

PAINTING & COATING FOR INDUSTRIAL PURPOSE



INDEX

- Coating Material.
- Equipment for Blasting & Painting.
- Calibration of test Equipment.
- Consumable Inspection.
- Weather Condition.
- Surface Preparation.
- Paint System
- Drying & Curing test.
- Paint Defect.
- Painting report Sample.

COATING MATERIAL

Coating Material Should be procured from approved paint manufacturer vendor as per client approved procedure/specification.

If its required in specification performance test of paint material to be carried out Before commencing any paint activity on job. Performance test result shall meet Client requirement.

Inspection of coating material – Visual , Paint label on each Container ,paint batch Certificate , Paint that has exceeded its marked shelf life shall not be used. Store paint material in cool & dry place as per manufacturer instruction.

Abrasive type Size & Quality - Visual Inspection prior to start blasting, verify Label of the abrasive material, Abrasive shall be free from oil, grease, moisture, Salts, rust and contamination , if specified in specification conductivity test.

Thinner – Thickening of paint usually due to prolonged storage. If thickening Prevents proper application by brush/Spray , not more than 5% by part of thinner shall be added . In all cases thinners recommended or approved by the paint Manufacturer shall be used.



EQUIPMENT

Check Compressor accessories and Compressed air –

- Visually once in a day prior to start using blot paper.
- Equipment shall be electrically earthed . The compressed air supply used for blasting and painting shall be free from water and outlet air temperature less than 80 deg. while checking using blotting paper it shall not indicate any traces of contaminants of oil and water.
- Check discharge pressure – Nozzle pressure shall be 95-100 PSI for effective blasting operation.

Spraying Equipment - (Air Spray , Airless Spray)

- Visually Check prior to start painting.
- Check for mode of application in Paint data sheet Example –Brush, Airless or Air Gun
- Equipment shall be electrically earthed .
- Spray equipment used as recommended by paint manufacturer.
- Spray tip size range as recommended by paint manufacturer



CALIBRATION OF TEST EQUIPMENT

Instrument required for inspection

- 1 Whirling Hygrometer,
 - 2. Surface temp. gauge,
 - 3. Profile gauge,
 - 4. DFT meter,
 - 5. WFT gauge ,
 - 6. Inspection Mirror,
 - 7. Adhesion Tape
-
- Check Calibration of all measuring & test equipment's pertaining to every activity.
 - All instruments calibrated within the required time.
 - All calibration certificate shall be available for review.



CONSUMABLE INSPECTION

- Receiving Inspection of material(Grit, paint thinner) all material as per approved Painting procedure.
- Check abrasive trade mark and size and shall be as per approved painting procedure.
- Check paint trade mark and shade and shall comply to manufacturer data sheet.
- Check thinner trade mark, shall met paint manufacturer requirement.
- Check paint shelf life- shelf life of paint shall not exceed the shelf life stipulated by paint manufacturer as per batch certificate.



WEATHER CONDITION

- What are the Ideal environmental condition for Surface Preparation & Coating ?
- Weather plays an important role when it comes to painting.

The following are few basic rule.

Paint only when temperature is above 55 deg F and below 100 deg F.

Relative Humidity needs to be below 85%.

Do not paint in rainy weather or freezing condition.

The surface temperature at least 3 deg above dew point temperature.

Wind velocity should not exceed 15 mph.

Temperature - Lower air/Metal temperature will generally slow down curing

rate. Too High surface temperature can also cause problem, if surface temperature too hot, the solvent can evaporate before Coating is able to **wet the surface**. This can affect adhesion development and result in peeling failure.

Relative Humidity - High relative Humidity, the paint is exposed to greater amount of water vapor, which retards curing of coating. Except some coating required RH% min 50% for drying. Example Two Pack-In-organic Zinc silicate, Polyurethane. So in Such case Paint Manufacturer Data sheet should be preferred.



WEATHER CONDITION

Dew Point Temperature – Temperature at which moisture will condense on surface. No coating should be applied unless surface temperature is at least 3 deg above dew point temperature.

Example – If air temperature is 21 deg. and relative humidity is 65% the dew point is 14 deg. No coating should applied unless surface temperature is 17 deg minimum.

Wind Condition- Wind Speed and direction should be monitored during outdoor application. Wind Speed cannot alter air temperature ,but it can accelerate solvent evaporation. Rapid solvent loss can affects a coating ability to wet the surface, Also spraying in high wind speed cause dry spray.

