fail-safe” position.

In tandem – Protection and isolation

To cope with this extremely critical situation, a decision was made during construction on a major French nuclear expansion in the 1980s to install added protection to the primary circuit. Two pilot-operated valves were mounted in tandem (Figure 2).

Fail-safe

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Main Focus

beneficial for both practicality (saves stand-by time) and safety (increases confidence in valve operation).

Emergency shut-off

In some cases, a plant designer might judge that a failure of the protection valve to reseat is very unlikely to be combined with a total loss of control systems. For such situations, another version of the concept has been developed under the acronym ESO, for Emergency Shut-Off system (Figure 4).

This device is coupled to a single pilot-operated safety valve. If the valve delivers a “disc opened” signal associated with low system pressure, then the ESO can be manually or automatically actuated to override the action of the pilot. The safety valve is then operated like a CSPRS until the plant can be safely shut down.

Such a valve has been successfully qualified in actual primary conditions (Figure 5).

No more “Sultanas”

High-level safety devices such as pilot-operated valves can integrate numerous safety, operational or inspection functions that guarantee safe and reliable operation of the most critical pressurized systems – like the primary circuits of the nuclear power plant – with a high degree of confidence. Safety devices for valves can thus facilitate the prevention of disasters like that of the “Sultana” steamboat, which cost the lives of more people than those lost when the Titanic sank. This is particularly reassuring given the destructive potential of modern technology.

Performance-based innovation for boilers and pressure vessels

by Stuart Cameron, UK expert on ISO/TC 11, Boilers and pressure vessels

Boilers and pressure vessels are used in industrial systems for electric power generation, chemicals, petrochemicals, pharmaceuticals, food processing, paper and other types of manufacturing. They are also essential elements in the systems that heat and cool homes, offices, hospitals, schools, factories and places of worship, to name just a few.

In many countries, boilers and pressure vessels are regulated by government bodies, either through technical statutes or by the application of standards and conformity assessment requirements.

Not surprisingly, the market in pressure equipment is highly internationalized. Companies naturally wish to control costs and optimize equipment designs and sources, and, in an ideal world, there would be a single, comprehensive ISO standard they could follow.

Reality check

However, the development of a single comprehensive boiler and pressure vessel standard would be a very lengthy process, not least because of the difficulty of achieving the necessary level of compromise among the member countries. The main reasons for this are the differing approaches historically taken by regulatory authorities, and differences in the underlying design and construction philosophies in the various national and regional product standards.

Up to now, codes, standards, certification systems and regulations have together formed a set of interlocking requirements to assure that the equipment is safe to operate.

Nonetheless, with the increasing globalization of economies and imple-
Mechanical innovation

Mechanical innovation of trade agreements, customers and regulatory authorities need international standards in order to provide the structure to facilitate free trade while assuring the expected levels of equipment safety.

Standardization in this field must strike a balance between safety, function and technical innovation. It is also important to recognize that developing countries need assurance that the standards of other countries and regions provide the necessary safety requirements for specific failure modes.

An innovative solution

Given these various constraints, the development of a performance-based international standard was seen as the most realistic approach to facilitate world trade and enhance the recognition of national and regional standards with a proven history of supporting public safety and good commercial operating experience. Such an international performance-based standard would enable these standards to coexist, providing an approach that could accommodate technical innovations, existing regulatory frameworks and business needs.

This was an innovative approach for ISO. The main objective was to produce and encourage the use of an international performance-based standard that ISO members could use to accommodate their specific market needs – for both users and regulatory bodies.

One of the priorities was to identify obstacles that in the past have impeded the development of such a standard and to provide recommendations to overcome them. The second priority was to ensure that decision makers, particularly in emerging economies, understood the benefits of this performance-based standard.

It was also important to emphasize that the alternative of a single ISO standard that could replace all others – however preferable that might appear to be in theory – is simply not feasible in the short term, given current market and regulatory impediments. Rather than force a scheme that could not work, ISO decided to take a new, flexible approach to work around existing barriers.

Essential common element

Pressure equipment standards result from the consensus distillation of experience, research and development. They have proven to be a successful way to ensure optimal performance, safety, trade and compliance with regulations.

An element common to all standards is that they must address the various failure modes applicable to boilers and pressure vessels. This evaluation of failure modes can be carried out by different methods and some standards may not cover all the potential failure modes. Therefore, before specifying the use of a particular standard, it is important to first be aware of which failure modes it addresses.

The designer may mitigate against failure modes through a combination of design techniques, material selection, manufacturing features, levels of inspection and operation of the boilers and pressure vessels.

From basic to comprehensive

Conceptually, there are two basic types of standards or system of standards – those which cover basic requirements and those which cover comprehensive requirements. In practice, there are very few
standards which fit neatly into either of these two categories. In some cases, both types may be combined in one standard. In other cases, a standard may lie somewhere between the two extremes.

A standard addressing basic requirements would be applicable to vessels that are expected to be subject to steady-state operational conditions (i.e. nominal load cycles, no rapid temperature changes, etc.), and where minimum design effort is required (essentially based on mandatory formulae for determining wall thicknesses, etc.). In general, the failure modes are addressed by the use of code limits, which result in relatively low stresses when the loadings are applied. This also accommodates secondary effects, which are not considered in detail.

A comprehensive standard would be applicable to both low-duty and severe-duty vessels. The allowable design stresses are relatively higher than those in a basic design code, and a design assessment to address the applicable failure modes should be carried out by competent engineers. In this type of code, there is usually detailed methodology directly addressing the failure modes that could result in malfunction of the pressure equipment.

Addressing failure modes

In both cases, failure modes can be addressed through more than just design calculations; for instance, by limitations on use of materials, welding techniques or heat treatment requirements. Geometric features may also be specified to minimize the stress concentration factors for cyclic loading or excessive local strains. The acceptable limits for non-destructive examination may also vary, depending on the failure modes being considered.

There is usually a level of involvement by an independent inspection authority – either inherent within the standard or specified by regulation – which may vary, depending on the type and service of the pressure equipment.

Most standards do not fit directly into either one of these two types, but the concept generally applies.

The majority of standards cover failure modes through what is generally known as “design-by-rule” or “design-by-formulae”, where prescriptive formulae are applied to determine the shell thickness, compensation for nozzle openings and other specifications. These normally provide satisfactory designs for pressure loading of a typically non-cyclic nature. However, according to the criteria used when basic failure modes are assessed, a margin may exist to permit a certain number of operational fatigue cycles (e.g. 500 cycles based on experience) rather than have the standard directly address loads such as thermal cycling, rapid start-up and shutdown.

Design-by-analysis may be used as an alternative or to supplement design-by-rule applications. Or it may have to be used for cases not covered by the design-by-rule criteria, which can include significant fatigue, thermal transients and environmental loadings. It may also be used in cases where the specified manufacturing tolerances are exceeded and require a more accurate evaluation of the stresses in a component.

Generally, a basic standard uses a design-by-rule methodology, while a comprehensive standard may include this methodology as well as one or both of the design-by-analysis approaches.
Practical and performance-based

The performance-based standard developed by ISO/TC 11 was published in August 2007. It comprises two parts.

ISO 16528-1:2007, Boilers and pressure vessels – Part 1: Performance requirements, defines the requirements for national and regional standards to coexist by providing an approach that can accommodate existing regulatory requirements and market needs. Specifically, it defines:

- the duties and responsibilities of the main parties;
- the failure modes which should be addressed;
- the technical requirements covering materials, design, manufacture, etc.; and
- the methods by which conformity assessment may be accomplished.

