

**SURFACE
VEHICLE
RECOMMENDED
PRACTICE**Issued 1994-12
Revised 2006-08

Superseding J1756 DEC1994

**(R) Determination of the Fogging Characteristics
of Interior Automotive Materials****1. Scope**

- 1.1** This recommended practice describes two methods for determining the tendency of interior materials used in automobiles and other vehicles to (a) produce a light scattering deposit (fog) on a glass surface, or (b) produce a measurable deposit (mass) on aluminum foil.
- 1.2** This document is applicable to the measurement of a fog condensate on glass or aluminum foil surfaces within the limits of the test conditions.
- 1.3** It is the responsibility of the user of this document to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to its use.

1.4 Rationale

This document has been edited for the following reasons: to eliminate redundancy, to commonize terminology, to consolidate methodology, eliminate specimen weighing in the gravimetric procedure, and to eliminate references to specific equipment suppliers per SAE policy.

2. References**2.1 Applicable Publications**

The following publications form a part of this specification to the extent specified herein.

2.1.1 ASTM PUBLICATIONS

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D 523—Standard Test Method for Specular Gloss

ASTM D 883—Standard Terminology Relating to Plastics

ASTM D 1125—Standard Test Methods for Electrical Conductivity and Resistivity of Water

ASTM D 1600—Standard Terminology for Abbreviated Terms Relating to Plastics

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2006 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: <http://www.sae.org>

2.1.2 ISO PUBLICATION

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 2813—Paints and Varnishes—Determination of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 DIN PUBLICATION

Available from Deutsches Institut für Normung e.V., Burggrafenstrasse 6, 10787 Berlin, Germany, www.din.de.

DIN 75-201—Determination of the Windscreen Fogging Characteristics of Materials in Motor Vehicles

2.2.2 BSI PUBLICATION

Available from British Standards Institution, Customer Services, 389 Chiswick High Road, London W4 4AL, United Kingdom, Tel: +44-0-20-8996-9001, www.bsi-global.com.

BS AU 168—Determination of the Windscreen Fogging Characteristics of Organic Trim Materials in Motor Vehicles

2.2.3 ISO PUBLICATION

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO/DIS 6452—Rubber- or plastic-coated fabrics—Determination of fogging characteristics of trim materials in the interior of automobiles

2.2.4 JASO PUBLICATION

Available from Japanese Automobile Standards Organization, 10-2, Gobancho, Chiyoda-ku, Tokyo 102-0076, Japan, Tel: +81-3-3262-8211, www.jsae.or.jp.

JASO M313-88—Standard Methods for the Testing of Automotive Vinyl and Leather (fogging method is included in the set of standards)

3. Definitions

Definitions are in accordance with ASTM D 883 and abbreviations with ASTM D 1600, unless otherwise indicated.

3.1 Fog

Fog is an undesirable light-scattering deposit (fine particulate, oily material, and/or water condensation droplets) on the interior glass surface of a vehicle.

3.2 Fog Number

When using the photometric method, the quotient, expressed as the average of the 60 degree reflectance values of a glass plate with fogging deposits and the average of the 60 degree reflectance values of the same glass plate without fogging deposits, multiplied by 100.

3.3 Fog Mass

When using the gravimetric method, the difference between the weight in grams of the aluminum foil and condensate after testing, and the original weight of the clean foil.

4. Apparatus and Materials Required

Suitable equipment, supplies, and training materials can be obtained from the sources listed in Appendix C.

4.1 Fog Test Units

A controlled heating unit with multiple chambers and with a typical temperature range from 60 °C to 120 °C. Cooling of the glass plate for each beaker in the unit is required with a typical temperature range from 20 °C to 40 °C.

The heating unit and the cooling system must be able to maintain the temperatures to within ± 0.5 °C.

The cooling plates, which are laid upon the glass plates, should apply a weight of approximately 1 kg to ensure an adequate seal with the beaker.

4.2 Glass Plates

Float glass plates 3 mm $\pm$ 0.2 mm thick must be used. Glass plates for 400 mL beakers must be at least 83 mm x 102 mm. Glass plates for the 1000 mL beakers must be at least 110 mm x 110 mm.

