



PETROVIETNAM GAS JOINT STOCK CORPORATION
PV GAS PROJECT MANAGEMENT COMPANY

PROJECT

PV GAS THI VAI LPG STORAGE TANKS PROJECT

PACKAGE

ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC)

**PAINTING & PROTECTIVE COATING
SPECIFICATION**

PV GAS PMC

PTSC

1	14/07/23	Issued for Approval	N.V.Tuan	T.Q.Tuan	N.T.Son	N.K.Dung	N.X.Thanh	B.V.Khoa
0	31/03/23	Issued for Approval	N.V.Tuan	T.Q.Tuan	N.T.Son	N.K.Dung	N.X.Thanh	B.V.Khoa
A	28/02/23	Issued for Review	N.V.Tuan	T.Q.Tuan	N.T.Son	N.K.Dung	N.X.Thanh	B.V.Khoa
Rev.	Date	Description	Engineer	Lead	EM	PM	Reviewed	Checked
			PTSC				PV GAS PMC	

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Document Number:
231375-09-SPE-002

**PETROVIETNAM TECHNICAL SERVICES
CORPORATION**

Number of pages: 31 page
(Including cover sheet)

COMMENTS RESPONSE SHEET (CRS)

Drawing / Document Number, Title and Revision:

Transmittal Document Purpose:

Doc. No.	231375-09-SPE-002	Title:	PAINTING & PROTECTIVE COATING SPECIFICATION	Comment Code	Status
Rev. No.	0				
Transmittal No.: 231375-08-COM-096				2	Approved with comments

No.	Comments	Confirmation / Explanation by Contractor
1	APPENDIX 3: COATING SYSTEM NO.7 (WRAPPING): Đề nghị cập nhật bổ sung thông số kỹ thuật cho bọc chống ăn mòn mối hàn của đường ống chôn ngầm bằng HSS (heat shrink sleeve).	HSS thông thường áp dụng cho pipeline. Nhà thầu đề xuất áp dụng cold wrapping tương tự như các dự án của PVG, đảm bảo đúng yêu cầu dự án và yêu cầu của holiday test
No.	KVT' comment: 231375-08-COM-KVT-012	Confirmation / Explanation by Contractor
2	Đề đồng bộ với màu của các hệ thống hiện hữu tại KCTV và thuận tiện trong công tác vận hành, sửa chữa, KVT đề nghị sửa: Màu của hệ thống Instrument Air thành màu trắng Traffic White RAL-9016	Màu trắng được Qui định cho ống công nghệ LPG liquid. Màu ống Instrument ai đã được áp dụng cho công trình kho chứa LPG Lạnh và kho LNG hiện hữu. Vì vậy nhà thầu đề xuất vẫn giữ màu Light Blue (RAL-5012) cho hệ Instrument Air.
3	Đề đồng bộ với màu của các hệ thống hiện hữu tại KCTV và thuận tiện trong công tác vận hành, sửa chữa, KVT đề nghị sửa: Màu của hệ thống Nitrogen thành màu Light Blue (RAL-5012)	Màu ống N2 đã được áp dụng cho công trình kho chứa LPG Lạnh và kho LNG hiện hữu. Vì vậy nhà thầu đề xuất vẫn giữ màu Agate Grey (RAL-7038) cho hệ Nitrogen.
No.	DNV' comment: 10428599-VC-013 Rev.0 ©	Confirmation / Explanation by Contractor
4	No comment	Noted

	PV GAS THI VAI LPG STORAGE TANKS PROJECT PAINTING & PROTECTIVE COATING SPECIFICATION	
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TABLE OF CONTENTS

1.	INTRODUCTION	4
1.1.	Project overview	4
1.2.	Site location	5
1.3.	Document Purpose	5
1.4.	Definition and Abbreviations.....	5
1.4.1	Definition:	5
1.4.2	Abbreviation	6
1.5.	Language.....	6
2.	CODE, STANDARDS AND REFERENCES.....	6
2.1.	Regulatory Requirement.....	6
2.2.	Applicable codes and standards.....	6
2.3.	Order of Precedence.....	7
3.	TECHNICAL REQUIREMENT	8
3.1.	General.....	8
3.2.	Protection of other equipment.....	9
3.3.	Flanged connections	10
3.4.	Inaccessible areas.....	10
3.5.	Protrusions through insulation	10
3.6.	Galvanized pipin hardware and fasteners	11
4.	QUALITY, SAFETY AND ENVIRONMENT REQUIREMENT.....	11
4.1.	Quality.....	11
4.2.	Safety	11
4.3.	Environment.....	13
5.	SURFACE PREPARATION	13
5.1.	Solvent cleaning.....	13
5.2.	Hand/power tool cleaning.....	13

	PV GAS THI VAI LPG STORAGE TANKS PROJECT PAINTING & PROTECTIVE COATING SPECIFICATION	
---	--	---

5.3.	Blast cleaning general requirement.....	13
5.4.	Conventional Blast.....	14
5.5.	Automatic Blast	15
5.6.	Touch up/ Repair	15
6.	COATING APPLICATION	15
6.1.	General.....	15
6.2.	Spray application	18
6.3.	Brush application	18
6.4.	Other coating application methods	19
7.	INSPECTION AND TESTING	19
7.1.	General.....	19
7.2.	Specific test methods	20
7.2.1	Blasting Abrasive Quality.....	20
7.2.2	Blast Profile Height	21
7.2.3	Climatic Conditions	21
7.2.4	Dry film thickness.....	21
7.2.5	Continuity Testing	22
7.2.6	Adhesion testing	22

