The leading role that ASME Codes and Standards play in the future development of Mechanical Engineering worldwide

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Abstract. *Having global standards becomes more and more important as companies merge 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, used to selling to just one market, now 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.

Key words: *ASME Codes & Standards, ASME's Council on Codes and Standards, American National Standards Institute (ANSI), ASME standards committees, Testing and Materials (ASTM)*

1. INTRODUCTION

For over 100 years, industries worldwide have depended on ASME for the promulgation of technically sound and state of art codes and standards. Participation by volunteer members in the standards development process, with the support of their employers, is the foundation of ASME Codes & Standards. In addition to making valuable contributions to industry, Codes & Standards participation also benefits the participants, their employers, and the general public.

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."

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." This balanced approach to committee composition became the norm for subsequent ASME standards committees

After the founding of ASME (1880), other societies and associations came into being that were to make a marked impact on the evolution of boiler codes and standards. One of these was the American Boiler Manufacturers' Association (ABMA), which was chartered in 1889. Its stated objective was to raise the standards of boiler design and manufacture, and prevent the production and sale of boilers unfit for safe operation. Initially committees were formed on materials, recommended tests and inspections, riveting, tubes, the attachment of valves and fittings, and setting. Three years later, ABMA appointed its first committee on uniform specification laws.

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 50,000 dead and 2 million injured annually 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 couldn't buy a bolt in California and use it on a nut acquired in New Jersey because the threading didn't match. Therefore, the farm implement, shotgun, or pipe was rendered useless, unreliable, or dangerous.

After a series of explosions in 1905 – 1906 (Figure 1), in 1907 the first Massachusetts Rules were approved. The document was short and simple, containing only 3 pages. The first was devoted to a facsimile of the standard format of the certificate of insurance. The second page covered fusible plugs and their performance characteristics, based on the earlier state requirements for these safety devices. The third page provided specific rules, which included, among others, limiting cast-iron boilers to a pressure of 25 psi, limiting boiler with cast-iron headers to 160 psi, and data governing the shearing strength of rivets.

The first edition of the ASME Boiler and Pressure Vessel Code, published in 1915, provided for a stamp to be affixed to every product constructed in accordance with the Code. Since its first edition in 1925, the ASME Unfired Pressure Vessel Code has been an important reference for designers and fabricators of pressure vessels. Its specifications now govern all unfired pressure vessels used in most states and all Canadian provinces.

Origin of the ASME B&PV Code ***Why we have B&PV Codes***

Fig. 1.1 The Brockton, Massachusetts shoe factory.

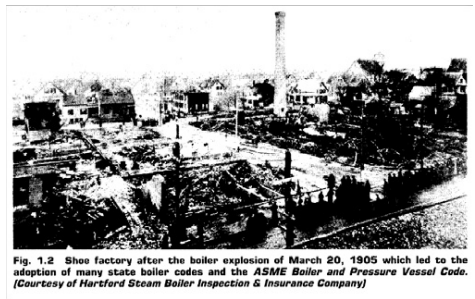

Fig. 1.2 Shoe factory after the boiler explosion of March 20, 1905 which led to the adoption of many state boiler codes and the *ASME Boiler and Pressure Vessel Code.* *(Courtesy of Hartford Steam Boiler Inspection & Insurance Company)*

Figure 1. March 10, 1905, when a fire-tube boiler in Brockton, Massachusetts, shoe factory exploded. The toll was 58 dead, 117 injured, and damages of one quarter of a million dollars.

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 the dominant standard, or to develop an umbrella standard that references other regional and national standards, or to develop a global consensus standard 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 last few years to include new construction materials, to address new topics, and to incorporate new calculation methods. As these changes continue to be introduced, globalization brings even more change, requiring greater flexibility and adaptation from industry.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities. The Code does not address all aspects of these activities and those aspects which are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase engineering judgment refers to technical judgments made by knowledgeable designers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code.

Engineering standards and codes are essential guidelines and norms that impact nearly every business sector from construction, manufacturing, acoustical and visual devices, dairy and livestock production, and energy production. ASME is an important resource for engineering professionals to find solutions to real world challenges. It works with other interdisciplinary engineering agencies to promote and coordinate standards development, approve national consensus standards and develop user acceptability for standards and codes.

