

(7) A02-020 PAINTINGS AND COATINGS

1 GENERAL

Read this Section with G01-010 "General Requirements" and all other contract documents.

1.1 Scope

This Section covers the requirements for paintings and coatings on all surfaces of buildings, other elements/components as described, and the application of paints on substrates that may be of cementitious, timber, metal or PVC in nature. For requirements relating to paintings and coatings for structural steelwork, refer to the structural specifications.

1.2 Related Sections

Read this Section in conjunction with the relevant requirements of the following sections:

A02-030	Plasters and Renders
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1.3 Standards, Codes, Regulations and Technical References

1.3.1 Standards and Codes

Unless otherwise agreed by the SO, ensure all of the Works comply with the relevant requirements of the standards and codes listed below or referenced in the body of the Specification. Alternative standards and codes may be proposed for approval by the SO, provided it can be demonstrated that the alternative standards and codes comply with the requirements of the standards specified. All standards and codes quoted are the current version, unless specific year references are noted.

In the event that the standards or codes are partially superseded or have become obsolete, refer to the current edition or the approved substitution for the relevant clauses.

Singapore Standards	
SS 5	Methods of Test for Paints, Varnishes and Related Materials
SS 7	Specification for Paint – Finishing, Gloss Enamel
SS 34	Specification for Undercoat Paint for Gloss Enamel
SS 37	Specification for Aluminium Paint
SS 38	Specification for Aluminium Wood Primer
SS 150	Specification for Emulsion Paint for Decorative Purposes
SS 341	Specification for Safety Glazing Materials for Use in Buildings (Human Impact Considerations)
SS 345	Specification for Algae Resistant Emulsion Paint for Decorative Purposes

SS 375	Suitability of Non-Metallic Products for Use in Contact with Water Intended for Human Consumption with Regard to Their Effect on The Quality of The Water
SS 494	Specification for Lead and Chromate-Free Primer for Iron And Steel Substrates
SS 500	Specification for Elastomeric Wall Coating
SS 542	Code of Practice for Painting of Buildings
SS 579	Specification for Water-Based Sealer for Interior and Exterior Uses
SS 624	Specification for Water-Based Acrylic Road Marking Paint
SS 678:2021 + C1:2022	Specification for Solar Reflective Water-Based Coatings
Other Standards	
AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminium Extrusions and Panels
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminium Extrusions and Panels
BS 245	Specification for Mineral Solvents (White Spirit and Related Hydrocarbon Solvents) for Paints and Other Purposes
BS 476-6	Fire Tests on Building Materials and Structures – Part 6: Method of Test for Fire Propagation for Products
BS 476-7	Fire Tests on Building Materials and Structures – Part 7: Method of Test to Determine the Classification of the Surface Spread of Flame of Products.
BS 476-20	Fire Tests on Building Materials and Structures – Part 20: Method for Determination of The Fire Resistance of Elements of Construction (General Principles)

BS 476-21	Fire Tests on Building Materials and Structures – Part 21: Methods for Determination of The Fire Resistance of Load Bearing Elements of Construction
BS 1710	Specification for Identification of Pipelines and Services
BS 3698	Specification for Calcium Plumbate Priming Paints
BS 3761	Specification for Solvent-Based Paint Remover
BS 4652	Specification for Zinc-Rich Priming Paint (organic media)
BS 4800	Schedule of Paint Colours for Building Purposes
BS 5252	Framework for Colour Co-ordination for Building Purposes
BS 5707	Specification for Preparations of Wood Preservatives in Organic Solvents
BS 7079	General Introduction to Standards for Preparation of Steel Substrates before Application of Paints and Related Products
BS 7956	Specification for Primers for Woodwork
BS EN 927-1	Paints and Varnishes – Coating Materials and Coating Systems for Exterior Wood – Part 1: Classification and Selection
BS EN 1062-3	Paints and Varnishes – Coating Materials and Coating Systems for Exterior Masonry and Concrete – Part 3: Determination of Liquid Water Permeability
BS EN 1542	Products And Systems for The Protection and Repair of Concrete Structures – Test Methods – Measurement of Bond Strength by Pull-Off
BS EN 10169	Continuously Organic Coated (Coil Coated) Steel Flat Products – Technical Delivery Conditions
BS EN 12206-1	Paints and Varnishes – Coating of Aluminium and Aluminium Alloys for Architectural Purposes – Part 1: Coatings Prepared from Coating Powder
BS EN 13438	Paints and Varnishes – Powder Organic Coatings for Hot Dip Galvanized or Sherardised Steel Products for Construction Purposes

BS EN ISO 4618	Paints and Varnishes – Terms and Definitions
BS EN ISO 8501	Preparation of Steel Substrates Before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness
BS EN ISO 8502	Preparation of Steel Substrates Before Application of Paints and Related Products. Tests for The Assessment of Surface Cleanliness.
BS EN ISO 8503	Preparation of Steel Substrates before Application of Paints and Related Products. – Surface Roughness Characteristics of Blast-Cleaned Steel Substrates
BS EN ISO 8504	Preparation of Steel Substrates before Application of Paints and Related Products. Surface Preparation Methods
BS EN ISO 12944	Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems
BS EN ISO 14713	Zinc Coatings – Guidelines and Recommendations for the Protection against Corrosion of Iron and Steel in Structures
AS 1580	Paints and Related Materials – Methods of Test
AS 2855	Paints and Related Materials – Micaceous Iron Oxide Pigment
AS 3715	Metal Finishing – Thermoset Powder Coating for Architectural Applications of Aluminium and Aluminium Alloys
AS 4049.3	Paints and related materials – Pavement marking materials, Part 3: Waterborne paint - For use with surface applied glass beads
AS/NZS 4548.3	Guide to Long-Life Coatings for Concrete and Masonry. Latex – Textured Coatings – Non-Aggregate
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D41 / D41M	Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D523	Standard Test Method for Specular Gloss
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D1308	Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1653	Standard Test Methods for Water Vapor Transmission of Organic Coating Films
ASTM D1654	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D2697	Standard Test Method for Volume Non volatile Matter in Clear or Pigmented Coatings
ASTM D2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	Standard Test Methods for Rating Adhesion by Tape Test
ASTM D3363	Standard Test Method for Film Hardness by Pencil Test
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4214	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E337	Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)
ASTM E1980	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
ASTM G14	Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)

DIN 4102-1	Fire Behaviour of Building Materials and Building Components – Part 1: Building Materials; Concepts, Requirements and Tests
DIN 18363	German Construction Contract Procedures (VOB) – Part C: General Technical Specifications in Construction Contracts (ATV) – Painting and Coating Work
DIN EN 13300	Paints and Varnishes – Water-Borne Coating Materials and Coating Systems for Interior Walls and Ceilings – Classification
ISO 2812-2	Paints and Varnishes - Determination of Resistance to Liquids – Part 2: Water Immersion Method
ISO 3549	Zinc Dust Pigments for Paints – Specifications and Test Methods
ISO 4618	Paints and Varnishes – Terms and Definitions
ISO 7783	Paints and Varnishes – Determination of Water-Vapour Transmission Properties - Cup Method
ISO 11890-1	Paints and Varnishes – Determination of Volatile Organic Compound (VOC) Content – Part 1: Difference Method
ISO 11890-2	Paints and Varnishes – Determination of Volatile Organic Compound (VOC) and/or Semi Volatile Organic Compounds (SVOC) Content – Part 2: Gas-Chromatographic Method
ISO 12944-1	Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems – Part 1: General Introduction
ISO 12944-5	Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems – Part 5: Protective Paint Systems
ISO 17895	Paints and varnishes – Determination of the volatile organic compound content of low-VOC emulsion paints (in-can VOC)
ISO 19840	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces
JIS Z 2801	Antibacterial Products – Test for Antibacterial Activity and Efficacy

Surface Preparation Standards for Metal			
System	SSPC Codes	NACE	Swedish Standard
Solvent Cleaning	SSPC.SP1	–	–
Hand Tool Clean	SSPC.SP2	–	St.2 (approx.)
Power Tool Clean	SSPC.SP3	–	St.3
White Metal Blast	SSPC.SP5	NACE #1	Sa.3
Commercial Blast	SSPC.SP6	NACE #3	Sa.2
Brush Off Blast	SSPC.SP7	NACE #4	Sa.1
Pickling	SSPC.SP8	–	–
Near White Blast	SSPC.SP10	NACE #2	Sa.2½
Power Tool Cleaning to Bare Metal	SSPC.SP11	–	–

1.3.2 Regulations

Refer to the following regulations for compliance in carrying out the Works:

Building and Construction Authority – Approved Document ("Approved Document")
Code for Environmental Sustainability of Buildings

The above regulations refer to the latest edition (including any amendments) that are currently in use.

1.3.3 Technical References

No item.

1.4 Trade Preamble

1.4.1 Contractor's Submissions

The intended type of painting systems and locations are indicated in the schedules and drawings.

Engage qualified and experienced personnel to carry out the Works and submit the following items for the SO:

- (a) Name of the manufacturers and the proprietary brand name of the painting and coating products to be used. Wherever possible, obtain the paint products from the same manufacturer.
- (b) Labelled samples of each coating system, on representative substrate, showing surface preparation, colour, gloss level, texture and physical properties.
- (c) Test reports and certificates, and certification documents for all paint products and materials listed under Section A02-020:Clause:1.4.6. Submit the manufacturer's certification for paints and materials that require an integral fungus and algae inhibitor.
- (d) Certification for indoor paints with low volatile organic compound (VOC) products shall be certified by an approved local Certification Body, tested in accordance with ISO 11890 or ISO 17895.

1.4.2 Co-ordination with Other Works

Co-ordinate the external and internal painting works, particularly the interfaces with the following work packages and trades, where applicable:

- (a) Masonry and in-situ concrete walls
- (b) Windows, doors and louvres
- (c) Dry walls
- (d) Internal masonry, render and plaster
- (e) Internal joinery and doors

1.4.3 Provision of Spare Materials

Deliver to site in strong protective packages marked for identification, and store where directed by the SO, the following spare components and materials for future replacements and repairs:

Spare Material	Description (Size, type, etc)	Quantity
PU paint (of each colour in reference to the existing G.S paint at railing, awning, sun-shade, metal bar)	In tin of 10L equivalent to 5% the total surface of applicable area	5%
Emulsion weather proof, anti algae paint (of each colour in reference to the existing G.S paint at railing, awning, sun-shade, metal bar)	. In tin of 10L equivalent to 5% the total surface of applicable area	5%

1.4.4 Quality Control Plan

Prepare and submit a quality control plan for SO's acceptance.

1.4.4.1 Testing Requirements

All materials for paint and film finishes will be subjected to the respective product test report for approval and acceptance, and may cover as below where relevant:

(a) Applied Paint Film

- (i) Fading and Colour fastness
- (ii) Bending and scratching resistances
- (iii) Oxidation, weathering and accelerated weathering
- (iv) Resistance to mould, fungus and algae
- (v) Application and self-levelling properties

(b) Material/Content

- (i) Pigment content and fineness of grind
- (ii) Chemical analysis (particularly anti-corrosive paints)

(c) Samples and Reports

- (i) Samples for testing shall be supplied without charge. The costs of testing shall be borne by the Contractor should the product fail the test.
- (ii) The Contractor shall provide samples prepared and delivered.
- (iii) The performance of the paints when tested shall be equivalent to the test data of paints supplied by the manufacturers.

(d) Compatibility Test Report: Provide report to ensure that proposed painting system is compatible with existing substrate.

1.4.5 Warranty

Provide the following warranty in accordance with the specimen warranty, or otherwise as agreed with the SO:

Item of Works to be Warranted	Period of Warranty Required
External Painting and/or Coating System	5 year warranty
Internal Painting and/or Coating System	5 year warranty
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1.4.6 Maintenance Manual

Prepare and submit a maintenance/replacement manual covering external painting and coating systems. Refer to the Section G01-010:Clause:1.4.5 for details.

