

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

CENTRIFUGAL PUMPS (AMENDMENTS/SUPPLEMENTS TO ISO 13709: 2003)

PTS 31.29.02.30

DECEMBER 2010



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PTS No:	31.29.02.30	
PTS Title:	Centrifugal Pumps (Amendments / Supplements to ISO 13709; 2003)	

This revision of PTS 31.29.02.30– Centrifugal Pumps (Amendments / Supplements to ISO 13709; 2003) 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.

The previous version of this PTS 31.29.02.30 (May 2004) will be removed from PTS binder/ e-repository from herein onwards.

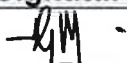
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Document Approval

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May 2004	1		
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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's 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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PART I INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for centrifugal pumps.

This PTS is based on ISO 13709:2003. Part II and Part III of this PTS amend, supplement and delete various clauses of ISO 13709.

NOTE: API 610, 10th edition, is identical to ISO 13709:2003.

Part II of this PTS applies to pumps for non-essential service and to spared pumps for essential service.

Part III of this PTS applies, in addition to Part II, to pumps for vital service and to unspared pumps for essential service.

All clauses of ISO 13709 not modified by this PTS shall remain valid as written.

This PTS shall be used in conjunction with data/requisition sheet PTS 31.29.02.93.

This PTS is a minor revision of the PTS of the same number dated May 2004; a summary of the main changes is given in (1.5).

1.2 DISTRIBUTION, APPLICABILITY AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this document 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, supply/marketing installations and, where applicable, in onshore exploration and production facilities.

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 combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document 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 document 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 or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier/Vendor** 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 **Purchaser** may be the Contractor or 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 (Part IV).

1.5 SUMMARY OF MAIN CHANGES SINCE PREVIOUS EDITION

Clause	Change
3.61	<i>Definitions of hazardous categories aligned with PTS 31.29.02.11 and PTS 31.29.00.33</i>
3.64	<i>Acronyms defined for clarity</i>
5.4.3.4	<i>"or if ISO 15156 or NACE MR0103 is applicable" added</i>
6.5.1.2	<i>Added to align with PTS 31.29.00.33</i>
6.5.2.4	<i>Added to align with PTS 31.29.00.33</i>
9.2.1.1	<i>Modified to include exceptions to this PTS</i>

PART II PUMPS FOR NON-ESSENTIAL SERVICE AND SPARED PUMPS FOR ESSENTIAL SERVICE (AMENDMENTS/SUPPLEMENTS TO ISO 13709:2003)

1. SCOPE

ADD TO THIS CLAUSE:

Part II of this PTS applies to pumps for non-essential service and to spared pumps for essential service.

3. DEFINITION OF TERMS

ADD NEW CLAUSE:

3.60 continuous operation

uninterrupted operation for a period of at least 24 000 h at the specified operating conditions

NOTE: This does not include intermittent operations such as:

- pumps started and stopped automatically at intervals by process-operated controls;
- pumps started up and stopped manually for batch transfer;

ADD NEW CLAUSE:

3.61 hazardous service

service comprising the following categories, which shall be specified on the data/requisition sheets:

Category 1

- *Liquids consisting of or containing very toxic substance as defined in PTS 01.00.01.30, Section 5, paragraphs i and ii. These substances are also known as "very toxic - acute".
Examples of very toxic - acute substances include, but are not limited to: liquids containing hydrogen sulphide in concentrations above 600 mg/kg, HF acid, phenol, ethylene oxide, and concentrated sulphuric acid.*

Category 2

- *Liquids consisting of or containing very toxic substance as defined in PTS 01.00.01.30., Section 5, paragraph iii. These substances are also known as "very toxic - chronic".
Examples of very toxic - chronic substances include, but are not limited to: liquids containing benzene, 1,3-butadiene, HCL, ammonia.*
- *Hydrocarbon liquids at an operating temperature above their auto-ignition temperature.*

Category 3

- *Hydrocarbon liquids with a seal chamber vapour pressure higher than 500 kPa (abs) [73 psia];*
- *Light hydrocarbon services (ISO 21049:2004, Clause 3.38).*

ADD NEW CLAUSE:

3.62 Multi-stage pumps

pumps with three (3) or more stages

ADD NEW CLAUSE:

3.63 abrasive service

service in which there is an expected wear rate of 0.1 mm (0.004 in) or more per year, or where hard particles larger than 100 µm (0.004 in) exist in quantities exceeding 100 mg/kg (100 ppm).

ADD NEW CLAUSE:

3.64 vital, essential and non-essential services

These terms are defined as follows:

	SAFETY EQUIPMENT	OTHER EQUIPMENT		
	SERVICE CATEGORY			
	VITAL	ESSENTIAL		NON-ESSENTIAL
		Non-spared equipment	Spared equipment	
Definition	A service in which failure of equipment causes an unsafe condition of the plant or installation resulting in jeopardy to life and/or major damage (fire, explosion etc.).	A service in which failure of equipment renders a plant or process unit inoperable or reduces performance to a level unacceptable to the Principal.	A service in which failure of equipment renders a plant or process unit inoperable or reduces performance to a level unacceptable to the Principal.	All other services.
Examples	- Firewater pumps with diesel and motor drives; - Emergency Shutdown (ESD) systems; - Emergency Instrument Air (EIA) compressor.	- Hydrocracker (HCU) feed pump; - HCU recycle compressor; - Cat Cracker (FCCU) main air compressor; - Forced Draft (FD) and Induced Draft (ID) fans.	- Boiler Feedwater (BFW) pumps; - Fractionator's bottom pumps; - Fresh gas compressors (HCU).	- Drinking water pumps; - Sewage pumps.

