

# PAINTING OF PLANTS AND CRYOGENIC TANKS

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4	30/06/17	Revision for paint type change	Manzotti	Gritti
3	01/07/09	Revision for paint type change	F.Dondossola	Gritti
2	03/11/08	General revision	F.Dondossola	Gritti
1	14.09.00	Modified table 1 – par. 3	F.Dondossola	Gritti
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**INDEX**

1. SCOPE AND APPLICATION FIELD
  2. REFERENCE STANDARDS
  3. DEFINITIONS
  4. SAFETY
  5. GENERAL PRESCRIPTIONS
  6. PAINT STORAGE
  7. SURFACE PREPARATION
  8. PAINTING
  9. INSPECTIONS
  10. REPAIRS
  11. HANDLING AND PRESERVATION
  12. RECORDING
  13. DURABILITY
- APPENDIX "A"**
- APPENDIX "B"**

### 1. SCOPE AND APPLICATION FIELD

- 1.1 This specification defines the criteria for the painting of plants and cryogenic tanks. Additionally it covers the modality for surfaces preparation, methods of application, paints to utilize and inspections to carry out.
- 1.2 This specification is applied to the surfaces of all components of plants and cryogenic tanks: structure steels, piping, vessels, skid (cold box, valves, drying and purification), electric panels, valves, instruments, motors, etc., with limitations listed at following point 5.1.
- 1.3 This specification is applied for atmospheric corrosivity, it is neither applicable for structures immersed in water or buried in soil nor for off-shore structures

### 2. REFERENCE STANDARDS

The activities describes in this specification are carried out in accordance with international standards below listed and with the recommendations of paint's producers.

- ASTM D3359 Standard test Methods for Measuring Adhesion by tape test.
- ASTM D4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers
- ASTM D 4752 Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
- ISO 4628-3 Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Assessment of degree of rusting
- ISO 8501-1 Preparation of steel substrate before application of paints and related products. Visual assessment of surface cleanliness - Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
- ISO 8501-3 Preparation of steel substrate before application of paints and related products. Visual assessment of surface cleanliness - Preparation grades of welds, cut edges and other areas with surface imperfections
- ISO 8502-3 Preparation of steel substrates before application of paints and related products - Test for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure sensitive tape method).
- ISO 8502-4: Preparation of steel substrates before application of paint and related products - Test for the assessment of surface cleanliness - Part 4: Guidance on the estimation of the probability of condensation prior to paint application.
- ISO 8502-6 Preparation of steel substrates before application of paint and related products - Test for the assessment of surface cleanliness - Part 6: Extraction of soluble contaminants for analysis - The Bresle method.
- ISO 8502-9 Preparation of steel substrates before application of paint and related products - Test for the assessment of surface cleanliness - Part 9: Field method for the conductometric determination of water-soluble salts.
- ISO 8503-1 Preparation of steel substrates before application of paints and related products. Surface roughness characteristics of blast-cleaned steel substrates. Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces
- ISO 8503-2 Preparation of steel substrates before application of paints and related products. Surface roughness characteristics of blast-cleaned steel substrates. Method for the grading of surface profile of abrasive blast-cleaned steel -- Comparator procedure
- ISO 8503-5 Field measurement of surface profile of abrasive blast-cleaned steel surfaces using a Replica Tape.

- ISO 12944-5 Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Protective paint systems
- SSPC-PA1 Structural STEEL Painting Council – Painting Application Specification.
- SSPC-PA2 Measurement of Dry Coating Thickness with Magnetic Gages.
- SSPC-SP1 Surface preparation specification –Solvent Cleaning
- SSPC-SP2 Surface preparation specification –Hand Tool Cleaning
- SSPC-SP3 Surface preparation specification –Power Tool Cleaning
- SSPC-SP 10 Near-White blast cleaning.
- SSPC-VIS1 Guide and reference photographs for steel surfaces prepared by dry abrasive blast cleaning.
- SSPC-SP 11 Power tool cleaning to bare metal.
- SSPC-VIS3 Guide and reference photographs for steel surfaces prepared by hand and power tool cleaning.

### 3. DEFINITIONS

In the description of this specification are defined the following subjects:

- Applicator of paints (PA): production personnel of SIAD MI, of the subcontractor and/or of the SIAD MI's supplier
- Inspector of painting (PI): Quality Control personnel of the applicator of paint

### 4. SAFETY

All possible precautions must be taken to guarantee the operator safety during the painting according to the requirements listed in the safety data sheets of each product and the laws in force.

