Codes and Standards

In professional work after graduation engineers start to refer more to codes and standards rather to text books which you used to study during academic study

BAHER ELSHEIKH

Codes and Standards

Codes

Generally the top-tier documents, providing a set of rules that knowledgeable people recommend for others to follow that specify the minimum acceptable level of safety for manufactured, fabricated or constructed objects.

Code is a standard adopted by one or more governmental bodies and can be enforced by law

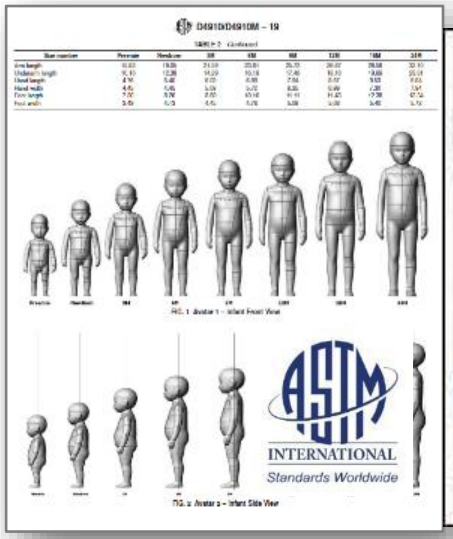
Example: ASME BPVC, ASME B31, API 650, BS, DIN, … etc.

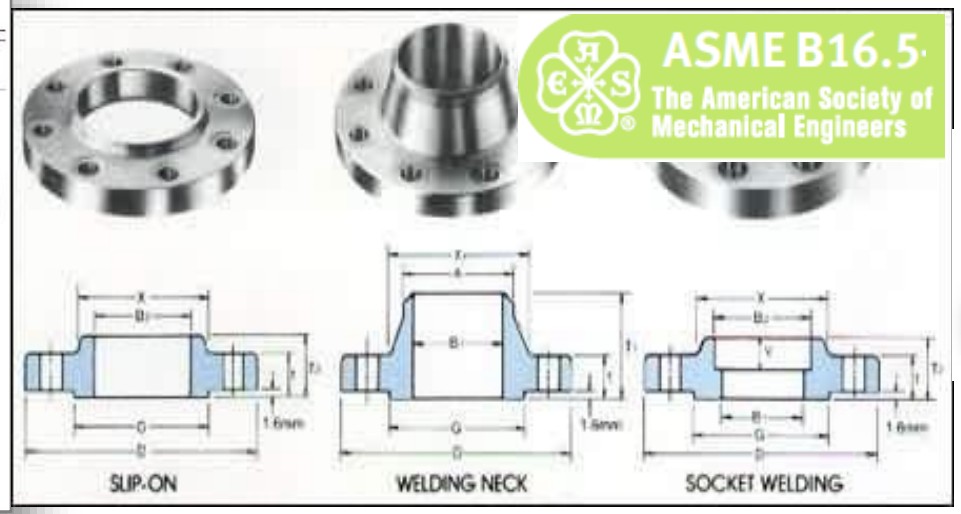
Standards

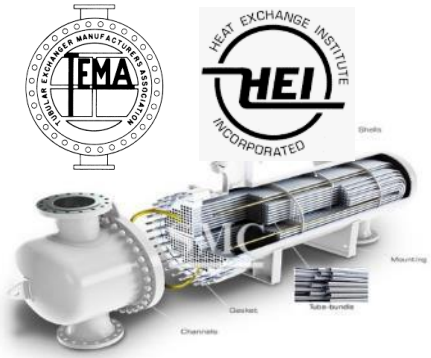
Documents that establish engineering or technical requirements for products, practices, methods or operations.

Examples: ASTM, ISO, API, MSS, NACE, NFPA, ANSI, TEMA, HEI, ……

ASTM D4910 *(Standard Tables of Body Measurements for Children, Infant Sizes); ASME B16.5 (Flanges dimensions)*







TEMA
HEI
ISO International Organization for Standardization
ASME SETTING THE STANDARD
ANSI American National Standards Institute
API American Petroleum Institute
NFPA
NACE INTERNATIONAL
DIN Deutsches Institut für Normung

Regulations, Specifications and Recommended Practices

Regulations

Generally issued by a state or federal agency when public safety is an issue.

Specifications

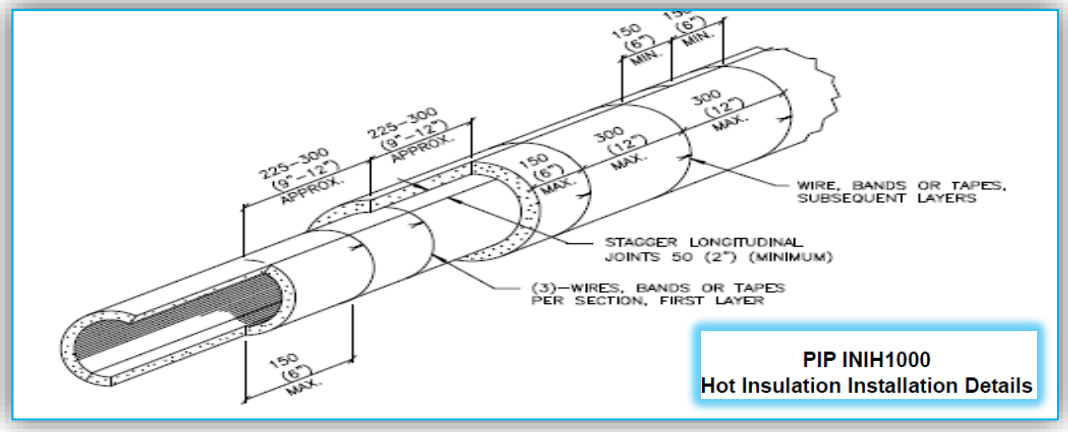
Provide specific requirements for materials, components or services and are often generated by private companies to address additional requirements for design and service.