APPENDICES

APPENDIX 1	:	Coating system table
APPENDIX 2	:	Colour table
APPENDIX 3	:	Coating system No.7 (Wrapping)

1. INTRODUCTION

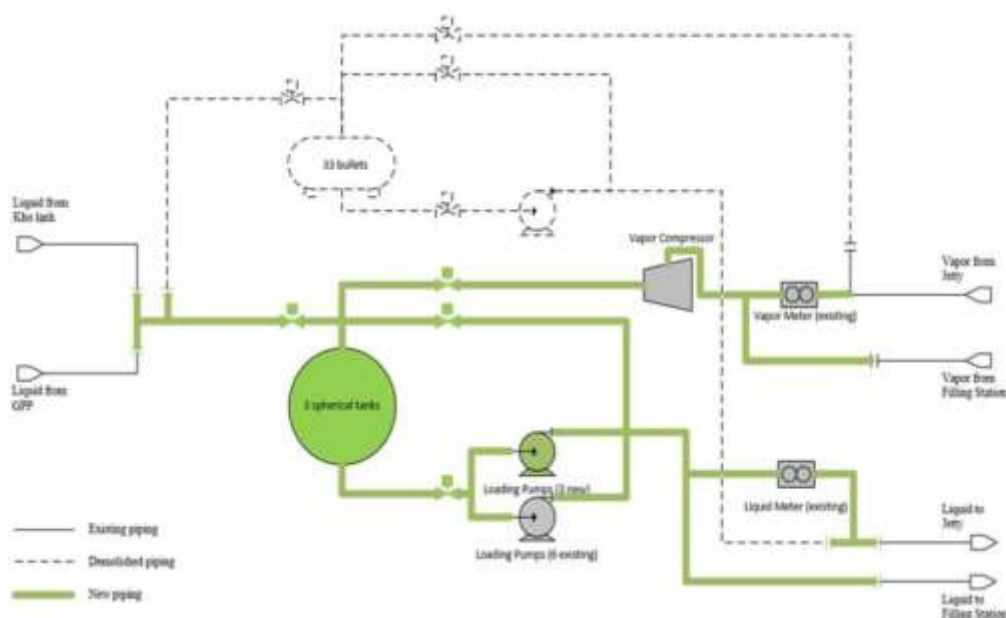
1.1. Project overview

PV GAS Vung Tau Terminal at Thi Vai (KCTV) was built and operated by PV GAS since 2000. Its main function is to import, store and export liquid products including LPG and Condensate.

KCTV has been built and arranged as the Oil & Gas Industrial Zone included Jetty, LPG storage, Condensate storage tank, Truck loading station, LPG refrigerated storage and LNG 1 MMTPA storage. However, the existing LPG storage was designed according to the old containment technology using 33 bullets resulting in number of tanks increased and occupied more space than the new containment technology. Moreover, the placement of tank in the bunkers and fully filled with sand cause waste cost for waterproofing, anti-corrosion system and it is also difficult for tank repairing and maintenance processes.

Therefore, in the future, the re-arrangement of 33 existing bullets to LPG spherical storage tanks to create additional land fund is essential to comply with PV GAS development strategy.

LPG Spherical Storage Terminal Facility will be connected with existing LPG Terminal Facility as below Figure.



	PV GAS THI VAI LPG STORAGE TANKS PROJECT PAINTING & PROTECTIVE COATING SPECIFICATION	
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1.2. Site location

The Terminal is located in Block N9B in planned LPG Processing Area of PVG, in Cai Mep Industrial Zone, Ward Tan Phuoc, Tan Thanh District, Ba Ria- Vung Tau Province.

1.3. Document Purpose

This specification covers minimum technical requirements for the selection of materials, coating systems, colour coding, surface preparation, application and inspection of paint and other protective coatings applied to structural steel, piping, process plant and other related items within the fabrication/installation at the PV GAS THI VAI LPG STORAGE TANKS PROJECT.

It is the intent of COMPANY, whenever possible, to utilize equipment that is supplied with fully coated corrosion resistant VENDOR standard finishes which have abrasive blast cleaned surfaces, chemically cleaned surfaces or other approved surface preparation procedures. The VENDOR shall submit surface preparation procedures and paint system technical data sheets to the COMPANY for approval. When approved, these VENDOR standard finishes do not require removal and repainting in the field

1.4. Definition and Abbreviations

1.4.1 Definition:

Definitions used in this document are described below

COMPANY	Petrovietnam Gas Project Management Company (PVGAS-PMC)
CONTRACTOR	Petrovietnam Technical Services Corporation (PTSC)
END USER	PetroVietnam Gas Vungtau Processing Company (KVT)
VENDOR	Party responsible for manufacturing and/or packaging of equipment
SUB-VENDOR	Other entity employed by VENDOR to perform work and/or supply equipment.
Correspondence	Letters, memorandum, telexes, facsimile, transmittal note and e-

	PV GAS THI VAI LPG STORAGE TANKS PROJECT PAINTING & PROTECTIVE COATING SPECIFICATION	
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mails.