### 5. GENERAL PRESCRIPTIONS

5.1 All the metallic surfaces are painted with exception of:

- a) stainless steel
- b) nameplate
- c) plastic components
- d) electricals and instrumentations junction box in plastic material
- e) earthing connections

At next paragraph 8.8 and 8.9 the surfaces to be protected and the components to be dismantled before the blasting and the painting and when spray booth system is used are listed.

The internal surfaces of the piping aren't painted.

### 6. PAINT STORAGE

- 6.1 The paint is stored in a suitable room, closed and well ventilated, equipped with a fire extinguisher checked periodically, where the temperature is between + 5 ° C and + 40 ° C taking account of the safety requirements established by the respective producers.
- 6.2 Packages must always be provided with label or plate identifying the type of painting and its lot number and must be kept sealed.
- 6.3 The hardener for dual painting whose expiry date on the use has already been exceeded, it must be considered unusable and then removed from local storage.

### 7. SURFACES PREPARATION

- 7.1 The steel surfaces must meet the requirements of the degree of finish of ISO 8501-3 indicated in tables 1, 2, 3, 4, 5 of appendix "A" where for each type of component and on the basis of operating temperatures, the relative painting cycle is defined. Before to perform the blasting, flanges seal surfaces (RF) and other machined surfaces must be protected.
- 7.2 On components is carried out a dry blasting with the grade indicated in the cycles of Table 1, 2, 3, 4, 5 in accordance with ISO 8501-1. The blasting shall be carried out with metallic grit or, as alternative, synthetic based grit such as aluminium oxides or copper oxides (copper slag) and/or natural low dustiness abrasives (Garnet). The surface incision profile shall be medium grade type with average roughness between  $50 \div 85 \mu m$  according to ISO 8503-1.  
Within 2-4 hours after the end of blasting the carbon steel surfaces prepared for painting must be coated with primer.
- 7.3 Where the blasting can not be performed a mechanical manual preparation is carried out as follow:
- a) the preparation is done using electric wheels, wire brushes, sandpaper, etc.
  - b) steel carbon surface so prepared for painting must be coated within 4 hours from the end of brushing and before formation of visible rust shadows. This procedure applies also for areas that need radical touches of paint.
- 7.4 All surfaces brushed or sanded must be free from dust. Otherwise proceed with a mechanical cleaning or by blowing with compressed dry and oil free air.
- 7.5 All surfaces brushed or sanded must be free from dust. Otherwise proceed with a mechanical cleaning or by blowing compressed air dry free from oil.
- 8. PAINTING**
- 8.1 The painting cycles and procedures of SIAD MACCHINE IMPIANTI products are indicated in tables 1, 2, 3, 4, 5 of appendix "A".
- 8.2 The painting is performed by skilled operators knowing very well this specification. The modalities of application (brush, spray, roll) must conform to the manufacturer's painting provided on the relevant product data sheets.
- 8.3 The execution of the painting must not take place when:
- a) the temperature drops below  $+ 10^{\circ} C$
  - b) the relative humidity is above 85%
  - c) the metal surface temperature does not exceed at least  $3^{\circ} C$  ambient dew point
  - d) there are adverse weather conditions (rain, fog, snow)
- The environmental conditions of temperature and humidity are observed and recorded on daily report.
- 8.4 When on a coat of paint oil, grease or dirt is deposited, it must be properly removed before covering with the next layer.
- 8.5 The painting can be diluted using only thinners prescribed by the manufacturer of paint.
- 8.6 In case the execution of piping spool is foreseen on site, the edge of welding joints must be protected with tape to a width of 30 mm so that the anti-rust paint does not influence the execution of welding.
- 8.7 The welded joints exposed to weather and waiting to be tested for pressure and leak test must be protected by a painting film like 'Deoxaluminite'.

- 8.8 The contact surfaces (sealing) of flanged bolted joints shall not be painted. The non sealing internal surface and internal surfaces of the holes shall be painted.  
The ends of the tie rods made from threaded bar are painted with primer.
- 8.9 Before painting, especially in case the cabin with paint spraying is used, nameplates and parts that shall not be painted must be temporarily protected or removed.  
Following components surfaces have to be protected:
- electrical cables, for 200 mm at the end
  - earthing point connections, each type they are (bar, plate, bolt, etc.)
  - instrumentation
  - safety valves, if already painted
  - stem, actuators and not metallic parts of control valves
  - stem and handwheel of manual valves
  - electric motors
  - electric panels
  - junction boxes
  - equipment nameplates
  - dials, warning lights and flow indicators
  - galvanized cables trays
- 8.10 With the exception of inorganic zinc, if the number of layers applied doesn't not succeed in obtaining the required minimum thickness, it is accepted, after checking on product data sheet, the application of additional layers up to achieve the desired thickness.
- 8.11 When the identification of piping or other components which are intended for a dangerous service is required, this is carried out according to a criterion to be defined on a case-by-case basis (e.g. colored stripes at both ends of the component). The identification of insulated piping or components is performed on the external surface of the insulation covering.