1.5 Definitions and Abbreviations

The following definitions and abbreviations apply within this Section:

1.5.1 Definitions

1.5.1.1 primer coat

first coat

1.5.1.2 undercoat

intermediate coat

1.5.1.3 top coat

finishing coat

1.5.2 Abbreviations

1.5.2.1 SGBC

Singapore Green Building Council

1.5.2.2 SGLS

Singapore Green Label Scheme

1.5.2.3 uPVC

unplasticised polyvinyl chloride

2 PERFORMANCE REQUIREMENTS

2.1 Contractor's Brief

When carrying out the proposals as set out in Section A02-020:Clause:1.4.1, take account of the requirements listed below:

2.1.1 Durability and Weather Resistance

Paint products submitted shall achieve a service life of 5 years, and must not degrade or deteriorate due to solar or any other weathering exposure.

2.1.2 Fungal/Algae Resistance

Where specified in Section A02-020:Clause:1.3, finishing coats are required to be fungal/algae resistant.

2.1.3 Appearance

Ensure the paintworks achieve uniform colour and texture as that accepted in a mock-up panels, with no defects that would impair appearance.

Provide joints as indicated in the drawings if any.

Where specified in Section A02-020:Clause:1.3, finishing coats shall comply with the reflectance requirements stated in the BCA Approved Document.

2.1.4 Fire

Take into account, that the works shall be non-combustible throughout. Ensure that the Works comply with fire regulations.

2.1.5 Washability

Where specified in Section A02-020:Clause:1.3, finishing coats shall be allow for easy removal of tough stains, marks, scuffs by using a wet cloth.

2.1.6 Low Volatile Organic Compound Products

Where specified in Section A02-020:Clause:1.3, paint systems shall be of low volatile organic compound (VOC) products, or ordourless systems.

3 MATERIALS

3.1 Paint Coating Systems

Refer to Tables 1 and 2 listed below for details on the selected coating systems as highlighted for the Project.

3.1.1 External Paint and Coating Systems

External paint and coating systems (EPC) for the Project shall consist of the following types:

Coating Type: <i>PT-01</i>		
Item	Material or Product	Requirements(thickness, etc.)
SUBSTRATE	<u>Rendered masonry/ Dry wall partitions substrates masonry/ concrete</u>	<u>Patch all cracks, holes, depressions voids etc with approved non-shrink grout, allow to dry, and sand smooth to a flush, smooth surface</u>

First Coat	1 coat of water-based acrylic primer with excellent resistance to fungus growth and alkalinity.	Green Label certified. 1 coat dry film thickness: 20-30 microns. White finish. Coverage: 6-8m ² /litre/coat.
Second Coat	1 coat of water reducible modified acrylic resin reinforced spray body texture.	Green Label certified. 1 coat dry film thickness depends on size of texture. White finish. Coverage: 1.00-1.70 kg/ m ² / coat.
Top Coat	2 coats of high performance anti-algae acrylic sheen water-based emulsion paint	Green Label and SS 345 certified. 1 coat dry film thickness: 40-60 microns. Sheen finish. 7 -10 m ² / litre/coat.

Coating Type: <i>PT-02</i>		
Item	Material or Product	Requirements(thickness, etc.)
SUBSTRATE	<u>Ferrous metal</u>	General sanding and cleaning of surfaces
First Coat	1 coat of non-lead, non-chromate anti-rust primer.	1 coat dry film thickness: 30-40 microns. Grey finish. Coverage 0.13- 0.15 litres/ m ² / coat.
Second Coat	-	-
Top Coat	2 coats of two pack gloss polyurethane enamel	1 coat dry film thickness: 35-45 microns. Coverage 0.125-0.15 kg/ m ² / coat.

Refer to Table 1 below for possible permutations for painting external surfaces and standards to comply with where applicable. Ensure that all dry film thicknesses are within the range recommended by the paint manufacturers.

Table 1. Internal Painting Systems and Standards

	System	Primer coat	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(S)	Reference Standard
MASONRY AND CONCRETE	Conventional	Solvent borne acrylic sealer				Acrylic emulsion x2	SS 345 SGLS/SGBC
		Water borne acrylic sealer	SS 579 SGLS/SGBC	Acrylic textured body coat (Optional)	AS/NZS 4548.3	Acrylic emulsion x2	SS 345 SGLS/SGBC

	System	Primer coat	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(S)	Reference Standard
SUBSTRATE	Elastomeric	Water borne acrylic sealer	SS 579 SGLS/SGBC	Acrylic textured body coat (Optional)	SGLS/SGBC	Elastomeric coat x2	SS 500 SGLS/SGBC
	Inorganic Vapour Permeable	Water based mineral silicate primer		Silicate mineral	DIN 18363 2.4.1	Silicate mineral	DIN 18363 2.4.1,
	High performance	Epoxy Primer				Acrylic aliphatic polyurethane topcoat x2	
FERROUS METAL	Conventional	Alkyd zinc phosphate primer	BS 4652	Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7
		Lead and chromate free anti-corrosive primer	SS 494	Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7

	System	Primer coat	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(S)	Reference Standard
SUBSTRATE		Alkyd zinc phosphate primer	BS 4652	Alkyd micaceous iron oxide	AS 2855	Alkyd enamel topcoat x2	SS 7
	High performance ISO 12944-5, C3(M)	Epoxy Primer (80 µm)		Acrylic aliphatic polyurethane topcoat (80 µm)		Acrylic aliphatic polyurethane topcoat (80 µm)	
	High performance ISO 12944-5, C5(H)	Epoxy zinc phosphate primer (125 µm)	BS 4652	Epoxy micaceous iron oxide (125 µm)	AS 2855	Acrylic aliphatic polyurethane topcoat (50 µm)	
NON-FERROUS METAL	Conventional	Etch primer		Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7

	System	Primer coat	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(S)	Reference Standard
SUBSTRATE		Alkyd micaceous iron oxide	AS 2855	Alkyd micaceous iron oxide	AS 2855	Alkyd enamel topcoat x2	SS 7
		Yellow chromate / pre-anodisation	AAMA 2604			Polyester powder coating	AAMA 2604
	High performance	Etch primer				Acrylic aliphatic polyurethane topcoat x2	
	High performance	Yellow chromate / pre-anodisation	AAMA 2605			PVDF Coating (70% Kynar 500 resin min.)	AAMA 2605

	System	Primer coat	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(S)	Reference Standard
SUBSTRATE	High performance ISO 12944-5, C4(H)	Epoxy Primer (80 µm)		Acrylic aliphatic polyurethane topcoat (60 µm)		Acrylic aliphatic polyurethane topcoat (60 µm)	
	High performance ISO 12944-5, C5(H)	Epoxy Primer (80 µm)		Epoxy micaceous iron oxide (70 µm)	AS 2855	Acrylic aliphatic polyurethane topcoat (50 µm)	
WOOD	Conventional	Aluminium wood primer	SS 38	Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7
		Water borne acrylic primer	SGLS/SGBC			Water borne acrylic enamel x2	SGLS/SGBC
TRANSPARENT WOOD STAIN / VARNISH		Transparent wood stain		Transparent wood stain		Transparent wood stain	

	System	Primer coat	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(S)	Reference Standard
		Modified alkyd transparent		Modified alkyd transparent		Modified alkyd transparent	
		wood finish		wood finish		wood finish	
		Polyurethane varnish		Polyurethane varnish		Polyurethane varnish	
		Water borne Polyurethane varnish		Water borne Polyurethane varnish		Water borne Polyurethane varnish	????
S[NuObTeS:TTRhAeTEproducts listed have been selected for the types of surfaces or SUBSTRATES, and the standard of quality particularly applicable to the specific surfaces to be painted or coated.]							

Internal Paint and Coating Systems

Internal paint and coating systems (IPC) for the Project shall consist of the following types:

Coating Type: PT-01		
Item	Material or Product	Requirements(thickness,etc.)
SUBSTRATE	Plastered finished concrete or precast concrete	NA
First Coat	1 coat of acrylic emulsion sealer with anti-fungus properties, low VOC and low odour.	Green Label certified.1 coat dry film thickness: 40-60 microns. Coverage 6-8 m ² /litre/ coat.
Top Coat	2 coats of low VOC, low odour, anti-bacterial and elastomeric internal paint.	Green label certified. 1 coat dry film thickness: 45-60 microns. Coverage 7-10m ² /litre/ coat.

Refer to Table 2 below for possible permutations for painting internal surfaces and standards to comply with where applicable. Ensure that all dry film thicknesses are within the range recommended by the paint manufacturers.

Table 2. Internal Painting Systems and Standards

Substrate	System	Primer COAT	Reference Standard	UNDERCOAT	Reference Standard	TOPCOAT(s)	Reference Standard
MASONRY AND CONCRETE	Conventional	Solvent borne acrylic sealer				Acrylic emulsion x2	SS 150 SGLS/SGBC
		Water borne acrylic sealer	SS 579 SGLS/SGBC	Acrylic textured body coat (Optional)	AS/NZS 4548.3	Acrylic emulsion x2	SS 150 SGLS/SGBC
	Anti-Bacteria	Water borne acrylic sealer	SS 579 SGLS/SGBC			Anti-Bacteria acrylic emulsion x2	JIS Z 2801 SGLS/SGBC
	High Performance	Water borne acrylic sealer				Water borne Anti-Bacteria Polyurethane	JIS Z 2801 SGLS/SGBC
	Inorganic Vapour Permeable	Water based mineral silicate primer		Silicate mineral	DIN 18363 2.4.1	Silicate mineral	DIN 18363 2.4.1
FERROUS METAL	Conventional	Alkyd zinc phosphate primer	BS 4652	Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7
		Lead and chromate free anti-corrosive primer	SS 494	Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7
		Alkyd zinc phosphate primer	BS 4652	Alkyd micaceous iron oxide	AS 2855	Alkyd enamel topcoat x2	SS 7
		Water borne acrylic primer	SGLS/SGBC			Water borne acrylic enamel x2	JIS Z 2801 SGLS/SGBC
	High performance ISO 12944-5, C3(M)	Epoxy Primer (80 µm)		Acrylic aliphatic polyurethane topcoat (80 µm)		Acrylic aliphatic polyurethane topcoat (80 µm)	

		High performance ISO 12944-5, C5(H)	Epoxy zinc phosphate primer (125 µm)	BS 4652	Epoxy micaceous iron oxide (125 µm)	AS 2855	Acrylic aliphatic polyurethane topcoat (50 µm)	
NON- FERROUS METAL	Conventional	Etch primer			Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7
		Alkyd micaceous iron oxide	AS 2855		Alkyd micaceous iron oxide	AS 2855	Alkyd enamel topcoat x2	SS 7
		Etch primer			Water borne acrylic primer	SGLS/SGBC	Water borne acrylic enamel x2	JIS Z 2801 SGLS/SGBC
	High performance	Etch primer					Acrylic aliphatic polyurethane topcoat x2	
	High performance ISO 12944-5, C4(VH)	Epoxy Primer (80 µm)			Acrylic aliphatic polyurethane topcoat (60 µm)		Acrylic aliphatic polyurethane topcoat (60 µm)	
	High performance ISO 12944-5, C5(H)	Epoxy zinc phosphate primer (80 µm)	BS 4652		Epoxy micaceous iron oxide (60 µm)	AS 2855	Acrylic aliphatic polyurethane topcoat (50 µm)	
WOOD	Conventional	Aluminium wood primer	SS 38		Alkyd undercoat	SS 34	Alkyd enamel topcoat x2	SS 7
		Water borne acrylic primer	SGLS/SGBC				Water borne acrylic enamel x2	JIS Z 2801 SGLS/SGBC
TRANSPARENT WOOD STAIN / VARNISH		Transparent wood stain			Transparent wood stain		Transparent wood stain	
		Modified alkyd transparent wood finish			Modified alkyd transparent wood finish		Modified alkyd transparent wood finish	
		Polyurethane varnish			Polyurethane varnish		Polyurethane varnish	

		Water borne Polyurethane varnish		Water borne Polyurethane varnish		Water borne Polyurethane varnish	
[Note: The products listed have been selected for the types of surfaces or substrates, and the standard of quality particularly applicable to the specific surfaces to be painted or coated.]							