Company specifications; Shell, Aramco, BP,…

Recommended Practices

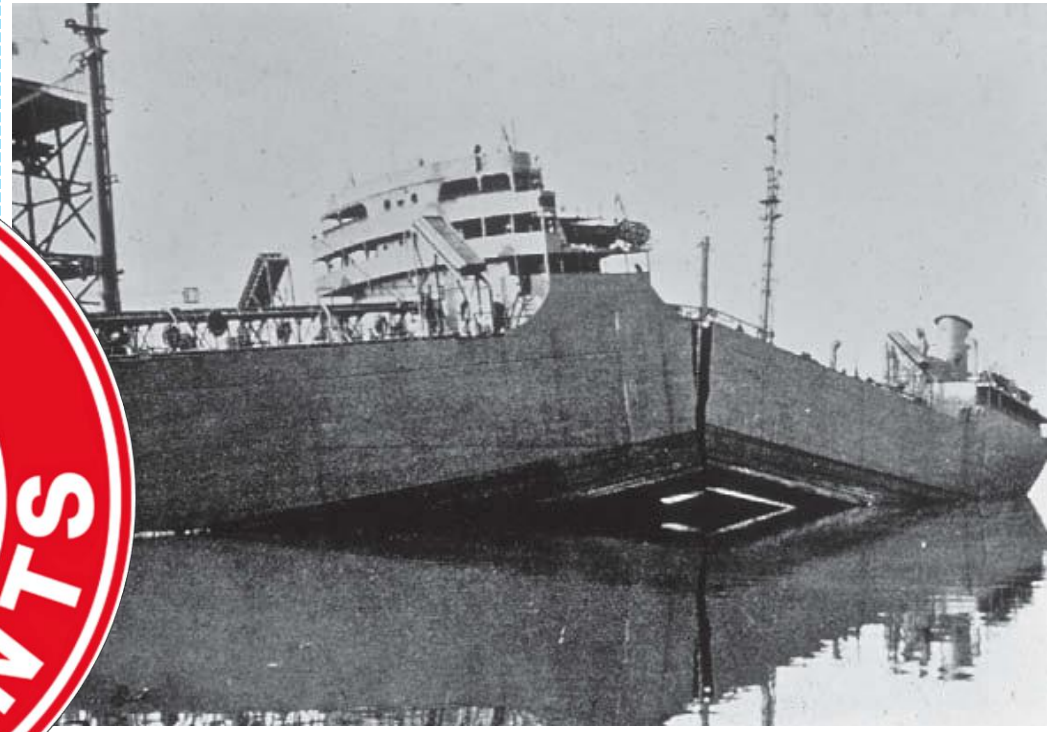
Recommended practices are the documents prepared by a professional group, committee, or company based upon good engineering practices held in the industry. In order to have consistency in design and avoid having one project differ from others for cost-effective.

PROCESS INDUSTRY PRACTICES



Why Codes and Standards Required

In the 19th century there were literally thousands of boiler explosions in the United States and Europe, some of which resulted in many deaths



Failure of many of the World War-II Liberty ships is dramatic example of the brittle fracture of steel that was thought to be ductile.

Why Codes and Standards Required

Provide and ensure minimum acceptable limits of safety and quality

The local government shows the green signal only if the plant is designed under the published codes and standards

It creates a similarity and consistency in engineering

Standardization to the way of working

It minimizes mismatching and promote the interchangeability

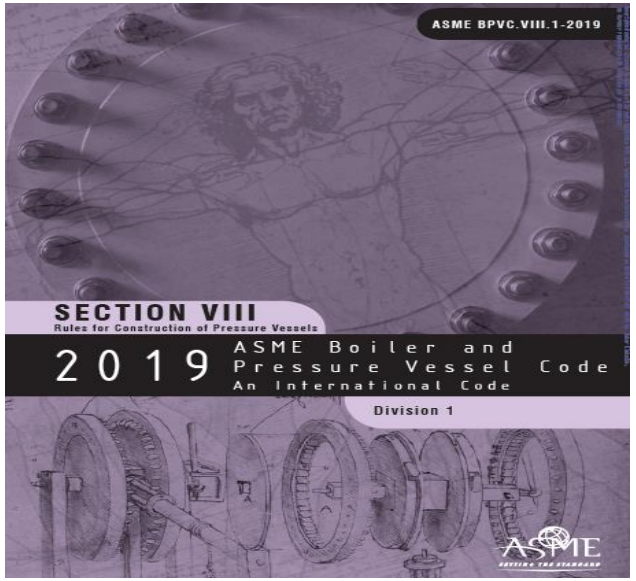
Requirements of Codes and Standards

- Suitable for repetitive use
- Enforceable, should be worded so that auditing person can point out where it has or has not been followed
- Definite, requirements should be expressed as specific instructions and never as explanations.
- Realistic, Requirements that are unrelated, excessive, or more restrictive than necessary should not be included
- Clear, Express the requirements in easily understood language that is not ambiguous
- Complete, All areas open to question or interpretation (or misinterpretation) should be covered
- Requirements should be technically correct and accurate and cover only those properties that are subject to control

ASME BPVC

The ASME Boiler and Pressure Vessel Code (BPVC) was conceived in 1911 out of a need to protect the safety of the public. This need became apparent shortly after the conception of the steam engine in the late 18th century.

12 sections and section 13 for PRD published in 2021 for the first time



SEC. I	Power Boilers
Sec II	Materials
Sec III	Rules for Construction of Nuclear Facility Components
Sec IV	Rules for Construction of Heating Boilers
Sec V	Nondestructive Examination
Sec VI	Rules for the Care and Operation of Heating Boilers
Sec VII	Guidelines for the Care of Power Boilers
Sec VIII	Rules for Construction of Pressure Vessels
Sec IX	Welding, Brazing, and Fusing Qualifications
Sec X	Fiber-Reinforced Plastic Pressure Vessels
Sec XI	Inservice Inspection of Nuclear Power Plant Components
Sec XII	Construction and Continued Service of Transport Tanks

ASME Pressure Piping Codes – B31

ASME B31.1 Power Piping ASME B31.1 Code is mainly used for the design and construction of power piping of Electric Power Generating Stations, Industrial & Institutional Plants, Geothermal Heating Systems, and Central & District Heating and Cooling Systems.

ASME B31.3 Process Piping ASME B31.3 Code is mainly applicable to the design and construction of pressure piping found in Petroleum Refineries, Chemical plant, Pharmaceutical, Food, Textile, Paper, Paint, Cryogenic, and any Process Plants and Terminals.

ASME B31.4 Hydrocarbon Transportation Pipeline ASME B31.4 Code is applicable for the pipelines that are used to transport liquids between plants, terminals, and pumping regulating stations. These liquids include crude oil, condensate, natural gasoline, liquefied petroleum gas, carbon dioxide, liquid alcohol, and liquid petroleum products. For example the pipeline from upstream to midstream or downstream.

ASME B31.5 Refrigeration Piping and Heat Transfer Components ASME B31.5 Code is applicable for the design and construction of pressure piping containing refrigerants or coolants. It is mainly used for HVAC piping system.

ASME Pressure Piping Codes- B31 – Cont’

ASME B31.8 Gas Transportation and Distribution Piping Systems ASME B31.8 Code is applicable for gas transportation pipelines between the sources and terminals. It also applies to gas pipelines, gas compressor stations, gas metering & regulation stations.

