

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

(CORE)

TECHNICAL SPECIFICATION

THERMAL SPRAY COATINGS OF ALUMINIUM AND 85/15 ZINC/ALUMINIUM ALLOY

PTS 30.48.40.31

DECEMBER 2010



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This revision of PTS 30.48.40.31 – Thermal Spray Coatings of Aluminium and 85/15 Zinc/Aluminium Alloy (**December 2010**) has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards.

The previous version of this PTS **30.48.40.31 (May 2004)** will be removed from PTS binder / e-repository from herein onwards.

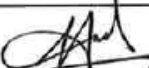
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PREFACE

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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.

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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1. INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the application of thermal spray coatings, of such quality as to last for 25 years prior to first maintenance, to onshore and offshore structures, equipment and piping etc. under atmospheric conditions and beneath insulation. Thermal spray coatings may also be used on immersed and buried surfaces, equipment and structures. The following coating systems are included in this PTS:

- Aluminium;
- Zinc-Aluminium (85/15);
- Duplex coating system: Zinc-Aluminium (85/15) + Topcoat.

All three systems, when applied in the manner and to the requirements specified by this PTS, are equivalent for use under atmospheric conditions.

This PTS is a revision of the PTS of the same number dated August 2005; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to PETRONAS companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them.

This PTS is intended for use in oil refineries, chemical plants, gas plants and exploration and production facilities as well as distribution storage PTSots and installations.

When PTSs 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 the more stringent and which combination of requirements will be acceptable with regard to the 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, the objective being to obtain agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 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 coating materials, 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 **Coating Contractor** is the party that applies the thermal spray coatings.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Bend test	180° bending of a sample on a mandrel.
Companion coupon	Rectangular steel coupon, prepared for qualification of thermal spray coating materials and coated concurrently with the workpiece for quality control and inspection.
CUI	Corrosion under insulation.
Dew point	The temperature of a given air/water-vapour mixture at which, under atmospheric pressure, condensation starts.
Feather	Smooth tapered transition between thermal spray coating and the adjacent non-coated surface
Holding period	Time between the completion of the final surface blasting and completion of the thermal spraying.
Overspray	The portion of the thermal spray PTSosit that is not PTSosited on the desired area of the workpiece.
Rust bloom	Discoloration indicating the beginning of rusting, bleeding through the interconnecting pores of the thermal spray coating.
Sealer	A thin paint coating, about 40 µm thick, that is absorbed into the pores of the thermal spray coating and seals the coating surface.
Shift	Production run of which the beginning and end coincide with a change in personnel.
Soluble salt contaminants	Water-soluble salts, such as chlorides and sulphates, which contaminate the steel surface and cause rust bloom and premature coating failure.
Thermal spray	Application of metallic coating by means of arc- or flamespray equipment.
Topcoat	Paint coat applied over a sealed thermal spray coating.
TSA	Thermally Sprayed Aluminium.

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 (10).

1.5 CHANGES FROM THE PREVIOUS EDITION

This PTS is a revision of the PTS of the same number dated August 2005. The following are the main, non-editorial changes.

Section	Change
General	- QA/QC better aligned with PTS 30.48.00.31-P - Added: Zinc/aluminium (85/15) alloy and Duplex coating - Increased alignment with ISO standards.
1.	Extended application: TSA for CUI, increased maximum TSA service temperature.
2.	Added: Section on applications and limitations Added: Table on risks and safety measures.
3.	Revised: more prescriptive material specifications for thermal spray coating, sealer, and topcoat.
4.	Revised: More prescriptive requirements for surface preparation. Better aligned with requirements of offshore coating in PTS 30.48.00.31-P
5.	Revised: More prescriptive requirements for qualification of thermal sprayers, and coating materials.
6.	Revised: More prescriptive requirements for quality assurance and quality control for thermal spray coatings, including sealers, and topcoats. Better aligned with requirements of PTS 30.48.00.31-P Added Figure showing bend test arrangement and pass/fail samples.
7.	Revised: More prescriptive requirements for coating application.
8.	Revised: More prescriptive requirements for coating repair. Added: Section on field welds

2. APPLICATIONS, LIMITATIONS AND SAFETY CONSIDERATIONS

2.1 APPLICATIONS AND LIMITATIONS

Thermal spray coatings specified in this PTS shall be applied by arc or flame spraying, using a solid metal wire. Powder consumables, high velocity oxy-fuel (HVOF) and plasma techniques shall not be used.

