PIPING CLASS SPECIFICATION

WHAT IS A PIPING CLASS SPECIFICATION FOR INDUSTRIAL PLANTS?



What's inside:

- Structure and sections
- Coding and services
- Pressure and temperature

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Introduction

A piping system is a **set of closed conduits intended for the transport of fluids, as well as their fittings.**

The vast majority of pipes act as pressure containers, that is, without free surface area, with the fluid wetting the entire cross-sectional area, the exception being drains or sewers where the fluid works with a free surface, such as channels.

The need to use pipes arises from the fact that the point of storage or generation of fluids is generally far from the areas where the fluid is needed.

Their use dates back to ancient times, but their industrial application and commercial manufacturing was only developed at the end of the 19th century due to the need for materials to resist the increasing pressures caused by the use of steam.



Aqueduct for transporting water, 5th century AD.

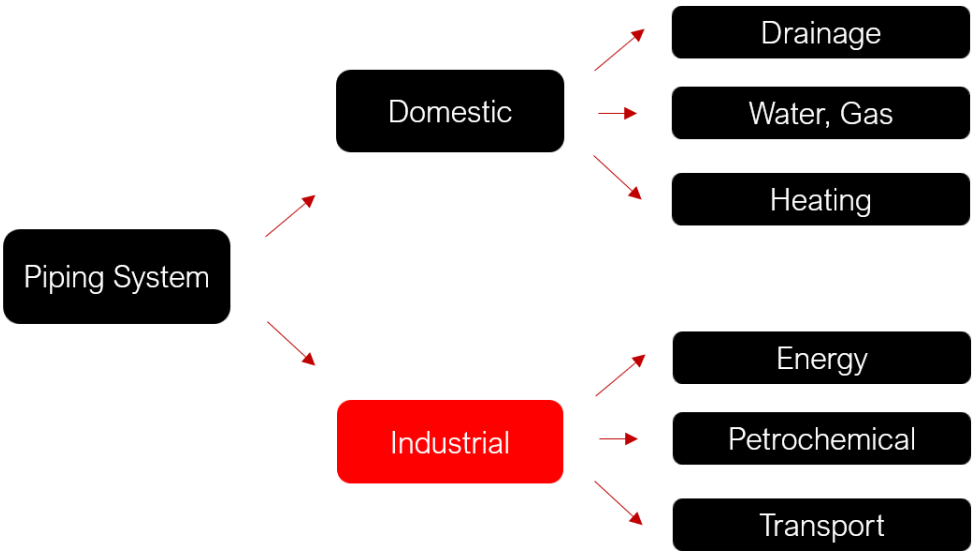
Pipes are used for the transport of all known fluids, liquid or gaseous, for pasty materials or pulp, and for fluids in suspension, in the entire range of pressures found in the industry, from absolute vacuum to pressures of 400 Mpa or higher, and from absolute zero to the melting temperatures of metals.

Pipes with a circular section are the most common, since this shape offers not only greater structural resistance but also a greater cross section for the same external perimeter than any other shape. Unless specifically indicated, the word "pipe" in these notes will always refer to a closed conduit of circular section and constant internal diameter.

In an industrial facility there are different processes, systems, and services. Each of these systems will have certain specific requirements for pressure, temperature and corrosion, among other things. **Due**

to this, there will be different pipe specifications in an industrial plant covering the entire operational spectrum of said facility.

Piping systems can be classified as follows:



Classification of Piping Systems according to their use.



Construction of an Industrial plant, intensive in the use of pipes.



Penstock of a hydroelectric power plant.

Nomenclature and terminology

Numerous abbreviations, acronyms and terms are used throughout this document. The explanation of each of them is found in Annex I.

1. What is a piping class specification?

A piping class specification or, simply "Piping Class", is a document normally developed during the design phase of a project, that details all the properties of the elements that make up a piping system for a specific service.

A piping system is made up of different elements: the piping itself, all fittings, valves, flanges, gaskets, bolts, pressure relief devices, as well as special piping elements and equipment, such as: expansion joints, flexible joints, pipe supports, steam traps, filters, separators, flowmeters, pumps, compressors, heat exchangers, tanks and pressure vessels, among others.

In general, a piping class specification includes all in-line elements such as: the pipe, fittings, flanges, gaskets, bolts, valves, filters, steam traps, etc.; elements not included in this document are supports, flexible joints, expansion joints, etc.

