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TECHNICAL SPECIFICATION

Doc No: DSF-SPC-MEC-006

Rev. 1

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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

EXTERNAL PAINTING

JUNE 2021

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REVISION HISTORICAL SHEET

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REFERENCES DOCUMENTS

EU Directive 2010/75/EU

[Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)]

EU DIRECTIVE **92/58/EEC**

[on the minimum requirements for the provision of safety and/or health signs at work]

Presidential Decree no. 105/22.03.1995 Governmental Gazette FEK 67A/10.04.1995

[National Measures implementation of EU Directive **98/59/EC**]

ELOT EN ISO 8501-1

[Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings]

ELOT EN ISO 12944

[Paints and varnishes - Corrosion protection of steel structures by protective paint systems]

ELOT EN 12921

[Machines for surface cleaning and pre-treatment of industrial items using liquids or vapours]

ELOT EN ISO 8504-2

[Preparation of steel substrates before application of paints and related ELOT

EN ISO 8504-3

[Preparation of steel substrates before application of paints and related products; surface preparation methods; part 3: hand- and power-tool cleaning]

ELOT EN ISO 2808

[Paints and varnishes - Determination of film thickness]

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1. SCOPE

This specification outlines the general requirements for the external painting of piping, pipe components, steel structures, machinery and equipment for shop and field painting.

Painting works include surface preparation, selection, application, inspection and clean-up of paints.

Painting systems, including surface preparation, painting materials, application, etc. must comply with applicable local laws.

This specification does not specify paint systems operating above 120°C.

If such are required, appropriate paint systems must be developed case by case.

Painting system will be provided for pipe work, fittings, equipment and steel structure both internally and externally mounted, subjected to normal or higher than normal working temperatures.

At pipeworks, the coating of belowground part of the pipeline shall extend at a height of at least 150 mm from the ground. Then the pipeline will be painted as above ground part.

2. GENERAL REQUIREMENTS

Painting of steel surfaces shall be performed in accordance with **ELOT EN ISO 12944** and Paint Manufacturer's recommendations.

Where above documents are given in permissive terms e.g. "should", "may" and "recommend" these shall be considered mandatory.

Surface preparation of steel surface shall be in accordance with the referred **ELOT EN ISO 12944** and **ELOT EN ISO 8501-1** standard.

The following surfaces shall not be painted:

- Concrete.
- Building Brick, Masonry Units and Wall Tile.
- Mortar
- Galvanized Surfaces (except safety painting).
- Insulation Weatherproofing.
- Insulated Carbon Steel Piping and Equipment (Vessels and Heat Exchangers) operating over 90°C.
- Aluminium, Copper, Brass and other Nonferrous Metals.



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- Not insulated Stainless Steels (except in preparation for ocean shipment or storage/ installation in a coastal area).
- Equipment supplied with Manufacturer's standard finish coat.
- Tripping Mechanism of Steam Turbines.
- Equipment supplied with Manufacturer's standard finish coat.
- Plastic and Plastic Coated Materials.
- Machined and Gasket Surfaces.
- Nameplates.

Platforms/walkways gratings shall be hot dip galvanized.

The galvanizing shall be carried out in accordance with ELOT EN ISO 1461.

The thickness of the zinc painting shall be at least 86 microns corresponding to coverage of 610.3 g/m² of surface to be painted.

All shop fabricated materials (vessels, heat exchangers, structural steel, piping, etc.) requiring painting shall be cleaned and shop primed by the Fabricator or Manufacturer.

The finish coat will be applied in field after erection at Contractor's care.

Machinery, electric motors, instruments, spring hanger, etc. will be completely painted in accordance with the Manufacturer painting standards selected on the basis of attached Painting Systems.

The final color of the equipment will be in accordance with TABLE E Color System.

Non insulated portions of insulated/fireproofed equipment, which extend beyond the insulation or fireproofing system shall be painted including the welded joint. Requirement for painting of piping includes the entire piping system including fittings, flanges valves, strainers, traps, etc.


The general Contractor shall be responsible for properly handling and storing the painted materials prior to erection to minimize damage on them.

Damaged areas of the primer shall be repaired after erection by the painting Contractor to the satisfaction of Owner.

If primer has weathered at not accepted condition, Owner will determine how much repriming is required.