Document All documents (including drawings) other than correspondence

1.4.2 Abbreviation

Abbreviations used in this document are described below:

DFT	Dry Film Thickness
HSE	Health Safety and Environmental
ISO	International Organisation of Standards
ITP	Inspection and Test Plan
NDT	Non-Destructive Testing
QC/QC	Quality Assurance / Quality Control
SSPC	The Society for Protective Coatings
TSA	Thermally Sprayed Aluminium

1.5. Language

All documents and drawings to be submitted shall be lettered in English language.

2. CODE, STANDARDS AND REFERENCES

2.1. Regulatory Requirement

Application of painting and protective coating shall comply with the requirements of the latest versions of all relevant regulations.

2.2. Applicable codes and standards

Wherever possible, the design, construction and installation will comply with relevant Vietnamese Codes and Standards. Where applicable Vietnamese standards do not exist or cannot be applied, other industry recognised international standards and recommended practices will be used.

Painting and protective coating shall be designed in accordance with the latest edition of the following international codes and standards including any addenda published for the edition listed.

SSPC-SP 1	Solvent Cleaning
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	PV GAS THI VAI LPG STORAGE TANKS PROJECT PAINTING & PROTECTIVE COATING SPECIFICATION	
---	--	---

SSPC-SP 2	Hand Tool Cleaning
SSPC-SP 3	Power Tool Cleaning
SSPC-SP 4	Flame Cleaning
SSPC-SP 5	White Metal Blast Cleaning
SSPC-SP 6	Commercial Blast Cleaning
SSPC-SP 7	Brush Off Blast Cleaning
SSPC-SP10	Near White Metal Blast Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal
SSPC-Vis1	Pictorial surface preparation standards
SSPC-PA 1	Shop, Field & Maintenance Painting
SSPC-PA 2	Measurement of Dry Paint Thickness
SSPC-PA 3	A Guide to Safety in Paint Applications
ISO 8504 Part 2	Preparation of steel substrates before application of paints and related products – Surface preparation methods – part 2: Abrasive blast cleaning
ISO 12944:2018	Painting and varnishes – Corrosion protection of steel structure by protective paint system.
ISO 4624	Paints and varnishes – Pull-off test for adhesion

2.3. Order of Precedence

Where conflicting requirements are specified, these shall be brought to the attention of COMPANY in writing. The order of precedence shall be:

This Purchase Order

Datasheets

Approved drawings

This specification and Project specification.

Referenced Codes and Standards

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

3. TECHNICAL REQUIREMENT

3.1. General

The CONTRACTOR and VENDOR shall furnish all labour, materials, and equipment to prepare properly the surface and to apply the protective coating in accordance with this specification.

The items and surfaces to be coated shall include but not be limited to those noted in Appendix 1. The following information summarizes the requirements for the coating work.

All fabricated carbon steel, fireproofed carbon steel, cast iron, and ductile iron surfaces will be prepared and coated per requirements in Appendix 1 and 2 unless the equipment has been approved for purchase with a “vendor standard” or other type finish that is specified as acceptable in procurement documents for this PROJECT.

Surfaces and materials not requiring coating, unless otherwise specified:

- Flexible braided connectors, rubber, hoses, belts
- Concrete, brick, tile, transite, rubber and plastic
- GRP, GRE, GRV / FRP cable ladders / trays
- Metal jacketing and weather proofing on insulation
- Glass
- Nickel, nickel alloys, aluminium, aluminium alloys, copper, copper alloys and stainless steel.
- Nameplates, informational markings and signs (Stainless Steel)
- Packing glands
- Packing seals
- Bearings
- Rotating equipment couplings
- Rotating equipment shafts
- Lubrication fittings
- Pressure gauges

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

- Gauge glasses
- Motor starters
- Control valves (manufacturer's powder coatings that meet the intent of this specification are acceptable)
- Remote mounted instruments (gauges, transmitters, etc.)
- Vents
- Exposed linkages
- Valve stems
- Light bulbs and light bulb enclosures
- Light reflectors
- Air intakes
- Turbine tripping mechanisms
- Instrument / Electrical Panels, Junction Boxes and cable or tubing trays
- Non metallic surface

Unless otherwise specified, all hardware, accessories, nameplates, machined surfaces, pilot valves, pneumatic controllers, filter regulators and similar items in contact with painted surfaces shall not be painted. They shall be removed (when designated by COMPANY), masked or protected prior to beginning of any surface preparation or coating operation. Any items that have been removed require replacement after painting work is completed and all masking materials shall be removed and surfaces cleaned of masking residue.

Special care must be taken to protect the electrical devices, wiring and other components on compressors, engines and motors from cleaning fluids, drifting abrasives and paint overspray while still providing accessibility for process operators. Motors shall be shielded so that necessary cooling air is not cut off.

3.2. Protection of other equipment

Where possible, electrical wiring and instrumentation conduit should be installed after blasting and coating.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

When Instrument and Electrical Equipment items are installed, they shall be fully protected from direct spraying or from spray paint being blown / dripping on to the Equipment items. Items to be covered shall include cable/tubing trays, Junction Boxes etc.

Air intakes on engines, compressors, motor housings and blowers shall be protected with filter media and covered at all times to prevent damage or contamination from blasting and painting operations.

3.3. Flanged connections

Masking will be installed before blast cleaning and coating operations to protect gasket surfaces and pipe or nozzle interiors. Masking materials shall be removed after coating operations are completed and flange covers shall be reinstalled when appropriate.