A piping specification is an essential document for the development of any construction project, but also throughout the useful life of a plant, since for any type of maintenance or repair of a piping section, the specification is essential for the correct selection of the component to be replaced.

Before beginning any repair work, it is essential to reference the piping specification to specify and use the correct components. Sometimes, mainly due to emergencies, but also due to lack of knowledge, the first reaction to selecting components is: "you have to buy the same components that were originally installed." This criterion may not be appropriate since plant piping specifications might have evolved along with the production process in place.

It is worth mentioning that a piping specification only applies to the plant, location, type of installation, and defined service. As will be seen in the different sections of these study notes, a piping specification depends on numerous variables, which is why it is not interchangeable with another plant, location, or service.

A piping specification is fundamentally defined by the following parameters:

- Service | fluid
- Material
- Design code
- Pressure-temperature range
- Corrosion allowance

Important note! The piping class specifications shown in this document, including tables, values and references, are only examples provided for the assimilation of concepts; they should not be used for the design of piping systems in industrial plants as they are.

1.1) Structure of a piping specification.

A piping specification can have different configurations depending on each organization and each project. If specifications from different companies are compared, the information is organized slightly differently. However, the minimum information contained in this document is always the same. A typical piping specification is shown below, followed by its respective explanation of the different sections.

1

Piping Class Code:	AA1							
Design Code:	ASME B31.3							
Heat treatment:	No							
Rating	150#							
Limits: Temperature [ºC] & Pressure [barg]:	-29 | 38	100	150	200	250	300	350	
	20	18	16.1	14	12.3	10.4	8.5	
Material:	Killed carbon steel							
Corrosion allowance:	1.5							

2

Services:	LO	Lubrication Oil
	OS	Fuel Oil

3

Type of pipe:	NPS	Material	SCH	Rating	Standard	End	Notes
SMLS	½"-1 ½"	ASTM A106 Gr.B	80		ASME B36.10	PE	
SMLS	2"-6"	ASTM A106 Gr.B	40		ASME B36.10	BE	(1) (10)
SMLS	8"-12"	ASTM A106 Gr.B	20		ASME B36.10	BE	(1) (10)
SMLS or ERW	14"-18"	ASTM A106 Gr.B	20		ASME B36.10	BE	(1) (10)
		API 5L Gr.B	20		ASME B36.10	BE	(1) (10)
SMLS or ERW	20"-24"	ASTM A106 Gr.B	20		ASME B36.10	BE	(1) (10)
		API 5L Gr.B	20		ASME B36.10	BE	(1) (10)

4

Fittings	NPS	Material	SCH	Rating	Standard	End	Notes
Elbow | Tee | Caps	½"-1 ½"	ASTM A105		#3000	ASME B16.11	SW	
Reducers	3"-24"	ASTM A234 Gr.WPB	(3)		ASME B16.9	BW	(1)
Sockolet | Elb | Latro	½"-1 ½"	ASTM A105		#3000	MSS-SP 97	SW	
Weldolet | Elb | Latro	2"-4"	ASTM A105	(3)		MSS-SP 97	BW	
Spectacles | 8 Figure	½"-24"	ASTM A516 Gr.60		#150	ASME B16.48	RF	(2)
Spacers	½"-24"	ASTM A516 Gr.60		#150	ASME B16.48	RF	(2)

Flanges	NPS	Material	SCH	Rating	Standard	End	Notes
Socket Weld (SW)	½"-1 ½"	ASTM A105	(3)	#150	ASME B16.5	RF	(2)
Threaded (TH)	½"-1 ½"	ASTM A105		#150	ASME B16.5	RF	(2)
Welding Neck (WN)	2"-24"	ASTM A105	(3)	#150	ASME B16.5	RF	(2)
Blind (BL)	½"-24"	ASTM A105		#150	ASME B16.5	RF	(2)

Gaskets	NPS	Material	SCH	Rating	Standard	End	Notes
Flat (t=1,5mm)	½"-8"	Klinger | Similar		#150	ASME B16.21		(5)
Flat (t=3mm)	10"-24"	Klinger | Similar		#150	ASME B16.21		(5)
Spiral Wound (t=4,5mm)	½"-8"	AISI 316 | Graphite, External Ring CS Zinc		#150	ASME B16.20		
Spiral Wound (t=4,5mm)	10"-24"	AISI 316 | Graphite, External Ring CS Zinc, Internal Ring SS		#150	ASME B16.20		

