Tightening of the Volatile Organic Compound Content Limits of Regulated Architectural Paints

PURPOSE

This consultation paper sets out a proposal to tighten the volatile organic compound (VOC) content limits of 22 types of architectural paints being regulated under the Air Pollution Control (Volatile Organic Compounds) Regulation (Cap. 311W) (the VOCs Regulation).

BACKGROUND

2. VOCs are organic chemicals that would evaporate at room temperature and could contribute to the formation of ozone under photochemical reactions. The ambient concentrations of major air pollutants have dropped significantly in recent years, except that of ozone which has exhibited an increasing trend[1]. As VOCs are one of the key precursors to the formation of ozone, reducing the VOC emissions at sources is a critical measure to tackle the worsening ozone pollution in Hong Kong and the region.

3. The ozone pollution also affects the Pearl River Delta region. The Governments of the Hong Kong SAR and Guangdong Province are committed to improving regional air quality and have jointly set emission reduction targets for major air pollutants, including VOCs[2]. In addition, Hong Kong, Guangdong and Macao authorities have collaboratively launched a joint study on the characterisation of ozone formation and regional transportation in the Greater Bay Area, with a view to tackling the regional ozone pollution in a comprehensive manner.

MEASURES TARGETING LOCAL VOC EMISSIONS

4. In Hong Kong, the top VOC emission source is the consumption of VOC-containing products, followed by road transport and marine vessels[3]. The Government has been adopting a multi-pronged strategy to reduce local VOC emissions from these

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[1] Compared with 1999, the ambient concentration of respirable suspended particulates, fine suspended particulates, nitrogen dioxide and sulphur dioxide dropped by 48%, 55%, 42% and 72% respectively in 2020. However, ozone showed an increase in concentration by 53% in the same period.

[2] A set of emission reduction targets has been set for 2015 and 2020 covering four major air pollutants, namely sulphur dioxide, nitrogen oxides, respirable suspended particulates and VOCs. Taking 2010 as the base year, the VOC targets in Hong Kong for 2015 and 2020 were set as 5% and 15% respectively.

[3] In 2019, the consumption of VOC-containing products, road transport and marine vessels accounted for 49%, 23% and 12% of the total VOC emissions respectively.

sources. For instance, the emission standard of petrol motorcycles, which emit a significant amount of VOCs amongst other types of vehicles, has been tightened to Euro 4 since October 2020. An Euro 4 petrol motorcycle emits about 50% less VOCs than its Euro 3 counterpart.

5. The VOCs Regulation[4] was enacted in 2007 to prohibit in phases the import and local manufacture of specified VOC-containing products such as paints, consumer products, printing inks, adhesives and sealants, etc. if their VOC content exceed the relevant statutory content limits. The Regulation was amended in 2009 and 2017 to extend the control to cover more products. There are currently 172 types of VOC-containing products being regulated under the Regulation, including 51 types of architectural paints.

6. The VOC emissions in Hong Kong have been steadily reducing due to the continuous implementation of air pollutant emission reduction measures. The total VOC emissions have reduced by 50% from 42 500 tonnes in 2006 to 21 130 tonnes in 2019[5]. As regards the VOC emissions from products, they have reduced by 62% to 10 350 tonnes in 2019 since the implementation of the Regulation. Of which, emissions from architectural paints accounted for about 2 210 tonnes. To further improve air quality, the Clean Air Plan for Hong Kong 2035[6] has set out that the Government would further tighten the VOC content limits of architectural paints before 2024.

PROPOSED TIGHTENING OF THE VOC CONTENT LIMITS OF REGULATED ARCHITECTURAL PAINTS

7. The prevailing VOC content limits of 51 types of regulated architectural paints (RAPs) covered under the VOCs Regulation were set based on the relevant limits set out by the California Air Resource Board[7] (CARB) and the South Coast Air Quality Management District[8] (SCAQMD) of the United States of America which cover control limits for a wide range of architectural products and are considered as one of the most comprehensive and stringent control on paint products worldwide. The CARB limits are the California state's suggested standards generally adopted by California districts,

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[4] Reference about the VOCs Regulation can be found at the following website: http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/voc_reg.html

[5] The figures are based on the 2019 Hong Kong Air Pollutant Emission Inventory Report published in August 2021.