Outer edge of ring groove flanges and raised face flanges will be blasted and coated to the upper (outer) edge of the ring groove or the outside edge of the raised portion of the flange with primer and second coat only

3.4. Inaccessible areas

All surfaces that will be made inaccessible during the fabrication processes shall receive proper surface preparation and coating per the requirements of the appropriate coating system prior to fit up.

3.5. Protrusions through insulation

When insulation and/or fireproofing is specified, it is intended that all structures, brackets, nozzles, manheads, manways, etc., which extend beyond the insulation or fireproofing system shall be protected with a complete coating system and continuing back onto the structure, piping or equipment to which they are attached. This shall include the attachment weld and extending under the insulation at least 200 mm (8 inches), unless otherwise approved by the COMPANY. Uninsulated exposed areas on coated insulated systems shall be coated with the same material as the pipe, equipment, etc. If a topcoat colour requirement exists for the uninsulated attachment, refer to Appendix 1 and 2 for the appropriate system or consult COMPANY.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

3.6. Galvanized pipin hardware and fasteners

All piping that is designated in the project line list to be galvanized and threaded hardware and fasteners associated with piping systems shall be hot dip galvanized per applicable code. Field welds on galvanized piping systems (if unavoidable) must be approved on a case by case basis in writing by COMPANY.

COMPANY intention is to complete all welding, fabrication works prior to application of mid & topcoat of the applicable paint system. Ongoing fabrication, handling, installation of VENDOR equipment, etc. shall be performed with the paint system in a tie coat. CONTRACTOR shall propose and mutually agree with COMPANY on the practical application of the mid & topcoats.

4. QUALITY, SAFETY AND ENVIRONMENT REQUIREMENT

4.1. Quality

The CONTRACTOR shall have an established and documented Quality System in accordance with ISO 9001. The CONTRACTOR shall maintain up to date documentation relating to the coating activities including, but not limited to, the following:

- Coating procedures/method statements and manufacturer's data sheets.
- An Inspection and Test Plan which refers to specific requirements of this specification and to related supplier/contractor procedures.
- Coating inspection and test reports and daily reports.
- Certification for all coating materials and blasting consumables in use in the work.
- Up to date calibration certificates for all test or measurement equipment.

4.2. Safety

The CONTRACTOR shall be responsible for ensuring that all work meets statutory health and safety regulations and the purchase order/contract HSE requirements specifications. In addition, the following specific requirements shall be observed:

- All personnel are to be adequately experienced, competent and fully conversant with all hazards and safety requirements of the works, and supplied with all necessary personal protective equipment.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

- All work areas shall be signposted, flagged and barricaded, and screens, dropsheets or other barriers provided as necessary to protect other trade operations and personnel from abrasive blasting and coating operations.
- Safe areas shall be established and clearly identified for the storage and mixing of all flammable and hazardous materials. These areas are to be freely ventilated and located remote from all hot work. No source of ignition shall be permitted within these areas at any time.
- Material Safety Data Sheets and any other relevant product information shall be available at all times in the storage area and at the application location.
- Fire extinguishers, applicable to the fire hazard, shall be provided and regularly serviced, adjacent to all storage, mixing and application areas.
- Eye wash stations shall be provided throughout the fabrication facility.
- Scaffolding and other methods of access to the work shall be constructed to provide clear, easy access with free use of body and arms.
- Pressure containing devices (eg Abrasive Hoppers and Compressed Air Tanks) shall be tested, certified and regularly inspected by an acceptable Third Party Inspectorate, and shall be provided with automatic pressure relieving devices to protect against over-pressurisation.
- Abrasive blasting equipment shall be provided with 'Dead Man Controls' at the operator's nozzle. The “Dead Man Handle” shall only be manually held in position by the blaster.
- Pressure hose connections shall incorporate positive locking or be wired to prevent accidental disconnection whilst under pressure.
- Spray painting and abrasive blasting equipment shall be securely earthed and all other necessary precautions taken to prevent build-up and discharge of static electricity, in accordance with the paint manufacturers recommendations.
- Safety requirements for confined space operations shall include, but not be limited to; forced air ventilation, lighting, communications, and positive pressure full faced masks equipped with integral emergency backup air

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

supply for all exposed personnel. All equipment is to be intrinsically safe and suitable for the hazardous atmosphere.

4.3. Environment

All coating work shall comply with local environmental regulations and the related Contract requirements, taking particular account of limits on coating products and of the disposal of waste and surplus materials including spent abrasives.

5. SURFACE PREPARATION

5.1. Solvent cleaning

Solvent cleaning shall be carried out to remove any visible oil, grease and soils per requirements of SSPC SP-1 Solvent Cleaning before conventional (air blast) cleaning, automatic (wheel blast) cleaning or hand/power tool cleaning.

5.2. Hand/power tool cleaning

SSPC SP 2 and/or SP 3 procedure(s) shall be used to remove weld splatter and to "break" sharp edges and corners before abrasive blasting operations are started. These methods shall also be used to remove weld flux, metal slivers (small laminations) and other imperfections revealed by the abrasive blast operation. Note that carbon steel wire brushes are prohibited for use on stainless steel.

5.3. Blast cleaning general requirement

Abrasive blasting shall be performed in an area remote from coating operations and freshly coated surfaces to prevent dust and abrasive contamination.

Dust and spent abrasive shall be removed prior to coating application by blowing off with clean dry air, brushing or vacuuming.

