Additional Information

Theoretical and Practical Coverage

Prepared by:

International Paint Ltd.
www.international-pc.com

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INTRODUCTION

Estimating paint coverage is a key factor in the costings of both owners and contractors.

On site, practical coverage is a function of many factors, with losses due to surface condition, paint distribution, application procedure and wastage being the major factors in determining the volume of paint required for a given specification. At the initial costing stage, however, paint usage is calculated from the quoted volume solids.

The variety of methods used by different manufacturers to calculate or determine volume solids can lead to confusion and misunderstanding, particularly when comparisons between paint systems are being made. These notes are intended to guide users and specifiers both in the practical assessment of paint losses, and in their theoretical calculations.

The technique and approach described have been adopted by International Protective Coatings throughout its worldwide organisation.

VOLUME SOLIDS

The volume solids of a coating is the ratio of the volume of its non volatile components to its initial wet film volume.

Traditionally, this figure was calculated from the paint formulation but, since this took no account of factors such as pigment packing, solvent retention, or film contraction, the value bore little relation to that obtained in practice. Also, since these factors vary in importance between paint types, the calculated volume solids can result in an underestimation of coverage on some generic types of paint and an overestimation on others.

MEASUREMENT OF VOLUME SOLIDS IN THE LABORATORY

The volume solids figure given in the data sheets is the percentage of the final film obtained from a given wet film thickness under specified application method and conditions. These figures have been determined under laboratory conditions using (unless otherwise specified) the test method described in the standard ISO 3233:1998 – Determination of percentage volume of non-volatile matter by measuring the density of a dried coating.

SPECIAL SITUATIONS – INORGANIC ZINC PAINT

These paints can be so highly pigmented that the dry film contains voids. An alternative method of measuring volume solids has therefore been used to circumvent the variable void content of the dry film and thus provide a reliable figure. In general a modification of ASTM D-2697 gives the most meaningful results and is used for International Protective Coatings' data sheets.

THEORETICAL COVERAGE DETERMINATION FROM VOLUME SOLIDS

The theoretical coverage can be determined from the two formulae below:

Formula 1 (Metric)

$$\frac{\text{volume solids (\%)} \times 10}{\text{measured dft (in microns)}} = \text{Theoretical Coverage } (m^2/ltr)$$

Formula 2 (US Measures)

$$\frac{\text{volume solids (\%)} \times 16.04}{\text{measured dft (in mils)}} = \text{Theoretical Coverage (sqft/US gallon)}$$

CONVERSION FROM THEORETICAL TO PRACTICAL COVERAGE

Introduction

Estimating accurately the quantity of paint required for a particular job is complicated, since the theoretical coverage takes no account of the variable losses involved in converting paint in the can to a film on the chosen surfaces. Experienced contractors, with their knowledge of local conditions and their workforce etc. are best able to produce accurate estimates. This document is intended to supplement this experience by highlighting the major areas of losses. Two types of loss are considered; apparent losses where the paint, though on the surface, does not contribute to the specified thickness, and actual losses, where the paint is lost or wasted. These losses are discussed in more detail below.

APPARENT LOSSES

When paint is applied to an abrasive blasted surface, the paint thickness over the peaks on the surface is less than the thickness over the troughs. However, in general, it is the thickness over the peaks which is most important in relation to performance. Therefore, it can be considered that the paint which does not contribute to this thickness is lost in the steel profile. This is an apparent loss.

The Effect Of Blast Profile

The surface profile produced by blasting and the corresponding apparent loss is proportional to the dimensions of the abrasive used; where blasting has been carried out using coarse grit, for instance, the allowance that must be made for paint lost in the profile is considerable. Conversely, where steel has been blasted by small round steel shot and shop primed, the surface roughness is less pronounced and so the loss is much lower.

Typical losses in dry paint film thickness for given blast profiles are suggested below:

Surface	Blast Profile	D.F.T. Loss
Steel prepared by wheelabrator using round steel shot, then shop primed	0-50 µm (0-2 mils)	10 µm (0.4 mils)
Fine open blasting (e.g. J Blast Super)	50-100 µm (2-4 mils)	35 µm (1.4 mils)
Coarse open blasting (e.g. J Blast A)	100-150 µm (4-6 mils)	60 µm (2.4 mils)
Old honeycomb pitted steel - reblasted	150-300 µm (6-12 mils)	125 µm (5 mils)

Note that for the shop primers and holding primers, which are applied at low film thickness, the concept of losses in the blast profile is not appropriate. These thin coatings are not normally considered to contribute to the total film thickness of the paint system.

Paint Distribution

This is the loss of paint resulting from over-application when a competent painter is attempting to achieve the minimum thickness specified with reasonable certainty. The extra paint used above that calculated from the theoretical spreading rate is very dependent on the method of application, i.e. brush, roller or spray, and also on the type of structure being painted. A simple shape with a high proportion of flat surfaces should not incur heavy losses but if there are stiffeners or open lattice work involved then obviously losses will be high.

The following approximate over-applications are suggested as being appropriate:

Brush and Roller	Loss
Simple structures	5%
Complex structures	10-15% (including stripe coat)

Spray	Loss
Simple structures	20%
Complex structures	60% for single coat (inc. stripe coat)
	40% for two coats
	30% for three coats

Where open lattice work is sprayed, no realistic estimate can be made of paint distribution loss.

In those special cases where the specification calls for a minimum thickness at all measured points, then the distribution losses would be greater than those indicated above.

ACTUAL LOSSES

There is a real loss of paint during the painting operation, e.g. paint which is lost inside spray application equipment, or which drips from a brush or roller during the transfer from the paint container to the surface to be painted. With care this can be disregarded as a significant contribution to the overall loss. The use of "man helps" to extend the painter's reach can increase this type of loss however, and in an extreme case could result in a 5% loss.

Application

When application is by spray, losses are inevitable and their magnitude is dependent on the shape of the structure being painted, together with weather conditions. The following losses are common:

Environment	Loss
Well ventilated but confined space	5%
Outdoors in almost static air	5-10%
Outdoors in windy conditions	>20% (this figure can be exceptionally high if painting is attempted in unsuitably windy conditions)

PAINT WASTAGE

Some paint wastage is inevitable; paint is spilt, a certain amount remains in discarded containers and in the case of two pack materials, mixed paint may be left beyond its pot life.

SUMMARY OF LOSSES

Paint losses are summarised as follows:

Apparent loss	Surface profile (effectively applies only to the first coat)
	Distribution
Actual loss	Application losses
	Wastage

Apparent losses should be added and actual losses compounded.

PRACTICAL COVERAGE

Given the theoretical coverage and the preceding loss factors, it is possible to calculate a practical coverage. However, due to the extremely complex nature of the calculations, and variability of a number of external factors which include surface roughness, ambient climatic conditions, complexity of structure, access limitations and application methods, it is advised that these calculations are performed by professional estimators who have the appropriate knowledge and experience of the application of protective coatings under various site conditions.