Frequency of Measurement – Reading prior to start activity and at least 5 times in a day during the activity in progress. For same Log register to be maintained.



Surface Preparation

- **Surface Preparation** - Involves removing the contaminants, and in some instances increasing the area available for adhesion by roughening up the substrate. Therefore two factors need to be considered when inspecting a surface preparation.
- Degree of cleanliness
- Surface Profile (degree of roughness).
- **Abrasives**; Abrasives come in many forms and can be classified in several different ways, as shown below.

None metallic (Mineral) Expendable	Metallic (Recyclable)	Agricultural by-product
Copper Slag	ACI (Angular Chilled Iron)	Walnut Shell
Nickel Slag	Steel Grit	Coconut Shell
Boiler Slag	Steel Shot	Eggshell
Glass Bead	Grit and Shot Mix	Corn Cob Husk
Aquamarine	Garnet	Peach Husk
Garnet		



Surface Preparation

Copper Slag -



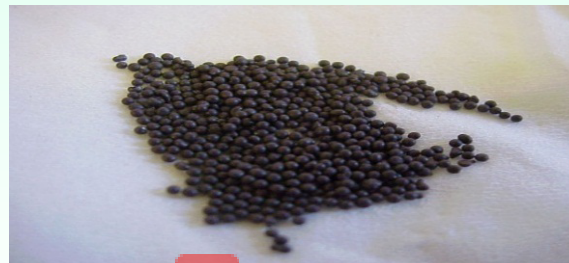
Garnet-



Metallic Grit-



Metallic Shot



SURFACE PREPRATION

- Profile measurement; If a profile requirement is specified, it is the inspector's duty to ensure that the specification requirements are met.
- Abrasive Blasting Grades- ISO-8501-1
- Sa 1- Light Blast Cleaning. When viewed without magnification, the surface shall be free from visible oil grease and dirt **and from poorly adhering mill scale**, rust, paint coatings and foreign matter.
- Sa 2 -Thorough Blast Cleaning. When viewed without magnification, the surface shall be free from visible oil grease, dirt, **and most of the millscale**, rust, paint coatings and foreign matter. **Any residual contamination shall be firmly adhering.**
- Sa 2 1/2 -Very Thorough Blast Cleaning. When viewed without magnification, the surface shall be free from visible oil grease and dirt and from mill-scale, rust, paint coatings and foreign matter. **Any remaining traces of contamination shall show only as slight stains in the form of spots or stripes.**
- Sa 3 -Blast Cleaning to Visually Clean Steel. When viewed without magnification the surface shall be free from visible oil grease and dirt, **and shall be free from millscale**, rust, paint coatings and foreign matter. **It shall have a uniform metallic colour**



SURFACE PREPREATION

- SURFACE CONTAMINANTS AND TESTS FOR DETECTION.
- **Blotter Test –ASTM 04285** -Compressed air for the blast cleaning operation can be checked for the presence of oil or water by a simple test which involves the use of white absorbent paper held in the air stream discharging from the compressor
- **Tests for salts- Standard- ISO-8502-6** -The **Bresle method** is used to determine concentration of soluble salts on metal surfaces prior to coating application, such as painting. These salts can cause serious adhesion problems after time. (Blisters)
- **Test to detect the presence of dust on a substrate –ISO-8502-3** - Any dust on a blasted substrate will adversely affect the adhesion of a paint film.
- **Test to detect the presence of moisture on a substrate** - A very simple test for the presence of moisture is to sprinkle with talc or powdered chalk and then lightly blow away. The powder will stick to areas where moisture is.



PAINT SYSTEM

- **Primer** - The first layer of cycle of painting which has the function of providing good adhesion to metal surface sufficiently clean and roughened. It provide adhesion for next layer It also provide corrosion protection during the time interval before application of Subsequent coat.
- Before starting the painting works all surfaces must be free of all phenomenon's' that prevent corrosion protection (Workmanship):
- All sharp edges to be round off to $r > 2 \text{ mm}$
- All welding must be free from weld defect
- All weld chips must be removed.
- Apply the first coat of paint (primer) immediately after the surface has been cleaned. Depending on the ambient conditions, the first coat must be applied within 4 hours after surface preparation.
- Check paint label, Steel temperature , check air temperature , Check RH% and dew point ,Check Mixing Ratio, Check Pot life, Check tip size of spray gun, Batch Number & Shelf life, check Mixing , product name approved by principle. (This applicable for all coating system-Primer, Intermediate ,Final)
- Check **Wet film thickness** of coat immediate after application.
- Check **Dry Film thickness** after proper curing , Visual inspection , Numeric reading as per applicable standard and specification (ISO-2808 ,SSPC SP-2A)