The glass must have the tin and non-tin surfaces identified.

The tin and non-tin surfaces of the glass plates can be identified by viewing the surfaces in a darkened room under a UV light at 254 nm wavelength. The tin surface will fluoresce (have a white/yellow hue) when it is exposed to the UV light. The non-tin surface will have a blue/purple hue when it is exposed to UV light. The tin surface shall be engraved for identification purposes. The non-tin surface is the test surface and faces the sample during the test. A new glass plate must be used for each test.

4.3 Beakers

Berzelius tall-form beakers (400 mL or 1000 mL capacity without pouring spout) are acceptable. The top of the beaker shall have a flat portion to accept the annular seal.

4.4 Metal Rings

Rings having a uniform weight and made of stainless steel or another inert material with a diameter to fit inside of the beaker may be used. The metal ring prevents solid test specimens from curling and producing non-uniform heating. The approximate dimensions and weights of the rings are 51 mm $\pm$ 0.7 mm ID; 57 mm OD and 38 g $\pm$ 2 g for 400 mL beakers and 73 mm $\pm$ 1 mm ID; 79 mm OD and 55 g $\pm$ 2 g for 1000 mL beakers.

4.5 Annular Seals

Silicone rubber seals, as recommended by the manufacturer, with a diameter to match the beaker rim must be used. The seals must be inspected before each use. If they are not soft and pliable or if they have cracks or voids, they are unacceptable and should be discarded.

4.6 Diisodecyl Phthalate (DIDP)

Diisodecyl phthalate (DIDP) may be used as an internal laboratory performance guide.

4.7 Glossmeter

When performing the photometric method, a suitable 60 degree glossmeter (gloss reflectometer) meeting the requirements of ASTM D 523 (Section 6.2), or ISO 2813 must be used.

4.8 Black Matte Surface

When performing the photometric method, the black matte surface the glass plates are placed upon to obtain gloss readings shall have a specular reflectance reading of less than 0.5 gloss units when measured with the 60 degree glossmeter.

4.9 Measuring Template (Optional)

When performing the photometric method, a template constructed from acrylic (or equivalent) may be used to precisely position the glossmeter on the glass plate. Refer to DIN 75-201 for detailed information. If a measuring template is used, a notation must be made on the Data Report (Appendix A).

4.10 Microscope (when required)

A suitable microscope with a 40 to 100 X magnification may be used to view the fog residue on the glass plate with the photometric method.

4.11 Analytical Balance

When weighing foils for the gravimetric method, a suitable analytical balance capable of weighing accurately to five places beyond the decimal point or a minimum accuracy of 0.00001 g is required.

4.12 Aluminum Foil

When using 400 mL beakers, use 80 mm $\pm$ 2 mm diameter by 0.02 mm $\pm$ 0.01 mm thick foil disks. When using 1000 mL beakers, use 103 mm $\pm$ 2 mm diameter by 0.02 mm $\pm$ 0.01 mm thick foil disks. The foil disks must be smooth and free of creases.

4.13 Mechanical Laboratory Dishwasher

A mechanical laboratory dishwasher having a deionized water rinse and steam cycle is required.

4.14 Detergent

Non-foaming laboratory detergent for mechanical laboratory dishwashers must be used.

4.15 Cotton Cloth

A laboratory quality, lint free cotton cloth is recommended for wiping the cooling plates on the fog test unit.

4.16 Purified Water

Dishwashing water shall have a quality of <20 S/cm (S = Siemens) at 25 °C maximum conductivity as outlined in ASTM D 1125.

4.17 Forceps and/or Tweezers

Forceps and/or tweezers must be used to handle the samples, annular seals, foil disks, and stainless steel rings.

4.18 Sample Disk Cutter

A hydraulic cutting press and circular dies or other suitable cutting equipment.

4.19 Calibrated Timer

Used where timing is required.

4.20 Denatured Ethyl Alcohol (90% Ethyl Alcohol - 5% Methyl Alcohol - 5% Isopropyl Alcohol or Equivalent)

Used to clean the cooling plates.

4.21 Data Reports

A form for recording all pertinent data is located in Appendix A (Photometric Method) and B (Gravimetric Method). An equivalent electronic form can be created, if desired.

