



**STANDARD PAINTING SCHEMES FOR  
BOILERS, VALVES & OIL FIELD EQUIPMENT  
COMPONENTS**

**DOC.No: SIP: PP: 22**

**Rev. No: 06**

**Date: 03.03.2016**

**RECORD OF REVISIONS**

Rev. No.	Date	Details of revision	Remarks
00	15.07.96	PR: QE: 104/05 was revised totally and renamed as SIP: PP: 22. Content of PR: QE: 185 /00 is also merged with this document.	
01	16.07.98	The document has been revised to incorporate service condition oriented painting selection scheme for components PGMA wise. SIP: VS: 09 and SIP: VS: 18 are merged with this document.	
02	02.08.99	Editorial changes in several clauses based on feedback. Annexure - VI & VIII of Revn 01 removed. Annexure VII added. Clauses renumbered. Sub clauses added in CL. 5.0 based on feedback. Annexure- III painting schemes changed.	
03	23.04.03	Completely modified	
04	07.05.07	Completely modified; A Standard Painting Scheme for normal environment for indigenous orders developed, covering a fairly comprehensive PGMA list of all capacity FB Units.	
05	10.06.08	Painting scheme for Valves added & editorial corrections made in Cl. 2.1 & Notes. Piping Centre PGMA's deleted. Painting schemes modified in Sl.No. 2.4 & 3.5.	Feedback from QA and task performers. & Galvanization of floor grills based on ED's approval note BHE: QC: 2008 Dt. 03.01.2008
06	03.03.16	All SIP:PP documents are merged into one. Document revised based on the decision taken at PQC (Ref QQC: 8:2016 dt.29.01.2016) to have an improved painting scheme for Boiler Structural PGMA and other improvements.	As per feedback from QC, QA & task Performers.

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## 1.0 SCOPE

- 1.1 This procedure covers the requirements of Surface preparation, application of primer, intermediate and finish paints, personnel qualification, testing, inspection for manufactured and subcontracted components of boilers and Valves based on various environmental service conditions.
- 1.2 As these standard painting schemes have evolved well over the years, and the performance of these paint systems have been satisfactory in many sites, these schemes will be offered to the customers during the tender stage. The use of standard painting scheme has several advantages including the avoidance of certain time consuming surface preparations and also the use of the proven techno-economic options for painting of the products.
- 1.3 In case of special contract requirements, wherein the customer is specific about having a painting scheme different from the above, then those special contractual requirements will be addressed through a Contract Specific Document, which will be initiated by the concerned Engineering/ Commercial/ Marketing group and further details filled in by Plant Laboratory. The linkage will be provided in the CQP issued by QA.
- 1.4 Good preservation /transportation enhance the life of painted products. Suitable lasing method (use of rubber, nylon rope/belt) shall be used while transporting and avoid metal slings to tie up the product with load carrier.

## 2.0 GENERAL

- 2.1 This procedure specifies the painting requirements to
  - a) provide adequate surface protection of components under prescribed storage conditions at shop / Site
  - b) Temporary protection for components coming inside the boiler in flue gas path till they are erected inside the boiler and
  - c) protection for a reasonable time till completion of erection for components continuously exposed to atmospheric environment.
- 2.2 The scheme is based on the site practice of need-based touch-up / re-preservation program based on the duration of storage and the condition.
- 2.3 For bought-out items, the painting scheme shall be as specified in Engineering Drawing / Specification. Wherever it is not specified, the vendor's standard practice has to be followed. Manufactured items for bought-out items shall be as per the painting scheme of the applicable PGMA in this document.
- 2.4 All currently active PGMAs are covered. Requirements for Missing / new PGMA s can be obtained from Engineering & Plant Lab.

## 3.0 PAINTING SCHEME & REFERENCE ANNEXURES

- 3.1 The surface preparation, primer coat, intermediate coat and finish coat requirements for various painting schemes are given as part of this document.
- 3.2 Standard painting scheme for normal environment / coastal (or) refinery environment/ export projects can be referred in Part – I / II / III available with this document.
- 3.3 Annexure-I shall be referred for notes on painting scheme furnished in this document. Necessary instructions given for protective coating of various boiler components.
- 3.4 Total PGMA list of boiler components required to be painted is grouped under Annexure II.
- 3.5 Inspection and testing plan on surface preparation and painting is given under Annexure III. Description given for various grade of surface cleanliness and inspection techniques.

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- 3.6 Procedure for painter qualification given under Annexure IV. Painter qualification certificate for BHEL painters and BHEL vendor painters provided separately under annexure – IVA & IVB.
- 3.7 The Paints envisaged as per this document are indicated in this document under the annexure V-“Painting Scheme-Details for procurement & application purposes”.
- 3.8 Good Painting Practices, which will be of assistance to task performers, have been detailed in Annexure-VI.

*All the annexures as stated above are indexed with page number for ready reference.*

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## **PART-I**

### **Standard Painting Scheme for Normal Environment**

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu$ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
1.1	1AC	Drum/ Collecting and separator vessels (Except Internals)  Drum/ Collecting & separator vessels suspension	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 / DFT= 20 $\mu$ per coat	International Orange Shade No: 592 of IS 5	70
1.2	5	(Drum/ collecting & separator vessels) Internals & Other Machined Components, DD items (threaded/ machined surfaces)	SSPC-SP1 or SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04	1 / DFT=25 $\mu$ per coat	--	--	--	--	--	25
1.3	1AE	Drum - Transport Structures  Temporary structures to be removed after erection at site	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 / DFT= 20 $\mu$ per coat	Yellow Shade No: 356 of IS 5	70
2.1	5B	Foundation Materials and Pin:, & Columns below " 0 " level of PG 35,36, 38 & 39	--		--	--	--	Rust Preventive Fluid to PR: CHEM: 09 – 04	2 / DFT= 20 $\mu$ per coat	--	40

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'



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PART-I contd.....

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu$ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats / DFT	Paint	No. of coats/ DFT	Shade	
2.2	31D	Buck Stays and Structural Items: Buck stays, Boiler Supporting Structures, Duct supports, bunker structures (exposed to atmosphere) etc.	Blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy based Zinc phosphate Primer to IS 13238 (latest)	1 / DFT= 30 $\mu$ per coat	Epoxy Based MIO pigmented intermediate coat (latest)	1 / DFT= 75 $\mu$ per coat	Epoxy based Polyamide cured finish paint to IS14209 (latest) + Aliphatic acrylic Polyurethane paint to IS 13213 (latest)	1 / DFT= 30 $\mu$ per coat	Smoke Grey Shade No: 692 of IS 5	165
2.3	1A	Hangers	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ per coat	Smoke Grey Shade No: 692 of IS 5	70
2.4	6	Floor grills, Guard plate** Step treads	Floor Grills: Hot dip Galvanizing to a coating weight of 610 gm per sq.m (minimum) and to a coating thickness of 85.0 microns (minimum). ** Guard plates will be painted as given in SI. No. 2.2.								
2.5	1AB	Hand Rails & Posts  Ladders & Stairs	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2/ DFT= 20 $\mu$ per coat	Black	70
3.1	9	<u>Components &gt;95 deg.C but &lt;400deg.C Un-insulated components other than coming in Gas Path.</u>	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 microns )	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 $\mu$ per coat )	Aluminium	40
	10	<u>Components &gt;400 deg.C &amp; &lt;600deg.C Un-insulated components other than coming in Gas Path</u>	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 microns )	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 $\mu$ per coat )	Aluminium	40

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu$ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats / DFT	Paint	No. of coats/ DFT	Shade	
3.2	3	<u>Components &gt; 95° C Insulated</u>	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30 $\mu$ per coat	-	--	--	--	Red Oxide	60
3.3	2	Heat Exchanger Coils: (SH, RH & Economizer Coils)	SSPC – SP2 or SSPC – SP3 Hand tool / Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	1/ DFT= 35 $\mu$ per coat	--	--	--	--	Red Oxide	35
3.4	3	Components coming in Gas Path other than coils	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30 $\mu$ per coat	--	--	--	--	Red Oxide	60
3.5	8A	Uninsulated Fuel pipes, Duct for Tube Mill	SSPC-SP3/ Power Tool Cleaning	General purpose Aluminium paint to IS 2339	2 / DFT= 20 $\mu$ per coat	--	--	--	--	Aluminium	40
4	15	Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14 of ANNEXURE V)	Abrasive blast cleaning to Sa 2 1/2 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1 DFT= 40 $\mu$ / coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min) t	1 / DFT= 30 $\mu$ per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1A	Miscellaneous and Casing Sheets, Steam Blowing Piping, Duct Plates and Expansion Joints, Coal Handling, (Temp: <95 deg.C)	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2/ DFT= 20 $\mu$ per coat	Smoke Grey Shade No: 692 of IS 5	70

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate coat		Finish coat			Total DFT $\mu$ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
5.2	3	Erection Materials and Commissioning Components:	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30 $\mu$ / coat	--	--	--	--	Red Oxide	60
6.1	10 / 9	Cast carbon steel valves (Conventional) Cast alloy steel valves (Conventional) All API valves, QCNRV, SV & SRV Silencers, Water Level gauge HP / LP system 22-101,889, Control valves (spring loaded bypass, economizer CV etc)	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.I / II	2 / DFT= 20 $\mu$ per coat	--	--	--	--	--	40
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq.ft.	--	--	--	--	--	--	--
6.3	1AS	Soot Blower components	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 / DFT= 20 $\mu$ per coat.	Verdigris Green Shade No. 280 of IS5	100
6.4	36	On Shore OFE Components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer	2 / DFT= 50 $\mu$ per coat	--	--	Chlorinated Rubber Based Finish Paint	2 / DFT= 30 $\mu$ per coat	French Blue Shade No: 166 of IS 5	160
6.5	35B	Off Shore Components	SSPC-SP3/ Power Tool Cleaning	Epoxy based Free Mastic G-316 Primer	1 / DFT= 100 $\mu$ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT=30 $\mu$ per coat	French Blue Shade No: 166 of IS 5	130
6.6	8A	Hand Wheels	SSPC-SP3/ Power Tool Cleaning	General Purpose Aluminium Paint to IS 2339	2 / DFT= 20 $\mu$ per coat	--	--	--	--	--	40

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'

