METHODS OF APPLICATION

The accepted methods of applying the protective coatings described in this manual are by brush, roller, conventional spray and airless spray. The advantages and disadvantages of each method are briefly described below.

Brush Application- Brush Application is a relatively slow procedure, but is generally used for decorative paints and for coating small areas. It is particularly suitable for coating complex small areas where the use of spray method leads to considerable losses due to overspray. However, most high build coating is designed for application by airless spray, and high film built will generally will not achieved by brush application.

Roller application- This is a faster method than brush application on large, even surfaces and can be used for application for thixotropic protective coatings but control of film thickness and high film build is not achieved.

Conventional Spray- This is a widely accepted and rapid method of paint application in which the paint is atomised by a low-pressure air stream. Conventional spray is relatively simple and inexpensive, but it is essential to use the correct combination of air volume, air pressure and fluid flow to give good atomisation and a paint film free from defects.

If conventional spray application is not controlled correctly , large losses of paint can result from overspray and rebound from the surface. The major disadvantage of conventional spray is that high build coatings can generally not be applied by this method ,as most paints have to be thinned to a suitable viscosity for satisfactory atomisation and so lose their high build properties.

Pressure pot - These are generally used in association with conventional spray guns to provide a means of delivering paint from a tank to a spray gun through a hose.

The compressed air, which has entered the tank forces, paints from it to the gun through a hose and atomises he paint. Paint in the tank is prevented from settling by means of a stirrer driven by a compressed air motor or by hand.

Pressure pots are used in cases where large quantities of paint are to be applied and their use, instead of a gravity feed cup attached to spray gun, significantly reduces waste time in constant refilling and also enables the gun to be turned to any angle without spilling of paints.

Airless Spray- Unlike conventional spray and pressure pot air is not mixed air is not mixed with the paint to form a spray, hence the name airless spray. Atomisation is achieved by forcing the paint through specially designed nozzles or tips, by hydraulic pressure. The required hydraulic pressure is usually generated by an air-powered pump

having a high ratio of fluid pressure to air input pressure. Pumps with ratios between 20:1 and 60:1 are available, the most common being around 45:1.
The chief advantages of airless spray are:
High build coatings can be applied without thinning.
Very rapid application possible , giving an economic advantage.
Compared to conventional spray , over-spray and bounce-back are cut back , leading to reduced losses of material and lessening dust and fume hazards.

The tips through which the paint is forced to achieve atomisation are precisely constructed from tungsten carbide . The atomised "fan" of paint is produced by a slot ground on the face of the orifice. Various orifice sizes together with different slot angles are available . The choice of tip is governed by the fluid pressure required to give atomisation coupled with the orifice size needed to give the corect fluid delivery rate. The fluid delivery rate controls the film thickness applied.

Different slot angles produce spray fans of different widths , and the selection of a particular fan width depends on the shape and size of the structure to be painted. Choice of fan width is also related to orifice size - for the same orifice size , the paint applied per unit area will be less, the wider the spray fan.

Generally , tips with an orifice size of 0.009" are suitable for coatings to be applied at approximately 50 microns (2mils) wet film thickness . Tip sizes from 0.013" - 0.019" for wet film thickness of 100-200 microns(4-8 mils) and 0.019" - 0.031" for above 200 microns (8 mils) are generally used . Heavy duty mastics which are applied at very high film thicknesses may need tips with orifices as large as 0.040" to 0.060".

There are several designs of tips available , the choice of which depends upon the finish required , the ease of application and ease of cleaning blockages from tips.

With some products, the decorative effect achieved with airless-spray is not as good as can be achieved by conventional spray. However, airless spray application is now widely accepted as a convenient method of applying high build coatings.

VOLUME SOLIDS, FILM THICKNESS & COVERAGE RATE

VOLUME SOLIDS

Volume solids of a paint is a very important factor for assessment of the spreading rate .It expresses in percentage the ratio between dry and wet film thickness of a coating applied under laboratory conditions, where no paint loss has been encountered.

$$\%\ \text{Volume solid} = \frac{\text{Measured DFT} \times 100}{\text{Measured WFT}}$$

The method of determination follows the rules of ASTM D 2697.

FILM THICKNESS

An adequate film thickness is essential for the success of any coating system . An under - applied coating will generally result in premature failure . Gross over application of paint coatings can lead either to solvent equipment and subsequent loss of adhesion , or to splitting of primer coats. With the majority of coatings , the limits of acceptable dry film thickness allow for reasonable practical variation , but the correct film thickness should always be the target during application.

