# SPECIFICATION AP-S0168

## SILANE BASED WATER REPELLENTS FOR CONCRETE AND MASONRY

## 1 SCOPE

This specification applies to clear low molecular weight penetrating silane/siloxane water repellent, intended to inhibit water uptake into concrete and masonry but not to significantly impede water vapour migration.

## 2 BACKGROUND

a) To obtain a broad overview of the Australian Paint Approval Scheme (APAS), refer to APAS document AP-D001.
b) To obtain an overview of restricted ingredients in APAS certified products, refer to APAS document AP-D123.
c) To obtain the current list of APAS participating manufacturers (and suppliers) and resellers, refer to APAS document AP-D152.
d) To obtain an overview of how to participate in the APAS, refer to APAS document AP-D177.
e) APAS approval to this specification may be gained by compliance with the requirements detailed in this specification and those in APAS document AP-D192.

## 3 DESCRIPTION AND GUIDE FOR USERS

### 3.1 General Requirements

a) This specification provides for four grades of clear low molecular weight penetrating silane/siloxane water repellent, intended to inhibit water uptake into concrete and masonry but not to significantly impede water vapour migration.
b) Within sub-classes AP-S0168/2 and AP-S0168/3, suppliers may offer a range of dilutions of the active ingredient and purchasers are advised to be aware of clause 8 Appendix B and clause 16, Table 3 below in particular. Refer to see clause 6.3 below for important health and safety issues related to these products.
c) These products should not be confused with silicone coatings (covered under APAS specification AP-S0116) which essentially provide a surface coating.
d) These coatings are intended to increase the long-term repellence to water ingress of concrete and masonry surfaces, particularly in order to inhibit the corrosion of steel reinforcement. Usually applied to clean, lightly abrasive blasted concrete surfaces, refer to clause 15, Table 2.
e) Sub-class AP-S0168/3 products should not be considered for critical situations as definitive performance criteria have not been defined.
f) Use of silanes over still waters may result in a thin slick on the surface of the water, resembling spilt fuel. Absorbent booms can sometimes be used to combat this. In choppy or fast-moving waters, this effect is less likely to be noticeable or to be a concern. The triethoxy products are less prone to slick formation.

### 3.2 Sub-Classes

a) This specification incorporates the following sub-classes

i. **0168/1:** Solvent-free silane with >95% active silane
ii. **0168/2:** Silane solution in organic solvent with >20% active silane
iii. **0168/3:** Siloxane solution in organic solvent with 6-20% siloxane
iv. **0168/4:** Silane cream at >75% active silane in water

### 3.3 Basis of this Specification

a) This specification is not based on any known standard or specification.
b) Paints approved under this specification are not described in either AS/NZS 2311 or AS/NZS 2312.

## 4 REFERENCED DOCUMENTS

a) The following standards are referenced in this document:

i. **AS 1012.2** – Methods of testing concrete – Preparing concrete mixes in the laboratory
ii. **AS 1012.8.1** – Methods of testing concrete – Method for making and curing concrete – Compression and indirect tensile test specimens
iii. **AS 1012.9** – Methods of testing concrete – Compressive strength tests – Concrete, mortar and grout specimens
**AS 1012.12.2** – Methods of testing concrete – Determination of mass per unit volume of hardened concrete – Water displacement method
iv. **AS 1012.20** – Methods of testing concrete – Determination of chloride and sulphate in hardened concrete and concrete aggregates
v. **AS/NZS 1580** – Paints and related materials: Methods of test
vi. **AS/NZS 2311** – Guide to the painting of buildings
vii. **AS/NZS 2312** – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
viii. **BS 1881-124** – Testing concrete. Methods for analysis of hardened concrete

These documents may be purchased through the Reference Standards Australia website: https://www.standards.org.au/

ix. **The Poisons Standard June 2021**: Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) No. 33, Part 2: Control on Medicines and Poisons, Section Seven / Appendix I Paint or Tinters