Particular emphasis is placed on failure modes, and these are categorized as:

- short-term failures, due to the application of non-cyclic loads which lead to immediate failure, e.g. brittle fracture, ductile failures, instability, etc.;

- long-term failures, due to application of non-cyclic loads which lead to delayed failure, e.g. creep rupture, erosion, corrosion, environmentally assisted cracking, etc.; and
- cyclic failures, e.g. progressive plastic deformation, fatigue, etc.

ISO 16528-2:2007, Boilers and pressure vessels – Part 2: Procedures for fulfilling the requirements of ISO 16528-1, provides a procedure and forms for standards-issuing bodies to demonstrate that their standards fulfill the performance requirements of Part 1. A task force of experts from ISO/TC 11, led by the author, is available to assist in completion of the conformance tables. When available, the completed tables will be published on the ISO Web site. Standards-issuing bodies may also incorporate the forms within their standards.

Market-based developments

ISO/TC 11 will continue to provide a forum for international cooperation and collaboration in developing common rules and approaches for national and regional standards.

Standards-issuing bodies are currently submitting ISO 16528 assessment forms for review. ISO/TC 11 intends to build on the information gathered during the development of the performance-based ISO 16528 to begin development of a common market-based international standard.

About the author

Stuart Cameron is Chief Engineer at Doosan Babcock, a large engineering company with offices in the UK, USA, Korea, India and China. He has specific responsibility for technical risk management and investigations throughout all parts of the company including compliance with existing and new legislation regarding pressure equipment. He has been involved in boiler and pressure vessels standards for 25 years and is the UK expert on ISO/TC 11, Boilers and pressure vessels, and its two working groups. He is also Chairman of the BSI Boiler Code committee and a member of ASME subcommittees on Power boilers and Boiler & pressure vessel accreditation.

The ultimate minimum

According to ISO 16528, as a minimum, the following failure modes must be addressed:

- brittle fracture;
- ductile failures;
- excessive deformation;
- elastic or plastic instability.

The standard does not need to address all failure modes, but an explanation must be provided defining limitations in its scope or application relative to the failure modes not addressed.

For each failure mode, a detailed checklist must be prepared, identifying which aspects are covered by:

- explicit design (e.g. formulas for sizing wall thickness for resisting ductile burst);
- implicit design (e.g. design margins on material properties);
- fabrication details (e.g. weld profiles to reduce failure due to fatigue);
- material requirements (e.g. provisions for addressing strain hardening);
- examination requirements (e.g. inspection techniques relevant to the failure mode);
- testing requirements (e.g. hydrostatic test pressure);
- use/application limits (e.g. any limitations on scope).

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**Main Focus**

**Reliable testing of metallic materials**

by Saito Tetsuya, Chair of ISO technical committee ISO/TC164, Mechanical testing of metals

Metallic materials are used as structural components in a variety of sectors, such as infrastructure, transport, construction and industry. To ensure safe performance and protect against failure of structural components subject to various loads, it is necessary to accurately determine the mechanical properties of metallic materials. This calls for well-defined testing techniques.

ISO/TC 164, *Mechanical testing of metals*, is the ISO technical committee responsible for developing standards on the measurement of mechanical properties of metallic materials. The requirements for these properties can change substantially depending on the intended application.

In addition, environmental conditions can have an effect on mechanical properties. ISO/TC 164 is therefore structured according to techniques for measurement of various mechanical properties. These are categorized as uniaxial, ductility, hardness, toughness and fatigue testing.

**Stress and strain**

Subcommittee ISO/TC 164/SC 1, *Uniaxial testing*, is primarily engaged in developing tensile testing methods at ambient temperature and high speed.

As for the developments on ambient temperature, through a study resulting from the European tenstand (tensile standard) project on computer-controlled tensile testing (2001 to 2004), it became possible to compare the materials’ properties in detail and to minimize measurement uncertainty. Given these results, ISO 6892:1998, *Metallic materials – Tensile testing at ambient temperature*, is currently being revised to ensure the latest and most accurate methodology.

The subcommittee is also working on high-speed tensile testing methods. Tensile testing of metallic materials at high strain rate is important, for example, to achieve a reliable analysis of vehicle crashworthiness. During a crash, the maximum strain rate often reaches more than 100 000 times the usual quasi-static tensile testing speed.

Strength increase with strain rate offers a potential for improved energy absorption during a crash event. This

**Hardness testing**

- ISO 4545 (4 parts), *Metallic materials – Knoop hardness test*
- ISO 6506 (4 parts), *Metallic materials – Brinell hardness test*
- ISO 6507 (4 parts), *Metallic materials – Vickers hardness test*
- ISO 6508 (3 parts), *Metallic materials – Rockwell hardness test*
- ISO 14577 (4 parts), *Metallic materials – Instrumented indentation test for hardness and materials parameters*
- ISO 18265:2003, *Metallic materials – Conversion of hardness values*

In addition, a technical report on the measurement of mechanical properties by instrumented indentation test (ISO/TR 29381) is under development.
Round robin evaluation

The observation methods for unfavorable phenomena such as fracture under various deformation conditions, and measurement of the indices by which formability of metallic materials can be evaluated, are addressed by ISO/TC 164’s subcommittee SC 2, Ductility testing. The targets are metal products of various shapes such as sheet, plate, pipe, tube, bar and wire. The subcommittee also develops standards on methods for the evaluation of characteristics of new metallic materials, such as superplastic metal.

Testing results are affected not only by the characteristics of the material itself, but also by the testing conditions. Since testing in conditions similar to practical use conditions is required, a “round robin test” is carried out, whereby the test is performed independently in multiple organizations and the reliability of the testing method is evaluated.

The forming limit diagram (FLD), developed by ISO/TC 164/SC 2, has played an important role in material selection as a common index for steel and aluminium makers on the supply side, and for automobile manufacturers on the user side.

Most widely used

Hardness testing, dealt with by ISO/TC164/SC 3, is among the most widely used materials tests because of its simple and rapid operation.

A number of hardness tests are currently used (see Box, page 20).

The instrumented indentation test (IIT) is a novel technique to evaluate the mechanical properties of materials by measuring the testing force and the indentation depth throughout the testing cycle. By analysing the force-displacement curve, this method can evaluate not only the hardness but also other material parameters, including elastic modulus, plastic work, creep or stress relaxation. The fundamental parts of ISO 14577, the standard for IIT, were published first in 2002, and another part focusing on coating measurement was added in 2007.

Toughness

Methods for testing toughness are the responsibility of ISO/TC 164/SC 4, Toughness testing – Fracture (F), Pendulum (P), Tear (T).

Measuring fracture toughness of metallic materials is important for selecting and evaluating materials for structures such as nuclear pressure vessels, ship hulls and high-pressure gas pipelines.

Here, the most important standard developed is the quasi-static fracture toughness testing method. Fracture toughness measurement using small specimens is also important, particularly for the nuclear industry. Current discussions are aimed at establishing a fracture toughness measurement at impact loading rates using pre-cracked Charpy test specimens.

When assessing brittle cleavage fractures from the flaws in a real structure, it is necessary to consider the influence of plastic constraints because fracture toughness values obtained from severely constrained specimens sometimes lead to overly conservative evaluations for a less-constrained flaw in a real structure.

