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**COATING FINGERPRINTING OVERALL
PROCEDURES FOR PAINT SYSTEMS
USING FTIR AND OTHER RELATED
METHODS**

INSTITUTE OF MATERIALS, MALAYSIA

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PUBLIC COMMENT STAGE
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Foreword

Institute of Materials, Malaysia (IMM) is a non-profit professional society that promotes honourable practice, professional ethics and encourages education in materials science, technology and engineering. Engineers, academicians, technicians, skilled workers and professionals are amongst its members exceeding 6800. Registered with the Registrar of Societies on 6th November 1987, the Malaysian Materials Science & Technology Society (MMS) changed its name to the Institute of Materials, Malaysia (IMM) on 16th June 1997. The objectives of the IMM include the following:

- Training and development of individuals and companies in Malaysia to attain professional recognition in various fields of materials science, technology and engineering.
- Development of IMM standards as recommended guidelines for good technical practice for consideration and implementation by various industries of materials science, technology and engineering.

IMM FP01:2019, *Coating fingerprinting overall procedures for paint systems using FTIR and other related methods* was developed by the IMM Task Force on Coating Fingerprinting.

This standard will be subjected for review to reflect current needs and conditions. Users and other interested parties may submit comments on the contents of this standard for consideration in future versions.

Compliance with this Standard does not of itself confer immunity from legal obligations.

COATING FINGERPRINTING OVERALL PROCEDURES FOR PAINT SYSTEMS USING FTIR AND OTHER RELATED METHODS

1. Scope

This Standard emphasises fingerprint checking of manufacturer's paint system, with the aim of reaffirming the consistency of the paint supplied with reference to the qualified paint. This Standard covers the fingerprint requirement of both single and multi-component paint systems for qualification, quality control and verification.

This Standard includes:

- i. Coating fingerprinting qualification
- ii. Test method to fingerprint the paint supplied in the manufacturer's container
- iii. Criteria and execution of Fingerprint Coating Certificate

NOTE. The requirement of coating fingerprinting is stated in various specifications and standards, namely ISO 12944-9:2018, *Paints and varnishes- Corrosion protection of steel structures by protective paint systems-- Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures*, ASTM D7588-11(2018) *Standard guide for FTIR fingerprinting of a non-aqueous liquid paint as supplied in the manufacturer's container*, and ASTM D2621-87 *Standard test method for infrared identification of vehicle solids from solvent-reducible paints*. However, all of these standards are lacking with respect to the interpretation of FTIR spectra or the estimation of the degree of similarity between two FTIR spectra. Hence, there is a need to establish a working standard for the execution of coating fingerprinting.

2. Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1. 3rd-party laboratory

laboratory independent of the manufacturer, supplier, designer or owner of the tested items, nor the authorized representative or a subsidiary of any of these parties.

2.2. attenuated total reflectance (ATR)

measures the changes that occur in an internally reflected IR beam when the beam comes into contact with a sample.

2.3. auditor

a person who conducts a systematic review on the execution of coating fingerprinting certificate.

2.4. certificate of analysis (COA)

document that confirms a product meets its product specification, as obtained from testing performed.

2.5. correlation

the interdependence of the spectra from sample to that of Reference.

2.6. Fourier-transform infrared (FTIR)

when infrared radiation is passed through a sample, some radiation is absorbed by the sample and some is transmitted. The resulting signals are generated at the detector. The Fourier Transform converts the detector output to an interpretable spectrum that may provide molecular structural insights.

2.7. material safety data sheet (MSDS)

document that provides information regarding safety and health of related substances and products.

2.8. owner

a person who acquires possession, ownership, or rights to the use or services of the paint by payment.

2.9. paint

pigmented coating material in liquid form that when applied to a substrate, forms a solid film having protective, decorative, or specific technical properties.

2.10. Reference sample

the sample that has been subjected to qualification test and referred to as standard.

2.11. shall

expressing an instruction, command or a strong assertion

2.12. should

used to indicate obligation, duty, or correctness

2.13. technical data sheet (TDS)

document that provides information regarding a specific product.

2.14. triplicate

the repetition of the set of experiment by means of same sample in three replications.

3. Coating fingerprinting qualification

Coating fingerprinting qualification shall be imposed for coating projects with total surface area of 1000 m² or more, or as required by the owner. The new coating has to pass all the performance tests, as agreed by the owner. The coating formulation that has changed after qualification shall be requalified. The coating formulation after qualification shall be consistent for batch-to-batch production.