[6] The Clean Air Plan for Hong Kong 2035 can be found at the following website: https://www.enb.gov.hk/sites/default/files/pdf/Clean_Air_Plan_2035_eng.pdf

[7] The VOC content limits of architectural paints set out by the CARB can be found at: https://ww2.arb.ca.gov/sites/default/files/2020-07/2020SCM_final.pdf

[8] The latest VOC content limits of architectural paints adopted in the SCAQMD can be found at: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1113.pdf?sfvrsn=24

while the content limits adopted in the SCAQMD are the most stringent ones amongst California districts. SCAQMD has continuously reviewed and updated the VOC content limits of architectural paints. Amongst the 51 RAPs, the content limits of 23 RAPs are already on par with the latest SCAQMD limits (See **Annex 1**). For the remaining 28 RAPs, the annual sales data submitted by paint importers revealed that the VOC content of many products were much lower than the statutory content limits and some could even comply with the latest SCAQMD limits. Therefore, there is room for tightening the VOC content limits of these 28 RAPs.

8. In 2017-2019, we conducted an assessment on the feasibility and scope to tighten the VOC content limits of the 28 RAPs mentioned above, and consulted relevant stakeholders, including paint suppliers, Hong Kong Institute of Construction (HKIC), Hong Kong Architectural Coating Association, Hong Kong Concrete Repair and Waterproofing Association, and government works departments to collect their views. In the assessment, we have also studied whether the VOC content limit of each of the 28 RAPs could be tightened according to the limits, in the order of preference: (i) the SCAQMD limits; (ii) the CARB limits and (iii) other practicable limits. The findings of the assessment are summarised in paragraphs 9 to 14 below:

(a) *RAPs of which the VOC content limits are proposed to be tightened to the SCAQMD limits*

9. VOC content limits of 15 RAPs out of the 28 RAPs that are proposed to be tightened to meet the SCAQMD limits are set out in **Annex 2**. Provisions will be also made for some of the RAPs to have higher VOC content for specific applications under certain conditions. Specifically, concrete-curing compounds (Regulated Product Code[9] P08-06) and waterproofing concrete or masonry sealers (P08-24) used in specific applications such as concrete structures in road and bridge works requiring high durability, and applications subject to severe environmental conditions (e.g. immersion in water, wastewater or chemical solutions) can retain a higher VOC content limit as the prevailing one, as suggested by paint suppliers and government works departments. Similarly, primers, sealers and undercoaters (P10-11) and quick-dry primers, sealers and undercoaters (P10-13) with higher VOC content are allowed for use in outdoor applications to withstand severe weather conditions. Similar provisions are also provided in the SCAQMD to allow the use of high VOC paints in specific applications in order to ensure that the paints could meet certain technical requirements.

[9] A regulated product code is assigned for each type of regulated paints. Relevant details can be found at the following website: https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/prob_solutions/files/EPD_311R_GNE_v8.pdf

10. Stakeholders consulted were in general supportive to tightening the VOC content limits for these 15 RAPs as many paint products in compliance with the SCAQMD limits[10] are readily available on the local market.

(b) *RAPs of which the VOC content limits are proposed to be tightened to the CARB limits*

11. VOC content limits of other three RAPs that are proposed to be tightened to the CARB limits are set out in **Annex 3**. Further tightening the content limits of these RAPs to the SCAQMD limits would not be feasible, as the local sales data revealed that the number of paint products that can comply with the SCAQMD limits is limited[11]. To ensure that there is an adequate supply of compliant products on the local market[12], VOC content limits of these RAPs could only be tightened to the CARB limits, and this was generally accepted by paint suppliers. In fact, except the SCAQMD, California districts are generally adopting the CARB limits for these paints.

