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TITLE : FOGGING TEST METHOD FOR NON-METALLIC MATERIALS

CLASS : C

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Changed terms and explanation.

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(9)

FOGGING TEST METHOD FOR NON-METALLIC MATERIALS

1. Scope

This standard covers the standard fogging test method for non-metallic materials to be used chiefly for automobile interiors.

2. General Test Conditions

2.1 Conditioning

Test samples and test specimens shall be kept and dehumidified before the tests for at least 24 h in a desiccator in the atmosphere specified in Section 2.2.

2.2 Test Atmosphere

Tests shall be carried out indoors, as a rule, at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%. If it is not possible to create this condition, the actual test atmosphere shall be reported.

2.3 Quantity of Test Pieces

Three or more test pieces shall be used for each test.

3. Test Procedures

3.1 Cleaning and Storage of Glass Plates, Glass Bottles, Beakers, etc.

(1) Cleaning

Glass plates, glass bottles, beakers, silicon rubber sealing materials, metal rings, etc. to be used for tests shall be completely cleared of oil and anything else adhering to them by the method described below.
Wipe away the substances adhering to the glass plate surfaces, glass bottles, and beaker inner walls using acetone, ethyl acetate, or another appropriate solvent, and then rinse them in acetone. After gently wiping the residual acetone off the glass plates with a non-fluffy cloth or other material and rinsing the glass bottles and beakers, etc. for 2 to 3 min, dry them for 2 to 3 min in a dryer or the like.
Do not use the same glass plate more than 10 times.

Prepared and Written by :
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(2) Storage

As a rule, clean the above implements prior to testing, via the above method. If it is necessary to store the implements after cleaning, store them in a desiccator etc. to avoid the adherence of dust or dirt to the implements.

3.2 Accelerated Fogging Test

3.2.1 Method A

(1) Test piece

Dimensions of the test pieces shall be as specified in Table 1, according to the type of material.
The test pieces may be sampled from either actual parts or material rolls. In any case, the source material of test pieces shall be reported.
When the source material is powder, liquid, or paste, the amount of the test sample shall be 10 ± 0.2 g.

Table 1 Test Piece Dimensions

Unit: mm

Classification		Dimensions
Skin material(1)		50 × 100 × Product thickness (report)(2)
Plastic molding material		25 × 100 × Product thickness (report) × 2 pieces(3)
Seat foam(4)		φ65 × 40(5)
Composite material (cut from actual product)	Seat(6)	See Fig. 1.
	Other than seat(7)	50 × 100 × Product thickness(8) (report)
Others(9)		50 × 100 × Product thickness(8) (report)

Notes: (1) Such as vinyl chloride sheet, fabric, carpet, synthetic leather, and natural leather.

(2) If it is difficult to obtain 50 mm long, 100 mm wide test pieces, use test pieces of the same surface area (150 cm^2).

(3) If it is difficult to obtain 25 mm long, 100 mm wide test pieces, use test pieces of the same surface area (150 cm^2).

(4) Mainly urethane foam

(5) If the thickness is less than 40 mm, report the actual thickness.

(6) Such as a combination of laminated pad and seat foam, and seat cover and seat foam

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Notes:(7) Such as safety pad, door trim, head lining, and coated plastic part. If it is difficult to obtain 50 mm long, 100 mm wide test pieces, use test pieces of the same surface area.

(8) When product thickness exceeds 50 mm, measure the dimension 50 mm from the interior end.