Painting Scheme for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5



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## **PART II**

### **Standard Painting Scheme for Costal/Refinery Environment**

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
1.1	1AC	Drum/ Collecting and separator vessels (Except Internals)  Drum/ Collecting & separator vessels suspension	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ per coat	International Orange Shade No: 592 of IS 5	70
1.2	5	(Drum/ collecting & separator vessels) Internals & Other Machined Components, DD items (threaded/ machined surfaces)	SSPC-SP1 or SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04	1 / DFT=25 $\mu$ per coat	--	--	--	--	--	25
1.3	1AE	Drum - Transport Structures  Temporary structures to be removed after erection at site	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ per coat	Yellow Shade No: 356 of IS 5	70
2.1	5B	Foundation Materials and Pin., & Columns below " 0 " level of PG 35,36, 38 & 39	--	--	--	--	--	Rust preventive	2 DFT=20 microns	--	40
2.2	31D	Buck Stays and Structural Items: Buck stays, Boiler Supporting Structures, Duct supports, bunker structures (exposed to atmosphere) etc.	Blast cleaning to Sa 2 ½  35- 50 microns	Epoxy based Zinc phosphat e Primer to IS 13238 (latest)	1 / DFT= 30 $\mu$ per coat	Epoxy Based MIO/ TiO2 pigmented intermediate coat (latest)	1 / DFT = 75 $\mu$ per coat	Epoxy based Polyamide cured finish paint to IS14209 (latest) +  Aliphatic acrylic Polyurethane paint to IS 13213 (latest)	1 / DFT= 30 $\mu$ per coat  1 / DFT= 30 $\mu$ per coat	Smoke Grey Shade No: 692 of IS 5	165

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'





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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of Coats/ DFT	Shade	
2.3	1BA	Hangers:	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50 $\mu$ per coat	1	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu$ per coat	2	Smoke Grey Shade No: 692 of IS 5	90
2.4	6	Floor grills, Guard plate** Step treads	Floor Grills: Hot dip Galvanizing to a coating weight of 610 g per sq.m (minimum) and to a coating thickness of 85.0 microns (minimum). ** Guard plates will be painted as given in Sl. No. 2.2.								
2.5	1BB	Hand Rails & Posts  Ladders & Stairs	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50 $\mu$ per coat	1	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu$ per coat	2	Black	90
3.1	9	<u>Components &gt;95 deg.C but &lt;400deg.C Un-insulated components other than coming in Gas Path.</u>	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 microns )	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 $\mu$ per coat )	Aluminium	40
	10	<u>Components &gt;400 deg.C &amp; &lt;600deg.C Un-insulated components other than coming in Gas Path</u>	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 microns )	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 $\mu$ per coat )	Aluminium	40
3.2	3	Components >95° C_ <b>Insulated</b>	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30 $\mu$ per coat	---	--	--	--	Red Oxide	60
3.3	2	Heat Exchanger Coils: (SH, RH & Economiser Coils)	SSPC – SP2 or SSPC – SP3 Hand tool / Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	1 DFT= 35 $\mu$ per coat	--	--	--	--	Red Oxide	35
3.4	3	Components coming in Gas Path other than Coils	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30 $\mu$ per coat	- -	--	--	--	Red Oxide	60

\*\*\_ For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu$ m (min)
				Paint	No. of Coats / DFT	Paint	No. of Coats	Paint	No. of Coats/ DFT	Shade	
3.5	8A	Uninsulated Fuel Pipes Duct for Tube Mill:	SSPC-SP3/ Power Tool Cleaning	General purpose Aluminium paint to IS 2339	2 DFT= 20 $\mu$ per coat	--	--	--	--	Aluminum	40
4	15	Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14 of ANNEXURE V)	Abrasive blast cleaning to Sa 2 1/2 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1 DFT=40 $\mu$ m / coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1 DFT=30 $\mu$ per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1A	Miscellaneous and Casing Sheets: Steam Blowing Piping: Duct Plates and Expansion Joints: Coal Handling (Temp: <95 deg.C)	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu$ m per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20	Smoke Grey Shade No: 692 of IS 5	70
5.2	3	Erection Materials and Commissioning Components:	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30 $\mu$ m / coat	--	--	--	--	Red Oxide	60
6.1	10/ 9	Cast carbon steel valves (Conventional) Cast alloy steel valves (Conventional) All API valves, QCNRV, SV & SRV Silencers, Water Level gauge HP / LP system 22-101,889. Control valves (spring loaded bypass, economizer CV etc)	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.I/II	2	--	--	--	--	Aluminum	40
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq. ft	--	--	--	--	--	--	--
6.3	1AS1	Soot Blower components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer	1 DFT= 50 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ per coat	Verdigris Green Shade No. 280 of IS5	90

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu$ m (min)
				Paint	No. of Coats / DFT	Paint	No. of Coats	Paint	No. of Coats/ DFT	Shade	
6.4	36	On Shore OFE Components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50 $\mu$ per coat	2	--	--	Chlorinated Rubber Based Finish Paint DFT= 30 $\mu$ per coat	2	French Blue Shade No: 166 of IS 5	160
6.5	35B	Off Shore Components	SSPC-SP3/ Power Tool Cleaning	Epoxy based Free Mastic G-316 Primer	1 / DFT= 100 $\mu$ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT=30 $\mu$ per coat	French Blue Shade No: 166 of IS 5	130
6.6	8A	Hand Wheels	SSPC-SP3/ Power Tool Cleaning	General Purpose Aluminium Paint to IS 2339	2 DFT= 20 $\mu$ m per coat	--	--	--	--	--	40

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'

Painting Scheme for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5



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## **PART III**

## **Standard Painting Scheme for EXPORT CONTRACTS**

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	Total DFT $\mu\text{m}$ (min)
1.1	18	Drum/ Collecting and separator vessels (Except Internals)  Drum/ Collecting & separator vessels suspension	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 70 $\mu$ per coat	--	--	Epoxy Polyamide cured Finish Paint to IS 14209	1/ DFT= 35 $\mu$ per coat	Smoke Grey Shade No: 692 of IS 5	105
1.2	4S	(Drum/ collecting & separator vessels) Internals  RETAINERS  Other Machined Components: DD items (threaded/ machined surfaces)	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 35- 50 microns	Sea worthy Rust Preventive Fluid to PR: CHEM: 09 – 06	2/ DFT=25 $\mu$ per coat	--	--	--	--	--	50
1.3	1AE	Drum - Transport Structures  Temporary structures to be removed after erection at site	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu$ per coat	2	Yellow Shade No: 356 of IS 5	70
2.1	4S	Foundation Materials and Pin:, & Columns below " 0 " level of PG 35,36, 38 & 39	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 35- 50 microns	Sea worthy Rust Preventive Fluid to PR: CHEM: 09 – 06	2/ DFT=25 $\mu$ per coat	--	--	--	--	--	50

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
2.2	19C/19RC	Buck Stays and Structural Items: Buck stays, Boiler Supporting Structures, Duct supports, bunker structures (exposed to atmosphere) etc.	Blast cleaning to Sa 2 1/2 (Near white metal) with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 75 $\mu$ per coat	Epoxy Based MIO pigmented intermediate coat	1 / DFT= 75 $\mu$ per coat	#Epoxy based finish paint  +  Aliphatic acrylic Polyurethane paint to IS 13213 (latest)	2 / DFT= 35 $\mu$ per coat  1 / DFT= 30 $\mu$ per coat	Smoke Grey Shade No: 692 of IS 5 or Grey White RAL 9002	250
2.4	6	Floor grills, Guard plate	Floor Grills: Hot dip Galvanizing to a coating weight of 610 g per m <sup>2</sup> (minimum) and to a coating thickness of 85.0 microns (minimum). ** Guard plates & Stringer channels will be painted as given in Sl. No. 2.2.								
2.5	6	Hand Rails & Posts  Ladders and Stairs	Hot dip Galvanizing to a coating weight of 610 g per m <sup>2</sup> (minimum) and to a coating thickness of 85.0 microns (minimum).  Hood ladders will be painted as given in Sl. No. 2.2								
3.1	10A	Un-insulated Components >95° C but <400° C (Other than components coming in Gas Path) <u>Control valves (spring loaded bypass, economizer CV etc)</u>	Blast cleaning to SSPC-SP10 with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 65 $\mu$ per coat	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-2	2/ DFT= 20 $\mu$ per coat	Aluminium	105
	10C	Un-insulated Components >400° C but <600° C (Other than components coming in Gas Path)	Blast cleaning to SSPC-SP10 with surface profile 35- 50 microns	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20 $\mu$ per coat	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20 $\mu$ per coat	Aluminium	80
3.2	1JS	Components >95° C <u>Insulated</u>	Blast cleaning to SSPC-SP10/ Sa2 1/2 (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30 $\mu$ per coat	2 Shall be done at shop	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu$ per coat	2 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	100
**- For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'											



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3.3	2A	Heat Exchanger Coils: (SH, RH & Economiser Coils)	SSPC – SP6## or SSPC – SP3 Commercial Blast cleaning/ Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	2/ DFT=35 $\mu$ per coat	--	--	--	--	--	70
			## - Commercial blast cleaning is to be adopted for components which cannot be containerized during voyage								
3.4	1GS	Components coming in Gas Path other than Coils	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2/ DFT=30 $\mu$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu\text{m}$ per coat	1 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	80
3.5	10A	Uninsulated Fuel Pipes	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 65 $\mu$ per coat	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-2	2/ DFT= 20 $\mu$ per coat	Aluminium	105
4.0	15	Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14 of ANNEXURE V)	Abrasive blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1/ DFT=40 microns per coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1/ DFT=30.0 microns per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1JS	Miscellaneous and Casing Sheets Fuel Firing: Steam Blowing Piping: Duct Plates and Expansion Joints: Coal Handling:	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30 $\mu\text{m}$ per coat	2 Shall be done at shop	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu\text{m}$ per coat	2 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	100
**- For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'											