4. CLASSIFICATION AND DESIGNATION

4.2 Pump designations

4.2.4 ADD TO THIS CLAUSE:

Pump type OH4 shall not be used.

4.2.5 ADD TO THIS CLAUSE:

OH5 pumps shall also comply with BS 4082-1, with a casing test pressure rating of Code R.

4.2.10 ADD TO THIS CLAUSE:

Pump type BB4 shall not be used.

4.3 Units and governing requirements

ADD NEW CLAUSE:

4.3.3 In the case of conflicting requirements between documents relating to the enquiry or order, the following hierarchy of documents shall apply:

- upper level: applicable regulations
- second level: purchase order and variations thereto;
- third level: data/requisition sheets and drawings;
- fourth level: this PTS

5. BASIC DESIGN

5.1 General

5.1.10 REPLACE THIS CLAUSE BY:

The Net Positive Suction Head Required (NPSHR) shall be based on water [at a temperature of less than 65 °C (150 °F)] at the rated flow and rated speed; no reduction or correction factors shall be applied for other liquids.

The Net Positive Suction Head Available (NPSHA) shall exceed the Net Positive Suction Head Required (NPSHR) by at least 1 m (3 ft) throughout the range from minimum continuous stable flow up to and including the rated capacity, and by 0.3 m (1 ft) at 120 % of rated flow. If the suction pressure at the pump is less than atmospheric, this margin shall be at least 2 m (6 ft).

For liquids containing dissolved gases, to avoid cavitation damage due to vapour-induced flow path restrictions, NPSHA shall be 1.5 x NPSHR, with a minimum margin of 5 m (15 ft) between NPSHA and NPSHR.

5.1.11 ADD TO THIS CLAUSE:

Suction specific speeds shall be no greater than 12 800 unless approved by the Principal.

NOTES: 1. The above value shall be calculated in accordance with Annex A, however using the following units:

- rotative speed expressed in revolutions per minute;
- flow rate expressed in cubic metres per hour;
- NPSHR expressed in metres.

2. The above value is 11 000 when calculated using the following US Customary units:

- rotative speed expressed in revolutions per minute;
- flow rate expressed in U.S. gallons per minute;
- NPSHR expressed in feet.

5.1.13 REPLACE THE FIRST SENTENCE OF THIS CLAUSE BY:

Pumps shall have stable head/capacity curves which continuously rise by at least 5 % from rated capacity to shut-off. The gradient of the tangent to the curve shall continuously decrease from 125 % of the best efficiency point to minimum continuous stable flow and shall remain positive.

5.1.16 Noise Control

REPLACE THIS CLAUSE BY:

5.1.16.1 Limits

The Contractor shall comply with PTS 31.10.00.31 and thereby communicate to the Vendor the specified equipment noise limitations by using data sheet PTS 31.10.00.94-Gen., which forms part of the requisition. The Vendor is responsible for assuring that these equipment noise limitations have been specified.

5.1.16.2 Information to be submitted with the tender

The Vendor shall submit guaranteed sound power levels and sound pressure levels (including octave band spectrum) of the equipment, together with any other relevant information as requested in the data sheet, PTS 31.10.00.94. The Vendor shall indicate what special silencing measures, if any, are proposed in order to meet the specified levels.

5.1.17 ADD TO THIS CLAUSE:

The numbers of vanes in impellers shall be different to the numbers of vanes in diffusers. On pumps with two or more stages impellers/diffuser configuration shall be staggered to avoid coincidence of pressure pulses.

5.1.19 REPLACE THE FIRST SENTENCE OF THIS CLAUSE BY:

Cooling water plans shall not be supplied, unless it is required by the seal flush plan or if the pumping temperature exceeds 200 °C (400 °F). Above 200 °C (400 °F) cooling water plans shall only be applied if recommended by the vendor.

5.1.20 REPLACE THIS CLAUSE BY:

Heating jackets for seal chambers, and bearings shall be integrally cast or welded design. The coolant passage shall allow cleaning, flushing and draining of the entire passageway. Only heating chambers for bearing brackets may be equipped with O-ring sealed covers to facilitate cleaning.

5.1.26 REPLACE THIS CLAUSE BY:

All major joints shall make up metal-to-metal. Pump designs which require gauging for parallelism shall not be used.

5.1.30 ADD TO THIS CLAUSE:

For marine applications, the vendor shall state the maximum inclination at which the pump can operate.

