

# PAINTING

## A. Environmental Conditions

Unless otherwise specified, painting should not be carried out under the following conditions:

- The temperature is below 5°C.
- The surface temperature is less than 3°C above the dew point.
- The relative humidity is over 85%.
- The steel surfaces to be painted are wet.
- The surface temperature is above 80°C.

In addition to the above, and depending on the geographical location of the repair yard, other ambient conditions may apply (e.g. strong wind) requiring the approval of the coating supervisor prior to initiating or continuing the painting process.

## B. Paint Application Procedures

### I. Inspection of paint and thinner

Check whether the paint and thinner supplied are the same as those described in the paint specification sheet for the job in hand.

### II. Mixing

Mix the components of the paint according to the specified ratio and stir using mechanical stirrers or paddle mixers until the paint mixture becomes homogeneous.

### III. Thinning

Thinning is sometimes necessary to improve the workability of the paint under different temperatures. However it should be noted that excessive thinning may produce a thin film, with occasional sagging, resulting in degraded film properties and a reduced hiding power. It is also to be noted that adding thinner to certain 2 component types of paint is strictly prohibited. Please consult the Data Sheet of each paint type separately.

### IV. Filtering

If the paint contains small pieces of paint-skin or any small paint-lumps, it should be filtered through a special cloth filter or a wire 60-100 mesh filter.

### V. Pot Life

Once the paint is mixed, specially that of 2 or 3 components, the resulting mixture must be used within the specified time limit, otherwise and should this limit elapses, the mixture will harden rendering it difficult or impossible for continued application.

### VI. Overcoating Interval

Paints should be allowed to dry according to the manufacturer recommendation before overcoating. Should the specified interval not being observed, the resulting paint film will not dry or cure in due course, leading to premature film failure.

## C. Application

### I. Stripe coat and additional coat

If necessary, holes, seams, edges, where painting is difficult, should be given a stripe coating and an additional coating using a brush prior to application by airless spraying.

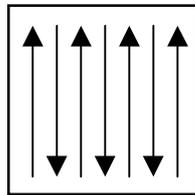
### II. Brushing

- The brush should not be dipped deeply into the paint, as this will overload the bristles and fill the brush heel with paint, which is difficult to remove.
- When paint is applied, the brush should be held at an angle of about 45° to the surface. Several light strokes will transfer much of the paint to the surface to be coated. The paint should then be spread to cover the surface and provide a uniform coating. Excessive pressure should not be applied to the brush, as this will tire the painter and cause extra wear on the brush.

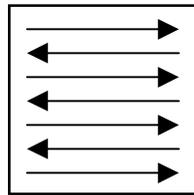
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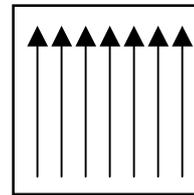
- After the surface is completely covered with paint, the painted area should be brushed crosswise to ensure uniformity and finally brushed lightly to smooth out brush marks and laps. On large areas, this final light brushing should be made in vertical direction. The proper brushing method is depicted in the following drawings:



Transfer



Spread



Light Finish

- After the paint job is finished, the brush should be well cleaned using the appropriate thinner as specified.

### III. Airless Spraying

Airless spraying of large surfaces has replaced conventional spraying for the following reasons:

- Airless spraying is faster and saves time.
- Paint is applied at a high viscosity, resulting in reduced waste of thinners and a lesser tendency for the paint to sag at a higher paint film thickness.
- Since the compressed air is not used to atomise the paint, there is less rebound of paint spray. This reduces paint loss, and provides a better coverage of crevices, angles, and other places that are hard to paint.

#### Airless Spraying Operation

- Adjust both equipment and parts as specified.
- Inbound pressure to the airless spray pump will vary with the length of the hose, the exterior temperature, and the viscosity of the material. The air pressure should be adjusted to achieve uniform atomisation of the material.
- The spray gun should be moved in parallel direction and at a perpendicular angle to the surface to obtain a smooth and uniform coating. The overlap of each pass should be 50%. The above suggested method prevents sagging or dust coats and secures the specified paint film thickness.
- Care should be taken not to spray towards people, since the sprayed paint or thinner is under high pressure.
- Following to the application of multi-component type paints, all airless spray machines should be well cleaned using the specified thinner.

