
CHAPTER 1

CODES AND STANDARDS

This chapter describes the codes and standards used and referenced most often that affect the materials, design, and installation of the service and utility systems described in this handbook.

GENERAL

Codes relating to piping provide specific design criteria such as allowable materials, working stresses, seismic loads, thermal expansion, and other imposed internal or external loads as well as fabrication, installation, and testing for many aspects of a total piping system. Code compliance is mandated by various federal, state, and local agencies that have jurisdiction and enforcement authority. Each code has precisely defined limitations on its jurisdiction. Familiarity with these limitations can be obtained only after a thorough reading of the code.

These codes often refer to standards prepared by nationally recognized organizations. The term *nationally recognized* is defined as a group or organization composed of a nationwide membership representative of its members' views. To achieve nationally recognized status, an association must have been in existence for a reasonable period of time, be active in research and other issues relating to its area of interest, and be generally regarded by its peers to be scientifically accurate.

Standards provide specific design criteria and rules for specific components or classes of components such as valves, joints, and fittings. Dimensional standards provide control for components to assure that components supplied by different manufacturers are physically interchangeable. Pressure integrity standards provide performance criteria so that components supplied by different manufacturers will function and be service rated (pressure and temperature) in a similar manner. Standards compliance is usually required by construction or building codes or purchaser specifications.

In any piping system design, if different code requirements are discovered, the most stringent requirements must be followed.

The applicability of various codes and standards must be ascertained before the start of a project, because submission of plans is often required for approval prior to construction and installation of the piping systems. This requires a code search and consultation with the various authorities having jurisdiction.

Fire insurance carriers are another consideration in the area of standards. They very often have more restrictive requirements than the building and construction codes that are normally applicable to every project, particularly in the area of water supply storage and distribution for fire protection purposes, which may be combined with the domestic water system.

AMERICAN GAS ASSOCIATION (AGA)

The AGA advances the safe, economical, and dependable transport of gas to the public. In conjunction with the NFPA, it publishes NFPA-54, the Fuel Gas Code.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI serves as the national coordinating institution for voluntary standardization and related activities in the United States. Through ANSI, organizations concerned with such activities may cooperate in establishing, improving, and approving standards and certification that such activities remain dynamically responsive to national needs and prevent duplication of work. ANSI's goals are to further the voluntary standards movement as a means of advancing national economy and benefiting public health, safety, and welfare; to facilitate domestic and international trade; to assure that the interests of the public, including consumers, labor, industry, and government, have appropriate protection, participation, and representation in standardization and certification; to provide the means for determining the need for new standards and certification programs; to assure activities by existing organizations competent to resolve the need; to establish, promulgate, and administer procedures and criteria for recognition and approval of standards as American National Standards and to encourage existing organizations and committees to prepare and submit such standards for approval by the institute; to cooperate with departments and agencies of the federal, state, and local governments in achieving optimum use of ANSI in regulation and procurement; and to serve as a clearinghouse for information on standards and standardization, certification, and related activities in the United States and abroad.

AMERICAN PETROLEUM INSTITUTE (API)

This organization affords a means to cooperate with the government in all matters of national concern relating to American petroleum products; to foster foreign and domestic trade in American petroleum products; to promote in general the interests of all branches of the petroleum industry; to promote the mutual improvement of its members and the study of the arts and sciences connected with the petroleum industry.

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS (ASHRAE)

The purpose of ASHRAE is to advance the art and science of heating, ventilation, and air conditioning and allied arts and sciences, as well as related human factors for the benefit of the general public. To fulfill its role, the society recognizes the effect of its technology on environmental and natural resources.

AMERICAN SOCIETY OF PLUMBING ENGINEERS (ASPE)

The purpose of this organization is to develop and disseminate technical information in the field of engineered plumbing systems and to provide a forum for exchange of this information with other technical and construction code organizations.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM's objectives are to develop full consensus standards for the characteristics and performance of various materials, products, standards, and services; to develop and publish information designed to promote the understanding and advancement of technology; and to ensure the quality and safety of products and services.

ASTM has developed standards that consist of 67 volumes divided into 16 sections. Each volume is published annually to incorporate new standards and revisions.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME promotes the arts and sciences connected with engineering and mechanical construction for scientific purposes.

The ASME publishes the two principal codes used in facility systems: the Boiler and Pressure Vessel Code and ASME B31 series, Code for Pressure Piping. The Code for Pressure Piping has the following published sections:

B31.1. Power Piping

B31.3. Chemical Plant and Petroleum Refinery Piping

B31.4. Liquid Transpiration Systems for Hydrocarbons, Liquid and Petroleum Gas, Anhydrous Ammonia, and Alcohols

B31.5. Refrigeration Piping

B31.8. Gas Transmission and Distribution Piping

B31.9. Building Services Piping

B31.11. Slurry Transportation Piping

AMERICAN SOCIETY OF SANITARY ENGINEERS (ASSE)

ASSE promotes the welfare, health, and safety of the public through better sanitary engineering principles.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

The purpose of the AWWA is to promote public health, safety, and welfare by improving the quality and increasing the quantity of water delivered to the public and to further an understanding of the problems involved by:

