SS 654:2020+A1:2023
(ICS 91.060.10)

SINGAPORE STANDARD

Code of practice for curtain walls

Incorporating Amendment No. 1

Singapore Standards Council

SS 654:2020+A1:2023
(ICS 91.060.10)

SINGAPORE STANDARD

Code of practice for curtain walls

Published by Enterprise Singapore

ISBN 978-981-5118-43-8

Contents

Page

Foreword

This Singapore Standard was prepared by the Working Group on Curtain Walls set up by the Technical Committee on Architectural Works under the purview of the Building and Contsruction Standards Committee.

This development of this Singapore Standard resulted from the review of CP 96 : 2002 (2011), “Code of practice for curtain walls” and SS 381 : 1996 (2007), “Materials and performance tests for aluminium curtain walls”. The provisions have been combined into a single standard for ease of reference by users. It also introduces updates and expands on the use of other materials besides aluminium for curtain walls. SS 654 replaces CP 96 and SS 381.

It is presupposed that in the course of their work, users will comply with all relevant regulatory and statutory requirements. Some examples of relevant regulations and acts are listed in the Bibliography. The Singapore Standards Council and Enterprise Singapore shall not be responsible for identifying all of such legal obligations.

In preparing this standard, reference was made to the following publications:

1. ASTM E283 Standard test method for determining rate of air leakage through exterior windows, curtain walls, and doors under specified pressure differences across the specimen

2. ASTM E330 Standard test method for structural performance of exterior windows, doors, skylights and curtain walls by uniform static air pressure difference

3. ASTM E331 Standard test method for water penetration of exterior windows, skylights, doors, and curtain walls by uniform static air pressure difference

4. Standard and guide to good practice for curtain walling by Centre for Windows and Cladding Technology (CWCT) University of Bath, UK

Permission from ASTM International was sought for the adaption/reprint of materials from the following ASTM standards:

Adapted, Sections 11.1, 11.1.1 and 11.2.3 from ASTM E330/E330M-2014 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference and Sections 9.1, 9.1.1, 11.1, 11.5 and 11.7 from ASTM E331-00 (2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken PA 19428.

Reprinted, Sections 6.2.3, 11.1, 11.2, 11.3 and 11.4 from ASTM E283-2004 (2012) Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen, Sections 6.2.3, 6.2.4, 10.1.2.1, 10.1.2.2, 10.1.2.3 and 11.3.3 from ASTM E330/E330M-2014 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference, and Sections 6.2.3, 11.2, 11.3, 11.4 and 11.6 from ASTM E331-00 (2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken PA 19428.

Materials from the “Guide to Good Practice for Facades” were reproduced/adapted in this standard with the kind permission of the Centre for Window and Cladding Technology (CWCT).

Acknowledgement is made for the use of information from the above publications.

Attention is drawn to the possibility that some of the elements of this Singapore Standard may be the subject of patent rights. Enterprise Singapore shall not be held responsible for identifying any or all such patent rights.

NOTE

1. *Singapore Standards (SSs) and Technical References (TRs) are reviewed periodically to keep abreast of technical changes, technological developments and industry practices. The changes are documented through the issue of either amendments or revisions. Where SSs are deemed to be stable, i.e. no foreseeable changes in them, they will be classified as "mature standards". Mature standards will not be subject to further review unless there are requests to review such standards.*

2. *An SS or TR is voluntary in nature except when it is made mandatory by a regulatory authority. It can also be cited in contracts making its application a business necessity. Users are advised to assess and determine whether the SS or TR is suitable for their intended use or purpose. If required, they should refer to the relevant professionals or experts for advice on the use of the document. Enterprise Singapore and the Singapore Standards Council shall not be liable for any damages whether directly or indirectly suffered by anyone or any organisation as a result of the use of any SS or TR. Although care has been taken to draft this standard, users are also advised to ensure that they apply the information after due diligence.*

3. *Compliance with a SS or TR does not exempt users from any legal obligations.*

Code of practice for curtain walls

0 Introduction

Curtain wall systems are commonly used as the external façade enclosure for various building types. The systems can be of varying complexity and there are several families of systems available around the world, either as custom systems or proprietary designs. They are popular for the high quality achieved, use of prefabrication and speed of installation.

Good planning, design, quality control and management of materials are critical to the successful application of curtain wall systems. However, there are a number of technical requirements to be met and this standard aims to define the main criteria, underpinning the technical information and requirements of the project specification. These criteria need to be addressed by the design of the system and compliance demonstrated through drawings, calculations and various technical project submissions.

To verify the performance of any façade system, testing is important and in addition to various tests of the components and materials, it is vital to test the curtain wall as a complete system and this standard also describes the testing requirements on full-scale specimens to be completed preferably prior to fabrication and installation.

1 Scope

This Singapore Standard specifies materials and performance standards for metal-framed curtain walls and gives requirements for good practices in the design and installation of a curtain wall system. The performance standard includes only tests for air permeability, water-tightness and structural performance.