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Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
5.2	1GS	Erection Materials and Commissioning Components:	Blast cleaning to SSPC-SP10/ Sa2 1/2 (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30 $\mu\text{m}$ per coat	2/ Shall be done at shop	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20 $\mu\text{m}$ per coat	1 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	80
6.1	10C	Cast carbon steel valves (Conventional) Cast alloy steel valves (Conventional) All API valves, QCNRV, SV & SRV Silencers, Water Level gauge HP / LP system 22-101,889.	Blast cleaning to SSPC-SP10 with surface profile 35- 50 microns	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20 $\mu\text{m}$ per coat	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20 $\mu\text{m}$ per coat	Aluminium	80
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq. ft	--	--	--	--	--	--	--
6.3	15	Soot blower components	Blast cleaning to Sa 2 1/2 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1/ DFT=40 microns per coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1/ DFT=30. microns per coat	Phirozi Blue Shade No. 176 of IS5	70
6.4	36	On Shore OFE Components	SSPC-SP10/ Blast cleaning to Sa 2 1/2 with surface profile 35 microns	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50 $\mu\text{m}$ per coat	2	--	--	Chlorinated Rubber Based Finish Paint DFT= 30 $\mu\text{m}$ per coat	2	French Blue Shade No: 166 of IS 5	160
6.5	35B	Off Shore Components	SSPC-SP10/ Blast cleaning to Sa 2 1/2 with surface profile 35 microns	Epoxy based Free Mastic G-316 Primer	1 / DFT= 100 $\mu$ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT= 30 $\mu$ per coat	French Blue Shade No: 166 of IS 5	130
6.6	8A	Hand Wheels	SSPC-SP3/ Power Tool Cleaning	General Purpose Aluminium Paint to IS 2339	2/ DFT= 20 $\mu\text{m}$ per coat	--	--	--	--	--	40

\*\* - For PGMA details, refer corresponding Sl.No. in Annexure-II- 'PG-MA Grouping'

Painting Scheme for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5



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## **ANNEXURE I**

### **NOTES FOR PAINTING SCHEME PART I, II & III:**

1. This painting scheme covers a comprehensive list of PGMA's being used in 125 to 800 MW and Industrial Boilers under Fossil Boilers working in normal environment, in an effort to standardize the painting scheme. Therefore, the entire list of PGMA's will not be applicable for any specific project and only those PGMA's applicable for the project may be used, while choosing the painting scheme applicable.
2. Rust Preventive coating should be given on HSFG Bolt and Nut threads and inside surfaces of fabricated structure shall be painted with red oxide primer paint during fit up stage.
3. All threaded & machined surfaces and retainers are to be applied with a coating of Temporary Rust Preventive oil.
4. All surfaces of foundation materials, insulation pins, Anchor channels, Sleeves Splice/cover plate/gusset plate, and metal contact area usually bolted at site to enhance the load transfer by friction grip shall be coated with Temporary Rust Preventive Fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
5. PGMA's under Sub-Vendor items are not indicated. Please refer respective Engineering Document for all sub-vendor items. Wherever it is not specified, it shall be as per the painting scheme of the applicable PGMA.
6. No painting is required for Aluminium, Stainless Steel components and galvanized items. Abrasive blast cleaning to SSPC-SP6 (Sa 2) grade shall be done on any damaged painting area. This repair is not applicable to inorganic ethyl zinc silicate painted component.
7. Wherever **inside surfaces** of components under PGMA 48 – XXX, need protection till erection, and all running meter items for spares and main item two coats of Red-oxide zinc phosphate primer paint to IS12744 to a DFT of 60 microns shall be applied, after power tool cleaning. For items meant for Spares and subcontracting where no further processing is involved, the painting scheme selected shall be the same as that of similar product configuration/ description. Inside surface of fabricated items such as box type columns need to be painted with 2 coat of red oxide primer before fabrication of the component.
8. The Temporary Rust Preventive coating that has already been applied on any component, tubes, pipes etc., shall be visually inspected for good adherence. If the coating is intact, direct coating of alkyd based red oxide paints over the coating is permitted. In case, the coating has peeled off over a large area, then the coating is to be removed by suitable solvents / heating to 350 –400 C for an hour before primer paint application –but, in this case, it should be ensured that the minimum surface cleanliness required for primer paint application shall be SSPC – SP2 (equivalent – Hand Tool cleaning).
9. All currently active PGMA's are covered. Requirements for Missing / new PGMA s will be included under the relevant section, following the appropriate paint logic.
10. Ground shade/color finish paints & identification tag/ band for equipments, piping, pipe service, boiler supporting structures and other boiler components shall be followed as per tender.
11. In components, wherever plates/sheets of thickness less than or equal to 5 mm, tubes/ rods/drain pipe dia <25mm are used, power tool /hand tool cleaning to SSPC-SP3/ SSPC-SP-2 shall be followed and the painting shall be done as described in SI no: 5.1 of SIP:PP:22-A/B/C. For all commissioning components-erection materials (xx-993) two coats of Red oxide Zinc Phosphate Primer shall be applied to meet the temporary protection till erection, after power tool cleaning.
12. Touch-up painting of damaged areas shall be carried out as per clause applicable painting scheme.
13. Structural members having welded connections at site, relevant area can be painted with primer paint. Instead of Weldable primer.



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14. DUs coming under Constant Load Hangers (CLH)/ Variable Load Hangers (VLH) shall be painted as per the system - PS 15 indicated in Sl. No. 4 of the table. However, for DUs other than CLH/VLH, the painting shall be as per Painting Scheme PS 1A indicated in Sl. No. 5.1 of the table. (i.e., one coat of Red Oxide Zinc Phosphate Primer followed by two coats of Synthetic Enamel Paint –shade smoke grey, total DFT – 70 microns)

15. For internal protection of Pipes, tubes, headers and other pressure parts, Volatile Corrosion Inhibitor (VCI) pellets shall be put ( after sponge testing/ draining/ or drying ) and subsequently end capped. The dosage of VCI pellets shall be approximately 100 gm/m<sup>3</sup>. For tubes typically 4 – 5 tablets per end are to be put. For C & I items the dosage of self-indicating Silica Gel (colorless) shall be 250 gm/ m<sup>3</sup>. (About 2 to 3 bags weighing approximately 100 grams each). VCI pellets shall not be used for stainless steel components and its composite associates.

16. For chequered plates having thickness ≤5mm, surface preparation can be power tool cleaning to St3 and painting shall be in line with Sl. No. 5.1 of corresponding category.

17. Structures: Metal to metal contact area usually bolted connections (namely, Splice/cover plate, rest plate etc.,) designed to enhance the load transfer by friction grip bolt shall be applied with rust preventive fluid after blasting.

18. Handrails covered under Sl. No. 2.2 of annexures-II/III/IV need to be painted in line with painting scheme for handrails (i.e. Sl .No. 2.5). Similarly step treads of structurals (sl.no.2.2) shall be galvanized in line with PS6.

19. This painting scheme is the final document and it overwrites any other document indicating painting/ coating schemes. The component not covered in approved painting scheme, this is the governing document to decide the type of paint application.

20. All threaded components of spring assemblies and turnbuckles shall be galvanized and achromatized to 15 microns minimum thickness.