The qualification tests shall be carried out or witnessed and certified by an independent 3rd-party authority, or to be agreed by the owner. The recommended 3rd-party testing laboratory shall be recognized by the owner for a grace period of at least 3 years prior to accreditation by authorized body.

Fingerprint check may serve as a verification tool to confirm that the paints supplied are identical to those subjected to qualification test, by means of the degree of similarity (*r*) of FTIR spectra.

Routine batch check shall be carried out on the first and every subsequent batch of the paint in a qualified paint system to substantiate the accuracy of batch-to-batch production.

NOTE. Routine batch check discloses the distinction between the paints supplied with qualified paint.

Coating Fingerprinting Qualification shall be made to the whole wet paint in the *as-is* basis but not solvent-reducible to ensure the consistency of the solvent component for batch-to-batch production. In addition, Coating Fingerprinting Qualification shall be applicable to both single and multi-pack paint systems. For single-pack, the sample is analysed directly. For multi-pack paint, each pack is analysed separately.

4. Sample collection (by paint manufacturer)

For every new paint system, three samples are required from the **Top** (1 sample), **Middle** (1 sample) and **Bottom** (1 sample) (*c.f.* Figure 1) of the mixing tank, respectively. Subsequently, one sample is obtained from the **Bottom** of the mixing tank for each batch of production.

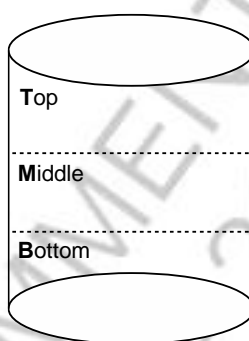


Figure 1. Schematic diagram of sampling location at **Top**, **Middle** and **Bottom** of the mixing tank / paint container

5. FTIR test method

5.1. FTIR spectrophotometer

Both mobile and handheld FTIR spectrophotometers are suitable for on-site analysis, while the benchtop spectrophotometer shall be used for laboratory analysis. The results obtained from benchtop, mobile and handheld spectrophotometers should be comparable.

The FTIR spectrophotometer shall encompass a wavelength range of at least 4000 cm^{-1} – 700 cm^{-1} with resolution of no less than 4 cm^{-1} . In addition, the FTIR spectrophotometer shall be equipped with single or multi-bounce ATR with horizontal arrangement. The common ATR crystal materials are diamond, zinc selenide (ZnSe) and germanium (Ge), with the spectral range of 4000 cm^{-1} – 650 cm^{-1} , 4000 cm^{-1} – 650 cm^{-1} , and 4000 cm^{-1} – 700 cm^{-1} respectively. The ATR crystal material shall be compatible and not react with the respective paint sample. The finite comparison of the spectra is recommended (but not essential) to be obtained with same ATR crystal material.

5.2. Sample preparation

The paint sample shall be stirred and the **Top** of the paint sample shall be withdrawn and applied on the ATR crystal.

5.3. Sample annotation

Sample annotation is required to reproduce the spectrum and the information shall include:

- a) Sample name;
- b) Batch number;
- c) Date and time being analyzed;
- d) Analyst and/or company name;
- e) FTIR brand and model, spectral range, number of sample scans (min 32), number of background scans (min 32), resolution;
- f) ATR crystal material; and
- g) Spectral correction (if any).

5.4. Instrumental analysis

The analyses are recorded in transmittance mode by averaging 32 scans at a maximum resolution of 4 cm⁻¹. Each sample is required to have a minimum of triplicate analysis. A background infrared spectrum shall be collected prior to each sample analysis.

The paint sample is applied on the ATR crystal and the spectrum is collected immediately. A sufficient amount of sample shall be used as the sample volume of less than 1 mL is prone to solvent loss and/or reaction with atmospheric component.

5.5. Spectra analysis

A comprehensive examination of the original spectrum is required prior to spectrum processing. It is recommended to retain the original spectra for further deliberation. The spectra shall not be baseline corrected or subjected to any other types of spectral correction.

The commercially available FTIR software contains different algorithms for processing FTIR spectra. For the Coating Fingerprint Certificate, only the Compare function is involved. A Compare function or equivalent shall be used in all cases.

The range of wavenumbers as fingerprint regions for resin and hardener is as shown in Annex A. For other paint systems, the range of fingerprint region is as per agreed upon with owner.