The paint system shall be suitable for the corrosive environment and the operating temperature of equipment and piping except:

- The exterior temperature of internally lined items shall be used where specified in the

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requisition.

- Supports (skirts, legs, saddles, etc.) shall be considered as operating below 90°C, unless otherwise noted.
- Higher temperatures required for non-operating conditions shall be used where specified in the requisition.

Only paint and painting materials approved by Owner shall be used. These materials shall be delivered at job site in sealed and labeled containers. They shall be stored in a location that is well protected, well ventilated, and free from excessive heat, open flame, or other sources of ignition.

Paint materials susceptible to freezing shall be stored in a heated area.

Primers and finish coats for any particular system shall be of the same Manufacturer, whenever possible, to assure compatibility.

Paint shall be thoroughly mixed and thinned in accordance with the Manufacturer's instructions immediately prior to application.

Only thinners of a type recommended by the paint Manufacturer shall be used.

The equipment listed below shall be shielded to prevent damage during surface preparation and painting operations. All openings, including those that are flanged or threaded, shall be sealed to prevent entry of sand, dust, or coating material.

After completion of the external painting, all vessels and valves (above DN100) shall be labeled (with the tag number) on a well visible place with black paint (equivalent with the external paint) by using stamped figures. The size of the figures will be in accordance with the following:

- Figure's height 45mm.
- Figure's width 25mm.
- Figure's line width 6mm.
- Clearances between figures 5mm.

After completion of painting operations, all materials used for shielding and sealing shall be removed.

- Nameplates.
- Packing Glands
- Packing Seals.
- Bearings.



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- Rotating Equipment Couplings.
- Rotating Equipment Shafts.
- Lubrification Fittings.
- Pressure Gauges.
- Gauge Glasses.
- Motor Starters.
- Instruments Dials.
- Vents.
- Exposed Linkages.
- Valve Stems.
- Light Bulbs.
- Light Bulb Enclosures.
- Light Reflectors.
- Air Intakes.
- Rubber Parts and Plastic.

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3. SURFACE PREPARATION

Surfaces shall be thoroughly cleaned of any material conducive to premature failure of the paint coating. The method of surface preparation used shall be compatible with, and suitable for, the prime coat of paint.

Surfaces shall be primed after cleaning before any rusting occurs (if rust forms after cleaning the surface shall be cleaned again before painting).

Prior to cleaning, oil and similar matter shall be removed with a solvent wash as per ELOT EN 12921 and the requirements of EU directive **2010/75/EU VOC** shall be fulfilled. Blast cleaning with grit or synthetic abrasives is preferred to sand.

In case blast cleaning is performed using sand it shall be silica sand taken from riverbed.

Sea beach sand is not allowed.

Steel surfaces, shall not be blasted when surface temperature is less than 3°C above the dew point, relative humidity is greater than 85 % or there is a possibility that the blasted surface will be subject to wetting before the coat of primer can be applied.

Surfaces shall be blown, wiped or vacuumed free of blasting abrasive and dust before they are primed.

Since freshly blasted surfaces are subject to immediate corrosion, no other surface shall be blast cleaned than that which can be primed before visible or detrimental rerusting occurs. Blasted surfaces shall be primed within three hours after blasting. A300 mm wide strip of unpainted, blasted surface shall be left between primed and unblasted surfaces to prevent damage to the newly dried coating when additional blasting is done. When blast cleaning is resumed, the strip of previously blasted surface shall require only a light brush blast to remove any rust that may be present.


Cleaning shall be accomplished by holding the cleaning nozzle in a direction away from the painted surface.

In case to adopt hand or power tool cleaning, care shall be exercised in the use of tools to prevent excessive roughening of the surface and the formation of ridges and burrs. Excessive power wire brushing produces a burnished slick surface not suitable for painting.

All sharp edges shall be removed and edges shall have a minimum roundness of 2 mm.

Roughness profile shall be according to Rugotest no 3 BN 10a BN 11 (Ras 12 1/2 to 25 mym)

4. PAINT APPLICATION

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Paint shall be applied by one, or a combination, of the following methods:

- Brushing.
- Roller Painting.
- Air Spraying.
- Airless Spraying.

The method of application shall be governed by the paint Manufacturer's recommendation for the particular paint being applied.

For the application techniques, requirements and precautions, **ELOT EN ISO 12944** shall be used as a general reference.

