IMM STANDARD

IMM FP01:2020

COATING FINGERPRINTING OVERALL PROCEDURES FOR PAINTS USING FTIR AND OTHER RELATED METHODS

INSTITUTE OF MATERIALS, MALAYSIA

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For further information on this Standard, please contact:

Institute of Materials, Malaysia
Suite 515, Level 5, Block A, Kelana Centre Point,
No. 3, Jalan SS7/19, Kelana Jaya,
47301 Petaling Jaya, Selangor, Malaysia

Tel: +603 7880 1753

https://www.iomm.org.my
Email: secretariat@iomm.org.my

Contents

Contents *(continued)*

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 paints 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 PAINTS USING FTIR AND OTHER RELATED METHODS

1. Scope

This Standard emphasizes the evaluation of manufacturer's paint fingerprint, 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-pack and multi-pack paints 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 Coating Fingerprint Certificate

NOTE. The requirement of coating fingerprinting is stated in various specifications and standards, namely ISO 12944-9:2018, ASTM D7588-11(2018) and ASTM D2621-87. 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. container

an object used for or capable of holding, especially for transport or storage, such as bottle, can, bag, drum and so on.

2.6. correlation

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

2.7. 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.

2.8. material safety data sheet (MSDS)

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

2.9. owner

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

2.10. paint

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

2.11. Reference sample

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

2.12. shall

expressing an instruction, command or a strong assertion.

2.13. should

used to indicate obligation, duty, or correctness.

2.14. technical data sheet (TDS)

document that provides information regarding a specific product.

2.15. 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 m^2 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 to substantiate the accuracy of batch-to-batch production.

NOTE. Routine batch check discloses the distinction between the paint 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 paints. For single-pack, the sample is analyzed directly. For multi-pack paint, each pack is analyzed separately.

4. Sample collection (by paint manufacturer)

For every new paint, three samples are required from the **T**op (1 sample), **M**iddle (1 sample) and **B**ottom (1 sample) (*c.f.* Figure 1) of the mixing tank, respectively. Subsequently, one sample is obtained from the **B**ottom of the mixing tank for each batch of production.

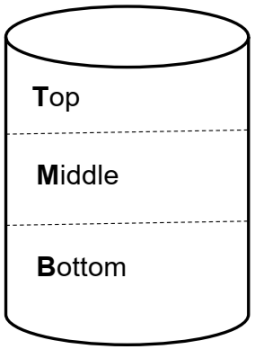


Figure 1. Schematic diagram of sampling locations at **T**op, **M**iddle and **B**ottom of the mixing tank

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 wavenumber 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 **T**op 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 absorbance mode by averaging 32 scans at a maximum resolution of 4 cm^{-1}. Each sample is required to have a minimum of triplicate analyses. 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 region(s) for resin and hardener is as shown in Annex A. For other paints, the range of fingerprint region(s) is/are as per agreed upon with owner.

5.5.1. Reference spectrum

Reference spectrum shall be generated from the average spectra of **T**op, **M**iddle and **B**ottom of the mixing tank (refer Clause 4).

Paint manufacturer shall average a minimum of nine spectra from **T**op, **M**iddle and **B**ottom 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 $r \geq 0.900$, with 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* ≥ 0.900 (with tolerance of ± 0.002) 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

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 laboratories, as given by Equation 1.

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

The Reference spectrum for 3rd-party testing laboratory ($\mathrm{Ref_{3rd-party}}$) is obtained by averaging nine spectra generated from the **T**op (one sample), **M**iddle (one sample) and **B**ottom (one sample) of the mixing tank. The $r_{\mathrm{Ref_{3rd-party}}}$ can be estimated by referencing $\mathrm{Ref_{3rd-party}}$ to $\mathrm{Ref_{in-house}}$, which is submitted by the 3rd-party testing laboratory to paint manufacturer.

The Reference spectrum for in-house ($\mathrm{Ref_{in-house}}$) is obtained by averaging nine spectra generated from the **T**op (one sample), **M**iddle (one sample) and **B**ottom (one sample) of the mixing tank. The $r_{\mathrm{Ref_{in-house}}}$ can be estimated by referencing $\mathrm{Ref_{in-house}}$ to $\mathrm{Ref_{3rd-party}}$, which is carried out in-house by paint manufacturer.

The acceptance criterion for the qualification of Reference sample is r_{Ref} ≥ 0.90 ± 0.01 for the whole FTIR region and fingerprint region(s). 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 **B**ottom of the mixing tank is obtained. The *r* is approximated by referencing the Reference sample to the sample collected from the **B**ottom of the mixing tank for every subsequent batch of the paint production.

