INTERNATIONAL STANDARD

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Glass in building — Silvered, flat-glass mirror

Verre dans la construction — Miroir argenté en verre plat

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 25537 was prepared by Technical Committee ISO/TC 160, *Glass in building*, Subcommittee SC 1, *Product considerations*.

Introduction

This International Standard specifies tests procedures for assessing the durability of a mirror by measuring its ability to resist corrosion, and adhesion of its protective paints.

Two of the tests prescribed are defined in other International Standards: ISO 9227 and ISO 2409.

Two additional tests, a water-condensation test and a dip test, are also prescribed and the procedure for carrying them out is described in annexes.

This International Standard also specifies the minimum requirements regarding reflectance as well as reflective silver-coating faults, edge faults and protective-coating faults, and optical quality.

The quality of a silvered mirror can be affected by faults that alter the appearance of the image of reflected objects. Such alteration of the image can result from optical faults, faults in the glass and faults in the reflective coating.

Glass in building — Silvered, flat-glass mirror

SAFETY PRECAUTIONS — This International Standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and to determine the applicability of regulatory requirements prior to use.

1 Scope

This International Standard specifies the minimum quality requirements (regarding optical, visual and edge faults) and durability tests for silvered float glass for internal use in buildings.

This International Standard applies only to mirrors from silvered glass manufactured from flat, annealed clear or tinted float glass, from 2 mm to 6 mm thick, and supplied in stock/standard sizes and as-cut finished sizes to which no further processing (such as edgework or other fabrication) has been done.

NOTE Upon consultation with the mirror manufacturer, it is possible to apply this International Standard to float glass having a thickness less than 2 mm or greater than 6 mm.

This specification covers the quality requirements of silvered, annealed, monolithic, clear and tinted flat glass mirrors.

Mirrors covered in this specification are not intended for use in environments, e.g. horse-riding halls, swimming pools, medical baths, saunas, swimming pool areas, chemical laboratories and other corrosive environments, where high humidity or airborne corrosion promoters, or both, are consistently present. This International Standard is not applicable to reflective glass for external glazing applications.

2 Normative references

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

ISO 2409:2007, *Paints and varnishes — Cross-cut test*

ISO 9227:2006, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 9050, *Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance, and related glazing factors*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
fault
blemish US
imperfection in the body or on the surface of the mirror

3.2
linear fault
scratch, hairline scratch, rub, dig, extended spot fault and other similar imperfections

3.3
spot fault
halo, colour spot, dirt, pinhole, stone, gaseous inclusion (seed or bubble), tin particle, deposit and other similar imperfection

3.4
centre zone
central part of a mirror defined by 80 % of the length and 80 % of the width dimensions

3.5
chip
imperfection on the edge of a mirror due to breakage of a small fragment out of an otherwise-regular surface

3.6
cloud
frosted appearance in the reflected image from a silvered mirror

3.7
cluster
group of not fewer than three spot faults separated by not more than 50 mm

3.8
colour spot
alteration of the reflective coating in the form of a small, generally coloured spot

3.9
dig
deep, short scratch in the glass surface

3.10
dirt
small particle of foreign material imbedded in the glass surface

3.11
edge corrosion
change in the colour or level of reflectance along the mirror edge as a result of degradation of the silver coating from external sources

3.12
edge fault
fault that affects the as-cut edge of the silvered glass

NOTE Edge faults can include entrant/emergent faults, shelling, corners on/off, vents (small cracks), chips, shell chips, and flare.

3.13
edgework
fabrication of the mirror edge beyond the original clean-cut condition

3.14
flare
protrusion on the edge of a piece of mirror

3.15
gaseous inclusion
seed
bubble
round or elongated bubble at the surface (open) or within the body thickness leaving a cavity in the mirror

3.16
hairline scratch
very fine, circular scratch that can barely be seen that is associated with glass-cleaning techniques

3.17
halo
distortion zone around a spot fault

3.18
silvered mirror
flat, annealed, clear or tinted float glass, the rear surface of which has been coated with a protected reflective silver layer

3.19
mirror cut size
mirror cut to a stock/standard size that is intended for final use in the size ordered (i.e. mirror not intended for re-cutting)

NOTE These mirrors can be subject to further processing, e.g. edge working, drilling, face decoration, etc.