#### D. Film Thickness Control

The wet layer of film must be measured using a wet-film thickness gauge, such as roller or prone gauge, within a few seconds after the paint is applied to minimise the effect of solvent evaporation. If the required paint film thickness has not been achieved, additional coats should be applied until the specified thickness is attained.

#### E. Drying

- Any coated substrate should remain undisturbed until the paint film dries completely.
- Paint applied to areas where drying conditions are not ideal should be allowed to dry by natural ventilation.

#### F. Inspection of Dry Film Thickness

The dry paint coating should be measured using a dry film thickness gauge. If the required coating thickness has not been achieved, it should be touched up with airless spray, brush or roller.

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**Instructions for Spray Paint Application****I. Paint Application (General) Using Spray Methods**

Spray paint application methods, whether by air spray, airless spray, hot air spray or hot airless spray should be in accordance with the following:

- The equipment used should be suitable for the intended purpose, capable of properly atomising the paint to be applied, and outfitted with the required pressure regulators and gauges. The equipment should be maintained in proper working condition.
- Paint ingredients should be kept uniformly mixed in spray pots or other containers during painting and the paint should be continuously or intermittently mixed by mechanical means.
- Spray equipment should be kept clean. Dirt, dried paint or other foreign materials must not be deposited in the paint film. Any solvents left in the equipment should be completely before they are reused.
- Paint should be applied in a uniform layer with a 50% overlap on each pas. During application, the paint gun should be held perpendicular to the surface and at a distance which ensure that a uniform layer of paint is deposited on the surface. The gun's trigger should be released at the end of each "stroke".
- All runs and sags should be brushed out immediately or the coating should be removed and the surface re-painted.
- Cracks, crevices, blind areas of all rivets and bolts and all other inaccessible areas should be painted by brush.
- The paint should be suitable for the particular spray application method used.
- Particular attention should be given to thinner type and amount, paint temperature and operating techniques to avoid applying paint that is too viscous, too dry or too thin. In some cases, the paint may have to be thinned to suit the application method.
- Caution must be exercised so that hot coatings are not applied on cold surfaces and conversely, that cold coatings are not applied on hot surfaces.

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**Marine & Protective Coatings**
**II. Trouble Shooting for Spray Application**

FAULT	PROBABLE CAUSE	SUGGESTED CORRECTION
Runs and sags	Improper spray technique	Only personnel (sprayers) who are familiar with airless application techniques should be used
	Gun is passed too close to surface	Gun should be held at a distance of about 30 cm from the surface for general work
	Gun stroked at wrong angle to surface	Gun should be stroked at the right correct angles
	Gun not triggered properly Excess overlapping	The spray pattern should overlap slightly and the gun should be triggered at surface interruptions
	Excessive deposit	In addition to the above check spray nozzle for excessive wear or improper selection
	Excess dilution	Each paint has a given viscosity and solids content below which it cannot be diluted and still hold the specified film thickness. Therefore, do not thin the paint unless absolutely necessary
Streaks (rat tails)	Wrong nozzle	Select a smaller nozzle
	Nozzle is worked out or worn out	Use a new nozzle
	Incorrect overlapping of strokes	Follow the previous stroke accurately. Deposit a wet coat
	Paint too cold	Increase pressure / heat paint
	Too high viscosity	Increase pressure / thin paint
Too high film	Improper technique	See notes on "Runs and sags". Use a smaller nozzle. Hold the gun at the right angles to the application surface.
Dry over-spray	Excessive atomisation. Nozzle too small. Improper Technique	Reduce pressure. Use a larger nozzle. Hold spray gun closer to the surface. Spray at right angles to the surface.
Excessive spray fog	Excessive atomisation	Reduce pressure
	Gun stroked too far from surface	Stroke the gun about 30cm from the surface
	Paint thinned out too much	Only the correct amount of thinner should be added to the paint
Pinholes	Paint film too heavy Poor atomisation	Apply lesser wet film thickness. Increase pressure.
"Orange Peel"	Paint not thinned sufficiently	Add the correct amount of thinner
	Paint too cold	Paint requires heating prior to application or use hot applicators
	Not building a wet coat	Check that the correct thinner is used
Blistering	Rust, oil or grease on surface	Degrease the surface properly before painting Remove rust layer on surface by the appropriate means
	Moisture on or in surface	Surface temperature must be above dew point Dry surface completely before application
	Solvents trapped under dried paint	Use a solvent with a higher evaporation speed

