

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

TECHNICAL SPECIFICATION

SELECTED CONSTRUCTION MATERIALS FOR SHELL AND TUBE HEAT EXCHANGERS

PTS 31.21.01.31

FEBRUARY 2010



PTS Circular 2010 – 1



PTS No:	31.21.01.31
PTS Title:	Selected Construction Materials for Shell and Tube Heat Exchangers

This revision of PTS **31.21.01.31 – Selected Construction Materials for Shell and Tube Heat Exchangers (Revision 14, February 2010)** has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates, if any, in the document are highlighted in *italic* font.

The previous version of this PTS **31.21.01.31 (December 2004)** will be removed from PTS binder / e-repository from herein onwards.

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Revision History

Rev No.	Reviewed by	Approve By	Date
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PREFACE

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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.

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1. INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the selection of construction materials for shell and tube heat exchangers.

The general selection of construction materials should be made after careful consideration of the design and operating conditions, the corrosivity of the fluids involved and all potential degradation mechanisms. This should be done in consultation with the materials/corrosion engineering department. Once the general selection has been determined, the lists in this PTS will enable effective specification of all heat exchanger parts.

This PTS contains a matrix with generic material designations for non-fired shell and tube heat exchangers including coolers, condensers and reboilers.

The range of materials has been expanded to include other material groups including low alloy steels, low temperature steels, duplex stainless steels and titanium. The recommendations are shown in the matrix. This still leaves many materials and materials combinations un-addressed; for instance, high-alloy stainless steel tube bundles. A materials and corrosion specialist shall be consulted for materials combinations not covered by this PTS. Particular combinations and restrictions for exploration and production facilities are governed by PTS 39.01.10.11.

Shell and tube heat exchangers shall be considered to be pressure vessels. The construction materials specified in this PTS are limited to those for the tube bundle and channels (tube side). The materials for the shell are not sufficiently distinctive from other pressure vessels to justify separate PTS. Therefore shell materials selection shall be in compliance with the selected pressure vessel standard such as PTS 31.22.10.32, PTS 31.22.11.32, or PTS 31.22.20.31.

The lower design temperature of the heat exchanger shall be determined according to PTS 30.10.02.31, and any additional requirements of that PTS shall be adhered to.

A materials specialist shall be consulted to prevent possibility of the selected bundle material having an undesired influence on the shell construction or, for instance, if galvanic effects between bundle and shell are possible.

This PTS is a revision of the PTS of the same number dated December 2004; it is impractical to summarise the differences, see (1.5).

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 or managed by a Group company and, where necessary, to Contractors and Manufacturers nominated by them.

This PTS is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and where applicable, supply/marketing installations. When PTS are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

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 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

The **Contractor** is the party which 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 which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. 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 word **should** indicates a recommendation.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced by this PTS are listed in (4).

1.5 CHANGES FROM PREVIOUS EDITION

This is a revision of the PTS of the same number dated December 2004.

This has been mainly an editorial revision, with no technical change.

2. CLASSIFICATION OF MATERIAL DESIGNATION LISTS

(Appendix 1, Table A-1) gives a basic materials selection guide for a number of generalised service conditions. 'General non-corrosive service' assumes that both the shell side and tube side are exposed to non-corrosive products. 'Non corrosive service, low temperature' assumes that both the product side and the heating medium side are exposed to non-corrosive products. Definitions for cooling water corrosivity are given in (3.3).

Seven main groups of materials have been considered; they are given in (Appendix 1, Table A-2):

- A. Carbon steel
- B. Low temperature carbon steel
- C. Low alloy and stainless steels
- D. Copper-based alloys
- E. Duplex stainless steels
- F. Alloy 400 (Monel)
- G. Titanium

The most common types of heat exchangers are considered in Table A-2, including fixed tube sheet, floating head and hairpin bundle designs. It is not the intention to cover all possible heat exchanger designs, although variants will generally require similar materials selection.