

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

DIESEL ENGINES

PTS 31.29.80.30

NOVEMBER 2010



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This revision of PTS 31.29.80.30 – Diesel Engines has been updated and has incorporated PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. This PTS is still valid and with editorial changes only.

The previous version of this PTS 31.29.80.30 (December 2000) will be removed from PTS binder / e-repository from herein onwards.

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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/Divisions 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 stationary Diesel engines used as prime movers. It is intended to cover the basic engine and its essential auxiliaries produced as a proprietary item by an engine Manufacturer. This PTS does not include packaging of the driven equipment.

The scope of this PTS is for engines above 250 kW rated power. Special circumstances may dictate its application to smaller engines, such as for use in vital service.

Information regarding the specific engine will be given in the requisition.

This PTS is a revision of the PTS of the same number dated October 1994; a summary of the main changes since the previous edition is given in (1.6).

1.2 DISTRIBUTION, INTENDED USE 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 and Manufacturers/Suppliers nominated by them.

This PTS is intended for use in oil refineries, gas handling installations, chemical plants, oil and gas production facilities (both onshore and offshore) 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 which carries out all or part of the design, engineering, procurement, construction, and 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** 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.

1.3.2 Specific definitions

The terminology used in this PTS is in accordance with ISO 2710.

All statements regarding engine power in this PTS are in accordance with ISO 3046-1.

The following are specifically defined:

auxiliaries	equipment necessary for the operation of the engine but not an intrinsic part of the engine, often manufactured by a party other than the Diesel engine Manufacturer
hazardous area 423-03-01, IEC 60050	area in which an explosive gas mixture is or may be expected to be present in a quantity such as to require special precautions for the construction, installation and use of electrical apparatus
ISO power	continuous power output of the engine at rated speed at the standard ambient conditions given in ISO 3046-1
package	complete assembly of the engine, its auxiliaries, the driven machine and controls with or without a baseplate, which fulfils the Principal's requirement for generation of electricity or the movement of gas or liquid. The package may include any associated process equipment relating to the driven machine
packager	party responsible for the design, fabrication, assembly and testing of a package
requisition	information exchanged prior to order placement, using data/requisition sheets PTS 31.29.80.93.
service power	power output of the engine at the most severe ambient conditions given in the requisition. Refer also to (2.3).
vital service	service in which, if equipment fails in operation or fails when called upon to operate, an unsafe condition on the installation or jeopardy to life or major damage to the installation can be caused. The requisition shall identify whether the service is vital.

1.4 ABBREVIATIONS

BICERI	British Internal Combustion Research Institute (111/112 Buckingham Avenue, Slough SL1 4PH, England).
ESD	Emergency shutdown.

1.5 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced in this PTS are listed in (12).

1.6 SUMMARY OF CHANGES SINCE PREVIOUS EDITION

The previous edition of this PTS was dated December 2000 and is still valid with editorial changes only.

1.7 ACTION ITEMS

A list of action items which need to be resolved when using this PTS is given in (11). The action items are cross-referenced to the appropriate section of this PTS by the letter 'A' and a number which appears in the left-hand margin of the page concerned.

1.8 ORDER OF PRECEDENCE

Unless otherwise agreed, the following precedence of standards shall apply:

1. National or legal codes or regulations
2. The requisition
3. This PTS
5. Other PETRONAS and external standards referenced herein.

Any conflict of requirements which cannot be resolved by the above order of precedence shall be referred to the Principal for resolution.

2. BASIC REQUIREMENTS

2.1 APPLICABLE STANDARDS

Diesel engines shall be in accordance with ISO 3046-1, ISO 3046-3, ISO 3046-4, ISO 3046-5, ISO 3046-6 and ISO 3046-7, as amplified by this PTS.

2.2 RANGE OF APPLICATION

The driven machines will include alternators, pumps (including firewater pumps) and compressors in a variety of duties. The engine will in general be supplied to a packager who will undertake the packaging of the engine into a complete unit to fulfil the Principal's requirement for electric power or fluid movement.

The engine will be in continuous or intermittent use in vital or non-vital service as described in the requisition. The engine shall be suitable for continuous unattended baseload operation for 24 hours per day at the extremes of ambient conditions given in the requisition.

- (A1) Engines in vital service shall be guaranteed by the Manufacturer to be able to accept full load within 10 seconds of receiving the starting signal. Any shorter period required in a specific project will be given in the requisition.