5.5.1. Reference spectrum

Reference spectrum shall be generated from the average spectra of **Top**, **Middle** and **Bottom** of the mixing tank (refer Clause 4).

Paint manufacturer shall average a minimum of nine spectra from **Top**, **Middle** and **Bottom** of the mixing tank (with minimum of three spectra from each location).

5.5.2. Degree of similarity (*r*)

The degree of similarity, which is termed correlation (*r*), of the spectra is generated by comparing the spectra of the sample to that of the Reference spectrum using Compare features of the FTIR software.

The degree of similarity is directly proportional to quantities of *r*, i.e. *r* = 1 represents the complete matching of the sample spectrum to that of the Reference spectrum. The acceptance criterion is set at *r* ≥ 0.900, with tentative tolerance of ± 0.002 (or the range of 0.898 – 1.000).

It is to be noted that the degree of similarity has no correlation with the performance of the coating. The $r \geq 0.900$ is only an indication that the batch of the paint supplied has high degree of similarity as compared to the Reference paint that passed the qualification test.

6. Qualification of paint system

6.1. Qualification of Reference sample (new formulation)

The qualification of the Reference sample is approximated by degree of similarity (r) from the in-house and 3rd-party testing laboratory, as given by Equation 1.

$$r_{\text{Ref}} = \sqrt{r_{\text{Ref}_{\text{in-house}}} \times r_{\text{Ref}_{\text{3rd-party}}}} \quad (\text{Equation 1})$$

The Reference spectrum for 3rd-party testing laboratory ($\text{Ref}_{\text{3rd-party}}$) is obtained by averaging nine spectra generated from the **Top** (one sample), **Middle** (one sample) and **Bottom** (one sample) of the mixing tank. The $r_{\text{Ref}_{\text{3rd-party}}}$ can be estimated by referencing $\text{Ref}_{\text{3rd-party}}$ to $\text{Ref}_{\text{in-house}}$, which is submitted by the 3rd-party testing laboratory to paint manufacturer.

The Reference spectrum for in-house ($\text{Ref}_{\text{in-house}}$) is obtained by averaging nine spectra generated from the **Top** (one sample), **Middle** (one sample) and **Bottom** (one sample) of the mixing tank. The $r_{\text{Ref}_{\text{in-house}}}$ can be estimated by referencing $\text{Ref}_{\text{in-house}}$ to $\text{Ref}_{\text{3rd-party}}$, which is carried out in-house by paint manufacturer.

The acceptance criterion for the qualification of Reference sample is $r_{\text{Ref}} \geq 0.90$ for the whole FTIR region and fingerprint region. The successfully qualified Reference sample is employed as standard for in-house batch-to-batch monitoring, random/scheduled on-site analysis, and retained paint sample analysis.

6.2. In-house batch-to-batch monitoring

For each batch of the paint production, one sample from the **Bottom** of the mixing tank is obtained. The r is approximated by referencing the Reference sample to the sample collected from the **Bottom** of the mixing tank for every subsequent batch of the paint production.

If the r of the sample spectrum is ≥ 0.900 (with tentative tolerance of ± 0.002) for whole FTIR region and fingerprint region as compared to the Reference spectrum, then the sample is accepted.

If the r of the sample spectrum is < 0.900 for whole FTIR region and fingerprint region as compared to the Reference spectrum, a verification test using samples from each location (**Top**, **Middle** and **Bottom**) of the mixing tank is required, prior to rejection of the whole lot of paint sample.

6.3. Random/scheduled on-site analysis (by owner)

For the on-site paint sampling (using handheld or mobile FTIR spectrophotometer), one sample from the **Top** of the randomly selected paint container is required. The r for on-site sample spectrum is approximated by referencing the Reference sample to the on-site collected paint sample.

If the r of the sample spectrum is ≥ 0.900 (with tentative tolerance of ± 0.002) for whole FTIR region and fingerprint region as compared to the Reference spectrum, then the sample is accepted.

If the r of the sample spectrum < 0.900 as compared to the Reference spectrum for whole FTIR region and fingerprint region, verification test of the on-site paint sample shall be carried out by 3rd-party testing laboratory (recommended by the owner).

If the 3rd-party analysis of on-site paint sample demonstrated $r < 0.900$ as compared to the Reference spectrum, an additional verification test of the retained paint sample shall be carried out by 3rd-party testing laboratory, prior to rejection of the whole lot of paint sample.