3.2 General Requirements of Paint Systems

Supply all primer coats, undercoat coats and top coats from one manufacturer for use on the same surface. The various appropriate coats must be recommended by the said manufacturer for the particular substrate and take into consideration the condition of the substrate, weathering exposure and usage of the premises. The various coats must be compatible.

Where surfaces have been treated or applied with preservative or fire retardant, check with the paint manufacturers for the types of paint products suitable for use on such surfaces. The paint products selected:

- (a) Shall be compatible with the treatment products.
- (b) Shall not inhibit the performance of the treatment or paint products.

3.3 Pipework Paint Systems

3.3.1 Exposed uPVC Products

Unless otherwise specified, light sanding to prepare the surface for painting, apply one coat of enamel undercoat followed by 2 coats of enamel paints.

3.3.2 Galvanised Steel Pipes and Fittings

Unless otherwise specified, apply either Option 1 or 2:

- (a) Option 1
 - One coat etching primer
 - One coat lead and chromate free primer
 - One coat alkyd enamel paint undercoat
 - Two finishing coats of alkyd enamel paint
- (b) Option 2
 - One coat etching primer or epoxy primer (suitable for galvanised metal)
 - Two coats of acrylic aliphatic polyurethane topcoat

Agree on the selection with the SO.

3.4 Miscellaneous Materials

Ensure that paint thinners, tints, turpentine and fillers, are manufactured by the same

manufacturer of the coatings, or are approved by the coating manufacturers for use with their paint products.

3.5 Mineral Silicate Paints

3.5.1 Silicate Paints

Ensure that each type of silicate paint comprises a two-pack (or a compliant alternative) system made of potash water glass with pigments resistant to potash water glass, and containing no organic components such as emulsions.

3.5.2 Silicate Emulsion Paints

All types of silicate emulsion paints and coating materials (for textured surfaces) shall be made from potash water glass with pigments resistant to potash water glass, with water repellent additives and with an organic additive content of no more than 5% by mass.

4 WORKMANSHIP

4.1 General

Only apply paints to firm and dry surfaces, prepared in accordance with good trade practice. All materials shall be applied by skilled trades people. Paints shall be evenly and thoroughly applied, using clean brushes, rollers or spraying equipment.

Make edges of completed paintwork adjoining other materials, building elements and different coloured paintwork clean and sharp, without overlapping.

4.2 Delivery, Storage and Handling

Deliver to site materials that are ready-mixed (except for two-pack paint products) in original sealed containers with labels intact showing brand name, product name and manufacturer's batch number.

Store materials in accordance with manufacturer's recommendations in well-ventilated areas. Use in order of delivery and before shelf life expiry dates.

After works have ceased and when containers are not in use, close the containers (empty or otherwise) and remove to the designated storage area.

Stir liquid paints so that solids are fully and evenly incorporated.

Shake clear varnishes, and do not stir.

4.3 Preparation

4.3.1 Generally

Clean all surfaces to be painted of all oil, grease, dirt, mould, mildew, loose or flaking paint, and all other materials deleterious to achieving a good paint finish prior to filling, sanding or painting.

Smooth surface irregularities. Fill and patch up all joints, cracks, holes and other depressions with appropriate non-shrink, ultraviolet-resistant fillers suitable for the substrates. Finish off flush with

surface and abrade to a smooth, even finish. Make good defects to the satisfaction of the SO prior to any coating works being carried out.

Use the types of preparation materials as recommended by the material manufacturers and the coating manufacturers for the situation and surfaces being prepared.

4.3.2 Preparation of Concrete Surfaces

Remove form oil, mould release oil, laitance, grease, dirt and debris from concrete surfaces using a suitable solvent and then neutralise. Remove grit, dirt, loose materials, mortar drippings and the like. Remove all nibs, projections and protuberances.

Patch concrete surfaces with a non-shrink cementitious grout, or filler compound (to be weather-resistant if exposed to weather), suitable for such use filling all cracks, depressions and voids to provide smooth surfaces. Refer any defects other than surface imperfections to the SO before patching.

Prior to application, allow the concrete to cure for a minimum of 30 days. Measure the concrete surfaces for moisture content and ensure that the moisture content is below 15% if a Protimeter scale is used, below 6% if a Kett meter is used or below 4% if a Sovereign Moisture Master is used.

4.3.3 Preparation of Wood Surfaces

Sand down the wood surfaces to remove all roughness, loose edges, splinters, and brush to remove dust. Remove all grease and dirt using solvents recommended by the paint manufacturers.

Fill all cracks, splits, nail holes, screw holes, and surface defects with wood putty or non-shrink compound, after the priming coat has been applied. Apply putty flush with the surface, sand smooth and touch up with primer when dry. For varnishing works, ensure the putty matches the finished colour.

Cover knots and sappy areas with two coats of appropriate wood sealer before priming.

Prior to installation, prime fire-retardant treated wood or preservative treated wood, required to be painted or stained, with shellac or other selected sealer, as recommended by the manufacturers.

Prior to application, measure the wooden surfaces for moisture content and ensure that the moisture content does not exceed 20% if a Sovereign Moisture Master is used.

4.3.4 Preparation of Rendered Surfaces

Allow surfaces to dry prior to applying primer coat. Remove any efflorescence and brush down. Scrape off all plaster nibs and other projections, and sand smooth. Do not apply any primer coat until efflorescence ceases.

Cut out all scratches, cracks, holes, depressions and voids and fill with non-shrink grout, patching plasters or other selected patching materials. Allow to dry, refill, if necessary, and sand smooth to provide a flush, smooth surface.

Measure the rendered surfaces for moisture content and ensure that the moisture content is below 15% if a Protimeter scale is used, below 6% if a Kett meter is used or below 4% if a Sovereign Moisture Master is used.

4.3.5 Preparation of Masonry Surfaces

Thoroughly clean off all grit, grease, dirt, mortar drippings and splatters. Remove nibs or projections from masonry surfaces. Fill cracks, holes and voids, with appropriate cementitious grout, or filler compounds, and wipe surfaces so that they have the same texture as the adjacent masonry surfaces.

4.3.6 Preparation of Ferrous Metal Surfaces

Surfaces to receive paint system shall be abrasive blasted to Swedish Standard SA 2.5 grade, according to BS EN ISO 8501-1.

Surfaces to receive film galvanising system shall be grit blasted to cleanliness degree SA 2.5 grade, according to BS EN ISO 8501-1

4.3.6.1 Repairs

Complete fresh water hose down to remove any visible and soluble contaminants.

Carry out mechanical tool cleaning on affected areas to ST3 in accordance with BS EN ISO 8501- 1.

Prior to coating application, solvent clean in accordance with SSPC-SP1.

Surfaces shall be clean, dry and free from contamination prior to painting.

4.3.7 Preparation of Non-Ferrous Metal Surfaces

Surfaces to receive paint system shall be treated by non-metallic abrasive sweep blasting to create a dense profile or as per paint manufacturer's recommendations.

After sweep blast-cleaning, the zinc coating shall be continuous and free from mechanical damage.

4.3.7.1 Repairs

Degrease in accordance to SSPC-SP1 and abrade to remove corrosion deposit.

Prime galvanised surfaces with etching primer or epoxy primer (suitable for galvanised metals) prior to coating.

4.3.8 Painting Pipework

Lightly sand the surfaces before the application of coatings.

4.4 Applications

4.4.1 Conditions

Apply paint only to surfaces prepared in accordance with this Section.

Maintain adequate ventilation during painting and drying periods.

Apply materials at the rate recommended by the manufacturers.

Comply with the manufacturer's recommendations for drying times between coats.

Ensure that each coat is dry before the next coat is applied.

4.4.2 Climatic Conditions

Take into account the influence of the changeable weather on the drying time for all the various coats of the paint or coating systems.

Do not undertake painting or coating when the air is dust-laden or when weather and temperature conditions are unsuitable, as specified by the manufacturers.

4.4.3 Substrate Conditions

Ensure that the substrates are in a suitable state for the application of any coatings.

4.4.4 Other Unsuitable Conditions

Do not apply any coatings when other ongoing trades create dust or damp conditions.

Do not apply paint when the lighting levels are too low to ensure acceptable levels of finish.

4.4.5 Coating Colours

Where specially required, ensure each succeeding coat of paint differs slightly in colour from the preceding coat.

4.4.6 Finishing Coats

Ensure that all finishing coats are smooth, and free of streaks, laps, pile-up of paint, skipped or missed areas.

Ensure that the final dry film thickness is in accordance with that as specified in the manufacturer's technical literature.

4.5 Protection

Protect all surfaces not to be coated, by covering with dust sheets, masking or other suitable materials.

Provide adequate signage and barriers to protect the general public, and to prevent damage to freshly applied coatings.

4.6 Making Good Defects

Make good all damage caused to other works. Re-touch all coated and finished work wherever necessary.

4.7 Cleaning

Remove all protections, surplus materials, empty containers, rags, dirt and other debris. Remove daubs and spatters from coatings and materials, and leave surfaces clean.

5 VERIFICATION AND SUBMISSION

5.1 Submissions

5.1.1 Technical Submissions

Include in the construction programme, the event for submission of the following information:

- (a) Name of the paint manufacturers and inclusion of copies of technical data relating to paints to be used.
- (b) Name of sub-contractors, if any.
- (c) Information of current or completed similar jobs during the previous 5 years, and details of Quality Control Procedures adopted.

5.1.2 Work Submissions

Prepare an installation strategy, containing method statements that include surface preparation, coating systems with appropriate overcoating intervals, and any other necessary information.

5.1.3 Test Reports and Certificate Submissions

No item.

5.1.4 Quality Control Plan Submissions

Prepare and submit the quality control plan for SO's acceptance prior to start of any works.

Provide product test reports where relevant.

5.1.5 Warranty

Submit the warranty to the SO upon completion of the Works.

5.1.6 Maintenance Submissions

Include the following information in the maintenance manual and logbook:

- (a) Installed materials, painting systems, brand and colour code numbers.
- (b) Cleaning methods and maintenance.

5.2 Samples and Mock-ups

5.2.1 Samples

Submit the following samples to the SO prior to ordering materials:

- (a) A 1.0 m x 1.0 m panel of each of the paint or coating systems as set out in A02- 020:Clause:3.1 at a designated location to be agreed upon the SO.
- (b) A 1.5 m long sample of each paint system on any frames or tubes or other building elements/components at a designated location to be agreed with the SO.

5.2.2 Mock-ups

Provide mock-ups for the Project as follows:

Mock-up	Size of Panel (mm)
PT-01 (emulsion pain)	1m x 1m (of each colour with 2 optional colour in slight tonality (1 with light shade lighter and 1 with 1 shade darker)
PT-02 (PU paint)	1m x 1m (of each colour with 2 optional colour in slight tonality (1 with light shade lighter and 1 with 1 shade darker)

5.3 Inspections

Upon completion of the first section of any paint types, inform and request for an inspection from the SO. Proceed only after approval from the SO.

The SO will determine the extent of the this first section.

5.4 On-Site Tests

5.4.1 Watertightness Tests

No item.

5.4.2 Acoustic Tests

No item.

5.4.3 Pull-off Tests

Inform the SO when the first section of each painting or coating has cured. Undertake a pull-off test by pasting 5 lengths of 150 mm length of adhesive tapes onto the paint surface and pull off slowly. Should the paint be removed in any of the tests, undertake 5 more. Should any further failures occur, remove the paint from the wall by sanding down to a firm surface and repaint.

Tests shall be carried out in accordance with the ISO 4624 or ASTM D4541. Contractor shall incorporate repairs to damaged coatings since this is a destructive test.

5.4.4 Adhesion Tests

Carry out adhesion tests when directed by the SO. Ensure that all adhesion tests are carried out in accordance with SS 5.

5.4.5 Dry Film Thickness Measurements

Dry film thickness shall be measured for cured coatings. Carry out dry film thickness measurements when directed by the SO. Ensure that all dry film thicknesses are within the range recommended by the paint manufacturers.

5.4.6 Schedule of Tests

Carry out the following tests at locations selected by the SO throughout the progress of the Works:

Item	Clause Reference	Location	Total Number of Tests
Pull-off Test	5.4.3	.	.
Adhesion test	5.4.4	.	.
Dry Film Thickness	.	.	.
.	.	.	.
.	.	.	.

(8) A02-030 PLASTER AND RENDERS

1 GENERAL

Read this Section with G01-010 âGeneral Requirementsâ and all other contract documents

1.1 Scope

This Section covers the requirements for the application of plasters or renders to reinforced concrete and masonry surfaces.

1.2 Related Sections

Read this Section in conjunction with the relevant requirements of the following sections:

A01-010	Brickwork
A01-020	Blockwork
A01-030	Precast Concrete Panels
A01-040	Precision Blocks
A02-020	Paintings and Coatings
A02-040	Wall Tiling
A04-060	Windows
A09-010	Doors
A09-020	Roller Shutters
A14-020	Liquid Applied Membrane System
A14-030	Cementitious System
A15-010	Hardscape
A15-030	Pool Finishes

1.3 Standards, Codes, Regulations and Technical References

1.3.1 Standards and Codes

Unless otherwise agreed by the SO, ensure all of the Works comply with the relevant requirements of the standards and codes listed below or referenced in the body of the Specification. Alternative standards and codes may be proposed for approval by the SO, provided it can be demonstrated that the alternative standards and codes comply with the requirements of the standards specified. All standards and codes quoted are the current version, unless specific year references are noted.

In the event that the standards or codes are partially superseded or have become obsolete, refer to the current edition or the approved substitution for the relevant clauses.

Singapore Standards

SS EN 197-1	Cement – Part 1: Composition, Specifications and Conformity Criteria for Common Cement
SS EN 197-2	Cement – Part 2: Conformity Evaluation
SS EN 934 Series	Admixtures for Concrete, Mortar and Grout
SS CP 56	Code of Practice for Internal Plastering
SS CP 68	Code of Practice for Ceramic Wall and Floor Tiling
SS CP 90	Code of Practice for Design and Installation of Partition Walls
Other Standards	
BS EN 196 Series	Methods of Testing Cement
BS EN 459 Series	Building Lime
BS EN 480-1	Admixtures for concrete, mortar and grout – Test methods. Part 1: Reference concrete and reference mortar for testing
BS EN 934-3	Admixtures for Concrete, Mortar and Grout – Part 3: Admixtures for Masonry Mortar – Definitions, Requirements, Conformity and Marking and Labelling
BS EN 998-1	Specification for Mortar for Masonry – Part 1: Rendering and Plastering Mortar
BS EN 1015-11	Methods of Test for Mortar for Masonry – Part 11: Determination of Flexural and Compressive Strength of Hardened Mortar
BS EN 1015-12	Methods of Test for Mortar for Masonry – Part 12: Determination of Adhesive Strength of Hardened Rendering and Plastering Mortars on Substrates
BS EN 1015-19	Methods of Test for Mortar for Masonry – Part 19: Determination of Water Vapour Permeability of Hardened Rendering and Plastering Mortars
BS EN 1015-21	Methods of Test for Mortar for Masonry – Part 21: Determination of The Compatibility of One-Coat Rendering Mortars with Substrates
BS EN 1461	Hot Dip Galvanized Coatings on Fabricated Iron and Steel Articles – Specifications and Test Methods.
BS EN 1542	Products and Systems for The Protection and Repair of Concrete Structures – Test Methods – Measurement of Bond Strength by Pull-Off

BS EN 10088-1	Stainless Steel – Part 1: List of Stainless Steels
BS EN 12878	Pigments for The Colouring of Building Materials Based on Cement And/or Lime – Specifications and Methods of Test.
BS EN 13501-1	Fire Classification of Construction Products and Building Elements – Part 1: Classification Using Data from Reaction to Fire Tests
BS EN 13658-1	Metal Lath and Beads – Definitions, Requirements and Test Methods – Part 1: Internal Plastering
BS EN 13658-2	Metal Lath and Beads – Definitions, Requirements and Test Methods – Part 2: External Rendering
BS EN 13914-1	Design, Preparation and Application of External Rendering and Internal Plastering – Part 1: External Rendering
BS EN 13914-2	Design, Preparation and Application of External Rendering and Internal Plastering – Part 2: Internal Plastering
BS EN 15167-1	Ground Granulated Blast Furnace Slag for Use in Concrete, Mortar and Grout – Part 1: Definitions, Specifications and Conformity Criteria
BS EN 15167-2	Ground Granulated Blast Furnace Slag for Use in Concrete, Mortar and Grout – Part 2: Conformity Evaluation
BS EN 15743	Supersulfated Cement – Composition, Specifications and Conformity Criteria
BS EN ISO 14021	Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labelling)
BS EN ISO 14713	Zinc Coatings – Guidelines and Recommendations for The Protection Against Corrosion of Iron and Steel in Structures
BS 476	Fire Tests on Building Materials and Structures
BS 4551	Mortar – Methods of Test for Mortar and Screed– Chemical Analysis and Physical Testing.
BS 5270-1	Bonding Agents for Use with Gypsum Plasters and Cement – Part 1: Specification for Polyvinyl Acetate (PVAC) Emulsion Bonding Agents for Indoor Use with Gypsum Building Plasters
BS 8000-0	Workmanship on Construction Sites – Part 0: Introduction and General Principles
BS 8481	Design, Preparation and Application of Internal Gypsum, Cement, Cement and Lime Plastering Systems – Specification

AS 1530	Methods for Fire Tests on Building Materials, Components and Structures
AS 1530.4	Methods for Fire Tests on Building Materials, Components and Structures – Part 4: Fire-Resistance Test of Elements of Construction
ASTM C150	Standard Specification for Portland Cement
ASTM C423	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C634	Standard Terminology Relating to Building and Environmental Acoustics
ASTM C926	Standard Specification for Application of Portland Cement-Based Plaster
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E903	Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
EN 13823	Reaction to Fire Tests for Building Products – Building Products Excluding Floorings Exposed to The Thermal Attack by a Single Burning Item
EN ISO 1182	Reaction to Fire Tests for Products – Non-Combustibility Test
EN ISO 1716	Reaction to Fire Tests for Products – Determination of Gross Heat of Combustion (Calorific Value)
EN ISO 11925-2	Reaction to Fire Tests - Ignitability of Products Subjected to Direct Impingement of Flame – Part 2: Single-Flame Source Test
ISO 10545	Ceramic Tiles
ISO 13006	Ceramic Tiles – Definitions, Classification, Characteristics and Marking

1.3.2 Regulations

Refer to the following regulations for compliance in carrying out the Works:

Code for Environmental Sustainability of Buildings
Code of Practice for Fire Precautions in Buildings

The above regulations refer to the latest edition (including any amendments) that are currently in use.

1.3.3 Technical References

Refer to the following technical reference for guidance in carrying out the Works:

Building and Construction Authority Quality & Standard for Architectural Works PD 6678 & Guide to the Specification of Masonry Mortar
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1.4 Trade Preamble

1.4.1 Contractor's Submissions

The intended types of plasters and/or renders are set out in Section A02-030:Clause:3.1 and the locations are indicated in the drawings.

Engage qualified and experienced personnel to carry out the Works and submit the following items to the SO:

- (a) Names of suitable manufacturers/suppliers and technical information on products of prepacked plasters and/or renders where specified.
- (b) Statement of suitable mix and application methods taking into account the performance requirements as set out in Section A02-030:Clause:2.1.
- (c) Provide a laser survey to determine the plumb and alignment of the external columns, walls and corners of the building prior to commencement of renders.

1.4.2 Co-ordination with Other Works

Co-ordinate the Works, particularly the interfacing with the following work packages and trades, where applicable:

- (a) RC walls, columns and slabs
- (b) Masonry walls and partitions
- (c) Openings such as windows and doors, etc.
- (d) Waterproofing
- (e) Other finishes such as tiles, textured coatings, cladding, etc.

(f) Ceiling works

(g) Built-in furniture, accessories, devices, etc.

1.4.3 Provision of Spare Materials

No item.

1.4.4 Quality Control Plan

Prepare and submit a quality control plan to the SO.

1.4.5 Warranty

Provide the following warranties in accordance with the specimen warranty, or otherwise agreed with the SO:

Item of Works to be Warranted	Period of Warranty Required
All items as indicated	5 years from issuance of completion certificate
.	.

1.4.6 Maintenance Manual

No item.

1.5 Definitions and Abbreviations

The following definitions and abbreviations apply within this Section.

1.5.1 Definitions

1.5.1.1 bonding agent

A liquid applied to a masonry surface to increase the adhesion of the scratch coat to the surface or a liquid added to a sand/cement plaster mix to increase adhesion

1.5.1.1 final coat

Normally a plaster coat applied over the scratch coat and finished to a level 2 mm to 4 mm below the final level, with a wood float finish if it is to receive a final finishing coat of gypsum plaster. If the surface is to be painted, the final coat can receive a steel trowelled finish, that provides a smooth dense surface.

1.5.1.2 plasters

Cement-based products applied on internal walls.

1.5.1.3 renders

Cement-based products applied on external walls.

1.5.1.1 scratch coat

The first coat applied to the surface of a new wall, normally scratched to provide a key for the final coat.

1.5.1.1 skim coat

A thin coat (maximum 6 mm) of premixed or prepacked mortar with polymer additive to achieve a smooth surface.

1.5.1.1 skim coat onto gypsum plasterboard

A thin gypsum-based coat applied onto plasterboard walls in a thickness of 2 mm to 4 mm.

1.5.1.2 spatterdash coat

A keying mix of one part cement to one-and-half parts clean sharp coarse sand and additive mixed to a slurry paste and applied to the wall surface.

1.5.1.3 styrene butadiene rubber (SBR)

This is styrene butadiene rubber in liquid form, added to cement plaster mixes to improve flexural strength and provide additional adhesion to the plaster to the surface.

1.5.2 Abbreviations

1.5.2.1 NRC

Noise Reduction Coefficient

1.5.2.2 STC

Sound Transmission Class

2 PERFORMANCE REQUIREMENTS

2.1 Contractor's Brief

When carrying out the proposals as set out in A02-030:Clause:1.4.1, ensure that there is no undue shrinkage cracks in the Works and take account of the performance requirements listed below.

2.1.1 Structural Movement and Movement between Other Works

Take into account that performance, appearance and proper functioning of the Works are not affected by any movements, settlements, deflections, or expansions or contractions that can be expected to occur in the building or during the construction process.

Junctions between the Works and adjacent works by others shall be formed to take into account possible structural deflections or movements in that adjacent element without distortion to the Works, or compromise to or disintegration of joints between works.

2.1.2 Environmental

Take into account the environment for which the Works shall to be applied, paying particular attention to the following environmental effects:

- (a) Daily variations in humidity and temperature resulting from air-conditioning within the building.
- (b) For non-air-conditioned areas, daily and seasonal variations in rainfall, humidity and temperature.
- (c) Humidity / damp variations / other consequences resulting from the activities occurring within the spaces for which the Works are applied or are in proximity.

2.1.3 Thermal Performance

The rendering must achieve the "U" value as indicated for the wall with application. Refer to the relevant sections under Section A01-010 "Brickwork", Section A01-020 "Blockwork", Section A01-030 "Lightweight Concrete Panels" and Section A01-040 "Precision Blocks".

2.1.4 Fire Performance

2.1.4.1 Combustibility

The works shall be non-combustible throughout.

2.1.4.2 Fire Rating

The plasters and/or renders must achieve the fire rating as indicated for the wall with application. Refer to the relevant sections under Section A01-010 "Brickwork", Section A01-020 "Blockwork", Section A01-030 "Lightweight Concrete Panels" and Section A01-040 "Precision Blocks".

2.1.5 Acoustic Performance

2.1.5.1 Sound Absorption

Achieve NRC rating if specified in Section A02-030:Clause:3.1, when tested to ASTM C423.

2.1.5.2 Sound Insulation

The plasters and/or renders must achieve the STC rating as indicated for the wall with application. Refer to the relevant sections under Section A01-010 "Brickwork", Section A01-020 "Blockwork", Section A01-030 "Lightweight Concrete Panels" and Section A01-040 "Precision Blocks".

2.1.6 Appearance

Include any measures necessary to ensure that the surface finishes are uniform in colour, texture and appearance throughout.

Achieve surface level tolerance as set out in Section A02-030:Clause:4.1.

If plane and level surface is not possible within the tolerance allowed by the thickness of the plastered or rendered surface, submit to the SO remedial measures to account for the inaccuracies of substrates (walls and structures). Thicker plasters or renders may be applied, if necessary, to achieve a plane and level surface, subject to prior approval of the SO.

3 MATERIALS

3.1 Plaster and Render Types

Internal plaster (IP) shall consist of the following types:

Type: IP-1		
Item	Requirements	Clause Reference(s)
Substrate	.	.
Plasters	.	.
-Proprietary Product	.	.
-Mix	<i>(Not applicable if using premixed mortar system or pre-packed mortar mix)</i>	.
-Thickness	.	.
Final Coat	.	.
-Mix	<i>(Not applicable if using premixed mortar system or pre-packed mortar mix)</i>	.
-Additives	<i>(Waterproof additive, binder, plasticiser, etc.)</i>	.
Skim Coat	.	.
-Proprietary Product	.	.
-Thickness	.	.
-Additives	<i>Waterproof additive</i>	.
Beads	.	.
Lathing	.	.
Fire Rating	<i>Refer to requirements for wall</i>	.

Acoustic Rating	<i>NRC (between 0.5 to 1.0).</i>	.
Tests	<i>Refer to A02-030:Clause:5.1.3 a</i>	.
Certificates	<i>Refer to A02-030:Clause:5.1.3 b</i>	.

External render (ER) shall consist of the following types:

Render Type:ER-1		
Item	Requirements	Clause Reference(s)
Substrate	.	.
Renders	.	.
-Proprietary Product	.	.
-Mix	<i>(Not applicable if using premixed mortar system or pre-packed mortar mix)</i>	.
-Thickness	.	.
Final Coat	.	.
-Mix	<i>(Not applicable if using premixed mortar system or pre-packed mortar mix)</i>	.
-Additives	<i>(Waterproof additive, binder, plasticiser, etc.)</i>	.
Skim Coat	.	.
-Proprietary Product	.	.
-Thickness	.	.
-Additives	<i>Waterproof additive</i>	.
Beads	.	.
Lathing	.	.
U-value	<i>Refer to requirements for wall</i>	.
Fire rating	<i>Refer to requirements for wall</i>	.
Tests	<i>Refer to A02-030:Clause:5.1.3 a</i>	.
Certificates	<i>Refer to A02-030:Clause:5.1.3 b</i>	.

3.2 Cement

Ordinary Portland cement: Grey or white to SS EN 197 Series. Coloured cement for integral coloured plasters or renders may have colouring additives not exceeding 5% of the cement by weight incorporated. Colours shall be directed by the SO.

For sustainable construction, use green cement with approved industrial by-product to replace ordinary Portland cement by at least 10% by mass.

3.3 Gypsum Plaster

Conform to BS 8481.

3.4 Sand

Conform to BS EN 13139.

3.5 Water

Water shall be potable, clean and fresh, and free from mineral and organic substances.

3.6 Beads

3.6.1 Corner Beads

For plastering, galvanised steel (450g) to BS EN 13658-1, stainless steel grade 1.4401 to BS EN 10088-1, or polyvinyl chloride (PVC) to BS EN 13658-1 and BS EN 13914-2 (refer to Section A02-030:Clause:3.1).

For rendering, stainless steel Grade 1.4401 to BS EN 10088-1, or PVC to BS EN 13658-2 and BS EN 13914-1 (refer to Section A02-030:Clause:3.1). Galvanized steel shall not to be used.

Nominal sizes shall be 5 mm bead with 62 mm minimum wings, subject to manufacturer's recommendations.

3.6.2 Casing Beads

For plastering, galvanized steel (450 g) to BS EN 13658-1, stainless steel Grade 1.4401 to BS EN 10088-1, or PVC to BS EN 13658-1 and BS EN 13914-2 (refer to Section A02-030:Clause:3.1).

For rendering, stainless steel Grade 1.4401 to BS EN 10088-1, or PVC to BS EN 13658-2 and BS EN 13914-1 (refer to Section A02-030:Clause:3.1). Galvanized steel not to be used.

Nominal sizes to be 5 mm return square-edged bead with 75 mm wide wing depth to suit plaster or render thickness. Materials, gauges and sizes shall be to manufacturer's recommendations.

3.6.3 Control Beads

For plaster-to-plaster surfaces, or render-to-render surfaces, use 2 casing beads back-to-back of the same type and manufacturer as specified for casing beads. For joints between plasters or renders and dissimilar materials, use a single casing bead.

3.6.4 Expansion Joint Beads

For plasters, galvanised steel, stainless steel or PVC with adjustable opening, subject to manufacturer's recommendations.

For renders, stainless steel with adjustable openings to manufacturer's recommendations. Galvanised steel shall not be used.

Gauges and sizes shall be to manufacturer's recommendations.

3.6.5 Special Beads and Accessories

Provide "shadow gap" beads at all wall/ceiling junctions.

3.7 Lathing

For plasters, use galvanised steel, stainless steel or PVC self-furring diamond mesh, standard diamond mesh, flat rib, or 10 mm rib.

For renders, use stainless steel or PVC self-furring diamond mesh, standard diamond mesh, flat rib, or 10 mm rib. Galvanised steel shall not be used.

Refer to Section A02-030:Clause:3.1 for types required. Gauges and sizes shall be to manufacturer's recommendations.

Corner lath shall be 75 mm wide wings, or as indicated in the drawings. Rib lath shall be integrally ribbed with 10 mm deep ribs.

3.8 Materials for Plastering and Skimming Works

3.8.1 Mortar Mix

3.8.1.1 General

Mortar shall comply with the following:

- (a) Tensile adhesion strength: ≥ 0.75 N/mm² when tested to BS EN 1015-12.
- (b) Shear adhesion strength: ≥ 1.00 N/mm² when tested to BS EN 1015-12.
- (c) Average shrinkage: $\leq 0.10\%$ when tested to ASTM C531.

3.8.1.2 Premixed or Prepacked

Use premixed mortar system or prepacked mortar mix specified in Section A02-030:Clause:3.1 for all plastering and rendering works on masonry walls, block walls and RC surfaces. The premixed mortar system shall be a fully-automated system that stores, conveys and mixes mortar for instant application. The prepacked mortar mix shall be in bag form, and to be mixed mechanically according to the manufacturer's recommendations.

Refer also to BCA Quality Standard for Architectural Works for requirements on plastering using prepacked plaster.

3.8.1.3 Plaster or Render Mixes

If premixed mortar system or prepacked mortar mix is not specified, use plaster or render mixes to specified cement to sand ratios, including additives specified in Section A02-030:Clause:3.1, and mechanically mix in accordance with manufacturer's recommendations.

"Shovel" measurements and hand mixing are not permitted.

Add minimum quantity of water to produce sufficient workability.

Clean mixer and remove all set or hardened materials prior to loading mixer with each new batch of materials. Mix each batch separately.

Do not re-temper or use partially set materials.

Do not use caked or lumpy material.

3.8.2 Skimming Materials

3.8.2.1 General

Use proprietary product for all skimming works, to comply with the following:

- (h) Tensile adhesion strength: ≥ 0.80 N/mm² when tested to BS EN 1015-12.
- (i) Average shrinkage: $\leq 0.10\%$ when tested to ASTM C531.
- (j) Polymer content: minimum 1% by mass for internal application, minimum 2% by mass for external application.

Mechanically mix the prepacked skimming materials according to the manufacturer's recommendations.

3.8.2.2 Skim Coat onto Sand Cement Substrates

Use gypsum skim plaster.

3.8.2.3 Skim Coat onto RC

Use proprietary skim coat containing polymer additives.

3.8.3 Cement Plaster

3.8.3.1 Scratch Coat (on Metal or PVC Lath)

Scratch coat shall be one part cement to four parts damp, loose sand, by volume, plus 0.05 kg of binder to each sack (50 kg) of cement.

3.8.3.2 Scratch Coat (on Brickwork or Concrete)

Scratch coat (on brickwork or concrete) shall be the same as scratch coat (on metal or PVC lath), but with no binder.

3.8.3.3 Finish Coat

One part cement, four parts damp, loose sand, by volume or 2 mm to 4 mm gypsum plaster. Refer to Section A02-030:Clause:3.1 for final coat.

3.8.4 Gypsum Plaster Skim Coat

Gypsum plaster skim coat shall be proprietary mix for thin coat application onto sand cement base.

3.8.5 Grouting for Metal Door and Window Frames

Grouting for metal door and window frames shall be one part cement to three parts damp loose fine sand, by volume.

4 WORKMANSHIP

4.1 General

All plastered and rendered finished surfaces shall be plumb, level and true, accurately finished to planes or profiles indicated, without trowel marks or defects.

Extend plasters on vertical surfaces from floor to at least 100 mm above the ceiling height or to full height to underside of structural slab or beam above, or otherwise as indicated in the drawings.

Terminate plaster and render works at the end of each day at casing bead, corner, opening or other acceptable intersection of surfaces.

Angles, intersections and corners shall be clean, sharp and accurately formed.

Flat surfaces to be level and true within 4 mm in 3 m (measured in any direction), checked with a metal straight edge. Curved, radial, splayed or irregular plastered surfaces shall be true to profile, and to be formed and verified by means of accurate metal forms and templates.

Do not use or remix partially or wholly set plasters or renders.

4.1.1 Delivery, Storage and Handling

- (a) All materials shall be delivered to Site in original packaging, containers or bags bearing manufacturer's brand name and identification.
- (b) Materials shall be stored inside, under cover and kept dry at all times, protected from the weather and contamination.

4.1.2 Preparation for Plastering and Rendering

Clean masonry, concrete, lath and other backing surfaces of dust, dirt, debris, oil or any other detrimental materials.

Correct irregular brick and concrete surfaces that cannot be covered by plasters or renders prior to scratch coat applications.

Paint all rust producing surfaces with rust inhibitive paint where plasters or renders are in direct contact.

Examine works to ensure that all casing beads, corner beads, screeds, joints and other accessories are properly secured and accurately located.

Unless otherwise agreed, add SBR bonding agent to brick and concrete surfaces prior to scratch coat applications in accordance with manufacturer's instructions.

4.1.3 Chases

If chases or recesses are more than 50 mm wide, cover with lath extending 75 mm beyond each side of the recess. Increase plasters or renders to a finished thickness not exceeding 20 mm to allow for concealment of M&E services.

4.1.4 Angles in Plastering

Internal angles, external angles, etc., shall be straight plumbed and slightly rounded.

4.1.5 Making Good

Making good of defectives or renders shall be carried out in rectangular areas, the edges undercut to form dovetailed key, and finished flush with face of surrounding plasters or renders.

4.2 Plastering and Rendering Applications

4.2.1 Plastering or Rendering onto RC Surfaces

Clean, using high-pressure water jet, to free the surface of dust, residues of any form of oil and organic growth prior to the application of plasters or renders.

Apply spatterdash coat of 3 mm to 5 mm coat thrown onto concrete surface and kept damp with water spray. Allow to dry out slowly and harden before applying second coat.

On dense high strength concrete surface, add SBR bonding agent to scratch coat applications in accordance with manufacturer's instructions.

First coat of the plasters or renders to be of a thickness between 5 mm to 8mm and be pressed hard onto the surface. Lightly scratch to provide key for the second coat and allow to cure before the application of the second coat.

Thickness of plastering or rendering on RC surfaces to be a minimum of 5 mm and not exceeding 18 mm. Should the structural works be constructed with good alignment and surface condition, application of a thinner coat of plasters or renders or skimming may be proposed subject to approval by the SO. The finished surfaces shall be smooth and true to plane and shape.

Total thickness of plasters or renders not to exceed 18 mm on vertical surfaces or 13 mm on horizontal surfaces.

4.2.2 Skim Coat onto RC Surfaces

Fill surfaces and irregularities of concrete surfaces.

Apply bonding agent according to manufacturer's instructions.

Remove all protrusions, fins, imperfections and blemishes from concrete surfaces.

Apply skim coat 3 mm to 5 mm thick. Finish coat shall be smooth, level, plumb, true finish and free of waves, trowel or brush marks, telegraphing or other defects.

Water-cure skim coats commencing 12 hours after completion by fog spraying very lightly and then continue fog spraying for 36 hours. Protect against rapid drying until the whole surface is thoroughly cured.

Skim coat plasters or renders (on concrete surfaces) shall be provided where shown in the drawings or as stated in schedules of finishes.

4.2.3 Plastering or Rendering onto Masonry Surfaces

Clean the substrates to remove all laitance, dust, oil or other substances that affect the bonding. Wash the substrates using water jet. Dampen surfaces prior to scratch coat application to obtain uniform suction.

Apply premixed plasters or renders to the substrate to a finished thickness of 8 mm to 10 mm to achieve a flat and even surface. Lightly scratch to provide key for the second coat. Keep damp for 24 hours and allow to dry before the application of the second coat.

Apply the necessary number of coats to achieve a flat, true and uniform surface.

For plastering, final coat shall be 3 mm to 5 mm layer of gypsum skim plaster or otherwise noted in Section A02-030:Clause:3.1.

For rendering, final coat shall be 6 mm to 10 mm thick or otherwise noted in Section A02-030:Clause:3.1.

4.2.4 Plasters or Renders onto Lath

4.2.4.1 Scratch Coat

Apply scratch coat on lath approximately 9 mm thick with sufficient force to form good key. Adhere firmly and form good bond into lath. Scratch surface horizontally. Keep coat moist with fog spray of water until scratch coat has cured (about 4 to 5 hours), or for 48 hours if finish coat is not to be applied immediately after scratch coat has set.

Scratch coat on concrete surfaces shall be water cured with fog spray for 48 hours and then allowed to dry for at least 24 hours.

4.2.4.2 Final Coat

Dampen scratch coat prior to final coat application to obtain uniform suction. Apply final coat approximately 6 mm to 9 mm thick, bring out to face of grounds and bring to a true surface with straight edge, and float to a uniform texture to receive finish coat. Keep final coat moist with fog spray of water for 48 hours, then allow to dry for a minimum of 5 days.

4.2.5 Grouting of Metal Door and Window Frames

Where metal door or window frames are fixed to walls to be plastered or rendered, fill the frames, grounds and beads solid with plasters or renders during application. Cut back base and finish coats where plastered or rendered finishes against metal frames. Use waterproof grout at external door or window junctions.

4.3 Drips and Grooves

Form drips and grooves to give a clean, clear and straight surface free from loose sandy mortar. Use forms to achieve a straight edge. Pay attention to ends of drips to avoid water ingress due to surface tension or gravity flow.

Form grooves with proprietary channels with warranty for use in the tropics and provisions for anti-staining and anti-streaking features.

4.4 Beads

4.4.1 Corner Beads and Casing Beads

- (a) Use longest lengths so as to minimise joints between members. Wedge beads as necessary to provide proper ground for plastered or rendered finishes.
- (b) Secure beads to lath with tie wires, at ends and at 300 mm maximum apart.
- (c) Install corner beads at all external corners and install casing beads where plasters or renders terminate or abut dissimilar surfaces.

4.4.2 Movement Joints

Include plaster or render expansion joints over all movement joints in the building structure.

4.5 Making Good

Carry out making good of defective plasters or renders in rectangular areas, the edges undercut to form dovetailed key and finished flush with face of surrounding plasters or renders.

4.6 Repairs

Repair, point, cut and patch all plaster or render works around all work abutting, setting or extending into plastered or rendered surfaces after work of other trades are in place.

- (a) Repair plasters or renders disturbed or damaged due to installation of work of other trades.
- (b) Cut out and repair all plasters or renders in which hairline cracks, pits, checks, waves, blisters, discolouration or other defects develop.
- (c) Cut out and replace with new materials all beads or frames that are rusted, improperly set, out of alignment or otherwise defective.

Repair works shall be thoroughly raked or cut out, moistened and filled with plaster or render finishing coat materials, surfaces floated or trowelled flush to match adjoining works. Use bonding agent on existing plaster or render edges or surfaces to which new plasters or renders will be applied.

4.7 Cleaning

Clean all finishes and adjoining works immediately upon completion of plaster or render works. Remove stains, finger marks, any other marks and writing.

4.8 Protection

Protect plastered or rendered surfaces from dust, dirt and draught during plastering or rendering application until completely cured.

5 VERIFICATION AND SUBMISSION

5.1 Submissions

5.1.1 Technical Submissions

Include in the construction programme, events for submission of the following information:

- (a) Name of manufacturers of all specified or proposed premixed plasters/renders for each of the plaster/render types, additives, beads, drips, grooves, etc.

- (b) Technical data for all specified or proposed premixed plasters/renders for each of the plaster/render types, additives, beads, drips, grooves, etc.
- (c) All other submissions specified below.

5.1.2 Work Submissions

Prepare and submit to the SO the following information:

- (a) Method statements.

5.1.3 Test Reports and Certificate Submissions

Submit relevant test reports and certificates from a recognised Certification Body to demonstrate compliance with all required material characteristics specified.

- (a) Tests

Carry out tests as follows:

Material	Test	Description
.	.	.
.	.	.

[Note: Check the required certification under the BCA Approved Document, Code for Environmental Sustainability of Buildings, Fire Code, etc.]

- (b) Certificates

Provide certificates as follows:

Material	Certificate	Description
.	.	<i>Sustainable Product Certification</i>
.	.	.

[Note: Check the required certification under the BCA Approved Document, Code for Environmental Sustainability of Buildings, Fire Code, etc.]

5.1.4 Quality Plan Control Submissions

Prepare and submit the quality control plan to the SO prior to start of any works.

5.1.5 Warranty

Submit the warranty to the SO upon completion of the Works, as required under Section 02-030:Clause:1.4.5.

5.1.6 Maintenance Submissions

No item.

5.2 Samples and Mock-Ups

5.2.1 Samples

Submit the following samples:

1 m length of all beads.

[Note: State other samples required.]

5.2.2 Mock-Ups

One wall, location to be agreed with the SO, shall be completed for each of the types of plasters and/or renders specified in Section 02-030:Clause:3.1.

The mock-up may form part of the final construction, if approved.

Provide additional mock-ups as follows:

Mock-Up	Size of panel (mm)	Description
.	.	.
.	.	.
.	.	.

Do not proceed with other plastering or rendering works until the SO has approved the mock-ups.

5.3 Inspections

Give at least 7 days' notice to the SO when the first sections of the following are ready for inspection:

- (a) Preparation of the substrate
- (b) Completion of any plaster or render type
- (c) Grouting of door and/or window frames

Proceed with other areas only after approval by the SO.

The SO will determine the extent of these first sections.

5.4 Tests

5.4.1 Watertightness Tests

Carry out tests on rendering works, to the relevant sections under Section A01-010 "Brickwork", Section A01-020 "Blockwork", Section A01-030 "Lightweight Concrete Panels" and Section A01-040 "Precision Blocks" under A01 Masonry.

5.4.2 Acoustic Tests

Conduct field tests and measurements at locations to be agreed with the SO, to verify that acoustic rating specified in Section A02-030:Clause:3.1 is achieved.

5.4.3 Tap Tests

Tap all walls at centres of not more than 600 mm 10 days after installation of final coat, to identify any hollow areas.

Submit remedial measures for any hollow areas to the SO.

5.4.4 Adhesion Tests

Conduct pull-out tests on plasters and/or renders where required by the SO. The first test is to be conducted at an early stage of plastering and/or rendering works. The remaining tests to be spread out and carried out progressively.

Each test shall cover five randomly selected spots and conducted within 21 days to 28 days after plastering or rendering. The test spots shall be cut to a size of 75 mm x 75 mm for the pull-out test.

The average tensile pull-out strength of the 5 spots for:

- Plastering works shall achieve a minimum value of 0.35 N/mm². No individual test shall fall below 0.25 N/mm².

- Rendering works shall achieve a minimum value of 0.40 N/mm². No individual test shall fall below 0.30 N/mm².

(9) A02-040 WALL TILING

1 GENERAL

Read this Section with G01-010 "General Requirements" and all other contract documents.

1.1 Scope

This Section covers the requirements for adhesive fixed internal wall tiling and on external walls, and ceramic and homogenous tiled finishes. For floor tiling, refer to Section A07-06 "Floor Tiling". Details of the render coatings for the adhesive fixing of wall tiles are set out in Section A02-030 "Plasters and Renders".

1.2 Related Sections

Read this Section in conjunction with the relevant requirements of the following sections:

A01-010	Brickworks
A01-020	Blockworks
A01-030	Precast Concrete Panels
A02-030	Plaster and Renders
A04-030	Stone Cladding
A07-010	Floor Screeds and Hardeners
A07-070	Floor Tiling
A14-010	Damp-proof Membranes
A14-020	Liquid-applied Membrane System
A14-030	Cementitious System
A15-010	Hardscape
A15-030	Pool Finishes

1.3.1 Standards and Codes

Unless otherwise agreed by the SO, ensure all of the Works comply with the relevant requirements of the standards and codes listed below or referenced in the body of the Specification. Alternative standards and codes may be proposed for approval by the SO, provided it can be demonstrated that the alternative standards and codes comply with the requirements of the standards specified. All standards and codes quoted are the current version, unless specific year references are noted.

In the event that the standards or codes are partially superseded or have become obsolete, refer to the current edition or the approved substitution for the relevant clauses.

Singapore Standards	
SS EN 12620	Specification for Aggregates for Concrete
SS CP 68	Code of Practice for Ceramic Wall and Floor Tiling

SS 32	Welded Steel Fabric for The Reinforcement of Concrete
SS 485	Specification for Slip Resistance Classification of Public Pedestrian Space Surface Materials
Other Standards	
BS EN 197-1	Cement – Part 1: Composition, Specifications and Conformity Criteria for Common Cements
BS EN 998-2	Specification for Mortar for Masonry – Part 2: Masonry Mortar
BS EN 12004-1	Adhesives for Ceramic Tiles – Part 1: Requirements, Assessment and Verification of Constancy of Performance, Classification and Marking
BS EN 12004-2	Adhesives for Ceramic Tiles – Part 2: Test Methods
BS EN 12808-2	Grouts for Tiles – Part 2: Determination of Resistance to Abrasion
BS EN 12808-3	Grouts for Tiles – Part 3: Determination of Flexural and Compressive Strength
BS EN 12808-4	Grouts for Tiles – Part 4: Determination of Shrinkage
BS EN 12808-5	Grouts for Tiles – Part 5: Determination of Water Absorption
BS EN 13888	Grout for Tiles – Requirements, Evaluation of Conformity, Classification and Designation
BS EN 14411	Ceramic Tiles – Definitions, Classification, Characteristics, Assessment and Verification of Constancy of Performance and Marking
BS 4483	Steel Fabric for the Reinforcement of Concrete – Specification
BS 4551	Mortar – Methods of Test for Mortar and Screed – Chemical Analysis and Physical Testing
BS 5385	Wall and Floor Tiling
BS 7976	Pendulum testers
ISO 8339	Building Construction — Sealants — Determination of Tensile Properties (Extension to Break)
ISO 10545	Ceramic Tiles

ISO 13006	Ceramic Tiles- Definitions, Classifications, Characteristics and Marking
ISO 13007-1	Ceramic Tiles – Grouts and Adhesives – Part 1: Terms, Definitions and Specifications for Adhesives
ISO 13007-2	Ceramic Tiles — Grouts and Adhesives — Part 2: Test Methods for Adhesives
ISO 13007-4	Ceramic Tiles — Grouts and Adhesives — Part 4: Test Methods for Grouts
ASTM C920	Standard Specification for Elastomeric Joint Sealants
AS 3958.1	Ceramic Tiles – Guide to The Installation of Ceramic Tiles
ANSI A108-A118-A136.1	American National Specifications for the Installation of Ceramic Tile
CEN/TS 15209	Tactile Paving Surface Indicators Produced from Concrete, Clay and Stone

1.3.2 Regulations

Refer to the following regulations for compliance in carrying out the Works:

Building and Construction Authority â Approved Document ("Approved Document")
Building and Construction Authority â Construction Quality Assessment System (CONQUAS) Manual

The above regulations refer to the latest edition (including any amendments) that are currently in use.

1.3.3 Technical References

Refer to the following technical reference for guidance in carrying out the Works:

Building and Construction Authority â Good Industry Practice Guide for Ceramic Tiles
--

1.4 Trade Preamble

1.4.1 Contractorâs Submissions

The intended types of applied tiled finishes for the Project are set out in the Section A02-040:Clause:3.1 and locations are indicated in the drawings.

Engage qualified and experienced personnel to carry out the Works and submit the following items to the SO:

- (a) Develop all necessary details for the tiling layout (including co-ordination and setting-out details) based on the design drawings.

- (b) Submit tiles, tile bedding, adhesives, sealants and grouts. Submit technical literature (including data on Items listed in Section A02-040:Clause:5.4.1 below) on the products selected. Submit evidence of product conformity for the following:
 - Marking and classification of tiles with regards to water absorption and shaping to ISO 13006.
 - Marking and classification of tile adhesives to ISO 13007-1.
- (c) Submit labelled samples of tiles, including fittings, accessories, grouts and sealants, illustrating the range of variations in colours and finishes.
- (d) Submit suitable method of laying and fixing the tiles to meet specified performance requirements.
- (e) Submit suitable proprietary products and suppliers when required.
- (f) Test reports for each type of tiles for the following:
 - (i) Dimensional tolerances (ISO 10545-2)
 - (ii) Straightness of sides (ISO 10545-2)
 - (iii) Squareness (ISO 10545-2)
 - (iv) Flatness of surface (ISO 10545-2)
 - (v) Surface quality (ISO 10545-2)
 - (vi) Water absorption (ISO 10545-3)
 - (vii) Breaking strength (ISO 13006, ISO 10545-4)
 - (viii) Modulus of rupture (ISO 10545-4)
 - (ix) Thickness & Impact resistance (ISO 10545-5)
 - (x) For ceramic tiles & Craze resistance (ISO 10545-11)
 - (xi) Colourfastness and lightfastness
 - (xii) Acid resistance and alkali resistance
 - (xiii) Stain resistance (ISO 10545-14)
 - (xiv) Chemical resistance (ISO 10545-13)

1.4.2 Co-ordination with Other Works

Co-ordinate the internal and external wall tiling works, in particular, interfacing with the following work packages and trades:

- (a) Internal walls including masonry walls, drywalls, precast lightweight partition walls and reinforced columns and walls, including openings such as kitchen hatches.
- (b) External walls including masonry walls, precast lightweight partition walls and reinforced columns, and walls including openings such as windows.
- (c) Doors and glass panels.
- (d) Sanitary fittings.
- (e) External and internal plasterings.
- (f) Internal service runs and outlets, such as at kitchens and pantries.
- (g) Structural expansion joints.
- (h) Waterproofing works.

Liaise and co-ordinate with SO for location of all services buried beneath tiling in walls.

1.4.3 Provision of Spare Materials

Deliver to site in strong protective packages marked for identification, and store where directed, components and materials for future replacements and repairs.

Allow for sufficient quantities of the various individual tiles from the same production batch for timely rectification works during construction and Defects Liability Period.

Provide the following spare material and store in an area agreed with the SO:

Item	Quantity
.	.
.	.

1.4.4 Quality Control Plan

Provide an Inspection and Test Plan as described in the Building and Construction Authority Good Industry Practice Guide for Ceramic Tiles and/or as agreed with the SO.

1.4.5 Warranty

Provide a 5-year warranty in accordance with contract conditions for the bonding of tiles for the scope shown in the drawings or as agreed with SO.

1.4.6 Maintenance Manual

Provide a Maintenance Guide including methods for maintaining the installed tiles and related products, and precautions against cleaning materials and methods detrimental to finishes and performances, where applicable.

1.5 Definitions and Abbreviations

No item.

2 PERFORMANCE REQUIREMENTS

2.1 Contractor's Brief

When carrying out the proposals as set out in A02-040:Clause:1.4.1, take account of the requirements listed below.

2.1.1 Dead Loads

The self-weight and other associated dead loads of the complete tiling works (tile layers and sub-layers) shall be supported and transferred to the main building structure.

2.1.2 Wind Load

Take into account wind loads where applicable. Also take cognisance and request from the SO the likely wind load that will be imposed on the walls.

2.1.3 Deterioration of Grout

Take cognisance and incorporate appropriate grout products for walls facing the sea.

2.1.4 Structural Movement and Movement between Works by Others

Take into account, that the performance, appearance and proper functioning of the Works are not affected by any movements, settlements or deflections in the building structure that can reasonably be expected to occur. Also take into account the construction accuracy of works by others to which the tiling works are attached.

3 MATERIALS

3.1 Types of Tiled Finishes

External Wall Tiles (EWT) for this Project shall consist of the following:

Tile Finishes Type: <i>EWT-1</i>		
Item	Product/Manufacturer	Clause Reference
Tile	.	.
Type	.	.
Size	.	.
Base	.	.
Adhesion Method	.	.
Adhesive	.	.
Joint Width	.	.
Grout	.	.
Movement Joint Sealant	.	.
Skirting	.	.
Terminations	.	.
Waterproofing	.	.
Tests Certificates Required	.	.

Internal Wall Tiles (IWT) for this project shall consist of the following:

Tile Finishes Type: <i>HT-02</i>		
Item	Product/Manufacturer	Clause Reference
Tile	White Honed	.
Type	Homogeneous Tile	.
Size	300 x 600 x 10mm	.
Base	.	.
Adhesion Method	.	.
Adhesive	.	.
Joint Width	+/- 1mm	.
Grout	.	.
Movement Joint Sealant	.	.
Skirting	Ref to drawing	.
Terminations	Corner homogenous tile with metal trimming	.
Waterproofing	Ref to drawing	.
Tests Certificates Required	Skid Resistance Slipperiness	.

3.2 Tiles

3.2.1 Ceramic and Homogeneous Tiles

Consistent in colour, tonality and finish (and preferably from the same production batch).
Comply with the requirements of ISO 13006.

3.3 Sand

Clean and graded natural sand, free from efflorescing salts complying with SS EN 12620.

3.4 Cement

Comply with BS EN 197-1.

3.5 Water

All water shall be potable.

3.6 Adhesives

3.6.1 General

Provide adhesives compatible with the materials and surfaces to be adhered and as documented. Use adhesives strictly in accordance with manufacturers's instructions.

Comply with BS EN 12004.

3.6.2 Cementitious Adhesives

Mixture of hydraulic binding agents, minerals, polymeric and other organic additives. Mix thin set mortar with water before use.

Where used in wet areas, consult manufacturers's literature and mix with latex admixture rather than water.

3.6.3 Latex Portland Cement Mortar

Modified Portland cement mortar with polymer additive suitable for use as thin bed mortar.
Comply with BS EN 12004. Follow manufacturers's instructions for use.

3.6.4 Dispersion Adhesives

Use ready-to-use mixtures. Do not use in wet areas.

3.7 Spatterdash

Spatterdash comprising 1 to 1.5 parts Portland cement, to BS EN 197, to 2 parts clean sharp sand. Mix to a thick slurry and keep well stirred.

3.8 Grouts

3.8.1 Types

Cement-based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

General purpose cement-based grout: Mix with fine sand. Provide minimum water consistent with workability.

Mix proportions (cement:sand), by volume:

- For joints <3 mm: 1:2.

- For joints ≥3 mm: 1:3.

For fresh water swimming pools and water feature applications, only epoxy grout shall be used.

3.8.2 Pigments

Pigments for coloured grouts to SO's selection. Provide colourfast fillers compatible with the grout materials. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.

3.8.3 Joints

For joints up to 3 mm, use proprietary unsanded grouts with polymer additives and colouring pigments. Colour to the SO's selection.

For joints 3 mm to 12 mm, use proprietary sanded grouts with polymer additives and colouring pigments. Colour to the SO's selection.

3.9 Sealants and Accessories

3.9.1 Sealants

Refer to A02-040:Clause:3.1 for proprietary product selected for the Project. Use only non-bleed, non-stain, neutral cure silicone sealant.

3.9.2 Joint Fillers

Polyethylene rod. Submit proprietary product to the SO.

3.9.3 Trim Tiles

Submit proprietary products to the SO.

3.10 Waterproof Membranes

Submit suitable product to the SO. Refer to Section A14-020 "Liquid-Applied Membrane System" and Section A14-030 "Cementitious System" for general requirements of waterproofing materials. Refer to Section A02-040:Clause:3.1 for particular waterproofing product specified under the tiles, if any.

3.11 Crack Control Reinforcements

Provide galvanised 25 mm mesh centre, wire no less than 1.0 mm diameter to SS 32 or BS 4483 at joint locations.

3.12 Joints

3.12.1 Joint Widths

Joint widths shall be consistent throughout installation unless specified otherwise.

The minimum joint widths are as follows:

3.12.1.1 Floors

Dust-pressed tiles: 3 mm

Extruded tiles: 6 mm

3.12.1.2 Walls

Dust-pressed tiles: 1.5

mm Extruded tiles: 6 mm

4 WORKMANSHIP

4.1 Delivery, Handling and Storage

4.1.1 Delivery

All tiles shall be delivered to Site in original packaging, containers or bundles bearing manufacturer's brand name and identification, and shall be inspected on delivery for compliance with approved samples. Any damaged tiles to be rejected.