(9) Such as slab urethane foam and felt

Unit: mm

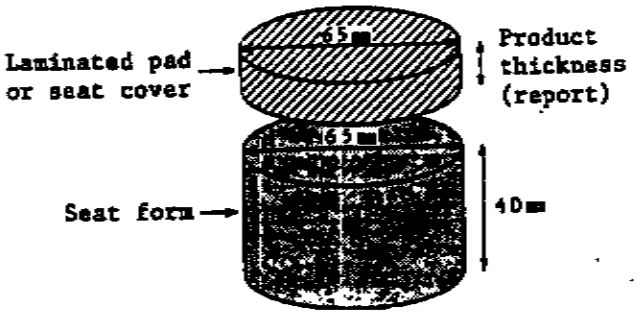

Fig. 1 Test Piece Dimensions for Composite Material (Seat)

(2) Test equipment

For tests, use the accelerated fogging tester shown in Fig. 2. The glass containers(10) to be used for the tests shall have a capacity of about 500 mL, and their dimensions shall follow those shown in Fig. 2, as much as possible.
The glass plates shall be 47 × 47 mm in size, with a thickness of 3 mm. In addition, their original fogging rate shall be 0.5% max.

Note:(10) Such as a "pressure resistant, glass fogging measuring bottle" made by Sansho Co.

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Unit: mm

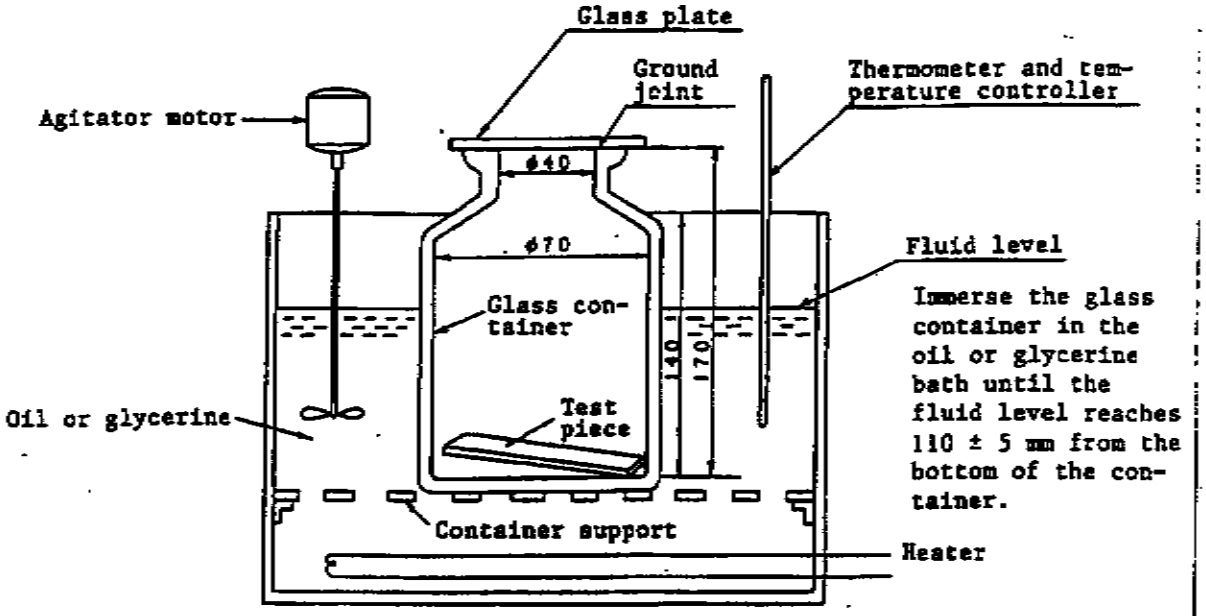

Fig. 2 Accelerated Fogging Tester

(3) Test method

Place the test piece in the glass container in the test equipment shown in Fig. 2. Seal the container with a glass plate which also serves as the lid. In this procedure, fix the plate to the container at its four corners with tape. The glass container and glass plate shall be cleaned in advance, as specified in Section 3.1. After setting the oil or glycerine bath temperature as specified in Table 2, place the container in the bath so that the fluid level reaches 110 mm above the bottom of the container. Under this condition, heat the bath for the time period specified in Table 2.
After heating the bath for the specified time period, immediately remove the glass plate, and store in a desiccator until the measurement of fogging.