Government agencies define industry standards and codes. Legislation controls the practices of the manufacturers that impact the environment, public health or worker safety. Standards ensure that companies, manufacturers and others adhere to accepted professional practices. Engineering regulations are defined by the government to ensure the public's protection and uphold ethical standards for professional engineers.

The quality systems of more than 4500 companies in more than 65 countries are currently accredited by ASME. Whether or not an ASME Code Symbol Stamp is legally required, it provides users with a high degree of confidence that the stamped items conform to established safety standards.

Distribution of companies certified to ASME Boiler and Pressure Vessel Code in Europe for 2010 is shown on Figure 2.

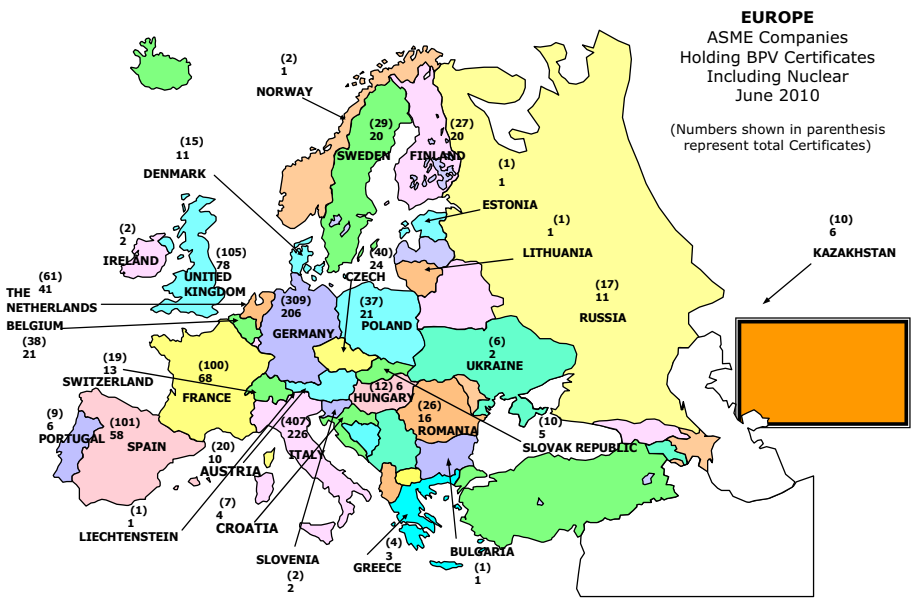

Figure 2. Europe ASME Companies Holding BPV Certificates.

2. ASME STANDARD

A standard can be defined as a set of technical definitions and guidelines that function as instructions for designers, manufacturers, operators, or users of equipment. Depending on the subject, a standard can run from a few pages to hundreds of pages, and is written by professionals in a particular technical field, who serve on an ASME committee.

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

It also provides stamps that accredited 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. It has been adopted by one or more governmental bodies and is enforceable by law, or when it has been incorporated into a business contract.

3. ASME CODE

A code is a standard that has been adopted by one or more governmental bodies and has the force of law, or when it has been incorporated into a business contract. ASME Code is the Standard for Pressure Retaining Components.

Today, the various boiler and pressure vessel stamps are recognized by most states and many foreign countries as indicative of products manufactured in compliance with the Code and under a quality program acceptable to the Society.

A manufacturer obtains permission to use one of the stamps through the ASME conformity assessment process. The manufacturer’s quality control system is reviewed by an ASME team. If it meets ASME requirements and the manufacturer successfully demonstrates implementation of the program, the manufacturer is accredited by ASME. The manufacturer then may certify the product as meeting ASME standards and apply the stamp to the product. A stamp consists of a modified cloverleaf (derived from the shape of the ASME logo) with one or more letters in the center (Figure 3).

Figure 3. The letters refer to the type of equipment and the applicable code.

The Code, which is issued once every three years, and from 2010 ones every two years is comprised of 28 separate volumes which establish rules of safety governing the design, fabrication and inspection of boilers and pressure vessels, including nuclear power systems.

