DRAFT GUIDE TO THE MEASUREMENT AND USE OF DRY FILM THICKNESS DATA ON MOD(N) VESSELS.

Prepared by the

Dry Film Thickness Sub-Committee

of the

Marine Paint Forum.

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TABLE OF CONTENTS

	PAGE
1. AIMS	1
2. BACKGROUND	1
3. CURRENT DFT MEASUREMENT STANDARDS	1
4. MEASUREMENT OF DFT USING A MAGNETIC FLUX TYPE OF INSTRUMENT.	2
4.1 Calibration.	2
4.2 Rate of DFT Measurement	3
4.3 The Meaning of DFT	4
5. REFERENCES	4

1. AIMS

This Note has been prepared for use by MOD(N), its ship building and ship repair contractors, their sub-contractors and paint suppliers.

The aim of the Note is to provide a standardised method for the measurement and interpretation of the Dry Film Thickness (DFT) data recorded for paint films on HM Ships.

The Note has been produced by the DFT Measurement sub-committee of the Marine Paint Forum and it is our view that the two most important parameters in DFT measurement, namely common sense and paint manufacturers' experience and opinions cannot be over emphasised.

2. BACKGROUND

The problem of DFT measurement and the use to which the data is put is far from being new and has been an occupational hazard for many years. It has occupied the thoughts of many and yet there is still no Internationally recognised Standard which has found universal acceptance for recording or using DFT data.

It was quickly recognised by the working group that the major reason for this was that in practical terms painting is an art not a laboratory science, common sense cannot be Standardised, and experience is mightier than the micron.

3. CURRENT DFT MEASUREMENT STANDARDS.

There are currently 3 Standards which may be employed.

1. Swedish Standard SS 18 41 60 " Paints and varnishes - Determination of thickness of a dry film on a metal substrate - Magnetic flux and eddy current methods".

2. Steel Structures Painting Council SSPC PA-2 "Paint application specification No.2. Measurement of dry paint thicknesses with magnetic gauges".

3. BS 3900 Part C5 1992 (ISO 2808 1991) "Determination of film thickness".

Unfortunately the least useful of these documents is BS 3900 as in reality it states nothing more than follow manufacturer's instructions albeit for a wide variety of measuring devises.

Both Swedish and American standards require multi-point sampling around a single point followed by averaging of that data. When the whole painted structure has been examined the averages obtained above are further averaged to derive the DFT of the work piece. In practice this means this means taking between 135 and 166 individual readings per $100m^2$ of painted surface depending on which standard is followed. (Cf. the recommendation in NES 756

which requires a minimum of 40 DFT's over the same area with no requirement to average the results).

It is also important to note that both Standards allow for local film thicknesses to be below the nominal value provided the mean film thickness is at least equal to the nominal film thickness. The American standard allows for local DFT's to be within 80% of the nominal value whilst the Swedish standard states readings should be within 85% of the nominal DFT. In reality this means that for a nominal 100um DFT values as low as 80um would be accepted provided the mean or average over the job was at, or above, 100um. Unfortunately neither Standard appears to limit the number of low readings permissible although 20% seems to be an acceptable paint industry norm.

In simple terms this means that at least 80-85% of all readings should be at, or above, the Specified minimum DFT. The remaining 15% of readings should be within 80% of the Specified minimum DFT. No single reading should be below this value.

Similarly, both Standards require an allowance to be made for the surface profile which is currently not required by the NES's. The working group felt that in all probability this was not a common practice in the UK in general. However, some of the better commercial applicators may make an allowance for these effects.

In terms of where DFT's should be measured the Standards and other documents are also reasonably specific regarding areas and paint thickness that should be avoided. Typically areas less than 15mm from an edge, areas less than 30mm from shoulders, and thin film paints on a blasted surface (ie DFT's <75um) should all be avoided with magnetic flux probes without first undertaking some form of special calibration. The Swedish Standard also mentions reading errors on concave surfaces (too low) and on convex surfaces (too high) if the gauge is calibrated on a flat surface.