Bolts & Nuts	NPS	Material	SCH	Rating	Standard	End	Notes
Bolts		ASTM A193 Gr.B7			ASME B18.2.1		(4)
Nuts		ASTM A194 Gr.2H			ASME B18.2.2		

5

Ball valve	½"	¾"	1"	1½"	2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"& up	Notes
Body	ASTM A105				ASTM A216 Gr.WCB										
Stem	AISI 316 – Non extractable stem														
Seat	Reinforced PTFE														
Sphere	AISI 316														
Rating	2000 WOG o #800				#150										
Ends	SW (A) (C)				Flanged RF, ASME B16.5										
Operation	Lever								Gear box						
Type	Fireproofed | Reduced flow(B) | Divided body | Non extractable sphere														
Guided sphere	No														

6

References:

A. In special cases, RF 150# flanged ends can be used

B. Unless full flow is established in the P&ID

C. In special cases NPT 2000 WOG or Class 800# ends can be used

D. Internals entirely in AISI 316

7

Branch scheme:

24"																5	24"
20"															5	3	20"
18"														5	3	3	18"
16"													5	3	3	7	16"
14"												5	3	3	7	7	14"
12"											5	3	3	7	7	7	12"
10"										5	3	3	7	7	7	7	10"
8"									5	3	3	7	7	7	7	7	8"
6"								5	3	3	7	7	7	7	7	7	6"
4"							5	3	3	6	6	6	6	6	6	6	4"
3"						5	3	3	3	6	6	6	6	6	6	6	3"
2½						5	3	3	6	6	6	6	6	6	6	6	2½
2"					5	3	3	3	6	6	6	6	6	6	6	6	2"
1½				1	3	3	3	8	4	4	4	4	4	4	4	4	1½
1"			1	2	3	8	8	4	4	4	4	4	4	4	4	4	1"
¾"		1	2	2	8	8	4	4	4	4	4	4	4	4	4	4	¾"
½"	1	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	½"
	½"	¾"	1"	1½	2"	2½	3"	4"	6"	8"	10	12	14	16	18"	20"	24"	

BRANCH

HEADER

References:

1. Norma Tee SW
2. Reducer Tee SW
3. Reducer Tee BW
4.a. Half Coupling SW
4.b. Half Coupling NPT (Instruments, Drains, Vents)
4.c. Elbolet NPT/SW
4.d. Latrolet SW
5. Normal Tee BW
6. Weldolet, Elbolet BW, Latrolet BW
7. Pipe-to-Pipe with reinforcement (check repad requirement) (16)
8. Sockolet

Next, the main aspects of the specification shown will be described. The numerical references on the left margin coincide with the numerals of the sections described.

1.2) Sections of a piping specification

The first two sections of a piping class specification establish the framework/application limits of the specification. In other words, for what services and conditions the piping specification can be applied. Starting in the third section, all the details of each of the components of the piping system for the service(s) included in the specification are defined.

1. Framework | Application limits

The first section of any piping specification contains the fundamental application data. In other words, it is the framework, where the limits of application of the specification are established. The main fields contained in this section are the following:

Piping Class: The name given to a piping specification, usually in code form.

Design code: The design code used to define the different components of the specification.

Rating: The class, work range for which the specification has been developed. The rating of the specification coincides with the rating of the main flanges of the piping system.

Pressure and temperature limits: pressure and temperature range for which the piping specification is applicable. Generally, the limits coincide with those of the main piping flanges.

Material: in this field the metallurgy of the components of the specification is indicated.

Corrosion allowance: value of excess thickness due to corrosion, defined for the working conditions of the services included in the specification.

2. Services

An industrial plant service is a **piping system used to for a specific purpose, for example: a plant's lubrication oil piping system, compressed air system, or medium-pressure steam system.**

A piping specification can be developed for one or several services with similar operating pressure and temperature, and material and corrosion allowance, among other things.