The use of steel shot or steel grit is not permitted for blast cleaning stainless steel surfaces.

No acid washes, other cleaning solutions, inhibitors or solvents may be used on metal surfaces after being blasted, unless such solutions can be properly removed prior to painting. CONTRACTOR shall obtain written approval from the COMPANY prior to using these types of materials.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

Bolt holes shall be complete and burrs shall be removed prior to abrasive blasting. COMPANY may require a practical demonstration of hole drilling / burr removal, blasting and subsequent coating application on site.

Steel defects revealed during abrasive blasting (slivers, laminations, cracks, pitting, etc.) shall be reported to the COMPANY for evaluation. Defects will be ground or otherwise repaired as directed by the CONTRACTOR and approved by COMPANY. The repair area may require reblasting and will require coating after repair.

After cleaning, the surfaces shall be kept free of oil, grease, dirt, and other contaminants until the protective coating has been applied. Any surfaces left overnight without coating shall be reblasted before application of coating. In all cases, application of primer shall take place prior to the appearance of any corrosion "bloom" on the cleaned surface.

5.4. Conventional Blast

Conventional (air blast) blast abrasives for use on exterior surfaces that are not immersed or buried must meet the following requirements:

- Will not contain greater than 1% free silica unless the CONTRACTOR's work procedures prevent exposure to the silica containing dust and the use of the high silica abrasive has been approved by the COMPANY.
- Will not contain harmful amounts of heavy metals.
- Contain less than 125 ppm water soluble chlorides.
- Contain less than 200 ppm water soluble sulfates.
- Will be essentially free of clay, limestone, shells, undersize and oversize particles.

Abrasives used for preparing surfaces which will be used in immersion service or buried will meet all the requirements listed above except the water soluble materials will not exceed 100 ppm total (total of chlorides and sulfates).

The compressed air supply shall be free of water and oil or other contaminants. Adequate operating moisture separators and traps shall be provided, and these shall be kept emptied of water and oil. A Blotter test in accordance with ASTM D4285 will be conducted at the beginning of each day's work as a minimum. Utilization of

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

“air coolers” may be required if moisture contamination cannot be adequately controlled by separators and traps.

Compressors shall be of a size large enough to maintain a minimum 6.21 bar nozzle pressure and 3.4 cubic meter per minute (120 cfm) flow at each blast nozzle.

Abrasive blasting shall continue a minimum of 25.4 mm (1”) into adjoining coated surfaces. When daily coating work ends, a minimum of 152.4 mm (6”) around the edge of abrasive blasted areas shall be left uncoated.

5.5. Automatic Blast

The use of automatic blast equipment is acceptable when the specified anchor profile, degree of cleanliness and cleanliness of abrasive can be achieved and maintained.

The "operating mix" of abrasive will contain enough sharp grit to obtain a predominately sharp and acceptable (specified) anchor pattern.

5.6. Touch up/ Repair

Hand tool or power tool cleaning, per SSPC SP-2 or SP-3, is allowed for surface preparation on a case by case basis with prior written approval from COMPANY on small damaged areas (measuring less than 200mm (8 inches) in every dimension, or as defined by the COMPANY). Necessary tools, wheels or equipment shall be used to achieve the anchor profile for the specific coating system. The use of wire wheels tends to trap contaminants and polish the surface; therefore, the use of wire wheels will also require written approval by the COMPANY. In any case, do not polish steel surfaces that are to be coated.

Larger repairs shall be spot blasted with abrasive unless hand or power tool cleaning is approved by the COMPANY. All repairs shall be feathered approximately 25.4 mm (1”) into the adjacent undamaged coating.

6. COATING APPLICATION

6.1. General

Any surfaces to be coated shall be prepared to comply with the requirements of this Specification and shall be rendered free from dust, blasting residues or entrained grit prior to the application of any coating.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

All graffiti and other fabrication markings on coated surfaces shall be removed prior to the application of coatings.

All coating material shall be thoroughly stirred with a power mixer for a time sufficient to thoroughly mix all components.

Coatings containing heavy or metallic pigments, which have a tendency to settle, shall be kept in suspension in the application equipment by continuous agitation with a mechanical stirrer.

No thinners are allowed, except where so specified by the paint manufacturer.

If a coating material requires the addition of a catalyst, the pot life under application conditions shall be clearly stated on the label, or on the product data sheets, which shall be available at the work place. The pot life shall not be exceeded, regardless of the apparent visible condition of the product. When the pot life limit is reached, the equipment shall be emptied, cleaned and the material discarded.

Coatings shall not be applied under the following conditions

- When the substrate is damp, wet or contaminated in any way.
- When the substrate temperature is greater than 40°C, or than the manufacturer's recommended upper limit if higher and subject to qualification testing.
- When the substrate temperature is less than 3°C above the dew point of the surrounding air.
- When the relative humidity of the air is greater than the coating supplier's recommendations, or 85%, whichever is more stringent.
- When the air temperature is less than 10°C.
- When the local lighting is less than 1000 lux.
- When there is a likelihood of a change in weather conditions after application which would result in air temperature below those specified or deposition of moisture in the form of rain, condensation or other upon the surface.



- For the application of zinc silicate primer, the coating supplier's recommendations shall be followed for relative humidity during application and curing. Typically, these require that a relative humidity of >70% will exist during the curing period, or that water spraying may be required after the initial cure.