Established / 3 th Jul. 1997 Revised:

Table 2 Heating Temperature and Time

Location			Heating temp. (°C)	Heating time (h)
Front and rear	With direct radiation(11)		100 ± 2	20
	Without direct radiation	Above belt line(12)	80 ± 2	
		Below belt line(13)	70 ± 2	
Side	Above belt line(14)		80 ± 2	
	Below belt line(15)		70 ± 2	
Composite material (seat)(16)			80 ± 2	72

Notes:(11) This shall apply to skin materials for instrument panel safety pads, package trays, rear seat backs, etc.

(12) This shall apply to materials for the front and rear pillar garnishes, sun visors, etc. Materials that do not appear on the surface, such as urethane foam for instrument panel safety pads, urethane foam for seats and slab urethane foam, shall be included in the scope of application.

(13) This shall apply to materials for carpets, etc. Materials for luggage compartment interiors are included in the scope of application.

(14) This shall apply to materials for door trims (skin materials, fabrics, and base materials, for example), head linings, etc.

(15) This shall apply to materials for door trim carpets, etc.

(16) For the test, place the combination of a laminated pad and seat foam or a seat cover and seat foam in a glass container as shown in Fig. 3.

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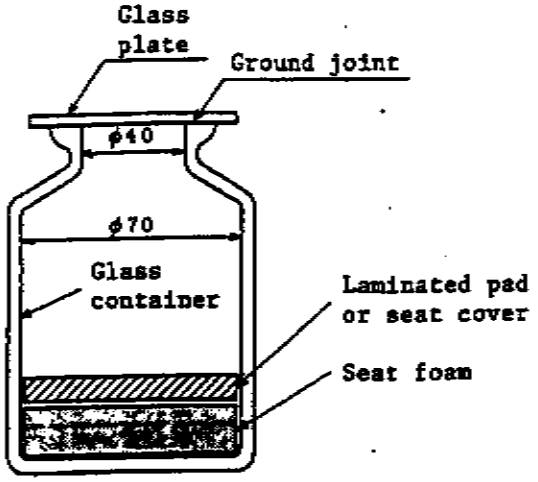

Fig. 3 Test for Composite Material (Seat)

(4) Test results

After 1 h from the completion of the test, place the glass plate obtained in procedure (3) above in an integrating sphere type light permeability measuring instrument(17), shown in Fig. 4. Then measure the amount of light incident upon the glass plate T_1, the total amount of light transmitted through the glass plate T_2, the amount of light scattered by the instrument T_3, and the amount of light scattered by the instrument and test piece T_4. Calculate the glass fogging rate A (%) according to equation (1).

$$\text{Glass fogging rate A (\%)} = \frac{T_d}{T_t} \times 100 \quad \ldots\ldots \quad (1)$$

where, T_t: $\frac{T_2}{T_1} \times 100$ (total transmittance)

$$T_d: \frac{T_4 - T_3\left(\frac{T_2}{T_1}\right)}{T_1} \times 100 \text{ (diffusion transmittance)}$$

Conduct the measurement at four or more points on the fogged area of the same glass plate, and report the maximum, minimum, and mean values. For the fogging rate to be reported, use the mean of the calculated values. (See Fig. 5.)

Note:(17) "Direct reading type haze computer" made by SUGA TEST DEVICE CO., for example.