Recommended dry film thickness for individual products are given on the Product Data Sheets .Measuring DFT of primers and coatings applied over blast cleaned surfaces in thickness upto 30 microns gives in accurate readings.

Dry film thickness can be calculated from the applied Wet Film Thickness as below :-

$$\frac{\text{Desired DFT} \times 100}{\%\ \text{Volume Solids}}$$

$$\frac{\text{WFT} \times \%\ \text{Volume Solid}}{}$$

WFT =

DFT =

100

COVERAGE

Theoretical Spreading Rate (TSR) :
Theoretical Spreading Rate of the given dry film thickness on a smooth steel substrate is calculated as follows :

$$\frac{\text{Volume Solids \% X 10}}{\text{DFT (microns)}} = \text{Theoretical Coverage (Sq.Metre / litre)}$$

This does not take into account the various losses involved during application . Also this cannot be given for paints used for saturation of absorbent like wood, concrete etc.

Practical Spreading Rate (PSR) :
Accurate estimation of the quantity of paint required for a particular job is complicated , since TSR does not take care into account the various losses involved in application .

In practice allowance must be made for losses . Two types of losses are considered : "Apparent losses" and "Actual losses."

Apparent Losses :
Where the paint , tough on the surface, does not contribute to the specified thickness:
When the paint is applied on the blasted surface , the film thickness over he peaks is less than the thickness over the troughs . It is the thickness over the peaks which is most important in relation to protective properties . Hence the paint which does not contribute to this thickness is considered as "lost in steel profile". The surface roughness produced by blasting and hence the extent of the paint loss is proportional to the dimension and type of abrasive used. Tyoical "losses " in DFT for given blast profiles are shown below:

SURFACE	BLAST PROFILE	DFT "LOSS"
Sheet prepared by round steel shots	0 - 50 microns	10 microns
Fine open blasting	50 - 60 microns	35 microns
Coarse open blasting	100 - 150 microns	60 microns

Old "honey comb pitted" steel re blasted	150 - 300 microns	125 microns

Effect of Distribution: This is the loss of paint resulting from over application . The extra paint used over and above that calculated from TSR is very dependant on method of application , i.e., brush, roller, or spray and also or the type of structure being painted . A simple structure with a high proportion of flat surface should not incur high loss , but loss will be high for complex structures. As a guide , following table is suggested as being appropriate:

TYPE OF STRUCTURE	METHOD OF APPLICATION	"LOSS"
Simple structures	Brush or Roller	5 - 10 %
Complex structures	-do-	10 - 15 %
Simple structures	Airless Spray	20 - 25 %
Complex structures	-do-	60 % for single coat 40 % for two coats 30 % for three coats

No realistic estimate of distribution loss can be made where open complex structure is sprayed . Also in those special cases where the specification calls for a minimum DFT at all measured points , then the distribution losses would be higher than those indicated above.

Actual Losses:
Where the paint is lost during application or wasted.

Application Loss: There is a loss during painting i.e., paint which drips from a brush or roller during transfer from the container. When application is by spray, losses are inevitable and their magnitude is dependent on the shape of the structure together with weather conditions.
The following spray losses are common:

Confined Space but well ventilated : 5 %
Outdoors in almost static air : 5 - 10 %
Outdoors in windy condition : Over 25 %

(Figure can become unusually high if painting is done in unsuitably windy conditions)

Paint Wastage: Paint is split , a certain amount remains in discarded containers, and in case of two pack of materials , mixed paint may be left beyond its pot life . Following losses are common :

Single pack paints : Upto 5 %

Two pack paints : 5 - 10 %

Calculation of Practical Spreading Rate (PSR) from given Theoretical Spreading Rate (TSR)

This is illustrated by an example below :

Example :Two coats of a two pack paint are to be applied by spray in a confined space to a shot blasted shop primed surface to yield a dft of 100 microns per coat (Total dft 200 microns). Solid volume of the paint is 60 % . What is the practical spreading rate ?