A curtain wall is a form of building enclosure system which supports no load other than its own weight and the environmental forces which act upon it. There are many different methods of curtain wall construction and many different materials can be involved. In this standard, the term “curtain wall” include all brackets, anchors, flashings, gutters, copings, secondary steel frame, and all other components necessary for its proper construction and assembly outside of the main structural frame and floors.

Specifiers for the curtain wall systems may consider part of this standard to be relevant to their respective specifications. However, detailed considerations of the different requirements of the different systems are considered to be outside the scope of this standard.

This standard may involve hazardous materials, operations and equipment. It is not intended to address all of the safety problems associated with their use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use and assess the risks of using these systems for their particular application.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AAMA 501.1	Standard test method for water penetration of windows, curtain walls and doors using dynamic pressure

AAMA 501.2	Quality assurance and diagnostic water leakage field check of installed storefronts, curtain walls, and sloped glazing systems
AAMA 2604	Voluntary specification, performance requirements and test procedures for high performance organic coatings on aluminium extrusions and panels (with coil coating appendix)
AAMA 2605	Voluntary specification, performance requirements and test procedures for superior performing organic coatings on aluminium extrusions and panels (with coil coating appendix)
AS 1665	Welding of aluminium structures
AS/NZS 1664	Aluminium structures
AS/NZS 4284	Testing of building facades
ASTM A240	Standard specification for chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels and for general applications
ASTM C97	Standard test methods for absorption and bulk specific gravity of dimension stone
ASTM C170	Standard test method for compressive strength of dimension stone
ASTM C880	Standard test method for flexural strength of dimension stone
ASTM C1036	Standard specification for flat glass
ASTM C1048	Standard specification for heat-strengthened and fully tempered glass
ASTM C1172	Standard specification for laminated architectural flat glass
ASTM E773	Standard test method for accelerated weathering of sealed insulating glass units
ASTM E774	Standard specification for the classification of the durability of sealed insulating glass units
ASTM E783	Standard test method for field measurement of air leakage through installed exterior windows and doors
ASTM E2307	Standard test method for determining fire resistance of perimeter fire barriers using intermediate-scale, multi-story test apparatus
BS 952	Glass for glazing
	Part 1 Classification
	Part 2 Terminology for work on glass
BS 1449	Steel plate, sheet and strip. Carbon and carbon-manganese plate, sheet and strip.
BS 3987	Specification for anodic oxidation coatings on wrought aluminium for external architectural applications
BS 6180	Barriers in and about buildings. Code of practice
BS 6262	Glazing for buildings
BS 6338	Specification for chromated conversion coatings on electroplated zinc and cadmium coatings
BS EN 485-3	Aluminium and aluminium alloys. Sheet, strip and plate. Tolerances on dimensions and form for hot-rolled products

BS EN 755	Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles	
	Part 1	Technical conditions for inspection and delivery
	Part 2	Mechanical properties
	Part 3	Round bars, tolerances on dimensions and form
	Part 4	Square bars, tolerances on dimensions and form
	Part 5	Rectangular bars, tolerances on dimensions and form
	Part 6	Hexagonal bars, tolerances on dimensions and form
	Part 7	Seamless tubes, tolerances on dimensions and form
	Part 8	Porthole tubes, tolerances on dimensions and form
	Part 9	Profiles, tolerances on dimensions and form
BS EN 1011	Welding. Recommendations for welding of metallic materials.	
	Part 1	General guidance for arc welding
	Part 2	Arc welding of ferritic steels
	Part 3	Arc welding of stainless steels
	Part 4	Arc welding of aluminium and aluminium alloys
	Part 5	Welding of clad steel
	Part 6	Laser beam welding
	Part 7	Electron beam welding
	Part 8	Welding of cast irons
BS EN 1999	Eurocode 9: Design of aluminium structures. General structural rules	
BS EN 10025	Hot rolled products of structural steels. General technical delivery conditions	
BS EN 10088	Stainless steels	
	Part 1	List of stainless steels
	Part 2	Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
	Part 3	Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
BS EN 10219	Cold formed welded structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements	
BS EN 12206	Paints and varnishes. Coating of aluminium and aluminium alloys for architectural purposes. Coatings prepared from coating powder	
BS EN 12844	Zinc and zinc alloys. Castings. Specifications	
BS EN ISO 1456	Metallic and other inorganic coatings. Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium	
BS EN ISO 2063	Thermal spraying. Zinc, Aluminium and their alloys	

BS EN ISO 3506	Mechanical properties of corrosion-resistant stainless steel fasteners. Bolts, screws and studs
BS EN ISO 6892	Metallic materials. Tensile testing. Method of test at room temperature
ISO 1460	Metallic coatings – Hot dip galvanized coatings on ferrous materials – Gravimetric determination of the mass per unit area
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
ISO 11600	Building construction – Jointing products – Classification and requirements for sealants
SS 212	Specification for aluminium alloy windows
SS 341	Safety glazing materials for use in buildings (human impact considerations)
SS 555	Code of practice for protection against lightning
	Part 1 General principles
	Part 2 Risk management
	Part 3 Physical damage to structures and life hazard
	Part 4 Electrical and electronic systems within structures