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## ANNEXURE- II

### PG-MA Grouping

Sl. No.	PGMA / Description
1.1	Collector and separator vessels/ Drum & Drum suspension (Except Internals), supports <b>04</b> – 114, 116, 118, 124, 126, 128, 142, 144, 146, 147, 148, 210 212, 214, 270 , 321, 323, 547
1.2	(Collector and separator vessel/ Drum) Internals: <b>04</b> – 114, 134, 136, 138, 210, 347; Retainers: <b>30</b> -310, 410, 510, 520; <b>32</b> -010, 310, 410, 510, 520, 610, 710; <b>33</b> -310; <b>37</b> -010; Other Machined Components: <b>43</b> – 101, 102, 103, 104, 105, 106, 107; Dd items: <b>07</b> -302, 309, 331, 361, 362, 393; <b>12</b> -314, 317, 324, 327, 328, 344, 348, 354, 393; <b>17</b> -304, 306, 319; <b>19</b> -306, 307; <b>21</b> -602, 605; <b>24</b> -352, 803, 813, 818, 827, 842; <b>41</b> -710; <b>42</b> -710; <b>43</b> -710; <b>45</b> -710; <b>47</b> -710; <b>65</b> -710; <b>67</b> -710
1.3	Drum Transport Structures <b>04</b> - 194, 196, <b>35</b> - 391, 810 & Temporary structures to be removed after erection at site
2.1	Foundation Materials and Pin: <b>28</b> -700; <b>35</b> - 010, 011, 012, 013, 020, 030, 190, 700, 701; <b>36</b> -700, 701; <b>38</b> – 010; <b>39</b> - 010, 011, 012, 020, 030, 040, 700; <b>48</b> – 019, 913 & Columns below “ 0 ” level of PG 35, 36, 38 & 39
2.2	<u>Buck Stays and Structural Items:</u> Buck stays: <b>08</b> – 001, 003, 006, 007, 101, 104, 107, 111, 380, 382, 400, 500, 501, 503, 700, 900, 901, 904, 907, 910 <u>Boiler Supporting Structures:</u> <b>35</b> – 100, 110, 111, 112, 120, 121, 122, 130, 131, 132, 133, 134, 135, 136, 140, 141, 142, 143, 144, 145, 146, 150, 151, 152, 153, 154, 155, 156, 160, 161, 162, 171, 172, 173, 174, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 210, 211, 212, 213, 214, 220, 221, 222, 230, 231, 232, 240, 250, 310, 311, 312, 320, 321, 322, 330, 331, 332, 340, 341, 342, 350, 351, 352, 360, 361, 362, 371, 372, 380, 381, 382, 383, 384, 385, 386, 387, 390, 392, 410, 420, 430, 440, 441, 442, 443, 444 to 447, 451, 452, 453, 454 to 457, 461, 462, 463, 471, 472, 473, 481, 482, 483, 500, 510, 511, 512, 513, 514, 515 to 558 520, 521, 522, 523, 524, 525 to 528, 530, 531, 532, 533, 534 to 538, 540, 541, 542, 550, 551, 552, 561, 562, 563, 571, 572, 573, 581, 582, 583, 591, 592, 593, 594, 595, 596, 597, 598, 599, 610, 612, 613, 710, 711, 712, 713, 715; <b>36</b> – 110, 120, 130, 150, 200, 210, 211, 212, 220, 221, 222, 230, 231, 232, 240, 241, 242, 250, 251, 252, 260, 261, 262, 270, 271, 272, 280, 281, 282, 290, 291, 292, 300, 301, 302, 310, 311, 312, 313, 314, 315, 316, 320, 321, 322, 323, 324, 325, 326, 327, 330, 331, 332, 333, 334, 335, 336 to 338, 340, 341, 342, 343, 344, 345, 346, 347, 348, 350, 351, 352, 353, 354, 355, 356, 360, 361, 362, 363, 364, 365, 366, 370, 371, 372, 380, 381, 382, 383, 390, 391, 392, 393, 394, 395, 396, 397, 410, 420, 430, 490, 491, 492, 510, 520, 610, 612, 620, 621, 630, 631, 632; <b>38</b> – 110, 120, 130, 210, 211, 299, 310, 311, 380, 381, 390, 410, 510, 511, 512, 513, 521, 522, 610, 611, 612, 620, 710, 712, 720, 730; <b>39</b> - 100, 101, 102, 110, 120, 121, 130, 140, 141, 142, 143, 150, 160, 200, 210, 299, 300, 301, 303, 304, 305, 306, 311, 312, 323, 390, 391, 392, 393, 901; <u>Duct Supports</u> <b>48</b> – 005, 015, 025, 045, 055, 065, 085, 105, 115, 125, 145, 155, 185, 195, 200, 205, 215, 225, 235, 245, 255, 265, 275, 295, 305, 315, 325, 335, 345, 355, 365, 375, 385, 395, 415, 425, 435, 445, 455, 465, 475, 485, 495, 665, 805, 815, 825, 845, 855, 865, 875, 885, 995 <u>Piping Centre:</u> <b>80</b> -800 to 882, 920 to 933, 940. <u>Bunker structures:</u> <b>34</b> - 100 to 104, 111, 112, 151, 152, 200, 201, 205, 206, 251, 255, 256, 301 to 303, 351 to 353, 390, 401 to 403, 406 to 408, 451 to 453, 456 to 458, 501 to 503, 506 to 508, 551 to 553, 556 to 558, 610, 650, 911, 951. <u>Columns, bracing, bunker shell &amp; hopper, platforms, monorails etc.</u> <b>68</b> - 101, 102 to 104, 111 to 114, 150, 160, 180, 190, 201 to 203, 206 to 208, 211 to 213, 216 to 218, 251, 253, 256, 261, 263, 266, 281, 286, 287, 291, 296, 297, 301, 306, 311, 316, 351, 356, 361, 366, 381, 383, 386, 391, 396, 401, 411, 610, 620, 630, 640; <b>66</b> - 101, 102, 151, 152;
2.3	Hangers: <b>36</b> - 740, 741, 742, 743, 744.
2.4	Floor grills, Guard plate** <b>35</b> – 811, 812; <b>36</b> - 010, 810, 811, 812, 813, 814, 815, 816, 840; <b>38</b> - 810, 811; <b>39</b> – 810, 811, 840, 841
2.5	<u>Hand Rails &amp; Posts</u> <b>34</b> -810, 820, 850; <b>35</b> - 850, 851; <b>36</b> – 820, 850, 851, 852, 853; <b>38</b> – 820, 850, 851; <b>39</b> – 820, 850, 851; <u>Ladders &amp; Stairs</u> <b>35</b> – 820, 821, 822, 823; <b>36</b> – 820, 821, 822, 823; <b>38</b> – 820, 821; <b>39</b> – 820, 830, 831; <b>48</b> – 466
3.1	<u>Components &gt;95 C Un-insulated other than components coming in Gas Path</u> <b>09</b> - 001, 002, 003; <b>21</b> - 800, 850, 875, 997; <b>24</b> – 120, 160, 173, 180, 185, 190, 195, 220, 260, 273, 280, 285, 290, 320, 345, 360, 373, 380, 385, 390, 395, 420, 460, 480, 485, 490, 495, 520, 560, 573, 580, 585, 590, 642, 660, 665, 680, 685, 690, 807, 820, 860, 865, 867, 880, 885; <b>28</b> – 200, 220; <b>42</b> – 200, 318, 328, 348, 358; <b>48</b> – 380, 915. Valves/ Temp up to 400 deg.C: <b>42</b> - 300; <b>24</b> - 883; Seal boxes (temp >400 & <600 deg.C): <b>09</b> -004, 005; For export projects: (>95°C but <400°C) <b>24</b> -120, 185, 190, 195, 220, 373, 395, 420, 490, 495, 520, 590, 820, 860, 885; <b>42</b> - 300, 318, 328, 348, 358; (>400°C but <600°C) <b>09</b> -001, 002, 003; <b>21</b> -800, 850, 875, 997; <b>24</b> -160;
3.2	<u>Components &gt;95 C Insulated</u> <b>05</b> - 137, 139, 147, 153, 154, 155, 158, 159, 175, 188, 195, 220, 227, 229, 231, 236, 241, 246, 251, 265, 281, 283, 296, 327, 330, 340, 341, 350, 493, 879, 900; <b>07</b> - 101, 102, 104, 106, 107, 108, 109, 110, 125, 200, 201, 202, 203, 204, 211,



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	212, 214, 215, 216, 217, 218, 221, 222, 223, 225, 226, 229, 231, 232; <b>10</b> – 100, 120, 122, 135, 136, 140, 141, 151, 170, 174, 178, 179, 180, 191, 195, 218, 220, 222, 235, 236, 240, 241, 251, 270, 274, 278, 279, 280, 283, 284, 285, 291, 295, 315, 687; <b>12</b> –178,179, 181,850,852,900; <b>15</b> – 136, 138, 147, 174, 177, 178, 192, 193, 236, 238, 274, 278, 279, 292, 293, 999; <b>17</b> – 138, 177, 407, 776, 807, 900, 903; <b>18</b> – 001, 002, 003, 010, 020; <b>19</b> – 701, 702, 753, 903; <b>21</b> – 600,602,603,604; <b>24</b> – 100, 115, 175, 200, 215, 275, 295, 300, 315, 375, 475, 500, 568, 600, 603, 620, 624,627,628, 675,811,824,828,836,837,855,860,865,867; <b>42</b> – 020, 021, 025, 030, 031, 032, 033, 036, 037, 038, 128, 150, 153, 158, 159,200; <b>48</b> –018,035,135,202, 204, 207, 208, 212, 214, 217, 221, 222, 224, 227, 228, 229, 232, 234, 242, 244, 252, 254, 261, 262, 264, 267, 272, 274, 276, 282, 284, 292, 294, 302, 304, 307,308, 309, 311, 312, 314, 318, 319, 322, 324, 332, 334, 342, 352, 362, 364, 372, 374, 381, 382, 384, 386, 388, 389, 392, 412, 414, 422, 424, 426, 432, 434, 438, 439, 442, 444, 452, 454, 462, 464, 467, 468, 469, 472, 474, 482, 484, 486, 487, 488, 489, 491, 492, 494, 496, 497, 498, 499, 602, 612, 622, 632, 646, 652, 654, 656, 662, 664, 666, 667, 668, 669, 676, 686, 696.
3.3	<u>Heat exchanger coils: (SH, RH &amp; Economizer coils):</u> <b>11</b> – 036,037,038,074,077,078,095,135,136,138,170,174,175,178,179,235,236,237,238,248, 250,251,271,272,274,275,277,278, 279,280,336,337,338, 340,342,356,358,370, 374,377,378,395,406, 416,467,469,474, 487,491,494,585,587,591, 606,608,616,618,682,683,684,685,686,687, 688,694,716, 717,718,767, 768,769,787,791,882,883,884,885,887,916,917,918,967,968, 969,986,987,988,991,994,999; <b>12</b> – 135,136,170,174,178,184,187,335, 368,395, 403,405, 495,506,514,515, 517, 524,528,535,544,548, 551,554,568,619,800,803,805,850,851,852,900,901,903,906,914,917,924,927, 928,944,948,954,968, 988,999; <b>16</b> – 077,079,132,201,202, 203,235,236,237,238,256,270,275,277,278,279,281,377,379; <b>19</b> – 001,104,105,114,124,184,802,803,804,814,824,884,886,887,914,924,984, 987;
3.4	<u>Components coming in Gas Path other than Coils</u> <b>06</b> – 033, 036, 037, 041, 043, 046, 047, 052, 054, 089, 090, 091, 092, 093, 094, 130, 133, 136, 137, 141, 143, 146, 147, 152, 154, 189, 190, 191, 192, 193, 194, 231, 331, 350, 400, 401,430, 431,437,447,451,455,466, 467, 500, 501,530, 609, 611, 613, 614, 616, 620, 621, 623, 624, 630, 631, 633, 634, 636, 637, 639, 640, 641, 643, 644, 646, 647, 649, 650, 651, 652, 653, 654, 655, 657, 658, 659, 670, 689, 690, 691, 692, 693, 694, 695, 709, 713, 714, 715, 716, 720, 723, 730, 731, 733, 734,735, 737, 740, 741, 743, 744, 745,747, 749, 750, 751, 752,753, 755, 759,789, 790, 830, 840, 850, 851, 857, 895, 896, 897; <b>07</b> –315,316,318,883,993; <b>10</b> – 182, 183, 184, 185,687; <b>12</b> –883; <b>16</b> – 988, 999; <b>17</b> – 174,175,474,476,504,506,519,910,903; <b>18</b> –002; <b>19</b> – 091,092,703, 704, 708, 753,763,783,793, 802,850, 851, 852,853,900, 988, 999; <b>20</b> –988,998; <b>21</b> –987,988; <b>24</b> – 822,823,987,988,989,993; <b>30</b> – 010, 103, 104, 105, 211, 212, 215, 216, 217, 218, 219, 220, 223, 227, 228, 233, 235, 993; <b>31</b> – 010, 101, 102, 103, 104, 105, 108, 301, 993; <b>32</b> – 001, 002, 005, 006, 007, 008, 009, 010, 011, 012, 021, 022, 023, 024, 025, 026, 027, 031, 033, 041, 042, 043, 044, 050, 055, 061, 073, 110, 120, 210, 310,410,510,520,610, 620,710, 720, 810, 910, 993; <b>35</b> –993; <b>37</b> –010,810; <b>38</b> –993; <b>39</b> –993; <b>41</b> –988; <b>42</b> – 129,858,988; <b>48</b> –664,993; <b>67</b> –200; <b>95</b> –988; <b>96</b> –193; <b>97</b> – 282,590; <b>99</b> –099,501,502;
3.5	<u>Uninsulated Fuel Pipes</u> <b>47</b> – 229, 265, 266, 267, 268, 269, 306, 307, 308, 309; <u>Duct for Tube Mill:</u> <b>48</b> – 802, 804, 812, 814, 817, 822, 824, 832, 834, 842, 844, 852, 854, 857, 862, 864, 867, 872, 874, 882, 884;
4	<u>Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14)</u> <b>07</b> – 400, 401, 402, 403, 404, 405, 410, 420, 431; <b>10</b> – 200; <b>17</b> – 904, 906, 919, 929; <b>19</b> – 506,507,901, 904, 905, 906, 907; <b>24</b> – 346, 351,353,817,819; <b>48</b> –206;
5.1	<u>Miscellaneous and Casing Sheets:</u> <b>07</b> –409,431,460,461,462,500, 501, 502, 503, 531, 560, 561, 600, 601, 997, 999; <b>12</b> – 906,907; <b>19</b> – 101, 102; <b>21</b> – 601, 604,606,987; <b>24</b> – 101, 125, 130, 135, 140, 201, 225, 230, 235, 240, 301, 325, 335, 340, 350, 351,352,354,370, 374, 400, 401, 425, 430, 435, 440, 470, 471, 473, 501, 525, 535, 540, 570, 601, 604,625, 626,635, 640, 641,800, 801, 804,805,806,808,809,810,815, 821,825,826,835,840,841,950,987 989, 996, 998,998;30-233,234, <b>35</b> – 994, 995; <b>36</b> – 396,611,613, 903, 999; <b>37</b> – 010, 110, 210, 310, 410, 510, 610; <b>39</b> – 302, 924; <u>Fuel Firing:</u> <b>41</b> – 100, 110, 200, 310, 320, 330, 340, 350, 390, 410, 420, 430, 450, 460, 470, 500, 997; <u>Steam Blowing Piping:</u> <b>42</b> – 001,002, 003, 005, 010; <b>42</b> – 040, 045, 046, 050, 055, 060, 065, 070, 111, 112, 113, 114, 118, 119, 120, 121, 122, 123, 124, 130, 131, 132, 151, 152, 154, 155, 156, 157, 160, 165, 170, 176, 180, 195, 196, 989, 997, 998; <b>43</b> –000, 001, 002, 003, 004, 005, 006, 007, 008, 104,105,200,997, 999; <b>45</b> – 050, 120, 160, 161, 180, 181, 200, 220, 221, 260, 261, 321, 325, 326, 401, 801, 803, 804, 805, 858; <b>47</b> – 121, 122, 123, 124, 125, 129, 140, 141, 142, 143, 144, 145, 146, 149, 161, 162, 163, 164, 165, 169, 180, 181, 182, 183, 184, 185, 189, 200, 201, 202, 203, 204, 205, 209, 221, 222, 223,224, 225, 241, 242, 243, 244, 245, 246, 247, 248, 249, 261, 262, 263, 264, 301, 303, 647, 648, 649, 650, 746, 858, 953, 959, 963; <u>Duct Plates and Expansion Joints:</u> <b>48</b> – 002, 004, 007, 011, 012, 014, 017, 018, 022, 024, 028, 032, 034, 040, 042, 044, 052, 054, 062, 064, 066,072, 074, 082, 084, 092, 094, 102, 104, 107, 112, 114, 116, 122, 124, 132, 141, 142, 144, 152, 154, 162, 172, 182, 184, 192, 194, 911; <u>Coal Handling:</u> <b>65</b> – 051, 060, 070, 260, 402, 403, 460, 724, 736, 738, 786; <b>67</b> – 204, 251, 256, 261, 266, 271, 272, 276, 277, 283, 286, 400, 801, 802, 803, 804, 999; <b>99</b> – 201, 299 <u>Others:</u> <b>95</b> –088,089,091,092,485,495; <b>96</b> –186,187,189; <b>97</b> –099,585,591,592; <b>99</b> –100,300,600;