The fuel specification will be given in the requisition; the Manufacturer shall guarantee that the fuel is suitable for the engine at the service power. See also (3.4.1).

If the Manufacturer proposes a turbocharged version of an engine originally developed for natural aspiration, the suitability of the engine to meet the operating requirements shall be demonstrated by means of design calculations and service references.

2.3 POWER OUTPUT, FUEL AND LUBRICANT CONSUMPTION

The service power of the engine in accordance with ISO 3046-1 shall be the continuous power available at the drive coupling of the engine after deduction of all engine-driven auxiliaries. The Manufacturer shall state the auxiliaries driven by the engine and their power absorbed in computing the rated power.

Engine-driven fuel and lubricating oil pumps and separate lubricators for valve gear or cylinders are regarded as engine components and not auxiliaries within the context of the declaration of power according to ISO 3046-1.

The ISO power shall be derated to the service power at the most severe ambient conditions under which the engine will operate.

The service power of the engine as defined in ISO 3046-1 shall be not less than 110% of the maximum power required by the driven equipment under extremes of driven equipment operating conditions.

The fuel and lubricant consumption at the above declared powers shall be declared by the Manufacturer.

2.4 TECHNICAL AUDIT

The Principal reserves the right to review and check any part of the design of the equipment to be supplied, using his own expert or a consultant employed for the purpose. The Manufacturer shall make available to such an expert or consultant all the necessary drawings or other information to enable him to make any check calculations or analyses as he may consider necessary. The expert or consultant will, if so required by the Manufacturer, give a written undertaking not to divulge such information or drawings to any other party except as is necessary to satisfactorily complete his review or check.

In the event of a conflict between any calculations, analyses or recommendations made by the expert or consultant and the corresponding calculations, analyses, etc., made by the Manufacturer, every effort shall be made to resolve such conflicts and arrive at a mutually acceptable solution.

As a last resort, if mutual agreement cannot be reached, the Principal shall have the right to insist that any modifications, additional calculations or additional tests recommended by the expert or consultant be made. If the Principal does overrule the Manufacturer in this way, it is clearly accepted that the Manufacturer's responsibilities, both contractually and in relation to the costs of any modifications, additional tests, etc., shall be limited to the extent indicated by the Manufacturer's calculations or design, unless it can be shown either at the time or subsequently by, for example, the analysis of test results that the Manufacturer's calculations or designs were in error.

2.5 BOUGHT-OUT ITEMS AND SUB-SUPPLIERS

The Principal shall be advised if:

- the Manufacturer proposes to purchase any item from sub-Suppliers (except standard fasteners and other small items covered by internationally recognised standards), and
- there is any intent to employ sub-Suppliers to partly or wholly manufacture any part of the equipment or its auxiliaries.

Any purchase from or manufacture by sub-Suppliers shall be disclosed to the Principal as soon as possible, in any case before the orders for such items are placed. The Principal shall have the right to request that a nominated sub-Supplier and/or type of equipment be substituted for the Manufacturer's initial selection for any reason including rationalisation, past experience in similar service or technical superiority. If such requests are made before or at the time of placing the order, they shall be considered mandatory. Requests for substitutions made after the order is placed shall not be refused by the Manufacturer without good reason.

Alternatively, the Principal may, at the outset, nominate Suppliers from whom certain items (e.g. instruments) shall be obtained.

2.6 MATERIAL IDENTIFICATION AND TRACEABILITY

The Manufacturer shall operate and maintain an effective material control system. The Manufacturer shall submit, via the packager if applicable, a description of the quality assurance procedures in place at the engine production facility.

The Manufacturer shall have an acceptable system of numbering all replaceable parts. The part number shall completely define the part, including the materials from which it is made. For example, two items which are dimensionally identical but are made from different material shall have different part numbers.

The Principal shall have the right to review, inspect and monitor the operation of the Manufacturer's materials control systems.

2.7 UNCONVENTIONAL MANUFACTURING METHODS

The Manufacturer shall declare to the Principal his intention to use any unconventional methods to manufacture any item or component.

NOTE: An unconventional method is a method of manufacture which the particular Manufacturer has not used for closely similar items for a sufficient period for the items to have been proved satisfactory in service. For example, fabrication by welding of components which hitherto have been cast or otherwise made from one solid piece.