ASME B31.9 Building Services Piping ASME B31.9 Code is used for the design and construction of piping found in Industrial, Institutional, Commercial, Public Buildings, and multi-unit residences which do not require the different range of pipe sizes.

ASME B31.11 Slurry Transportation Piping Systems ASME B31.11 Code is mainly applicable to transport slurry of non-hazardous materials, such as coal, mineral ores, and other solids, between the slurry process plants and process piping system. One of the important uses of these pipelines is in the mining industries to move ores from the mines to elsewhere.

ASME B36 – Pipe Dimensions

ASME B36.10M — Welded and Seamless Wrought Steel Pipe

ASME B36.19M — Stainless Steel Pipe

Q 3 ASME B36.10M can be used to specify required thickness /schedule for stainless steel pipe

a. YES

b. NO

ASME B16 – 4 Groups

1. Valves

ASME B16.10

ASME B16.34

ASME B16.44

ASME B16.33

ASME B16.38

ASME B16.40

2. Flanges

ASME B16.5

ASME B16.36

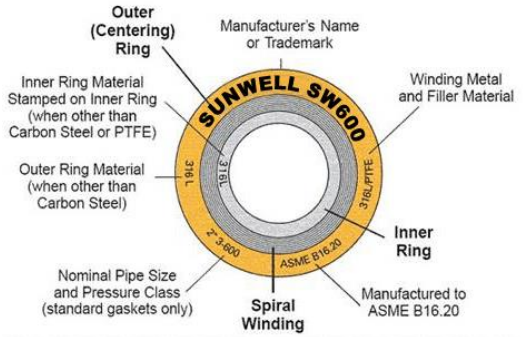
ASME B16.47

ASME B16.48

3. Gaskets

ASME B16.20

ASME B16.21



3. Fittings

ASME B16.1
ASME B16.3
ASME B16.4
ASME B16.9
ASME B16.11
ASME B16.12
ASME B16.14
ASME B16.15
ASME B16.18
ASME B16.22
ASME B16.23
ASME B16.24
ASME B16.25
ASME B16.26
ASME B16.29
ASME B16.39
ASME B16.42
ASME B16.49
ASME B16.51

API – Pressure Vessels

API 510

Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair, and Alteration

Covers the in-service inspection, repair, alteration, and rerating activities for pressure vessels and the pressure-relieving devices protecting these vessels. This inspection code applies to most refining and chemical process vessels that have been placed in service.

API RP 572

Inspection Practices for Pressure Vessels

Supplements API 510 by providing pressure vessel inspectors with information that can improve skills and increase basic knowledge of inspection practices. This recommended practice (RP) describes inspection practices for the various types of pressure vessels (e.g. drums, heat exchangers, columns, reactors, air coolers, spheres) used in petroleum refineries and chemical plants

API – Piping Systems

API 570

Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems

Covers inspection, rating, repair, and alteration procedures for metallic and fiberglass reinforced plastic (FRP) piping systems and their associated pressure relieving devices that have been placed in service. This inspection code applies to all hydrocarbon and chemical process piping

API RP 574

Inspection Practices for Piping System Components

Supplements API 570 by providing piping inspectors with information that can improve skill and increase basic knowledge of inspection practices. This recommended practice describes inspection practices for piping, tubing, valves (other than control valves), and fittings used in petroleum refineries and chemical plants.

API – Fired Heaters

API Std 530 — Calculation of Heater-Tube Thickness in Petroleum Refineries

Specifies the requirements and gives recommendations for the procedures and design criteria used for calculating the required wall thickness of new tubes and associated component fittings for fired heaters for the petroleum, petrochemical, and natural gas industries.

API RP 538 — Industrial Fired Boilers for General Refinery and Petrochemical Service

Specifies requirements and gives recommendations for design, operation, maintenance, and troubleshooting considerations for industrial fired boilers used in refineries and chemical plants. It covers waterside control, combustion control, burner management systems (BMSs), feedwater preparation, steam purity, emissions.

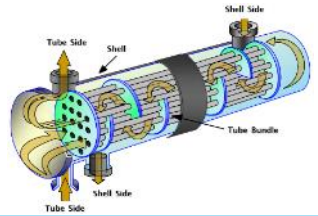
API RP 573 — Inspection of Fired Boilers and Heaters

Covers the inspection practices for fired boilers and process heaters (furnaces) used in petroleum refineries and petrochemical plants.

API – Heat Exchangers

API Std 660 — Shell and Tube Heat Exchangers

Requirements for the mechanical design, material selection, fabrication, inspection, testing, and shipment preparation shell-and-tube heat exchangers for the petroleum, petrochemical, and natural gas industries.



API Std 661 — Petroleum, Petrochemical, and Natural Gas Industries Air-cooled Heat Exchangers

Requirements for the design, materials, fabrication, inspection, testing, and shipment preparation for shipment of air-cooled heat exchangers for use in the petroleum, petrochemical, and natural gas industries

API Std 662 — Plate Heat Exchangers for General Refinery Services

Requirements and gives recommendations for the mechanical design, materials selection, fabrication, inspection, testing and preparation for shipment of Plate heat exchanger for use in the petroleum, petrochemical and natural gas industries.

API Std 663 — Hairpin-type Heat Exchangers

Requirements and gives recommendations for the mechanical design, materials selection, fabrication, inspection, testing and preparation for shipment of hairpin heat exchangers for use in the petroleum, petrochemical and natural gas industries.

API Std 664 — Spiral Plate Heat Exchangers

Requirements for the mechanical design, materials selection, fabrication, inspection, testing, and preparation for shipment of spiral plate heat exchangers for the petroleum, petrochemical, and natural gas industries.

API – Storage Tanks

API Std 650 — Welded Storage Tanks for Oil Storage

Requirements for material, design, fabrication, erection, and inspection for vertical, cylindrical, aboveground, closed- and open top, welded storage tanks for internal pressures approximating atmospheric pressure

API Std 620 — Design and Construction of Large, Welded, Low-pressure Storage Tanks

design and construction of large, welded, low-pressure carbon steel above ground storage tanks. designed for temperatures not greater than 250 °F and pressures in their gas or vapor spaces not more than 15 psig

API Std 653 — Tank Inspection, Repair, Alteration, and Reconstruction

Covers steel storage tanks built to Std. 650 and its predecessor Spec 12C. It provides minimum requirements for maintaining the integrity of such tanks and addresses inspection, repair, alteration, relocation.