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5.2	Erection Materials and Commissioning Components: <b>04</b> - 988, <b>05</b> -993, <b>06</b> -993, <b>07</b> – 988, 993, <b>12</b> -993, <b>24</b> – 993, <b>28</b> – 993, <b>35</b> – 993, <b>36</b> – 993, <b>37</b> – 993, <b>38</b> – 993, <b>39</b> – 993, <b>48</b> – 988, 993, <b>65</b> – 988, <b>97</b> -585, <b>99</b> – 045, 099, 501, 502;
6.1	Cast carbon steel valves (Conventional) Cast alloy steel valves (Conventional) All API valves, QCNRV, SV & SRV Silencers, Water Level gauge HP / LP system 22-101,889
6.2	Forged valves
6.3	Soot Blower components <b>20</b> -001,003,004,021,051,054,201,204,301,304,331,511,794,801,821,831,962,972
6.4	On Shore OFE Components
6.5	Off Shore Components
6.6	Hand Wheels

\*Consolidated list of above PGMAs are categorized tentatively. Modification/ inclusion can be made periodically with approval.

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### ANNEXURE III

#### INSPECTION & TESTING PLAN FOR SURFACE PREPARATION, PAINTING

SL NO	COMPONENT/ OPERATION	CHARACTERISTICS	CI	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOC/ ACCEPTANCE NORM	TYPE OF RECORD	AGENCY			REMARKS
								M	C		
1.0	Surface preparation for Plates /Rolled sections /Components										
1.1	Raw material	Rust, pitting	B	Visual	100%	Note 1	R	P	V	-	
1.2	Blasting media	Type & quality of abrasives	B	Random sample test	Abrasive quality for each lot	Note 1a	R	P	V		
1.2.1	Blasting /Power tool cleaning	Surface roughness /cleanliness	A	Visual Measurement	100% 10 spots/ Sq.meter	Surface profile as per approved painting scheme, Note 2	R	P	W	-	
		Profile defects	B	Visual	100%	Note 3	R	P	W		
1.2.2	Substrate Dust contamination (for blasting)	Adhesive tape test	B	Measurement	Two spots/ component	Note 4	R	P	W	-	Randomly selected 10 X magnifier, Transparent adhesive tape 25mm width
1.2.3	Substrate Chemical contamination (for blasting)	Surface Contamination test	B	Measurement	One Test/ abrasive lot used	SSPC-SP12 Chloride < <b>15</b> µg/cm² (PPM), Sulphate < <b>20</b> PPM	R	P	W	-	Any suitable method to identify salt contamination
1.2.4	Substrate-Coating conditions	Flash rusting Steel temp. Environmental Condition	A	Visual Measurement	100% One spot /Lot	Note 5	R	P	V	-	



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SL NO	COMPONENT/OPERATION	CHARACTERISTICS	CI	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOC/ACCEPTANCE NORM	TYPE OF RECORD	AGENCY			REMARKS
								M	C		
2.0	In process PAINTING										
2.1	Paint	Physical & Chemical	A	Review of documents	100%	In voice/data sheet	TC	P	V	-	Physical verification of Shade, batch no, date of manufacture . Supplier Approval status
2.2	Mixing (Two pack system)	Mixing ratio & durations	B	Documents	100%	Painting data sheet Note 6	R	P	V		Electrical/pneumatic Agitator
2.2.1	Filtering	Free from foreign particle	B	Documents	100%	use sieves 80-100 microns	R	P	V		Nylon mesh or muslin cloth.
2.2.2	Paint testing	Physical & Chemical properties	C	Lab test	Random \$	Supplier TC/data sheet/ IS specifications	R	P	W		\$ - sample collected at each vendor at regular intervals as advised by BHEL shall be sent to BHEL/NABL accredited lab.
2.2.3	Painting	Personnel qualification- i. Painter	C	Review of documents	100%	In line with this SIP- Annexure-III	R	V	V		
		ii. Inspection personal	C	Review of documents	100%	Certification by reputed Institution or by an Expert. (NACE/SSPC LEVEL II)	R	V	V		
2.3	Airless /air spray	Spray process Pot life	B	Documents	100%	Supplier manual	R	V	V		
						Tip selections ,  Note 7	R	P	V		



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SL NO	COMPONENT/OPERATION	CHARACTERISTICS	CI	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOC/ACCEPTANCE NORM	TYPE OF RECORD	AGENCY			REMARKS
								M	C		
2.4	Coating thickness & coating intervals	Wet film, Dry film thickness	B	Measurement	100%	SSPC-PA 2 Note 8	R	P	V		
		Intervals	B	Documents	100%	Painting data sheet/specification	R	P	V		Min:24 Hrs or as per paint specification/data sheet
3.0	<b>FINAL TESTING</b>										
3.1	Peel off test Cross cut /X-cut	Adhesive strength between substrate & primer and subsequent over coats	A	Test on each coat : Primer, intermediate and final coat	3 spots	ASTM D3359-7 Note 9	R	P	W		4X magnifier lens, 25 mm width pressure sensitive tape (P99), Cutting edges with template
3.2	Final inspection	Dry film thickness	A	Document	15 spots / Sq. M	Approved Painting scheme, SSPC-PA 2 Note 8	R	P	W		
		Finish, shade and Paint defect	A	Visual	100%		R	P	W		<b>Use of shade card</b>



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#### NOTE-1: Rust grade

As per ISO 8501-1, rust and pitting are graded into four categories as A, B, C & D. Rust and pitting shall be removed by competent process prior to application of primer. Pitted area shall be cleaned by blasting /power tool cleaning/grinding provided thickness shall be met to the design requirement. Plates/Components identified under heavy pitted category C or D, acceptance/rejection reserved to QC/ BHEL.

#### NOTE - 1a: Blasting media

Blasting media shall be copper slag, iron slag, steel shots/grits & aluminum oxide. The abrasive used for blasting process shall be within chemical contaminations chloride < 15 ppm and sulphate < 20 ppm. Mixing ratio of shots/grits (generally 3:1) shall meet the surface roughness 35-50 microns after blasting. Blasting media shall be suitably sieved to get the required particle size 0.5 to 1.0 mm. (Steel shots ASTM G40/G80)

#### NOTE 2: Blast cleaning

- Air quality must be checked before start of blasting process by blotter test.
- Surface finish: The blasted surface shall meet the SSPC-SP10 (SA 2.5) finish near white metal. Surface roughness shall be checked in 10 spots/ Sq.m. Digital/ Analog instrument duly calibrated shall be used to measure the surface roughness. Power tool cleaned surface shall be met to SSPC -SP3. Blasting/ power tool cleaned surface shall be met as per ISO 8501-1 requirement.
- Surface roughness: Average value shall be 35-50 microns for blast cleaned surface.
- Blasting: Shall not be done during rainy / mist seasons where Relative Humidity is more than 80%.
- Optimum blasting pressure and nozzle size (straight bore or venture type) to get required surface roughness (90-100 psi for mineral abrasives and 120-125 psi for metallic abrasives, standing distance 12-18 inches and standing angle 80-90 deg. for full blasting, Sweep blast 45-60 deg. with respect to the substrate).