In any engineering project it is highly recommended to group together as many services as possible, which is common practice for piping systems with similar services. Now, **if we try to group non-similar services in the same specification, that is, with different operating pressures/temperatures and/or materials, the result will be a specification that is adequate for only some services, and most likely will present excessive requirements for other services.**

3. Pipes

The most important component of a piping system is the pipes themselves. For this reason, you typically start by defining this component first in a piping specification. All the necessary parameters must be defined to fully define a pipe:

- Pipe type: welded, seamless, etc.
- Nominal diameter
- Material
- Thickness
- Applicable standard
- End finishing: flat, beveled
- Any other requirements can be indicated in the “Notes” field

4. Fittings

The fittings of a piping system are used for different functions, allowing changes in direction, changing diameter, facilitating branching, interconnecting the piping system with different equipment, etc. These fittings are elbows, tees, caps, O'let fittings, reducers, etc.

Depending on the pressure, temperature, and fluid requirements of the services, a piping system can have different types of fittings: threaded, welded, flanged, etc. In the same way that the parameters of a pipe must be defined, all the necessary parameters to adequately specify fittings must also be defined:

- Type of fitting: elbow, tee, reducer, cap, etc.
- Type of union: butt weld (BW), socket weld, (SW), threaded (TH), etc.
- Nominal diameter
- Material
- Thickness (for butt weld fittings)
- Rating (for plug-weld or threaded fittings)
- Applicable standard
- Any other requirements can be indicated in the “Notes” field.

5. Flanges, gaskets, bolts, and nuts

The flanges of a piping system are used to join two elements that generally need to be dismantled periodically, such as the interconnection of piping systems with static equipment, joining sections of pipes with valves, etc. As is the case for the fittings of a piping system, depending on the pressure, temperature, and fluid requirements of the services, flanges can also be of different types: welding neck (WN), socket weld (SW), slip on (SO), etc. At the same time, flanges can have different facings depending on the type of joint: raised face (RF), flat face (FF), etc. In the same way that the parameters are defined in the previous sections, all the necessary parameters to adequately specify flanges must also be defined:

- Type of flange: welding neck (WN), socket weld (SW), etc.
- Facing (type of seat): raised face (RF) flat face (FF), etc.
- Nominal diameter
- Material
- Neck thickness (for WN and SW flanges)
- Rating: flange pressure/temperature range
- Applicable standard
- Any other requirements can be indicated in the “Notes” field.

Considering that the size and number of bolts and nuts is determined by the characteristics of the flanges, only the following information should be indicated in the piping class specification to adequately specify these elements:

- Material
- Applicable standard
- Any other requirements can be indicated in the “Notes” field.

6. Valves

The basic function of valves is to control the flow of a fluid, both in direction and quantity, which will be achieved by inserting an object (flow control element) that will allow for the diversification, restriction, or regulation of the flow. The specification of a valve is a complex process that involves various definitions.

There is no agreement between different engineering companies in the sector on the amount of information that a piping specification should contain regarding valves; some specifications only include the minimum information on valves and dedicate another document to fully cover the details, while other specifications include all the parameters necessary to adequately specify these elements.

In the example of a piping class specification presented in the previous sections, only the fundamental characteristics of a ball valve are included, these are:

- Valve type: ball, gate, check, etc.
- Material of the main parts: body, stem, seat.
- Type of ends: threaded, welded, flanged, etc.
- Nominal diameter.
- Valve rating/class.
- Definition of the control element and seating.

- Definition of the valve handwheel or operating system.
- Any other requirements can be indicated in the “Notes” field.

7. Branch scheme

A branch connection is made when the header pipe has a branch line of equal or smaller size connected to it. Making branches in the header pipe is useful to avoid complex piping networks. Some of the reasons for using branches are the following:

- Fluid distribution to the different pieces of equipment of a plant: columns, drums, storage tanks, pumps and exchangers.
- Provide drainage and vents for hydraulic testing purposes.
- Installation of instruments directly in the header pipe.

The type of branch connection to be used is specified in the piping class specification and must comply with the applicable code of the project. There are many options for branch connections, including:

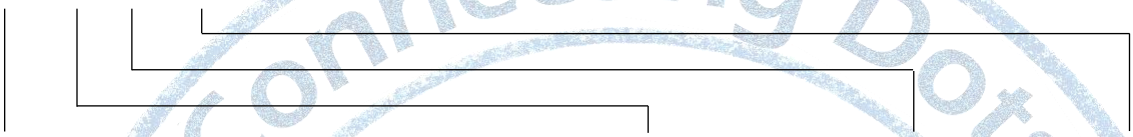
- Normal tee
- Reducer tee
- Coupling
- O’let fittings (elbolet, latrolet, weldolet, sockolet)
- Pipe-to-pipe attachment (with or without reinforcement)

1.3) Piping specification coding

There are as many piping specification coding systems as there are projects. The aim is for the coding to be as simple as possible and quickly recognizable by the people involved in an industrial plant or engineering project.