“Differences in measuring methods among countries and regions can create barriers to international trade.”

In toughness evaluation by the widely used impact pendulum test method, characteristic values acquired by Charpy testing have often been adopted as specifications in structural steel standards, as well as in CODE and instructions for pressure vessels and shipping classification rules.

The subcommittee is revising parts of ISO 148, Metallic materials – Charpy pendulum impact test. An addendum to Part 1, Test method, is being developed to address measurement uncertainty of an absorbed energy value, KV. New revised versions have been developed for Part 2, Verification of a testing machine, and Part 3, Preparation and characterization of Charpy V-notch test pieces for indirect verification of pendulum impact machines.

The radius of the striker edge of the Charpy test machine is now under discussion for standardization, as radii of 2 mm and 8 mm are currently in use by different countries.

About the author

Saito Tetsuya

received his Dr.-Eng. from the University of Tokyo in 1978. He has held various positions at Japan’s National Research Institute for Metals, including Director of the Materials Evaluation Division and Deputy Director-General of the institute. Dr. Saito has worked at the National Institute for Materials Science in Tsukuba, Japan, since its inception in 2001 as Vice President and Auditor, and he is NIMS Invited Scientist and Senior Adviser Emeritus of the institute. He is Chair of ISO/TC 164, Mechanical testing of metals.
The phenomenon of fatigue

Fatigue testing methods are standardized in ISO/TC 164/SC 5, Fatigue testing. The phenomenon of fatigue of metallic materials consists of three stages: crack initiation, gradual growth of the initiated cracks, and final fracture under repeated loading. Figure 2 (page 21) is a typical SEM photograph of a fatigue fracture surface, which indicates the crack initiation site (in this case, non-metallic inclusion), from which the crack propagates radially.

Surrounding environmental conditions, such as temperature and humidity, influence fatigue fracture of metallic materials. A primary purpose of fatigue testing is to evaluate fatigue life data, which should be used as basic data for the design of components.

Because fatigue testing is conducted by applying continuous repeated loading for long periods under the influence of various environmental factors, it has more parameters to take into consideration than other mechanical testing, e.g. the pattern of repeated load, the direction of load, environmental factors and their complex contributions. Therefore, although international standardization of test methods and equipment in this field is highly time-consuming, it is of great importance.

Key topic

Nowadays, measurement uncertainty issues are a key topic in the field of materials measurement – of concern in all areas. In recognition of this, ISO/TC 164 is currently discussing how measurement uncertainty issues should be handled as an overall problem within the committee.

Reaping the benefit

Differences in measuring methods among countries and regions can create barriers to international trade. It is thus important that International Standards regarding metallic materials are supported and applied by all countries and regions. These standards will help ensure safety and performance of structures using metallic materials so that we can all reap the benefits, be it the resistance of a car in a crash or the solidity of a building.

Cutting costs for cutting tools

by Marguerite de Luze, Union de normalisation de la mécanique (UNM)

ool manufacturers can now offer significant reductions in tool inventory, making possible a single tool system for a variety of operations on lathes and machining equipment by conforming to the latest state-of-the-art ISO standards for cutting tools. Indeed, the technological content of cutting tools standards reaches new highs with the soon-to-be-published ISO 26622-1 and ISO 26622-2, Modular taper interface with ball track system, and ISO 26623-1 and ISO 26623-2, Polygonal taper interface with flange contact surface.

“International agreement was high on these items: 100 percent approval with a very fast development time.”

International agreement was high on these items: 100 percent approval with a fast development time of less than three years from registration to submission for publication.

After a short break

Three families of tool machine interfaces are widely used:

- hollow taper interface with flange contact surface, commonly designated as HSK;
- modular taper interface with ball track system (US system);
- polygonal taper interface with flange contact surface (German system).

ISO 12164, parts 1 and 2, dealt with the dimensions and designation of the hollow taper interface with flange contact surface. After the publication of this standard in 2001, standardization of tool machine interface families took a break, since the modular taper with ball track system was subject to patent rights until 2007.

In 2005, with the end of the patent period in sight, the ISO members for Germany and the US submitted a proposal to standardize the system. Shortly after, the new proposal was accepted into the work programme of ISO technical committee ISO/TC 29, Small tools. The development of the drafts was allocated to ISO/TC 29/WG 33, Hollow tool shank interface, a working group directly under the responsibility of the technical committee. China, France, Germany, Japan, the Netherlands, the UK and the US nominated experts to take part in drafting the standards.
ISO technical committee ISO/TC 29, Small tools, was created in 1947. Since that time, France has been involved in both its Chair and Secretariat, addressing the assigned scope of: “Standardization of any kind of tool to be used on machines, and any kind of hand tool.”

ISO/TC 29 currently represents 20 participating countries and 27 observer countries, and is responsible for no less than 375 published standards. The technical committee manages three working groups and five active subcommittees:

- WG 33, Hollow tool shank interface
- WG 34, Cutting tool data representation and exchange
- WG 36 (Joint TC 39-TC 29 WG): Tool to spindle interface
- SC 2, High speed steel cutting tools and their attachments
- SC 5, Grinding wheels and abrasives
- SC 8, Tools for pressing and moulding
- SC 9, Tools with cutting edges made of hard cutting materials
- SC 10, Assembly tools for screws and nuts, pliers and nippers

Standards from ISO/TC 29 provide user benefits in terms of tools interchangeability and production rationalization (reduction of references), mainly for machine tools, but also for hand tools.

ISO/TC 29 standards can be seen as the cornerstone of productivity improvement. Complementary objectives correspond with today’s concerns regarding safety enhancement and environmental protection.

ISO/TC 29 was the first ISO product committee to work jointly with ISO/TC 184/SC 4 to make available a cutting tool part library standard, ISO 13399, on cutting tool data representation and exchange (see ISO Focus, December 2007).

Major manufacturers, suppliers, end users and test laboratories are represented in ISO/TC 29. The main importing and exporting regions are Asia, Europe, the Middle East and North America.

About the author

Marguerite de Luze has more than 15 years of experience in standardization. Joining UNM (Union de normalisation de la mécanique) in 2002, she was first involved in the ventilation and rubber industry. Ms. de Luze has been the Secretary of the French national committees for welding, geometrical product specification, refrigeration and air-conditioning, and tools, since 2005. Together with the Secretary of ISO/TC 29, she is currently developing the Maintenance Agency for the ISO 13399 series, Cutting tool data representation and exchange. UNM, on behalf of AFNOR, has held the Secretariat of ISO/TC 29 since 1990.

New standardized interfaces

The modular taper interface with ball track system and polygonal interface with flange contact surface were developed as twin standards specifying, in each case, dimensions and designation for the shank (part 1) and for the receiver (part 2).

To disseminate the use and the application of these interfaces, information is given regarding clamping forces, speed, torques, bending load, stiffness, material and heat treatment, surface hardness and balancing.

These interfaces apply to both automatic and manual tool exchange. Lathes, drilling machines, milling machines and turn/milling machines most commonly use this tool system.

Shank and receivers ranging in size from 32 mm to 100 mm are now standardized. This means that designations such as “Modular taper shank ISO 26622-1 – 63TS” or “Polygon-receiver ISO 26623-2 – 32” will become commonplace, and we can expect to see them becoming a regular part of commercial catalogues.