4.1.2 Handling

Handle tiles in a manner to ensure no damage occur, with particular care taken to protect edges.

4.1.3 Storage

Tiles shall be stored indoor, level, under cover and kept dry at all times, protected from the weather, other elements and damage from construction operations and other causes.

Protect all tiles, components and accessories from being chipped or damaged.

4.2 Preparation of Wall Substrate

4.2.1 New In-Situ Concrete

Scrub with water containing detergent to ensure complete removal of mould oil, surface retarders and other materials incompatible with the bedding. Rinse with clean water and allow to dry unless specified otherwise.

4.2.2 New Plasters

Ensure plasters are dry, solidly bedded, free from dust and friable matters. Apply plaster primer if recommended by the adhesive manufacturers and allow to dry before tiling.

4.2.3 Plasterboard Backgrounds

Ensure that boards are dry, moisture-resistant, securely fixed and rigid with no protruding fixings, and the face intended to receive the decorative finish is exposed.

4.2.4 Fibro Cement Board Backgrounds

Ensure that boards are dry, moisture-resistant, securely fixed and rigid with no protruding fixings. Seal or prime surfaces to be tiled where recommended by the tile adhesive manufacturers.

4.2.5 Hacking for Key

Roughen specified backgrounds thoroughly and evenly by removing the entire surface to a depth of 3 mm by pneumatic scabbling, bush hammering or abrasive blasting. Remove all dust and debris, and wash clean before commencing tiling.

4.2.6 Spatterdash/Stipple Keying Mix

Apply spatterdash by throwing and stipple by brushing vigorously onto previously dampened background to a thickness of 3 mm to 5 mm, and leave rough.

Keep damp with fine water spray until set and allow to dry out slowly before applying bedding.

4.3 Fixing

4.3.1 Setting-Out

Joints shall be true to line, continuous and without steps.

Joints on walls shall be truly horizontal, vertical and in alignment (including around corners).

Cut tiles shall be kept to the minimum, as large as possible and in unobtrusive locations.

Position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or in the centre of tiles.

Where positions of movement joints are not specified, agreed on such positions with the SO. They shall be shown in the setting-out drawings.

Before laying tiles, obtain approval for setting-out drawings.

4.3.2 Fixing Generally

Thoroughly mix variegated tiles. Check that there are no unintended colour/shade variations within the tiles for use in each area/room.

Check that adhesive is compatible with each background/base. Use a primer where recommended by the adhesive manufacturers.

Cut tiles neatly and accurately.

Unless specified otherwise, fix tiles so that there is adhesion over the whole of each background/base and tile backs.

Before bedding material sets, make adjustments necessary to give true, regular appearance to tiles and joints when viewed under final lighting conditions.

Clean surplus bedding materials from joints and face of tiles without disturbing tiles.

4.3.2.1 Adverse Weather

Do not fix tiles in wet conditions.

Comply with manufacturer's recommendations for maximum temperatures when using proprietary adhesives.

Take adequate precautions to protect the Works from inclement weather and premature drying out.

4.3.3 Fixing Wall Skirting Tiles

4.3.3.1 Sit-On Tile Skirtings

Bed solid to wall with adhesives after laying floor tiles. Ensure joints in skirtings match and align with joints in floor tiling.

4.3.3.2 Variations

Distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

4.3.4 Fixing Wall Tiles

4.3.4.1 Thin Bed Adhesive Ribbed

Apply 3 mm floated coat of adhesive to dry background in areas of approximately 1 m², then trowel to a ribbed profile using the recommended notched trowel. Press tiles firmly into adhesive with a twisting/sliding action.

4.3.4.2 Thin Bed Adhesive Solid

Apply floated coat of adhesive to dry background in areas of approximately 1 m² and comb the surface with the recommended solid bed trowel. Apply thin even coat of adhesive to back of dry tiles. Press tiles onto bedding with twisting/sliding action to give finished bed thickness of not more than 3 mm.

4.3.5 Pull-Off Tests

Pull-off tests (POTs) shall be carried out to verify the bonding strength of the tiles with the adhesive and substrate to achieve the standards of CONQUAS (currently, a minimum tensile strength of 0.15 N/mm² for internal wall installation), or greater, per adhesive manufacturer's recommendations.

The test reports shall be submitted to the SO. The requirement of POTs in this Specification applies irrespective of whether the project requirements call for a specific CONQUAS score or not.

4.3.6 Tolerances

4.3.6.1 Alignment and evenness

Wall tiling shall be uniform and level.

Change of finish: Maintain finished wall level across changes of wall finish.

4.4 Sealants

4.4.1 Sealant Movement Joints through Wall Joints

Ensure that joints extend through tiles and bedding to substrates and that they coincide with any movement joints in the substrates. Refer to Section A02-040:Clause:3.1 for joint width, sealant and sealant colour.

4.5 Grouting

Grout tiles as soon as possible after bedding has set sufficiently to prevent disturbance of tiles.

Ensure that joints are 6 mm deep (or the depth of the tile if less), and are free from dust and debris.

Fill joints completely, tool to an approved profile, clean off surface and leave free from blemishes.

Clean the grouted tiling works before the bedding material hardens with a damp sponge. Rinse the sponge with clean water and continue the cleaning process until the tile surface is completely clean.

Check the potential risk of staining by applying the grout to a few tiles in a small trial area. If discolouration occurs, apply a protective sealer to the tiles and repeat the trial.

4.6 Coloured Grouts

Check the potential risk of staining by applying the grout to a few tiles in a small trial area. If discolouration occurs, apply a protective sealer to the tiles and repeat the trial.

4.7 Protection and Completion

4.7.1 Protection Generally

Adequately protect and keep clean all completed areas. Clean off any droppings immediately.

4.7.2 Protection in Wet Areas

Tiles in kitchens and bathrooms shall be kept dry and not brought into service for at least three weeks after grouting/jointing.

4.7.3 Protection of Walls

Keep wall corners protected along traffic routes.

5 VERIFICATION AND SUBMISSION

5.1 Submissions

5.1.1 Technical Submissions

Include in construction programme, event for submission of the following information:

- (a) Name of manufacturers of tiles and other components. Include copies of technical data relating to each of the tile and component types.

- (b) Information on tests to be conducted for the tiles and related components. Refer to Section A04-030:Clause:5.3 for the specified requirements.
- (c) Information of current or completed similar jobs during the previous 5 years and details of Quality Control Procedures adopted.

5.1.2 Work Submissions

5.1.2.1 General Information

Submit the following to the SO prior to the preparation of detailed shop drawings:

- (a) Copies of technical certificates for each tile bedding mortar, tile type, adhesive, admixture and component.
- (b) Means of accommodating movement in the tiles and substrates.
- (c) Specimen of warranty, if any.
- (d) Drawing list setting out the drawings to be prepared.

5.1.2.2 Shop Drawings

Prepare shop drawings, that shall include:

- (a) Drawings to show all tiles on elevation and location plans at 1:20 with movement joints, service outlets and termination details.
- (b) Details of tile junctions at all terminations, junctions with service outlets, skirtings and any other element puncturing the tiles

Do not commence laying tiles until shop drawings have been reviewed and permission to proceed has been obtained from the SO.

5.1.3 Test Reports and Certificate Submissions

Provide certificates by a test laboratory accredited under SINGLAS. Submit the test certificate to the SO prior to bulk ordering. Tiles, that do not comply, shall be rejected. Laid tiles, that do not comply, are to be hacked up and replaced.

(a) Tests

For all tiles installed, carry out the following tests for the Project and submit the results or certification:

Test	Requirement * (Yes/No)	Specific Requirement
Dimensional Tolerances	Yes	ISO 10545-2
Straightness of Sides	Yes	ISO 10545-2
Rectangularity	Yes	ISO 10545-2

Flatness of Surface	Yes	ISO 10545-2
Surface Condition	Yes	ISO 10545-2
Crazing Resistance	Yes	For glazed tiles only ISO 10545-11
Modulus of Rupture	Yes	ISO 10545-4
Scratch Hardness of Surface	Yes	ISO 10545-7
Resistance to Acids and Alkalis	Yes	ISO 10545-13
Water Absorption	No	ISO 10545-3
Colour Fastness and Lightfastness	Yes	ISO 10545-16
Reverse Staining	No	ISO 10545-14
Stain Resistance	Yes	ISO 10545-14

For all adhesives used, carry out the following tests for the project and submit the certification:

Test	Requirement	Test Method
Open time	≥ 0.5 N/mm ² after no less than 20 min	ISO 13007-2: 4.1 or BS EN 12004-2: 8.1
Slip	≥ 0.5 mm	ISO 13007-2: 4.2 or BS EN 12004-2: 8.2
Tensile adhesion strength	≥ 0.5 N/mm ²	ISO 13007-2: 4.4.4.2 or BS EN 12004-2: 8.3
Transverse deformation Deformable (S1) or Highly deformable (S2)	≤ 2.5 mm & < 5 mm ≤ 5 mm	ISO 13007-2: 4.5 or BS EN 12004-2: 8.6
.	.	.
.	.	.

For all grouts used, carry out the following tests for the Project and submit the certification:

Test	Requirement	Test Method
Abrasion resistance	$\geq 2,000$ mm ³	ISO 13007-4: 4.4 or BS EN 12808-2
Flexural strength after dry storage	≥ 2.5 N/mm ²	ISO 13007-4: 4.1.3 or BS EN 12808-3
Compressive strength after dry storage	≥ 15 N/mm ²	ISO 13007-4: 4.1.4 or BS EN 12808-3
Shrinkage	≤ 3 mm/m	ISO 13007-4: 4.3 or BS EN 12808-4
Water absorption after 30 min	≤ 5 g	ISO 13007-4: 4.2 or BS EN 12808-5
.	.	.
.	.	.

For all sealants used, carry out the following tests for the Project and submit the certification:

Test	Requirement	Test Method
Elongation at break at +23oC	≥100%	ISO 8339
.	.	.
.	.	.

[Note: Customise table to reflect project specific requirements.]

(b) Certificates

Provide certificates from the manufacturers as follows:

Material	Certificate	Description
Tiles	Singapore Green Label	.
Adhesives	Singapore Green Label	.
Grouts	Singapore Green Label	.
.	.	.
.	.	.

5.1.4 Quality Plan Control Submissions

Prepare and submit the quality control plan (including the inspection and test plan records) to the SO prior to start of any laying works.

5.1.5 Warranty

Submit the warranty to the SO upon completion of the Works, as required under Section A02-040:Clause:1.4.5.

5.1.6 Maintenance Submissions

Refer to Section A02-040:Clause:1.4.6.

5.2 Samples and Mock-ups

5.2.1 Samples

Submit the following samples to the SO:

- (a) Three samples of each tile type shall be submitted at least 30 days prior to commencement of any works.
- (b) The SO may request for samples at any time for testing purposes.

5.2.2 Mock-ups

A wall approximately 3 m x 2.4 m and adjacent floor area approximately 3 m x 2 m shall be tiled, including termination at heads, skirtings, and movement joints, at a designated location to be agreed with the SO.

Do not undertake any more internal wall or external wall tiling works until the SO has approved the mock-ups.

The mock-ups may form part of the final building. If not, retain these mock-ups until the SO agrees for their removal.

Provide additional mock-ups for the Project as follows:

Mock-up	Additional Requirements
.	.
.	.

5.3 Inspections

Inform the SO on completion of the first section of any tiling works. Proceed only after approval by the SO.

The SO will determine the extent of this first section.

Proceed also as per approved inspection and test plan.

5.4 On-Site Tests

5.4.1 Watertightness Tests

No item.

5.4.2 Acoustic Tests

No item.

5.4.3 Schedule of Tests

Carry out the tests as specified in Section A02-040:Clause:1.4.1(f) at locations selected by the SO throughout the progress of the Works.