Thermal spray aluminium (TSA) and zinc/aluminium (85/15) alloy coatings provide both a barrier and cathodic protection to the steel substrate.

Thermal spray Aluminium (TSA) and Zinc-Aluminium (85/15) coatings shall not be used in acidic or caustic environments; the acceptable range is pH 4 to 8.

TSA coatings only shall be used to protect stainless steel against chloride stress corrosion cracking.

TSA coatings only shall be used for protection against corrosion under insulation (CUI).

The maximum service temperature for TSA coatings shall be 590 °C under dry conditions, and 200 °C under wet, or immersed conditions.

Thermal spray aluminium coating shall not be sealed when applied:

- (i) to immersed components;
- (ii) under insulation (to protect against CUI); or
- (iii) to buried components (e.g. buried piping).

The maximum atmospheric service temperature for zinc/aluminium (85/15) alloy coating shall be 300 °C under dry conditions, and 60 °C under wet, immersed, or buried (e.g. pipe) conditions. Zinc/aluminium (85/15) alloy coating shall not be used under insulation (CUI).

Thermal spray zinc/aluminium (85/15) alloy coating shall not be sealed when applied:

- (i) to immersed components, and
- (ii) buried components (e.g. buried piping).

Thermal spray zinc/aluminium (85/15) alloy coating shall not be used for coating stainless steel.

The maximum atmospheric service temperature for coated zinc/aluminium (85/15) alloy, the so-called "duplex system" shall be 120 °C. The duplex system shall not be used for immersed or buried applications.

2.2 SAFETY

2.2.1 General

Thermal spray coatings may involve the use of hazardous materials, operations, and equipment. However, this PTS does not address all of the potential safety concerns associated with their use.

It is the responsibility of the Contractor and/or Applicator to establish appropriate safety and health requirements, and determine any regulatory requirements or limitations prior to use.

Safe working is of the greatest importance particularly in confined spaces such as tanks and vessels.

All personnel shall be provided with approved personnel protection, e.g. protective clothing, safety glasses, safety shoes, hard hats, goggles, respirators, earplugs, fresh-air-fed hood and any other necessary safety equipment. All safety equipment shall be maintained in good working condition.

Adequate warning signs shall be prominently displayed at all access points to areas where abrasive blasting and thermal spraying is in progress.

Thermal spraying is a safe process when performed by an Applicator who follows the recommended precautionary measures, has a proper understanding of thermal spraying practices, has knowledge and skill, and exercises care in using thermal spray equipment.

2.2.2 Hazardous components

Potential thermal spray hazards include exposure to flame, heat, vapours, (metal) dust, fumes, gases, noise, (from the spray gun) and arc ultraviolet (UV) radiation. Additionally, improperly used thermal spray equipment can create potential fire and explosion hazards from the fuel and carrier gases and a potential electrical shock hazard from the electrical and electronic equipment and charged wire spools. To minimize hazards, adequate safety precautions shall be followed. Thermal sprayers shall comply with the procedures in the safety regulations, the Manufacturer's technical manuals, and the material safety data sheets.

2.2.3 Safety measures

Risk factors, consequences, and recommended safety measures for thermal spray coatings shall include as a minimum the following:

Source	Risk	Safety measures
Heat from spray gun Flame from spray gun	Burn injuries Fire	Wear non-flammable, heat-resistant clothing, in compliance with ISO 14877.
Noise from spray gun	Ear damage	Wear suitable ear protectors
UV-exposure from arc spray	Irritation / damage of eyes	Wear dark (welder's) glasses
Metal (spray) dust	Irritation of airways / lungs Fire Dust explosions	Wear hood with forced air supply Water shall not be used; Use dry sand, or Class D fire-extinguisher; Regular cleaning of floor and equipment to remove metal spray dust (good housekeeping).
Heavy weight of gun	Overstraining muscles	Regular job rotation during spraying