Where do the systems come from?

The modular taper with ball track system design originated from a joint development effort between two prominent tool manufacturers in 1985. The benefits to be achieved by the joint development effort were to offer a complete, flexible tooling system-to-machine connection by joining the strengths of two tooling suppliers for the European and North American customer markets. The modular taper with ball track system product was first introduced in 1987 at the Machine Tool Exhibition in Milan, Italy.

Since its introduction, this tooling system has become a globally-accepted design for both static and rotating applications. The characteristics of the modular taper interface with ball track system are designed to be used equally on both static and rotating applications. The high mechanical advantage of the modular taper with ball track system design application allows for small springs, small bearings and high spindle speeds. This tool interface uses three areas of contact (one face and two on the taper) that provide a very simple, rigid tool design. These features have made the modular taper with ball track system the quick-change tooling of choice on many tens of thousands of machine tools throughout the world.

The polygonal taper interface with flange contact surface was introduced in 1990. Since then, this tool system has spread very widely. Today, polygonal taper interface with flange contact surface is installed worldwide on more than 200,000 machine tools. Characteristic for this tooling system is the polygonal cone, which guarantees a safe and play-free transmission of torque without further elements such as driver slots.

The polygonal taper interface coupling is equally as suitable for static as for rotating operations. For this reason, this tooling system has gained substantial market share, especially on turn-mill centres.
**Main Focus**

**Springs – From the Stone Age to the Nano Age**

by Shigeo Aiba, Secretary of ISO technical committee ISO/TC 227, Springs

A spring is defined as an elastic object which performs a function by utilizing energy stored as a result of deformation and resilience. Traps and bows made of bent wood for hunting and fighting are among the earliest spring devices known to have been invented by human beings, more than 20,000 years ago.

Scissors, used around 1000 BC in Egypt, seem to be the oldest examples of iron devices employing spring mechanisms. By the 2nd century BC, the Greek engineer Ctesibius had invented a method for treating bronze to give it spring-like characteristics.

Peter Henlein is believed to have invented spiral springs for clocks in Germany at the end of the 15th century. By 1660, Robert Hooke conceived the theory of elasticity, which he introduced as Hooke’s Law in 1678.

The use of springs spread to Japan in the late 14th century in the matchlock mechanisms of hand-held firearms. With industrialization came a rapidly expanding range of applications as parts for bicycles, trains, cars, farm implements and every form of manufacturing equipment.

**To the ISO Age**

Today, springs are widely used in various industries and the market is estimated to be worth some USD 7,900 million. The ISO technical committee on metallic springs, ISO/TC 227, *Springs*, was created in 2004. Its aim is to standardize the tolerance, terminology and test methods as well as processing technology of springs. Among its expected benefits are the following.

- prevention of overkilled quality;
- reduction of defects;
- cost reduction.

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**Springing to standards**

The first Japanese spring material standards – for train spring steel – were introduced in 1914 by the Imperial Government Railways. Japanese Engineering Standards (JES) was established in 1922 and joined the International Federation of the National Standardizing Association (ISA) in 1929 to actively promote standardization.

Today, the Japanese Industrial Standards Committee (JISC), founded in July 1949, is the ISO member for Japan, and is responsible for the Secretariat of ISO technical committee ISO/TC 227, *Springs*. The Japan Spring Manufacturers Association (JSMA) operates the ISO/TC 227 Secretariat on behalf of JISC.

1) ISA was succeeded by ISO in 1947.
By standardizing inspection/test methods:
• avoidance of redundant investment of testing equipment;
• establishment of common ground for quality assurance.

By standardizing process technology, i.e. characteristics of springs (e.g. shot peening):
• promotion of advanced technology transfer;
• development of light-weight springs;
• improvement of fuel consumption for automobiles and the reduction of CO₂ release.

Starting on the standardization in the basic area, the committee will proceed to the series of spring terminologies, spring classification, and tolerance standardization.

A host of improvements
Spring theory has advanced considerably in recent decades, including studies of fatigue characteristics and mechanical functions of various shapes of springs (such as coil and plate springs). With the advancement of analysis techniques such as the finite element method, it has become possible to simulate spring applications, which has helped expand their range. Advancements in evaluation techniques now provide a very high level of accuracy, increasing the quality and reliability of products.

Materials with high heat resistance and rigidity have also been developed, including carbon, alloys, and special steels, and oil-tempered wire. Improved surface treatment has increased heat resistance, anti-corrosion properties, and durability of springs.

Materials have been improved in component optimization, hardness (strength), grading, and purity. Furthermore, attempts are underway to reduce defects in hardened materials. Improved surface treatment methods include hardening processes such as shot peening (hammering to relieve tensile stresses) and nitriding (introduction of nitrogen at high temperature), as well as anti-corrosion processes represented by plating.

Optimization is propelled by a combination of improvements in materials and processes. Materials such as shape-memory alloy, amorphous, titanium alloy, ceramics, plastics, and fibre-glass reinforced plastics (FRP) are being developed and studied to determine if they can be applied as spring materials. Carbon nanotubes might be used for spring material in the future.

Evolution in manufacturing
Along with materials developments, manufacturing methods and equipment have advanced a great deal since 1900. The evolution from manual to mechanical processing increased productivity while improving quality and reliability. Material refining has also progressed substantially – blast furnace technology has led to productivity gains and vacuum melting has brought higher quality. With advancements in controlling technology, further efforts are under way to control components and improve purity.

Productivity in forming coil springs has improved dramatically due to the development of mandrel winding coiling equipment with one or two pins, and the additional feature of an automatic cutting mechanism. At the same time, various configurations of other machines have been developed, including hooking and double torsion spring forming equipment.

“Traps and bows made of bent wood are among the earliest spring devices known to have been invented by human beings.”

An important recent change is the increased sophistication of computer-aided engineering (CAE) analysis. This enables identification of new requirements for each mounting position, resulting in higher precision and optimization of the entire flow from design to production. The challenge of improving environmental performance and space saving by seeking higher rigidity and lighter weight will continue.

Committed to further progress
For the spring manufacturing industry to progress along with continuing globalization and IT introduction, sector-wide efforts are essential. We are committed to making further efforts to improve total quality through standardization, and to supply products satisfying customer needs.

About the author
Mr. Shigeo Aiba is the Secretary of ISO technical committee ISO/TC 227, Springs, and President of TOGO Seisakusyo Corporation, which manufactures a variety of cold-formed springs, plastic fasteners and connectors. He also chairs the standardization meeting for the Japan Spring Manufacturers Association (JSMA), and has led the development of national standards for springs.
Power generation equipment manufacturers have made significant strides in recent years toward developing more cost-effective products with improved performance and lower exhaust emissions. The most notable of these advances are in gas turbines (GTs), steam turbines, heat recovery steam generators, conventional boilers, pollutant removal systems, and water treatment and fuel treatment equipment.

Over the past 30 years, gas turbine powerplants have become a leading form of electric power generation. Gas turbines have several wide areas of application. The largest are electric power generation with turbines typically rated above 50 MW and up to 250 MW or larger. For industrial applications, which include both electric power and compressor drives, the units are generally in the 5 to 40 MW range. For emergency power in buildings, hospitals, and other business complexes, there are many turbines installed with ratings of 50 kW to 5 MW.

