

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUAL

PIPING CLASSES – REFINING AND CHEMICALS

PTS 31.38.01.12

October 2011



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PTS No:	31.38.01.12
PTS Title:	Piping Classes – Refining and Chemicals

This revision of **PTS 31.38.01.12 – Piping Classes – Refining and Chemicals** has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in are indicated in (1.5) Summary of Major Changes.

The previous version of this **PTS 31.38.01.12 (January 2010)** will be removed from PTS binder/ e-repository from herein onwards.

Document Approval

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Revision History

Rev No.	Reviewed by	Approved by	Date



PREFACE

PETRONAS Technical Standards (PTS) publications reflect the views, at the time of publication, of PETRONAS OPU/ Divisions.

They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

When Contractors or Manufacturers/ Suppliers use PTS they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, it is expected of them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the PTS. If in doubt, the Contractor or Manufacturer/ Supplier shall, without detracting from his own responsibility, consult the owner.

The right to use PTS rests with three categories of users:

- 1) PETRONAS and its affiliates.
- 2) Other parties who are authorised to use PTS subject to appropriate contractual arrangements.
- 3) Contractors/ subcontractors and Manufacturers/ Suppliers under a contract with users referred to under 1) and 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

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Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, PTS shall not, without the prior written consent of PETRONAS, be disclosed by users to any company or person whomsoever and the PTS shall be used exclusively for the purpose they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of PETRONAS.

The copyright of PTS vests in PETRONAS. Users shall arrange for PTS to be held in safe custody and PETRONAS may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

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1. INTRODUCTION

1.1 SCOPE

This PTS provides guidelines, requirements and recommended piping classes, developed for use in refineries and chemical plants. The basis of design of the piping classes is described in PTS 31.38.01.10.

The general requirements for piping systems are specified in PTS 31.38.01.11.

Piping classes developed primarily but not exclusively for exploration and production facilities are contained in PTS 31.38.01.15.

This is a revision of the PTS of the same number dated January 2010; Refer to (1.5) for summary of changes since the previous edition of this PTS.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of the PETRONAS Group of companies, and to Contractors nominated by them.

This PTS is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and supply/ marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/ or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Hydrogen service	service in which the process stream contains hydrogen at a partial pressure of 7 bar (abs) and higher.
Low temperature	metal temperature of 0 °C and lower.

Term	Definition
Piping class	assembly of piping components in a piping system, suitable for a defined service within design limits.
Post Weld Heat Treatment	heat treatment carried out after welding to reduce residual stresses and to temper hardened microstructures created by welding.
Very toxic (substances)	substances that are very hazardous for the environment or human health, as specified in PTS 01.00.01.30. (which also identifies "toxic" substances by reference to chemical substances databases).

1.4 CROSS REFERENCES

Where cross references to other parts of this PTS are made, the referenced PTS number is shown in brackets. Other standards referenced in this manual are listed in (6).

1.5 SUMMARY OF MAIN CHANGES

This is a revision of the PTS of the same number dated April 2003 and the last edition of the various piping classes was dated January 2000.

Additionally, the piping class portfolio has been updated in line with business development requirements, new and updated international standards, and feedback from clients. A number of cost saving developments have been introduced.

The most substantial changes are explained below.

A detailed overview of the changes in each piping class is given in Appendix A and for history on changes to the piping classes to date shall be referenced from DEP 31.38.01.12 February 2011 Appendix B.

1.5.2 Design code update

A new revision of ASME B31.3 was issued in December 2008. Piping classes have been updated in line with the latest code requirements for welded components at elevated temperatures.

1.5.3 New piping classes

New piping class (31311) has been introduced for trace hydrofluoric acid service (HF below 2%) and operating below 220°C (430°F). For this piping class, base material is fine grain carbon steel with restriction of residual elements in accordance to supplementary requirements S2 of ASTM A333.

1.5.4 Fittings

Branch outlet fittings were reviewed and updated where applicable.

In stainless steel piping classes, welded stainless steel fittings for sizes DN 200 (NPS 8) and above have been introduced to take the cost advantage.

1.5.5 Valves

New set of small-bore socket welded valves with 13% Cr trim has been introduced in line with market supply and for economic benefit for non-sour and non-corrosive services.

In order to enhance the cost effectiveness of our standards, the current valve standards have been reviewed and modified where necessary to align with manufacturer's practice where appropriate. As part of this, following changes were incorporated:

- For small bore welded valves (without PWHT requirement), face to face dimensions changed to manufacturer's standard.

- For carbon steel steam service piping classes with valve trim material as SS 316 + stellite has been changed to 13% Cr + Stellite,
- For gate/ globe valves with plain trim material as AISI 410 (or) 13 % Cr steel, has been changed to AISI 410 + Stellite 6.