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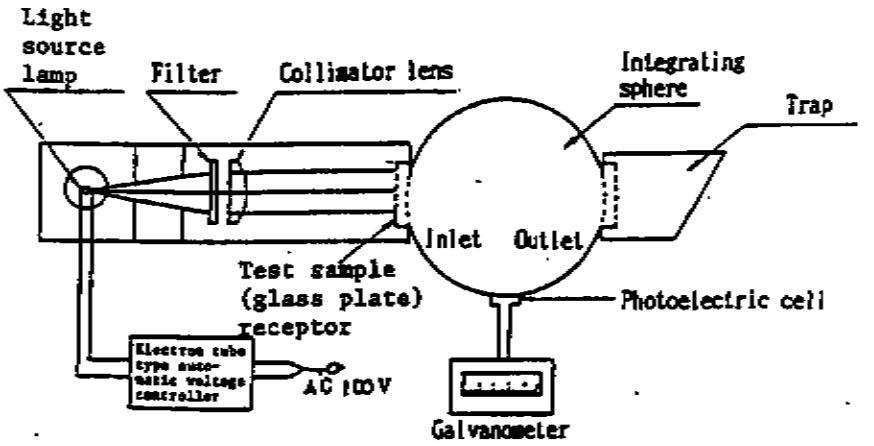

Fig. 4 Integrating Sphere Type Light Permeability Instrument

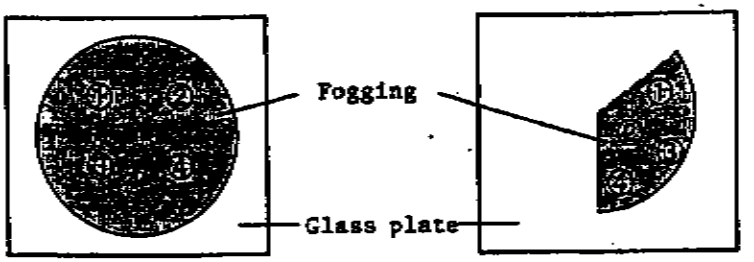

Fig. 5 Measurement Spots

3.2.2 Method B

(1) Test piece

Test pieces shall have the dimensions specified in Table 3 according to the type of material.
They may be cut out from either actual parts or material rolls. In any case, report the source of the test pieces.
For powder, liquid, and paste, take 10 ± 0.2 g as a test sample.

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Table 3 Test Piece Dimensions

Unit: mm

Classification		Dimensions
Skin material(18)		ϕ80 × Product thickness (report)
Plastic molding material		
Seat foam(19)		ϕ80 × 40(20)
Composite material (cut from actual product)	Seat(21)	See Fig. 6.
	Other than seat(22)	ϕ80 × Product thickness(23) (report)
Others(24)		ϕ80 × Product thickness(23) (report)

Notes: (18) Polyvinyl chloride skin material, fabric, carpet, synthetic leather, artificial leather, natural leather, for example

(19) Mainly urethane foam

(20) If the thickness is less than 40 mm, report the actual value.

(21) Combinations of laminated pad and seat foam, seat cover and seat foam, for example

(22) Safety pads, door trims, head linings, and coated plastic parts, for example

(23) If the product thickness exceeds 50 mm, measure the dimension 50 mm from the interior end.

(24) Slab urethane foams and felts, for example

Unit: mm

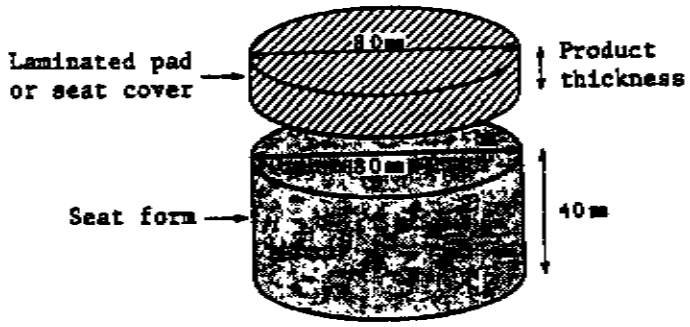

Fig. 6 Dimensions of Test Piece for Composite Material (Seat)

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(2) Test equipment

Use the accelerated fogging tester(25) shown in Fig. 7. The beaker to be used for the test shall have a flat bottom and its dimensions should conform to Fig. 7, as much as possible. The glass plate shall be 110 × 110 mm in size with a thickness of 3 mm, and a 60° reflection factor of 135% or more as determined via gloss measuring instrument.
Do not use the same glass plate more than 10 times.