PAINT SYSTEM

- Coat overlap – Overlap shall be minimum 50%.
- Check over Coat interval before next coating application – Refer applicable index , in case over-coating interval exceeds the limit , the surface shall be abraded using emery paper. Surface contamination if any , Check for runs, drip, sags or other imperfection.
- Curing time shall be as per manufacturer data sheet.
- Curing test – For Example In-organic zinc silicate - MEK test as per ASTM D4752

Main generic types of paint and their properties

- **Air drying paints** -*For example alkyds*
These materials dry and form a film by an oxidative process, which involves absorption of oxygen from the atmosphere.
- **One pack chemical resistant paints** *For example acrylated rubbers, vinyls*
For these materials, film formation requires only solvent evaporation and no oxidative process is involved.
- **(c) Two pack chemical resistant paints** *For example epoxy, urethane*
These materials are supplied as two separate components, usually referred to as the base and the curing agent. When these two components are mixed, immediately before use, a chemical reaction occurs. This material dry by chemical reaction.



PAINT SYSTEM

- **Mid Coat** - Intermediate coats are applied to 'build' the total film thickness of the system. Generally, the thicker the coating the longer the life. Intermediate coats are specially designed to enhance the overall protection and delays moisture penetration in humid atmospheres and improves tensile strength. Undercoats must remain compatible with finishing coats when there are unavoidable delays in applying them.
- **Finish Coat** - The finish coat provides the required appearance and surface resistance of the system.
- **Stripe Coat**- Stripe coats are additional coats of paint that are applied locally to welds fasteners and external corners. Their function is to build a satisfactory coating thickness at edges and corners where paint not reach.
Specification should indicate the type and number of stripe coats required and state when they are. to be applied.



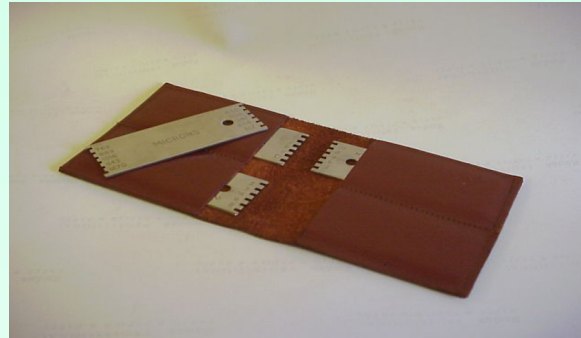
PAINT SYSTEM

- An important factor in the coating system is measurement of the dry film thickness (dft). Dry film thicknesses are generally checked on the complete paint system, although individual films may be checked separately. Usually, nominal dry film thicknesses are specified but sometimes minimum values are quoted.
- For nominal dry film thicknesses, individual values less than 80% of the nominal thickness are not acceptable. Values between 80% and 100% are acceptable provided that the overall average (mean value) is equal to or greater than the nominal.
- **Specifications for minimum** dry film thicknesses require careful paint application to avoid excessive film thickness. The 'over application' of paints can result in premature failure of the system. Wet film thickness (wft) checks may also be required during the application of the coating to check that a subsequent satisfactory dry film thickness will be achieved



PAINT SYSTEM

- **Wet film thickness measurement;** -Wet film readings should be taken immediately after application, in order to obtain true readings (solvent starts to evaporate away as it exits the spray tip). WFTs can be measured by using comb gauges.
- WFT Gauge – Combo gauge



- **Dry film thickness;** - The specification for a painting will state DFT criteria for each coat of paint applied. As it is the inspector's main function to ensure that work is carried out to specification, he should perform as many checks as needed to ensure that the specification criteria is met. The DFT value can be determined by following method (Non destructive test gauge – example Elcometer)

Drying and curing tests

X' cut test - ASTM –D3359 - These test methods intended for assessing the adhesion of coating film to metallic surface by applying and removing pressure Sensitive tape over cuts made in the film.