API Std 625 — TANK SYSTEMS FOR. REFRIGERATED, LIQUIFIED GAS STORAGE

Tanks with min temperature as low as -198 C

API RP 651 — Cathodic Protection of Aboveground Petroleum Storage Tanks

corrosion control on aboveground storage tank bottoms through the use of cathodic protection

API RP 652 — Linings of Aboveground Petroleum Storage Tank Bottoms

corrosion control by the application of tank bottom linings in aboveground storage tanks

API – Pressure Relief Devices

API 520 Parts I & II — Sizing, Selection, and Installation of Pressure-Relieving Devices

API 520 Std. part I and RP part II applies to the sizing and selection of pressure relief devices used in refineries and related industries. PRDs covered in this standard intended to protect pressure vessels and related equipment against overpressure from operating and fire contingencies

API Std 521 — Pressure-Relieving and Depressuring Systems

This standard specifies requirements and gives guidelines for the following: examining the principal causes of overpressure; determining individual relieving rates; and selecting and designing disposal systems, including such component parts as piping, vessels, flares, and vent stacks

API RP 576 — Inspection of Pressure-Relieving Devices

inspection and repair practices for automatic pressure relieving devices (pressure-relief valves, pilot-operated pressure-relief valves, rupture disks, and weight-loaded pressure-vacuum vents)

Q 4

When the operating pressure higher than 90% of the MAWP (set pressure), which of the following PRV type is best to be used

a. Conventional Spring Loaded PRV

b. Balanced Spring Loaded PRV

c. Pilot Operated PRV

API – Risk Based Inspection

API RP 580

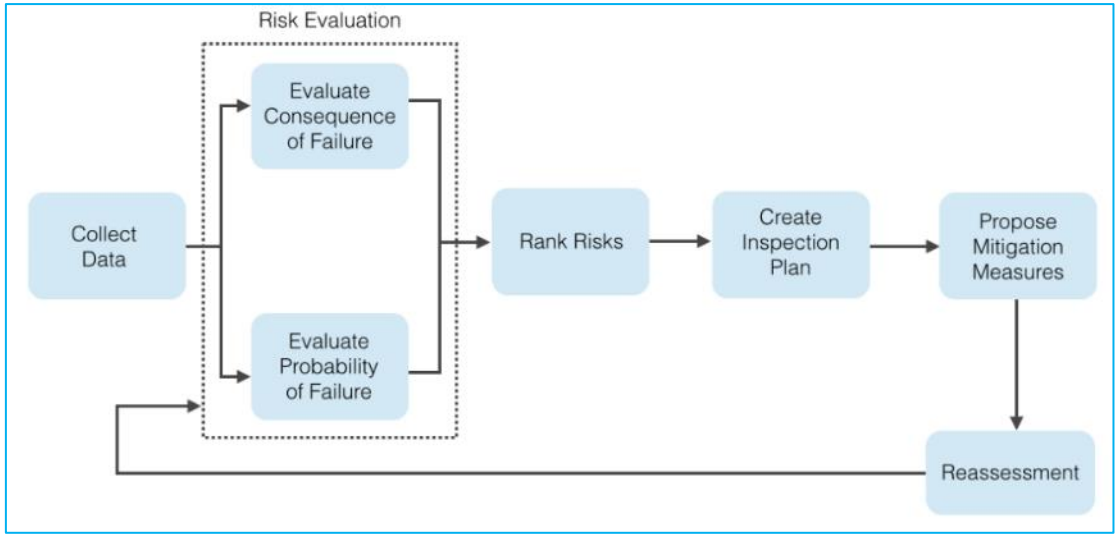
Risk Based Inspection

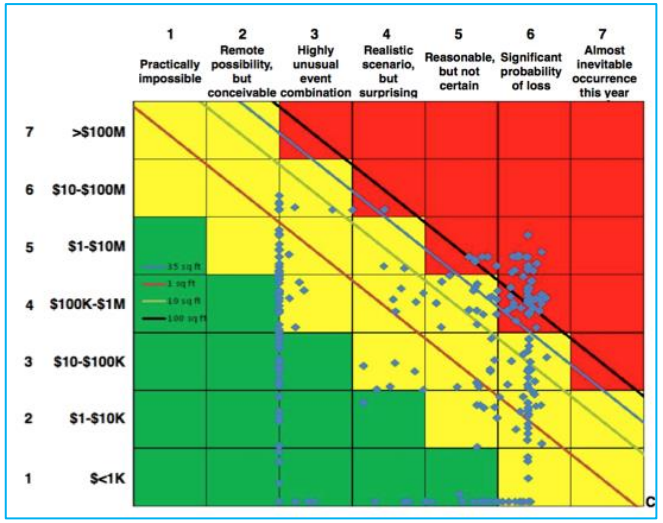
recommended elements for developing, implementing, and maintaining a risk-based inspection (RBI) program. It also provides guidance to owner-users, operators, and designers of pressure-containing equipment for developing and implementing an inspection program

API RP 581

Risk Based Inspection Methodology

Provides quantitative procedures to establish an inspection program using risk based methods for pressurized fixed equipment





API – Corrosion and Material

API RP 571 — Damage Mechanisms Affecting Fixed Equipment in the Refining Industry

Provides background information on damage that can occur to equipment in the refining process. It is intended to supplement Risk-Based Inspection (RP 580 and Publ. 581) and Fitness-for-Service (Std. 579-1/ASME FFS-1) technologies

API Std 579/ ASME FFS — Fitness for Service (FFS)

Provides guidance for conducting FFS assessments using methodologies specifically prepared for pressurized equipment. The guidelines provided can be used to make run-repair- replace decisions to help determine if components in pressurized equipment containing flaws that have been identified by inspection

API RP 577 — Welding Processes, Inspection, and Metallurgy

Provides guidance to the API authorized inspector on welding inspection as encountered with fabrication and repair of refinery and chemical plant equipment and piping.

API RP 582 — Welding Guidelines for the Chemical, Oil, and Gas Industries

supplementary guidelines and practices for welding and welding related topics for shop and field fabrication, repair, and modification

TEMA Standards

TEMA: Tubular Exchanger Manufacturer Association – Developed in 1939 Current edition is 10th Edition published in 2019

TEMA is a manufacturer standard

The focus is on manufacturing and mechanical design. TEMA also provides references for thermal design and fouling. There are cost differences between the three heat exchanger classes.