#### NOTE 3: Profile defects

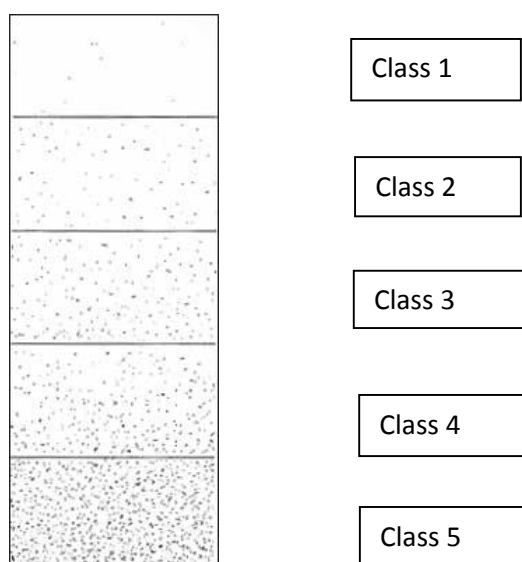
- Surface shall be visually checked and free from defects such as rust, dust, grease , oil, sharp corner/edges, rolling imperfection / overlap, vein, undulations, mill scales, improper weld beads/shapes/undercuts, weld slag, spatters etc.
- Sharp corner/edges shall be ground off to radius 1.5 to 2 mm and blunted. Other profile defects if any shall be ground/chipped out / repaired by suitable means



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#### NOTE 4: Dust

A transparent adhesive tape test shall be conducted on substrate to ensure cleanliness of the substrate and the same shall meet class 1 requirement



#### NOTE 5: Coating Conditions

- Abrasive media used for blasting shall be free from moisture and other contaminations.
- Flash rusting if any, shall be removed by sweep blasting
- Primer paint shall be applied immediately or within 4 hours in the case of blast cleaning and within 8 hours in the case of power tool cleaning.
- Painting shall not be done during rainy / mist seasons when Relative Humidity is  $> 80\%$ .
- Painting shall be commenced, when the metal surface temperature is  $> 3^{\circ}\text{C}$  above the dew point temperature.
- Painting shall not be done, when the steel surface temperature is  $> 45^{\circ}\text{C}$
- A suitable instrument duly calibrated is required to check the dew point temperature and steel surface temperature.

#### NOTE 6: Mixing

- Paint mixing ratio for two packs painting system shall be done as per painting data sheet provided by the paint manufacturer. Individual component shall be mixed thoroughly and then mix the both component as per data sheet ratio (by volume or by weight). Blend by boxing is prohibited for inorganic zinc rich primer (ie react with moisture). Off ratio (partial ratio) blends won't cure properly.
- Mixing of thinner is not required for airless spray, however mixing of thinner  $< 5\%$  is permitted. If required add thinner after mixing of paints and mix it with homogenously.
- Paint mixing shall be done at least for not less than 20 minutes or as per Paint Data Sheet with electrical/pneumatic operated tool to achieve mixing chemically matured.
- Mixed paint particles shall be filtered with sieves of 80-100 microns to avoid clogging of nozzle tip. Once components are blended, pot life begins and use the mixed paint immediately as

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specified pot life period indicated in the data sheet.

- e) Zinc rich powders dispersed slowly in to binder and agitate slowly while mixing process.
- f) Primer, intermediate and final coat, shall be the same supplier, if any change, compatibility certificate shall be obtained from the paint supplier.

#### **NOTE 7: Spray Process**

- a) Painting shall be done at controlled environment only and free from dust & paint soot.
- b) When volume solids of paint is more than 50%, airless spray shall be selected for painting application.
- c) Select proper nozzle tip size and pressure to achieve uniform DFT and less wastage.
- d) Painting shall be done within pot life period specified in the paint product data sheet, to avoid premature paint failure.
- e) Avoid arcing, tilting, maintain constant distance (12-18 inch), tip selection and tip pressure according to paint, triggering at appropriate locations and banding while painting.
- f) While painting of inorganic zinc silicate, RH shall be above 65%, if painted below RH 65% water curing is required.
- g) Top coat over and above epoxy intermediate coat shall be done within a month and proper roughness shall be created before top coat.

#### **NOTE 8 : Coating Thickness**

- a) Wet film thickness (WFT) shall be measured immediately after paint applications using Comb gauge / eccentric wheel.
- b) WFT can be calculated as:  $WFT = (100 \times DFT) / VS$  where, DFT is the dry film thickness and VS = % of volume solid of supplied paint from data sheet.
- c) Dry film thickness shall be measured after hard dry condition of each coat.
- d) Dry spray /dust particles embedded after previous coat shall be cleaned / removed with fine emery paper prior to application of subsequent Coat. Coating thickness shall not be less than the requirement as specified in the painting scheme at any case tolerance on total DFT as specified in the applicable painting scheme shall be within - 0 / +20 microns or + 10% of total DFT, whichever is higher.
- e) Coating thickness shall not be less than the requirement as specified in the painting scheme at any case. Tolerance shall be within - 0/ +20 microns as specified in the applicable painting scheme.
- f) Painted surface shall be free from paint defects namely crack, sagging, dry spray, orange peel, etc.,.
- g) Finish and shade as per paint data sheet. A painted panel shall be made available at works to check/compare the painted surface.

#### **NOTE 9: Peel off Test**

- a) Paint peel off test shall be done after 48 hours of painting operation, on single/ multi coated painted surface of the component for each coat.
- b) When total DFT is less than 125 microns- Cross cut method shall be followed.
- c) DFT up to 50 microns 1 mm spacing with 6 cuts minimum to the length of 20 mm .
- d) DFT more than 50 microns and less than 125 microns 2 mm spacing with 6 cuts minimum to the length of 20 mm
- e) When total DFT is more than 125 microns- X cut method shall be followed .The smaller angle

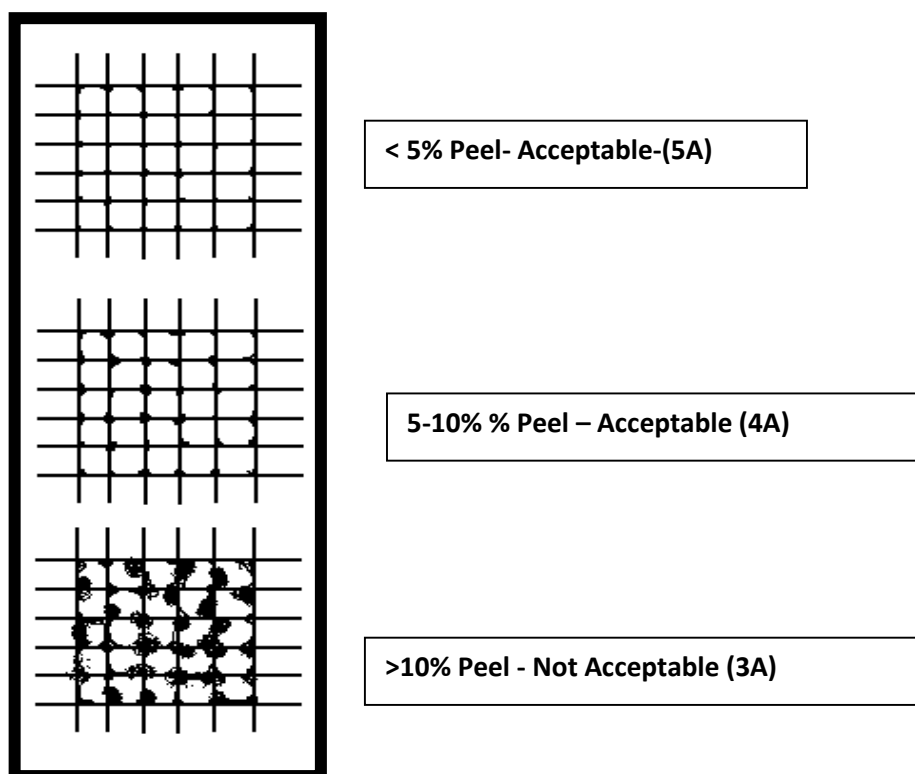
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of cut shall be between 30 to 45 degrees cut to length of 40 mm.

- f) For all tests, ensure that coating film has been penetrated and minimum three locations shall be tested.

The adhesion test shall be conducted when the substrate temperature is below 35 °C for alkyd base paints.

#### Acceptable norm for Cross cut method:



#### Acceptable norms for X cut method:

5A -No peeling - Acceptable.

4A- Trace peeling along incisions or at their intersection –Acceptable.

3A- Jagged removal along incision up to 1.6 mm on either side- Not acceptable.