This document is available from the Australian Government Federal Register of Legislation web site at: https://www.legislation.gov.au/Details/F2021L00650

b) The following APAS documents are referenced in this document:

i. AP-D001 Rules Governing How APAS® Operates
ii. AP-D123 Restrictions on Ingredients in Product Formulations
iii. AP-D152 APAS® Participating Manufacturers and Resellers
iv. AP-D177 Rules Governing How Product Manufacturers participate in APAS®

v. AP-D181 Volatile Organic Compounds (VOC) Limits
vi. AP-D192 Rules Governing APAS® Product Certification Scheme

All APAS documents are available for download from the APAS website: https://vs.csiro.au/apas/documents/

## 5 COMPOSITIONAL REQUIREMENTS

### 5.1 Binder

a) **0168/1:** Products shall consist of undiluted iso-butyl or iso-octyl trialkoxy silanes, where the alkoxy groupings may be methoxy, ethoxy or propoxy.
b) **0168/2:** Products shall be a silane or silane/siloxane mixture in organic solvent at >20% active constituent.
c) **0168/3:** Products shall be an oligomeric siloxane in an organic solvent at concentrations in the range 6-20% active constituent.
d) **0168/4:** Products shall be an octyl triethoxy silane in water in the form of non-drip thixotropic cream.

### 5.2 Volatiles

a) Although not restricted by this specification, the volatile component can be expected to consist principally of hydrocarbon-based solvents except for sub-class 0168/4 where the solvent is normally water.
b) For VOC content restrictions, refer to APAS document AP-D181.

### 5.3 Pigmentation

a) These products are generally unpigmented.
b) Where pigments (prime or extender) are incorporated, they shall comply with the requirements of the SUSMP.

### 5.4 Colour

a) Not applicable as, although they may be milky white or clear in appearance in the wet state, they dry clear.

## 6 PRODUCT APPROVAL REQUIREMENTS

### 6.1 General Requirements

a) The product and its application for approval shall comply with the relevant requirements of APAS document AP-D192 during the life of the approval.

### 6.2 Technical Requirements

a) The product shall comply with **all** the requirements of clause 16, Table 3 below.
b) Tests shall be carried out under the routine conditions of AS/NZS 1580.101.5 unless otherwise specified.
c) Test coupons/cylinders shall be prepared by coating without thinning in accordance with the manufacturer's directions. For sub-class AP-S0168/1, AP-S0168/2 and AP-S0168/3 products, flood coating shall be employed. For sub-class AP-S0168/4 products, the manufacturer's recommended spreading rate shall be used.
d) Unless otherwise specified, the test specimens shall be cylinders of 50 MPa concrete made and cured as indicated in clause 9, Appendix C.
e) Test specimens shall be coated in accordance with clause 10, Appendix D and tested in accordance with clause 16, Table 3.
f) A testing authority capable of undertaking the testing in clause 16, Table 3 is SGS Australia Pty. Ltd.:

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g) Subject to compliance with all the requirements of this specification, the level of Approval appropriate to the application shall be given to the system.

### 6.3 Health and Safety Requirements

a) The manufacturer's Safety Data Sheet (SDS) must be studied closely prior to using the product and complied with during use of the product.
b) Silanes are widely considered to be highly toxic ingredients and concern has been expressed in literature about the effects on worker health and environmental impacts. Safer alternatives may be available and should be researched prior to making any product decisions.
c) Many of these products contain flammable volatile solvents, and thus should be stored away from all sources of heat or ignition. Although AP-S0168/1 products are solvent free, when spilt or used in confined spaces, these products can hydrolyse sufficiently to produce flammable atmospheres and all due precautions should be taken to guard against fires or explosions in such circumstances.
d) Containers should be resealed immediately after use and good ventilation provided during use to minimise the risk of fire or explosion and the long-term toxic effects of absorption of the vapour into the lungs.
e) Silanes may be irritating to the skin and tend to be aggressive on hoses, plastic seals and spray equipment in general. Some may have a pungent odour. Care should be taken to avoid contact with the skin by the use of protective clothing and barrier cream. All pumping equipment should be adequately earthed.
f) Silane-based products hydrolyse with residual moisture in the substrate to release significant quantities of methanol (TLV 200 ppm) or ethanol (TLV 1000 ppm) which are toxicants and may cause drowsiness. A full-face air fed respirator should be used when applying in confined spaces.
g) Products intended for sale in Australia shall comply with all the requirements of the SUSMP. Products