5. Equipment Cleaning Procedure

- 5.1** All beakers, glass plates, stainless steel rings, forceps, and annular seals must be cleaned and dried in a mechanical laboratory dishwasher as described in this section prior to use, even if they are new.
- 5.1.1** If the beakers are dirty from a previous test (either on the outside from the circulating fluid and/or on the inside from liquid or paste samples), they must be hand-washed with laboratory detergent prior to being placed in the dishwasher.
- 5.2** The following dishwasher cycle is recommended for cleaning the annular seals, stainless steel rings, beakers, forceps, and glass plates:
- 5.2.1** Pre-wash (5 min.), Wash (8 min.), Steam (10 min.), Main wash (35 min.), 1st rinse (5 min.), 2nd rinse (5 min.), 3rd rinse (12 min.), Deionized water rinse (10 min.) and Dry (30 min.) for a total of 120 minutes.
- 5.2.2** Set the control panel to achieve the following cycle: heavy wash, steam action, final rinse with purified water, and heated dry cycle.
- 5.2.3** The temperature of the water must be a minimum of 49°C.
- 5.2.4** Deionized water is required for the final rinse.
- 5.3** New glass plates must be washed prior to use. The glass plates must be positioned vertically in a rack without touching each other. After washing, the glass plates may only be handled on the edges.
- 5.4** After washing, annular seals and stainless steel rings should only be handled with forceps. Beakers should only be handled on the outside.
- 5.5** After removing the beakers from the dishwasher, place them open side up and allowed to equilibrate in the standard atmosphere for at least 30 minutes prior to use. Beakers should be placed open side down if they are going to be stored prior to use.
- 5.6** Wipe the cooling plates on the fog test unit with a cotton cloth moistened with ethyl alcohol, then wipe with a dry cotton cloth to remove any contamination/condensation that may be present.

6. Sample Preparation and Conditioning

- 6.1** Test specimens should not be handled with bare hands or even with gloved hands. Rather, test specimens should be handled with clean forceps to avoid the possibility of contamination and introduction of additional variability to the test.
- 6.2** Prior to testing, all test specimens are to be conditioned in a controlled atmosphere of 21 °C ± 2 °C and 50% ± 5% relative humidity for a minimum of 24 h, or until moisture equilibrium is obtained.

6.2.1 Alternatively, desiccation of the test specimens prior to testing may be required by agreement between contractual parties. Refer to DIN 75-201.

6.3 Using a hydraulic cutting press and circular die, or other suitable cutting technique, cut three test specimens from each sample of material or component (or as specified by contractual parties) that are the appropriate diameter to fit inside the beakers of the fog test unit. The thickness shall not be greater than 50 mm. For components with irregular surfaces, cut several pieces to make up the required test size.

6.3.1 The diameter of the test specimens shall be $80 \text{ mm} \pm 2 \text{ mm}$ when using 1000 mL beakers and $58 \text{ mm} \pm 2 \text{ mm}$ when using 400 mL beakers.

7. Photometric Procedure

7.1 In this procedure, the test specimen is heated in a beaker assembly in a fog testing unit. The fog is collected on a glass plate and the fog number is determined by measuring the difference in gloss value before and after testing.

7.2 Equilibrate the fog testing unit a minimum of 30 minutes prior to use.

7.2.1 Operate the fog testing unit according to the manufacturer's instructions. Test parameters (heating time and temperatures and post-conditioning times) are per contractual agreement.

7.2.2 The heating temperature should be $100 \text{ }^{\circ}\text{C} \pm 0.5 \text{ }^{\circ}\text{C}$ and the cooling plate temperature $21 \text{ }^{\circ}\text{C} \pm 0.5 \text{ }^{\circ}\text{C}$ for a duration of $3 \text{ h} \pm 0.05 \text{ h}$, followed by $1 \text{ h} \pm 0.05 \text{ h}$ of conditioning at $21 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ and $50\% \pm 5\% \text{ RH}$, unless otherwise prescribed by contractual agreement.