6.4. Retained paint sample

The paint manufacturer shall retain one sample from every new paint system and submit for 3rd-party testing laboratory (recommended by the owner) to act as a verification tool whenever there is a dispute on the paint delivered on-site. For each batch of the paint production, one sample from the **Top**, **Middle** and **Bottom** of the mixing tank is kept as retained paint sample.

The r is approximated by referencing the Reference sample to the retained paint sample from **Bottom** of the mixing tank. If the r of the sample spectrum is ≥ 0.900 (with tentative tolerance of ± 0.002) for whole FTIR region and fingerprint region as compared to the Reference spectrum, then the sample is accepted.

If the r of the sample spectrum is < 0.900 for whole FTIR region and fingerprint region as compared to the Reference spectrum, a verification test using samples from each location (**Top**, **Middle** and **Bottom**) of the mixing tank is required, prior to rejection of the whole lot of paint sample.

6.4.1. Dispute of results from 3rd-party testing laboratory

The 3rd-party laboratories (recommended by the owner) yielding contrasting results shall complete the Test Method Assessment checklist (Annex B) in the presence of representatives from the respective laboratories. Upon completion of the checklist and site verification, the respective laboratories shall perform the testing of samples (not limited to certified reference material) prepared by the paint manufacturer in the presence of representatives from all respective laboratories.

7. Coating Fingerprint Certificate

The Coating Fingerprint Certificate is comprised of two parts, namely physical analyses and structural analyses, as shown in Annex A. This certificate is applicable for paint system with 1-pack or more.

7.1. Physical analyses

Physical analyses are performed by in-house testing laboratory, with parameters including viscosity, density, colour code, non-volatile matter, mass of Zn metal/Total Zn, and others required by the owner. The MSDS, TDS, COA and certificate of % purity by manufacturer shall be appended wherever applicable.

7.1.1. Anomaly

7.1.1.1. Specific coating system

For those parameters listed in Section 2 (under *Physical analyses*) of Annex A but not being evaluated by the paint manufacturer, an alternative of appending the related COA with remarks on the Coating Fingerprint Certificate is recommended.

7.1.1.2. Organic and inorganic zinc coating

For the calculation of weight solid (zinc metal/total zinc), the paint manufacturer shall either attach the original COA with Coating Fingerprint Certificate or reproduce the data from the original supplier without appending the COA. However, the latter shall be cross-referenced to the original supplier's COA document number for future traceability.

7.2. Structural analyses

Structural analysis is performed using FTIR. The inorganic components in the paint that are IR inactive shall be appended with other compliances such as certificate of percent purity by the metal manufacturer.

The FTIR analysis shall provide the spectrum that is properly identified and labelled, as listed in Clause 5.3. Other information necessary to duplicate the sampling and/or spectral collection shall be provided as well.

7.3. Confidentiality

The Coating Fingerprint Certificate shall be converted into non-editable digital format and/or encrypted, e.g. in PDF format and recommended to be with password protection. It shall not be circulated through social media which would violate the confidentiality of the company or to the customers.

7.4. Signatory

The Coating Fingerprint Certificate shall be signed by a certified signatory who has passed the IMM Certified Fingerprint Quality Controller course. The certified signatory shall include name, function, IMM membership number and Coating Fingerprint Quality Controller rubber stamp. All pages of Coating Fingerprint Certificate shall be either signed or initialed by certified signatory.

The Coating Fingerprint Certificate can be signed by employee under the supervision of the certified signatory. The signatory (i.e. the employee) shall include name, function of the employee and shall be counter-signed by the same certified signatory giving his/her name, function, IMM membership number and Coating Fingerprint Quality Controller rubber stamp.

8. Execution of coating fingerprinting

8.1. Certified signatory for in-house Coating Fingerprint Certificate

The Coating Fingerprint Certificate shall be generated per batch basis by the paint manufacturer for qualification of coating fingerprinting, for routine batch check on every subsequent batch of the paints for the qualified paint system, for scheduled client's audit or random client's audit as requested by client as deemed necessary, and for verification test of the retained paint sample.

8.2. 3rd-party testing laboratory

The 3rd-party testing laboratory shall perform the qualification of coating fingerprint and certify the on-site paint sample delivered on schedule or random basis. In addition, 3rd-party testing laboratory shall verify the retained paint sample whenever there is a dispute on the on-site paint sample.

8.3. Coating inspector

Coating inspector shall prepare and certify the Coating Fingerprint monitoring report for on-site paint delivered on schedule or random basis. In addition, coating inspector shall perform the schedule or random basis on-site coating fingerprint structural analysis by handheld or mobile FTIR spectrometer.

8.4. Fabricator, contractor, sub-contractor

The fabricator, contractor or sub-contractor will receive the 1-pack or 2-pack paint on-site attached with the Coating Fingerprint Certificate either in hard copy or submitted separately in digital format. The fabricator, contractor or sub-contractor shall validate the Coating Fingerprint Certificate submitted by paint manufacturer. He/she shall certify the Coating Fingerprint Certificate submitted by 3rd-party testing laboratory on a scheduled or random basis for on-site coating fingerprint structural analysis by handheld or mobile FTIR spectrometer.

8.5. External auditor

The external auditor shall review and validate the Coating Fingerprint Certificate and coating fingerprint (scheduled/random) monitoring report.

8.6. End user

The end user shall review and validate the Coating Fingerprint Certificate and coating fingerprint (scheduled/random) monitoring report.

Annex A
(informative)

Coating Fingerprint Certificate

Company name:	<i>e.g.</i> Company ABC	Country:	<i>e.g.</i> Malaysia		
Certificate number:	<i>e.g.</i> epoxy/001/02Jan2016	Date:	<i>e.g.</i> 2 Jan 2016		
Number pages:	<i>e.g.</i> 05				
Section 1: General information					
Product name:	<i>e.g.</i> EPOXY123		Product type:	<i>e.g.</i> epoxy, polyurethane, polyester, inorganic zinc, epoxy zinc, <i>etc</i>	
Date of issue:	Base material (<i>e.g.</i> epoxy / epoxy zinc / polyacrylate / polyester / inorganic zinc / silicone)		Curing agent / hardener (<i>e.g.</i> amine / isocyanate / peroxide / ethyl-silicate)		
Specify base material & curing agent	<i>e.g.</i> epoxy		<i>e.g.</i> amine		
Trade name	<i>e.g.</i> Epikote123		<i>e.g.</i> Amine123		
Generic	<i>e.g.</i> Epoxy		<i>e.g.</i> Hardener		
Factory location	<i>e.g.</i> Shah Alam, Selongor		<i>e.g.</i> Shah Alam, Selongor		
Batch number	<i>e.g.</i> 1234567A		<i>e.g.</i> 1234567B		
Production date	<i>e.g.</i> 02 Jan 2016		<i>e.g.</i> 02 Jan 2016		
Product technical data sheet number	<i>e.g.</i> TDS123A		<i>e.g.</i> TDS123B		
Material safety data sheet number	<i>e.g.</i> MSDS123A		<i>e.g.</i> MSDS123B		
Shelf life	<i>e.g.</i> 24 months		<i>e.g.</i> 24 months		
Section 2: Test methods and results					
<i>Physical analyses</i>					
Parameters	Method	Base material		Curing agent / hardener	
		Specification with tolerance	Test result	Specification with tolerance	Test result
Viscosity	<i>e.g.</i> ASTM D4287 ASTM D5125 ASTM D562 ISO 2431 ISO 2884-1	<i>e.g.</i>± 0.05 P	<i>e.g.</i> 3.24± 0.02 P	<i>e.g.</i>± 0.05 P	<i>e.g.</i> 2.78± 0.03 P
Density	<i>e.g.</i> ISO 2811-4	<i>e.g.</i>± 0.05 g cm ⁻¹	<i>e.g.</i> 1.48 ± 0.03 g cm ⁻¹	<i>e.g.</i>± 0.05 g cm ⁻¹	<i>e.g.</i> 0.943 ± 0.02 g cm ⁻¹
Color code	<i>e.g.</i> BS 4800 RAL Color Standards	<i>e.g.</i> colour difference (dE) < 1	<i>e.g.</i> Light grey	<i>e.g.</i> colour difference (dE) < 1	<i>e.g.</i> clear
Non-volatile matter (by mass)	<i>e.g.</i> ISO 3251	<i>e.g.</i>± 2 %	<i>e.g.</i> 78± 2 %	<i>e.g.</i>± 2 %	<i>e.g.</i> 99± 2 %

Weight Solid: Zn metal/Total Zn Note: submit certificate of % purity by manufacturer Note: applicable to <u>organic zinc paint and inorganic zinc paint only</u>	<i>e.g.</i> ISO 14680-2	<i>e.g.</i>± 1 %	<i>e.g.</i> N/A for epoxy system	<i>e.g.</i>± 1 %	<i>e.g.</i> N/A for epoxy system
<i>Structural analysis</i>					
Infrared spectra	Wet sample as supplied in can. Degree of similarity (r) ≥ 0.900* (tentative tolerance = ± 0.002 or range of r = 1.000 – 0.898)				
	Method	Base material		Curing agent / hardener	
Base material: epoxy Curing agent: amine	ASTM D7588	700-4000 cm ⁻¹	0.988	700-4000 cm ⁻¹	0.970
		1000-1300 cm ⁻¹	0.995	1000-1400 cm ⁻¹	0.957
		700-900 cm ⁻¹	0.996	N/A	N/A
Base material: polyacrylate / polyester Curing agent: isocyanate	ASTM D7588	700-4000 cm ⁻¹		700-4000 cm ⁻¹	
		1600-1800 cm ⁻¹		2000-2500 cm ⁻¹	
		3000-3800 cm ⁻¹		3000-3800 cm ⁻¹	
Base material: polyester Curing agent: peroxide	ASTM D7588	700-4000 cm ⁻¹		700-4000 cm ⁻¹	
		1600-1800 cm ⁻¹		900-1200 cm ⁻¹	
		2700-3100 cm ⁻¹		N/A	N/A
Base material: epoxy zinc Curing agent: amine	ASTM D7588	700-4000 cm ⁻¹		700-4000 cm ⁻¹	
		1000-1300 cm ⁻¹		1000-1400 cm ⁻¹	
		700-900 cm ⁻¹		N/A	N/A
Base material: inorganic zinc Curing agent: ethyl-silicate	ASTM D7588	700-4000 cm ⁻¹		700-4000 cm ⁻¹	
		N/A	N/A	2700-3200 cm ⁻¹	
		N/A	N/A	1000-1500 cm ⁻¹	
Base material: Silicone-aluminum	ASTM D7588	700-4000 cm ⁻¹		N/A	N/A
				N/A	N/A
				N/A	N/A

*average results of triplicate analyses


Section 3: FTIR test details (as per ASTM D7588)			
Analyst & company name	<i>e.g.</i> Name & Company ABC Sdn Bhd		
Brand & model of FTIR	<i>e.g.</i> FTIR Brand XYZ & model: 2016		
Type of FTIR spectrophotometer	<i>e.g.</i> benchtop / mobile / handheld		
Benchtop: ATR crystal material	<i>e.g.</i> diamond, zinc selenide (ZnSe), germanium		
Spectral correction (<u>circle</u>) Note: correction is <u>NOT</u> recommended.	YES / NO [Note: if YES , please state the correction(s) made] <i>e.g.</i> automatic baseline correction		
Spectral range (cm ⁻¹)	<i>e.g.</i> 600 - 4000 cm ⁻¹		
No. of sample scans (min 32)	<i>e.g.</i> 32 scans		
No. of background scans (min 32)	<i>e.g.</i> 32 scans		
Resolution (min 4 cm ⁻¹)	<i>e.g.</i> 4 cm ⁻¹		
High sensitivity of correlation compare algorithm for matching ratio in absorbance mode	Note: Correlation compare algorithm of the FTIR software should depend on both x- (wavenumber) and y- (absorbance) vectors. High sensitivity compare algorithm, which analyzes the variations <i>via</i> summation of the squared differences of each variation from the overall mean OR equivalent, should be used.		
	Dependence on BOTH x- and y- vectors (<u>circle</u>)	<u>YES</u> NO	High sensitivity compare algorithm (<u>circle</u>)
			<u>YES</u> NO

Trade name and batch number of reference spectrum for base material	<i>e.g.</i> Epikote123 & 1234567A-Reference
Trade name and batch number of reference spectrum for curing agent / hardener	<i>e.g.</i> Amine123 & 1234567B-Reference

Notes:

1. Full range of FTIR spectra for both base and curing agent without automatic baseline correction and in absorbance mode are to be attached with this report (raw data).
2. Compliance to matching criteria values does not exclude meeting the requirements of other QA/QC checks *e.g.* drying time, gloss, hiding power *etc.*
3. Methods used shall refer to the latest published document.
4. This certificate is applicable to all systems.
5. This certificate can be submitted in CD or other digital formats.

The undersigned hereby declare that all the analytical tests were performed according to the procedures specified herein and that this report represents a true and accurate record of the results obtained.

Authorized QA/QC Executive: <i>e.g.</i> <div style="border: 1px solid black; padding: 5px; text-align: center;"> NAME Company ABC Sdn Bhd (123456-X) QC Department </div>	Validated by: <i>e.g.</i> 
Signature: <i>e.g.</i> <i>Name</i>	Signature: <i>e.g.</i> <i>Yoga Salim</i>
Date: <i>e.g.</i> 2 Jan 2016	Date: <i>e.g.</i> 2 Jan 2016
IMM membership member: (optional to be IMM member)	IMM membership member: <i>e.g.</i> O-1234

Section 4: Compulsory appendices (to be submitted in CD or other digital formats)	
Appendix 1	Overlay reference and sample FTIR spectra for base materials (Note: In addition, raw data of reference and sample FTIR spectra must be provided in two raw data files)
Appendix 2	Overlay reference and sample FTIR spectra for curing agent / hardener (Note: In addition, raw data of reference and sample FTIR spectra must be provided in two raw data files)
Appendix 3	Certificate of analyses which are relevant to the in-house standard testings
Appendix 4	Certificate of % purity of zinc by metal manufacturer for organic zinc paint & inorganic zinc paint OR certificate of analysis of alum paste for silicone-aluminum paint / glass flake for glass flake polyester / inorganic filler for any paint

END OF REPORT

Received & checked:

Date: e.g. 15 Jan 2016



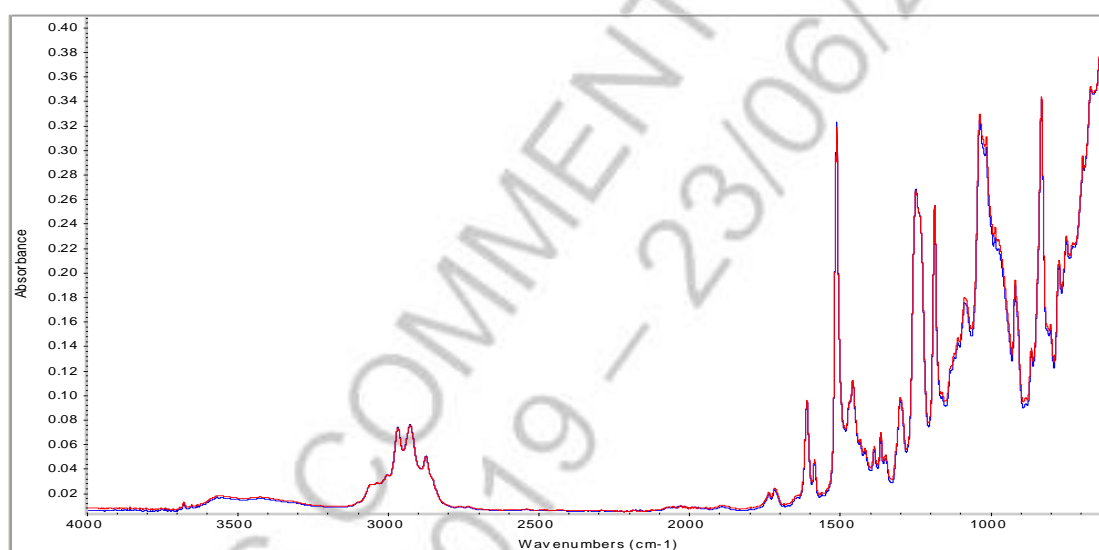
Melissa Chan

Appendix 1 Overlay reference and sample FTIR spectra for base materials

Reference spectrum – red (generated by averaging the FTIR spectra from **Top**, **Middle** and **Bottom** of the mixing tank for the sample sent for qualification for painting systems and products for offshore application)

Sample spectrum – blue (for each batch of production, sample at the location of **Bottom** of the mixing tank)