TEMA Classes

Class **R**

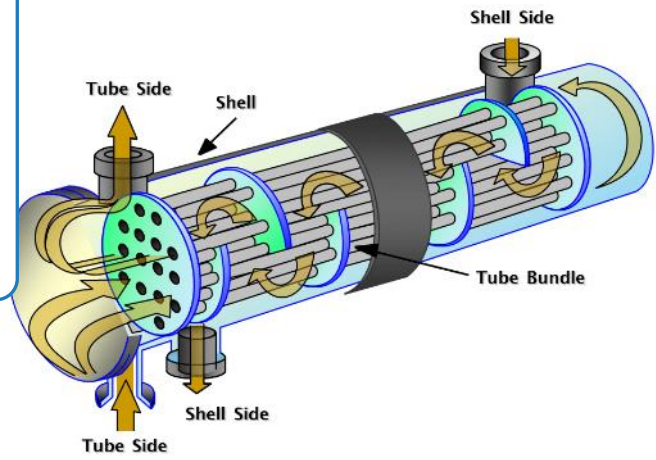
Generally severe requirements for petroleum and related processing applications

Class **C**

Generally moderate requirements of commercial and general processing applications

Class **B**

Chemical Process service



API Individual Certification Program (ICP)

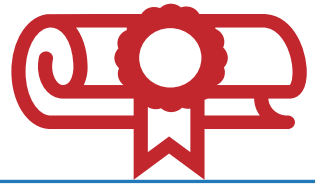
Individual Certification Programs (ICP) have been offered by the American Petroleum Institute (API) since 1989 as a way to test the knowledge and document the experience of inspection and technical personnel. These programs provide certification for several different API standards. Most API ICPs remain valid for three-year terms and can be renewed after that period.

Each ICP program has minimum qualification requirements, which usually include a certain degree of knowledge about the corresponding API standard, as well as a specific amount of experience in the field. Scheduled exams are conducted at computer testing centers and completed online.

API Individual Certifications are powerful assets for inspectors and other personnel looking to advance their careers. They enable a person to demonstrate their knowledge, skills, and experience to potential employers or clients.

API Individual Certification Program (ICP)

API 510	Pressure Vessel Inspector
API 570	Piping Inspector
API 653	Above Ground Storage Tank Inspector
API 571	Corrosion and Materials Professional
API 577	Welding Inspection and Metallurgy Professional
API 580	Risk Based Inspection Professional
API 936	Refractory Quality Control Personnel
API 1169	Pipeline inspector
API SIFE	Source inspector fixed equipment
API SIRE	Source inspector rotating equipment
API QUPA	Qualification of Ultrasonic Testing Examiners (Phased Array)
API QUSE	Qualification of Ultrasonic Testing Examiners (Sizing)
API QUTE	Qualification of Ultrasonic Testing Examiners



More details about the API ICP and other available certificates and requirements for each to be checked at API website; Individual Certification Programs (ICP)

https://www.api.org/products-and-services/individual-certification-programs

American Petroleum Institute

API Individual Certification Program (ICP)

API 510

Pressure Vessel Inspector

Certified API 510 Pressure Vessel inspectors must have a broad knowledge base relating to maintenance, inspection, repair, and alteration of pressure vessels

Qualifications Required to apply for API 510 Certificate

More details about qualifications for API ICP and exam information to be checked at API website; Individual Certification Programs (ICP)
https://www.api.org/products-and-services/individual-certification-programs

Education	Years of Industry Experience	Experience Required
BS or higher in engineering or technology	1 year	Supervision or performance of inspection activities as described in API 510
2-year Associate's degree or certificate in engineering or technology	2 years	Design, fabrication, repair, operation, or inspection of pressure vessels, of which one year must be in supervision or performance of inspection activities as described in API 510
High school diploma or equivalent	3 years	Design, fabrication, repair, operation, or inspection of pressure vessels, of which one year must be in supervision or performance of inspection activities as described in API 510
No formal education	5 or more years	Design, fabrication, repair, operation, or inspection of pressure vessels, of which one year must be in supervision or performance of inspection activities as described in API 510

API Individual Certification Program (ICP)

API SIFE

Source Inspector Fixed Equipment

Qualifications Required to apply for API SIFE Certificate

More details about qualifications for API ICP and exam information to be checked at API website; Individual Certification Programs (ICP)
https://www.api.org/products-and-services/individual-certification-programs

The API SIFE Source Inspector Fixed Equipment certification is open to applicants with any experience in the petroleum and petrochemical industries, as well as applicants wanting to gain industry experience.

To obtain an API SIFE certification, candidates will need to pass the Source Inspector Fixed Equipment examination.

IFE - Source Inspector Fixed Equipment focuses primarily on pressure containing equipment and structural equipment, including: vessels, columns/towers, heat exchangers, piping, valves, pressure relief devices, tubulars, and associated structural fabrications.

American Petroleum Institute

Code Scope and Limitations

Each code has its own scope and extent of application.

Code scope and interactions with other applicable codes and standards should be understood

Photo: www.turbosquid.com

Scope of Design Codes

Vertical Cylindrical Storage Tank At atmospheric Pressure	API 650 “Welded Tanks for Oil Storage”
Vertical Cylindrical Storage Tank At Internal Pressure <= 2.5 psi	API 650 “Welded Tanks for Oil Storage” - Appendix F “Design of Tanks for Small Internal Pressures” or API 620
Vertical Cylindrical Storage Tank At Internal Pressure <= 15 psi and >2.5 psi	API 620 “Design and Construction of Large, Welded, Low-pressure Storage Tank”
Vessel At Internal Pressure > 15 Psig and <= 3000 Psig	ASME BPVC Sec. VIII div.1
Tanks with min temperature as low as -198 C	API 625 Tank Systems for Refrigerated Liquefied Gas Storage
Small capacity shop fabricated steel tanks	API 12 F “Specification for Shop-welded Tank for Storage of Production Liquids”
Water Storage Tanks	API 650 + AWWA D100 AWWA D100 “Welded Carbon Steel Tanks for Water Storage”