1. Advancing the knowledge, design, construction, operation, water treatment, and management of water utilities
2. Developing standards for procedures, equipment, and materials used by public water supply systems
3. Advancing the knowledge of problems involved in the development of resources, production, and distribution of safe and adequate water supplies
4. Educating the public on the problems of water supply and promoting a spirit of cooperation between consumers and suppliers in solving problems
5. Conducting research to determine the causes of the problems of providing a safe and adequate water supply and proposing solutions in an effort to improve the quality and quantity of the water supply

AMERICAN WELDING SOCIETY (AWS)

The purpose of the AWS is to encourage in the broadest sense the advancement of welding, to encourage and conduct research in sciences related to welding, and to engage and assist in the development of sound practices for the application of welding and related processes.

COMPRESSED GAS ASSOCIATION (CGA)

The CGA is a trade organization that writes and publishes guides, in the form of pamphlets, that include all aspects of compressed gas storage, distribution, and purity.

CURRENT GOOD MANUFACTURING PRACTICE (cGMP)

cGMP is a regulation established by 21 CFR 210 and 211 in the Federal Food, Drug, and Cosmetic Act. It establishes minimum good practices for methods, controls, facilities, manufacturing, processing, and packing of items to assure they meet the requirements covered by the act. Enforcement is provided by the FDA.

cGMP has no strict guidelines and is completely subject to reviewers of the FDA. It is intended to detail what must be done rather than how. The manufacturers must establish the durability and safety to the public of all products, and prove they meet the purity and efficacy characteristics that they represent to possess by application to the FDA.

CODE OF FEDERAL REGULATIONS (CFR)

The Code of Federal Regulations is the collection of the general and permanent rules and regulations originally published in the Federal Register by agencies of the federal government. There are 50 separate titles that are revised once a year. The most up-to-date information will be found in the Federal Register on a daily basis until revision is made to the CFR.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Created in 1970, the EPA is the government organization responsible for the prevention of pollution to the environment. The EPA creates national pollution standards and criteria, creates compliance and enforcement plans, and performs research and development for identifying pollution-related risks. Criminal enforcement is also within the jurisdiction of the EPA.

FOOD AND DRUG ADMINISTRATION (FDA)

The FDA is a government agency originally created by the Federal Food, Drug, and Cosmetic Act and charged with the responsibility to see that all drugs are safe, effective, and properly labeled. The regulation implementing its authority is 21 CFR 211.

ISO 9000

ISO is the English translation of the International Organization for Standardization based in Geneva, Switzerland. ISO consists of national standards organizations from approximately 100 countries throughout the world. The United States is represented by ANSI. Internationally recognized and accepted standards are required to establish a minimum level of consistency and standard of quality (quality assurance) for any product to be sold internationally. These are called ISO 9000 standards. Conformance with these standards is assured by audit, inspection, and review from third-party organizations, called registrars, which receive their accreditation through individual countries' accreditation bodies, approved by the ISO.

ISO standards are voluntary between members and are not a legal requirement. They assure that a manufacturer has a quality assurance system in place and that the procedures are written, documented, and observed by all employees. The ISO 9000 series consists of five quality standards:

1. *ISO 9000, ANSI/ASQC Q90* defines the terms and presents principal quality management and quality assurance practices used in the ISO 9000 series of standards and establishes guidelines for their selection and use. This standard is applicable to all industries.

2. *ISO 9001, ANSI/ASQC Q91* establishes models for quality assurance in the design, development, production, manufacture, installation, and service sectors of

an organization. This standard, which is the most comprehensive of the three external quality assurance standards, is applicable to organizations that develop and produce their own products. This also applies to construction and engineering services.

3. *ISO 9002, ANSI/ASQC Q92* establishes models for quality assurance in production and installation. This standard is applicable to service industries and manufacturers that produce designs and specifications for other organizations.

4. *ISO 9003, ANSI/ASQC Q93* establishes models for quality assurance during final inspections and testing. This standard is applicable to testing laboratories, small shops, divisions within a firm, and equipment distributors that inspect and test supplied products.

5. *ISO 9004, ANSI/ASQC Q94* establishes internal organization management guidelines for design and implementation of quality systems; it is applicable to all industries.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

The purpose of OSHA, a division of the Department of Labor, is to establish regulations that control and promote safety in the workplace. These regulations primarily concern the manufacturing, construction, transportation, and agricultural industries. OSHA also determines permissible exposure limits for chemicals and establishes norms for safety and monitoring procedures where workers are exposed to hazardous and toxic chemicals. These regulations require that all chemicals and hazardous materials be labeled and defined by material safety data sheets (MSDS).