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

If the *r* of the sample spectrum is < 0.898 for whole FTIR region and fingerprint region(s) as compared to the Reference spectrum, a verification test using samples from each location (**T**op, **M**iddle and **B**ottom) of the mixing tank is required, prior to rejection of the whole lot of paint.

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 **T**op 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 tolerance of ± 0.002) for whole FTIR region and fingerprint region(s) as compared to the Reference spectrum, then the sample is accepted.

If the *r* of the sample spectrum < 0.898 as compared to the Reference spectrum for whole FTIR region and fingerprint region(s), 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 $r < 0.898$ 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.

6.4. Retained paint sample

The paint manufacturer shall retain one sample from every new paint 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 **B**ottom 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 **B**ottom of the mixing tank. If the *r* of the sample spectrum is ≥ 0.900 (with tolerance of ± 0.002) for whole FTIR region and fingerprint region(s) as compared to the Reference spectrum, then the sample is accepted.

If the *r* of the sample spectrum is < 0.898 for whole FTIR region and fingerprint region(s) as compared to the Reference spectrum, a verification test using samples from each location (**T**op, **M**iddle and **B**ottom) of the mixing tank is required, prior to rejection of the whole lot of paint.

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 with single-pack or multi-pack.

7.1. Physical analyses

Physical analyses are performed by in-house testing laboratory, with parameters including viscosity, density, color 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 type

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 confidentially 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 paint for the qualified paint, 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 spectrophotometer.

8.4. Fabricator, contractor, sub-contractor

The fabricator, contractor or sub-contractor will receive the single-pack or multi-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 should 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 spectrophotometer.

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:	*e.g.* Company ABC	**Country:**	*e.g.* Malaysia
Certificate number:	*e.g.* epoxy/001/02Jan2016	**Date:**	*e.g.* 2 Jan 2016
Number pages:	*e.g.* 05		

Section 1: General information			
Product name:	*e.g.* EPOXY123	**Product type:**	*e.g.* epoxy, polyurethane, polyester, inorganic zinc, epoxy zinc, *etc.*

Date of issue:	**Base material** (*e.g.* epoxy / epoxy zinc / polyacrylate / polyester / inorganic zinc / silicone)	**Curing agent / hardener** (*e.g.* amine / isocyanate / peroxide / ethyl-silicate)
Specify base material & curing agent	*e.g.* epoxy	*e.g.* amine
Trade name	*e.g.* Epikote123	*e.g.* Amine123
Generic	*e.g.* Epoxy	*e.g.* Hardener
Factory location	*e.g.* Shah Alam, Selangor	*e.g.* Shah Alam, Selangor
Batch number	*e.g.* 1234567A	*e.g.* 1234567B
Production date	*e.g.* 02 Jan 2016	*e.g.* 02 Jan 2016
Product technical data sheet number	*e.g.* TDS123A	*e.g.* TDS123B
Material safety data sheet number	*e.g.* MSDS123A	*e.g.* MSDS123B
Shelf life	*e.g.* 24 months	*e.g.* 24 months

Section 2: Test methods and results

Physical analyses

Parameters	**Method**	**Base material**		**Curing agent / hardener**	
		Specification with tolerance	**Test result**	**Specification with tolerance**	**Test result**
Viscosity	*e.g.* ASTM D4287 ASTM D5125 ASTM D562 ISO 2431 ISO 2884-1	*e.g.*….. ± 0.05 P	*e.g.* 3.24. ± 0.02 P	*e.g.*….. ± 0.05 P	*e.g.* 2.78. ± 0.03 P
Density	*e.g.* ISO 2811-4	*e.g.*….. ± 0.05 g cm^{-1}	*e.g.* 1.48 ± 0.03 g cm^{-1}	*e.g.*….. ± 0.05 g cm^{-1}	*e.g.* 0.943 ± 0.02 g cm^{-1}
Color code	*e.g.* BS 4800 RAL Color Standards	*e.g.* color difference (dE) < 1	*e.g.* Light grey	*e.g.* color difference (dE) < 1	*e.g.* clear
Non-volatile matter (by mass)	*e.g.* ISO 3251	*e.g.*….. ± 2 %	*e.g.* 78. ± 2 %	*e.g.*….. ± 2 %	*e.g.* 99. ± 2 %