3.20
mirror stock size
mirror intended for architectural use supplied with as-cut edges, where trimming is required

3.21
optical fault
fault directly associated with the distortion of the reflected image

3.22
protective coating(s) fault
pinhole, burst bubble, scratches or loss of adhesion of the protective coating(s) and other types of faults in the protective coating(s) where the metallic layer is exposed

3.23
reflective silver-coating fault
fault in the reflective silver layer, altering the appearance of the silvered glass, e.g. scratches, colour spots and edge deterioration and corrosion

3.24
rub
abrasion of the mirror surface producing a frosted appearance

3.25
scratch
damage on the glass surface in the form of a line caused by the movement of an object in contact with the glass surface relative to the surface

3.26
shell chip
circular indentation in the mirror edge due to breakage of a small fragment

3.27
silver coating
metallic silver layer in a silvered mirror product

3.28
stain
alteration of the reflective coating characterized by a more or less brownish, yellowish or greyish colouration of zones

NOTE Stains can sometimes cover the whole reflective surface.

3.29
stone
crystalline inclusion in the mirror

4 Materials

4.1 Glass products

Silvered, flat-glass mirror shall be manufactured from monolithic float glass. In the absence of an appropriate International Standard for float glass products, and until such an International Standard is published, the float glass used shall conform to the appropriate national standards.

4.2 Reflective coating

The mirror shall be manufactured with a reflective coating made of silver.

4.3 Protective coating(s)

The reflective coating described in 4.2 shall be protected by one or more layers and/or protective coatings e.g. paint, lacquer, etc.

5 Dimensions

The dimensional tolerances for thickness, length, width and squareness of the mirrors shall be those applicable to float glass.

6 Reflectance of clear glass mirrors

Measurement of reflectance shall be undertaken in accordance with ISO 9050 with an angle of incidence of the light within 8° of normal. For the calculation of the reflectance, illuminant D65 and a 2° observer shall be used.

When measured in accordance with ISO 9050, the minimum visible-light reflectance of silvered mirrors made of clear glass shall be at least 83 %.

The reflectance of mirrors made from tinted glass, when measured in accordance with ISO 9050, may be below 83 %.

7 Quality requirements

7.1 Quality assessment and inspection methods for silvered mirrors

7.1.1 Glass, reflective coating, edge and protective coating quality

7.1.1.1 Inspection method

The silvered mirror shall be observed in a vertical position, with the naked eye and under normal diffused daylight conditions, (between 100 lx and 1 000 lx at the silvered mirror), from a distance of 1 000 mm. The direction of observation shall be normal, i.e. at right angles, to the silvered mirror. The use of an additional lighting source, e.g. spotlight, shall not be allowed.

7.1.1.2 Glass faults

Glass faults shall be assessed in accordance with the method described in 7.1.1.1. The dimensions and number of spot faults and linear faults that cause disturbance to the image shall be noted.

7.1.1.3 Reflective silver coating faults

Reflective silver-coating faults shall be assessed in accordance with the method described in 7.1.1.1. The dimensions and number of spot faults and linear faults that cause disturbance to the image shall be noted.

7.1.1.4 Protective coating(s) faults

The presence of protective coating(s) faults shall be assessed in accordance with the method described in 7.1.1.1 looking at the protective-coated side (backside) of the mirror.

7.1.1.5 Edge faults

The presence of edge faults shall be assessed in accordance with the method described in 7.1.1.1. The dimensions of the chips, shell chips and flares shall be measured. The depth shall be the measured distance of a fault from the face of the mirror into the thickness. The length shall be the distance, parallel to the edge of the mirror, from one edge of a fault to the other. The width shall be the perpendicular distance from the edge of the mirror to the inner edge of the fault.