Unit: mm

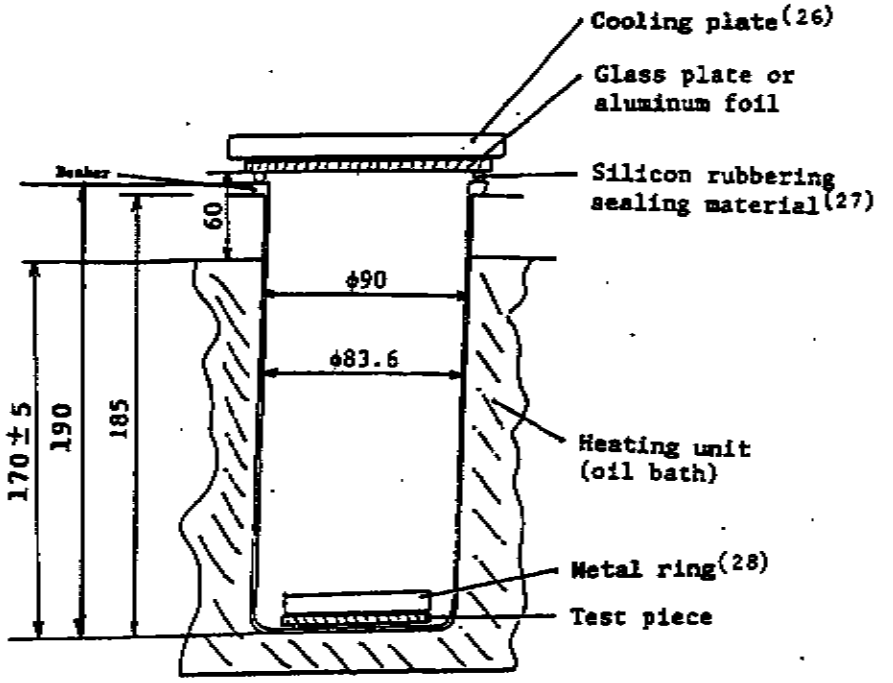

Fig. 7 Accelerated Fogging Tester

Notes:(25) "HAAKE Temperature Control Unit for Fogging Test" made by HAAKE Co., for example

(26) The cooling plate shall be hollow and made of aluminum or other rust resistant material. It shall be provided with a connection unit capable of feeding and draining cooling water. Its mass shall be at least 1 kg when measured together with cooling water in it.
The surface in contact with the glass plate shall be flat.

Established: 3 th Jul. 1997 | Revised:

Notes:(27) Use a ring-form silicon rubber sealing material with an inside diameter of approximately 95 mm and a hardness of approximately 60 as measured with a Shore A tester.

(28) The mass of the metal ring shall be approximately 55 g, the outside diameter 80 mm, the inside diameter 74 mm, and the thickness 10 mm. It shall be made of rust resistant material.

(3) Test method

(a) For reflection factor measurement

Place the test piece flatly on the bottom of the beaker as shown in Fig. 7, with the decorated surface pointing upward. Place a metal ring on the test piece to prevent it from warping.
The metal ring may be omitted when there is no possibility of the test piece warping.
After setting the temperature of the heating unit (oil bath) as required in Table 4, dip the beaker in the oil bath so that the oil level reaches a point approximately 60 mm below the glass plate, as shown in Fig. 7. Then put the silicon rubber sealing material in and immediately seal the beaker with the glass plate that serves also as a lid.
Thereafter place the cooling plate, in which cooling water is circulated at 20 ± 1°C, on the glass plate and heat the beaker according to Table 4.
For this measurement, use a beaker, metal ring, glass plate, and silicon rubber sealing material that have been rinsed according to Section 3.1.