## 9. INSPECTIONS

All measurements, inspections and tests are listed in the following table:

Par.	Test type	Method	Extension	Acceptance criteria	Actions	By
9.0	Blotter test	White adsorbent paper astm D4285	Shift beginning	A piece of clean white absorbent paper shall be positioned at the airoutlet. After about 1 min. Of air discharge there shall be no trace of water and oil on the paper.	Any accumulated moisture and oil in the traps, separators and filters shall be emptied. The air supply shall then be checked once again until conformity is achieved.	PA
9.1	Temperature Relative Humidity Dew point	Thermo Hygrometer ISO 8502-4	Before and during blasting and coating operations	- Air temp. Min. 5°C max. 40°C - steel temp. 5° min. and 3°C or more above dew point temp. - 85% max. relative humidity	No blasting or coating	PA
9.2	Visual examination	/	100% of all surfaces	See ISO 8501-3 Grade P1+P3 where applicable	Defects to be repaired	PA
9.3	Surface preparation cleaning	See ISO 8501-1	100% of all surfaces	The required visual standard of blast surface cleaning shall correspond to grade Sa (see Table 1, 2, 3, 4, 5)	Recleaning and retesting until acceptable	PA
Par.	Test type	Method	Extension	Acceptance criteria	Actions	By

<b>9.4</b>	Water Soluble Salt	Bresle-kit ISO8502-6 ISO8502-9	Spot checks	The salt concentration (chlorides) test on the blast-cleaned surfaces shall not exceed 50 mg/m <sup>2</sup> for all type of surfaces.	Washing with potable water and retesting until acceptable	PA
<b>9.5</b>	Blasted surface roughness	Replica tape ISO 8503-5 or comparator ISO 8503-2	One measurement per each item	For carbon steel the surface profile shall be Rz 50 to 85 µm, unless otherwise indicated in painting system tables.	Reblasting	PA
<b>9.6</b>	Surface dust cleaning	ISO 8502-3	Spot checks	After surface preparation any grit, dust, etc., shall be removed	Recleaning until acceptable	PA
<b>9.7</b>	Intermediate visual inspection	/	During all phases of surface preparation and coating application	The coating shall be smooth, of uniform colour, free of runs, sags, visible holidays, drips, over-spray, loss of adhesion, blisters, scratches, heavy surface marks or any other irregularities	Repair and retesting	PA
<b>9.8</b>	Final visual inspection	/	After the completion of painting cycle	The coating shall be smooth, of uniform colour, free of runs, sags, visible holidays, drips, over-spray, loss of adhesion, blisters, scratches, heavy surface marks or any other irregularities	Repair and retesting	PI
<b>9.9</b>	Dry film thickness	SSPC-PA2 Electromagnetic thickness gauge calibrated at least before each inspection	Min. 5 spot measurements per each area of 10 m <sup>2</sup> as follow: - no.3 areas until 100 m <sup>2</sup> of surface - for each additional 100 m <sup>2</sup> no.1 further area of 10 m <sup>2</sup>	According to level 3 of coating thickness restriction, each spot measurement (the average of at least three gauge readings made within a 4 cm diameter circle) shall have min. value not less than 0,8x(NDFT) (Nominal Dry Film Thickness) and max. value not more than 1.2x(NDFT). A DFT value higher than 1,2x(NDFT) can be allowed provided it is not higher than the value of the Paint manufacturer's PTDS (Product Technical Data Sheet) A DFT value higher than those indicated in the PTDS shall be allowed only for those areas subjected to stripe coating. The area measurement (average of 5 spot measurements) shall not be less than NDFT.	Repair, additional coats or recoating as appropriate	PI
<b>9.10</b>	MEK test	ASTM D4752	One measurement per each item	This test shall be performed 36 hours min. after application of inorganic zinc. Resistance rating 5: no traces of zinc after 50 double rubs of white cotton flock saturated with Methyl Ethyl keton	The inorganic zinc coating shall be wetted and cured properly. Retesting until acceptable	PI
<b>9.11</b>	Adhesion test (1)	ASTM D4541 Pull-Off	<u>When required by contract</u> , must be performed on the panel coupon of paint cycle completely finished, including drying	An equipment with automatic centred pulling force shall be used. The minimum measured value should be equal to 5 MPa	Coating to be rejected	PI
<b>9.12</b>	Adhesion test	ASTM D3359 Method A		An X-cut is made in the film to the substrate, pressure-sensitive tape is applied over the cut and then removed. The adhesion rate shall be min. 4: trace peeling or removal along incisions or at their intersection	Coating to be rejected	PI

Note (1): Not applicable for siliconic painting cycles

Possible witness of inspectors and/or Third Party at inspections and tests referred to above table must be contractually foreseen.