- Test Method A- An X-cut is made in the film to surface by making two cuts in The film each about 40mm long that intersecting near their middle with a smaller angle of between 30 to 40 deg, After incision ensure that cut penetrated the film thickness up to metal surface, if the surface has not been reached make another X cut at different location. Place the center of tape at the intersection of the cut and pulling it off rapidly. Inspect the X cut area for removal of coating from surface or previous coating and rate the adhesion as per specified in procedure/ITP.

Cross cut (cross hatch test)- ASTM-D3359 - Test Method B- This test method is applicable for paint thickness up to 125 micron , If thicker than 125 micron use test method A. Cut through the paint using six horizontal and six vertical cuts approximately 2 mm spaces giving a 25-squared grid, apply pressure sensitive tape on inspected area , rub smoothly and snatch off. The resulting area of disbondment are then compared to diagram as mark in ASTM D3359.



Drying and curing tests

- Dolly test – ASTM D4541 AND ISO 4624 - The purpose of this test is to measure the mechanical tensile strength of a coating.

A typical procedure for the test would be: -

- Ensure the test area is clean and oil/grease free, lightly abrade the area and apply mixed two pack heavy duty adhesive.
- Firmly place the aluminum alloy dolly in position onto the adhesive ensuring that the skirted flange is to the adhesive.
- Leave for manufacturers recommended cure time
- Place the core drill supplied around the dolly and cut through the coating to the substrate (this ensures that only the area of the dolly flange receives the pull off forces).
- Apply the pull off gauge and apply pull off force, (some models use a ratcheted lever, others a knurled wheel) until failure occurs.



Drying and curing tests

- HOLIDAY/PINHOLE DETECTION- NACE RP-0188
- Holidays and pinholes in a paint film are defects which allow ingress of an electrolyte.
- Not all defects of this nature are visible to the naked eye and we therefore need equipment to facilitate the detection
- For coatings of thicknesses **above 500 um** it would be necessary to use a high voltage holiday detector.
- But for coatings of **less than 500 um** it is normal to use a wet sponge pinhole detector
- **Voltage Setting** - Two options for setting, 9v and 90v.
- For DFTs of less than or equal to 300 um the 9v setting is normal.
- For DFTs of 300 – 500 um 90v or 67½v



COATING FAULTS/DEFECTS

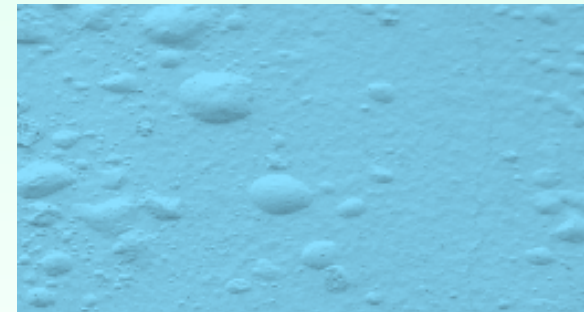
Delamination - Results from loss of adhesion between the substrate and coating OR between coat.

- Common cause - Poor Surface Preparation.
- Inter-coat cleanliness.
- Exceeding over-coating times



Blistering - Coating lifting from the underlying substrate.

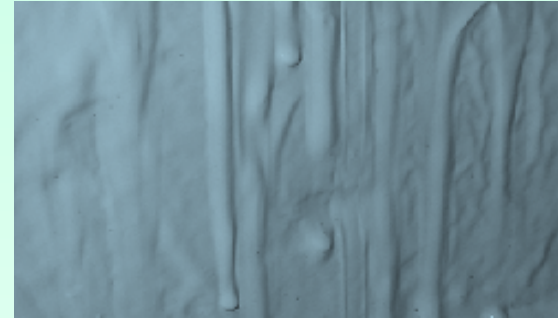
- Common cause- Contamination on the substrate Oils and greases
- Soluble Salts (osmotic blistering).
- Solvent entrapment



COATING FAULTS/DEFECTS

Sags/Runs - Downward movement of paint soon after application on vertical surfaces.

- COMMON CAUSE - Over application.
- Excessive thinning.
- Poor workmanship.