Conventional solvent-base paints shall not be applied to exterior surfaces in humid weather, when the air temperature is less than 3°C above the dew point.

Water-base paints may be applied to damp surfaces.

Wetting of exterior surfaces is recommended during hot weather application. Water-base paints shall be applied at air temperature above 10°C.

Chemically cured paints shall not be applied at air or surface temperatures below 10°C or when relative humidities are above 85% (paint Manufacturer's recommendations shall be consulted in each case for possible special temperature requirements). No paints shall be applied to a surface at a temperature that will cause blistering, porosity or otherwise be detrimental to the life of the paint.


Contact surfaces shall be painted as follows:

Contact surfaces of steel members to be joined by high-tensile bolting in friction-type joint shall be left unpainted, except for inorganic zinc primers as approved by ECSC (European Coal and Steel Community) and according to the requirements of EU Directive **2010/75/EU VOC**.

Steel painted in the shop or in the field before erection shall not be coated within 50 mm of the edges to be welded.

Surfaces not in direct bonded contact, but inaccessible after assembly, shall receive the full-specified paint system before assembly.

Surfaces shall not be repainted until the preceding paint has properly dried or cured. The surface may be considered ready for recoating when the next can be applied without the

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development of paint film irregularities, such as lifting or loss of adhesion of the undercoat. However, the minimum or maximum drying or curing time specified by the paint Manufacturer shall be the acceptable recoat period.

Paint shall not be force-dried under conditions which will cause cracking, wrinkling, blistering, formation of pores, or which will be detrimental to its condition or appearance.

Newly painted surfaces shall be protected to the fullest extent practically from rain, condensation, contamination, snow and freezing until the coating has dried.

The type of paint to be used and the number of coats to be applied shall be in accordance with **TABLE A, B and C** of this specification.

5. FIELD PROTECTION AND CLEAN-UP

Paint applicator shall fully protect all equipment, walls, floors, ceilings and other surfaces from damage and shall provide the necessary drop cloths or other protection required to fully protect all surfaces from dust, paint droppings, paint mist, other contaminants during the execution of his work.

While painting around switches and controls, painters shall be careful to avoid tripping of switches. It is imperative that all switches remain unmoved and undisturbed by the painters.

All shipping tags, wires, strings and other means of temporary or shipping identification on surfaces to be painted shall be removed, but only after checking and receiving authorization by Owner.

Paint applicator shall clean all surfaces, which have been spotted with paint such as window glass, floors, walls, equipment, etc., leaving the premises clean to the satisfaction of Owner.

Paint applicator shall provide a temporary shelter for storage and mixing of paint materials.



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Applicator shall provide adequate firefighting equipment, satisfactory to Owner, for the temporary shelter and all the locations where painting work is in progress.

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6. INSPECTION

Surfaces prepared for painting are to be inspected and approved as satisfactory by the Owner's field Representative and/or supervision before any paint is applied by the Contractor.

The Contractor shall also inspect all surfaces after cleaning and shall notify the Owner's field Representative about any defects, improper material or workmanship, or other conditions, which in his opinion will affect the satisfactory performance and duration of his work. Where such defects have been pointed out to, or by, the contractor shall not start any painting until all such defects or faulty conditions have been remedied, or until a written agreement has been made with the Owner's field Representative with respect any subsequent defects which may develop because of the conditions noted.

The Owner's Representative and/or Supervision shall monitor wet and dry film thickness of the paint and shall compare his findings with those recommended. In cases of inadequate film build, the Contractor shall be required to repaint the surface at his own expense. Dry-film thickness measurements shall be taken in at least three places on each item.

Porosity shall be checked over at least 5% of the total surface area by use of a low voltage pore detector of the wet sponge type. Pinholes shall not exceed 5 per m² of running meter.

Adhesion tests will not be specifically required unless requested by the independent appointed site Inspector.

The Inspector shall determine the adequacy of:

Surface preparation using blast cleaning shall be according to **ELOT EN ISO 8504-2** prior to the application of the first coat of paint.

Dry films thickness shall be defined with measurement of each coat and of the total system by procedures specified in **ELOT EN ISO 2808**.

Resets of dry film thickness measurements shall be recorded on reports form in accordance with **ATTACHMENT A**.

Such reports shall become part of the permanent inspection records.