Prepared surfaces shall be coated with the first coat specified within four hours of blasting and prior to any visible deterioration of the surface preparation occurring. The first coat applied to power tool cleaned surfaces shall be applied by brush, thoroughly working the product into the surface.

All edges, irregular weld profiles, corners and boltholes shall receive an additional "stripe coat" applied by brush, (except inorganic zinc silicate primers), between each spray applied coat, to assure complete coverage and adequate film thickness in these areas.

Surfaces where access will be restricted after assembly shall be precoated, including all contact surfaces. Special consideration shall be given to areas under high strength bolted connections which should be primed with a product having a suitable slip factor.

Regular checks shall be made using wet film thickness gauges to ensure an even coating of the correct thickness.

Each coating shall be allowed to dry or cure thoroughly for the specified time as per coating manufacturer's written instructions, prior to application of the succeeding coat, which shall be of a contrasting colour. Each coat of a system shall be complete and accepted (including any repair work) prior to the application of subsequent coats.

No coating shall be applied within 50 mm of edges intended for welding, except approved by COMPANY. Where coatings have been applied to areas which are subsequently allocated for welding or cutting, the coating shall be removed from the proposed area before cutting or welding takes place to prevent coating burn back. After welding the paint shall be reapplied in accordance with the provisions of repairs of defects in this Specification.

Coatings shall be of the correct colour, gloss level, hiding power and texture and be applied uniformly and with good adhesion over the entire surface. The applied film

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

shall be free from runs, sagging, cracking, misses, holidays, pinholes, dry spray, overspray and other contamination or detrimental defects. Compliance to these requirements will be based on best industry standard for a high quality finish, however COMPANY's decision as to the acceptability of any coating application shall be final.

6.2. Spray application

Spray application equipment shall meet the requirements and recommendations of the coating manufacturer for satisfactory application of the product. Spray guns, lines and application equipment shall be clean before adding coating material.

Adequate traps shall be provided to remove moisture, oil and other contaminants between the air supply and the spray equipment. The traps shall be of the automatic or continuous bleed type.

Operating pressures shall comply with the recommendations of the coating manufacturer, and shall be above the minimum required to obtain satisfactory application characteristics. Suitable working pressure gauges and regulators shall be provided for all equipment.

The length of material hose between pressure pot and spray gun shall not exceed 15 metres, and the pot shall be placed at the same elevation as the spraying operation.

Each pass shall overlap the previous pass by at least 50% and surfaces shall normally have at least two passes at right angles to each other.

Each coat shall be applied uniformly and completely over the entire surface. All runs and sags shall be brushed out immediately or the paint shall be removed and the coating reapplied.

6.3. Brush application

Coatings may only be brush applied on limited surface areas where it is shown to be impossible to spray apply, where brush application is the preferred method recommended by the coating manufacturer, when stripe coating weld areas, edges, corners etc, or for the first coat applied to mechanically prepared surfaces.

Brushing shall be performed such that a smooth uniform thickness coating is obtained. There should be no deep or detrimental brush marks. Paint shall be

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

worked into all crevices and corners. Runs or sags shall be brushed out. No extension handles shall be allowed on brushes.

6.4. Other coating application methods

For all coatings requiring specialist application methods or equipment, including thermally sprayed aluminium (TSA) or other metals, proprietary resin coating/lining systems, fluorocarbon/resin coatings etc., application shall be in accordance with specifically prepared and approved procedures. These procedures shall be suitably qualified unless a waiver is granted based on documented history of previous application under equivalent conditions.

Surface preparation and general requirements of this specification, including test and inspection, shall be adopted to the maximum extent possible and identified deviations shall be approved in advance.

For any application requiring heat, a controllable, non-contaminating heat source shall be used. For thermally sprayed coatings, equipment settings shall be recorded.

7. INSPECTION AND TESTING

7.1. General

The CONTRACTOR shall develop and maintain adequate inspection and test plans and procedures to ensure that the works are checked and verified to comply with the requirements of this specification irrespective of any inspection carried out by COMPANY. The CONTRACTOR's Inspection and Test Plans shall comply with project quality requirements.

All inspection activities shall be performed by qualified personnel certified in accordance with the International Coating and Inspector Training Programme or approved equivalent and a minimum of 5 years experience in protective coatings inspection. All necessary equipment, including hygrometers, temperature, surface profile and film thickness gauges etc, shall be provided to ensure that inspection and testing is performed in a timely and accurate manner. COMPANY may witness, conduct, or arrange independent testing to verify the completeness and accuracy of any result.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

All activities, materials and equipment may be subject to audit at any time by COMPANY. The CONTRACTOR shall provide safe and ready access to any work area, materials, equipment or surface nominated by COMPANY.

COMPANY shall have the right to reject any or all of the work, materials or equipment that do not meet the minimum requirements of this Specification. Any defective work, materials or equipment shall be promptly repaired or replaced, as necessary, to meet the requirements of this Specification. All such corrective actions shall be at the CONTRACTOR's expense.

Inspection and testing activities shall be performed as defined in the approved inspection and test plans. Where inspection and test activities require witness by COMPANY or third party inspectors, the CONTRACTOR shall provide a minimum notice period of 48 hours. Longer periods of notice will be required, to be agreed in advance, where activities are remote from the COMPANY normal site offices. Notice periods for Third Party inspections shall be subject to separate agreement.

The results of all inspection and test activities shall be documented progressively throughout the contract. The records shall be maintained in a safe and retrievable system which may be subject to review or audit at any time by COMPANY.