2.8 RESPONSIBILITY

Engines will be purchased generally as an integral part of a driven equipment package. It is intended that this PTS be used by the Contractor or packager with whom the purchase order is placed and, if they are not one and the same, by the Manufacturer with whom the Contractor or packager places a sub-order for supply of the engine.

Overall responsibility for the package lies with the packager, who shall ensure that the engine complies with the requirements of the overall package specification as well as this PTS.

2.9 OFFSHORE INSTALLATION

2.9.1 Certifying authority

- (A2) If an engine is specified to be installed on an offshore installation, the design of the engine and its auxiliaries shall comply with the requirements of the appropriate Certifying Authority. Certifying Authorities are Det Norske Veritas, Lloyd's Register of Shipping, or the appropriate authority in the area of operation.

2.9.2 Weight control

The Manufacturer shall provide as part of the proposal an estimate of the total installed and operating weight of each item of equipment to be supplied. This includes all auxiliaries regardless of whether they are supplied loose or not. The estimate shall not be exceeded by more than 10%.

Within a period as specified in the requisition, after receipt of an order the Manufacturer shall supply information on the weight and position of the centre of gravity of each piece of equipment as follows:

- as intended to be shipped including packing, temporary shipping constraints, lifting equipment, etc.
- as installed including all auxiliaries, etc.
- in operation, including the normal contents of process fluids, lubricants, etc.
- any auxiliary or component to be shipped separately
- any component or item greater than 200 kg or 25% of the total weight of the engine, whichever is the lesser (defined as a major component).

The above information shall be provided on a mass/centre of mass data sheet PTS 30.10.01.92.

The Manufacturer shall operate a weight control programme and shall notify the Principal if at any time information becomes available indicating that the weight of the equipment or any major component differs from the data provided by more than 5% of the total weight. The Manufacturer shall weigh all components or auxiliaries as they are completed in his own workshops or received from sub-Suppliers.

On completion of the engine and its auxiliaries the Manufacturer shall weigh the complete package and revise the initial estimates if necessary. The mass/centre of mass data sheet shall then be issued as certified final.

2.10 EMISSION CONTROLS

- (A3) The requisition will state the requirements for emission control on the engine to meet the legislation applicable to the installation.

Emission control equipment shall be an integral part of the engine package. Control of nitrogen and carbon oxides and unburnt hydrocarbons in the engine exhaust should be achieved by the design of the engine combustion system. Catalytic converters in the engine exhaust should be regarded only as a last resort to meet the emission requirements and shall be installed only with the agreement of the Principal.

All other fugitive emissions such as from crankcase breathers shall be suitably controlled as part of the engine design. Disposal of such vents into the engine air intake upstream of any filter is not permitted.

The Manufacturer shall provide a statement of the emissions from his engine and the method of achieving them. Any maintenance requirements to maintain emission levels shall be clearly documented in the operating manual.

If there are limits on emissions of sulphur oxides, the Principal will supply fuel to the engine treated to residual levels of sulphur compounds which will not infringe the local regulations.

2.11 TROPICALISATION

If an engine is to be installed in a hot and humid (tropical) climate, the engine and its electrical and instrumentation equipment shall be suitably designed and preserved to ensure reliable operation in the specified climate.

2.12 NOISE CONTROL

- (A4) The Contractor or packager shall be responsible for meeting any noise limitations set by the Principal. The Manufacturer shall co-operate by providing noise spectra of the engine and auxiliaries and by providing attachments, supports, etc. for installation of any noise control equipment that may be necessary to meet the project noise specification. Any noise limitation for the package will be given in the requisition.

2.13 ELECTRIC MOTORS

Alternating current electric motors shall comply with PTS 33.66.05.31.

2.14 HEATERS

Heaters may be specified for maintenance of satisfactory temperatures on idle engines in cold climates (3.6.5 and 3.7.2). All heaters shall be fitted with integral thermostats to cut off the power when the fluid reaches the specified temperature. Power circuits supplying the heater shall be protected by miniature circuit breakers incorporating overload, short circuit and earth leakage protection, in accordance with IEC 60947 or IEC 60898. Heat dissipation from the heating element shall not exceed 2.3 W/cm^2 on heaters in hydrocarbon heating duty.

2.15 FIRE PUMPS

- (A5) On certain installations the application of NFPA 20, or other National Standard agreed with the Principal, may apply to engines driving fire pumps. This requirement will be stated in the requisition.