Weight Solid: Zn metal/Total Zn **Note:** submit certificate of % purity by manufacturer **Note:** applicable to organic zinc paint and inorganic zinc paint only	*e.g.* ISO 14680-2	*e.g.*….. ± 1 %	*e.g.* N/A for epoxy system	*e.g.*….. ± 1 %	*e.g.* N/A for epoxy system
Structural analyses					
Infrared spectra	**Wet sample as supplied in can. Degree of similarity (*r*) ≥ 0.900*** (tolerance = ± 0.002 or range of *r* = 1.000 – 0.898)				
	Method	**Base material**		**Curing agent / hardener**	
Base material: **epoxy** Curing agent: **amine**	IMM FP01	700-4000 cm^{-1}	e.g. 0.988 ± 0.003	700-4000 cm^{-1}	e.g. 0.970 ± 0.005
		900-2000 cm^{-1}	e.g. 0.995 ± 0.002	900-2000 cm^{-1}	e.g. 0.957 ± 0.001
Base material: **polyacrylate / polyester** Curing agent: **isocyanate**	IMM FP01	700-4000 cm^{-1}	e.g. 0.988 ± 0.003	700-4000 cm^{-1}	e.g. 0.970 ± 0.005
		900-2000 cm^{-1}	e.g. 0.995 ± 0.002	900-2000 cm^{-1}	e.g. 0.957 ± 0.001
Base material: **polyester** Curing agent: **peroxide**	IMM FP01	700-4000 cm^{-1}	e.g. 0.988 ± 0.003	700-4000 cm^{-1}	e.g. 0.970 ± 0.005
		900-2000 cm^{-1}	e.g. 0.995 ± 0.002	900-2000 cm^{-1}	e.g. 0.957 ± 0.001
Base material: **epoxy zinc** Curing agent: **amine**	IMM FP01	700-4000 cm^{-1}	e.g. 0.988 ± 0.003	700-4000 cm^{-1}	e.g. 0.970 ± 0.005
		900-2000 cm^{-1}	e.g. 0.995 ± 0.002	900-2000 cm^{-1}	e.g. 0.957 ± 0.001
Base material: **inorganic zinc** Curing agent: **ethyl-silicate**	IMM FP01	700-4000 cm^{-1}	e.g. 0.988 ± 0.003	700-4000 cm^{-1}	e.g. 0.970 ± 0.005
		900-2000 cm^{-1}	e.g. 0.995 ± 0.002	900-2000 cm^{-1}	e.g. 0.957 ± 0.001
Base material: **Silicone-aluminum**	IMM FP01	700-4000 cm^{-1}	e.g. 0.988 ± 0.003	N/A	N/A
		900-2000 cm^{-1}	e.g. 0.995 ± 0.002	N/A	N/A

*average results of triplicate analyses

Section 3: FTIR test details (as per IMM FP01)	
Analyst & company name	*e.g.* Name & Company ABC Sdn Bhd
Brand & model of FTIR	*e.g.* FTIR Brand XYZ & model: 2016
Type of FTIR spectrophotometer	*e.g.* benchtop / mobile / handheld
Benchtop: ATR crystal material	*e.g.* diamond, zinc selenide (ZnSe), germanium (Ge)
Spectral correction (circle) **Note:** correction is NOT recommended.	YES / NO [**Note**: if **YES**, please state the correction(s) made] *e.g.* automatic baseline correction
Spectral range (cm^{-1})	*e.g.* 700 - 4000 cm^{-1}
No. of sample scans (min 32)	*e.g.* 32 scans
No. of background scans (min 32)	*e.g.* 32 scans
Resolution (min 4 cm^{-1})	*e.g.* 4 cm^{-1}
High sensitivity compare algorithm for degree of similarity in absorbance mode	**Note:** Degree of similarity *compare* algorithm of the FTIR software should depend on both ***x***- (wavenumber) and ***y***- (absorbance) vectors. *High sensitivity compare* algorithm, which analyzes the variations *via* summation of the squared differences

	of each variation from the overall mean OR equivalent, should be used.			
	Dependence on BOTH ***x***- and ***y***-vectors (circle)	YES / NO	*High sensitivity compare* algorithm (circle)	YES / NO
Trade name and batch number of Reference spectrum for base material	*e.g.* Epikote123 & 1234567A-Reference			
Trade name and batch number of Reference spectrum for curing agent / hardener	*e.g.* 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:	**Validated by**:
e.g. NAME **Company ABC Sdn Bhd** (123456-X) QC Department	*e.g.* COATING IMM Yoga Sugama Salim FP002 FINGERPRINT QC
Signature: *e.g.* Name	**Signature**: *e.g.* Yoga Salim
Date: *e.g.* 2 Jan 2016	**Date**: *e.g.* 2 Jan 2016
IMM membership member: (optional to be IMM member)	**IMM membership member**: *e.g.* 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 poyester / inorganic filler for any paint