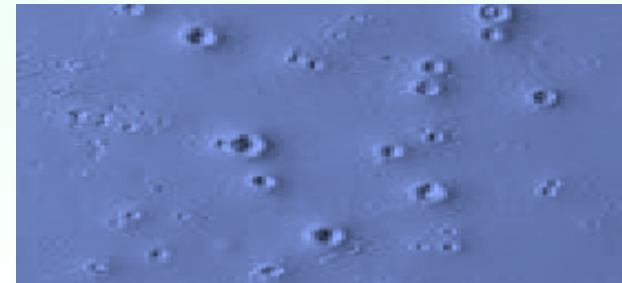


Pinholes- Formation of tiny holes in wet paint film during application and drying due to air/gas bubbles.

- COMMON CAUSE- Solvent or air entrapment.
- Incorrect spray application.



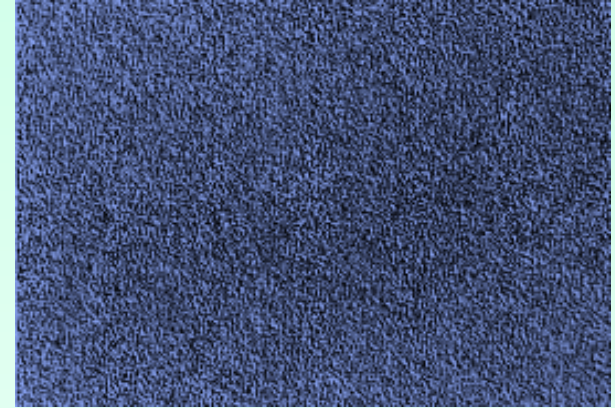
Fisheyes - Small crater-like openings that form during application or shortly after



COATING FAULTS/DEFECTS

Dry Spray- A rough or uneven finish in the paint film, where particles are not fluid and flowing together.

- COMMON CAUSE - Improper application technique
- Actual temperatures exceeding application range.
- High windy Atmosphere during paint application.



SAMPLE PAINTING REPORT

SURFACE PREPARATION DETAILS							
Cleaning Method	Abrasive Type	Grade Of Cleanliness		Surface (Anchor) Profile (μm)			Attach Press-O-Film
☐ Manual ☐ Power Tool ☐ Blasting	☐ Grit ☐ Garnet ☐ Copper Slag	Specified	Actual	Max. μm	Min. μm	Avg. μm	
		SA 2.5	2.5	35-50 Microns	40 Microns	48 Micro	
Soluble salts according to the specific ISO Standard 8502-9. Requirement not more than 20 mg/m ² . Results observed:- Soluble Salts:-11.1mg/m ² .							
AMBIENT CONDITIONS							
Coating →	Blasting	Primer Coat		Intermediate Coat		Finish Coat	
Ambient condition	Date: 20/06/2019 Time: 3.30PM	Date: 20/06/2019 Time: 5 PM		NA		Date: 25/06/2019 Time: 2 PM	
Dry Bulb Temp. (°C)	33°C	30°C				29°C	
Wet Bulb Temp. (°C)	22°C	22°C				24°C	
Relative Humidity (%)	39%	50%		NA		66%	
Surface Temp. (°C)	35°C	31°C				26°C	
Dew Point Temp. (°C)	15°C	16°C				21°C	
PAINT DETAILS							
Coat	Make	Paint Name	Batch Nos.	Mix Date	Fin Date	Mixing Ratio	Application Method
Primer	International	INTERZINC 22	A-VC1023HA, B-VC0347HA	A-23/03/19 B-13/03/19	B-23/06/19 B-12/06/20	As Per TDS	By Airless
Thinner		NA					
Finish paint	International	INTETHERM 50	A-B8291HA	A-11/02/19	A-11/02/20	As Per TDS	By Airless
Thinner		NA					
			NA				
COATING DETAILS				DRY FILM THICKNESS (DFT)			
Coat	Location	Paint Type	Shade	Specified DFT (μm)	Observed DFT (μm)		
					Max. μm	Min. μm	Avg. μm
Primer	Inside / Outside	Inorganic zinc Primer	Grey	65-75 μm	82 μm	74 μm	78 μm
Intermediate	NA	NA					
Finish	Inside / Outside	Heat Resistant Aluminum Paint	Aluminum	40 μm	135 μm	110 μm	122 μm
DECISION	☒ Accepted		☐ Rectify & Re-offer		☐ Reject		
REMARK:	ACCEPTED FOR BLASTING & PAINTING, RELEASED FOR FURTHER PROCESS.						