## 10. REPAIRS

For all systems above mentioned, use the following repair procedure. When Inorganic zinc is damaged, apply one coat of acryl silicone, do not apply inorganic zinc for touch up.

**TOTALLY DAMAGED COATING WITH EXPOSED METAL SUPPORT**
**SURFACE PREPARATION**

SSPC-SP 1 and SSPC-SP 10 of the damaged area and its surrounding (for a min distance of 50 mm into the adjacent undamaged coating). If blasting is not possible, strong sand-papering of the damaged area and its surrounding to SSPC- SP 3/11 shall be performed. The reminder of the existing coated surface shall be properly protected with shields or screens to prevent any possible damage to the sound coating.

**Apply the complete coating system**

**DAMAGED COATING WITHOUT EXPOSED METAL SUPPORT**
**SURFACE PREPARATION**

SSPC-SP 1 and sand-papering of the damaged area and its surrounding (manual sanding for a min distance of 50 mm into the adjacent undamaged coating). The reminder of the existing coated surface shall be properly protected with shields or screens to prevent any possible damage to the sound coating.

**Apply the Top-Coat only**

**The DFT of each single layer and the final DFT shall be as per original application.**

**OVER-THICK COATING THICKNESS**

Where over-thickness has resulted in unacceptable features (as per PDS), for example mud cracking, wrinkling, sags, etc., the coating shall be removed by blast cleaning or scraping, if necessary to bare metal until a proper visual appearance and DFT is achieved.

**THIN DRY FILM THICKNESS**

An additional layer of Primer, Intermediate or Top-coat shall be applied whenever their DFT. is found too thin. Final DFT shall be as per original application.

**11. HANDLING AND PRESERVATION**

- 11.1 All components must be handled with care and the necessary precautions to avoid damage. Until the operations of loading on the mean of transport, they must be arranged in such a way to avoid scratches and shock.
- 11.2 The components must be protected by non-metallic materials, non-abrasive, media wood or cardboard, pallets, rope or plastic net. Same precautions must be taken when the painted components are stored.

**12. RECORDING**

- 12.1 The measurements, inspections and tests foreseen in paragraph 9 and applicable for each table of appendix "A" are recorded by the Production and Quality Control staff. If requested by the customer, Quality Control staff issues a certificate of painting with the recorded data and applicable to every table and painting cycle described in appendix "A".

**13. DURABILITY**

- 13.1 The painting cycles listed in tables 1÷5 have been defined based on the ambient where the product and/or components subject to corrosion protection are installed and on the durability of the protection which depends from the different painting system adopted with reference to ISO 12944-5



- 13.2 The durability of anticorrosion protection is consistent with ISO 4628-3. In particular, it is established that the first major maintenance on areas protected is necessary when degradation of protection has exceeded the level Ri 3 of ISO 4628-3 which means that the surface rusted exceed 1% of the area painted.

In Appendix "B" - table 6 it is defined the maximum allowed durability of corrosion protection as per ISO 12944-5 corresponding to each painting system mentioned in the tables in Appendix "A".

Every other possible combination, below or above the limits set out in the table, must be assessed on case by case basis.

- 13.3 The durability range is not a "guarantee time" (ref. ISO 12944-1, par. 4.3.7)

	<b>SPECIFICA TECNICA</b> Technical Specification						No. TS 1.005					
							Sheet 10 di 27					
						Rev.	1	2	3	4	5	6

## APPENDIX “A”

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 1										Sheet 1 of 1	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER	TOTAL THICK. μ	MID	TOTAL THICK. μ	FINISH	TOTAL THICK. μ	TOTAL THICK. μ
			MECH.	SURF.	TYPE/TRADE MARK		TYPE/TRADE MARK		TYPE/TRADE MARK		
1	EXTERNAL JACKET OF MOBILE TRUCK TANK										
1.0	EXTERNAL JACKET OF MOBILE TRUCK TANK	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	SABRORAZI zinc wire 99.9% (spray of zinc fuse as per ISO 2063 Zn80)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	60	140