Established / 3 th Jul. 1997 Revised :

(b) For attached mass measurement

Place the test piece flatly on the bottom of the beaker as shown in Fig. 7, with the decorated surface pointing upward.
Place a metal ring on the test piece to prevent it from warping.
The metal ring may be omitted when there is no possibility of the test piece warping.
After setting the temperature of the heating unit (oil bath) as required in Table 4, dip the beaker in the oil bath to a point where the oil level reaches approximately 60 mm below the glass plate, as shown in Fig. 7. Immediately after this, put a silicon rubber sealing material in and seal the beaker with a round piece of aluminum foil(29) 103 mm in diameter.
Then place a cooling plate, in which cooling water is circulated at 20 ± 1°C, on the aluminum foil, and heat the beaker according to Table 4.
For this measurement, use a beaker, metal ring, and silicon rubber sealing material that have been rinsed as required in Section 3.1.

Note:(29) Aluminum foil (15 micron in thickness) made by MITSUBISHI ALUMINUM CO., for example.
Make the glossy surface come in contact with the beaker.

Table 4 Heating Temperature and Time

Location			Heating temp. (°C)	Heating time (h)	
				Reflection factor measurement	Attached mass measurement
Front and rear	With direct radiation(30)		100 ± 2	3	16
	Without direct radiation	Above belt line(31)	80 ± 2		
		Below belt line(32)	70 ± 2		
Side	Above belt line(33)		80 ± 2		
	Below belt line(34)		70 ± 2		
Composite material (seat)(35)			80 ± 2	72	72

Established / 8 th Jul. 1997 | Revised :

Notes:(30) This shall apply to skin materials for instrument panel safety pads, package trays, rear seat backs, etc.

(31) This shall apply to materials for front and rear pillar garnishes, sun visors, etc.
Materials that do not appear on the surface, such as urethane for instrument panel safety pads, urethane foam for seats, and slab urethane foam, shall be included in the scope of application.

(32) This shall apply to materials for carpets, etc.
Materials for luggage compartment interiors are included in the scope of application.

(33) This shall apply to materials for door trims (skin materials, fabrics, and base materials, for example) and head linings, etc.

(34) This shall apply to materials for door trim carpets, etc.

(35) For the test, put a combination of laminated pad and seat foam or seat cover and seat foam in the beaker, as shown in Fig. 8.

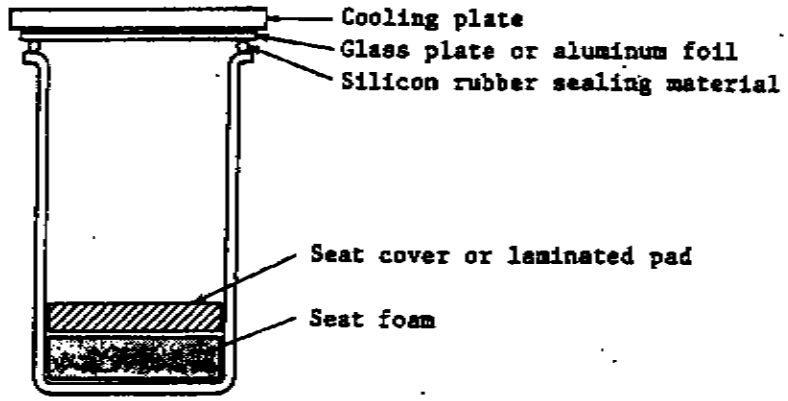

Fig. 8 Test for Composite Material (Seat)

Established / 3 th Jul. 1997 | Revised :

(4) Test results

(a) Reflection factor measurement

To calibrate the gloss measuring instrument, set the 60° reflection factor at 94.6% using a black reference plate. Then, after 1 h from the completion of the test, measure the 60° reflection factor of the glass plate obtained in (3) above, using a gloss measuring instrument(36). Take the measurement thus obtained to be R_1. Then, measure the 60° reflection factor at other points. Take the measurements thus obtained to be R_2, R_3, and R_4. Using the reflection factor R_0 of a clean glass plate measured before the test, calculate the fogging rate B (%) according to equation (2). When measuring 60° reflection factors, place a matting black plate(37) free of cracks or dirt under the glass plate.