END OF REPORT

Received & checked:

Date: *e.g.* 15 Jan 2016

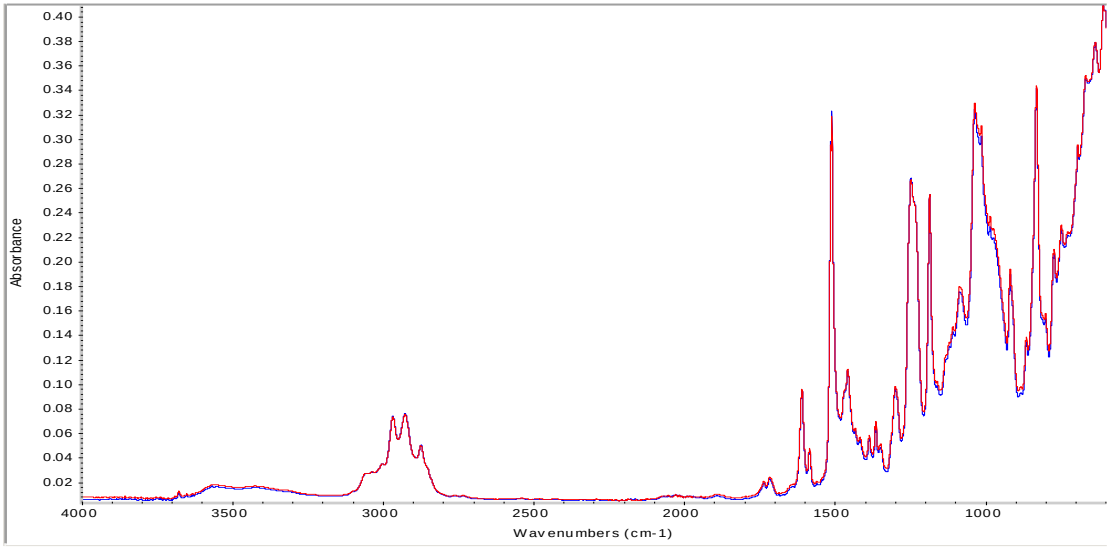
Melissa Chan

Appendix 1 Overlay Reference and sample FTIR spectra for base materials

Reference spectrum – red (generated by averaging the FTIR spectra from **T**op, **M**iddle and **B**ottom 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 **B**ottom of the mixing tank)