(c) *RAPs of which the VOC content limits are proposed to be tightened to other best practicable limits*

12. For the other four RAPs listed in Table 1 below, the trade expressed that the required performance would be impaired if only low VOC paints meeting the SCAQMD or CARB limits are allowed to be used. With a view to exploring the feasibility of tightening the VOC content limits, we commissioned HKIC and an accredited laboratory to assess the performance of the four RAPs with different VOC content.

Table 1 – VOC content limits of four RAPs with performance concern

RAP	**Prevailing limit (g/L)**	**SCAQMD limit / CARB limit (g/L)**	**Test on functional performance**
Roof coatings (non-exposed) (P08-17)	250	50 / 50	Waterproofing function
Clear lacquers^ i) Clear brushing lacquers (P08-04)	650	275 / 275	Gloss level and protection from scratches

[10] Based on the sales data in 2014-2019, except for recycled coatings (P08-15) which is seldom used in Hong Kong, over 52% of the available products of the 14 RAPs were in compliance with the SCAQMD limits.
[11] Based on the sales data in 2014-2019, only 21-41% of the available products of the three RAPs were in compliance with the SCAQMD limits.
[12] 52-58% of the available products of the three RAPs were in compliance with the CARB limits.

ii) Clear wood finishes (lacquers) (P10-01)	550	275 / 275	
Rust preventative coatings (P10-14)	400	100 / 250	Resistance to rusting

^ "Clear brushing lacquers" and "clear wood finishes (lacquers)" are very similar in nature and have similar applications. They are collectively categorised as "lacquers" in the SCAQMD. Hence, they were collectively considered as "clear lacquers" in the assessments.

13. For non-exposed roof coatings (P08-17), the assessment indicated that the low VOC paint samples could meet the basic waterproofing performance requirement. Having considered the need for the coatings to withstand additional loading of building materials, landscaping facilities, and motor vehicles, etc. in real applications (e.g. for applications on podium), it is proposed to tighten the VOC content limit of the coatings to a best practicable limit that paint suppliers considered the paint performance can still be maintained. As to clear lacquers (P08-04 and P10-01) and rust preventative coatings (P10-14), having regard to the unsatisfactory aesthetic and rust preventative performance of the respective low VOC paint samples, it is also proposed to tighten the VOC content limits to the best practicable limits for these paints. Details of the assessments and findings are set out in **Annex 4**.

(d) *RAPs of which the VOC content limits are proposed to remain unchanged*

14. The remaining six RAPs listed in **Annex 5** are widely used in severe environmental conditions or outdoor environments to provide protective coatings against corrosion, ultraviolet or abrasion. Paint suppliers advised that lowering the VOC content of these types of paints may adversely affect their protective performance in applications requiring high durability and hence not able to comply with technical requirements of works contracts. Meanwhile, except for the SCAQMD, other California districts are adopting the same or even less stringent VOC content limits[13] as our prevailing limits. While a few paint products that can comply with the SCAQMD limits were available in the market, they were not widely adopted by the trade. Against the above, the VOC content limits of these six RAPs will remain unchanged.

THE PROPOSAL

15. To summarise, among the 28 RAPs being assessed, the VOC content limits of 22 RAPs are proposed to be tightened as follows: -

[13] For superior durability solvent-borne coatings for metal, there is no such paint type in SCAQMD and CARB.

i. limits of 15 RAPs to be tightened to meet the SCAQMD limits (see paragraph 9 to 10);

ii. limits of three RAPs to be tightened to meet the CARB limits (see paragraph 11); and

iii. limits of four RAPs to be tightened to best practicable limits as revealed by the study (see paragraphs 12 to 13);

while the limits of the remaining 6 RAPs will remain unchanged.

16. The proposed new VOC content limits of the 22 RAPs are set out in the table below. To allow time for the trade to prepare for the necessary reformulation and testing of paints to meet the new limits, we propose that the new limits take effect from 1 January 2023.