Owner's Field Representative/Supervision shall have the right to obtain at any time samples of painting materials for laboratory analysis. If painting materials are found not to comply with the



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applicable specification, Contractor shall immediately take all necessary remedial steps to correct the work at his own care and cost.

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7. PAINT SYSTEMS

The paint systems to be adopted are in the following **TABLES A, B and C.**

The paint products acceptable for the job are shown in **TABLE D.**

The color system to be adopted in the plant will be per **TABLE E.**

8. CODE FOR PIPING IDENTIFICATION

The piping systems will be identified according to the requirements of **EU DIRECTIVE 92/58/EEC Presidential Decree no. 105/22.03.1995** Governmental Gazette FEK 67A/10.04.1995, pipeline identification tape for color coded marking of the contents of pipework.

The identification marks will contain the name of the product in Greek and English.

For very short lines, when both line ends can be seen contemporaneously, only one identification mark will be provided.

For lines with a length less than 30 meters, an identification mark will be provided at each end of the line.

For lines with a length greater than 30 meters, an identification mark will be provided at each end of the lines plus intermediate marks located approximately every 30 ÷ 50 meters based on line routing.



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9. ATTACHED DOCUMENTS

- 1. Table A**
[Painting Systems for Normal Environment]
- 2. Table B**
[Painting Systems for Corrosive Environment]
- 3. Table C**
[Painting System for Marine Exposure Environment]
- 4. Table D**
[Example of Acceptable Paint Materials]
- 5. Table E**
[Colour System]
- 6. Attachment A**
[Inspection Form]



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TABLE A

PAINTING SYSTEM FOR NORMAL ENVIRONMENT (1) (4)

COMPONENTS TO BE PAINTED	CYCLE No	TEMPERATURE RANGE DEG.C	SURFACE PREPARATION	PRIMER		INTERMED		FINISH	
				TYPE (2)	MICR. (3)	TYPE (2)	MICR. (3)	TYPE (2)	MICR. (3)
Bare Carbon Steel Parts of Structures, Vessels, fittings, etc.	1	-20°C to 50°C : normal -20°C to 80°C for short period only	ELOT EN ISO 8504-2	A	50	B	30	C(5)	160
Bare Carbon Steel Parts of Structures, Vessels, fittings, etc.	2	Up to 120°C	ELOT EN ISO 8504-2	A	70	-	-	A	70
¹ Insulated Carbon Steel Parts.	3	Bellow 90°C	ELOT EN ISO 8504-2	A	75	-	-	-	-
Insulated Stainless Steel Parts.	4	All	ELOT EN ISO 8504-3	D	25	-	-	-	-
Buried Carbon Steel Components (Note 6)	5	Up to 50°C	ELOT EN ISO 8504-2	A	30	(6)	(6)	(6)	(6)

Notes:

- (1) ENVIRONMENT DEFINITION: Normal Environment - lack of severe chemical fumes.
- (2) The types of paint are shown in the relevant Table.
- (3) The thickness is the total minimum after drying, (min. D.F.T.)
- (4) This painting system is valid unless otherwise specified in the Material Requisition.
- (5) Vinyl Top Coat maybe replaced by a chlorinated rubber paint, provided that:

Prior approval from Owner is received.

It can be demonstrated that the chlorinated rubber topcoat is completely compatible to undercoat.

Total system dry-film thickness is not less than 240 µm.

- (6) Buried carbon steel components shall be painted with jotamastic 87AL with (min. D.F.T.)
300 µm, for intermediate layer, and top finish shall be painted with jotamastic 87 (D.F.T.) 300 µm.


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TABLE B

PAINTING SYSTEM FOR CORROSIVE ENVIRONMENT (1) (4)

COMPONENTS TO BE PAINTED	CYC LE No	TEMPERATURE RANGE DEG.C	SURFACE PREPARATION	PRIMER		INTERMED		FINISH	
				TYPE (2)	MICR. (3)	TYPE (2)	MICR. (3)	TYPE (2)	MICR. (3)
Bare Carbon Steel Parts of Structures, Vessels , fittings, etc.	1	Below 120°C	ELOT EN ISO 8504-2	A	75	-	-	E	125
Insulated Carbon Steel Parts.	2	Bellow 90°C	ELOT EN ISO 8504-2	A	75	-	-	-	-
Insulated Stainless Steel Parts.	3	All	ELOT EN ISO 8504-3	D	25	.	-	-	-

Notes:

- (1) ENVIRONMENT DEFINITION: Corrosive Environment - severe chemical fumes present.
- (2) The types of paint are shown in the relevant Table.
- (3) The thickness is the total minimum after drying (mm D.F.T.).
- (4) This painting system is valid unless otherwise specified in the Material Requisition.