## Film Thickness

As far as long-term protection is concerned, it is important to apply paints in uniform coats of specified thickness. In order to achieve this, paint thickness must be regularly checked.

### A. Definition of Thickness

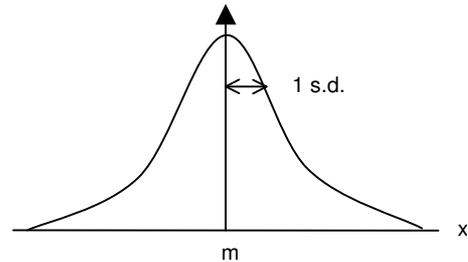
It is very important for the client, the ship builder or general contractor, the painting contractor and the paint supplier to agree on the thickness measurement method as well as on the interpretation of the results. In general, The thickness may vary depending on the method of measurement, while the definition of average minimum thickness may also differ from case to case. Therefore, it is advisable to clarify and agree on the definition before initialising the system.

### B. Basic Principle

#### Film Thickness Distribution

Under controlled application conditions, thickness distribution should follow the normal distribution curve. (see the figure right)

According to this figure, the standard deviation should be a good indication of the accuracy of the painting work. The smaller the deviation, the better is the job controlled.



#### Wet and Dry Film Thickness

Regardless of definition applied, it is clear that the following relationship exists between dry and wet film thickness.

$$\text{D.F.T.} = \text{W.F.T.} \times \text{SVR} (\%) / 100$$

<u>Definitions</u>	D.F.T.	Dry Film Thickness
	W.F.T.	Wet Film Thickness
	SVR	Solid Volume Ratio

#### Average Film Thickness and paint consumption

The following simple equation expresses the relationship between the average film thickness and paint consumption.

$$\text{D.F.T. (avr.)} = [(100 - L) / 100] \times [(10 \times \text{SVR} \times C) / A]$$

<u>Definitions</u>	D.F.T.	Dry Film Thickness
	L	Paint loss as a percentage of the amount of the paint
	SVR	solid volume ratio
	C	Amount of liquid paint used in litres
	A	Painted surface area in m <sup>2</sup>

### C. Other Factors that Affect Thickness Measurement

#### Surface Roughness of the Substrate

The surface roughness is a factor that considerably influences thickness measurement. Generally, rougher surfaces require more paint to cover all existing peaks on the substrates. As long as the measuring equipment use a magnetic system, measurement is affected by the surface roughness. Particularly in the case of tank coatings, thus and accordingly measurement standards must be considered.

#### Dryness of Paint

Although paint dries within a rather short time, it takes a long time to release the solvent completely. Therefore, timing is also important to achieve an accurate measurement.

### D. Measurement

The paint thickness should be measured using the mutually agreed upon method. The measurement should be carried out in accordance with such agreed upon conditions as frequency per unit area and number of coatings.

### E. General Standard and Minimum Thickness Guidelines

In general, the guidelines regarding standard thickness and minimum thickness in relation to the thickness distribution are as follows:

- The minimum thickness should be a least 90% of the standard thickness.
- The difference between the minimum thickness and the standard thickness should be less than 10%
- Areas in which the coating is thinner than the minimum thickness must be touched up until the thickness exceeds the minimum thickness and the total distribution curve satisfies the above condition.

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