Item	**RAP (Regulated Product Code)**	**Current VOC Content Limit (g/L)**	**Proposed New VOC Content Limit^ (g/L)**
I) VOC limits to be tightened to the SCAQMD limits			
1	Aluminium roof coatings (P08-01)	250	100
2	Concrete-curing compounds (P08-06)	350	100 (350** for road and bridge works / in severe conditions)
3	Dry-fog coatings (P08-07)	400	50
4	Fire-proofing exterior coatings (P08-08)	350	150
5	Mastic coatings (P08-12)	300	100
6	Other architectural coatings (P08-13)	250	50
7	Recycled coatings (P08-15)	250	150

Item	RAP (Regulated Product Code)	Current VOC Content Limit (g/L)	Proposed New VOC Content Limit^ (g/L)
8	Specialty primers (P08-20)	350	100
9	Waterproofing concrete or masonry sealers (P08-24)	400	100 (400** for road and bridge works / in severe conditions)
10	Fire-retardant coatings (clear) (P09-01)	650	150
11	Fire-retardant coatings (pigmented) (P10-04)	350	150
12	Primers, sealers and undercoaters (P10-11)	200	100 (200## for outdoor applications)
13	Quick-dry primers, sealers and undercoaters (P10-13)	200	100 (200## for outdoor applications)
14	Traffic coatings (P10-16)	150	100
15	Waterproofing sealers (P10-17)	250	100
II)	VOC limits to be tightened to the CARB limits		
16	Non-flat coatings (P09-06)	150	100
17	Floor coatings (P10-05)	250	100
18	Quick-dry enamels (P10-12)	250	100
III)	VOC limits to be tightened to best practicable limits		
19	Clear brushing lacquers (P08-04)	650	400
20	Roof coatings (non-exposed) (P08-17)	250	150

Item	RAP (Regulated Product Code)	Current VOC Content Limit (g/L)	Proposed New VOC Content Limit^ (g/L)
21	Clear wood finishes (lacquers) (P10-01)	550	400
22	Rust preventative coatings (P10-14)	400	350

Notes:

^ The VOC content in a ready-to-use condition shall be determined by USEPA Method 24 and SCAQMD Method 303 and using the equations set out in Schedule 1 – Part 5 of the VOCs Regulation.

** Similar to relevant provisions in the SCAQMD, the prevailing VOC content limit is maintained for road and bridge works requiring high durability and applications in extreme environmental conditions (e.g. immersion in water, wastewater or chemical solutions).

The prevailing VOC content limit is maintained for outdoor applications.

17. According to the sales data of the 22 RAPs of which the VOC content limits are proposed to be tightened, about 750 compliant products are available on the local market which accounts for over half of the market share generally[14]. The extensive use of a variety of low VOC paints in the market suggested that there should not be significant technical and cost implications in their applications.

OTHER CONTROL REQUIREMENTS

18. The following provisions in the VOCs Regulation for the control of architectural paints will remain unchanged:

(i) requirements for importers and local manufacturers to display relevant product information in the product's material safety data sheet, trade catalogue, packaging or container;
(ii) submission of product notification prior to sale or use in Hong Kong;
(iii) reporting and keeping of sales information;
(iv) exemption from control;
(v) determination of VOC content; and

[14] Based on the sales data of the 22 RAPs in 2014-2019, products compliant to the new, tightened limits in 19 RAPs occupied about 51% to 100% of the market share. Products, compliant to the new, tightened limits, in two other RAPs (namely clear wood finishes (lacquers) and rust preventative coatings) took up a market share of 45% and 28% respectively. Recycled coatings are seldom used in Hong Kong.

(vi) offences and penalties.

VOC REDUCTION

19. In 2019, about 2 210 tonnes of VOCs were emitted from the consumption of architectural paints. It is estimated that the implementation of the proposal could reduce about 540 tonnes of the VOC emissions annually.