Decision Tree for Selecting Design Code Based on Internal Design Pressure Value

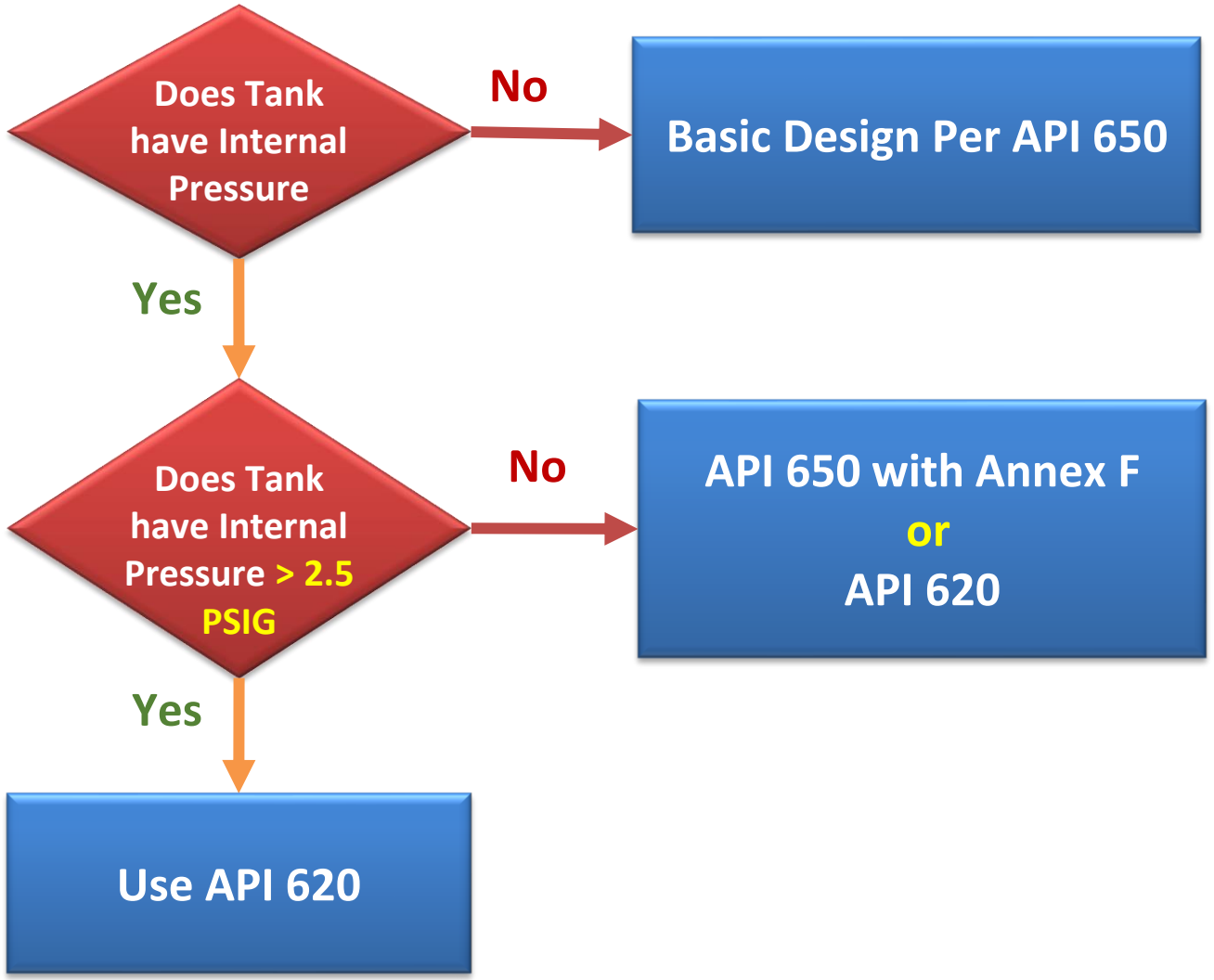
API Std 650 — Welded Storage Tanks for Oil Storage

Requirements for material, design, fabrication, erection, and inspection for vertical, cylindrical, aboveground, closed- and open top, welded storage tanks for internal pressures approximating atmospheric pressure

The standard API 650 covers the design and calculation of the different elements of the tank. In view of the materials of construction, erection sequences, welding procedures, tests and inspections as well as guidelines for operation.

API Std 620 — Design and Construction of Large, Welded, Low-pressure Storage Tanks

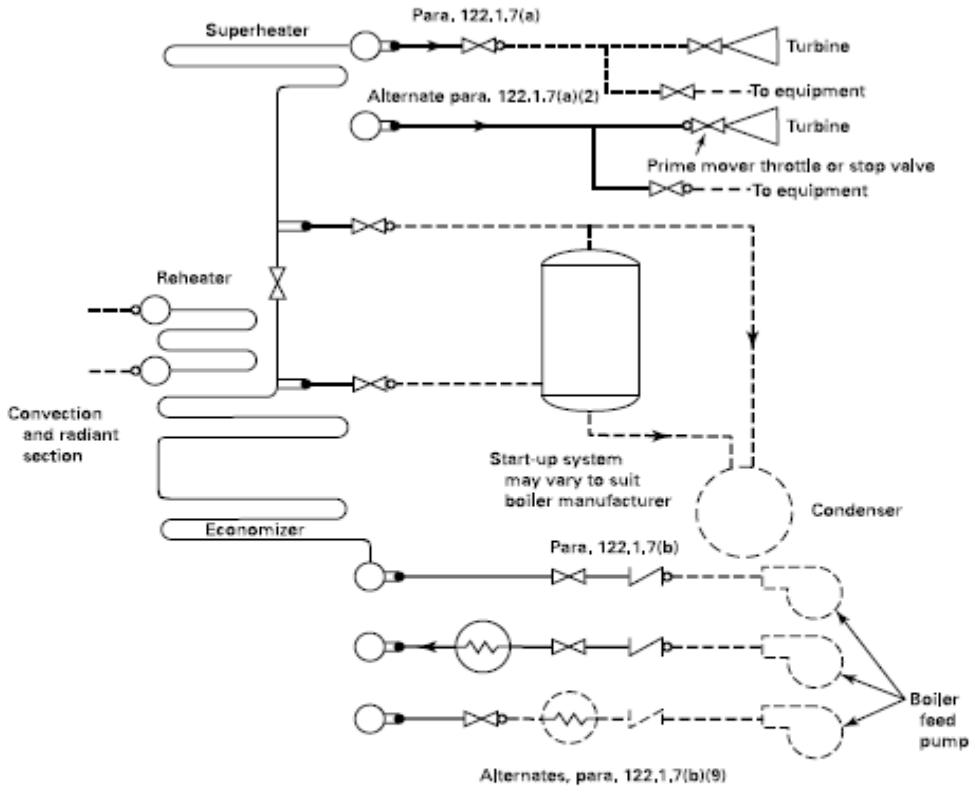
Deign and construction of large, welded, low-pressure carbon steel above ground storage tanks. designed for temperatures not greater than 250 °F and pressures in their gas or vapor spaces not more than 15 psig



Source: Customized from figure F.1 – Appendix F API 650 - 2016

Piping Codes : ASME B31.1 and B31.3 Scope

Figure 100.1.2-1 Code Jurisdictional Limits for Piping — An Example of Forced-Flow Steam Generators With No Fixed Steam and Waterline