$$\text{Glass fogging rate B (\%)} = \frac{\frac{R_1 + R_2 + R_3 + R_4}{4}}{R_0} \times 100 \quad \ldots\ldots (2)$$

(b) Attached mass measurement

After 1 h from the completion of the test, measure the mass of the aluminum foil obtained in (3) above to the mg. Calculate the difference from the foil mass measured before the test to determine the attached mass G (mg).

$$\text{Attached mass G (mg)} = G_1 - G_0 \quad \ldots\ldots\ldots\ldots (3)$$

where, G_1 (mg): mass of aluminum foil after test
G_0 (mg): mass of aluminum foil before test

Established / 3 th Jul. 1997 | Revised :

Notes:(36) The gloss measuring instrument is schematically illustrated in Fig. 9. The aperture S_1 of the light source shall be located at the focus point of the lens L_1, and shall be capable of forming a clear image of S_1 at the center of the aperture S_2 of the receptor, when a mirror is placed at the location of the test sample T. The angle of incidence θ shall be the angle formed between the line going through the center of the aperture S_1 and the center of the lens L_1 (principal point of the lens) and the normal of the test sample T. The light receiving angle θ shall be the angle formed between the line going through the center of the aperture S_2 and the center of the lens L_2 (principal point of the lens) and the normal of the test sample T. The open angles α_1 and α_2 shall be those of the apertures S_1 and S_2 respectively at the locations of the lenses L_1 and L_2. The optical axis on the incidence side and that on the light receiving side shall cross each other on the sample surface. The aperture S_1 may be substituted for by the light source filament at its location.
The beam of the light source shall be the standard light C specified in ASTM E308. The spectral sensitivity of the receptor shall be the same as the spectral stimulation value $\bar{y}\lambda$ specified in ASTM E308, or a combination of an equivalent light source and receptor shall be used.
A "REFO 60" made by DR LANGE Co. is recommended.

(37) Use a plate with the 60° reflection factor at 0.5 ± 0.2%

Established / 3 th Jul. 1997 | Revised :

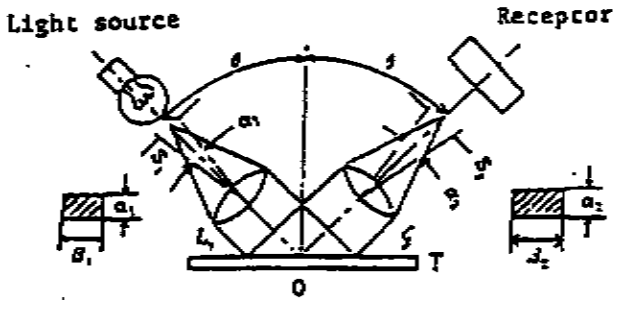

Fig. 9 Schematic of Gloss Measuring Instrument

4. Test Report

Report the test results after analyzing the data according to Attached Table 1. If the fogging rate determined by method A exceeds 15% or if the fogging rate determined by method B is less than 85%, analyze the chemical composition of the substance adhering to the glass plate and include the result in the test report. Also report the condition of the adhering substance in the manner of indicating "particulate," "liquid," and so on.

Applicable Standard

ASTM E308 Test Method for Computing the Colors of Objects by Using the CIE System

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Attached Table 1

GLASS FOGGING TEST RESULTS

Vehicle model ______________________ Date of test ______________________

Part No. ______________________ Test method A/B
(Circle correct word.)

Part name ______________________ Test conditions °C h

Material Painting Yes/No Ambient conditions °C %RH
(Circle correct word.)

Used/New (Circle correct word.) ⇒ Vehicle model ______________________

Date

Company name:		
Division:		

No.	Fogging rate (%)			Adhering substance	Chemical composition (analysis method)	Attached mass (mg) [for method B only]
	Mean	Max.	Min.			
1						
2						
3						
Mean		/	/	/	/	