MODEL REGIONAL BUILDING CODES

There are six regional building codes that along with their associated plumbing, mechanical, and fire protection codes have found general acceptance over various large areas of the country. They are:

1. *Building Officials Code Authority (BOCA)*. Plumbing Code: BOCA National Plumbing Code
2. *International Association of Plumbing and Mechanical Officials (IAPMO)*. Plumbing Code: Uniform Plumbing Code
3. *National Association of Plumbing-Heating-Cooling Contractors (PHCC)*. Plumbing Code: National Standard Plumbing Code
4. *Southern Building Code Congress International (SBCCI)*. Plumbing Code: National Standard Plumbing Code
5. *Council of American Building Officials (CABO)*. One and Two Family Dwelling Code
6. *International Conference of Building Officials (ICBO)*. Plumbing Code: Uniform Plumbing Code

MANUFACTURERS STANDARDIZATION OF THE VALVE AND FITTINGS INDUSTRY (MSS)

The MSS is a technical industry association organized for the development and improvement of industrial, national, and international codes and standards for valves, valve actuators, pipe fittings, flanges, pipe hangers, and seals. Society membership is composed of companies involved in the manufacture of these products. This society is recognized as the technical counterpart of the Valve Manufacturers Association and the American Pipe and Fittings Association, two nationally recognized trade associations.

Development of standards is a major part of its activities. The MSS provides technical assistance to other standards writing bodies in need of the expertise provided by its members. Many standards developed by MSS have been adopted as national standards, referenced by many codes.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA is a nonprofit trade organization that establishes standards for motors, motor dimensions, and enclosures and sets minimum performance standards for many electrical devices.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

The NFPA (also abbreviated NFPA to avoid conflict with the National Fluid Power Association) is a scientific and educational organization concerned with the causes, prevention, and control of destructive fire. Its purpose is to facilitate and encourage information exchange and to enhance the standards development process by providing the broadest possible forum for the consideration of proposed fire safety standards.

The NFPA is the principal source of consensus fire protection standards and codes. These codes and standards are written by voluntary technical committees and have been recognized by their adaptation and reference by statutory and regulatory law at all levels of government. More than 250 separate standards and codes have been published and are codified in the volumes of the *National Fire Codes*.

NATIONAL INSTITUTES OF HEALTH (NIH)

The NIH, a division of the Public Health Service, is a government agency responsible for biomedical research and science. It is one of eight agencies, comprising 24 separate institutes, centers, and divisions each devoted to a separate disease or disease group. Its mission is to discover new knowledge, conduct and fund research, and train research personnel.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

Established as part of the Department of Commerce, NOAA monitors and predicts the state of the solid earth, the oceans and their living resources, the atmosphere, and the space environment of the earth and assesses the socioeconomic impact of natural and technological changes on the environment.

NOAA publishes various types of scientific and technical information. Of primary importance to facilities are technical memoranda, which report on research and technology results, and the atlas, which presents analyzed data generally in the form of maps showing distribution of rainfall.

NUCLEAR REGULATORY COMMISSION (NRC)

Created in 1975, the NRC is the government agency responsible for protecting the public health and safety relating to the use and disposal of nuclear material. The NRC regulates all industrial, commercial, and institutional uses of nuclear material including power plants. Services include the establishment of standards and regulations for the use and disposal of nuclear material, licenses for the use of nuclear material, and inspection of users to assure compliance with the applicable rules and regulations and the terms of individual license agreements. The NRC also provides services to states when a request is made and regulatory criteria and regulations are in place.

NATIONAL SANITATION FOUNDATION, INTERNATIONAL (NSF)

The NSF is an independent, not-for-profit organization of scientists, engineers, and educators. It is a neutral agency serving government, industry, and consumers in achieving solutions to problems relating to public health and the environment. Services include development of consensus standards, voluntary product testing, and certification of products in conformance with NSF standards.

In general, compliance with NSF standards is required for any material or component that is intended to process or prepare food, clean food-processing equipment, or carry potable water.

UNDERWRITERS LABORATORIES (UL)

Underwriters Laboratories is an independent, public service corporation, originally founded in 1968 by the life insurance industry.

Its purpose is the promotion of public safety through scientific investigation, study, experiments, and tests to determine the relative safety of various materials, devices, products, equipment, constructions, methods, and systems.

UL develops specifications and standards for materials, products, and equipment affecting the safety of the public. It tests items to conform with nationally recognized standards, and approves such items if acceptable.

3-A STANDARDS

3-A Standards have been prepared by three organizations with input from the Public Health Service:

1. International Association of Milk, Food, and Environmental Sanitarians
2. The Milk Industry Foundation
3. Dairy and Food Industries Supply Association

In an abbreviated form, the standard mandates the following:

1. Material of construction shall be 18-8 stainless steel with a carbon content of not more than 12 percent, or of a material of equal corrosion resistance.
2. Thickness or gauge of the material shall be sufficient for the purpose intended.
3. Surfaces in contact with product shall have a number 4 finish or smoother. This is the equivalent of an 80 to 150 grit finish, or an Ra value of 20 to 25 microns (μin).
4. No threads shall contact product.
5. Square corners shall be avoided.
6. Piping shall be sloped to drain properly.
7. Design shall permit interchangeable parts.

Many pharmaceutical applications, particularly for pure water systems, are required by cGMP to exceed these requirements. This requires that metal surfaces be polished to a 150 to 240 grit (32 to 18 μin) finish to eliminate bacterial growth.