For DN 15 through DN 40 (NPS ½ through NPS 1½), Class 150 and 300, Metal Seated Floating Ball Valves ISO 17292 with reduced bore has been specified as single piece body, which by design physically limits the dimensions of the ball/stem. Metal seated valves require considerably higher torques and need higher strength ball/stem. In order to meet this requirement, metal seated floating ball valves for the above mentioned range has been modified to full bore ball valves.

1.5.6 Branch table

For toxic services (category M fluid service in accordance to ASME B31.3), "Pipe to Pipe connections" have been updated to branch outlet fittings to meet the requirements of Clause M306.5 of ASME B31.3.

1.5.7 Assemblies

In accordance to clause 8.7.2.2, PTS 31.38.01.11, for the following services, **double valve** isolation is required for:

- Piping classes with very toxic fluid service ANSI 150# to ANSI 600#
- Fluids containing Hydrogen at piping class ratings ANSI 600# and above.
- Flashing fluids at piping class ratings ANSI 600# and above
- For other processes at piping class ratings ANSI 900# and above.

Based on the above mentioned requirement, only in those piping classes where the isolation philosophy unambiguously requires double isolation, the following assemblies were updated:

- i) Pressure instrument connection
- ii) Orifice connection
- iii) Meter run connection

2. PIPING CLASSES – SERVICES AND MATERIALS SELECTION INDEX

This index is presented as a spreadsheet on Standard Form PTS 31.38.01.84.



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2011.xls

3. BALL VALVES

The use of soft-seated trunnion-mounted ball valves in listed services were reviewed. In cases where commonly used elastomers were not compatible with the fluid service, the service was reassigned to a piping class without elastomers. Formic acid service was deleted from the service index, pending the development of a new piping class.

For users wanting to include trunnion mounted ball valves in affected services, the table below shows the applicable MESC number range for suitable soft-seated ball valves that are available in MESC version 13.

It is intended that the next edition of this PTS will include a new ball valve piping classes for these services.

Piping class	Service	MESC number range	
11001	Acetone	770025	003.1 to 012.1
	Acetonitrile	770025	044.1 to 046.1
	Methanol		
	Butanone (Methyl ethyl ketone)		
13032	Carbon dioxide	770322	003.1 to 012.1
		770322	044.1 to 046.1
13033	Formic acid	770319	003.1 to 012.1
		770319	044.1 to 046.1
31001	Acetone	770025	053.1 to 062.1
	Acetonitrile	770253	064.1 to 066.1
	Methanol		
	Butanone (Methyl ethyl ketone)		
33032	Carbon dioxide	770322	053.1 to 062.1
		770363	064.1 to 066.1
33033	Formic acid	770319	053.1 to 062.1
		770359	064.1 to 066.1

4. LEVEL DISPLACER CHAMBERS

The table below shows level displacer chambers related to piping class material which are available in the MESC catalogue. The related standard drawing is S 38.056.

Piping class material description	Level displacer chamber material description	MESC number range
Alloy steel 0.5Mo	ASTM A 335 grade P1	768060 702.1 to 738.1
Alloy steel 1.25Cr-0.5Mo	ASTM A 335 grade P11	768060 802.1 to 978.1
Alloy steel 1.25Cr-0.5Mo PWHT	ASTM A 335 grade P11	768064 022.1 to 078.1
Alloy steel 5Cr-0.5Mo PWHT	ASTM A 335 grade P5	768060 742.1 to 938.1
Alloy steel 9Cr-1Mo PWHT	ASTM A 335 grade P9	768059 702.1 to 798.1
Carbon steel	ASTM A 106 grade B	768060 042.1 to 138.1
Carbon steel H-Sour	ASTM A 106 grade B	768060 402.1 to 498.1
Carbon steel PWHT	ASTM A 106 grade B	768059 042.1 to 118.1
Carbon steel H-Sour PWHT	ASTM A 106 grade B	768059 442.1 to 478.1
Carbon steel LT	ASTM A 333 grade 6	768060 242.1 to 338.1
Carbon steel LT H-Sour	ASTM A 333 grade 6	768060 582.1 to 678.1
Carbon steel LT PWHT	ASTM A 333 grade 6	768059 242.1 to 298.1
Stainless steel 304	AISI 304	768061 042.1 to 118.1
Stainless steel 316	AISI 316	768061 442.1 to 538.1
Stainless steel 316L	AISI 316L	768062 002.1 to 038.1
Stainless steel 321/347	AISI 321/347	768061 842.1 to 938.1
Stainless steel 321 stab HT	AISI 321 stab HT	768061 562.1 to 678.1
Duplex stainless steel	ASTM A 790 UNS S31803	768062 402.1 to 498.1
Super duplex stainless steel	ASTM A 790 UNS S32750	768062 502.1 to 538.1

5. PIPING CLASSES

The piping classes for ASME class ratings 150, 300, 600, 900, 1500 and 2500 are contained in separate files for each ASME class rating.