	<b>SPECIFICA TECNICA</b> Technical Specification										<b>No. TS 1.005</b>					
											<b>Sheet 11 di 27</b>					
											<b>Rev.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 2										Sheet 1 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION MECH.	SURF.	PRIMER TYPE/TRADE MARK	TOTAL THICK. μ	MID TYPE/TRADE MARK	TOTAL THICK. μ	FINISH TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
1	PLANTS ASSEMBLED ON SITE (included plants with modules)										
1.1	STRUCTURE STEEL – SUPPORTS	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 7035	80	160
1.2	CASING OF COLD BOX D.C.A. AND NITROGEN TOWER	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
1.3	EQUIPMENT – PIPING (without insulation)	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL (2)	80	160
1.4	EQUIPMENT – PIPING (without insulation)	>120 e ≤200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL (2)	50	125
1.5	EQUIPMENT – PIPING (without insulation)	>200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
1.6	EQUIPMENT – PIPING (with insulation)	up to 400	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	/	/	75
1.7	EQUIPMENT – PIPING (with insulation)	>400 and ≤540	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125

**No. TS 1.005**

Rev.	1	2	3	4	5	6
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PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 2										Sheet 2 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION MECH. SURF.		PRIMER TYPE/TRADE MARK	TOTAL THICK. μ	MID TYPE/TRADE MARK	TOTAL THICK. μ	FINISH TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
<b>1</b>	<b>PLANTS ASSEMBLED ON SITE (included plants with modules)</b>										
<b>1.8</b>	<b>MANUAL VALVES (body) (without insulation)</b>	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL (2)	80	160
<b>1.9</b>	<b>MANUAL VALVES (body) (without insulation)</b>	>120 e ≤200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL (2)	50	125
<b>1.10</b>	<b>MANUAL VALVES (body) (without insulation)</b>	>200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
<b>1.11</b>	<b>MANUAL VALVES (body) (with insulation)</b>	up to 400	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	/	/	75
<b>1.12</b>	<b>MANUAL VALVES (body) (with insulation)</b>	>400 and ≤540	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
<b>1.13</b>	Auxiliaries small parts for completion of each type of component	≤120	Grade P1 ISO 8501-3	Grinding and Brushing min. Gr. SA 2.5	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	100	/	/	Polyurethane CARBOTHANE 134HP RAL (3)	80	180
<b>1.14</b>	ELECTRIC PANELS, MOTORS, INSTRUMENTS, PURCHASED MACHINES, SAFETY VALVES, CONTROL VALVES (body, actuator), OTHERS	STD PAINTING CYCLE (COLOUR INCLUDED) OF SUPPLIER SUITABLE FOR CORROSIVITY CATEGORY C2, APPROVED BY SIAD M.I.									
<b>1.15</b>	SKIDS (e.g. valves skid, air equipment skid, air prepurifier unit)	PAINTING CYCLES No. 1.1 ÷ 1.14 TO BE APPLIED FOR COMPONENTS BELONGING TO SKIDS. FINAL COLOUR FOR ALL COMPONENTS (EXCLUDED COMPONENTS WITH MFR STD PAINTING CYCLE): RAL 5015									

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 2										Sheet 3 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION MECH.	SURF.	PRIMER TYPE/TRADE MARK	TOTAL THICK. μ	MID TYPE/TRADE MARK	TOTAL THICK. μ	FINISH TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
2	PLANTS PREASSEMBLED IN WORKSHOP										
2.1	STRUCTURE STEEL – SUPPORTS	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 7035	80	160
2.2	CASING OF COLD BOX	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
2.3	EQUIPMENT – PIPING (included interconnecting piping) (with/without insulation)	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
2.4	EQUIPMENT – PIPING (included interconnecting piping) (with/without insulation)	>120 e ≤200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL 9010	50	125
2.5	EQUIPMENT – PIPING (included interconnecting piping) (with/without insulation)	>200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
2.6	MANUAL VALVES (body) (with/without insulation)	≤120	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
2.7	MANUAL VALVES (body) (with/without insulation)	>120 e ≤200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL 9010	50	125
2.8	MANUAL VALVES (body) (with/without insulation)	>200	Grade P1 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
2.9	Auxiliaries small parts for completion of each type of component	≤120	Grade P1 ISO 8501-3	Grinding and Brushing min. SSPC-SP3	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	100	/	/	Polyurethane CARBOTHANE 134HP RAL (3)	80	180
2.10	ELECTRIC PANELS, MOTORS, INSTRUMENTS, PURCHASED MACHINES, SAFETY VALVES, CONTROL VALVES (body, actuator), OTHERS	PAINTING CYCLES No. 1.1 ÷ 1.14 TO BE APPLIED FOR COMPONENTS BELONGING TO SKIDS. FINAL COLOUR FOR ALL COMPONENTS (EXCLUDED COMPONENTS WITH MFR STD PAINTING CYCLE): RAL 5015									