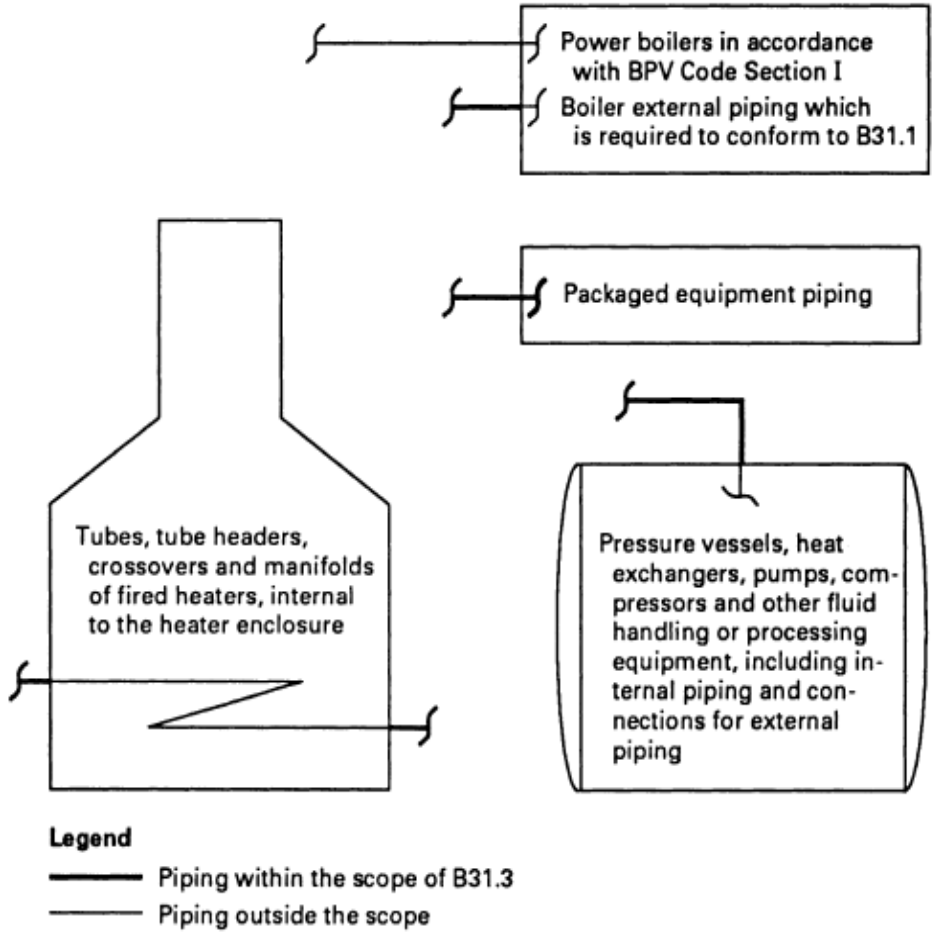
Administrative Jurisdiction and Technical Responsibility

——— Boiler Proper — The ASME Boiler and Pressure Vessel Code (ASME BPVC) has total administrative jurisdiction and technical responsibility. Refer to ASME BPVC, Section I, Preamble.

●——— Boiler External Piping and Joint (BEP) — The ASME BPVC has total administrative jurisdiction (mandatory certification by stamping the Certification Mark with the appropriate Designator, ASME Data Forms, and Authorized Inspection) of BEP. The ASME Section Committee B31.1 has been assigned technical responsibility. Refer to ASME BPVC, Section I, Preamble, fifth, sixth, and seventh paragraphs and ASME B31.1 Scope, para. 100.1.2(a). Applicable ASME B31.1 editions are referenced in ASME BPVC, Section I, PG-58.3.

○- - - - - Nonboiler External Piping and Joint (NBEP) — The ASME Code Committee for Pressure Piping, B31, has total administrative and technical responsibility.

Figure 300.1.1 Diagram Illustrating Application of B31.3 Piping at Equipment



E: The means by which piping is attached to equipment is within the scope of the applicable piping code.

Careful Use of Standards

Standards are in many cases direct selection or application of specific requirements

Standards contents are widely available and copied in vendors publications and internet forums

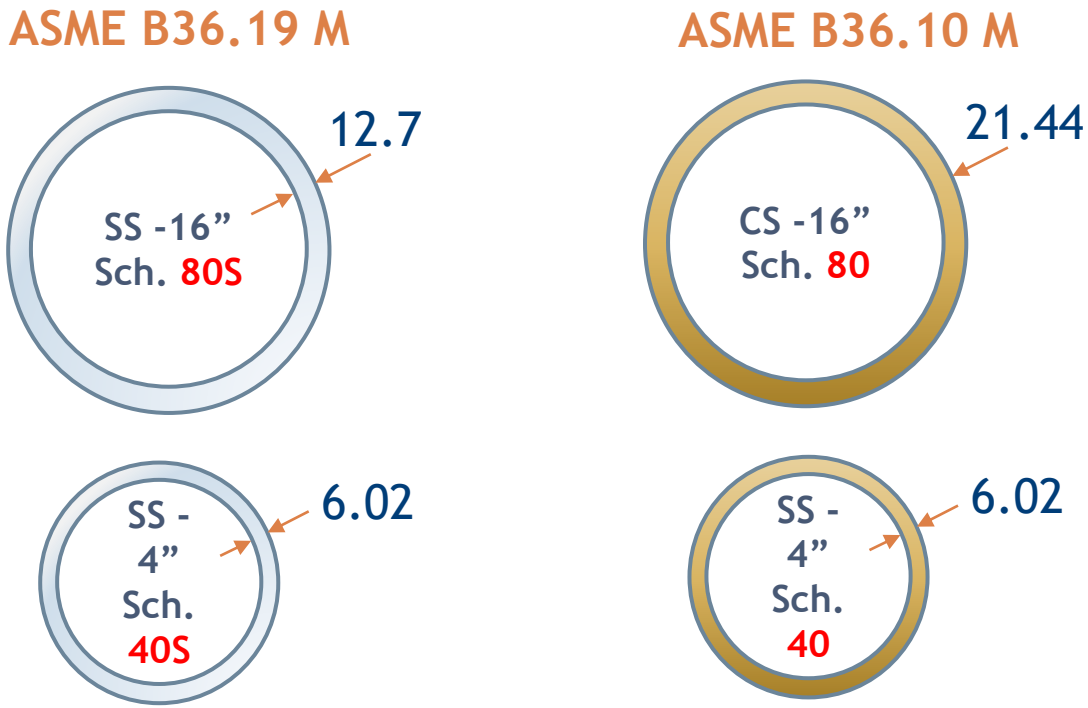
Wrong selection or application of standards requirements occurred due to many reasons:

- Unfamiliarity with the standards contents and structure
- Usage of free copied publications without cross check with the standard requirements
- Over confidence
- Unavailability of the standard
- Limited time (work in hurry)

Careful Use of Standards

Pipe dimensions and wall thickness of steel pipes covered under ASME **B36.10M** and stainless steel pipes under ASME **B36.19M**