Continuing with the same example of the piping class specification indicated at the beginning of the document, the coding used is explained below:

A A 1 - A



Material	Rating	C. Allowance	Variation (1)
A = Killed Carbon Steel	A = 150#	0 = 0 mm	A = PWHT
B = Carbon Steel	B = 300#	1 = 1,5mm	B= Refractory
C = Galvanized Carbon Steel	C = 600#	3 = 3mm	C= PTFE
D = Alloy 1 ¼ Cr – ½ Mo	D = 900#	5 = 4,5mm	
E = Alloy 2 ¼ Cr – ½ Mo	E = 1500#	6 = 6mm	
F = Stainless Steel 304L	F = 2500#		
G = Stainless Steel 316L			
H = Polypropylene			
I = PVC-U			

Notes:

(1) The variation of a pipe class may or may not exist.

1.4) Services of an industrial plant

Generally, an industrial plant has different services, which will have an associated piping specification. In order to define the different piping specifications required in an industrial plant, all the services present must first be listed.

Below is an example of a list of services for an industrial plant:

Service	Pressure [barg]	Temp [°C]	Material
Acidic water	0-3	20	Alloy 1 1/4 Cr - 1/2 Mo
Air Instruments	0-7	5	Galvanized Carbon Steel
Cold demineralized water	0-8	20	Stainless Steel 304 L
Cold water	0-8	20	Carbon Steel
Demineralized water	0-6	50	Stainless Steel 304 L
Drinking water	0-8	20	Galvanized Carbon Steel
Feed water to HP boilers	44.1-80	180	Killed Carbon Steel
Feed water to LP boilers	0-13	180	Killed Carbon Steel
Feed water to MP boilers	14.1-42	180	Killed Carbon Steel
FPS Water (Dry Column)	0-12	20	Galvanized Carbon Steel
FPS Water (Wet Column)	0-12	20	Carbon Steel
Hot demineralized water	0-6	80	Stainless Steel 304 L
HP superheated steam	0-50	450	Alloy 1 1/4 Cr - 1/2 Mo
Hydrocarbon + H2S	10	130	Killed Carbon Steel
LP condensates	0-4.5	90	Killed Carbon Steel
LP Steam	0-4.,5	100	Killed Carbon Steel
Lubrication oil	0-10	60	Killed Carbon Steel
MP Condensates	4.6-46	90	Killed Carbon Steel
Nitrogen	0-7	20	Carbon Steel
Oxygen	0-7	10	Carbon Steel
Plant air	0-7	15	Carbon Steel
Process air	0-7	15	Carbon Steel
Process water	0-8	20	Carbon Steel
Saturated steam	0-52	350	Killed Carbon Steel
Slurry	0-13	120	Killed Carbon Steel
Vacuum lines	-1	20	Killed Carbon Steel

This list of services constitutes a fundamental and key requirement for the preparation of the piping class specification of a plant; if the services are not correctly identified and ordered, it is not possible to carry out a correct development of the specifications, not to mention trying to group them.

Many variables can be recorded in this list of services, depending on the methodology followed by each company or industrial plant. **The objective of this list of services is to allow for the characterization of each system to evaluate a possible grouping**. The minimum variables that must be included are mentioned below:

- **Name of the service**: it will be defined based on the plant's criteria.
- **Service pressure range**: operating pressure of each system. This parameter is defined by the process department of a facility, licensor of a plant, or whoever carried out its engineering.
- **Service temperature range**: operating temperature of each system. Same as for pressure, this parameter is defined by the process department of a facility, the licensor of a plant, or whoever carried out its engineering.
- **Material**: basic metallurgy required for the different components of the piping system, to guarantee compatibility with the fluid to be transported. Depending on the organization of the industrial facility, the selection of materials is carried out by the process department, the licensor of a plant, or whoever carried out its engineering.
- **Corrosion allowance**: value of the corrosion margin defined for the working conditions of the material-fluid coupling. As with the selection of materials, the corrosion margin is determined by the process department, the licensor of a plant, or whoever carried out its engineering.