WAY FORWARD

20. After the consultation, we shall finalise the proposal and consult the Advisory Council on the Environment and the Panel on Environmental Affairs of the Legislative Council.

VIEWS SOUGHT

21. Please send us your views on the proposal on or before **28 February 2022** by mail/electronic mail/facsimile to the following:

Environmental Protection Department
33/F, Revenue Tower
5 Gloucester Road
Wan Chai, Hong Kong
(Attn.: VOC Consultation - Architectural Paints)

E-mail address: VOCConsult@epd.gov.hk

Facsimile: 2827 8040

22. Please note that the Government may, either in discussion with others or in any subsequent report, whether privately or publicly, refer to and attribute views submitted in response to this consultation document. Any request to treat all or part of a response in confidence will be respected, but if no such request is made, it will be assumed that the response is not intended to be confidential.

Environmental Protection Department
December 2021

Annex 1

23 types of regulated architectural paints of which the prevailing VOC content limits are <u>on par with the SCAQMD limits</u>

Regulated Product Code	Regulated Architectural Paint	Prevailing VOC Content Limit, g/L
P08-02	Below-ground wood preservatives	350
P08-03	Bond breakers	350
P08-05	Clear wood finishes (sanding sealers)	150
P08-10	Interior stains	250
P08-11	Magnesite cement coatings	450
P08-14	Pigmented lacquers	275
P08-16	Roof coatings (exposed)	50
P08-18	Shellacs (clear)	730
P08-19	Shellacs (pigmented)	550
P08-21	Stains	100
P08-22	Swimming pool repair coatings	340
P08-23	Swimming pool coatings (other)	340
P08-25	Wood preservatives (other)	350
P09-02	Flat coatings	50
P09-03	Granite look-a-like coatings or textured undercoaters	100
P09-04	Japans or faux finishing coatings	350
P09-05	Multi-colour coatings	250
P09-07	Roof primers (bituminous)	350
P10-02	Clear wood finishes (varnishes)	150
P10-06	High-temperature industrial maintenance coatings	420
P10-09	Pre-treatment coatings for metal	420
P10-10	Pre-treatment wash primers	420
P10-19	Low-solids coatings	120 g/L of material

Annex 2

15 types of regulated architectural paints of which the VOC content limits are proposed to be tightened to the SCAQMD limits

Regulated Product Code	Regulated Architectural Paint	Prevailing VOC Content Limit, g/L	Proposed New VOC Content Limit, g/L
P08-01	Aluminium roof coatings	250	100
P08-06	Concrete-curing compounds	350	100 (350 for road and bridge works / in severe conditions)
P08-07	Dry-fog coatings	400	50
P08-08	Fire-proofing exterior coatings	350	150
P08-12	Mastic coatings	300	100
P08-13	Other architectural coatings	250	50
P08-15	Recycled coatings	250	150
P08-20	Specialty primers	350	100
P08-24	Waterproofing concrete or masonry sealers	400	100 (400 for road and bridge works / in severe conditions)
P09-01	Fire-retardant coatings (clear)	650	150
P10-04	Fire-retardant coatings (pigmented)	350	150
P10-11	Primers, sealers and undercoaters	200	100 (200 for outdoor applications)
P10-13	Quick-dry primers, sealers and undercoaters	200	100 (200 for outdoor applications)
P10-16	Traffic coatings	150	100
P10-17	Waterproofing sealers	250	100

Annex 3

Three types of regulated architectural paints of which the VOC content limits are proposed to be tightened to the CARB limits

Regulated Product Code	Regulated Architectural Paint	Prevailing VOC Content Limit, g/L	Proposed New VOC Content Limit, g/L
P09-06	Non-flat coatings	150	100#
P10-05	Floor coatings	250	100#
P10-12	Quick-dry enamels	250	100#

Notes:

The proposed VOC content limits are commonly adopted in California districts. The corresponding VOC content limits in the SCAQMD are 50 g/L.