7.1.1.6 Cloud and stain

The presence of cloud and stain shall be assessed in accordance with the method described in 7.1.1.1.

7.1.2 Qualitative visual inspection method of the optical quality

A silvered mirror shall be examined in areas of 500 mm × 500 mm at a time. The observer shall be located at a distance of 2 000 mm in front of and normal to the area being examined. Behind the observer shall be an irregular background. The reflected image shall not be optically disturbed, e.g. by another reflective surface, window, etc.

7.2 Acceptance levels

7.2.1 Glass faults

Acceptance level for glass faults shall be as given in Table 1.

7.2.2 Reflective silver-coating faults

Acceptance level for reflective silver-coating faults shall be as given in Table 1.

7.2.3 Protective coating(s) faults

Acceptance level for protective coating(s) faults shall be as given in Table 1.

Table 1 — Acceptance levels for glass faults, reflective silver-coating faults and protective coating(s) faults

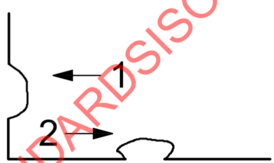
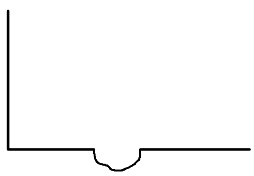
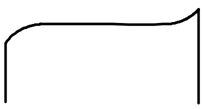
Fault		Number of faults per square metre		
Type	**Size** mm	**Stock size** [a]	**Cut size** [a]	
			Centre zone	**Edge zone**
Spot	< 0,3	Unrestricted	Unrestricted	Unrestricted
	⩾ 0,3 to < 0,5	Unrestricted	9,0 but clusters are not allowed	9,0
	⩾ 0,5 to < 0,8	2,6	None	9,0
	⩾ 0,8 to < 1,2	0,6	None	1,0
	⩾ 1,2 to < 1,5	0,3	None	None
	⩾ 1,5	0,3	None	None
Linear	⩽ 75	0,6	None	
	> 75	None	None	

[a] The number of faults is rounded to the first decimal using the standard rule.

7.2.4 Edge faults

Acceptance level for edge faults shall be as given in Table 2.

Table 2 — Requirements for edge faults

Edge faults (viewed from front)		**Stock size** mm	**Cut size** mm
Type	**Location**		
Chips, shell chips 	length width depth	⩽ 10 ⩽ 10 ⩽ 6	3,2 1,6 1,5
Flare 	length width depth	⩽ 10 ⩽ 10 ⩽ 6	3,2 1,6 1,5
Corners on/off 		Unrestricted	Allowed if less than 25 % of glass thickness

Key

1 chips

2 shell chips

7.2.5 Stain and cloud

When inspected in accordance with 7.1.1.1, the mirror shall not exhibit any stain or cloud.

7.2.6 Optical faults

When inspected in accordance with 7.1.2, the mirror shall not exhibit any disturbing optical distortion of the image.

8 Testing of silvered mirror

8.1 Durability

8.1.1 General

The durability of silvered mirror shall be determined by a number of tests in accordance with the following specifications.

— Resistance to neutral salt: test specimen shall be tested using either the neutral salt-spray test (NSS) in accordance with ISO 9227:2006, 5.2, or the dip test in accordance with Annex B.

— Resistance to acid salt: test specimen shall be tested using the copper-accelerated acetic acid salt spray test (CASS) in accordance with ISO 9227:2006, 5.4.

— Condensation water test at constant atmosphere: test specimen shall be tested in accordance with Annex A.

8.1.2 Test specimens

Silvered mirrors being tested shall be stored under suitable conditions and for a sufficient period to allow backing materials to cure. As the curing is dependant on the type of paint used, the mirror manufacturer shall request information from the paint manufacturer on the required curing conditions and time. Just prior to testing, the silvered mirror shall be cut to the specimen size. The dimensions of the specimen shall be mutually agreed upon between interested parties but the specimen shall have a minimum area of 10 000 mm^2, e.g. 100 mm × 100 mm, 70 mm × 150 mm, 150 mm × 150 mm.