After several technological breakthroughs, combined cycle power plants now approach 60% net efficiency\(^1\) – a significant milestone for electrical power generation from fossil fuels. A second-generation option, integrated gasification combined cycle, is being developed. This option, using a GT fuelled by coal, has even more proficient capability to capture carbon dioxide emissions.

\(^1\) Based on lower heating value of the fuel.
Evolution of class F gas turbines

A major challenge

With these developments, a substantial array of new and improved hardware has appeared in the marketplace. A major challenge now facing designers, users, and engineers, procurement, and construction (EPC) contractors is how to properly introduce and evaluate this equipment. On the one hand, incorporating the most advanced technology will yield higher thermal efficiency – of great importance, given ever-rising fuel costs. On the other hand, dealing with first-of-a-kind equipment could affect the reliability and availability of the plant, since the development process continues after the product has been introduced in the field.

Technologies generally evolve through incremental changes, but technology breakthroughs occur only through revolutionary advances. When a new model is introduced, all process shareholders – the equipment manufacturer, the owner and the EPC contractor – face the challenge of evaluating the revolutionary and evolutionary design changes, and of accurately assessing the risks and rewards associated with a new design. This decision-making process must rely on very specialized expertise and a solid experience database for new as well as upgraded gas turbine models.

ISO standards with their objectives of establishing best practices, disseminating new technologies, and facilitating access to markets, contribute significantly to this effort. The standards developed by ISO technical committee ISO/TC 192, Gas turbines, in particular, have an important role to play in this field. The technical committee, created in 1988, has the objective to develop standards to facilitate the negotiations among the parties involved in the procurement process. These standards provide a basis for specifying design and operational requirements and for the acceptance testing of the completed installation. Since turbines operate at high speeds and temperatures, safety is also a concern, and a new standard to be published this year, ISO 21789, will address safety requirements of gas turbines.

Revolution vs. evolution

Industrial heavy-duty GTs have undergone an unprecedented evolution in technology advancements. For the large GTs of power projects, letter designations identify the machine’s technology class, which is determined by the air flow amount, the compressor pressure ratio, and most importantly, the firing temperature.

In the 1980s the technology class was E, followed by the class F machines that appeared at the beginning of the 1990s. The most recent classes are labelled G and H. These new GT designs have relied on an evolutionary process using a proven existing design base and manufacturers’ accumulated expertise. Figure 1 illustrates the evolutionary process of class F machines over a period of 15 years. The improved power output and heat rate were achieved by increased airflow and power.
pressure through the compressor and a higher firing temperature, resulting from the use of better materials for the turbine blades and nozzles.

However, to meet stringent emissions requirements involving the need for substantial performance improvements, major design changes or even new designs must be implemented.

In search of performance improvements

One of the most common methods for increasing compressor airflow is to open the inlet guide vane (IGV) angle slightly. Manufacturers have obtained detailed data on surge margins from operational experience at various ambient temperatures and have gained the confidence to open the IGV beyond the initial setting.

“Technologies generally evolve through incremental changes, but breakthroughs occur only through revolutionary advances.”

Further compressor performance improvements can be achieved by modifying the aerodynamics of the two stages after the IGVs. While this practice can increase the power output, it can also reduce the compressor margin and negatively affect the compressor performance at high ambient temperatures. The performance benefits from increased mass flow at 40 °C will not be as good as the 15 °C specified by ISO 2314:1989, Gas Turbines – Acceptance tests.

Another method used to improve GT efficiency is to increase the pressure ratio. With current sophisticated computational fluid dynamics methods, it is possible to obtain a higher pressure ratio without increasing the number of stages. This option maintains the engine length and bearing locations but requires the use of better materials for the compressor last-stage blades because of the exposure to higher temperatures. A higher compressor discharge temperature also requires a detailed re-evaluation of the combustion system dynamics and air cooling circuits for the turbine section.

Unrelenting requirements to reduce emissions

The dry low NOx (DLN) premix combustion system is another GT component that is under continuous development. The unrelenting requirements to reduce GT emissions have led to the creation and application of combustion technologies capable of achieving single-digit NOx emissions for a 1300 °C firing temperature class.

However, DLN systems are sensitive to even minor changes in their geometry or cooling air patterns, so implementation of any evolutionary modification of this nature needs to be accompanied by thorough rig testing and field validation.

Gaining acceptance for radical change

Possibly the most common means of increasing GT power output and efficiency is to raise the firing temperature. Higher firing temperatures are made possible through the use of sophisticated nickel-based superalloys (single crystal nozzles and blades) as well as elaborate air cooling schemes. For many years, this was a gradual process with improvements of 10 °C to 15 °C at a time.

A revolutionary change in the cooling process is the introduction of steam cooling in a closed loop instead of the traditional air cooling. This process allows an increased firing temperature for the same combustor exit temperature (with no dilution from the cooling air) and at the same time uses the available heat in the steam cycle.

To gain acceptance for such a radical change, manufacturers have had to demonstrate the system’s capability as well as availability in a full-scale validation facility for a significant number of operating hours.

An important criterion

The dimensional scaling method is commonly employed in turbo-machinery development. Its goal is to obtain a different (usually larger) component size that will maintain the same positive characteristics of a successful previous design with minimum development time and effort. If the basic rules of scaling are followed 1), the basic mechanical safety margin and aerodynamic design will not be changed.

Unfortunately, however, the heat transfer characteristics cannot be simply scaled. Critical areas of turbine component development, such as cooling schemes, need to be analysed and validated again, as do mechanical tolerances, surface finish, tip clearances, etc. Therefore, an important criterion in the evaluation process (distinguishing revolution from evolution) of a scaled turbo-machinery component is determining how the implemented changes affect the integrity of the original design.

Technology exchange

An interesting phenomenon occurring among GT manufacturers is the “cross-pollination” between stationary and aero-engine designs. In some instances, aero-engine manufacturers have entered into commercial agreements with heavy-duty GT manufacturers. Compressor and turbine aero-design, air and steam cooling, combustors, and intake and exhaust systems are just a few examples of this type of technology transfer.

Testing and evaluation

The development process requires individual testing of all major GT components, including the compressor, combustion system and turbine. To alleviate the commercial consequences of introducing new models to the market prematurely, and to reduce development time and cost, several manufacturers have established their own inhouse testing facilities to evaluate equipment performance at load in a completely controlled environment. This allows early identification of potential problems.

Others have pursued an alternative approach whereby power plants are used as validation sites. In these cases, plant owners provide the equipment manufacturer with open access to conduct tests using additional instrumentation, and to implement changes.

Testing the equipment at these facilities is useful in identifying short-term issues for validating component compatibil-
Mechanical

bility and optimizing performance. Many solutions for the dry low NOx combustor problems are worked out at these sites, where complete combustion systems can be tested.

Testing of the complete GT (compressor, combustor, and turbine) is necessary to validate the combustion system design, since rig tests alone are not sufficient to determine the interaction between individual components. To overcome long-term issues, some new GTs are developed and operated at a demonstration site over a period of time before the engine is offered commercially.

The two tracks of performance betterment – new models and existing model upgrades – do interact. For example, many of the H class GT improvements are flowing back to F and G class equipment.

A complex process requiring expertise and dedication

Equipment manufacturers have identified and corrected many deficiencies associated with introduction of new technologies. The lessons learned and best practices have evolved into a due diligence process that is used at the equipment selection stage of all new projects. The process is refined and improved as more data becomes available from newly completed projects.