All inspection and test equipment shall be calibrated and maintained in accordance with the inspection and test equipment manufacturer's instructions. All relevant certificates shall be made available for COMPANY's review.

7.2. Specific test methods

General inspection and test methods developed in compliance with the following requirements:

7.2.1 Blasting Abrasive Quality

In the event of doubt over the cleanliness of abrasives, the following tests shall be carried out:

- Mix the abrasive material with distilled water at a ratio of one part abrasive to ten parts water by weight.
- The top of the solution shall show no evidence of grease or oil.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

- The solution shall not be discoloured.
- The pH of the solution shall not be less than pH5.
- The Chloride content of the solution shall not exceed 5 parts per million. This is equivalent to 50 parts per million in the abrasive material. This test may be performed by a Third Party testing laboratory or by the use of a field test kit.

7.2.2 Blast Profile Height

The profile height of abrasive blasted surfaces shall be determined by reference to the ISO 8503-2 visual comparator. Replica tape testing shall also be carried out at least twice per shift. The use of surface needle gauges or other methods shall only be with the approval of COMPANY.

7.2.3 Climatic Conditions

Humidity and air temperature shall be measured using a hygrometer or electronic hygro-thermometer. The substrate temperature shall be measured using an electronic surface temperature gauge. Such measurements shall be carried out on representative surfaces at least three times per working shift.

The test locations and frequency of testing shall be determined with due regard to the stability of weather patterns and micro-climates that may exist within enclosed spaces, buildings etc.

7.2.4 Dry film thickness

Dry film thickness shall be checked by the use of a non-destructive electronic thickness gauge in accordance with ISO 12944. The use of destructive type gauges to verify the acceptability and thickness of underlying coats may be requested by COMPANY at any time.

Dry film thickness gauges shall be calibrated for the thickness range to be checked at least twice per working shift, using foils in the film thickness range being checked and over the type of surface prepared in the same manner as that which is coated. Due allowance shall be given for the effect of surface profile and final coating thickness shall be determined as above the profile.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

At least three gauge readings shall be taken for each thickness determination, which shall be the average of the three readings. At least five separate thickness determinations shall be taken for each 9 square metres of coated surface. On surfaces less than 9 square metres in area, at least three thickness determinations shall be made. Test locations shall be randomly selected and evenly spaced over the surface and shall include areas of poor access, eg. behind angles and flanges.

The results of all determinations shall be recorded with the minimum, maximum and actual numerical average values being reported for each item or for each batch of smaller items.

Acceptance criteria for the completed coating system, based on the nominal dry film thickness stated in Appendix 1 and 2 are:

- The minimum acceptable thickness at any point is 80 - 85% of the specified DFT, provided that the average thickness locally is above the specified DFT.
- The average thickness is 100-120% DFT.
- The maximum acceptable thickness is 125% of the specified DFT.

7.2.5 Continuity Testing

Coating systems which will be subjected to burial or immersion exposure during service, including all tank/vessel linings, shall be subjected to holiday testing over the entire surface and all indicated defects shall be repaired and retested. Wet sponge testing shall only be used for coatings up to 300 microns, with high voltage spark testing used above that.

7.2.6 Adhesion testing

Adhesion testing shall be carried out during all coating system qualification trials and as a routine test for thermally sprayed aluminium (TSA) coatings and for all coatings intended for immersion duty. Routine testing shall be at a frequency of one test per 20 m², or once per operator per shift, if more frequent. Where specifically approved by COMPANY, testing may be carried out on test plates prepared and coated in parallel with production surface preparation and coating work. Adhesion testing shall normally be by a tensile pull-off technique using hydraulically operated test equipment.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

Acceptance criteria for adhesion testing shall depend upon coating type and available test data for equivalent systems. As a minimum, adhesion/cohesion levels of 5MPa for standard organic coatings, 10MPa for glass flake epoxy or polyester/vinyl-ester resins, and 7MPa for TSA coating shall be achieved in accordance with ISO 4624. Lower individual values shall require further investigation and remedial action.

	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

APPENDIX 1: COATING SYSTEM TABLE



PV GAS THI VAI LPG STORAGE TANKS PROJECT



PAINTING & PROTECTIVE COATING SPECIFICATION

Surface to be coated	Operating temp.	Coating system no.	Surface Preparation	Primer Coat	Intermediate Coat	Top Coat	Total No of Coat	Total DFT for total system	Remarks
UN-INSULATED CARBON STEEL SURFACES (Including Structural Steel, Equipment, Piping, Exhaust Stacks, Vessels, Heat Exchanger Shells, etc.)	Up to 120°C	PS1	SSPC-SP-10 Sa 2.5 Profile 50-75 µm	Two pack, self curing, Zinc Silicate 75 µm	Two pack Micaceous Iron Oxide Pigmented Epoxy 125 µm	Two pack Acrylic Modified Polyurethane 50 µm	3	250 µm	
SURFACES THAT ARE TO RECEIVE FIREPROOFING (Including Fireproofed Supports)	Up to 120°C	PS2	SSPC-SP-10 Sa 2.5 Profile 50-75 µm	Two pack Epoxy Phenolic 150 µm		Two pack Epoxy Phenolic 150 µm	2	300 µm	
GALVANIZED SURFACES THAT REQUIRE PAINTING OR REPAIR	Up to 120°C	PS3		Two pack Polyamide Cured Epoxy Primer 40 µm		Two pack Acrylic Modified Polyurethane 40 µm	2	150 µm	