These piping classes SHALL [PS] be used for services as specified in the Services and Materials Selection Index PTS 31.38.01.84. (e.g. fluid service, ASME pressure rating, temperatures, sizes, materials, valves, etc.).

For services not covered in PTS 31.38.01.84., piping classes shall be developed based on the philosophies outlined in PTS 31.38.01.10 and PTS 31.38.01.11. Guidance on the development of project-specific piping classes is given in PTS 31.38.01.21.

6. REFERENCES

In this PTS, reference is made to the following publications:

NOTES:

1. Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.
2. The PTSs are available to PETRONAS staff on the AXIS Web site at <http://pww.axis.petronas.com.my/sites/ptssite1/default.aspx/>.
3. Excluded from this list are the standards referenced in the piping classes themselves, a list of which would be too extensive.

PETRONAS STANDARDS

Definition of temperature, pressure and toxicity levels	PTS 01.00.01.30
Piping classes – Basis of design	PTS 31.38.01.10
Piping – General requirements	PTS 31.38.01.11
Piping classes – Exploration and production	PTS 31.38.01.15
Compilation of a specification for piping systems	PTS 31.38.01.21
Standard Form: Piping classes – Services and material selection index	PTS 31.38.01.84
Standard Drawing: Displacer chambers	S 38.056

AMERICAN STANDARDS

Process piping	ASME B31.3:2008
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Issued by:
American Society of Mechanical Engineers
345 East 47th Street
New York NY 10017
USA

Standard specification for seamless carbon steel pipe for high-temperature service	ASTM A 106
Standard specification for seamless, welded, and heavily cold worked austenitic stainless steel pipes	ASTM A 312
Standard specification for seamless and welded steel pipe for low-temperature service	ASTM A 333
Standard specification for seamless ferritic alloy-steel pipe for high-temperature service	ASTM A 335
Standard specification for electric-fusion-welded austenitic chromium-nickel stainless steel pipe for high-temperature service and general applications	ASTM A 358
Standard specification for seamless and welded ferritic/austenitic stainless steel pipe	ASTM A 790

Issued by:
American Society for Testing and Materials,
100 Barr Harbor Drive, West Conshohocken,
PA 19428-2959,
USA

INTERNATIONAL STANDARDS

Metal ball valves for petroleum, petrochemical and allied industries

ISO 17292

*Issued by:
ISO Central Secretariat
1, ch. de la Voie-Creuse
Case postale 56
CH-1211 Genève 20
Switzerland*

Copies can also be obtained from national standards organizations.

APPENDIX A DETAILED CHANGES PER PIPING CLASS



31380112 Appendix
A.xls

APPENDIX B HISTORY OF DEP PIPING CLASSES INDEX



History of piping
classes 2010.xls

AVA Documents
Document Sharing Hub

Reference	Piping class																							Material	Sour service (note 2)	PWHT	Corr. allow.	Valve FETC (note 13)	ASME B16.5 mat. group	Temperature			Ball valve seat
PTS	PTS Piping class	PTS Piping class (old)	PN barg max	Class rating / Diameter range																			Piping class [°C] (note 14)							where T _{min} is between 0° and -20°C use PC			
				ASME class 150	DN (min)	DN (max)	300	DN (min)	DN (max)	600	DN (min)	DN (max)	900	DN (min)	DN (max)	1500	DN (min)	DN (max)	2500	DN (min)	DN (max)	>2500											
PTS 31.38.01.12	1071	1071	///	1	15	1200	3	15	1200	6	15	1200	9	15	1200	15	15	200	///	///	///	///	Carbon steel	moderate		1	B	1.1	0	400	1071-KS		
PTS 31.38.01.12	1071-KS	-	///	1	15	1200	3	15	1200	6	15	1200	9	15	1200	15	15	200	///	///	///	///	Carbon steel	moderate		1	B	1.1	-20	340	///		
PTS 31.38.01.12	1073	1073	///	1	15	1200	3	15	1200	6	15	1200	///	///	///	///	///	///	///	///	///	///	Carbon steel	moderate		1	A(HS)	1.1	0	400	///		
PTS 31.38.01.12	1076	1076	///	1	15	1200	3	15	600	6	15	600	9	15	600	15	15	600	25	15	500	///	Carbon steel	moderate		3	B	1.1	0	400	1076-KS		
PTS 31.38.01.12	1076-KS	-	///	1	15	1200	3	15	600	6	15	600	9	15	600	15	15	600	25	15	500	///	Carbon steel	moderate		3	B	1.1	-20	340	///		