1.5) Pressure and temperature range

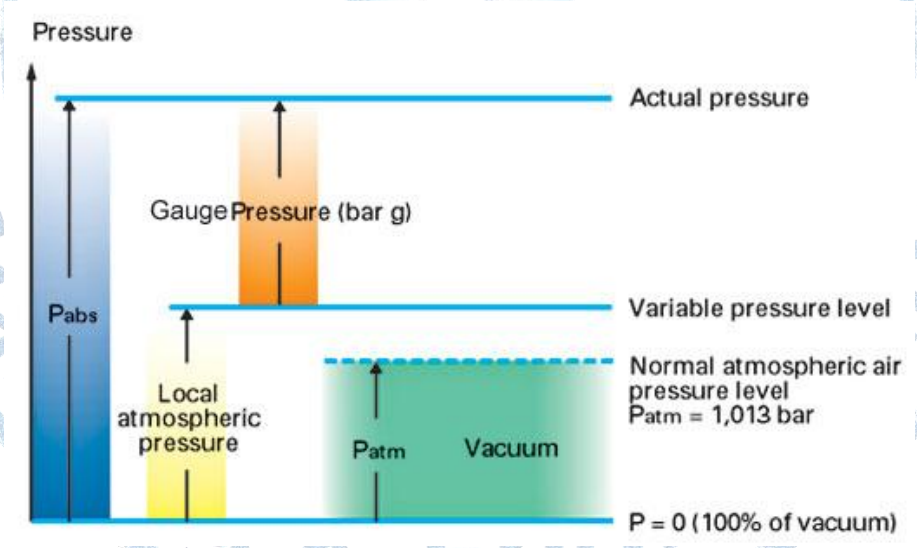
The combination of the effects of pressure and temperature are fundamental parameters in the sizing calculation of all components of a piping system. The effect of temperature sometimes determines the minimum resistance of a pipe by reducing the allowable stress of the material. The pressure causes stresses in all the components of the pipeline, which must be maintained within allowable values for a design to be satisfactory.

1.5.1) Operating and design conditions

The difference between the operating conditions of a piping system (Po, To) and its design conditions (Pd, Td) is a safety coefficient. This margin exists since it is usually difficult to establish design conditions with complete certainty. The difference between the operating and design conditions takes into account unwanted movements during plant transitions (start-up, shut down, upset conditions, pressure safety valves release, etc.).

1.5.2) Absolute and relative or manometric pressure

Typically, whenever pressure is discussed in the design of piping systems (whether design, operation, or testing), reference is made to gauge or gauge pressure (g). The graph below illustrates the relationship between pressures:



Absolute and relative pressure graph (gauge)

Barometric pressure is the level of atmospheric pressure above perfect vacuum. The normalized atmospheric pressure is 1.013 bar (14.69 psi) or 760 mm of mercury.

Gauge or relative pressure is the pressure measured above atmospheric pressure, while absolute pressure always refers to a perfect vacuum.

Absolute pressure is the sum of the barometric or atmospheric pressure, plus the relative or manometric pressure.

1.5.3) Definition of the range

The pressure and temperature range of a piping class specification is defined based on **the most severe coincident pressure and temperature conditions for all components of a system. That is, the conditions that result in the greatest required thickness and in the highest rating of the components of the piping system.**

Likewise, the range must show the intermediate pressure-temperature combinations at which the components included in that specification can operate. This is important for the application of the same piping specification to more than one service, where for some it may operate in the lower part of the range and for others in the upper part. Following with the example presented at the beginning of this document, the pressure-temperature range is shown below.

Limits: Temperature [ºC] & Pressure [barg]:	-29 | 38	100	150	200	250	300	350	
	20	18	16.1	14	12.3	10.4	8.5	

1.6) Grouping of similar services

Whenever services are grouped into a single piping class specification, it is usual to make a list of pipe classes to serve as a summary of the specifications available in a plant and in this way simplify their use.