4. THE BENEFITS OF PARTICIPATING IN ASME CODES & STANDARDS ACTIVITIES

For over 100 years, industries worldwide have depended on ASME for the promulgation of technically sound and state of art codes and standards. Participation by volunteer members in the standards development process, with the support of their employers, is the foundation of ASME Codes & Standards. In addition to making valuable contributions to industry, Codes & Standards participation also benefits the participants, their employers, and the general public.

4.1. BENEFITS TO PARTICIPANTS

Participants can have a significant influence on the direction and quality of Codes & Standards. Representation by many different organizations from around the world in the standards development process ensures that all interests are fully considered. Contributing to Codes & Standards committees is personally and professionally rewarding; these personal rewards include those derived from the following opportunities:

- Interacting with and learn from the foremost technical experts in a given field.
- Creating a personal network of contacts for valuable technical advice.
- Becoming aware of revisions to standards prior to publication
- Becoming aware of technical issues in the industry, and learning how others are dealing with them. Participants are able to avoid similar problems within their own organizations or prepare solutions in advance.
- Becoming intimately knowledgeable with the codes and standards used in a particular industry. Participants are able to be more thorough and confident in their application of code rules, leading to increased efficiency and the ability to get work done expeditiously.
- Realizing the satisfaction of having one's work incorporated into a globally recognized standard.
- Gaining experience in the arts of consensus building and teamwork.
- Learning how to run meetings that are productive and focused.
- Developing technical leadership skills by heading up a task group, subcommittee, or standards committee.
- Enhancing communication skills and the ability to persuade others in a technical forum.
- Broadening their understanding of other segments of their industry, both in the U.S. and globally.
- Receiving complimentary access to the ASME Codes & Standards related to committee work.
- Becoming familiar with the ASME Electronic Tools, including the C&S Connect portal for access to document and revision status, balloting, and more.
- Satisfying requirements for "continuing education" or "professional development hours" in some parts of the world.

4.2. BENEFITS TO SUPPORTING ORGANIZATIONS

Organizations realize direct and indirect benefits when they support the membership of their employees active in ASME Codes & Standards. These benefits include:

- Ensuring that the organization's interests, practices, and experience are thoroughly considered in developing and updating requirements in Codes & Standards.
- Reducing the risk that a code or standard will contain requirements that are incompatible with your products or services. This could help avoid costly design, fabrication, pattern, and tooling modifications, while gaining the ability to implement early compliance with critical requirements.

- Improving the business, technical, leadership and communication skills of the participants, which in turn increase their performance and contribution as employees.
- Ensuring that your organization is aware of revisions to standards and an understanding of the technical basis.
- Attaining early and ongoing awareness of technical issues in the industry and how others are dealing with them, permitting organizations to avoid these issues or prepare solutions in advance.
- Improving their employee's understanding of applicable Codes & Standards, allowing organizations to be more thorough and confident in their application of rules and leading to increased efficiency and reduced cost.
- Enhancing knowledge of ASME services.
- Gaining opportunities for shared participation in research and development.
- Realizing new benchmarking opportunities.
- Interacting with other technical experts from around the world.
- Providing input for related International Organization for Standardization (ISO) standards development in certain industries.
- Benefits to the Public
- Enhancing public health, safety and welfare.
- Reducing barriers to trade, reducing the cost of goods and services worldwide.

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5. SPECIFIC CASE ILLUSTRATIONS

- Changes in a standard have resulted in products that are less expensive and higher quality.
- "Special" requirements in company specifications have been reduced, resulting in improved service life and reduced cost all without reducing safety or reliability.
- Employing performance-based approaches within Codes & Standards have resulted in less costly changes to an organization's manufacturing process and to the cost of using the product.
- A pending change to a standard was incorporated into a new product line that resulted in virtually no extra cost to the organization.
- Design changes incorporated into new products, based on pending changes to a standard, have resulted in earlier product releases.
- Early knowledge of a new Code Case has saved organizations money on various projects.
- Solutions to many proprietary conflicts with Codes & Standards have been found through committee discussion

7. 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 for them increased. In addition to developing standards, ASME provides conformity assessment processes for use in industry. These help ensure both that manufacturers comply with equipment specifications and that personnel are properly trained in specialized equipment operation.

