

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE (CORE)

TECHNICAL SPECIFICATION

EXTERNAL POLYETHYLENE AND POLYPROPYLENE COATING OF LINEPIPE

PTS 31.40.30.31

JANUARY 2010



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This revision of PTS **31.40.30.31: External Polyethylene and Polypropylene Coating of Linepipe (January 2010, Revision 1)** has been updated to incorporate 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 **31.40.30.32 (February 2008)** will be removed from PTS binder / e-repository from herein onwards.

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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' OPUs 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

The custodian of this PTS has assessed/reviewed/evaluated the stated PTS and offered the following exceptions/amendments to the PTS. This PTS also includes PETRONAS Lessons Learnt and PETRONAS Best Practice for the subject matter as stated above.

All updates to the PTS has been incorporated into the main body of the PTS and highlighted as *italic font*.

1.1 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 or managed by a Group company.

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

1.2 DEFINITIONS

1.2.1 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 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** indicate a requirement.

The word **should** indicate a recommendation.

1.2.2 Specific definitions

adhesive - an intermediate coating layer to improve adhesion between the primer and the coating (three layer system) or between the steel and the coating (two layer systems).

Applicator - the party that applies the coating to the line pipe in its coating plant.

batch – the amount of materials produced within one uninterrupted production run of maximum 8 hours under constant production conditions.

chemical pre-treatment - Treatment of the blast cleaned pipe surface with a chemical solution before application of the primer or adhesive to improve adhesion of the first coating layer (phosphate, chromate).

holiday - a defect penetrating through the coating to the steel pipe surface, of such dimensions that it is detectable by means of the specified procedures.

Inspector - the party appointed by the Principal to witness the Applicator's quality control of coating materials and the coating process.

primer - an intermediate coating layer, applied directly onto the pre-treated steel surface to improve the adhesion of the final coating to the pipe surface. In two layer coating systems both the words primer and adhesive are sometimes used to name the same layer.

shift – a set of pipes coated in one production run of which the beginning and end coincide with a change in personnel. In the context of the quality control procedures of this PTS, the maximum duration of a shift is 10 h.

side extrusion - a coating process whereby hot extruded films of coating materials are wrapped around the pipe in layers. The pipes are moved past the extrusion head in a spiral motion. The extruded coating film is fused together to form a continuous adherent sheath around the pipe.

sintering - the coating process whereby the coating material is sprayed on the preheated pipe surface in the form of powder and is fused to a homogeneous and continuous layer under the influence of the heat from the pipe material.

sleeve extrusion or **crosshead extrusion** - a coating process whereby a hot extruded sleeve of coating material is applied around the pipes while the pipes are moved through the extrusion head in a linear motion.

three layer system - a pipe coating system consisting of three layers: primer, adhesive and outer layer.

two layer system - a pipe coating system consisting of two layers: primer and outer layer or adhesive and outer layer.

unit of production - Unless otherwise specified, a set of pipes coated in one production run on the same coating line, using the same coating technique, having the same nominal diameter and wall thickness and coated with the same coating products. Breaks in production caused by equipment or plant breakdown, factory shutdown or any other interruption exceeding three days shall be the end of a production run. Subsequent start-up constitutes a new unit of production.

1.3 ABBREVIATIONS

DN	- Diameter Nominal (mm)
FBE	- Fusion Bonded Epoxy
PE	- Polyethylene
PP	- Polypropylene
UV	- Ultraviolet light

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 in this PTS are listed in (11).

2. GENERAL INFORMATION

2.1 GENERAL

This PTS can be used for general qualification purposes or for specific projects. General coating qualification is performed for the purpose of an overall qualification of coating system and Applicator, but is not necessarily related to a specific project. With this process, a list of qualified coating systems and Applicators is developed, from which the Principal may select a coating system and Applicator for a specific project. It saves time and avoids re-qualification for similar projects.

The general qualification is given independent of line pipe diameter and wall thickness. When required for specific projects, additional testing should be performed on different line pipe diameters and wall thicknesses.

The coating system shall be suitable for the temperature class, based on the maximum operating temperature or design temperature of the pipeline. This PTS does not identify maximum temperature limits for polyethylene and polypropylene coating systems because there are a large variety of available grades of primer, adhesives and polymers. The maximum allowable temperature per coating system is defined by the choice of the individual components.

For general coating qualification, the coating Manufacturer/Applicator shall specify the temperature class.

The suitability of a coating system for a particular temperature class shall be demonstrated by performing the qualification tests at the relevant test temperature given in this PTS, see Tables 2, 4 and 5. For a specific project, additional testing should be performed at temperatures specified by the Principal.

All coating materials shall be new, in unopened containers and shall be properly labelled as to the contents within. Storage locations shall be well ventilated, protected from the sun, other weather elements and in accordance with the Manufacturer's recommended storage practices. Any material that has exceeded the Manufacturer's specified shelf life shall not be used. The Applicator shall provide protection for all of the coating equipment from conditions that could jeopardize the integrity of the coating system.

All persons involved in surface preparation and coating works shall be skilled in the use of the required equipment and in the application of the coating materials. Surface preparation and coating equipment shall be suitable for operation and be well maintained. The type of equipment and the nature of its operation shall be in accordance with the coating Manufacturer's recommendations.