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## **PAINTING INSPECTION FORMATS**

VENDOR CODE		I ST VENDOR : FABRICATION/ 2 ND VENDOR BLASTING					
		SURFACE PREPARATION (POWER TOOL/BLASTING REPORT)					
PAINTING SCHEME				REPORT NO& date			
PROJECT				PO.NO.			
WO.NO.							
PRODUCT DESCRIPTION							
SURFACE PREPARATION ( REF STANDARD ISO 8501)							
Sieve size used and size of abrasive							
BLASTING MEDIUM USED					RAW MATERIAL RUST GRADE		
					A	B	C
DU .NO		QTY	TEMPERATURE			RH	DATE
			DRY BULB	WET BULB	DEW POINT		
MOISTURE CONTENT TEST FOR IF COMPRESSED AIR USED ( BLOTING PAPER CHECK )						OK / NOT OK	
SURFACE PROFILE GAUGE READING( IN MICRONS) DATE & TIME SURFACE FINISH TO SA 2.5 (SSPC SP 10)/ SURFACE CLEANLINESS FOR POWER TOOL CLEANING							
SURFACE SALT CONTAMINATION TEST(IF ANY) FOR BLASTED SURFACE						REPORT	OK / NOT OK
DUST FREE CHECK TEST FOR BLASTED SURFACE		TAPE REPORT					
DUST FREE CHECK RESULT LEVEL FOR BLASTED SURFACE						1	2
						3	4
Visual inspection(pitting, weld spatter/slag, rolling defects ,etc.,							
FIRM QC						TPI /BHEL QC	



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VENDOR CODE	1 <sup>ST</sup> VENDOR; FABRICATION, 2 <sup>ND</sup> VENDOR: PAINTING									
	PAINT REPORT									
PAINTING SCHEME							REPORT NO & date			
PROJECT							PO.NO.			
WO.NO.										
PRODUCT										
<b>PRIMER COAT PAINT</b>										
PAINT SPECIFICATION/STD IS No:..... /SHADE										
PAINT MANUFACTURER										
SUPPLIER/TRADER NAME										
MANUFACTURING DATE / BATCH NO. / TC No										
MIXING RATIO / TWO PART SYSTEM IF ANY										
NUMBER OF COAT										
DURATION OF MIXING (use of stirrer) DATE / TIME :										
DU NO	QTY	TEMPERATURE				RH	DATE	START TIME	END TIME	REMARKS
		DRY BULB	WET BULB	METAL SURFACE	DEW POINT					
WET FLIM THICKNESS (in microns )										
SPRAY GUN USED										
HARD DRY TIME (REQUIED)										
DFT REQUIRED										
DFT ACTUAL MEASURED (SSPC PA 2)										
Visual inspection(pitting,weld spatter/slag,rolling defects ,etc.) / paint defect										
PEAL OFF TEST(AST M- D3359)	CROSS CUT TEST DFT UP TO 50 MICRONS PITCH 1mm , cut Length 20mm						REPORT	OK / NOT OK		
	CROSS CUT TEST DFT BETWEEN 50 TO 125 MICRONS PITCH 2mm, cut length 20 mm						REPORT	OK / NOT OK		
	X CUT TEST ABOVE 125 MIC( included angle 30 to45 deg, cut length 40mm)						REPORT	OK / NOT OK		
FIRM QC						TPI /BHEL QC				



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VENDOR CODE		1ST VENDOR;FABRICATION 2ND VENDOR: PAINTING									
PAINT REPORT											
PAINTING SCHEME		-				REPORT NO& Date					
PROJECT						PO.NO.					
WO.NO.											
PRODUCT											
INTERMEDIATE/FINAL COAT											
PAINT SPECIFICATION/ SHADE											
PAINT MANUFACTURER											
SUPPLIER/TRADER NAME											
MANUFACTURING DATE / BATCH NO. / TC No./DC											
MIXING RATIO / TWO PART SYSTEM IF ANY											
NUMBER OF COAT											
DURATION OF MIXING (use of stirrer) DATE / TIME :											
DU NO	QTY	TEMPERATURE				RH	DATE	START TIME	END TIME	REMARKS	
		DRY BULB	WET BULB	METAL SURFACE	DEW POINT						
WET FLIM THICKNESS (in microns )											
SPRAY GUN/NOZZLE NO USED											
HARD DRY TIME (REQUIRED)											
DFT REQUIRED											
DFT ACTUAL MEASURED (Not less than specified in painting scheme)											
Visual /paint defect ( if any)											
Peel of test (ASTM-D3359)	CROSS CUT TEST DFT BETWEEN 50 TO 125 MICRONS PITCH 2mm, cut length 20 mm						REPORT		OK / NOT OK		
	X CUT TEST ABOVE 125 MIC ( cut included angle 30 to 45 deg, cut length 40mm)						REPORT		OK / NOT OK		
FIRM QC						TPI/BHEL QC					

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## **Annexure IV**

### **PROCEDURE FOR QUALIFICATION OF PAINTERS**

#### **1.0 SCOPE:**

This standard describes, in general, the procedure and criteria to be followed for qualifying an operator / painter for carrying painting work at BHEL shop or at vendor works.

#### **2.0 OBJECTIVE:**

To evolve criteria and procedure for qualification of operators / painters.

#### **3.0 PROCEDURE:**

Following procedure shall be adopted for certification of operator/painter qualification for carrying out painting process.

3.1 Shop shall initiate the format 'Record of personnel deployed for painting work' as shown **3.1** in ANNEXURE III A & III B. This annexure is subsequently forwarded to concern certifying department of the unit. For out sourced product, the vendor shall initiate /arrange for painter certification program.

3.2 Concern certifying department/ reputed agency/expert having NACE/SSPC (Level II) shall assess and certify the suitability of an operator/painter to conduct a painting process. In case, a new operator/painter is inducted shall have experience in the painting field minimum 2 years and qualification not less than VII std, then he shall be assessed by certifying department/reputed agency/expert. In case, an operator/painter does not carry out painting work for more than two years, then he shall be re-qualified and issued a certificate in line with Annexure.

3.3 An operator/painter engaged in carrying special process like painting, shall be re-qualified once in 3 years.

3.4 Following criteria have been identified and evaluated for each operator/painter. Each criterion has been allocated 10 marks.

**3.4.1** Mainly, there are three type of painting processes which are being followed for carrying out painting. These are,

- Brush application,
- Air spray painting,
- Airless spray painting / air assisted airless spray

The operator/painter is expected to know the basics of the above painting processes, technical details of process equipment and their salient features, awareness about Do's and Don'ts in painting work.

#### **3.4.2 Understanding of the documents/specification**

The operator/painter should have the knowledge about surface cleaning and acceptance norms, paint systems, mixing ratio and pot life of two pack systems, drying and curing behavior, use of proper thinner, control of viscosity and its importance, overcoating interval, precautions to be observed during their use, etc.

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### 3.4.3 Awareness about handling of materials/jobs

The operator/painter is expected to have knowledge about handling of paint components like base, hardener and thinner, handling and upkeep of painting equipment, cleaning of brush, gun and other parts of equipment. He is also expected to know how to handle the cleaned and painted jobs.

### 3.4.4 Performance evaluation based on job/samples

The operator/painter shall be asked to prepare the test panel/job which shall be evaluated for following parameters:

- Uniformity of coating + 10% DFT required.
- Visual defects like, brush marks, wrinkles, pinholes, etc.
- Surface finish, gloss,
- Presence of dry spots, overflow marks

The operator/painter shall first clean the test panels thoroughly followed by a coat of primer/finishing paint etc., using the requisite painting process, i.e., brush / air spray/airless spray etc. After evaluation of test panels and based on result, the marks shall be allotted. After evaluation of test panels and based on result, the marks shall be allotted.

### 3.4.5 Knowledge about safety and hygiene

Each operator/painter is expected to know about the safety of self and surroundings, use of safety appliances, effect of solvent vapors on health etc. He is supposed to know personal hygiene as well as upkeep of painting equipment and painting area.

### 3.4.6 Class room training

A class room training by the supplier/expert (manufacturer like Nerolac, Berger etc.) of the paint which the respective units are procuring, must be arranged for the painters to have knowledge about the paints, enamels, coatings etc. and their applications. The class room training must be arranged in local languages for understanding of the painters

## 4.0 CERTIFICATION FOR QUALIFICATION

Each operator/painter is evaluated for above criteria and marks are being allotted for each criterion. The operator/painter must obtain a minimum marks 5 for each criteria and qualifying marks shall be 25 out of 50. The painter should pass in the field/practical test, even performed well in the written examination. The certification shall be specified in the area of type of application process as a painter is qualified (example: airless / pressure pot/air spray etc.)

## 5.0 ISSUE OF CERTIFICATE

The operator/painter who qualifies the test shall be issued a certificate in standard format shown below, which shall be kept in the concerned and certifying department/vendor works for record. The format can be modified to suit the requirement at vendor works but prior approval of plant lab. This certificate shall be signed by initiating section in charge and certifying department /reputed agency/expert

## 6.0 VALIDITY

The validity of the certification is for 3 years from the date of issue. The operator/painter is required to appear for re-test to extend the validity.





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## Annexure IV-A

(FOR BHEL PAINTER QUALIFICATION)

 <b>374-109</b>	<b>BHARAT HEAVY ELECTRICALS LIMITED</b> <b>Tiruchirappalli - 620 014</b>
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QUALITY/PLANT LABORATORY

### PAINTERS'S QUALIFICATION CERTIFICATE

1. Name :
2. Father's name :
3. Date of birth/ Age :
4. Basic Qualification :
5. Experience in the painting field :

Name of Expert trainer :  
Designation :

Photo

Date of start of training	Training subject	Faculty	Duration (Hrs.)	Certificate issued Yes/no	Remarks
	1.Painting process and Equipment		2		Issued on  Validity up to:
	2.Painting Document/ Data sheet/Batch TC		1		
	3.Knowledge of paint component and mixing		1		
	4.Painting performance Evaluation on sample		2		
	5. Safety and hygiene		1		

**Marks obtained: (each section carry 10 marks)**

- 1) Knowledge of painting process and equipment : .....
- 2) Understanding of documents / specification : .....
- 3) Handling of components : .....
- 4) Performance evaluation based on jobs/samples : .....
- 5) Knowledge of safety and hygiene : .....