8.1.3 Position of specimens

The specimens shall be placed in the testing cabinets with the protective coating (painted) side up at an angle as defined by the appropriate International Standard.

8.1.4 Evaluation

The specimens shall be examined in diffused daylight (minimum 300 lx and maximum 1 000 lx at the mirror) against a black background. A magnifying glass (7x) shall be used to measure the maximum edge corrosion and spot fault diameter(s). The determination of edge corrosion shall be carried out on two vertical edges for all tests.

8.1.5 Acceptance criteria

The acceptance criteria for silvered mirror when tested in accordance with 8.1.1 to 8.1.4 shall be as are given in Table 3.

Table 3 — Durability acceptance criteria for silvered mirror

Test method and reference	Requirements
NSS (ISO 9227:2006, 5.2)	120 h
Dip test (Annex B)	24 h
— coloured or diffused areas within reflective coating	none
— bubbles in protective coatings	none
— edge corrosion	⩽ 1,5 mm
— maximum number of defects	2 of 0,5 mm < ϕ ⩽ 3 mm 5 of 0,2 mm < ϕ ⩽ 0,5 mm ⩽ 0,2 mm accepted if not forming a coloured or diffused area by concentration
CASS (ISO 9227:2006, 5.4)	120 h
— coloured or diffused areas within reflective coating	none
— bubbles in protective coatings	none
— edge corrosion	⩽ 2,5 mm
— maximum number of spots	2 of 0,5 mm < ϕ ⩽ 3 mm 5 of 0,2 mm < ϕ ⩽ 0,5 mm ⩽ 0,2 mm accepted if not forming a coloured or diffused area by concentration
Condensation test (Annex A)	120 h
— coloured or diffused areas within reflective coating	none
— bubbles in protective coatings	none
— edge corrosion	⩽ 0,2 mm
— maximum number of spots	1 of 0,2 mm < ϕ ⩽ 0,5 mm ⩽ 0,2 mm accepted if not forming a coloured or diffused area by concentration

8.2 Protective coating(s) adhesion

The adhesion of the protective coating(s), excluding the metallic layer, shall be assessed by means of the cross cut test in accordance with ISO 2409. The test shall be carried out manually or automatically with 6-cut spacing of 1 mm using single or 6-bladed cutter.

The detached particulates shall be removed by using the soft brush only (see ISO 2409:2007, 6.2.5) without removing the tape as directed in ISO 2409:2007, 6.2.6. The results shall conform to class 3 in accordance with ISO 2409:2007, Table 1.

Annex A
(normative)

Condensation-water test in a constant atmosphere

A.1 Principle

This test method describes the general conditions that shall be observed when submitting specimens to condensation-water constant atmospheres, in order to ensure that the results of tests carried out in different laboratories are reproducible. The tests are designed to determine the behaviour of the specimens in humid ambient atmospheres, and to pinpoint any defects of the protection of the specimens against corrosion. The behaviour of the specimens in these test atmospheres does not, however, enable any direct assertions to be made with respect of the service-life expectation of the components tested under real conditions of use. The shape and the preparation of the specimens, the duration of the test, the evaluation of the test and the assessment of the test results do not form part of the subject matter of this test method.

A.2 Test conditions

The constant atmospheric temperature in the test cabinet during the condensation process of the condensation water test atmospheres of this International Standard shall be (50 ± 3) °C.

NOTE 1 Condensation-water test atmospheres promote the condensation of atmospheric humidity on the surfaces of specimens, the temperatures of which are lower than the temperature of the saturated air in the test cabinet, due to radiation onto the cabinet walls or to the cooling of the specimen.

NOTE 2 The quantity of condensation water formed on the surface of the specimen can also have an important influence on the action of the condensation water; this quantity is affected by the ambient temperature in the installation room or by the cooling of the specimen. The condensate that drips off the specimen consists of condensation water and also, in some instances, of solid and liquid constituents of the specimens dissolved in or mixed into the condensation water. Reproducible results can be expected only on condition that the test atmosphere is the same and that the test procedure is the same.

A.3 Climatic testing device

A.3.1 Climatic chamber

A vapour-tight climatic chamber is essential for testing with a warm and humid atmosphere. The material of the inner walls shall be corrosion-resistant and shall not affect the specimens. The climatic chamber shall be equipped with a floor trough that acts as the receptacle for the quantity of water prescribed in A.4.1 or other means of forming condensation water. The test cabinet conditions shall be achieved by heating the water in the floor trough. If the quantity of heat introduced via the water is insufficient to heat up the air in the test cabinet to the required temperature, then this air shall be heated up additionally.

The water temperature shall not exceed 60 °C.

NOTE The heating-up time depends on the nature and quantity of the specimens, and also on the ratio of the area of the water surface of the floor trough to the area of the wall of the test cabinet and on the water temperature. The dimensions of the climatic chamber and the arrangement of its temperature-measuring and control equipment can be modified, provided that the test conditions in accordance with A.2 and A.4.3 are observed and that the temperature of the test atmosphere in the useful space is measured.

The climatic chamber shall be provided with a suitable door or other aperture capable of being closed, which allows the charging with specimens and the ventilation of the test room.

Climatic testing devices not equipped with water-filled floor troughs shall be designed in such a way that an adequate formation of condensation water on the specimens is achieved.

A.3.2 Installation of the climatic chamber

The climatic chamber shall be installed in a room with an ambient atmosphere not containing any corrosive constituents (e.g. it shall not be installed in a chemical laboratory), at a room temperature of (23 ± 5) °C and at a relative atmospheric humidity not exceeding 75 % relative humidity, in such a way that it shall be protected against draughts and solar radiation. In the case of comparison tests, the ambient temperature in the installation room shall be (23 ± 2) °C.

NOTE A decrease in the ambient temperature results in an increase in the quantity of condensation water.

A.3.3 Device (specimen holder) for the accommodation of the specimens

The device for the accommodation of the specimens shall consist of a corrosion-resistant material and shall not promote the corrosion of the specimens. It shall allow the specimens to be arranged in accordance with the requirements of A.4.3.

A.4 Procedure

A.4.1 Filling the floor trough

Where a floor trough is used, it shall be filled with pure water (distilled water or de-ionized water) in such a way that the water shall be at least 10 mm deep at all times during operation.

A.4.2 Specimens

Only specimens that are not capable of mutually influencing one another shall be tested together at any one time. If the amount of condensation water formed is likely to additionally affect the specimens, then the quantity of condensation water shall be ascertained over a 24 h period, with the aid of a suitable device, for the purpose of describing the test conditions (see A.4.4).

A.4.3 Arrangement of the specimens

The specimens shall be arranged in the test cabinet in such a way that they are not in close contact with each other and that they are able to radiate heat adequately. The following minimum spacing shall be observed:

— distance from the walls: not less than 100 mm;

— distance of the bottom edge of the specimens from the surface of the water: not less than 200 mm;

— spacing between adjoining specimens: not less than 20 mm.

Steps shall be taken to ensure that condensation water is not allowed to drip onto the specimens from the walls of the test cabinet or from other specimens arranged overhead when the specimens are positioned.

A.4.4 Procedure for the determination of a comparison quantity of condensation water

A comparison quantity of condensation water can be determined in the following manner.

a) Use an 18 mm × 180 mm glass test tube filled with water as the standard specimen.

b) Place this tube (suspended from a thread of polyamide, for example) with its bottom situated 50 mm above the rim of a glass funnel having a diameter of 55 mm placed in a graduated cylinder with a nominal capacity of 10 ml.