7.3 Calibrate the glossmeter according to the manufacturer's instructions.

7.3.1 Place the glass plate tin side down on the black matte surface. Remember, handle glass plates only by the edges!

7.3.2 Place the 60 degree glossmeter in the center of the glass plate. Record four gloss readings, rotating the glass plate 90 degrees between each reading. Average the four readings and record as R_0 on the data report.

7.3.3 The glossmeter readings are to be taken under artificial light. No natural outside light is to be present when taking the gloss readings.

NOTE—Make sure the base of the glossmeter that rests on the glass plate is clean!

7.4 Using forceps, place a conditioned test specimen into the bottom of a prepared beaker. The finished side of the test specimen (the side that faces the vehicle interior) should be placed up.

7.4.1 If DIDP is used, place $10 \text{ g} \pm 0.2 \text{ g}$ into a beaker. If the DIDP values obtained are outside the accepted range, take corrective action but do not adjust the specified set temperature. Examples of corrective action are: verify the heating and cooling temperatures, verify cleanliness of the glass plates, beakers, annular seals, forceps, and stainless steel rings, verify the integrity of the seal between the beaker and the glass plate.

SAE J1756 Revised AUG2006

- 7.4.2 If powder, pastes, or liquids are tested, place a quantity of $10\text{ g} \pm 0.2\text{ g}$ directly into the bottom of the beaker. Do not pour liquid samples down the sides of the beaker.
- 7.4.3 Materials that may stick to the bottom of the beaker may be placed on aluminum foil and set into the beaker. Note the usage of foil on the data report.
- 7.5 Using forceps, place the specified stainless steel ring on top of the test specimen.
- 7.5.1 Stainless steel rings are not required for powder, paste, or liquid samples.
- 7.6 Using forceps, place an annular seal on the rim of the beaker containing the test specimen.
- 7.7 Place the glass plate tin-side up on top of the beaker assembly containing the sample, ring and annular seal. Make sure the non-tin side is facing down into the beaker.
- 7.8 Place the covered beaker assemblies into the fog test unit.
- 7.9 Place an aluminum foil disk described in Section 4.12 on top of the glass plate, then cover the beaker assembly with the cooling plate. Once all of the beakers are covered with cooling plates, this is considered time zero, the start of the heating period.
- 7.9.1 The aluminum foil disks used to separate the glass plates from the cooling plates may be reused as long as they remain clean and wrinkle free. Wrinkles may be removed by smoothing with a paper towel on a flat surface.
- 7.10 When using 1000 mL beakers, all test chambers of the fog test unit must contain a covered beaker and cooling plate, even if the beaker(s) does not contain a sample, for the duration of the heating period. When using 400 mL beakers, empty test chambers can remain empty during heating, but all of the cooling plate must be installed.
- 7.11 Following the heating period, remove the cooling plates and foil disks from the beaker assemblies.
- 7.12 Carefully remove the glass plates from the beakers and store them in a horizontal position, fog-side up, in a dust-free atmosphere and exposed only to artificial light for 1 hour at standard conditions of $21\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity. Longer conditioning times may be used according to contractual agreement.
- 7.13 After the conditioning period, examine the glass plates for the presence of visible droplets, crystalline deposits, or an oily film covering the exposed area of the glass plate. If any of these conditions are observed, the test specimen does not pass the fog test and the final glossmeter readings should not be taken. Report all observations and comments on the Data Report (Appendix A).
- 7.14 Measure the gloss of the fogged surface as previously described in section 7.3 and enter the results on the Data Report (Appendix A). Note: A dry, non-oily fog on the plate is acceptable if the fog number reading meets or exceeds the contractual parties specification.

- 7.15** If a permanent record of the test result is desired, a clean glass plate may be placed on the fogged plate which is shimmed with a layer of non-porous tape around the edges; then the glass plate assembly can be sealed along the edges with additional non-porous tape (transparent mending tape is recommended).

8. Calculations

To determine the fog number, calculate the ratio of $R_{(ave)}$ to $R_{0(ave)}$ X 100 for each fog plate and then average the results for all of the plates for a given sample. The fog number should be reported as a whole number.