Qualifying marks are 25/50

Qualified for : Airless spray & air spray  
Painting System : Alkyd/ Epoxy/zinc silicate and heat Resistant based paints

Signature of Section I/C  
Initiating the Certificate

Signature of  
Plant laboratory

Signature of  
Certifying expert



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## Annexure IV-B

(FOR BHEL VENDORS PAINTER QUALIFICATION)

### RECORD OF TRAINING & QUALIFICATION FOR PERSONNEL TO BE DEPLOYED FOR PAINTING PROCESS

VENDOR NAME AND ADDRESS

1. Name :
2. Father's name :
3. Date of birth/ Age :
4. Basic Qualification :
5. Experience in the painting field :

Name of Expert trainer :  
Designation :

Photo

Date of start of training	Training subject	Faculty	Duration (Hrs.)	Certificate issued Yes/no	Remarks
	1.Painting process and Equipment		2		Issued on
	2.Painting Document/ Data sheet/Batch TC		1		
	3.Knowledge of paint component and mixing		1		Validity up to:
	4.Painting performance Evaluation on sample		2		
	5. Safety and hygiene		1		

**Marks obtained: (each section carry 10 marks)**

- 1) Knowledge of painting process and equipment : \_\_\_\_\_
- 2) Understanding of documents / specification : \_\_\_\_\_
- 3) Handling of components : \_\_\_\_\_
- 4) Performance evaluation based on jobs/samples : \_\_\_\_\_
- 5) Knowledge of safety and hygiene : \_\_\_\_\_

Qualifying marks are 25/50

Qualified for : Airless spray & air spray  
Painting System : Alkyd/ Epoxy/zinc silicate and heat  
Resistant based paints

Signature of  
Initiating Official

Signature of  
Certifying expert

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### **Annexure V**

#### **Painting Scheme – Details for procurement & application purposes**

Sl. No.	Material Code of Paint	Generic nature of paint	Theoretical Covering Capacity Sq. m per Litre	No. of pack	Volume solids, % (min) **	DFT in microns (min) per coat	Shade	Shade No. to IS5	Mode of appln.	Over coating interval, Hrs.
1	120016131800	Heat Resistant Aluminium paint to IS 13183 Grade I	10	1	-	-	Aluminium	--	Brush / Spray	24
2	120011111900	Red oxide Zinc Phosphate primer paint to IS 12744	10	1	--	--	Red Oxide	--	Brush / Spray	12
3	120011121900	Red oxide Zinc Phosphate Dip coat primer paint to PR: CHEM: 09-03	10	1	--	--	Red Oxide	---	Dip	12
4	120011311200	Long oil alkyd synthetic enamel finish paint to IS2932	10	1	--	--	Reqd. shade	Corrpd g. Shade no.	Brush / Spray	12
5	120011140000	Temporary Rust preventive fluid to PR: CHE: 09 – 04	10	1	--	--	Amber	--	Brush / Spray	12
6	120012141700	Epoxy Zinc rich primer to IS14589 Gr. II	8	2	35	40	Grey	--	Spray	24
7	120013310200	Aliphatic acrylic polyurethane paint to IS13213	10	2	40	30	Phirozi – Blue./French Blue	176/166	Spray	24
8	120017101800	De Oxy Aluminate Weldable Primer- Colour Aluminium	10	1	--	--	Aluminium	--	Brush / Spray	24
9	120014111700	HB CR Based Zinc Phosphate Primer	10	1	40	50	Grey	--	Brush / Spray	12
10	120014300100	CR Based Finish Paint	10	1	30	30	French Blue Smoke Grey	166 692	Brush / Spray	12
11	--	Epoxy based Free mastic G-316 Primer-	10	2	100	100	Grey/ blue	---	Airless Spray	24
12	120011130000	General Purpose Aluminium Paint to IS 2339	10	Dual	20	20	Aluminium	---	Brush / Spray	24

The covering capacity of paints specified is only approximate.

The paints and Rust Preventive fluid shall be procured from BHEL's approved suppliers. \*\* Values are indicative.



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Sl. No.	Material Code of Paint	Generic nature of paint	Theoretical Covering Capacity Sq. m per Litre	No. of pack	Volume solids, % (min) **	DFT in microns (min) per coat	Shade	Shade No. to IS5	Mode of appln.	Over coating interval , Hrs.
13	120016121800	Heat Resistant Aluminium paint to IS 13183 Grade II	10	1	-	-	Aluminium	--	Brush / Spray	24
14	130070840000	Sea worthy Rust preventive fluid to PR: CHE: 09 – 06	10	1	--	--	Amber	--	Brush / Spray	12
15	120012311700 / 120012311800	Epoxy based polyamide cured finish paint to IS14209	10	2	40	35	Smoke grey/ Grey white	692/ RAL 9002	Spray	24
16	120015111700	Inorganic ethyl zinc silicate to IS 14946	8	2	60	65	Grey	--	Airless Spray only	16
17	120012211700	Poly amide cured Epoxy based Tio2/MIO pigmented intermediate coat	8	2	50	75	Grey/ Brown	--	Spray	24
18	120012111700	Epoxy based zinc phosphate primer to IS13238	10	2	40	35	Grey	--	Spray	24

The covering capacity of paints specified is only approximate.

The paints and Rust Preventive fluid shall be procured from BHEL's approved suppliers. \*\* Values are indicative.

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## **ANNEXURE-VI**

### **GOOD PAINTING PRACTICES (DOs and DON'Ts IN PAINTING)**

#### **1.0 DO'S:**

- 01 Remember, painting is an important value adding activity. Give it all your care.
- 02 Store paints in covered places. Avoid direct exposure to sunlight on paints.
- 03 Ensure the validity of the shelf life of the paint before use.
- 04 Roll the paint drum several times to ensure thorough mixing of the paint before use.
- 05 Use proper tools to open lid of the drum.
- 06 Mix the paints thoroughly to ensure homogeneity.
- 07 Apply strip coat on edges, corners and weld beads.
- 08 Follow instructions on the paint can or literature whenever a new scheme / source of paint is used.
- 09 Draw only the required quantity of the paint for the job and immediately recap the can.
- 10 Ensure proper ratio of mixing in case of two-pack system, as per norms.
- 11 Use only the specified thinner prescribed by the supplier or standard.
- 12 Ensure good quality of compressed air (free from moisture and oil) prior to spray painting.
- 13 Use only clean/new brushes of definite size for painting.
- 14 Clean the bristles well in the thinner before they are used for painting.
- 15 Painting shall be done in a well-ventilated area/identified area.
- 16 Ensure proper surface preparation as per the painting scheme.
- 17 Ensure that the blasted surface be painted within 4 hours after blasting.
- 18 Ensure that the surface to be painted is free from oil, grease, stray arcs, dents etc.
- 19 Adhere to the number of coats shade, dry film thickness and inter-coat curing time interval as specified. Clarify with lab, if needed.
- 20 Use lint free cloth/clean wiping rags for cleaning the surfaces prior to painting.
- 21 Maintain the right distance between the surface and spray gun (6 inches to 8 inches).
- 22 Ensure that mixed paints will be used before the expiry of its pot life in case of two-pack systems.
- 23 Ensure that the items to be painted/painted are inspected and cleared by the inspection personnel concerned.
- 24 Preserve the balance thinned paints in a separate closed container for future use, if they don't have any restricted pot life.
- 25 Clean the brush before and immediately after painting. Keep them clean during interruptions too.

#### **1.10 DON'TS:**

- 01 Do not use the paint, which has crossed its expiry date.
- 02 Do not draw paint than necessary from the stores.
- 03 Do not make holes in the drum to draw the paint.
- 04 Do not keep the paint drum open for a long time.
- 05 Do not inter-change the thinners for the same generic paint between suppliers.
- 06 Do not use kerosene as thinner.
- 07 Do not smoke while painting.
- 08 Do not leave the brush without cleaning after painting.
- 09 Do not paint close to a welding area.
- 10 Do not paint when there is rain or sandstorm or when the relative humidity is about 90%.
- 11 Do not paint when the metal is chill (temp < (dew point+3deg.C)) or very hot (>48 deg.C).
- 12 Do not paint when the surface is not cleaned/prepared for painting requirements.
- 13 Do not paint the finish coat if the primer coat is not satisfactory.
- 14 Do not leave the balance paint open after painting.
- 15 Do not use VCI pellets for stainless steel components and its composite assemblies.

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## 2.0 CLEANING OF PAINTED & RUST PREVENTIVE COATED SURFACES

Wherever required, paints and rust preventive protection can be removed either by using the following commercial solvents or by flame cleaning/ blasting.

For Rust preventive	Acetone, Methyl Ethyl Ketone or Tri-Chloro Ethylene
For all paints	Alkaline paint strippers or Solvent based paint strippers

## 3.0 SURFACE PREPARATION

- Surfaces of components shall be thoroughly cleaned before the application of primer paint and shall be free from grease, oil, dust, rust, weld slag, spatters etc.
- Abrasive blast cleaning to SSPC-SP6 (Sa2) grade shall be done to prepare the surfaces of hot worked pipes prior to application of primer.
- A comparative chart indicating the surface preparation standard equivalents is given below for ready reference.

DESCRIPTION	SSPC Scheme	Swedish Standard SIS - 05 - 5900
Solvent cleaning	SSPC-SP1	-
Hand tool cleaning	SSPC-SP2	St2
Power tool cleaning	SSPC-SP3	St3
Flame cleaning	SSPC-SP4	Fl
Blast cleaning to white metal	SSPC-SP5	Sa3
Commercial blast cleaning	SSPC-SP6	Sa2
Brush off blast cleaning	SSPC-SP7	Sa1
Pickling	SSPC-SP8	-
Blast Cleaning to near white metal	SSPC-SP10	Sa2½

## 4.0 APPLICATION OF PAINT

- Primer paint shall be applied immediately or within 4 hours in the case of shot blast cleaning and within 8 hours for mechanical cleaning.
- Wherever tubes / pipes are not either shot blasted or heat treated during manufacture, the rust preventive coating provided by the tube / pipe mill shall be treated as base for primer coating for subsequent painting of alkyd base paints like one coat of red-oxide zinc Phosphate (when called for). When special paint is specified in the painting scheme, the existing Rust preventive fluid is to be removed by blast cleaning. However, the rusted areas are to be cleaned free of oil, grease, rust etc. thoroughly using emery paper/ wire brush and making the rust preventive coated surfaces coarse.
- Ready mixed paints shall be used as supplied by the supplier **without any addition of thinner unless otherwise specified**. Two pack systems are to be used as per supplier's instructions.
- Wherever Second coat or Finish coat is to be applied in succession, 24 hours minimum drying time shall be provided between each coat for single pack paints. For two-pack system refer paint supplier's catalogue.
- No painting is required in case of Stainless Steel, Aluminum and Galvanized components, unless otherwise specified in contracts.
- For all machined components, rust preventive fluids shall be applied.

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7. All weld edge preparations for site welding shall be applied with one coat of Weldable primer. For small components having weld ends on both sides, full surface can be painted with Weldable primer.
8. Part processed items meant for shop assembly shall be painted at sub-contractors works with primer / special paints (when called for in the painting scheme) based on the scope of the indent/Purchase Order. Further paint touchup / Coating shall be given appropriately during assembly.
9. For items meant for Spares and subcontracting where no further processing is involved, the painting scheme selected shall be the same as that of similar product configuration / description and not with respect to PGMA. All running meter items for spares one coat of Red Oxide primer and two coats of Synthetic Enamel Paint to IS 2932 (Latest) shall be applied.
10. Assemblies consisting of machined components and special equipments shall not be shot blasted wherever it may affect the system. In such cases power tool cleaning may be adopted for the localized areas only.

\*\*\*\*\* End of Document\*\*\*\*\*