	SPECIFICA TECNICA Technical Specification										No. TS 1.005					
											Sheet 14 di 27					
											Rev.	1	2	3	4	5

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 2										Sheet 4 of 4		
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER	TOTAL THICK. μ	MID	TOTAL THICK. μ	FINISH	TOTAL THICK. μ	TOTAL THICK. μ	
			MECH.	SURF.	TYPE/TRADE MARK		TYPE/TRADE MARK		TIPO/MARCA E COLORE			
2	CRYOGENIC AND GASEOUS TANKS											
3.1	CRYOGENIC AND GASEOUS TANKS	≤120	Grado P1 ISO 8501-3	Sabbatura min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160	

**Note:** (1) Producers/products allowed: AMERON/Dimetcote 9 – HEMPEL/Galvosil 15700- INTERNATIONAL PAINT/Interzinc 22- JOTUN/ Resist 78

- (2) Green RAL 6001 for cooling water (UNI 5634)  
Red RAL 3000 for fire fighting water (UNI 5634)  
Azur blue RAL 5009 for air (UNI 5634)  
Ochre yellow RAL 1004 for other gases (UNI 5634)

Gas identification shall be made with bands to be defined with client.

- (3) Final colour identical to the one of the main component

	SPECIFICA TECNICA Technical Specification										No. TS 1.005					
											Sheet 15 di 27					
											Rev.	1	2	3	4	5

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - <b>TABLE 3</b>										Sheet 1 of 4		
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER		MID		FINISH		TOTAL THICK.	TOTAL THICK.
			MECH.	SURF.	TYPE/TRADE MARK	TOTAL THICK. μ	TYPE/TRADE MARK	TOTAL THICK. μ	TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ	
<b>1</b>	<b>PLANTS ASSEMBLED ON SITE (included plants with modules)</b>											
1.1	STRUCTURE STEEL – SUPPORTS	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 7035	80	160	
1.2	CASING OF COLD BOX D.C.A. AND NITROGEN TOWER	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160	
1.3	EQUIPMENT – PIPING (without insulation)	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL (2)	80	160	
1.4	EQUIPMENT – PIPING (without insulation)	>120 e ≤200	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL (2)	50	125	
1.5	EQUIPMENT – PIPING (without insulation)	>200	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125	
1.6	EQUIPMENT – PIPING (with insulation)	up to 400	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	/	/	75	
1.7	EQUIPMENT – PIPING (with insulation)	>400 and ≤540	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125	

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PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 3										Sheet 3 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION MECH.	SURF.	PRIMER TYPE/TRADE MARK	TOTAL THICK. μ	MID TYPE/TRADE MARK	TOTAL THICK. μ	FINISH TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
2	PLANTS PREASSEMBLED IN WORKSHOP										
2.1	STRUCTURE STEEL – SUPPORTS	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 7035	80	160
2.2	CASING OF COLD BOX	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
2.3	EQUIPMENT – PIPING (included interconnecting piping) (with/without insulation)	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
2.4	EQUIPMENT – PIPING (included interconnecting piping) (with/without insulation)	>120 e ≤200	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL 9010	50	125
2.5	EQUIPMENT – PIPING (included interconnecting piping) (with/without insulation)	>200	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
2.6	MANUAL VALVES (body) (with/without insulation)	≤120	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160
2.7	MANUAL VALVES (body) (with/without insulation)	>120 e ≤200	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL 9010	50	125
2.8	MANUAL VALVES (body) (with/without insulation)	>200	Grade P2 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
2.9	Auxiliaries small parts for completion of each type of component	≤120	Grade P2 ISO 8501-3	Grinding and Brushing min. SSPC-SP3	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	100	/	/	Polyurethane CARBOTHANE 134HP RAL (3)	80	180
2.10	ELECTRIC PANELS, MOTORS, INSTRUMENTS, PURCHASED MACHINES, SAFETY VALVES, CONTROL VALVES (body, actuator), OTHERS	PAINTING CYCLES No. 1.1 + 1.14 TO BE APPLIED FOR COMPONENTS BELONGING TO SKIDS. FINAL COLOUR FOR ALL COMPONENTS (EXCLUDED COMPONENTS WITH MFR STD PAINTING CYCLE): RAL 5015									