Annex 4

Summary of assessments on performance of four types of regulated architectural paints

In 2017-2019, the Environmental Protection Department (EPD) in collaboration with the paint suppliers, professional institution, trade association and government works departments conducted an assessment on the feasibility and extent to tighten the VOC content limits of 28 regulated architectural paints (RAPs) which are not on par with the latest SCAQMD limits.

2. Amongst the 28 RAPs, paint suppliers expressed that the required performance of four RAPs (set out in the table below) would be impaired if only low VOC paints meeting the SCAQMD/CARB limits are allowed to be used.

RAP	Prevailing limit (g/L)	SCAQMD limit / CARB limit (g/L)
Roof coatings (non-exposed) (P08-17)	250	50 / 50
Clear brushing lacquers^ (P08-04)	650	275 / 275
Clear wood finishes (lacquers)^ (P10-01)	550	
Rust preventative coatings (P10-14)	400	100 / 250

^ "Clear brushing lacquers (P08-04)" and "clear wood finishes (lacquers) (P10-01)" are very similar in nature and have similar applications. They are collectively categorised as "lacquers" in the SCAQMD. Hence, they were collectively considered as "clear lacquers" in the assessments.

3. In collaboration with paint suppliers, performance tests were conducted on the above four RAPs with different VOC content to assess the performance with respect to their decorative and protective functions. For each RAP, a readily available product that can comply with the SCAQMD limit (i.e. low VOC paint) and another product with a less stringent limit which has similar primary ingredients and application

characteristics (i.e. high VOC paint) were selected to assess their performance with details as follows:

(I) Assessment on decorative performance

- The Hong Kong Institute of Construction (HKIC) was commissioned to conduct assessments on finished coatings with low and high VOC paints respectively and provide expert views on the craftsmanship of paint application and aesthetic appearance of finished coatings.

(II) Assessment on protective performance

- Having considered the specific property of each paint type, suitable performance tests were identified to assess the technical performance of low and high VOC coatings. The performance test methods were commonly adopted in the paint industry and agreed by paint suppliers beforehand. The test methods were briefly summarised at below.

RAP	Performance test method
Roof coatings (non-exposed) (P08-17)	The waterproofing function of roof coatings was assessed by a water permeability test (DIN 1048-5:1991). Paints were applied on the surface of the concrete slabs and the coated surface was then exerted with a water pressure of 0.5N/mm^2 for a period of three days. The slab was then split into halves to assess the depth of water penetration to the substrate.
Clear lacquers [Clear brushing lacquers (P08-04) and Clear wood finishes (lacquers) (P10-01)]	A cross-cut test (GB/T 9286) was adopted to assess the coating performance in protecting from scratches. Lacquers were painted on wooden panels in accordance with the manufacturer's specifications. Incisions were made with a cutter to the coated surface in a lattice pattern. Adhesive tapes were applied to cover the cut area and then removed vigorously. Observations on any detached coating were recorded.
Rust preventative coatings (P10-14)	To evaluate the coating performance in resisting rusting, a salt spray test (ISO 7253) was adopted.

	Paints were applied on metal panels in accordance with the manufacturer's specifications. A scratch was made on the coated surface to trigger rusting. The samples were then put inside a controlled chamber with the spraying of a salt solution for 20 days. The rusting degradation of the sample was assessed after the completion of the spraying.