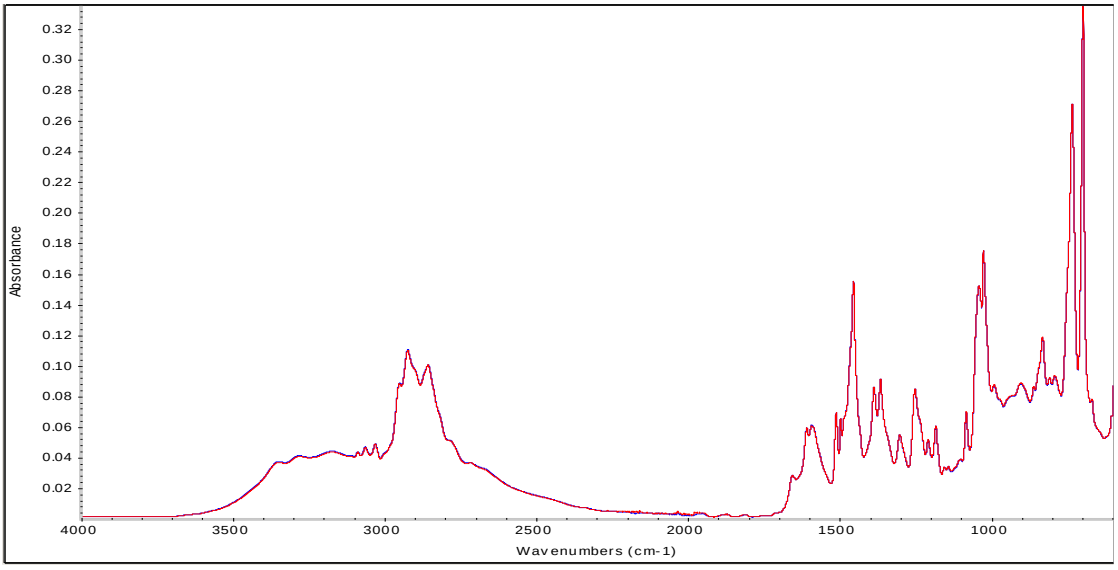
Degree of similarity (*r*) = 0.986



Appendix 2 Overlay Reference and sample FTIR spectra for curing agent / hardener
Reference spectrum – red (generated by averaging the FTIR spectra from **T**op, **M**iddle and **B**ottom 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 **B**ottom of the mixing tank)

Degree of similarity (*r*) = 0.970



Annex B
(informative)

Test Method Assessment of 3rd-Party Testing Laboratory in relation to dispute in Fingerprint Certificate for raw material, paint and dried coating samples

Test Method Assessment of 3rd-Party Testing Laboratory in relation to dispute in Coating Fingerprint Certificate for raw material, paint and dried coating samples 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: [ ] SAMM/ MS ISO IEC 17025 [ ] Others (Specify_____)		
Date of last audit		
Pending/ Unresolved non-compliances report (If any)		
SECTION 2.2: Competency of FTIR Analyst		
Haw 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 [ ] 3rd-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 number		

Bibliography

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[3] ASTM D2621-87(2016), *Standard test method for infrared identification of vehicle solids from solvent-reducible paints*

[4] Shell Global Solutions International B. V. Design and Engineering Practice (Technical Specification) (DEP 30.48.0031-Gen) (2017). *Protective Coatings for Onshore and Offshore Facilities*.

[5] PETRONAS Technical Standards (Technical Specification) (PTS 15.20.03) (2016). *Protective Coatings and Linings*.

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Acknowledgements

Members of Task Force on Coating Fingerprinting

Co-Chairmen	Prof. Ts. Dr. Mohamad Kamal Harun Prof. Ts. Dr. Melissa Chan Chin Han	Universiti Teknologi MARA
Secretary	Suhaila Idayu Abdul Halim	Universiti Teknologi MARA
Treasurer	Nurul Fatahah Asyqin Zainal	Universiti Teknologi MARA
Members	Chow Mee Ling Phuah Shok Chan (Alternate)	Agilent Technologies Sales (M) Sdn Bhd
	Dr. Chew Kong Chin	Becker Industry Coatings (M) Sdn Bhd
	Renee Teo Yong Yin	Bruker (M) Sdn Bhd
	Dr. Mahmood Anwar	Curtin University, Sawarak
	Selvandran Vello Paramjit Singh Darjit Singh (Alternate)	Hempel (M) Sdn Bhd
	Ahmad Badli Shah Abdul Aziz Mokhtar Othman (Alternate)	International Paint Sdn Bhd
	Lee Choon Siong Quah Kean Gin (Alternate) Teh Tiong Poh (Alternate)	Jotun (M) Sdn Bhd
	Chang Yau Chong	Kansai Asia Pacific Sdn Bhd
	Ismaliza Ismail	Malaysian Rubber Board
	Kelly Hong Mun Key	Nexus Analytics Sdn Bhd
	Ir. Max Ong Chong Hup Prema Latha Suppiah	Norimax Sdn Bhd
	Kenneth Way Elson Wah Eng Keong (Alternate)	Perkin Elmer (M) Sdn Bhd
	Muhammad Hawari Hasan Nurul Asni Mohamed	PETRONAS Group Technical Solution
	Terence Wee Tee Hin Mohd Wahidduzzaman Zainal (Alternate)	PPG-Sigma Coatings (M) Sdn Bhd
	Mohammad Ariff Sukur Leow Chun Ho (Alternate)	Sarawak Shell Bhd
	Lim Chuan Gee	SIRIM Bhd
	Abdul Aziz Haron Ir. Zarina Rasmin	SIRIM QAS International Sdn Bhd
	Assoc. Prof. Dr. Lim Teck Hock Ts. Dr. Chew Khoon Hee	Tunku Abdul Rahman University College
	Asst. Prof. Dr. Yu Lih Jiun	UCSI University
	Mark Hew Yoon Onn	Universal Corrosion Engineering (M) Sdn Bhd
	Hairunnisa Ramli	Universiti Teknologi MARA
Secretariat Coordinators	Noorul Shafika Misbah Aberamy Dayalam	Institute of Materials, Malaysia