

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

TECHNICAL SPECIFICATION

AIR-COOLED HEAT EXCHANGERS (AMENDMENTS/SUPPLEMENTS TO ISO 13706)

PTS 31.21.70.31

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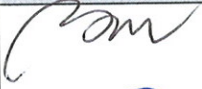
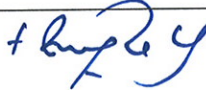
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This revision of PTS 31.21.70.31, Release 13: March 2001 for AIR-COOLED HEAT EXCHANGERS (AMENDMENTS/SUPPLEMENTS TO ISO 13702) has been updated incorporating PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in the document are highlighted in *italic* font.

Document Approval

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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.

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- 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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PART I INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for air-cooled heat exchangers.

Part III of this PTS provides amendments and supplements to ISO 13706, Second edition, **October 2005**. The section numbering in Part III follows that of ISO 13706. Where clauses of ISO 13706 are not amended or supplemented by this PTS, they shall apply as written.

This is a revision of the PTS of the same number dated March 2001; summary of changes, amendment and/or revision is noted in 1.5 below.

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 PETRONAS Group 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 Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 TERMS AND 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 air-cooled heat exchange equipment and services to perform the duties specified by the Contractor.

NOTE: The terms Supplier and Manufacturer as used in this PTS are synonymous with the term **Vendor** (as used in ISO 13706) depending on the context in which the term is used.

The **Principal** is the party which initiates the project work 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 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 referred to in this PTS are listed in Part IV.

1.5 CHANGES FROM PREVIOUS REVISION

The previous edition of this PTS was dated March 2001. The main changes are as follows:

Old Section	New Section	Changes
-	-	The PTS is based on ISO 13706:2005
7.1.6.2.7	7.1.6.2.6	Change clause number due to change in standard.
7.2.10.9	7.2.10.10	Change clause number due to change in standard.
10.2.10	10.1.9	Change clause number due to change in standard.
10.2.13	10.1.12	Change clause number due to change in standard.
11.2.1	11.2.1	Referenced PTS amended to PTS 30.48.00.31-P
12.2.3	12.2.2	Change clause number due to change in standard.
12.2.4	12.2.4	Retain clause number as an added new para in this PTS.
Part IV References	Part IV References	Referenced PTS amended to PTS 30.48.00.31-P – Painting and coating of new equipment.

PART II GENERAL INFORMATION

1. SELECTION OF TYPE OF AIR-COOLED HEAT EXCHANGER

For refinery services the horizontal air-cooled heat exchanger shall be applied, either forced draught or induced draught, so that several air-cooled heat exchangers can be grouped into one bank.

Vertical, "V" frame and "A" frame or "roof" type air-cooled heat exchangers are not covered by ISO 13706 or this PTS; none of these shall be selected without the agreement of the Principal.

2. ORDERING

2.1 Requisitioning

The applicable data/requisition sheets listed in Appendix 1 of this PTS shall be used, completed in accordance with Appendix 2 of this PTS.

2.2 Scope of supply

Unless otherwise specified, the scope of supply shall be as specified on data/requisition sheets PTS 31.21.70.93

The Manufacturer shall include all special features necessary for reliable and safe operation. These should include, where applicable, adequate means of control to cope with the specified variations in operating conditions.

With regard to safety and reliability, unspecified but self-evident conditions may occur during start-up, shutdown, power failure or interruption of the process flow. These shall be taken into account and may require one or more of the following features:

- heating coils combined with louvres in order to keep high pour-point fluids at an adequate temperature level under no-flow conditions;
- variable speed fans (drives);
- hand-controlled or motor-operated louvres for improvement of the air-side control range if direct air-side control during turndown or under winter conditions, etc., is otherwise made impossible by wind, rain or free convective air-flow effects;
- ducting and louvres for controlled air recirculation to enable handling of products which would otherwise cause pour-point and hydrate formation problems.

Excluded from the scope of supply are foundations, the erection of the supporting structure and the fireproofing of the structural steel.