Overall therefore, it is clear that the measurement of DFT has been, and still is, a mine field into which we stumble at our peril and the one thing that we need but is not spelt out in any Standard is to have a pragmatic approach and a large dollop of common sense. Clearly, surface preparation and painting are an art not a strictly controlled laboratory science and even when painting enters the laboratory it is still not possible to produce a perfectly uniform dry film.

4. MEASUREMENT OF DFT USING A MAGNETIC FLUX TYPE OF INSTRUMENT.

4.1 Calibration.

1. Zero the instrument on a steel surface having similar profile to that of the work piece. For best results the instrument should be calibrated on the structure to be measured. Where this is not possible a standard flat panel approximately 75 * 75 * 5mm blasted with the same media used on the job should be used. For mechanically (i.e. needlegun descaled,

wire brushed, grinder etc.) or chemically stripped surfaces calibration should be made on clean, flat steel. (NOTE. A prepared test panel will hold its finish for some weeks if stored with silica gel crystals in a sealed plastic bag and need not therefore be re-prepared for every calibration.)

2. Calibrate the instrument following manufacturers' recommendations using calibrated plastic shims with a thickness above and below the anticipated thickness to be measured.

3. The calibration shims shall be in good condition, free from wear and be calibrated to a traceable Standard. Probes shall be examined for damage or wear at regular intervals and be replaced as necessary.

4. Where possible calibration should be made at the work place. However, it is realised that in some situations this may not be practical (Eg. double bottom tank) in which case calibration should be made under environmental conditions as close to those of the work place as possible.

Once instrument calibration is complete DFT measurements can be made.

4.2 Rate of DFT Measurement.

On flat surfaces readings should be taken at a rate of 1 per square metre but should NOT be made within 15mm of edges, holes, welds, paint runs or substrate defects (Eg. pitted areas etc.). This distance should be increased to 30mm on flanges, shoulders and other areas of large changes in cross section of the substrate.

On I beams (webbing and flange) 1 reading per 50cm but taking note of the comments made above regarding distances from edges etc.

On pipe work 1 reading per 50cm, but taking note of the comments above regarding flanges etc., ensuring that all areas of the pipe are adequately represented. (NOTE. On pipe work unless the instrument can be re-calibrated on a test panel having the same radius as the pipe under examination it may be expected that the actual DFT may be lower than the value obtained. However, this variation cannot as yet be quantified and therefore the readings obtained should be used.)

Values that are obviously too low or too high and CANNOT be reproduced should be rejected. Low or high values should NOT be "chased" to determine the extent of their range at this stage as this will distort the mean value obtained.

It is recommended that on blast cleaned surfaces no DFT measurements are made on paint films below 75um as the errors induced by the effect of variation in surface profile are too great.

4.3 Using DFT data.

Using this method the recorded DFT is the average thickness of paint over the peaks in the area directly beneath the probe. When the examination is complete these values are added together and divided by the number of readings to produce an average DFT.

The AVERAGE value of the DFT measurements should not be below the minimum or target value specified by the paint manufacturer. At least 85% of all readings should be at, or above, the specified minimum DFT. The remaining 15% of readings shall not be less than 80% of the Specified minimum DFT. **No single value shall be below this thickness.**

Where practical paint over thickness should be kept to within 30% of the specified target thickness. However, it is recognised that overlap areas and complex structures can produce localised high spots which exceed this target. In these cases values of 50% or more may be obtained. The acceptability of such a situation is largely dependant on the paint system and the areas to which it is being applied. In such situations the values should be reported to the paint manufacturer and his advise obtained. Similarly, guidance on health or safety implications due to over application of a paint should be sought from interested parties.

Once this initial survey has been completed any unacceptably low or high areas identified can be examined in greater detail and the appropriate action taken.

5. REFERENCES.

1. Swedish Standard SS 18 41 60 " Paints and varnishes - Determination of thickness of a dry film on a metal substrate - Magnetic flux and eddy current methods".

2. Steel Structures Painting Council SSPC PA-2 "Paint application specification No.2. Measurement of dry paint thicknesses with magnetic gauges".

3. BS 3900 Part C5 1992 (ISO 2808 1991) "Determination of film thickness".

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