Degree of similarity (r) = 0.986

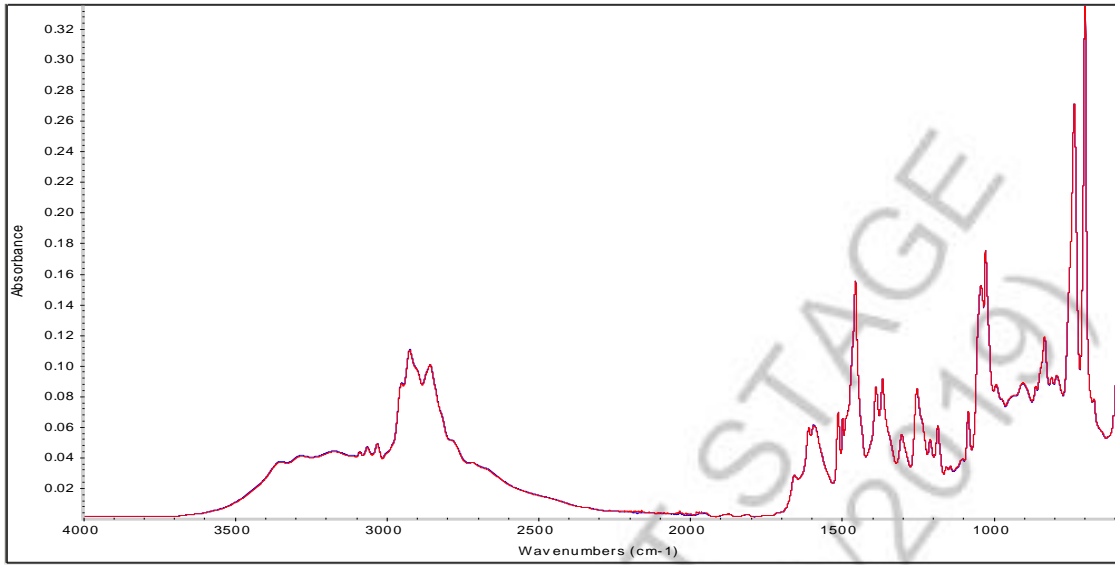


Appendix 2 Overlay reference and sample FTIR spectra for curing agent / hardener

Reference spectrum – red (generated by averaging the FTIR spectra from **Top**, **Middle** and **Bottom** of the mixing tank for the sample sent for qualification for painting systems and products for offshore application)

Sample spectrum – blue (for each batch of production, sample at the location of **Bottom** of the mixing tank)

Degree of similarity (r) = 0.970



PUBLIC COMMENT STAGE
(25/04/2019 – 23/06/2019)

Annex B
(informative)

Test Method Assessment of 3rd-Party Testing Laboratory in relation to dispute in Fingerprint Coating Certificate for paint sample

Test Method Assessment of 3rd-Party Testing Laboratory in relation to dispute in Fingerprint Coating Certificate for paint sample		
Attach all the analysis data as references.		
SECTION 1: Information of the 3rd-Party Testing Laboratory		
Name of the laboratory		
Representative of (which company)		
SECTION 2: Requirement of the laboratory		
SECTION 2.1: Accreditation		
Company/Institution is accredited to the following: [] SMM/ MS ISO IEC 17025 [] Others (Specify _____)		
Date of last audit		
Pending/ Unresolved non-compliances report (If any)		
SECTION 2.2: Competency of FTIR Analyst		
How many years of experience? (Min: One year)		
Qualification		
Professional Membership		
SECTION 3: FTIR Spectrophotometer		
SECTION 3.1: Description of Benchtop FTIR		
Brand and Model		
ATR Crystal material		
No. of background scans (min 32)		
No. of sample scans (min 32)		
Resolution (4 cm ⁻¹)		
Spectral range (min 4000 – 700 cm ⁻¹)		
SECTION 3.2: Calibration and Maintenance		
Calibrated by [] In-house [] 3 rd -party (Specify _____)		
Last calibration date		
Last Maintenance Record		
SECTION 3.3: Analysis		
Standard operation procedure (SOP)		
SECTION 4: Certified Coating Fingerprint Quality Controller (FPQC)		
Name of FPQC		
IMM membership number		
Certificate of Certified Coating Fingerprint Quality Controller (FPQC)		

Bibliography

- [1] ISO 12944-9:2018, *Paints and varnishes - Corrosion protection of steel structures by protective paint systems -- Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures*)
- [2] ASTM D7588-11(2018), *Standard guide for FTIR fingerprinting of a non-aqueous liquid paint as supplied in the manufacturer's container*
- [3] ASTM D2621-87(2016), *Standard test method for infrared identification of vehicle solids from solvent-reducible paints*
- [4] DEP 30.48.0031-Gen (2009), *Protective coatings for onshore facilities.*
- [5] PTS 15.20.03 (2016), *Protective coatings and linings*
- [6] SP0108-2008-SG, *Corrosion Control of Offshore Structures by Protective Coatings*

Acknowledgements

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