	SPECIFICA TECNICA Technical Specification										No. TS 1.005					
											Sheet 18 di 27					
											Rev.	1	2	3	4	5

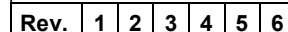
PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 3											Sheet 4 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER TYPE/TRADE MARK	TOTAL THICK. μ	MID		TOTAL THICK. μ	FINISH TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
			MECH.	SURF.			TYPE/TRADE MARK	TOTAL THICK. μ				
2	CRYOGENIC AND GASEOUS TANKS											
3.1	CRYOGENIC AND GASEOUS TANKS	≤120	Grado P2 ISO 8501-3	Sabbiatura min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	/	/	Polyurethane CARBOTHANE 134HP RAL 9010	80	160	

**Note:** (1) Producers/products allowed: AMERON/Dimetcote 9 – HEMPEL/Galvosil 15700- INTERNATIONAL PAINT/Interzinc 22- JOTUN/ Resist 78

- (2) Green RAL 6001 for cooling water (UNI 5634)  
Red RAL 3000 for fire fighting water (UNI 5634)  
Azur blue RAL 5009 for air (UNI 5634)  
Ochre yellow RAL 1004 for other gases (UNI 5634)

Gas identification shall be made with bands to be defined with client.

- (3) Final colour identical to the one of the main component

[illegible]

**NOT APPLICABLE**

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - <b>TABLE 4</b>										Sheet 2 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION MECH. SURF.		PRIMER TYPE/TRADE MARK	TOTAL THICK. μ	MID TYPE/TRADE MARK	TOTAL THICK. μ	FINISH TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
<b>1</b>	<b>PLANTS ASSEMBLED ON SITE</b> (included plants with modules)										
1.8	MANUAL VALVES (body) (without insulation)										
1.9	MANUAL VALVES (body) (without insulation)										
1.10	MANUAL VALVES (body) (without insulation)										
1.11	MANUAL VALVES (body) (with insulation)										
1.12	MANUAL VALVES (body) (with insulation)										
1.13	Auxiliaries small parts for completion of each type of component										
1.14	ELECTRIC PANELS, MOTORS, INSTRUMENTS, PURCHASED MACHINES, SAFETY VALVES, CONTROL VALVES (body, actuator), OTHERS										
1.15	SKIDS (e.g. valves skid, air equipment skid, air prepurifier unit)										

**NOT APPLICABLE**

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	SPECIFICA TECNICA Technical Specification										No. TS 1.005					
											Sheet 22 di 27					
											Rev.	1	2	3	4	5

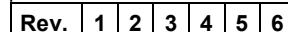
**NOT APPLICABLE**

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - <a href="#">TABLE 4</a>										Sheet 4 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER		MID		FINISH		TOTAL THICK. μ
			MECH.	SURF.	TYPE/TRADE MARK	TOTAL THICK. μ	TYPE/TRADE MARK	TOTAL THICK. μ	TIPO/MARCA E COLORE	TOTAL THICK. μ	
2	CRYOGENIC AND GASEOUS TANKS										
3.1	CRYOGENIC AND GASEOUS TANKS	≤120									

- Note:**
- (1) Producers/products allowed: AMERON/Dimetcote 9 – HEMPEL/Galvosil 15700- INTERNATIONAL PAINT/Interzinc 22- JOTUN/ Resist 78
  - (2) Green RAL 6001 for cooling water (UNI 5634)  
 Red RAL 3000 for fire fighting water (UNI 5634)  
 Azur blue RAL 5009 for air (UNI 5634)  
 Ochre yellow RAL 1004 for other gases (UNI 5634)  
 Gas identification shall be made with bands to be defined with client.
  - (3) Final colour identical to the one of the main component

	SPECIFICA TECNICA Technical Specification										No. TS 1.005					
											Sheet 23 di 27					
											Rev.	1	2	3	4	5