PV GAS THI VAI LPG STORAGE TANKS PROJECT

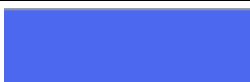


PAINTING & PROTECTIVE COATING SPECIFICATION

INTERIOR SURFACE OF WATER TANKS (Potable Water, Fire Water, etc.)	Up to 120°C	PS4	SSPC-SP-10 Sa 2.5 Profile 50-75 µm	Pure epoxy primer 50 µm	Epoxy tank lining grade 125 µm	Epoxy tank lining grade 125 µm	3	300 µm	
SAFETY COLOUR IDENTIFICATION SYSTEM	Up to 120°C	PS5	SSPC-SP-10			Epoxy in appropriate colour 150 µm	1	150 µm	
BURIED CARBON STEEL PIPING	-	PS6		SEE APPENDIX 3					
OUTER SURFACE OF LPG TANK & FIRE FIGHTING TANK				Two pack, Self curing, Zinc Silicate 75 µm	Two pack Micaceous Iron Oxide Pigmented Epoxy 200 µm	Two pack Acrylic Modified Polyurethane 75 µm	3	350mm	

	PV GAS THI VAI LPG STORAGE TANKS PROJECT		
	PAINTING & PROTECTIVE COATING SPECIFICATION		

APPENDIX 2: COLOUR TABLE

ITEMS	COLOUR		Remarks
TANK			
Pressurized LPG Tank	Traffic White (RAL-9016)		
Fire Water Tank	Traffic White (RAL-9016)		
VESSEL			
Diesel Tank Drum, Vessel	Agate Grey (RAL-7038)		
STRUCTURE			
All Steel Structure for Pipe rack, Shelter, etc. Pipe Support	Agate Grey (RAL-7038)		
Ladder, handrail	Rape Yellow (RAL-1021)		
PIPING & VALVE			
Process (Liquid)	Traffic White (RAL-9016)		
Process (LPG Vapor)	Rape Yellow (RAL-1021)		
Fire Fighting (Including Fire fighting equipment: fire truck, fire water pump, valve for fire fighting, extinguishers, etc.)	Flame Red (RAL-3000)		
Instrument Air	Light Blue (RAL 5012)		

	PV GAS THI VAI LPG STORAGE TANKS PROJECT		
	PAINTING & PROTECTIVE COATING SPECIFICATION		

Nitrogen	Agate Grey (RAL-7038)		
Diesel	Signal Brown (RAL 8002)		
Water Service	Traffic Green (RAL 6024)		
Hypochlorite, odorant	Signal Violet (RAL 4008)		

INSTRUMENT & ELECTRICAL	- Manufacture's Standard - Project Specification		
PUMP EQUIPMENT MACHINERY	Manufacture's Standard		

	PV GAS THI VAI LPG STORAGE TANKS PROJECT PAINTING & PROTECTIVE COATING SPECIFICATION	
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APPENDIX 3: COATING SYSTEM NO.7 (WRAPPING)

Coating System No.7:

Apply to: Underground piping

Surface Preparation: SSPC-SP-10 / SSPC-SP-06 / SSPC-SP-01

First Layer: Liquid adhesive layer

Second Layer: inner-layer tape of corrosion protection

Third Layer: outer-layer tape for mechanical protection

Liquid adhesive:

The liquid adhesive shall consist of the mixture of suitable rubber and synthetic compounds and a solvent. The liquid adhesive shall be applied to the properly prepared pipe surface before the application of inner layer tape. The function of the liquid adhesive is to provide a bonding medium between the pipe surface and the inner layer tape.

Physical properties of liquid adhesive:

Colour: Black

Base: Rubber and synthetic resins

Inner layer tape:

The inner-layer tape shall be a two layer consisting of a polyolefin (only) backing layer with a laminated butyl-based adhesive layer. The backing material which is polyolefin shall contain not less than 1.0 percent or more the 3.5 percent, by weight, of non polyolefin material consisting of carbon black and antioxidants. The inner layer tape shall be applied after the liquid adhesive and before the outer layer tape.

Physical properties of inner layer tape:

Thickness: Min. 483 microns Max. 559 microns

Recommended tape width: 300



	PV GAS THI VAI LPG STORAGE TANKS PROJECT	
	PAINTING & PROTECTIVE COATING SPECIFICATION	

the liquid adhesive layer. The inner layer tape shall be applied at a minimum roll temperature of 21 deg. C. The inner layer tape shall be spirally applied with overlap width and application tension as recommended by manufacturer. When applied to spirally welded pipe, the direction of tape spiral shall be generally parallel to the weld spiral. The minimum overlap shall not be less than 55 percent. When a new roll tape is started, the ends shall be overlapped at least 165mm measured circumferentially. The overlap shall be smooth and shall be located to ensure the continuity of inner layer coating. A hard rubber roller, wider than the width of the tape, which is used to ensure maximum contact of the tape with the pipe surface, is an option the fabricator may require.

Outer layer tape

The outer layer tape shall be applied over the inner layer tape using the same type of mechanical equipment used to apply the inner layer tape. The overlap of the outer layer tape shall not coincide with the overlap of the inner layer tape. The minimum overlap of the applied tape and minimum end lap of two rolls shall be the same as specified for inner layer tape.