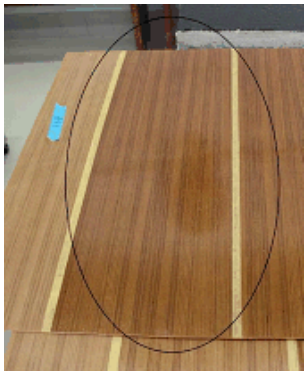
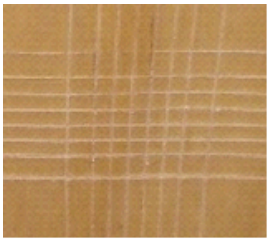
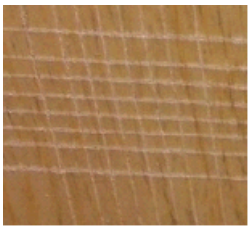
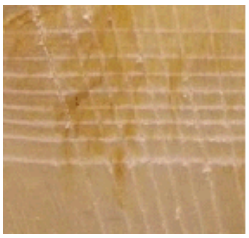
- As humidity is a crucial factor of coating formation during the curing process, the performance tests were carried out with duplicate samples prepared under two different humidity conditions (i.e. 65% and 90% relative humidity), having regard to the weather conditions in Hong Kong. For each test, at least four consistent data were obtained to ensure the validity of findings.

4. Major suppliers of each paint type were invited to attend demonstrations on performance tests and paint applications on 1 and 22 August 2019 respectively. The demonstration on paint applications were conducted by representatives of the HKIC at the HKIC's campus (Kwai Chung). The assessment results indicated that in general, low VOC paints were less viscous, easier to apply and dried faster than high VOC paints. The finished coatings of low VOC paints had lower gloss level and lower covering capability. EPD also commissioned the Hong Kong Productivity Council (HKPC) to conduct a review on the findings and provide recommendations on the assessments. The findings and recommendations were given as follows:

4.1 Clear lacquers (P08-04 and P10-01)

4.1.1 The findings on paint applications and performance tests of high and low VOC paints were summarised in the table below:

Clear lacquers	**High VOC paint**	**Low VOC paint**
Viscosity	Higher	Lower
Craftsmanship	Common paint brush is acceptable.	Softer brush is required to avoid imprint.
Work duration (single layer)	About the same	About the same
Curing time	Longer	Shorter
Covering capability	Higher	Lower

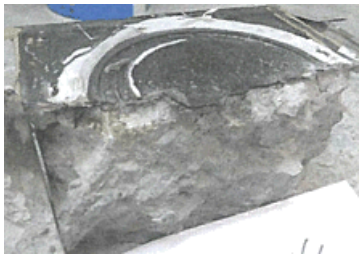
<table>
<tr><td>Aesthetic appearance</td><td>- Glossy
- Less obvious paint imprint was observed
  </td><td>- Matt
- Obvious paint imprint was observed
  </td></tr>
<tr><td>Cross cut test results (Curing condition: 65% relative humidity)</td><td colspan="2">For both high and low VOC paint samples, the edges of the cuts were completely smooth and none of the coatings detached.
  
High VOC paint sample Low VOC paint sample</td></tr>
<tr><td>Cross cut test results (Curing condition: 90% relative humidity)</td><td colspan="2">For both high and low VOC paint samples, the edges of the cuts were completely smooth and none of the coatings detached.
  
High VOC paint sample Low VOC paint sample</td></tr>
</table>

4.1.2 The results of the cross-cut tests revealed that samples using either low or high VOC paints and prepared under different curing conditions had similar performance. Low VOC paints could not achieve similar gloss level as the conventional high VOC paints. In addition, the low VOC paint samples had more obvious imprint after curing. The aesthetic appearance may not be acceptable to clients requiring a smooth and glossy finish. The low VOC paints were inferior from a decorative perspective. Given the unsatisfactory decorative performance of low VOC paints as revealed from the assessments, it is proposed to tighten the VOC content limit of clear lacquers to a less

stringent limit of 400 g/L, which is the best practicable limit that paints suppliers considered the performance of the paint can still be maintained.

4.2 Roof coatings (non-exposed) (P08-17)

4.2.1 The findings on paint applications and performance tests of high and low VOC paints were summarised in the table below:

Non-exposed roof coatings	**High VOC paint**	**Low VOC paint**
Viscosity	Higher	Lower
Craftsmanship	Common paint brush is acceptable.	Common paint brush is acceptable.
Work duration (single layer)	About the same	About the same
Curing time	Longer	Shorter
Covering capability	Higher	Lower
Aesthetic appearance	Glossy 	Matt 
Water permeability test results (Curing condition: 65% relative humidity)	For both high and low VOC paint samples, no sample was found with water penetration through the concrete substrate.  High VOC paint sample  Low VOC paint sample	
Water permeability test results (Curing condition: 90% relative humidity)	For both high and low VOC paint samples, no sample was found with water penetration through the concrete substrate.	

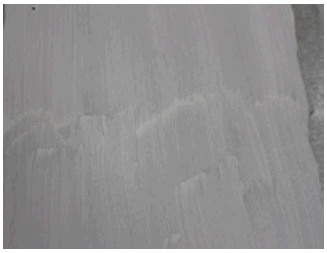
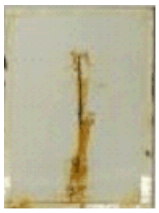
	 High VOC paint sample	 Low VOC paint sample

4.2.2 The water permeability test revealed that there was no water penetration through the concrete substrates coated with either the low or high VOC paints. There was not any deviation in performance in the samples prepared under different curing conditions. Considering that non-exposed roof coatings will need to withstand additional loading of building materials, landscaping facilities, and motor vehicles, etc. in real applications (e.g. for application on podium) and the water permeability test could not take into account these factors, it is proposed to tighten the VOC content limit of non-exposed roof coatings to a less stringent limit of 150 g/L, which is the best practicable limit that paint suppliers considered the performance of the paint can still be maintained.

4.3 Rust preventative coatings (P10-14)

4.3.1 The findings on paint applications and performance tests of high and low VOC paints were summarised in the table below:

Rust preventative coatings	**High VOC paint**	**Low VOC paint**
Viscosity	Higher	Lower
Craftsmanship	Common paint brush is acceptable.	Softer brush is required to avoid imprint.
Work duration (single layer)	About the same	About the same
Curing time	Longer	Shorter
Covering capability	Higher	Lower
Aesthetic appearance	Glossy	Matt

<table>
<tr><td></td><td>  </td><td>  </td></tr>
<tr><td>Salt spray test results
(Curing condition:
65% relative humidity)</td><td colspan="2">For high VOC paint samples, slight rusting corresponded to 0.5% of the sample area was found after 20-day salt spraying.
For low VOC paint samples, extensive rusting corresponded to 40-50% of the sample area was found after 20-day salt spraying.
  
High VOC paint sample Low VOC paint sample</td></tr>
<tr><td>Salt spray test results
(Curing condition:
90% relative humidity)</td><td colspan="2">For high VOC paint samples, slight rusting corresponded to 1% of the sample area was found after 20-day salt spraying.
For low VOC paint samples, extensive rusting corresponded to 40-50% of the sample area was found after 20-day salt spraying.
  
High VOC paint sample Low VOC paint sample</td></tr>
</table>

4.3.2 The samples coated with low VOC paint rusted earlier and the extent of rusting was more severe than that of the samples with high VOC paint. Samples prepared under different curing conditions had similar results. The test results indicated that the rust preventative performance of the low VOC paint was inferior to that of the high VOC paint. Given the unsatisfactory rust preventative performance of low VOC paints as revealed from the assessments, it is proposed to tighten the VOC content limit of rust preventative coatings to a less stringent limit of 350 g/L, which is the best practicable limit that paint suppliers considered the performance of the paint can still be maintained.

Annex 5

Six types of regulated architectural paints of which the VOC content limits remain unchanged

Regulated Product Code	Regulated Architectural Paint	Prevailing VOC Content Limit, g/L
P08-09	Graphic arts (sign) coatings	500
P10-03	Extreme high-gloss coatings for metal	420
P10-07	Industrial maintenance coatings	250
P10-08	Metallic pigmented coatings	500
P10-15	Superior durability solvent-borne coatings for metal	420
P10-18	Zinc-rich industrial maintenance primers	250