9. Gravimetric Procedure

- 9.1** This procedure differs from the photometric procedure in two respects. First, instead of collecting the fog residue on a glass plate, the fog residue is collected on a piece of aluminum foil which is placed in between the annular seal and the glass plate. Second, instead of measuring the amount of fog photometrically, the amount of fog is determined gravimetrically by the change in weight of the foil that collects the fog residue.
- 9.2** Equilibrate the fog testing unit a minimum of 30 minutes prior to use.
- 9.2.1** Operate the fog testing unit according to the manufacturer's instructions. Test parameters (heating time and temperatures and post-conditioning times) are per contractual agreement.
- 9.2.2** The heating temperature should be 100 ± 0.5 °C and the cooling plate temperature 21 ± 0.5 °C for 16 ± 0.25 h, followed by 4 ± 0.05 h of conditioning at 21 ± 2 °C and $50\% \pm 5\%$ RH, unless otherwise prescribed by contractual agreement.
- 9.3** Using forceps, place a conditioned test specimen into the bottom of a prepared beaker. The finished side of the test specimen (the side that faces the vehicle interior) should be placed up.
- 9.3.1** If DIDP is used, place 10 ± 0.2 g into a beaker. If the DIDP values obtained are outside the accepted range, take corrective action but do not adjust the specified set temperature. Examples of corrective action are: verify the heating and cooling temperatures, verify cleanliness of the glass plates, beakers, annular seals and stainless steel rings, verify the integrity of the seal between the beaker and the glass plate.
- 9.3.2** If powder, pastes, or liquids are tested, place a quantity of 10 ± 0.2 g directly into the bottom of the beaker. Do not pour liquid samples down the sides of the beaker.
- 9.3.3** Materials that may stick to the bottom of the beaker may be placed on aluminum foil and set into the beaker. Note the usage of foil on the data report.
- 9.4** Using forceps, place the specified stainless steel ring on top of the test specimen.
- 9.4.1** Metal rings are not required for powder, paste, or liquid samples.

SAE J1756 Revised AUG2006

- 9.5** Using forceps, place an annular seal on the rim of the beaker containing the test specimen.
- 9.6** Weigh a new, unused aluminum foil disk described in Section 4.12 that is free of wrinkles and record the weight on the data sheet (Appendix B).
- 9.7** Using forceps, place the weighed aluminum foil disk shiny side down on top of the annular seal.
- 9.8** Place a clean glass plate on top of the weighed aluminum foil disk to complete the beaker assembly. Make sure the weighed aluminum foil disk completely covers and is centered over the annular seal to ensure an adequate seal.
- 9.9** Place the covered beaker assemblies into the fog test unit.
- 9.10** Place a second aluminum foil disk described in Section 4.12 on top of the glass plate, then cover the beaker assembly with the cooling plate. Once all of the beakers are covered with cooling plates, this is considered time zero, the start of the heating period.
- 9.10.1** The aluminum foil disks used to separate the glass plates from the cooling plates may be reused as long as they remain clean and wrinkle free. Wrinkles may be removed by smoothing with a paper towel on a flat surface. Aluminum foil disks used to collect fog may not be reused.
- 9.11** When using 1,000 mL beakers, all test chambers of the fog test unit must contain a covered beaker and cooling plate, even if the beaker(s) does not contain a sample, for the duration of the heating period. When using 400 mL beakers, empty test chambers can remain empty during heating, but all of the cooling plates must be installed.
- 9.12** Following the heating period, remove the cooling plates from the beaker assemblies.
- 9.13** Remove the aluminum foil disks on top of the glass plates.
- 9.14** Carefully remove the glass plates from the beakers, taking care not to disturb the aluminum foil disks underneath that contain the fog residue.
- 9.15** The aluminum foil disks containing the fog residue must be removed and inverted with forceps (i.e., placed horizontal with the fog-side up) as quickly as possible onto a clean, flat surface to avoid losing any of the fog residue due to dripping.
- 9.16** The aluminum foil disks containing the fog residue must be weighed within 5 minutes of removal from the beakers and the data recorded on the data sheet (Appendix B).
- 9.17** Carefully store the aluminum foil disks containing the fog residue in a horizontal position, fog side up, in a dust-free atmosphere for $4\text{ h} \pm 0.25\text{ h}$ at $21\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity, or as prescribed by contractual parties. