ASME
SETTING THE STANDARD

ASME
STANDARDS & CERTIFICATION

Examples of Use of Codes and Standards for Students in Mechanical Engineering and Other Fields

The American Society of Mechanical Engineers (ASME)

DEAR ENGINEERING STUDENT:

The articles in this booklet explore different facets of ASME Standards & Certification. ASME Standards & Certification plays an important role in ensuring the safety of the public and in the standardization of things as common as nuts and bolts. We have selected the articles to draw your attention to some important aspects of your professional life and future in the mechanical or related engineering field.

For an overview of ASME Standards & Certification, see the "Codes and Standards at a Glance" section, which immediately follows the articles.

We hope that you find this collection of articles interesting and informative, and that it provides you with a new window into the field of ASME Standards and Certification. Please let us know what you think at: cs@asme.org.

Sincerely,

Task Group on ASME Codes and Standards for Mechanical and Other Engineering Students

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This brochure is an update of the previous brochure, which was issued about a decade ago. The Task Group acknowledges the work of the previous task group of: Gerard G. Lowen, Chair; Guy A. Arlotto; Stuart Brown; Domenic A. Canonico; Ryan L. Crane; John H. Fernandez; Philip M. Gerhart; Halit M. Kosar; Richard Merz and Sam Zamrik.

ABOUT ASME

ASME Mission

To serve our diverse global communities by advancing, disseminating, and applying engineering knowledge for improving the quality of life and communicating the excitement of engineering.

ASME Vision

ASME, the American Society of Mechanical Engineers, will be the essential resource for mechanical engineers and other technical professionals throughout the world for solutions that benefit humankind.

ASME HELPS THE GLOBAL ENGINEERING COMMUNITY DEVELOP SOLUTIONS TO REAL WORLD CHALLENGES FACING ALL PEOPLE AND OUR PLANET

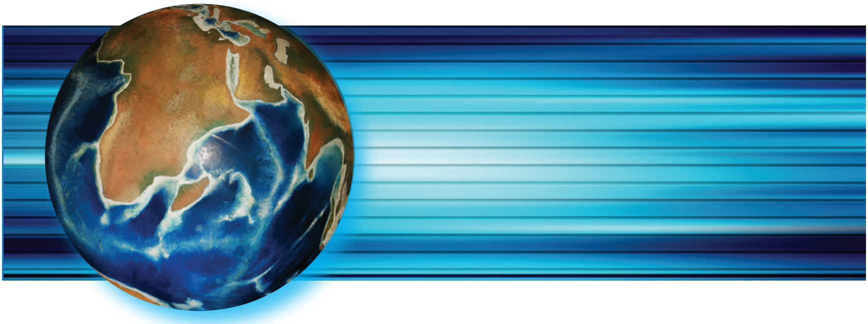
ASME is a not-for-profit membership organization that enables collaboration, knowledge sharing, career enrichment, and skills development across all engineering disciplines. Founded in 1880 by a small group of leading industrialists, ASME has grown through the decades to include more than 120,000 members in over 140 countries around the globe. The membership includes a wide diversity of technical disciplines who represent all facets of the technical communities.

ASME's diverse members range from college students and early-career engineers to project managers, corporate executives, researchers, and academic leaders. ASME serves this wide-ranging technical community through quality programs in continuing education, training and professional development, standards and certification, research, conferences and publications, government relations, and other forms of outreach.

Many engineers join ASME for career enrichment, lifelong learning, and the opportunity to network with professionals of like-minded interests. Others become active in local sections or in ASME's administrative structure of boards and committees, providing leadership and expertise to the Society and the profession at large.

The governance of the Society is the responsibility of member-elected governors, who volunteer their vast knowledge and expertise to the organization. The board of governors and other volunteer leaders of ASME work in collaboration with a professional staff to shape the Society's programs and strategies and make them available to engineers throughout the world. ASME administers its programs through offices and institutes in the United States, Belgium, China and India and through various committees and groups, to ensure that the myriad technical interests of its members and the global engineering community are met.

More information about ASME can be obtained from http://www.asme.org/about-asme



A STRATEGIC ROADMAP GUIDES ASME

ASME strategically aligns its programs and initiatives to focus on three main organizational priorities — energy, engineering workforce development, and global impact — in an effort to provide relevant knowledge-based resources to the broad spectrum of ASME members and constituents.

In energy, ASME is serving as an essential energy technology resource and leading advocate for balanced energy policies. In engineering workforce development, ASME fosters a broader, competent, vibrant and more diverse engineering workforce, with improved retention in both the profession and ASME over all career stages.

And in the area of global impact, ASME is committed to delivering locally relevant engineering resources to advance public safety and quality of life around the world.

Among many examples of the Society's growing outreach in the global arena is Engineering for Change (E4C). E4C is a dynamic community of engineers, technologists, social scientists, NGOs, local governments, and community advocates whose mission is to improve people's lives in communities around the world. E4C features an open, innovative, and user-friendly online platform that facilitates collaboration and knowledge exchange for the development of appropriate solutions to issues such as sanitation, access to clean water, energy, transportation food, education and housing.

More information about E4C can be obtained from https://www.engineeringforchange.org

ASME'S ROLE IN THE GLOBALIZATION OF CODES AND STANDARDS

by Donald R. Frikken, P.E., Becht Engineering Company

Movement to harmonization of standards requirements has taken on greater interest as companies continue to merge or expand operations across international boundaries, helped by regional trade agreements such as the North American Free Trade Agreement (NAFTA) and those established by the European Union (EU), which have facilitated international mergers through the lowering of tariffs on imports.

The companies involved in these consolidations or expansions are used to selling to just one market, find themselves selling to global markets. The standards for products in these markets are often different, which complicates manufacturing procedures. Local laws may require the use of a particular standard, yet these laws are viewed by the World Trade Organization (WTO) as technical barriers to trade, and WTO member countries are charged with reducing these and other barriers to free global trade.

What is the best way for standards-developing organizations like ASME and for users of standards to find a solution? Possible approaches are to adopt a prevalent standard, to perform a comparison of standards requirements to identify areas of possible convergence, or to develop an umbrella standard that references other regional and national standards. On new emerging topics or technologies, a global consensus standard may possibly be developed from scratch. ASME is involved in helping promote whichever approach best serves a specific industry and the users of the applicable ASME standards.

ASME standards have changed over the years to include new construction materials, to address new topics, and to incorporate new calculation methods. As these changes continue to be introduced, global developments bring even more change, requiring greater flexibility and adaptation from industry.

ELEVATORS, ESCALATORS AND MOVING WALKWAYS

by Jim Coaker, Coaker & Company, PC

A NORMAL CONVENIENCE IN EVERYDAY LIFE FUNCTIONING WITHOUT INCIDENT

How many times in the past week have you ridden in an elevator, on an escalator, or on a moving walk? These actions are so routine in everyday life that they happen automatically and are too numerous to recall.

Behind each mechanism is a web of machinery, power sources, control systems, and redundant safeguards in both design and operation that delivers safe vertical transportation without incident.

ASME elevator and escalator standards (A17 series), consisting of safety codes for elevators and escalators (including a code that covers existing installation requirements), Inspectors' Manuals, and Guidelines covering evacuation and electrical equipment requirements, is one of the largest areas covered by the Society's codes and standards program. Elevator ridership in the United States is conservatively estimated at more than 200 billion passenger rides per year, a figure that makes it easy to appreciate the critical role that codes and standards play in public safety.

Dynamic change defines the world of technical applications and ASME's standards are constantly updated to keep abreast of changes in technology. Starting with basic design principles relating to public safety, these codes and standards establish guidelines and requirements for equipment design, installation, operation, inspection and maintenance.

Performance-based codes have been developed to provide guidelines and requirements to allow latest state-of-the art technology, design, and materials in engineering design of new and renovated elevator systems. Advancements in technology and updates to codes and standards that support elevator systems have led to buildings that are ever taller, more efficient, and more resistant to natural forces helping to sustain the infrastructure of many of our great cities.

Even if the end result is invisible — a normal convenience in everyday life functioning without incident — underlying complexities of system application present stimulation and challenge to the engineering mind. Some professionals spend their careers in this industry.

WHAT ARE PERFORMANCE TEST CODES?

by Philip M. Gerhart, Ph.D., P.E., University of Evansville and Samuel J. Korellis, P.E., EPRI

PERFORMANCE TEST CODES PROVIDE A "LEVEL PLAYING FIELD" FOR BOTH MANUFACTURERS AND USERS OF THE EQUIPMENT OR SYSTEMS

ASME Performance Test Codes (PTC) provide rules and procedures for planning, preparing, executing, and reporting performance tests. A performance test is an engineering evaluation; its results indicate how well the equipment performs its functions.

Performance test codes originated as "Power Test Codes" and emphasized energy-conversion equipment. The first ASME code was *Rules for Conducting Boiler Tests*, published in 1884. Today, nearly 45 PTCs are available; they cover individual components (e.g., steam generators, turbines, compressors, heat exchangers), systems (e.g., flue gas desulfurization, fuel cells), and complete plants (cogeneration plants). In addition to equipment codes, supplements on instruments and apparatus cover measurement systems (e.g., temperature, pressure, flow) and analytical techniques (uncertainty analysis) common to most PTC codes.

For more than a century, ASME PTC tests have provided results with the highest level of accuracy, based on current engineering knowledge and practices, and taking into account the costs of the tests and the value of the information obtained. All ASME codes are developed using input from a range of parties, who may be interested in the code and/or in the associated equipment or process. Codes have the force of a legal document when cited in contracts, as they frequently are, for determining the method by which equipment performs as guaranteed.

PTCs are used by equipment owners, equipment suppliers, and test engineers. ASME PTCs protect users from poorly performing products and enable suppliers to compete fairly by offering reliable products. Performance test codes provide a "level playing field" for both manufacturers and users of the equipment or systems. Purchase specifications are greatly strengthened by citing the results of PTC tests. When buying new equipment, purchasers may specify that the equipment guarantee will be based on the results of a specific ASME PTC test. Design engineers consult PTC documents to ensure that proper instrument connections will be available. Test engineers install the required instrumentation and use the code's procedures and calculation methods to conduct tests on the new equipment. Representatives of all parties to the test ensure that the test methods are in compliance with the code. Finally, the test results are compared to the performance criteria.

Sometimes manufacturers and suppliers want to determine the exact performance of their equipment to understand the design margins or the effects of manufacturing tolerances on performance. In this case, code tests are conducted outside of any performance guarantees.

To ensure that ASME PTCs best serve global industries, existing and additional products and services are always being evaluated. As the preeminent provider of standardized methods for performance testing, monitoring, and analysis of energy conversion and industrial processes, systems, and equipment, ASME continues to develop and add new codes.

In recent years PTC committees have started working on emerging technologies earlier (i.e., prior to full commercialization).

Some of these areas are:

- Fuel Cell Power Systems
- Integrated Gasification Combined Cycle
- Combustion Turbine Inlet Air Conditioning Equipment
- Concentrating Solar Power Plants
- Overall Plant Performance with Carbon Capture

By having a reliable, repeatable performance test code available earlier, we are helping to facilitate the commercialization of these emerging technologies.

A LOOK AT THE ASME BOILER AND PRESSURE VESSEL CODE (BPVC)

by Domenic Canonico, Ph.D., Canonico & Associates

THE IDEA FOR THE BPVC AROSE IN 1911 OUT OF THE NEED FOR PUBLIC SAFETY

The ASME Boiler and Pressure Vessel Code (BPVC) is a standard that provides rules for the design, fabrication and inspection of boilers and pressure vessels.

A pressure component designed and fabricated in accordance with this standard will have a long, useful service life that ensures the protection of human life and property. The BPVC is written by volunteers, who are nominated to its committees based on their technical expertise and on their ability to contribute to the writing, revising, interpreting and administering of the document.

Following the invention of the steam engine in the late 18th century, there were thousands of boiler explosions in the United States and Europe, which resulted in many deaths and lasted throughout the 19th century.

The first *Boiler and Pressure Vessel Code* (1914 edition) was published in 1915; it was one book, 114 pages long. Today there are 32 books, including thirteen dedicated to the construction and inspection of nuclear power plant components and two Code Case books. The 2010 edition of the *Boiler and Pressure Vessel Code* is more than 16,000 pages. The 32 books are either standards that provide the rules for fabricating a component or they are support documents, such as *Materials* (Section II, Parts A through D), *Nondestructive Examination* (Section V), and *Welding and Brazing Qualifications* (Section IX). Code Cases provide rules that permit the use of materials and alternative methods of construction that are not covered by existing BPVC rules.

The BPVC is the largest ASME standard, both in size and in the number of volunteers involved in its development. At any one time, there are more than 950 volunteers serving on one or more committees. The fact that the BPVC is a committee organized and administered by ASME may give the impression that the volunteers are all mechanical engineers. This is not the case; to write such a standard requires a breadth of knowledge that is not available in any one discipline. Volunteers on the committees have expertise in materials (metallurgical and materials engineering), structures (civil engineering), physics, chemistry (chemistry and chemical engineering), and other disciplines in addition to mechanical engineering.

Various sections of the BPVC have been adopted into law in all Canadian provinces and all fifty states. More than half of the companies certified by ASME Standards & Certification to manufacture pressure parts in accordance with various sections of the BPVC are located outside of North America.

Internationally, the BPVC is recognized in more than 100 countries. The record of the BPVC is a testament to its success. The safety record of pressure containing components manufactured in accordance with the rules of the BPVC is outstanding. The contributions made over the past 100 years by thousands of volunteers who have participated in the preparation of the BPVC have made this possible.

MORE THAN 100,000 COPIES OF THE BPVC ARE IN USE IN 100 COUNTRIES AROUND THE WORLD, WITH TRANSLATIONS INTO A NUMBER OF LANGUAGES

U.S. GOVERNMENT USE OF ASME CODES AND STANDARDS

by David Terao, Nuclear Regulatory Commission

THE FEDERAL REQUIREMENTS GOVERNING THE USE OF ASME CODES AND STANDARDS BENEFIT ASME, THE NRC, AND MOST IMPORTANTLY, THE PUBLIC

An organization wants to construct and operate a nuclear power plant; to supply the reactor steam supply system; to supply architect-engineering services; to supply components (e.g., pressure vessels, piping, pumps, valves); or to supply an entire nuclear power plant design. The U.S. Nuclear Regulatory Commission (NRC), the federal agency responsible for issuing construction permits, operating licenses, or combined (construction and operating) licenses for new nuclear power plants, requires conformance with certain ASME codes and standards in its regulations. Therefore, to obtain a license to construct or operate a nuclear power plant, a plant owner and its subcontractors designing and supplying nuclear components must meet the requirements of these codes.

In the 1980s the federal government's Office of Management and Budget (OMB) first issued OMB Circular A-119, which required certain government agencies to use applicable national consensus standards, wherever practical, in lieu of developing their own regulations to accomplish their missions. Also, Public Law 104-113, "The National Technology Transfer and Advancement Act of 1995," requires all federal agencies to use technical standards that are developed by voluntary consensus standards bodies, such as ASME, as a means to carry out policy objectives, where practical. In complying with these laws, the NRC incorporates by reference certain industry codes and standards including Section III of the ASME Boiler and Pressure Vessel Code into its regulations. Section III provides rules for the materials selection, design, fabrication, installation, examination, and testing of nuclear components. It should be emphasized that under the Atomic Energy Act of 1954, as amended, the NRC has authority to promulgate regulations governing the design, construction, and operation of commercial nuclear power plants. Generally, the NRC develops and promulgates its own regulations. For its regulation governing the use of codes and standards, the NRC incorporates by reference into its regulations certain consensus standards such as ASME codes. "Incorporation by reference" was established by statute and allows the NRC and other federal agencies to refer to standards already published elsewhere. These standards are then treated like any other properly issued regulation and have the force of law.

FROM THE CONSTRUCTION PHASE TO THE OPERATING PHASE, THE NEED FOR RULES SHIFTS FROM DESIGN AND CONSTRUCTION TO INSERVICE INSPECTION AND TESTING OF COMPONENTS

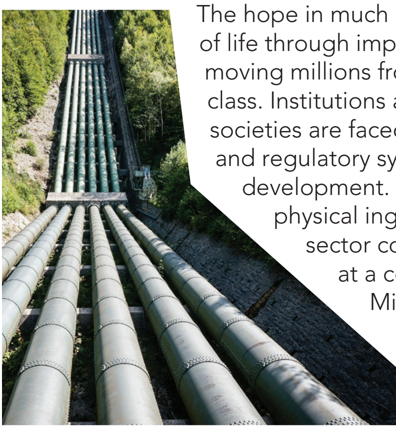
To address the safe operation of nuclear reactors, ASME developed and publishes Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," and the ASME OM Code, "Code for Operation and Maintenance of Nuclear Power Plants," to ensure that continued safe operation is maintained over the life of the plant. These two codes are also required by NRC regulations, making the periodic inspection and testing of components and meeting acceptance standards a federal requirement for maintaining a license to continue operation. This gives the NRC and the public a level of confidence that any degradation of the plant during the period of operation will be detected early, adequately corrected, and will not reduce safety below an acceptable level.

In recent years, the design and manufacturing of major components in nuclear power plants have become a global venture. Reactor vessels, steam generators, and reactor coolant pumps are often manufactured in one country and shipped to another country for installation in a nuclear plant. Section III of the ASME Boiler and Pressure Vessel Code is an international code that is used in many foreign countries. Although the NRC requires the use of Section III for the design and construction of nuclear power plant components in the United States, NRC's regulations contain a provision that would allow alternatives to the use of Section III when such alternatives are first authorized by the NRC. In order to authorize such an alternative, a comparison of the code differences would need to be made to demonstrate an acceptable level of quality and safety between the two codes. ASME, working with other international standards development organizations, has completed a comparison of Section III rules with several other major foreign pressure-boundary design codes used in other countries that provide useful information for such a decision-making evaluation.

In summary, the federal requirements governing the use of ASME codes and standards benefit ASME, the NRC, and most importantly, the public. ASME's codes and standards gain increased visibility and stature through government use, its volunteers see the fruits of their efforts, and public safety is maintained. The NRC benefits because, by using ASME codes, it can be a more efficient government agency, both in its decision-making and during various phases of the licensing process. The better the NRC functions, the better the health and safety of the public are protected.

ASME CODES AND STANDARDS IN EMERGING ECONOMIES

by Robert R. Lettieri, ASME



The hope in much of the emerging world is to raise the quality of life through improved living standards, which includes moving millions from impoverishment into a growing middle class. Institutions and agencies in rapidly industrializing societies are faced with the task of creating a standards and regulatory system that can keep pace with economic development. With energy being the largest single physical ingredient in any modern economy, the energy sector continues to be a key area of focus. Speaking at a conference in Mumbai, the Secretary of the Ministry of Petroleum & Natural Gas quoted Gandhi in expressing India's commitment to linking energy security with the drive to end poverty; in order to "wipe every tear from every eye" energy is required. Related standards are needed, and ASME with over 125 years of standards development experience is often seen as a valuable resource in pursuing these goals.

ASME Standards and Certification (S&C) has been working with Indian standards development organizations, regulatory agencies, and state-owned enterprises in the energy and other sectors to help make these goals a reality. ASME standards integrated into a multi-agency standards and regulatory regimen have included the Boiler and Pressure Vessel Code, nuclear codes and standards, pipeline transportation systems for liquid hydrocarbons and other liquids, welding qualifications, standards for valves and fittings, standards for screws, bolts and nuts, and performance test codes. India is making use of ASME B31.8, Gas Transmission and Distribution Piping Systems and related standards (ASME B31.8S, Managing System Integrity of Gas Pipelines and ASME B31Q Pipeline Personnel Qualification) as they engage in the rapid expansion of their gas pipeline infrastructure; 8500 kilometers of gas transmission pipelines will be added to the current system impacting numerous cities throughout the country and providing natural gas for the first time to millions of Indian citizens.

The World Trade Organization/Technical Barriers to Trade Agreement (WTO/TBT) is designed to prevent the unfair and unnecessary use of a particular set of standards to protect certain segments of industry at the cost of expanded commerce across borders. The international nature of ASME standards, including a standards development process consistent with WTO/TBT criteria, facilitates establishment of standards needed in developing countries and in turn further facilitates economic development. Standards such as ASME standards promote the aim of prosperity with safety.

Over 100 countries accept the ASME Boiler and Pressure Vessel Code as a means of meeting local safety requirements. The quality systems of more than

...THE SECRETARY OF THE MINISTRY OF PETROLEUM & NATURAL GAS QUOTED GANDHI IN EXPRESSING INDIA'S COMMITMENT TO LINKING ENERGY SECURITY WITH THE DRIVE TO END POVERTY.

6,000 manufacturers of pressure equipment in more than 70 countries are certified by ASME. ASME standards have recently been recognized in regulations or national standards in Colombia, India, Kazakhstan, Nigeria and South Africa.

Increasing interaction with agencies in China on development of national nuclear standards is expected to facilitate wider use of ASME nuclear codes and standards in the nuclear renaissance taking place there. The completion of the translation into Mandarin of ASME NCS was marked with a ceremony at The Great Hall of the People in Beijing and attended by Vice Premier Zeng Peiyan and other dignitaries along with senior ASME volunteers and staff. Through collaboration with The Institute of Nuclear and New Energy Technology of Tsinghua University (INET), ASME NCS related training has been provided to local experts working in the sector. State authorities involved in standards having to do with nuclear power generation are encouraging local manufacturers to embrace ASME Conformity Assessment to accommodate the new nuclear build. ASME S&C has been demonstrating its commitment to China for more than 20 years.

Following interaction with members of the standards and regulatory community in Central and South America, stakeholders and potential stakeholders inquired about the possibility of making the ASME Boiler and Pressure Vessel Code available in Spanish in order to have the Code be more accessible in the region. This led to the creation of the Committee on ASME S&C in Spanish, which includes Spanish speaking expert volunteers from throughout the Americas. The rate of participation by technical experts from outside the United States in ASME standards development has increased significantly in the past several years, and the developing world is well represented.

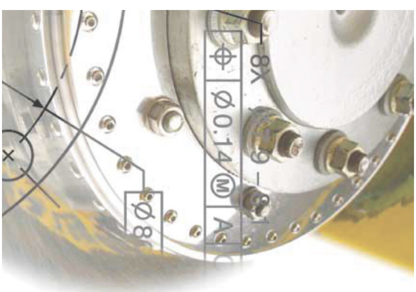
The impact ASME S&C seeks to make is consistent with ASME objectives overall: "ASME helps the global engineering community develop solutions to real world challenges.… ASME codes and standards, publications, conferences, continuing education and professional development programs provide a foundation for advancing technical knowledge and a safer world." In engaging partners in emerging economies, ASME S&C focuses on communicating the value of participating in ASME standards development — greater understanding and acceptance of ASME standards leading to reference or adoption in local standards and regulation, and the role ASME Conformity Assessment can play in promoting safety and making ASME standards related training more relevant and more available.

ASME volunteers and staff understand the importance of expanding cooperation and collaboration with organizations in emerging economies and continue to enjoy the experience and camaraderie of engineers, technicians and managers coming together to find solutions to create a safer world.

COMMUNICATING MECHANICAL ENGINEERING REQUIREMENTS CONSISTENTLY: ASME Y14.5, DIMENSIONING AND TOLERANCING

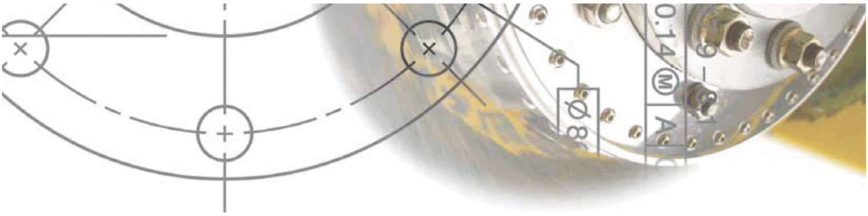
by Archie R. Anderson, Dimensional Dynamics, LLC

EACH REVISION ADDED MORE COMPLEX APPLICATIONS KEEPING PACE WITH THE CHANGES IN ENGINEERING REQUIREMENTS AND MANUFACTURING TECHNOLOGY



ASME Y14.5-2009 is the latest revision of the U.S. National Standard on Dimensioning and Tolerancing that had its beginning in the 1950s. The original goal of Y14.5 was to delineate and define mechanical part hardware and to create a common technical drawing language for standardized drawing practices. It was also recognized that representing a perfect part on the drawing must include a permitted tolerance as a deviation from the perfect part (because perfection cannot be achieved in real production). This explains the dimensioning and tolerancing emphasis of Y14.5. The Y14.5 standard is a valuable tool for: designers; product, manufacturing, and quality engineers; CMM operators; checkers; quality personnel; engineers; students; and anyone else who uses geometric dimensioning and tolerancing (GD&T) on the job. This standard is designated as an "International Standard," the standard of choice throughout much of the world.

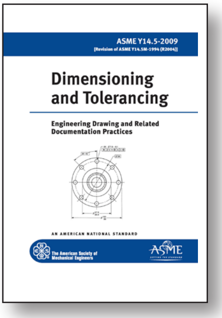
The original edition of Y14.5 defined and illustrated basic applications dealing predominately with the assembly of parts. Over the years of development and maturing of the standard, each revision added more complex applications keeping pace with the changes in engineering requirements and manufacturing technology. The 1973 revision of Y14.5 began to recognize the advancements of electronic manufacturing systems. More recently, it has incorporated technical innovations making it compatible with electronic systems, such as Computer Aided Design (CAD), Computer Numerical Controlled (CNC), and Coordinate Measuring Machines (CMM), as well as computerized dimensional tolerance analysis systems. The producers of these systems have worked together to make the data produced in the CAD system "intelligent" and downstream compatible, requiring fewer man-hours for programming of the supporting systems. In line with this, ASME also has a companion standard, Y14.5.1M-1994, *Mathematical*



Definition of Dimensioning and Tolerancing Principles, which is in the process of being updated to incorporate changes made in Y14.5-2009.

With the greater emphasis on CAD in industry and the goal of producing an "intelligent" math model, new symbology was added to eliminate words or supplemental geometry to describe tolerance limits. For example, there is a new "ALL OVER" symbol to indicate a tolerance applies all over the part. An "UNEQUALLY DISPOSED PROFILE" symbol is used to indicate that a profile of a surface tolerance applies either fully inside or outside, or partially inside or outside of the material. Another new symbol is the "CONTINUOUS FEATURE" symbol used to indicate that a feature that is interrupted is to be considered as a single feature. The existing and new symbology is necessary for an intelligent math model where the symbols are consistently recognizable by CAD and downstream software. These symbols are but a few of the additions and improvements in the 2009 revision of Y14.5.

GD&T reduces guesswork throughout the manufacturing process, thus helping to improve quality, reduce costs, and shorten delivery times. The members of the Y14.5 subcommittee represent and interface with many industries and are aware of the technical developments that need to be recognized and easily toleranced using ASME Y14.5. They continuously strive to maintain the Standard as a "state of the art" and practical document.



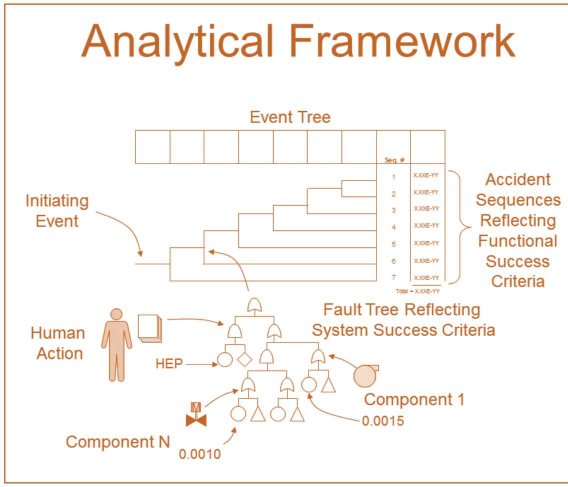
RISK MANAGEMENT FOR NUCLEAR FACILITIES

by Pamela F. Nelson, National University of Mexico, UNAM

SIMPLY PUT, RISK ANALYSIS ASKS THREE SIMPLE QUESTIONS: WHAT CAN GO WRONG? HOW LIKELY IS IT? WHAT ARE THE CONSEQUENCES?

ASME codes and standards have played a significant role in reducing the occurrence of component failures (which could have a serious impact on public safety) — the use of these documents support the design, construction, and operation of nuclear power plants and other facilities. ASME codes and standards are applied across all industrial sectors, especially the electric power industry. They are particularly evident in the nuclear power industry as they are important parts of meeting and maintaining safety margins. ASME recognizes that fabricating and erecting a nuclear power plant to code produces a plant that is safe and effective. However, it is recognized that operational events can still occur that can impact safety margins. Nuclear risk management is a discipline that identifies, analyzes, and quantifies the risks of hazards from operating a nuclear power plant over the life of the facility. In fact, risk management methods have been used in many other industrial sectors to understand their sources of risk and how best to prevent or mitigate them.

Nuclear risk management uses probabilistic risk assessment (PRA) and other engineering and probabilistic methods to understand the risk contributors, likelihood of occurrence and associated consequences. Risk analysis and associated risk management methods can be used to evaluate many different events and threats to safe, continuous operation. These risk contributors can range from external, weather-related events to events that can occur inside the plant itself. The analyses used to support these PRAs use past and present plant data and information to predict the likelihood of a risk contributor and the range of possibilities that can occur. Detailed PRAs dissect a plant into its various safety functions and other operational functions down to the component level to determine the overall reliability and availability of plant equipment. In this process a detailed systems analysis is performed to identify sources of equipment failures and unavailability. Plant specific equipment performance data is collected that is intended to reflect the as-built, as-operated plant. The logic models that are assembled are then integrated at the plant level to produce key performance measures, such as core damage frequency or frequency of production losses. In fact, these detailed models are considered "living" models as they are periodically updated and reflect the plant specific operational and maintenance practices of the facility. The use of probability methods enables one to produce a family of outcomes (called "probability distributions") that can indicate the impact of many events and their associated outcomes or consequences. Once a full PRA has been completed for a plant, many nuclear safety and plant reliability insights are produced. These insights range from improving understanding of important accident prevention actions, identifying equipment performance trends to improve equipment reliability, identifying human error issues, and prioritizing of facility design modifications and other plant enhancements. The ASME/American Nuclear Society Joint Committee on Nuclear Risk Management (JCNRM) is the consensus committee responsible for developing and maintaining PRA standards as applied to nuclear power plants. This committee consists of experts from around the globe in risk analysis as applied to known risk contributors for all phases of plant operation. Today's risk assessments have become important tools for decision-makers who own and operate complex engineered facilities like nuclear power plants. In the future, industrial facilities will operate for several decades and through the use of asset management may very well operate beyond their initial plant design life. Other areas where hazards exist and require further evaluation will be new areas for risk engineers to evaluate. Other industrial sectors such as aerospace and petrochemical sectors are also making more use of risk assessment and the associated operational insights that come with it. Engineers familiar and knowledgeable in risk analysis and risk management will be in more demand in future years as operational decisions and investment sdecisions become more heavily scrutinized in an ever increasing competitive global market.



TODAY'S RISK ASSESSMENTS HAVE BECOME IMPORTANT TOOLS FOR DECISION-MAKERS WHO OWN AND OPERATE COMPLEX ENGINEERED FACILITIES LIKE NUCLEAR POWER PLANTS

INSERVICE INSPECTION OF NUCLEAR POWER PLANT COMPONENTS

by Gary Park, Iddeal Solutions LLC

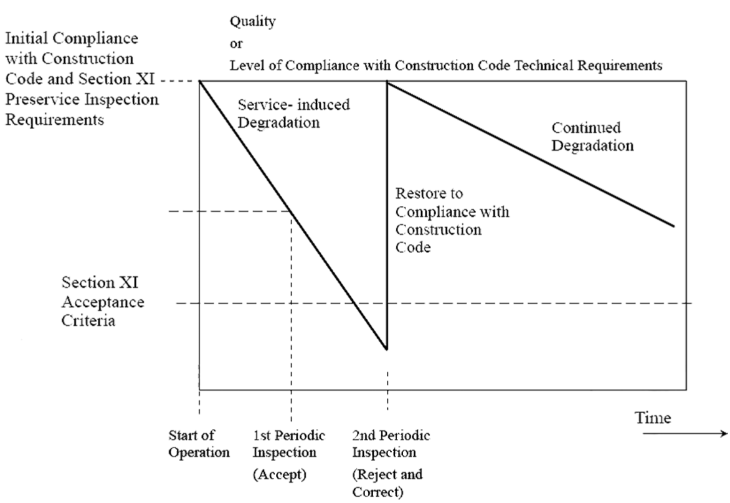
There are currently 99 nuclear power plants operating in the United States. Beside the operating nuclear power plants in the U.S., the following countries throughout the world have operating plants:

Argentina, Armenia, Belgium, Brazil, Bulgaria, Canada, China, Czech Republic, Finland, France, Germany, Hungary, India, Iran, Japan, Mexico, Netherlands, North Korea, Pakistan, Romania, Russia, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Ukraine, United Kingdom,

These plants must function in a manner that protects the public safety. The American Society of Mechanical Engineers (ASME) plays a key role in ensuring that they do.

Most U.S. nuclear power plants were built in the late 1960s and went online in the early to late 1970s. Initially, industry experts and government regulators thought the inspection practices used for fossil-fueled power plants could also be used for nuclear power plants, but they quickly discovered the need for inspection procedures specific to nuclear power plant designs. Section XI of the ASME Boiler and Pressure Vessel Code (BPVC), *Rules for Inservice Inspection of Nuclear Power Plant Components,* was the response to that need. It represented the joint efforts of the U.S. Atomic Energy Commission's regulatory organization [now called the Nuclear Regulatory Commission (NRC)] and the nuclear industry.

Periodic inspection of components is a fundamental part of maintaining a safely operating nuclear power plant. During construction of a plant, components are examined prior to installation to determine whether they are acceptable. Once the plant goes online, the components begin to age and degrade, and may eventually require repair or replacement. This degradation is detected by performing periodic examinations, as illustrated in the following figure:



In 1967, ASME initiated efforts to codify procedures for inspecting nuclear power plants components; those efforts culminated in a Section XI of the ASME BPVC, first published in 1970. Significant features of this Code include:

(1) the concept of designing the system to permit inspection and possible repairs

(2) the requirements of a complete examination prior to start-up to serve as a baseline for future examinations

(3) the acceptance of new inspection systems or techniques more amenable to remote application, provided such systems can be validated, and

(4) the establishment of inspection periods and levels of inspection for given components or sections of components based on the concepts of relative probability of degradation of the various portions of the systems and the significance of such degradation to the safety of the reactor system

Since the first issue of ASME BPVC Section XI, technological advancements have led to improved inspection methods. There are three methods of examination — visual, surface, and volumetric — and the type used depends on the safety significance of the component. Determining where in the plant to perform these examinations is also a key part of the inspection process. This can be done using risk evaluation techniques. Risk-informed techniques use a probabilistic risk assessment (PRA) to understand how the plant operations affect the safety of the nuclear power plant. PRA is defined as a qualitative and quantitative assessment of the risk associated with plant operation and maintenance that is measured in terms of frequency of occurrence of risk metrics, such as core damage or radioactive material release and its effects on the health of the public. Using PRA can focus the examinations on the areas of the plant most critical to safety.

The recent resurgence of the nuclear industry has brought new challenges. For example, the development of small modular reactors has created a demand for new processes to manage and maintain them. Reliability Integrity Management (RIM), currently being developed by BPVC XI, is one such process. The reliability of the nuclear plant and its systems and components is determined by the design, fabrication, inspection, surveillance, operation, and maintenance procedures used to build and operate that plant and its systems and components. In order for a nuclear plant to have a level of reliability that will satisfy both safety and economic goals, an appropriate combination of these contributors to reliability must be identified and implemented. The objective of the RIM program is to define, evaluate, and implement strategies to ensure that reliability targets for passive metallic components are defined, achieved, and maintained throughout the plant lifetime.

The NRC has incorporated ASME BPVC Section XI into the Code of Federal Regulations (CFR) Title 10, Part 50, which requires all U. S. operating nuclear power plants to develop inspection programs that meet the requirements contained therein.

The standards developed by the ASME BPV XI Committee reach well beyond the United States. They are being used throughout the world to maintain safety at operating nuclear power plants. This makes these standards unique: the examination, repair/replacement, and fracture mechanics evaluation techniques in Section XI can be applied to any reactor design.

As the nuclear industry moves forward, the ASME BPV XI Committee will continue to develop innovative ways of maintaining the safe operations of the current fleet of plants and those coming online in the future.

1 ASME Boiler and Pressure Vessel Code, Section XI, Nonmandatory Appendix R, Article R-9000, Glossary.

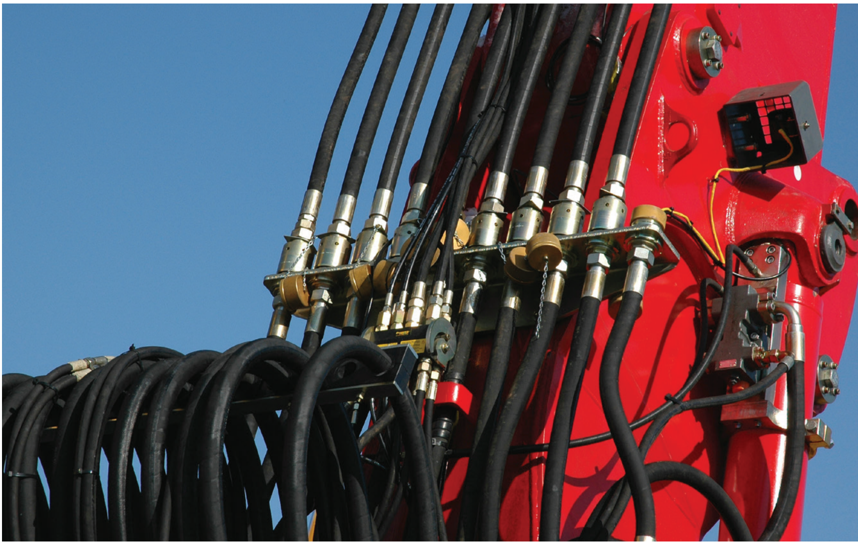
ASME B30 SAFETY STANDARD FOR CABLEWAYS, CRANES, DERRICKS, HOISTS, JACKS AND SLINGS – CRANES AND RIGGING IN EVERYDAY LIFE

By Brad Closson, Craft Forensic Service

TODAY, NOTHING SHORTER THAN 50 FEET GETS BUILT WITHOUT THE HELP OF SOME SORT OF CRANE AND RIGGING EQUIPMENT

You cannot go into any city without seeing buildings that rise high above, and you cannot go into any factory without seeing massive pieces of equipment turning out products. Today, nothing shorter than 50 feet gets built without the help of some sort of crane and rigging equipment, and nothing heavier than 100 pounds gets manufactured without using some sort of crane and rigging equipment. Further, the cell phone you talk on, the couch you sit on, the car you drive in, the road you drive on, the building in which you work, and thousands more items used daily were made using some sort of crane and rigging equipment. If it is big, heavy, or made in mass quantities, you can be assured that cranes, rigging, and the ASME B30 standards were somehow involved. Regardless of which slice of the mechanical engineering profession you focus on, you will be confronted with some need to consider cranes and crane operation safety, and you will want to use the best, most complete and user-friendly resource. Enter the ASME B30 standards. If you need to lift it, lower it, move it horizontally, or make it efficiently, you will need the information contained in the ASME B30 volumes.

Since 1916 ASME has been guiding the development of the crane and rigging equipment safety standards. This sustained effort in establishing the safe design and use of the cranes has helped make our industrialized society possible and workplaces safe. Starting with a single booklet, developed by nine people, and dealing with one configuration of crane, ASME's effort has grown into 29 volumes (each B30 standard designated an "American National Standard") that address over one hundred crane configurations and are worked on by over 150 experts from all sectors of equipment users, makers, regulators and interested persons.



With an ANSI "consensus" approach in their development, an 86-year history of considering the relevant issues and a process that publishes an entirely updated volume every three to five years, the B30 volumes are assured to be relevant to the industry in which they are used. The volumes currently produced by ASME are a singular resource for use by design engineers for facilities and tooling; contracting personnel for medium to heavy construction efforts; government agencies responsible for handling unique loads and special environments; regulatory bodies for developing laws for today's work force; and industry professionals for specifying the requirements for assuring competent and safe lifting equipment and lifting operations for their workers.

HOW PLUMBING STANDARDS CONTINUE TO PROTECT CIVILIZATION

By Milton N. Burgess, P. E., Milton N. Burgess FASPE

MANY ASME A112 STANDARDS ARE WRITTEN TO ENSURE WATER SYSTEMS REMAIN SAFE

What does a plumber in New York City have in common with one in Beijing, China? Quite a bit actually. In their daily work when they each install the flush valve (sometimes referred to as a ballcock) in most common two-piece toilets, regardless of where it is installed, the parts fit together the same. Although China and the U.S. do not have a formal agreement to harmonize standards between the two countries, China does utilize some ASME A112 Plumbing Equipment and Materials standards. As technology advances, so does the work of the ASME A112 committee. For example, with only one percent of the world's water available for seven billion people on earth, advances in waterless urinals, low flush toilets, low flow shower heads, and other water-saving manufacturing standards have been developed to keep pace with an ever-expanding population.

In this instance, the toilet may be a widely recognized toilet manufactured in the U.S., but is actually produced in China. The flush valve is manufactured according to ASME A112.19.5/CSA B125.10, and sold in both China and the U.S. The amazing story is that neither the New York City plumber nor the Beijing plumber has to be concerned about replacing the flush valve. The assumption is made correctly that it will fit and operate for its useful life.

And the "rest of the story" is that the development of ASME A112 standards employs a consensus-based process that considers input of all relevant stakeholders. The development process is open to public review at appropriate stages, and the actions of the development committee are documented and completely transparent. Since 1955 when ASME A112 was formed, this group has formulated and developed standards that regulate the manufacturing of plumbing materials and equipment used throughout the world. For example, the ASME A112.19.2/CSA B45.1 *Ceramic Plumbing Fixtures* standard is being used as a model not only in China, but in Brazil, Philippines and Singapore. In 2001 ASME A112 began harmonization efforts with the Canadian Standards Association (CSA) in accord with the North American Free Trade Agreement (NAFTA), which resulted in ASME/CSA standards that are used in both countries.

THE LACK OF SEPARATION BETWEEN HUMAN SEWAGE AND SAFE WATER IS A SOURCE OF RAVAGING DISEASE AND DEATH, ESPECIALLY AMONG CHILDREN

In some third-world countries where plumbing standards are non-existent, the lack of separation between human sewage and safe water is a source of ravaging disease and death, especially among children. Many ASME A112 standards are written to ensure water systems remain safe by maintaining that separation.

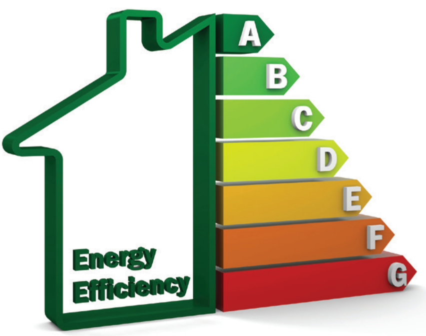
When a mother confidently turns on a shower valve to bathe a child, if the water pressure varies, the water will remain at the temperature she sets. ASME A112 standards guard life and health if they are applied during the manufacture of the valve, the system design and the construction. Scalding the child is preventable. But these standards do not carry the force of law unless they are listed in a model code such as the Uniform Plumbing Code or the International Plumbing Code, and then not until the local jurisdictions put a model code into statutory law to regulate the manufacture, design and construction of facilities used by consumers.

It is the ethical and moral responsibility of anyone connected with manufacturing plumbing equipment and materials and providing plumbing systems design and construction to be cognizant of the applicable standards available to them.

BOOST ENERGY EFFICIENCY OF INDUSTRIAL FACILITIES

by Ryan Crane, P. E., ASME

TO IMPROVE EFFICIENCY, ASME HAS PUBLISHED ENERGY ASSESSMENT STANDARDS AND ACCOMPANYING GUIDANCE DOCUMENTS



Efficiency of industrial systems contributes to a manufacturing facility's bottom line, improves reliability and better utilizes assets. But many industrial facilities continue to have unrealized system optimization potential. The lack of market definition for system energy efficiency assessment services prevents service providers from establishing market value for their services and consumers from determining the quality of such services.

To improve efficiency, ASME has published energy assessment standards and accompanying guidance documents that are designed to raise the bar by setting requirements for conducting an energy assessment at an industrial facility for different system types, such as compressed air, process heating, pumping and steam.

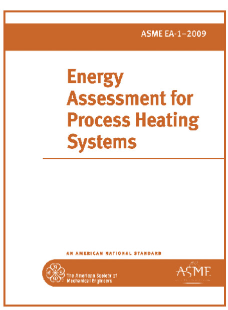
The standards address such topics as organizing and conducting assessments; analyzing the data collected; and reporting and documentation. Issues, challenges, and improvements to the standards arose from field testing by industrial facilities, consultants, and utilities, in which the requirements and guidance included in the standards were implemented during a trial-use period.

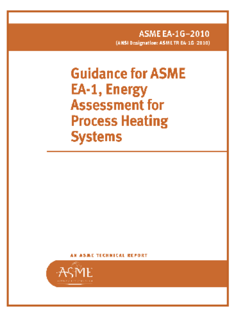
These efforts emerged from work on Superior Energy Performance (SEP), an initiative guided by the U.S. Council for Energy-Efficient Manufacturing, a voluntary partnership among U.S. industry, government, and other organizations. These requirements and guidance help plant personnel identify cost-effective and improved environmental performance, which often have limited capital requirements, and are key to the framework for assisting industry to meet the energy intensity improvement criteria of SEP.

A strong advocate and key contributor to this effort is the U.S. Department of Energy's Industrial Technologies Program (DOE/ITP), which has established a well-developed portfolio of system optimization resources and training for industrial motor, compressed air, fan, pump, steam, and process heating systems. This robust portfolio helps consultants and plant personnel quickly identify energy savings opportunities.

Other building blocks include such programs as the Compressed Air Challenge™, Pump Systems Matter™ (developed with support from the Hydraulic Institute), and resources and tools created at the state and regional level, such as Focus on Energy in Wisconsin and the Industrial Energy Efficiency Alliance in the Pacific Northwest.

Through collaboration among a cross-section of experts from government, laboratories, equipment manufacturers, consultants, and other organizations, these standards have proven to be a resource that is valuable for numerous industries and applications. Performing these assessments and identifying and implementing improvements not only saves the facility money but also significantly reduces the use of the world's energy resources and promotes a cleaner environment.





CODES AND STANDARDS AT A GLANCE

Why are there codes and standards...?

The Industrial Revolution profoundly changed the way people lived by introducing machinery that transformed daily life. Farm implements no longer had to be made by hand — they could be manufactured. Affordable manufactured goods of all kinds — textiles, dishware, reading material — have transformed home life. A coal-burning furnace and boiler could heat water in the home.

Transportation began to move at unimagined speeds, far exceeding that of a horse. Slowly, handmade items were being replaced with manufactured items; human strength and horsepower were being replaced by machinery driven by steam power — steam engines, boilers.

...Because it is a catastrophe when a screw does not fit.

The most serious problem facing 19th century engineers was exploding boilers. Heating water to produce steam and converting that steam into energy to power machinery revolutionized the production of goods. To build up pressure, steam must be contained in some type of vessel, but uncontrolled, pressurized steam can burst a vessel even if it's made of steel. For want of reliably tested materials, secure fittings, and proper valves, boilers of every description, on land and at sea, were exploding with terrifying regularity. (They would continue to do so into the 20th century.) Although engineers could take pride in America's strides in technology, they could not ignore the thousands dead and countless injured by such accidents. Thus, mechanical engineers in the 1880s began seeking reliable methods for testing steam boilers.

Lack of interchangeability was also becoming a problem. A consumer could not buy a bolt in California and use it on a nut acquired in New Jersey because the threading did not match. Therefore, the farm implement, shotgun, or pipe was rendered useless, unreliable, or dangerous.

When The American Society of Mechanical Engineers (ASME) was founded in 1880, discussion began immediately on establishing standards; it focused on shop drawing symbols, pulleys, line shafting, machine screws, key seats, and drawing boards. At its annual meeting in 1883, a committee on standards and gages was created, and a paper was presented urging the adoption of a set of rules for conducting boiler tests that could be accepted as a standard code of practice by engineers. The paper emphasized the prevailing lack of uniformity in which "every engineer who performs a boiler test makes a rule for himself, which may be varied from time to time to suit the convenience or interests of the party for whom the test is made."[1]

The result was the formation of a committee to study the subject of a uniform test code. In 1884 a test code for boilers was published; it was ASME's first standard. (Establishing a universally accepted construction standard would still take many years.) Shortly thereafter, the Society decided that pipes and pipe threads should also be standardized. The composition of this standards committee was "men representative of pipe manufacturers and pipe users, with perhaps one representative of sprinkling systems and certainly one of the manufacturers of taps and dies."[2] This balanced approach to committee composition became the norm for subsequent ASME standards committees.

1 The American Society of Mechanical Engineers, "Introduction to ASME Codes and Standards" (New York: The American Society of Mechanical Engineers, 2000). Unattributed source.

2 Safety: The foundation upon which economic value is built," Nuclear News, August 2001.

What is a standard?

A set of technical definitions, instructions, rules, guidelines, or characteristics set forth to provide consistent and comparable results, including:

- Items manufactured uniformly, providing for interchangeability
- Tests and analyses conducted reliably, minimizing the uncertainty of the results
- Facilities designed and constructed for safe operation

By custom, some standards are called codes.

Standards, not having the force of law, are considered voluntary and serve as guidelines. ASME publishes standards and certifies users of standards to ensure that they are capable of manufacturing products that meet those standards.

It also provides stamps that certified manufacturers affix onto their products to indicate that a product was manufactured according to the particular standard. ASME cannot, however, force any manufacturer, inspector, or installer to follow ASME standards. Their use is voluntary.

Why then are standards effective? The 1991 Annual Report of the American Society for Testing and Materials (ASTM) said it best: "Standards are the vehicle of communication for producers and users. They serve as a common language, defining quality and establishing safety criteria. Costs are lower if procedures are standardized; training is also simplified. And consumers accept products more readily when they can be judged on intrinsic merit." A standard may also be incorporated into a business contract.

What is the involvement of ASME in codes and standards today?

Since its creation in 1880, ASME and many other standards-developing organizations have worked to produce standards through a voluntary consensus process as the need increased. In addition to developing standards, ASME provides conformity assessment processes for use in industry. These help ensure that manufacturers comply with equipment specifications and that personnel are properly trained in specialized equipment operation.

ASME, American Society for Testing and Material (ASTM), Institute of Electrical and Electronics Engineers (IEEE), and the Society of Automotive Engineers (SAE) are four of the more than 200 volunteer organizations in the United States that follow the procedures accredited by the American National Standards Institute (ANSI) for the development of standards. These procedures must reflect openness, transparency, balance of interest, and due process.

ASME is one of the oldest and most respected standards-developing organizations in the world. It produces approximately 600 codes and standards covering many technical areas, such as boiler components, elevators, bioprocess equipment, pressure piping, cranes, hand tools, fasteners, machine tools, and verification and validation in computational modeling and simulation.

In general, ASME standards provide guidelines, procedures, and recommended practices for designing, operating, maintaining, and testing equipment and systems.

Codes, like the *ASME Boiler and Pressure Vessel Code and A17.1 Safety Code for Elevators and Escalators,* are linked with the interest of public safety and carry the force of law. More than 100,000 copies of the Boiler and Pressure Vessel Code are in use in 100 countries around the world, with translations in a number of languages.

How does ASME produce codes and standards?

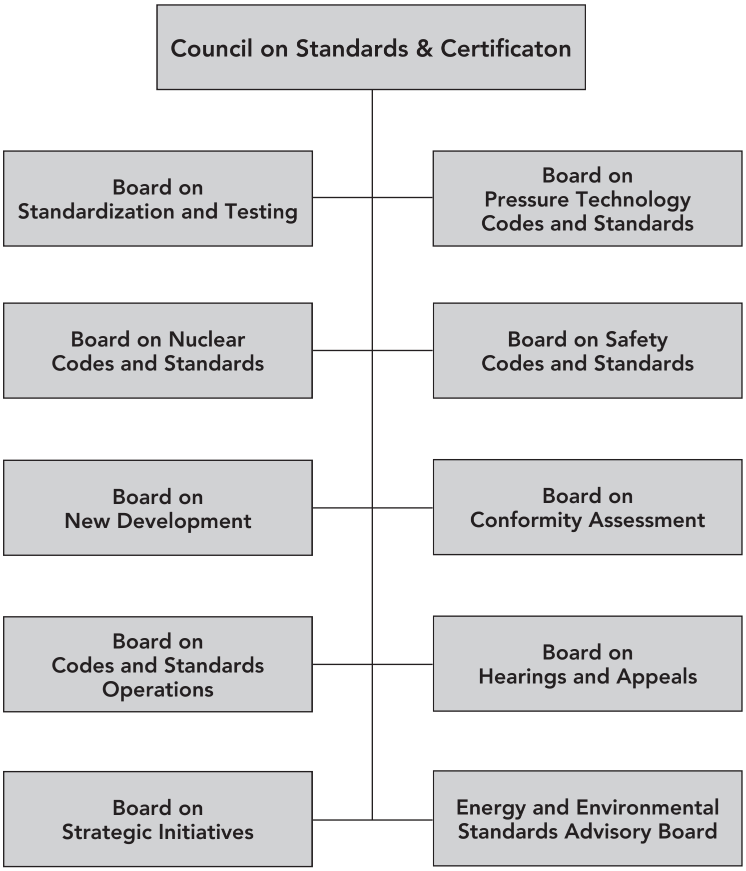
Contributors to the Society's codes and standards development process are mostly engineers who volunteer their valuable technical knowledge, resources, and expertise. Designers, constructors, manufacturers, inspectors, owners/operators, academia, consultants and representatives of regulatory agencies also participate on codes and standards committees. These committees continually revise and update codes and standards to reflect changes in procedures and technology.

Reflecting the Society's global strategy, ASME Standards and Certification promotes its activity in many international markets. ASME Standards and Certification collaborates with industry groups and governments from Mexico and South Korea to India and China. Through workshops, seminars, and other types of information exchange, ASME works to foster an understanding of the codes and standards process and to increase awareness of its programs and publications.

ASME's Council on Standards and Certification oversees six standards-developing supervisory boards and four advisory boards, which manage more than 100 committees and more than 4700 volunteer members (see figure on next page). The supervisory boards are responsible for pressure technology, nuclear installations, safety codes, standardization & testing, conformity assessment, and new development. The advisory boards deal with strategic initiatives, energy and environmental, hearings and appeals, and council operations.

ASME Standards Technology, LLC was established in August 2004 as a separate not-for-profit organization, with the mission of providing ASME's codes and standards committees with the technical basis necessary to develop new codes and standards for emerging technologies. ASME ST-LLC applies its core competencies of project management and administration to identify and conduct research projects that bridge gaps between technology development and standards development. Projects typically involve technology that has advanced beyond proof of concept and requires a focused evaluation to synthesize the knowledge gained from basic research and convert it into new code rules. ASME ST-LLC will typically depend on extensive basic research and development programs that have been performed by national, international, and university labs. The data, observations, and final reports from these research projects are reviewed for relevance as the technical basis for new code rules. The ultimate adoption of relevant consensus standards for emerging technologies helps overcome barriers to commercialization by establishing public confidence, permitting rapid and transportable workforce development, removing impediments to business, and enabling global trade.

STANDARDS AND CERTIFICATION ORGANIZATION



STANDARDS COMMITTEE AND PROCESS

Standards committees are composed of engineers and other interested parties with knowledge and expertise in a particular field. They represent users, manufacturers, consultants, academia, testing laboratories, and government regulatory agencies. The committee maintains a balance of members among the various interest classifications so that no one group dominates.

Committee volunteers agree to adhere to the ASME Policy on Conflict of Interest and the Engineer's Code of Ethics. Committee meetings must be open to the public, and procedures are used to govern deliberations and voting. All comments on technical documents during the approval process must be considered. Any individual may appeal any action or inaction of a committee relating to membership, or a code or standard promulgated by the committee.

Content is approved through consensus voting as defined by ANSI. Discussions are conducted at standards committee meetings, and votes are submitted online at ASME C&S Connect (http://cstools.asme.org). ASME developed C&S Connect, a web-based tool that allows volunteers from around the world to participate on ASME committees and provides a robust communication and process management solution for both proposal and balloting phases.

More than one vote may be necessary to resolve negative comments. If an individual member feels that due process was not observed, appeals may be made to the standards committee, supervisory board, and finally, to the Board on Hearings and Appeals.

Once consensus is reached, the proposed standard in draft form is submitted to a public review online. During the public review period, anyone may submit comments, to which the committee must respond. The draft is also submitted for approval to the supervisory board and to ANSI. When all comments and considerations have been satisfactorily addressed, the document is approved as an American National Standard and published by ASME. But the work does not end there; codes and standards are living documents that are constantly being updated, revised, and reissued to reflect new developments and technical advances.

CONCLUSION

Televisions, computers, hand tools, medical devices, elevators, boilers — virtually all modern mechanical devices involve one or more engineering standards in their manufacture. ASME is one of several professional and technical organizations that work together to maintain the machinery of the modern world.

The fact that the general public is unaware of their work is the best tribute to the success of their achievement — bringing stability to the systems of daily life through the production of voluntary codes and standards.

For an electronic copy of this brochure, visit
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