Below, a grouping of the piping class specifications of a plant is presented as an example:

Class	Material	Rating	CA [mm]	Work limits		Services	
				P[bar]	T [ºC]		
AA1	Killed carbon steel	150#	1.5	20	-29 | 38	LO	Lubrication Oil
				8.5	350	OS	Fuel Oil
						GN	Natural Gas
AA3	Killed carbon steel	150#	3	20	-29 | 38	WBL	Feed water to LP boilers
				8.5	350	SC	LP Condensates
						SL	LP Steam
AB3	Killed carbon steel	300#	3	52.1	-29 | 38	WBM	Feed water to MP boilers
				38.3	350	SC	MP Condensates
AC3	Killed carbon steel	600#	3	86	-29 | 38	WBH	Feed water to HP boilers
				69.1	350	SS	Saturated Steam
BA3	Carbon steel	150#	3	18.9	-29 | 38	AF	Flotation Air
				12.3	250	AM	Membrane Air
						AP	Plant Air
DA3	Alloy 11/4 Cr - 1/2 Mo	150#	3	20.1	-29 | 38	WA	Acidic Water
				6.6	400		
DC1	Alloy 11/4 Cr - 1/2 Mo	600#	1.5	105.4	-29 | 38	SH	HP Superheated Steam
				69	450		
FA0	Stainless Steel 304 L	150#	0	13.8	-29 | 38	WD	Demineralized Water
				6.6	400	WDR	Cold Demineralized Water
						WDC	Hot Demineralized Water

Annex I - Nomenclature and terminology

Below are the references used in this document.

ASME: American Society of Mechanical Engineers

BE: beveled ends

BL: blind flange

BW: butt weld bevel

CS: carbon steel

Dim. Norm: dimensional regulations (e.g.: ASME B36.10)

DN: nominal diameter

EN: reference to European design codes for the design of piping systems

ERW: electric resistance welded

FLG: flanged ends

FF: flat face

GE: grooved ends

LJ: lap joint

NPS: nominal pipe size

NPT: threaded ends, thread type NPT

OF: orifice flange

PE: plain ends

RF: raised face

RJ/RTJ: ring joint flange

SAW: submerged arc welding

SCH: schedule, nominal number representing the thickness of a pipe according to ASME

SMLS: seamless pipe

SS: stainless steel

STD: standard commercial thickness of a pipe according to ASME

Standard: geometric/fabrication requirements standard (e.g.: ASME B36.10)

SW: socket weld flange/fittings

TE: threaded ends

TH: flange/threaded fittings

PWHT: post-weld heat treatment

WN: welding neck flange

XS: extra strong commercial thickness of a pipe according to ASME

XXS: double extra strong commercial thickness of a pipe according to ASME

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Annex II - Bibliography

Considering that the selection of components of piping system is one of the critical points of any industrial installation, the available literature is almost infinite. Likewise, there are numerous applications (Excel, HTML, etc.) developed mainly to facilitate the collection of data on a day-to-day basis. Although it is true that some authors and papers have already been mentioned throughout this document, the following titles cannot be missing from the library of a good designer:

- Process Piping: The Complete Guide to ASME B31.3 by Dr. Charles Becht
- CASTI Guidebook to ASME B31.3 Process Piping by Glynn E. Woodsand Roy B. Baguley
- Design of Piping Systems, Kellogg, John Wiley & Sons Inc.
- The Piping Handbook, by Mohinder L. Nayyar
- The Piping Guide, Syentek
- Why Branch Connections Fail - A.R.C. Markl, E.C. Rodabaugh and H.H. George, 1955
- ASME B31.1: Power Piping
- B31.3: Process Piping
- B31.4: Pipeline transportation systems for liquid hydrocarbons and other liquids
- B31.8: Gas Transmission and Distribution Piping systems
- API 5L: Specification for Line Pipe
- API-600: Steel Gate Valves
- ANSI ASME B 16.5: Steel Pipe flanges and Flanged Fittings
- ANSI ASME B 16.9: Steel Butt-welding Fittings
- ANSI ASME B 16.11: Forged steel Socket welding and threaded fittings
- ANSI ASME B 16.20: Metallic Gaskets for pipe flanges, RT, spiral wound and jacketed flanges
- ANSI ASME B 16.21: Non-Metallic Gasket for pipe flanges
- ANSI ASME B 16.25: Butt Welding Ends
- ANSI ASME B 16.28: Short Radius Elbows and Returns
- ANSI ASME B 16.34: Steel Valves, flanged and butt-welding ends
- ANSI ASME B 16.47: Large Diameter Steel Flanges – NPS 26-60
- ANSI ASME B 18.2, 1 & 2: Square and hexagonal head Bolts and Nuts (in & mm)
- ANSI ASME B 36.10: Welded and seamless Wrought Steel Pipes
- ANSI ASME B 36.19: Welded and Seamless Austenitic Stainless Steel Pipes
- MSS-SP 97: Integrally Reinforced Forged Branch Outlet Fittings: SW, TH, BW

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