TSR :

1st Coat :

Required DFT = 100.0 microns

Loss due to surface roughness = 10.0 microns

Loss due to distribution - 40% = 40.0 microns

(i.e., 100 X 0.4)

Total = 150.0 microns

Loss due to application 5 % = 7.5 microns

(i.e., 150 X 0.05)

Total = 157.5 microns

Loss due to wastage 7% = 11.0 microns

(157.5 X 0.07)

Total = 168.5 microns

Extra paint required $= \frac{68.5}{100} \times 100 = 68.5\ \%$

(168.5 - 100 = 68.5)

2nd Coat:

Required dft = 100.0 microns

Loss due to surface roughness = Nil

Loss due to distribution-40% = 40.0 microns

(100 X 0.4)

Total = 140.0 microns

Loss due to application-5% = 7.0 microns

Total = 147.0 microns

Loss due to wastage-7% = 10.3 microns

(147 X 0.07)
Total = 157.3 microns

Extra Paint required
(157.3 -100)

$$= \frac{57.3}{100} \times 100 = 57.3\ \%$$

Total loss for two coats

$$= \frac{68.5 + 57.3}{2} = 62.9\ \%$$

In other words for the two coat system (2 X 100 micron) 62.9 % more paint will e required .
As per TSR one litre covers 5 sq.m. In practice 1.63 lt of paint can be expected to cover 5 sq.m.

Therefore , PSR is $\frac{5}{1.63}$ = 3.07 sq.m / litre

Loss Factors : This is normally expressed as the difference between TSr and PSr expressed as a percentage of TSR.

Loss factor = $\frac{5 - 3.07}{5} \times 100$

= 38.6 %

CHEMICAL RESISTANCE CHART

This Chart is a guide for selecting coatings based on general conditions of intermittent and sporadic spillage or exposure at normal temperature. It is not suited for conditions of constant immersion and prolonged or continued exposure.

	Chlorinated Rubber System	Two-Pack Epoxy System
ACIDS		
Acetic, 10%	LR	R
Acetic , Glacial	NR	NR
Benzene Sulphonic , 10%	R	R
Benzoic	R	R
Boric	R	R
Butyric, 100%	NR	LR
Chloroacetic, 10%	LR	RNR
Chromic, 10 %	LR	NR
Chromic , 50 %	NR	R
Citric	R	R
Fatty Acids, C6 & up	NR	R
Fluosilicic , 40%	R	R
Formic, 90 %	NR	R
Hydrobromic , 48 %	LR	R
Hydrochloric , 10%	R	R
Hydrochloric , 37%	R	R
Hydrocyanic , 25 %	R	R
Hydrofluoric ,40 %	R	LR
Hydrochlorous 10 %	R	NR
Lactic , 25 %	R	R
Maleic , 25 %	LR	R
Nitric, 5%	R	R
Nitric, 20%	LR	LR
Nitric, 40%	LR	NR
Oleic, 100%	NR	R
Oxalic , 20%	R	R
Perchloric	LR	LR
Phosphoric, 85%	LR	LR
Picric, 10 %	NR	R
Stearic , 100%	R	R
Sulphuric, 10%	R	R
Sulphuric, 10-15 %	R	R
Sulphuric, 70%	R	LR

Sulphuric, 93%	R	NR
ALKALIS		
Ammonium Hydroxide 28%	R	R
Calcium Hydroxide Saturated	R	R
Potassium Hydroxide , 25 %	R	R
Sodium Hydroxide, 25%	R	R
ACIDS SALTS		
Aluminium Nitrate , 10 %	R	R
Ammonium Chloride , Nitrate , Sulphate	R	R
Ferric Chloride, Nitrate , Sulphate	R	R
Nickel Chloride, Nitrate , Sulphate	R	R
Stannic Chloride	R	R
Zinc Chloride, Nitrate, Sulphate	R	R
ALKALINE SALTS		
Barium Sulphide	R	R
Sodium Bicarbonate	R	R
Sodium Carbonate	R	R
Sodium Sulphide	R	R
Trisodium Phosphate	R	R
NEUTRAL SALTS		
Calcium Chloride, Sulphate	R	R
Magnesium Chloride, Sulphate	R	R
Potassium Chloride, Nitrate, Sulphate	R	R
Sodium Chloride, Nitrate, Sulphate	R	R
GASES		
Chlorine, Dry or Wet	LR	LR
Sulphur Dioxide, Wet or Dry	R	R
Hydrogen Sulphide	R	R
ORGANIC MATERIALS		
Acetone	NR	LR
Alcohol	R	R
Aniline	NR	LR
Benzene	NR	R
Carbontetrachloride	NR	R
Chloroform	NR	R

Ethyl Acetate	NR	LR
Ethyl Chloride	NR	LR
Formaldehyde, 37%	R	LR
Gasoline	NR	R
Phenol, 5%	NR	R
Refinery Crudes	NR	R
Trichloroethylene	NR	R
FATS & OILS		
Animal	NR	R
Mineral	R	R
Vegetable	NR	R

R - Recommended.
LR - Limited Recommendation - performance varies with exposure severity, field test recommended under actual conditions .
NR - Not Recommended.