ADD NEW CLAUSE:

- 5.1.32 For balancing axial thrust in multi-stage pumps, only the following arrangements shall be used, either alone or in combination:
- individually-balanced impellers or opposed arrangements of impellers;
 - a balancing piston (except that this shall not be used if the pump is for abrasive service (see 3.63)).

Balance disk or combinations with a balance disk shall not be used.

5.3 **Pressure casings**

- 5.3.6 All parts referred to in the definition of pressure casing (3.42) shall have the same MAWP.

5.3.9 REPLACE SUBCLAUSE a) BY:

- a) A pumping temperature of 100 °C (200 °F) or higher, unless approved by the Principal.

5.4 **Nozzle and pressure casing connections**

- 5.4.2 Suction and discharge nozzles

5.4.2.1 REPLACE THIS CLAUSE BY:

All pumps shall have flanged suction and discharge nozzles of equal ASME pressure/temperature ratings.

5.4.2.2 REPLACE THIS CLAUSE BY:

Cast iron shall not be used.

5.4.3 Pressure casing connections

5.4.3.1 REPLACE THIS CLAUSE BY:

Threaded connections to the pressure casing shall not be used, except that the seal gland connection may be threaded.

5.4.3.4 REPLACE THIS CLAUSE BY:

All auxiliary connections to the pressure casing shall be fitted with flanged stubs. Integral flanges may be used. If the pump nozzles are Class 900 or above, or the pumping temperature is 0 °C (32 °F) or below, or if the pump is for hazardous service, or if ISO 15156 or NACE MR0103 is applicable, then socket welded connections shall not be used. In these cases full penetration butt welded connections are required.

5.4.3.6 ADD TO THIS CLAUSE:

Valves shall not be welded to the pump

5.4.3.7 REPLACE THE FIRST SENTENCE OF THIS CLAUSE BY:

Openings shall not be furnished unless they are essential, in which case they shall be located away from high-velocity areas. The provision and location of openings shall be identified in the vendor's proposal and shall be subject to the approval of the Principal. All openings furnished and not connected to piping shall be closed with a flange in accordance with (5.4.3.4).

ADD TO THIS CLAUSE:

Balance lines and their connections shall be flanged. Unions shall not be used.

5.6 Rotors

5.6.3 REPLACE THE THIRD SENTENCE OF THIS CLAUSE BY:

Collets shall not be used in vertical pumps.

5.6.11 REPLACE THE LAST SENTENCE OF THIS CLAUSE BY:

The use of target rings requires the approval of the Principal.

ADD NEW CLAUSE:

5.6.16 Shafts and impellers shall not be plated for repair purposes. Repairs to rotating elements shall be subject to review and approval by the Principal.

5.7 Wear rings and running clearances

5.7.2 ADD TO THIS CLAUSE:

The minimum hardness of wear rings shall be 250 HBW except where restricted by Appendix 1 of this PTS.

5.7.3 ADD TO THIS CLAUSE:

Wear rings shall not be of a U-shaped design.

5.8 Mechanical shaft seals

5.8.1 REPLACE THIS CLAUSE BY:

All mechanical seals shall be in accordance with PTS 31.29.00.33.

To ensure selection of the optimum mechanical seal and seal auxiliary facilities for the duty specified, the pump manufacturer shall be responsible for the engineering coordination, installation, and performance of its auxiliary facilities such as circulation, injection, quenching and cooling, as required for the seal selected by the seal manufacturer.

5.8.2 ADD TO THIS CLAUSE:

... except for vertical pumps.

5.9 Dynamics

5.9.2 Torsional analysis

5.9.2.1 ADD TO THIS CLAUSE:

Torsional analysis shall be performed if specified by the Principal.

NOTE: It is unusual for a torsional analysis to be required for a pump. A torsional analysis and the associated report can be expensive, so caution should be exercised when specifying a torsional analysis.

REPLACE SUB-CLAUSE d) BY:

d) electric motor with variable frequency drive (VFD) rated at 500 kW (670 hp) or higher.

5.9.3 Vibration

5.9.3.6 ADD TO THIS CLAUSE:

For vertical, close-coupled, in-line pumps vibration readings shall be taken on both bearings for the electric motor driver in the horizontal plane at 90° to each other. For vertical pumps with a flexible coupling additional readings shall be taken at the pump top bearing.

5.10 Bearings and bearing housings

5.10.1 Bearings

5.10.1.3 ADD SUB-CLAUSE e):

Non-metallic cages shall not be used.

Table 9 ADD SUB-CLAUSE d):

d) journal sizes greater than 150 mm (6 in).

5.11 Lubrication

5.11.4 REPLACE THIS CLAUSE BY:

Grease lubrication shall not be used.

5.12 Materials

5.12.1 General

5.12.1.1 REPLACE THIS CLAUSE BY:

The materials of construction shall be in accordance with Appendix 1 of this PTS, unless otherwise specified by the Principal.

5.12.1.2 REPLACE THE FIRST SENTENCE OF THIS CLAUSE BY:

The material specification of all components listed in Appendix 1 shall be clearly stated in the vendor's proposal.

5.12.1.4 DELETE THIS CLAUSE.

5.12.1.6 DELETE THIS CLAUSE.