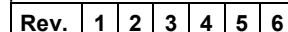
PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - <b>TABLE 5</b>										Sheet 1 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER		MID		FINISH		
			MECH.	SURF.	TYPE/TRADE MARK	TOTAL THICK. μ	TYPE/TRADE MARK	TOTAL THICK. μ	TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
1	PLANTS ASSEMBLED ON SITE (included plants with modules)										
1.1	STRUCTURE STEEL – SUPPORTS	≤120	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	110	Polyurethane CARBOTHANE 134HP RAL 7035	70	260
1.2	CASING OF COLD BOX D.C.A. AND NITROGEN TOWER	≤120	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	110	Polyurethane CARBOTHANE 134HP RAL 9010	70	260
1.3	EQUIPMENT – PIPING (without insulation)	≤120	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	110	Polyurethane CARBOTHANE 134HP RAL (2)	70	260
1.4	EQUIPMENT – PIPING (without insulation)	>120 e ≤200	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL (2)	50	125
1.5	EQUIPMENT – PIPING (without insulation)	>200	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 aluminum	50	125
1.6	EQUIPMENT – PIPING (with insulation)	up to 400	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	/	/	75
1.7	EQUIPMENT – PIPING (with insulation)	>400 and ≤540	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 aluminum	50	125



## Sheet 2 of 4

CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER	MID		FINISH		TOTAL THICK. μ	TOTAL THICK. μ
			MECH.	SURF.	TYPE/TRADE MARK	TOTAL THICK. μ	TYPE/TRADE MARK	TOTAL THICK. μ	TIPO/MARCA E COLORE		
1	PLANTS ASSEMBLED ON SITE (included plants with modules)										
1.8	MANUAL VALVES (body) (without insulation)	≤120	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	110	Polyurethane CARBOTHANE 134HP RAL (2)	70	260
1.9	MANUAL VALVES (body) (without insulation)	>120 e ≤200	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic Acrylic THERMALINE 4900 RAL (2)	50	125
1.10	MANUAL VALVES (body) (without insulation)	>200	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
1.11	MANUAL VALVES (body) (with insulation)	up to 400	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	/	/	75
1.12	MANUAL VALVES (body) (with insulation)	>400 and ≤540	Grade P3 ISO 8501-3	Blasting min. Gr. SA 2.5	Inorganic Zinc CARBOZINC 11 (1)	75	/	/	Siliconic THERMALINE 4700 alluminum	50	125
1.13	Auxiliaries small parts for completion of each type of component	≤120	Grade P3 ISO 8501-3	Grinding and Brushing min. Gr. SA 2.5	Epoxy CARBOGUARD E-19	100	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	140	Polyurethane CARBOTHANE 134HP RAL (3)	60	300
1.14	ELECTRIC PANELS, MOTORS, INSTRUMENTS, PURCHASED MACHINES, SAFETY VALVES, CONTROL VALVES (body, actuator), OTHERS	STD PAINTING CYCLE OF SUPPLIER (COLOUR INCLUDED) SUITABLE FOR CORROSIVITY CATEGORY C5, APPROVED BY SIAD M.I.									
1.15	SKIDS (e.g. valves skid, air equipment skid, air prepurifier unit)	PAINTING CYCLES No. 1.1 ÷ 1.14 TO BE APPLIED FOR COMPONENTS BELONGING TO SKIDS. FINAL COLOUR FOR ALL COMPONENTS (EXCLUDED COMPONENTS WITH MFR STD PAINTING CYCLE): RAL 5015									



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	SPECIFICA TECNICA Technical Specification										No. TS 1.005					
											Sheet 26 di 27					
											Rev.	1	2	3	4	5

PAINTING CYCLES OF PLANTS AND CRYOGENIC TANKS - TABLE 5											Sheet 4 of 4	
CYCLE N°	COMPONENTS	WORK. TEMP. °C	PREPARATION		PRIMER	TOTAL THICK. μ	MID	TOTAL THICK. μ	FINISH	TIPO/MARCA E COLORE	TOTAL THICK. μ	TOTAL THICK. μ
			MECH.	SURF.								
2	CRYOGENIC AND GASEOUS TANKS											
3.1	CRYOGENIC AND GASEOUS TANKS	≤120	Grado P3 ISO 8501-3	Sabbitura min. Gr. SA 2.5	Epoxy Zinc-rich primer CARBOZINC 858 (1)	80	Cycloaliphatic Amine Epoxy CARBOGUARD 890LT	110	Polyurethane CARBOTHANE 134HP RAL 9010	70	260	

**Note:** (1) Producers/products allowed: AMERON/Dimetcote 9 – HEMPEL/Galvosil 15700- INTERNATIONAL PAINT/Interzinc 22- JOTUN/ Resist 78

- (2) Green RAL 6001 for cooling water (UNI 5634)  
 Red RAL 3000 for fire fighting water (UNI 5634)  
 Azur blue RAL 5009 for air (UNI 5634)  
 Ochre yellow RAL 1004 for other gases (UNI 5634)

Gas identification shall be made with bands to be defined with client.

- (3) Final colour identical to the one of the main component

<b>Rev.</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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