2.2 COATING SYSTEM DESCRIPTION

The pipeline coating system described in this PTS shall be manufactured with polyethylene or polypropylene as the main coating material, and with suitable primers and adhesives to obtain the required coating properties under the prevailing installation and operating conditions.

2.3 INFORMATION TO BE SUBMITTED BY THE PRINCIPAL

For a project qualification, the Principal shall supply technical information to the Contractor regarding the project, in particular the installation and operating conditions. This information shall contain as a minimum:

- *project name;*
- *the type and thickness of coating required (PE/PP);*
- *the maximum operating temperature of the pipeline;*
- *description of steel pipe;*
- *the applicable line pipe specification;*

- *the geographical area (land/subsea);*
- *expected ambient temperatures during installation;*
- *installation method;*
- *soil and backfill conditions for land pipelines;*
- *seabed trenching, laying and burial conditions for subsea pipelines;*
- *subsequent coatings to be applied (e.g. weight coating, insulation);*
- *requirements for anti-slip treatment;*
- *type of cathodic protection system.*

The Principal shall indicate whether a specific brand of coating shall be used or whether the Contractor shall select the coating.

2.4 INFORMATION TO BE SUBMITTED BY THE CONTRACTOR

The Contractor shall submit information to the Principal on the coating system to be used. This information shall contain as a minimum:

- *system identification (5.2);*
- *Manufacturer's data (5.3);*
- *system qualification information (5.4);*
- *coating application procedures;*
- *the name(s) of the proposed coating applicator(s);*
- *Applicator's qualification information (6);*
- *Quality Plan.*

The Contractor shall confirm that the coating system is suitable for use under the specified conditions (2.3).

3. COATING SYSTEM REQUIREMENTS

3.1 GENERAL

The coating system shall be suitable for the pipeline installation and operating conditions specified by the Principal (2.3).

Prior to beginning any production run, the Contractor shall demonstrate that the coating system will fulfil the qualification requirements in accordance with (5.4). Any modification of a qualified coating system shall require re-qualification of the modified system.

The Contractor shall demonstrate by effective quality control procedures in accordance with (4.3) that the coating, as applied during normal production, fulfils the requirements of this PTS.

The coating system shall consist of the following:

- A layer of Fusion Bonded Epoxy (FBE);
- A layer of copolymer adhesive;
- A layer of UV stabilised polyethylene / polypropylene

The minimum coating thickness for the FBE layer and copolymer layer is 150 micron each.

3.2 FINISHED COATING SYSTEM REQUIREMENTS

3.2.1 Visual appearance

The coating shall be free from blisters, pinholes, scratches or any other irregularities and shall have a uniform colour and gloss.

3.2.2 Total coating thickness

For polyethylene and polypropylene coating systems, the minimum thickness of the total coating system shall be as specified in Table 1 unless otherwise specified by the Principal. The coating thickness shall be measured in accordance with (7.2).

Table 1 Minimum total coating system thickness for polyethylene and polypropylene pipeline coating systems

	Minimum total coating thickness, mm	
DN	Polyethylene	Polypropylene
≤ 100	2.5	1.8
> 100 and ≤ 250	2.7	2.0
> 250 and < 500	2.9	2.2
≥ 500 and < 800	3.2	2.5
≥ 800	3.7	2.5

Coating thickness of the individual layer shall be stated in the relevant project specification.

Provision shall be made for the use of high density polyethylene. If high density polyethylene material is used, the above stated coating thickness shall be reduced as required. Reference shall be made to Canadian Standard CSA Z245.2 for further information. In selecting the coating thickness, consideration shall also be given on the

backfill material, trench condition, soil stresses, pipe handling, pipe stacking height and subsequent coatings to be applied.

3.2.3 Holidays

The coating system shall be free from holidays when tested in accordance with (7.3).

3.2.4 Adhesion

The adhesion of the coating system shall be determined by peel resistance, measured at room temperature and at a test temperature related to the operating temperature in accordance with Table 2, using the test procedure in (7.4).

For crosshead-extruded coatings, the peel resistance shall also be measured in the longitudinal direction of the pipe at 20°C and shall be at least 35 N/10 mm.

The minimum peel resistance values at the given test temperatures shall be as specified in Table 2.

If the coating cannot be peeled from the line pipe, the minimum peel resistance value shall be recorded as greater than the measured tensile force at yield.

Table 2 Minimum coating peel resistance for polyethylene and polypropylene pipeline coating systems

Operating temperature, °C	Test temperature, °C	Peel resistance, N/10 mm	
		Polyethylene	Polypropylene
< 20	23 ± 2	> 35	> 150
20 - 50	50 ± 2	> 25	> 100
50 - 60	60 ± 2	> 20	> 80
60 - 80	80 ± 2	> 20	> 80
> 80	operating temperature ± 2	>20	> 40

3.2.5 Impact resistance

The impact resistance of the PE coating system shall be tested only at (23 ± 2) °C; the impact resistance of PP shall be tested at (0 ± 2) °C and (23 ± 2) °C. The testing shall be carried out in accordance with the procedure in (7.5) and the minimum impact resistance shall be as specified in Table 3.

Table 3 Minimum impact resistance for polyethylene and polypropylene pipeline coating systems

DN	Minimum impact resistance, J		
	PE at 23 °C	PP at 0 °C	PP at 23 °C
≤ 100	6.5	6.5	18
> 100 and ≤ 250	8.5	8.5	20