ASME, ASTM, and the Society of Automotive Engineers (SAE) are three 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 develops and maintains over 600 codes and standards that enhance public safety and enable learning and technical exchange opportunities that benefit the global engineering and technology community, covering many technical areas, such as boiler components, elevators, measurement of fluid flow in closed conduits, cranes, hand tools, fasteners, and machine tools.

ASME helps the global engineering community develop solutions to real world challenges. ASME is a not-for-profit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines, while promoting the vital role of the engineer in society. ASME codes and standards, publications, conferences, continuing education and professional development programs provide a foundation for advancing technical knowledge and a safer world.

8. HOW DOES ASME PRODUCE CODES AND STANDARDS?

ASME's Council on Codes and Standards oversees six standards-developing supervisory boards and four advisory boards, which manage more than 100 committees and 4000 volunteer members (Figure 2). The supervisory boards are responsible for pressure technology, nuclear installations, safety codes, performance test codes, conformity assessment, and standardization. The advisory boards deal with international standards, hearings and appeals, and council operations.

ASME formed the Codes and Standards Technology Institute (CSTI) in November 2001 to ensure that ASME standards committees are provided with a continuing source of research in the technologies that they cover. CSTI provides the research and technology development needed to establish and maintain the technical relevance of codes and standards. CSTI has its own Board of Directors, which also reports to the Council on Codes and Standards.

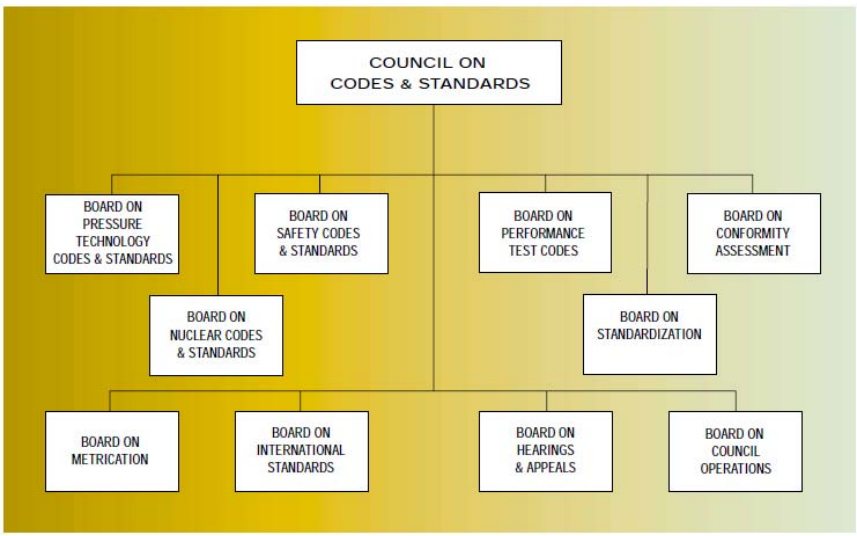

Figure 2. ASME organization chart.

The standards committee is 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 are 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.

Once consensus is reached, the proposed standard in draft form is submitted to a public review online. Anyone may submit comments during the public review period, 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 doesn't end there; codes and standards are living documents that are constantly being updated, revised, and reissued to reflect new developments and technical advances.

9. 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.

Recent developments in international trade that affect the use of codes and standards for pressure equipment are making manufacturers increasingly uncertain about how to conduct business internationally. This presents an opportunity for ASME Codes and Standards because manufacturers will have to use other standards. Already, many of them are turning to the ASME Boiler and Pressure Vessel Code for that purpose. Some of the most dynamic changes in pressure equipment manufacturing are occurring in Europe. Many European companies participate in major international projects, often requiring the application of ASME Codes and Standards or authorization obtaining for the project based on certification according to the ASME Code Stamps. It is time Bulgarian companies working in the field of Mechanical Engineering to be involved in this process with purpose to increase their competitiveness on the world market.

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Докладът е рецензиран.