Evaluating the most appropriate type of equipment for a specific site is a complex process. Distinguishing evolutionary from revolutionary aspects of the equipment development process requires special expertise and dedicated research.

Working on all aspects of gas turbine design, application, installation, operation and maintenance, the standards developed by ISO/TC 192, with its various working groups, are instrumental in supporting these activities. The work of ISO/TC 192 greatly facilitates the procurement process by addressing test procedures, condition monitoring, sound and exhaust emissions, and procurement of gas turbine equipment. Its multistakeholder, consensus-based approach ensures that the international requirements included in the standards are widely accepted by interested parties, so as to facilitate trade and disseminate best practices and technological developments.
A new phase in the development of ISO’s programme to promote consumer participation in standardization was launched by ISO/COPOLCO, ISO committee on consumer policy, and ISO/DEVCO, ISO committee on developing country matters, in February 2008.

At the kind invitation of the Ghana Standards Board, and with support from the Swedish International Development Cooperation Agency (Sida) and the British Standards Institution, COPOLCO and DEVCO jointly organized a five-day training workshop in Accra, Ghana. Local television and press attended the opening ceremony, where the Honourable Shirley Ayorkor Botchway, Deputy Minister of Trade, delivered the keynote address at the opening ceremony.

This event aimed to provide carefully selected experts with the necessary skills to become trainers in consumer participation in standardization in their own countries and regions, using interactive exercises. Therefore, this “hands-on” training was designed not only to raise awareness of standards and consumer participation, but also to replicate awareness of consumer involvement in standards-making on a broader scale through a “multiplier effect”.

Participants came from Argentina, Armenia, Chile, Costa Rica, Egypt, Ethiopia, Ghana, Kenya, Libya, Nigeria, Oman, Philippines, Sri Lanka, and St. Lucia, and were evenly split between representatives of consumer organizations and standards bodies. There was also an equal gender balance and a widely representative range of ages.

An ambitious programme

Starting in 2003, and with the help of some of its national members and outside donor agencies – notably Sida, ISO undertook an ambitious programme to improve the dialogue between consumers and standards-setting organizations to enable them to work together more effectively.

As a result, a series of seven regional workshops was held from 2003 to 2007 in Bangkok, Cairo, Prague, Toronto, Kuala Lumpur, Gaborone (Botswana) and Vienna. Consumers International also contributed greatly to the workshops’ content and delivery.

These highly successful events had a two-fold aim:

- to raise consumer organizations’ awareness of the importance of standards; and
- to encourage representatives of ISO’s national standards bodies to implement programmes for consumer participation in standards development.
From content delivery to empowerment

The approach of the train-the-trainers workshop was different to that of earlier ones: the participants received instruction not only in consumer participation issues but also in general training skills. This will allow them to launch programmes back home more effectively.

ISO Training Consultant Mr. Folke Hermansson Snickars acted as workshop facilitator and delivered the sessions on training skills. Topics included evaluation of the training audience, setting objectives and designing the training course to achieve these objectives, adaptation of training methodology for adults, and designing and conducting evaluations.

Mr. Hermansson Snickars emphasized the use of evaluation as a means to calibrate the course to meet the needs of participants. To demonstrate this, he surveyed the participants mid-way through the train-the-trainer course, and reported back on the results.

In addition, the participants were able to gain practical management skills, such as budgeting for and planning a training session, and assessing its benefits.

Ms. Caroline Warne (former Chair of ISO/COPOLCO), Ms. Sadie Homer (Policy Advisor, Consumers International) and Ms. Dana Kissinger-Matray (Secretary of ISO/COPOLCO), delivered content which represented an optimal choice of material from seven earlier regional training workshops. Their intensive work of distilling and refining the earlier material, carried out prior to the course, had resulted in the development of six basic resource presentations, from which the experts delivered the following four themes in Ghana.

• Setting the stage: Why are standards so important for consumers?
• Models and realities: The current situation of consumer participation.
• The way forward: Developing consumer representation.
• Using valuable resources: Networking and accessing knowledge.

Further, the participants were given practical case studies illustrating principles explained in the first four presentations, plus some background information on how to define an action plan for improving interactions between consumer interests and standards bodies.

Innovative handy tools

Each participant received a CD-ROM containing six basic PowerPoint presentations on the above subjects, which they could adapt and deliver according to their own needs. Detailed notes developed by the international experts accompanied these presentations. In addition, the CD-ROMs contained the full course documentation as well as a great deal of additional background references. The participants will therefore be able to use these CD-ROMs as a resource for their own training work.

In addition, the participants received a pilot version on CD-ROM of an interactive learning module on consumer participation in standardization, called Consumers and standards: partnership for a better world. Participants were asked to work through the module upon their return home and provide feedback via a detailed survey form. These comments will be used to finalize the distance learning module, to be released on CD-ROM.
Developments and Initiatives and made available for free downloading from the Consumers section of ISO Online during 2008.

More than bread and butter

Some countries have few or no structures for consumer involvement in developing standards, whereas others already have a strong awareness of the benefits of consumer participation. The participants were strongly encouraged to adapt the design and delivery of courses to their own circumstances.

This requires an active effort by participants not to learn predetermined solutions by rote, but to personally assimilate the new content and skills with their own background knowledge and experience, so that the result is meaningful to those they will train in the future.

Mr. Hermansson Snickars therefore incorporated many interactive exercises and group discussions into the programme. Participants departed from the usual bread-and-butter lecture and PowerPoint presentation formulas, and experimented with other techniques to reinforce content, which included use of role play, dialogue in pairs or in groups, question and answer sessions, and brainstorming with a flipchart.

Over the weeklong period, the participants worked with a course design matrix and used it to prepare short practice training sessions for their colleagues in pairs and then in groups of four, which they then peer-reviewed. The participants were encouraged to draw not only on materials received from ISO, but also on their own studies, pictures and anecdotes. Shown are some of the illustrations used by participants to make their points.

From theory to practice

As the week progressed, groups of participants delivered presentations of a training programme which they had designed the previous day for local trainees invited by the Ghana Standards Board.

On the final day, the workshop participants concluded by analysing the evaluations returned by the local participants from Ghana, and assessed their own peer-evaluation exercises. This underscored the importance, both to the participants and to the international experts, of accurately assessing the needs of any group of trainees prior to training (setting the baseline), and determining the assessment criteria very carefully in advance.

The participants then discussed possible future plans for developing training programmes back home. With continued support from Sida, the ISO Central Secretariat’s Development and Training Services unit (DEVT) is now providing incentives and coordinating with the participants to set up their own training programmes in their countries and regions of origin, with support of the ISO members of those countries.

Wide satisfaction

As the trainers emphasized several times, the true results achieved by the course will only become known through baseline assessment and evaluation. This is still ongoing, since full assessment can only be carried out once follow-up training has taken place in the participants’ regions and the results assessed.

Nonetheless, an immediate follow-up questionnaire showed that the participants were very satisfied with the training session. The chart above shows the score, on a scale of 1 to 5, on a number of criteria measured by the questionnaire.

The participants appreciated the opportunity both to meet and network with their colleagues from around the world, and to interact with the officers from the Ghana Standards Board.
The crucial role of statistical methods

by Christophe Perruchet, Chair of ISO/TC 69, Applications of statistical methods

The production, collection, analysis, presentation and interpretation of data play a key role in industry and service sectors, in scientific research and in human sciences. There is little point in collecting data if it is not going to be analysed and interpreted with a view to enlightening human actions or to further knowledge of phenomena. The aim of statistics should be to transform raw data into usable, understandable and communicable information.

Statistical methods are needed for assessing measurement uncertainty, for calibration, monitoring and improving measurement processes at the producer’s site. They are also required by the various agencies involved in testing, verifying conformance and validating the producer’s quality and environmental management systems.

In today’s competitive industries, and particularly so far as statistical methods are concerned, there is external pressure to demonstrate that good current practice is in place and used, and to have independent agencies certifying that this is really the case. This pressure is creating a growing demand for international standards on statistical methods.

To everyone’s advantage

ISO technical committee ISO/TC 69, Applications of statistical methods, is responsible for the development of International Standards on the application of statistical methods. Its standards are used by other ISO technical committees, manufacturers, and the continuously growing industry dedicated to certification, e.g. to ISO 9001:2000 on quality management.

ISO/TC 69 aims to develop and maintain an integrated system of generic standards reflecting good current practice of statistical thinking, which will enable organizations to identify and implement all relevant statistical considerations whenever data are generated, collected, analysed, presented, evaluated and/or interpreted.

A universe of statistical methods

The technical committee is composed of five subcommittees, each of which complements the work of the others.

Terminology and symbols

The terminology standards developed by subcommittee ISO/TC 69/SC 1, Terminology and symbols, are aligned with the business environment and can be applied to products and services. The subcommittee serves as both internal and external consultant on terminology matters in this field. To harmonize with other terminology documents, SC 1 ensures that every term and symbol used in the ISO/TC 69 standards has been compiled and annotated to designate preferred terms and symbols. This resource will be especially valuable to technical committees and other experts drafting International Standards and related documents.
Process management

Subcommittee ISO/TC 69/SC 4, Applications of statistical methods in process management, has developed statistical methods in the form of control charts, process capability, and process management strategies that are applicable to every enterprise that has continuous improvement as one of its objectives. The economic success of enterprises is enhanced by the application of these tools and techniques, which are essential to any organization in pursuit of lean concepts. In fact, SC 4 has provided ISO/TC 176, Quality management and quality assurance, with the statistical tools to enhance the ISO 9001 quality management systems. The same process would be applicable to any standards group.

“The aim of statistics should be to transform raw data into usable, understandable and communicable information.”

Acceptance sampling

ISO/TC 69/SC 5, Acceptance sampling, is responsible for the ISO 2859 series of standards on inspection by attributes, and the ISO 3951 series on inspection by variables. These useful standards apply just as much to services as to products. The sampling systems permit the level of inspection to be reduced as the level of trust in the producer increases. ISO 2859-1 is widely used in international trade, for example, in the seafood and pharmaceutical industries, among others.

Measurement methods and results

Subcommittee SC 6, Measurement methods and results, is responsible for maintenance and development of generic standards and deliverables in such fields as accuracy of measurement methods and results, aspects of the preparation and use of reference materials. SC 6 standards are also generic and apply to both services and products. The ISO 5725 series on accuracy (trueness and precision) of measurement methods and results, is widely used in laboratory testing environments and for conformity assessment. It was decided in 2007 to work on revising the series.


Six Sigma

Six Sigma is a set of practices originally developed by Motorola to systematically improve processes by eliminating defects. A defect is defined as nonconformity of a product or service to its specifications.

While the particulars of the methodology were originally formulated by Bill Smith at Motorola in 1986, Six Sigma drew also on the quality improvement methodologies which had grown out of the six preceding decades, such as quality control and TQM (total quality management). Like these, Six Sigma put emphasis on:

- continuous efforts to reduce variation in process outputs is key to business success;
- manufacturing and business processes can be measured, analysed, improved and controlled;
- succeeding at achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

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Six Sigma

SC 7 is a newly created subcommittee, Applications of statistical and related techniques for the implementation of Six Sigma, resulting from an approach made to ISO/TC 69 by the Six Sigma community to provide documents describing statistical procedures that will be useful to those engaged in the practices of Six Sigma. The nature of the task is that the work items will be...
ISO standards for statistical methods now available as CD-ROM collection

by Roger Frost, Manager, Communication Services

Product design, process control and improvement, quality management, market research, laboratory testing, regulatory inspection and certification are among the wide range of economic activities that stand to benefit from a new CD-ROM collection of more than 70 ISO International Standards on statistical methods. This is the sixth edition of the complete collection of the ISO standards for Statistical methods – previously published as a handbook in two volumes – and now available on CD-ROM for the first time.

The 74 International Standards contained on the CD-ROM set out the practical methodology for collecting, processing and interpreting measurement, testing or inspection results whenever goods or services are assessed from a sample. ISO International Standards for the application of statistical methods are generic and widely used in many technical fields. Not only are they used by organizations in all business sectors worldwide, but they are also cited in hundreds of ISO International Standards on specific products, processes and materials.

The CD-ROM includes standards for:
- Statistical methods in general;
- Terminology and symbols;
- Applications of statistical methods in process management;
- Acceptance sampling;
- Measurement methods and results.

A numerical index is provided to allow quick access to standards and the CD-ROM has full-text search functionality.

The economic benefits of statistical methods in industrial production are well known, but they are also widely used and bring benefits to the service sector, trade, regulation, scientific research and human sciences.

The standards on the CD-ROM have been developed by ISO technical committee ISO/TC 69, Application of statistical methods. This CD-ROM collection of ISO/TC 69’s work provides a solid, internationally harmonized basis for statistical methods to facilitate the growth of global markets.

The CD-ROM Statistical methods (ISBN 978-92-67-10476-8) is available from ISO national member institutes and from ISO Central Secretariat through the ISO Store (www.iso.org/isostore) or by contacting the Marketing & Communication department (sales@iso.org).

aligned horizontally across the traditional ISO/TC 69 structure.

ISO/TC 69/SC 7 will have the task of developing a framework for these new documents and of managing the work items, with the objective of:
- making the tasks easier to handle within ISO/TC 69;
- providing good external visibility of the work being undertaken; and
- providing consistency in the “look and feel” of the documents that target this new ISO/TC 69 stakeholder community.

The aim is to create documents that provide guidance on the application of statistical procedures for the Six Sigma and related communities, both manufacturing and business types, who strive to improve products and processes. Because these communities are characterized by a focus on speed to obtain results, a basic knowledge of statistics, and a propensity to use software applications to guide them through the mathematical challenges of statistical methods, the documents to be developed will have the objective of satisfying these characteristics.

Perspectives and new fields

To meet the technical requirements of ISO/IEC 17025:2005, it is necessary for testing and calibration laboratories to understand and adopt several statistical methods. Over the years, ISO/TC 69 has developed a wealth of statistical standards that can be used for this purpose.

A document on the application of statistical standards to the clauses of ISO/IEC 17025:2005 is now being developed. This document will give an overview and guidance on the selection of International Standards, guides, technical reports and draft International Standards on statistical methods developed by ISO/TC 69, other ISO technical committees and international organizations. It is presented from the user perspective in the form of a table, comparing the relevant ISO/IEC 17025 sub-clauses against these standards documents.

About the author

Christophe Perruchet has been Chair of ISO/TC 69 since 1994. He joined UTAC (a technical organization providing services to the automotive industry and administrations) in 1984 and is involved in the management and analysis of large databases related to road safety and environment. He is also very active in other ISO committees, such as the ISO technical advisory group TAG 4, Metrology, and the ISO committee on conformity assessment (ISO/CASCO) working group WG 28, Proficiency testing.
How long will a DVD last? This is a crucial question for businesses that put their faith in the medium for recording information and for suppliers and consumers of DVD products. The new International Standard ISO/IEC 10995:2008 specifies an accelerated ageing test method for estimating the life expectancy for the retrievability of information stored on recordable or rewritable optical disks.

This International Standard provides a methodology that includes the testing of newer, currently available products. This test includes details on the following formats: DVD-R/-RW/-RAM, +R/+RW and it may be applied to additional optical disk formats with the appropriate specification substitutions.

ISO/IEC 10995 covers the following aspects:

- stress conditions;
- assumptions;
- ambient conditions;
- evaluation system description;
- specimen preparation;
- data acquisition procedure;
- data interpretation.

The methodology includes only the effects of temperature (T) and relative humidity (RH). It does not attempt to model degradation due to complex failure mechanisms, nor does it test for exposure to light, corrosive gases, contaminants, handling, and variations in playback subsystems. Disks exposed to these additional sources of stress or higher levels of T and RH are expected to experience shorter usable lifetimes.

It is an outline of steps to estimate the life expectancy value, as a function of ambient temperature and relative humidity, and used to determine if a disk will or will not exceed a life expectancy of X-years.

ISO/IEC standard for estimating the useful life of DVDs
by Sandrine Tranchard, Communication Officer, ISO Central Secretariat

Dr. Yoshinobu Mitsuhashi, Chair of the ISO/IEC subcommittee (JTC 1/SC 23) that worked on the standard, comments: “Digital supports allow important storage capacities but the question is the permanity of these data. The implementation of ISO/IEC 10995:2008 will allow a storage for a known duration and thus a sure management of archived data.”

ISO/IEC 10995:2008 was prepared by Ecma International (as ECMA-379) and was adopted, under a special “fast track procedure”, by the joint technical committee ISO/IEC JTC 1, Information technology, in parallel with its approval by national bodies of ISO and IEC.

ISO/IEC 10995:2008, Information technology – Digitally recorded media for information interchange and storage – Test method for the estimation of the archival lifetime of optical media, is available from ISO national member institutes and from ISO Central Secretariat through the ISO Store (www.iso.org/isostore) or by contacting the Marketing & Communication department (sales@iso.org).

ISO technical report to help oil and gas sector measure flowrate in pipelines
by Sandrine Tranchard, Communication Officer, ISO Central Secretariat

The oil and gas sector will benefit from a recently published technical report from ISO on measuring flowrate in pipelines.


ISO 5167:2003 is an International Standard (in four parts) for flow measurement based on the differential pressure generated by a constriction introduced into a circular conduit. It covers the geometry and method of use (installation and operating conditions) of orifice plates, nozzles and Venturi tubes when they are inserted in a conduit running full to determine the flow rate of the fluid flowing in the conduit. It also gives necessary information for calculating the flow rate and its associated uncertainty.

ISO/TR 9464 answers some important questions which might arise on the use of ISO 5167, for example, on calculating upstream from downstream temperature. With the application of the rules it provides, it is practicable to achieve flow measurement within an uncertainty of approximately 1% of the calculated flowrate.

The report gives supplementary guidance on the use of all parts of ISO 5167 and information on the use of essential secondary instrumentation, including measurement of pressure, differential pressure, temperature, density and electrical supply.

ISO/TR 9464:2008, Guidelines for the use of ISO 5167:2003, was developed by ISO technical committee ISO/TC 30, Measurement of fluid flow in closed conduits, subcommittee SC 2, Pressure differential devices. It is available from ISO national member institutes and from ISO Central Secretariat through the ISO Store (www.iso.org/isostore) or by contacting the Marketing & Communication department (sales@iso.org).
Main Focus

Sports and leisure

As fans around the world get ready to support their favourite teams in the Olympics, Euro Cup and other sporting events, and excited tourists pack for their next holiday adventure, International Standards are at work behind the scenes to ensure the safety, quality and performance of these experiences.

The spirit of these friendly competitions is, in a way, no different from that of standardization, which aims to bring countries together to build consensus and facilitate international interactions and transactions.

Indeed, International Standards play an enabling role in the fields of sports and leisure: whether by providing common terminology or measurement standards, as with the International System of Units (SI), or through the application of specific standards as for diving, or simply through the building standards that ensure the stability of the infrastructure of sports and leisure events.

With ISO standards, we can feel confident when using sporting equipment or engaging in leisure activities in different parts of the world, that internationally agreed requirements for performance, quality and safety are in place.

In the next issue of *ISO Focus*, we explore some of the latest standards that are making their mark in the fields of sports and leisure. From the new standards for trapeze used in sailing which keep sportsmen attached to their boats, to those for overboard man prevention and recovery; from the life jackets that might save us from drowning, to the standards for treadmills and rowing machines at the gym.

The next issue looks at the new fields where ISO is heading to address current market needs (as for adventure tourism), as well as areas where ISO standards are making a difference (as in the environmental impact of golf courses).

The next issue will also provide us the highlights of the ISO Committee on consumer policy (COPOLCO) plenary, which marks the committee’s 30th anniversary. The event, which took place in May 2008, was preceded by a workshop focused on the topical subject of energy. Learn all about the outcome of this meeting in the next issue of *ISO Focus*.

In the interview, Mrs. Chen Li Fen tells us about the interest of Jiangsu Sunshine in the ISO committee developing standards on textiles. Jiangsu Sunshine also values the guidance that International Standards provide, and Mrs. Chen Li Fen explains how the company uses standards for accessing markets and driving their business.

Guest View

Mrs. Chen Li Fen

As the world’s attention turns to the Beijing Olympics, *ISO Focus* also turns to China in an exclusive interview with Mrs. Chen Li Fen, General Manager of Jiangsu Sunshine, a leading Chinese textile company. In the interview, Mrs. Chen Li Fen discusses the importance of International Standards for accessing international markets and assuring quality, as well as for promoting technological performance and innovation.

With an annual production of 3 million sets of high-grade garments, their own brand names, and a yearly capacity of superfine worsted fabric of 35 million meters, Jiangsu Sunshine claims to be the world’s largest wool fabric mill and high-end clothing production base.

“We believe that International Standards will be of increasing importance with the further globalization of the world economy,” she says.

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You never know what an unhappy customer is capable of.

Fortunately, ISO has a system for complaints handling.

Even the best organization can’t expect all its customers to be satisfied all the time. And complaints can provide benefits. Complaints can give an organization valuable information about how its products and services are performing. Positive treatment of unhappy customers can increase their loyalty. Three ISO standards offer a comprehensive framework for complaints management – from prevention, through handling to dispute resolution.

ISO 10001:2007, Quality management – Customer satisfaction – Guidelines for codes of conduct for organizations

ISO 10002:2004, Quality management – Customer satisfaction – Guidelines for complaints handling in organizations

ISO 10003:2007, Quality management – Customer satisfaction – Guidelines for dispute resolution external to organizations

Available from ISO national member institutes (listed with contact details on the ISO Web site at www.iso.org) and from the ISO Central Secretariat Webstore at www.iso.org/istore or e-mail to sales@iso.org.