intended for sale in other countries shall comply with all local WHS and environmental requirements.

h) The product shall comply with all requirements of clause 6.3 and 6.4 of APAS document AP-D192.

## 7 APPENDIX A

### Mass Loss

7.1 **Objective:** This Appendix describes how the non-volatile content of the test product is determined.

7.2 **Principle:** The change in mass following heating to drive off volatile components is used to determine the weight solids of the material.

7.3 **Equipment:** As per the requirements of AS/NZS 1580.301.1.

7.4 **Process:**

7.4.1 Determine the non-volatile content of the material in accordance with AS/NZS 1580.301.1 except that:

i. the oven temperature shall be 35 ± 3°C
ii. the sample shall be removed from the oven after 10 ± 0.5 minutes

7.4.2 The mass loss (ΔM) shall be determined:

$$\Delta M = (100 \times [M_0 - M_1]) / M_0$$

Where:
$M_0$ = original mass of sample
$M_1$ = mass of sample after oven drying

## 8 APPENDIX B

### Equivalent Siloxane Content

**8.1 Objective:** This Appendix describes a method for determining the equivalent siloxane content, i.e. the mass % of effective solids in silane/siloxane based waterproofing materials used on concrete and masonry.

**8.2 Principle:** The silane/siloxane components of the product are hydrolysed by reaction with sodium hydroxide solution. A condensation reaction then takes place to form polysiloxane residue which is dried to constant mass.

**8.3 Reagents:**

i. Analytical grade sodium hydroxide
ii. Distilled or deionised water
iii. Sodium Hydroxide Solution (dissolve 20g of analytical grade sodium hydroxide in 1 litre of 50/50 water/ethyl alcohol).

**8.4 Apparatus:**

i. Analytical balance, capacity 160 g accuracy to ±0.001 g
ii. Drying oven, 105 ± 3°C
iii. Glass jars, capacity 125 mL, with plastic lids
iv. L glass pipette
v. Desiccator with silica gel desiccant

**8.5 Procedure**: The following shall be carried out on duplicate samples and a blank test carried out on the sodium hydroxide solution:

i. Dry a glass jar at 105°C for 30 minutes and allow to cool to room temperature in a desiccator.
ii. Weigh the jar ($Ms_1$) to 0.001 g accuracy, introduce approximately 5 g of sample and reweigh ($Ms_2$).
iii. Pipette 10.0 mL of the sodium hydroxide solution into the jar and screw on the cap. At the same time, introduce 10.0 mL of sodium hydroxide solution into another dry weighed glass jar and treat as in (v) and (vi) below.
iv. Agitate the jars gently from time to time over the course of several hours to ensure complete mixing and allow the reaction to proceed for 18 hours at ambient temperature.
v. Remove the lid from the jar and evaporate to dryness in the oven at 105 ± 3°C. Cool to room temperature in the desiccator and reweigh ($Ms_3$).
vi. Repeat (v) above until constant mass is achieved

**8.6 Calculations**: Calculate the equivalent siloxane content as a % using the following formula:

Equivalent Siloxane Content =

$$100 \times [(Ms_3 - Ms_1) - (Mb_2 - Mb_1)] / (Ms_2 - Ms_1)$$

Where:

$Ms_1$ = Mass of sample jar
$Ms_2$ = Mass of sample jar and test sample
$Ms_3$ = Mass of sample jar and residues of test sample and NaOH
$Mb_1$ = Mass of blank jar
$Mb_2$ = Mass of blank jar and residue of blank (NaOH)

## 9 APPENDIX C

### Preparation of Concrete Test Specimens

9.1 **Objective:** The objective of this Appendix is to standardise the preparation of uniform concrete test coupons or specimens to be used in the testing described below.