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TABLE C
PAINTING SYSTEMS FOR MARINE EXPOSURE ENVIRONMENT

COMPONENTS TO BE PAINTED	CYCLE No	TEMPERATURE RANGE DEG.C	SURFACE PREPARATION	PRIMER		INTERMED		FINISH	
				TYPE (1)	MICR. (2)	TYPE (1)	MICR. (2)	TYPE (1)	MICR. (2)
Bare Carbon Steel Parts of Structures, piping, heat exchangers, Vessels including non insulated / fireproofed equipment and piping	1	Below 120°C	ELOT EN ISO 8504-2	A	75	E	125	E	50
Insulated of fireproofed steel	2	Below 120°C	ELOT EN ISO 8504-2	A	75	-	-	-	-
Bare stainless steel	3	Below 120°C	ELOT EN ISO 8504-2	F	50	E	100	E	50
Insulated Stainless Steel	4	All	ELOT EN ISO 8504-3	D	25	-	-	-	-

Notes :

- (1) The types of paint are shown in **TABLE D**.
- (2) The thickness is the total minimum required after complete drying (mm D.F.T.)



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TABLE D
EXAMPLE OF ACCEPTABLE PAINT MATERIALS

TYPE	MAX TEMPERATURE	DESCRIPTION
A	400°C	Inorganic Zinc Rich Etyl-Silicat.
B	+50°C-Norm +80°C-Short period	Vinyl primer of type PVC-PVA. (1)
C	+50°C-Norm +80°C-Short period	Vinyl Coat. (1)
D	400°C	Silicone for Stainless Steel.
E	120°C	High-built Epoxy Polyamide.
F	120°C	Epoxy each primer for stainless steel.

Notes:

- (1) After agreement between the Client and applicator.
- (2) Paint Suppliers are acceptable after qualification of their products.



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TABLE E
COLOUR SYSTEM

As per EU DIRECTIVE 92/58/EEC

ITEM	COLOUR	RAL
- STEEL STRUCTURES	BLUE	5010
- VESSELS, HEAT EXCHANGERS	ALUMINIUM	9006
- FIRE FIGHTING EQUIPMENT	RED	2002
- ROTATING MACHINERY	BLUE	5014
- ELECTRIC MOTORS	GREY	7030
- PIPING <ul style="list-style-type: none">▪ Fire fighting.▪ Process.▪ Cooling Water.	RED WHITE GREEN	2002 9010 6029
- SAFETY FACILITIES (Safety valves, CSO/CSC valves, safety showers, handrails of platform, ladder safety cages).	YELLOW	1021
- ELECTRICAL EQUIPMENT (Transformers, grounding resistors)	GREY	7030
- ELECTRICAL ACTUATOR HOUSING	RED ORANGE	2001
- HAND WHEELS ON VALVE GEAR & ACTUATORS	GRAPHITE BLACK	9011
- SWITCHBOARDS	HOLD	

Note: The colours are defined according to the following collection: “RAL 840 HR” issued by DEUTSCHER NORMEN AUSSCHUSS.



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ATTACHMENT A INSPECTION FORM

PAINT AND PROTECTIVE COATING								
CLIENT: LOCATION:				PLANT: CONTRACT No.:				
DRY FILM THICKNESS MEASUREMENTS IN ACCORDANCE WITH SSPC-PA2 Measurement unit : MICRONS								
ITEM No.	PAINT IDENTIFIC CODE & MANUF.	REG. MIN. DFT			SPOT MEASUREMENTS			
		Prim. coat	Int. coat	Fin. coat	Reading No's	Prim. coat	Int. coat	Fin. coat
								AVERAGE VALUES
CALIBRATION: Consult SSPC-PA2 for gage calibration on bare substrate, and for measurement procedures. ACCEPTANCE CRITERIA: No single spot measurement (average of 3 gage readings, discarding any unusually high or low gage reading that cannot be repeated consistently) in any section shall be less than 80% of minimum required dry film thickness (DFT).								