Reference	Piping class		Class rating / Diameter range																					Material	Sour service (note 2)	PWHT	Corr. allow.	Valve FETC (note 13)	ASME B16.5 mat. group	Temperature			Ball valve seat
	PTS	Piping class	PTS Piping class (old)	PN barg max	ASME class																		Piping class [°C] (note 14)							where T _{min} is between 0° and -20°C use PC			
					150	DN (min)	DN (max)	300	DN (min)	DN (max)	600	DN (min)	DN (max)	900	DN (min)	DN (max)	1500	DN (min)	DN (max)	2500	DN (min)	DN (max)	>2500								Min	Max	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1085	1172		1	15	1200	3	15	1200																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1086	1173		1	15	600	3	15	600																	1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1087			1	15	1200																				1	B	1.1	-50	150	-	soft	
PTS 31.38.01.12	1092	1091		1	25	300	3	25	300																	3	A(HS)	1.1	0	65	1092-KS	soft	
PTS 31.38.01.12	1092-KS	-		1	15	300	3	15	300																	3	A(HS)	1.1	-20	150		soft	
PTS 31.38.01.12	1141	1041		1	15	1200	3	15	1200	6	15	1200														1	A(HS)	1.1	0	400	1141-KS		
PTS 31.38.01.12	1141-KS	-		1	15	1200	3	15	1200	6	15	1200														1	A(HS)	1.1	-20	340			
PTS 31.38.01.12	1142	1042		1	15	1200	3	15	1200	6	15	1200														3	A(HS)	1.1	0	400	1142-KS		
PTS 31.38.01.12	1142-KS	-		1	15	1200	3	15	1200	6	15	1200														3	A(HS)	1.1	-20	340			
PTS 31.38.01.12	1160	1160					3	15	900	6	15	600														1	A(HS)	1.1	0	410	-		
PTS 31.38.01.12	1174	1174		1	15	1200	3	15	1200	6	15	1200														1	B	1.3	-50	340	-		
PTS 31.38.01.12	1175	1175		1	15	1200	3	15	1200																	1	B	1.3	-50	340	-		
PTS 31.38.01.12	1176	1176		1	15	1200	3	15	1200	6	15	1200	9	15	1200											3	B	1.3	-50	340	-		
PTS 31.38.01.12	1180	1180		1	15	1200	3	15	1200	6	15	1200	9	15	1200											1	B	1.3	-50	340	-		
PTS 31.38.01.12	1180	1180		1	15	1200	3	15	1200	6	15	1200	9	15	1200											1	B	1.3	-50	340	-		
PTS 31.38.01.12	1180	1180		1	15	1200	3	15	1200	6	15	1200	9	15	1200											1	B	1.3	-50	340	-		
PTS 31.38.01.12	1180	1180		1	15	1200	3	15	1200	6	15	1200	9	15	1200											1	B	1.3	-50	340	-		
PTS 31.38.01.12	1187			1	15	1200																				1	A(HS)	1.1	-50	150	-	soft	
PTS 31.38.01.12	1201	1201	16.0	1	15	1200																				1	-	1.1	0	90	-	soft	
PTS 31.38.01.12	1201	1201	16.0	1	15	1200																				1	-	1.1	0	90	-	soft	
PTS 31.38.01.12	1210	1210		1	50	400	3	50	400																	3	B	1.1	0	200	-		
PTS 31.38.01.12	1220	1220		1	15	400																				1	B	1.1	0	200	-		
PTS 31.38.01.12	1261	1261		1	15	1200	3	15	1200	6	15	1200	9	15	600	15	15	400								1	B	1.1	0	400	-		
PTS 31.38.01.12	1271	1271					3	25	150																	1	A(HS)	-	-35	70	-	soft	
PTS 31.38.01.12	1301	1300		1	15	600	3	15	600																	1	A(HS)	1.1	0	200	1301-KS	metal	
PTS 31.38.01.12	1301-KS	-		1	15	600	3	15	600																	1	A(HS)	1.1	-20	200		metal	
PTS 31.38.01.12	1310	1310					3	15	300																	3	A(HS)	-	-15	200			
PTS 31.38.01.12	1311	1310					3	15	300																	3	A(HS)	-	-15	200			
PTS 31.38.01.12	1374	1374		1	15	1200	3	15	1200	6	15	1200	9	15	600	15	15	150								3	B	1.1	0	400	1374-KS		
PTS 31.38.01.12	1374-KS	-		1	15	1200	3	15	1200	6	15	1200	9	15	600	15	15	150								3	B	1.1	-20	340			
PTS 31.38.01.12	1380	-		1	15	1200	3	15	1200	6	15	1200	9	15	1200											3	B	1.1	-50	340	-		
PTS 31.38.01.12	1380	-		1	15	1200	3	15	1200	6	15	1200	9	15	1200											3	B	1.1	-50	340	-		
PTS 31.38.01.12	1380	-		1	15	1200	3	15	1200	6	15	1200	9	15	1200											3	B	1.1	-50	340	-		
PTS 31.38.01.12	1382	-		1	15	1200											</																