3. UNITS OF MEASUREMENT

The SI system of units has been applied in this PTS and, where considered necessary, the metric sizes are followed by their imperial equivalents in brackets.

The use of SI units on the data/requisition sheets shall be in accordance with PTS 00.00.20.10 Care shall always be taken to indicate whether absolute pressure or gauge pressure is intended. If bar is used as the unit of pressure, this shall be qualified as bar (abs) or bar (ga), as applicable.

4. EQUIPMENT NUMBERING

Air-cooled heat exchangers shall be identified by specific equipment numbers in accordance with PTS 31.10.03.10

Equipment consisting of one or more tube bundles connected in series or parallel and performing a common duty is termed an item. In such cases, the item as a whole is identified by the specific equipment number, and each bundle within the item is separately

identified by the addition of a capital letter in alphabetical progression, e.g. E-101A, E-101B, E-101C etc. Each unique motor/fan combination shall have an equipment number which may differ from the bundle number. Identical motor/fan combinations in a bank shall be numbered in alphabetical progression, e.g. EM-110A, EM-110B, EM-110C etc.

5. THERMAL DESIGN AND RATING

The party (e.g. Contractor, Manufacturer) which performs the thermal design or rating of an air-cooled heat exchanger shall retain responsibility for the thermal design or rating.

In the case of a proprietary design, the Manufacturer shall contact the Principal to agree on the calculation method and the degree of responsibility.

The thermal design and rating of an air-cooled heat exchanger shall be based on design methods which have been proven in practice. In this respect, the design procedures and computer programs M-ACOL developed by HTFS and "ACE" developed by HTRI are considered proven design methods.

In the event of inadequate performance, the HTFS M-ACOL program shall be used as the basis for re-assessing the thermal performance rating. The applicable version shall be stated by the Principal.

The print-out of the computer runs shall correspond to the input data. No changes or deviations shall be made between running the input on computer program and printing the results.

Special requirements assumed for the thermal design, e.g. irregular pass lay-out or calculation of noise levels (e.g. fan inlet bell type), shall be recorded appropriately and/or shown on drawings (sketches).

Process data shall be provided for the base case as well as off-design or upset cases that could affect either the thermal or mechanical design of the air cooler.

The physical properties of the fluid and the mechanical requirements/limitations shall be specified on data/requisition sheet PTS 31.21.70.93, sheets 1, 2 and 3. If the data provided is considered by the designer or the Manufacturer to be insufficient for design purposes, it is his responsibility to request further information from the Principal.

Under non-critical process conditions, the air design temperature shall be the higher of the following:

- the highest air temperature which is exceeded for 400 hours per year;
- 4 °C lower than the highest air temperature which is exceeded for 40 hours per year.

Under critical process conditions, the air design temperature shall be the highest air temperature which is exceeded for 40 hours per year.

Typical fouling resistances shall be taken from PTS 20.21.00.31 To cater for increasing pressure drop on the tube side due to fouling, the pressure drop for the fouled condition shall be derived from the pressure drop calculated for the clean condition multiplied by the following factor:

Fouling resistance m ² .K/W	multiplication factor
0.00009 to 0.00033	1.1
0.00034 to 0.00085	1.2
0.00086 and higher	1.5

Consideration shall be given to the need for special devices to prevent erosion of the tube ends for gases and vapours when the ρV^2 in the tubes exceeds 7000 kg/m.s². For liquids the ρV^2 calculated with the maximum water velocities as specified in PTS 20.21.00.31. for

the different tube materials will be the maximum. For two-phase flow, the ρV^2 in the tubes shall be checked carefully against the danger of erosion of the tube ends. In such case, the velocity and density shall be based on a homogeneous gas/liquid mixture.

In exchangers with a condensing duty, the passes for the condensing phase shall extend over the full width of the bundle. In exchangers with total condensation, the size of the outlet nozzles shall be such that flooding of the bottom row of tubes cannot occur.

The Principal shall be consulted if turbulators, inserts and/or static mixers are envisaged.