9.2 **Principle:** A concrete mix of controlled proportions is prepared and allowed to cure under controlled conditions prior to use as a test coupon.

9.3 **Reagents:**

i. A commercially available concrete mix
ii. A saturated aqueous lime solution of sufficient volume

9.4 **Apparatus:**

i. Test cylinder mould of minimum dimensions 100 mm diameter by 200 mm height; four (4) required per test product
ii. Standard fog-room or alternatively a bath capable of totally immersing the cylinders in a curing solution

9.5 **Procedure**:

i. Prepare test cylinders from the concrete mix. Four cylinders are required for each product under test, plus an additional four cylinders for the untreated standards. The volume of a cylinder is about 1.6 litres.
ii. The amount of water used for the mix shall be calculated and weighed to yield a water-to-cement ratio of 0.4:1.
iii. Allow the cylinders to cure overnight and de-mould. Store under standard fog-room conditions or under lime-saturated water (AS 1012.8.1 clause 9.3) for 7 days, then transfer to drying racks under routine laboratory conditions (AS/NZS 1580.101.5) and leave for a minimum of three weeks and a maximum of 12 weeks before use.
iv. Qualification of test specimens: Use two of the cylinders to determine the density, unconfined compressive strength and acid soluble chloride content using the methods detailed in Table 1 below.

| Test Parameter | Method | Typical Value |
|---|---|---|
| Dry Density (28 days) | AS 1012.12 | 2380 |
| Unconfined Compressive Strength (28 days) | AS 1012.9 | 51 Mpa |
| Chloride Content | AS 1012.20 | < 0.2% bmoc |

**Table 1: Test Coupon Qualification Parameters**

## 10 APPENDIX D

### Application of Test Product(s)

10.1 **Objective**: The objective of this Appendix is to standardise the application of test samples to test coupons.

10.2 **Procedure**:

i. Apply each product under test to four cylinders by immersing each cylinder in the product (as intended for use) for 15 seconds maximum.
ii. Transfer the test cylinders to a drying rack for 6 hours under routine conditions (unless the manufacturer recommends specific drying conditions or recoat interval).
iii. Immerse each cylinder again for a further maximum of 15 seconds.
iv. In the case of silane cream application, the cream is applied by a paint brush at application rate of 500 mL/m$^2$ (to be determined by weight difference). Only one application is required.
v. Allow all cylinders to cure under routine conditions for 2 weeks before commencing testing.

## 11 APPENDIX E

### Reduction in Water Uptake

11.1 **Objective**: The objective of this Appendix is to standardise a method for the determination of the effectiveness of the test product to resist water absorption once applied.

11.2 **Principle**: The difference in weight between treated and untreated cylinders immersed in a water bath is used to quantify the water uptake and hence the efficiency of the water repellence.

11.3 **Reagents**:

i. 15% w/w sodium chloride (NaCl) aqueous solution at 25°C of sufficient volume to cover test cylinders by least 15 mm

11.4 **Apparatus**:

i. Water bath of sufficient volume to cover test cylinders with NaCl solution by least 15 mm.
ii. Balance capable of reading to 0.1 g accuracy
iii. Ventilated oven kept at 40°C

11.5 **Procedure**:

i. For each product under evaluation, weigh two treated cylinders and two untreated control cylinders, to 0.1 g accuracy. This figure is used as the initial mass ($M_0$) in future calculations.
ii. Place the cylinders in a bath containing 15% sodium chloride aqueous solution at 25°C so that there is approximately 15 to 20 mm of solution covering the top of the cylinders. The cylinders should not touch each other and should not be stacked on top of each other in layers.
iii. After 48 hours, remove each cylinder from the bath, towel it dry to **saturated surface dry**, weigh immediately and record the mass.
iv. Calculate $\Delta M_{48}$, the percentage mass change after water immersion for each cylinder as follows:

$$\Delta M_{48} = (100 \times [M_{48} - M_0]) / M_0$$

v. Calculate $RM_{48}$, the reduction in water uptake (after 48 hours immersion) for the product under test as follows:

$$RM_{48} = (100 \times [S - P]) / S$$

where:
S = Average $\Delta M_{48}$ for the two untreated standard cylinders
P = Average $\Delta M_{48}$ for the two cylinders treated with the product under test

vi. At the end of the 48-hour immersion test, place the cylinders in a ventilated oven at 40°C for 3 days.
vii. Remove from the oven, reweigh and record the result.
viii. Store cylinders on rack under routine laboratory conditions for 24 hours before re-immersing as detailed above.
ix. This 6-day cycle shall be carried out a total of five times, weighing the cylinders at the end of each drying stage.
x. Calculate and plot the percentage weight change over the 30-day period for both samples.

xi. The cylinders used for this test are required for further test (clause 12, Appendix F), which should follow-on immediately.

## 12 APPENDIX F

**Reduction in Chloride Ion Penetration under Cyclic Saltwater Immersion**

12.1 **Objective:** The objective of this Appendix is to determine the effectiveness of the test product in reducing the uptake of chloride ions from salt water.

12.2 **Principle:** Concrete samples from each cylinder before and after immersion in saltwater are analysed for chloride content using wet chemistry methods.

12.3 **Reagents:**

i. 15% w/w sodium chloride (NaCl) aqueous solution at 25°C of sufficient volume to cover test cylinders by least 15mm

12.4 **Apparatus:**

i. Water bath of sufficient volume to cover test cylinders with NaCl solution by least 15 mm
ii. Balance capable of reading to 0.1 g accuracy
iii. Power drill with 15 mm masonry bit

12.5 **Procedure**:

i. For each product under evaluation, weigh two treated cylinders and two untreated control cylinders, to 0.1 g accuracy. This figure is used as the initial mass ($M_0$) in future calculations.
ii. At the completion of the drying and cooling phase of the fifth cycle of clause 11, Appendix E, each cylinder is to be wiped with a clean, water dampened cloth to remove deposits of salt on the surface. Using a 15 mm masonry bit, drill each cylinder to a depth of 5 mm at four locations on the circumference separated by 90°.
iii. Collect all powder from the eight holes (four from each duplicate cylinder), homogenise and analyse for chloride content by mass of cement (bmoc) using the Volhard method as described in BS 1881-124.
iv. Potentiometric titration to determine chlorides is permissible. An acceptable alternative method is AS 1012.20 but it requires at least 15 g of sample so additional holes may need to be drilled.
v. Subtract the chloride content of the concrete mix (determined in clause 9, Appendix C) from the chloride content determined above to arrive at the **chloride uptake** for that depth.
vi. Extend the holes to a depth of 10 mm, angling the drill to widen the opening and discard all powder. Clean the hole carefully, taking care to dislodge loose material around the opening and carefully blowing out all residual powder in the hole. With the drill again perpendicular, drill to a depth of 15 mm, collecting all powder, blending and analysing it as for the 0 – 5 mm sample above.
vii. Repeat this process to obtain and analyse a further sample from the 20 - 25 mm depth.
viii. Calculate RCd, the reduction in chloride ion penetration for the product under test over the depth interval **d**, as follows.

$$RC_d = (100 \times [S_d - P_d]) / S_d$$

where
$S_d$ = Chloride uptake for the untreated standard at depth **d**
$P_d$ = Chloride uptake for the treated samples at depth **d**

ix. On a bar graph, show $S_d$ and $P_d$ for each depth **d**.

## 13 APPENDIX G

**Alkali Resistance**

13.1 **Objective:** The objective of this Appendix is to determine the effectiveness of water repellency under alkali conditions.

13.2 **Principle:** Test cylinders are immersed in an alkali solution, dried and weighed. The difference in weight before and after immersion is used to determine the effectiveness of water repellency under alkali conditions.

13.3 **Reagents:**

i. 0.1 M aqueous potassium hydroxide (KOH) solution at 25°C of sufficient volume to cover test cylinders by least 15 mm

13.4 **Apparatus:**

i. Water bath of sufficient volume to cover test cylinders with KOH solution by least 15 mm
ii. Balance capable of reading to 0.1 g accuracy
iii. Ventilated oven kept at 40°C

13.5 **Procedure**:

i. For each product under evaluation weigh two treated cylinders to 0.1 g accuracy and place them in a bath containing a 0.1 M KOH solution at 25°C so that there is approximately 15 to 20mm KOH solution covering the cylinders. The cylinders should not touch each other and should not be stacked on top of each other in layers.
ii. Remove the cylinders from the bath after 14 days and rinse thoroughly with fresh water. Place the cylinders in a 40°C ventilated oven and weigh at appropriate intervals until the mass has again fallen to within 0.5 g of the mass before immersion, or for 14 days maximum.
iii. Remove the cylinders from the oven, re-weigh and record the weight of each as $M_0$.
iv. The Reduction in Water Uptake Test as described in clause 11, Appendix E above is now repeated on these cylinders, with the result recorded as $RM_{KOH}$.

$$RM_{KOH} = (100 \times [M_{KOH} - M_0]) / M_0$$

v. Calculate $\Delta RM_{KOH}$, the decrease in water uptake performance, as follows:

$$\Delta RM_{KOH} = (100 \times [RM_{48} - RM_{KOH}]) / RM_{48}$$

Where:

$RM_{48}$ = Reduction in water uptake for the product
$RM_{KOH}$ = Reduction in water uptake after KOH-immersion

## 14 APPENDIX H

### Depth of Penetration

14.1 **Objective:** The objective of this Appendix is to measure the extent to which the product penetrates the concrete surface.

14.2 **Principle:** A cross-section of the test cylinder is stained with a dye and the resultant depth of penetration (DoP) is measured using graduated callipers.

14.3 **Reagents:**

i. 10% aqueous solution of a black drawing ink

14.4 **Apparatus:**

i. Concrete cutting power disc
ii. Graduated callipers

14.5 **Procedure**:

i. Use the cylinders from tests (clause 11, Appendix E and clause 12, Appendix F) above to determine the DoP after all other tests have been completed.
ii. Split the cylinder along the plane of the chloride sampling holes, and liberally wet one freshly exposed face with the black ink solution. Allow to dry.
iii. With a pair of sliding callipers, measure the depth (to 0.1 mm accuracy if possible) of the outer layer, which should remain unaffected by the red dye due to its water repellency.
iv. Make 8 measurements on one exposed face of each cylinder and express the result for the DoP as an average figure of the 16 readings for the two duplicate cylinders for each product.
v. Also record the maximum and minimum readings and report these as the **range**.

## 15 TABLE 2: PREFFERED USE OF SUB-CLASS TYPES

| Sub-class | Typical Depth of Penetration (mm) | Preferred Use* |
|---|---|---|
| AP-S0168/1 | 5 | Maximum protection in marine or coastal conditions, particularly in order to inhibit the corrosion of steel reinforcement or mitigate alkali aggregate reaction (unsuitable for application in warm or windy conditions because of high volatility). |
| AP-S0168/2 | 3 - 4 | General purpose use on reinforced concrete, concrete, masonry or brick work, particularly in climates where high temperatures cannot be avoided. |
| AP-S0168/3 | 1 - 3 | For general masonry protection in less critical areas and on non-alkaline substrates. Provides short term protection and is less effected by warm, dry and/or windy conditions. |
| AP-S0168/4 | 6 | Maximum protection in marine or coastal conditions, particularly in order to inhibit the corrosion of steel reinforcement or mitigate alkali aggregate reaction. It is suitable for most reinforced concrete structures including horizontal, vertical and overhead surfaces under versatile conditions including warm, windy and dry weather conditions. Only one coat application is required. |

**Note:**

* The cost effectiveness of products within each class is not necessarily equivalent and for direct comparison, the equivalent siloxane content of each should be taken into account

## 16 TABLE 3: PERFORMANCE PROPERTIES

| TEST | AS/NZS 1580 METHOD | REQUIREMENTS |
|---|---|---|
| Preliminary Examination | 103.1 | **0168/1, 0168/2 and 0168/3:** Shall be a clear liquid and readily reincorporated. They shall be free of coarse particles, gel and foreign matter.<br>**0168/4:** Shall be a white or cream paste and readily reincorporated. They shall be free of coarse particles, gel and foreign matter. |
| Non-volatile Content - Test for sub-class 0168/3 products **only** | 301.1 | QC testing shall ensure that production batches are within ± 3% of stated value. |
| Consistency – Flow Cup | 214.2 | QC testing shall ensure that production batches are within ± 5 secs of stated value. |
| Surface Appearance | | When applied to concrete or autoclaved fibrous cement, there shall be no visual change in appearance or texture of substrate after coating application **and drying**. |
| Mass Loss | Clause 7, Appendix A | **0168/2:** 20 - 40%.<br>**0168/3:** < 20.<br>**0168/4:** < 1%. |
| Reincorporation after Storage | 211.2 | To comply with all the preceding requirements after 12 months storage at ambient temperature. |
| Internal Corrosion of Can | | After 12 months storage, a sealed unopened can shall show no internal corrosion. |
| Refractive Index | | Shall not vary by more than 1 unit in the fourth significant figure. |
| Equivalent Siloxane Content | Clause 8, Appendix B | To be within ±5% of stated value. |
| Reduction in water uptake | Clause 11, Appendix E | **0168/1**: > 92%.<br>**0168/2:** > 80%.<br>**0168/4:** 84%. |
| Reduction in chloride ion penetration | Clause 12, Appendix F | **0168/1:** > 80% at 0 - 5 mm; > 90% at 10 - 25 mm.<br>**0168/2:** > 75% at 0 - 5 mm; > 80% at 10 - 25 mm.<br>**0168/4:** 88%. |
| Alkali Resistance | Clause 13, Appendix G | **0168/1:** Not more negative than - 4%.<br>**0168/2:** Not more negative than - 8%.<br>**0168/4:** < - 3%. |
| Depth of Penetration | Clause 14, Appendix H | **0168/1:** 4 mm minimum.<br>**0168/2:** 2 mm minimum.<br>**0168/4:** 4 mm minimum. |
| VOC Content | APAS AP-D181 | Refer to APAS document AP-D181 for method and limits.<br>If the APAS specification is not listed on AP-D181, a declaration of VOC content **is still required.** |

## 17 APPENDIX I

**Document History**

Status: Current
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| Document Version No.: | Date Published: | Summary of Changes: |
|---|---|---|
| 10 | 02-09-2021 | • General format changes<br>• Updated background information in clause 2<br>• Updated SUSMP information<br>• Updated APAS website information |
| 9 | 25-11-2020 | • Addition of Appendix I Document History and removal of the Editorial Note previously used in specification versions<br>• Updated document to the current format<br>• Updated internal and external document references, including current SGS details<br>• Inclusion of VOC Content requirement to Table 1 Performance Properties<br>• Addition of "People + Product = Protection" to Footer |
| 8 | 14-10-2009 | • Specification underwent a complete revision |