Make sure you have identified the correct pipe schedule



Notice the impact on the flow area for different pipe thickness

#	Description	Referenced Standard	OD (mm)	ID (mm)	Thickness (mm)	Flow area (mm^2)
1	20 inch, carbon steel pipe, sch. 40	ASME B36.10M	508	477.82	15.09	179,315
2	20 inch, stainless steel pipe, sch 40S	ASME B36.19M	508	488.94	9.53	187,759
3	1 inch, carbon steel pipe, sch. 40	ASME B36.10M	33.4	26.64	3.38	557.4
4	1 inch, carbon steel pipe, sch. XXS	ASME B36.10M	33.4	15.22	9.09	181.9

Be Carful in Using Standards

ASME B16.5-2017
(Revision of ASME B16.5-2013)

- **Specifying Standard Flange per ASME B16.5**
- Standard: ASME B16.5
- Type: WN/SW / SO / Thr. /Blind / Lap
- Class / Rating: 150# / 300# / 600# ……
- Facing: Raised Face, Flat Face, Ring Joint
- Material: CS ASTM A105, ……..
- Schedule/Hub Thk.: in case of WN Flange

Be Carful in Using Standards

Table SW-2.5-2 Maximum Bore of ASME B16.5 Flanges for Use With Spiral-Wound Gaskets

Flange Size (NPS)	Maximum Bore by Pressure Class							
	75	150	300	400	600	900 [Note (1)]	1500 [Note (1)]	2500 [Note (1)]
½	No flanges	WN flange only [Note (2)]		No flanges Use Class 600	WN flange only [Note (2)]	No flanges Use Class 1500	WN flange only [Note (2)]	
¾								
1								
1¼		SO flange [Note (3)] WN flange [Note (2)]			SO flange [Note (3)] WN flange [Note (2)]			
1½								
2		SO flange [Note (3)] WN flange, any bore			SO flange [Note (3)] WN flange, any bore			
2½								
3		SO flange WN flange, any bore			SO flange [Note (3)] WN flange, any bore			
4				WN flange with Schedule 10S bore described in ASME B36.19M [includes nozzle [Note (4)] but excludes SO flange]			WN flange with SW bore [includes nozzle [Note (4)] but excludes SO flange]	
6								
8						WN flange with Schedule 80 bore [excludes nozzle [Note (4)] and SO flange] [Note (5)]		
10								
12								
14				WN flange with Schedule 10S bore described in ASME B36.19M [excludes nozzle [Note (4)] and SO flange] [Note (5)]				No flanges
16								
18								
20								
24								

GENERAL NOTES:

(a) This Table shows the maximum bore of flanges for which the spiral-wound gasket dimensions shown in Table SW-2.1-1 are recommended, considering the tolerances involved, possible eccentric installation, and the possibility that the gasket may extend into the assembled flange bore.

(b) For maximum permissible flange bores for nonmandatory inner rings, see Table SW-2.5-1.

(c) Abbreviations: SO = slip on and threaded, WN = welding neck, and SW = standard wall.

NOTES:

(1) Refer to para. SW-2.5 for required use of inner rings. These inner rings may extend into the pipe bore a maximum of 1.5 mm (0.06 in.) under the worst combination of maximum bore, eccentric installation, and additive tolerances.

(2) In these sizes, the gasket is suitable for a welding neck flange with a standard wall bore, if the gasket and flanges are assembled concentrically. This also applies to a nozzle. It is the user's responsibility to determine if the gasket is satisfactory for a flange of any larger bore.

(3) Gaskets in these sizes are suitable for slip-on flanges only if the gaskets and flanges are assembled concentrically.

(4) A nozzle is a long welding neck; the bore equals the flange NPS.

(5) An NPS 24 gasket is suitable for nozzles.

- Maximum size of 2500 class is NPS 12. There is no 2500 flange of NPS 14 and larger
- Smallest size of class 400 is NPS 4. There is no class 400 of NPS 3.5 and smaller.
- Smallest size of class 900 flanges is NPS 3. There is no class 900 flanges of NPS 2.5 and smaller.

Be Carful in Using Standards

Low Strength Bolts

ASME B16.5-2017

Table 1B List of Bolting Specifications: Applicable ASTM Specifications

Bolting Materials [Note (1)]												
High Strength [Note (2)]			Intermediate Strength [Note (3)]			Low Strength [Note (4)]			Nickel and Special Alloy [Note (5)]		
Spec. No.	Grade	Notes	Spec. No.	Grade	Notes	Spec. No.	Grade	Notes	Spec. No.	Grade	Notes
A193	B7	...	A193	B5	...	A193	B8 Cl. 1	(6)	B164	...	(7)-(9)
A193	B16	...	A193	B6	...	A193	B8C Cl. 1	(6)	...	...	...
A193	B16	...	A193	B6X	...	A193	B8M Cl. 1	(6)	B166	...	(7)-(9)
A320	L7	(10)	A193	B7M	...	A193	B8T Cl. 1	(6)	...	...	...
A320	L7A	(10)									
A320	L7B	(10)	A193	B8 Cl. 2	(11)	A193	B8A	(6)	B335	N10665	(7)
										N10675	(7)
			A193	B8 Cl. 2B	(11)						
A320	L7C	(10)	A193	B8C Cl. 2	(11)	A193	B8CA	...			
A320	L43	(10)	A193	B8M Cl. 2	(11)	A193	B8MA	...	B408	...	(7)-(9)
			A193	B8M Cl. 2B	(11)						
			A193	B8T Cl. 2	(11)	A193	B8TA	(6)			
A354	BC	...							B473	...	(7)
A354	BD	...	A320	B8 Cl. 2	(11)	A307	B	(12)			
			A320	B8C Cl. 2	(11)				B574	...	(7)
A540	B21	...	A320	B8F Cl. 2	(11)	A320	B8 Cl. 1	(6)			
A540	B22	...	A320	B8M Cl. 2	(11)	A320	B8C Cl. 1	(6)			
A540	B23	...	A320	B8T Cl. 2	(11)	A320	B8M Cl. 1	(6)			
A540	B24	...				A320	B8T Cl. 1	(6)			
			A449		(13)						
			A453	651	(14)						
			A453	660	(14)						

- Bolting materials having no more than 206 MPa (30 ksi) specified minimum yield strength are listed as low strength. These materials and others of comparable strength are to be USED ONLY in Class 150 and 300 flanged joints and only with gaskets described in ASME B16.5 para. 5.4.2.
- Flanged assemblies using low-strength carbon steel bolts should NOT be used above 200°C (400°F) or below −29°C (−20°F).
- There are limitations also on the use of the intermediate strength bolts. Check ASME B16.5 for more details and clarity.
- Take care while specifying the bolt material, some stainless steel bolts like A193 B8A Cl.1 (SS304) are categorized as low strength bolts
- At High temperature application, B7 bolts will have very low allowable stress and B16 or B8 bolts will be required

Reference: ASME B16.5 para. 5.3.4

Codes and Standards

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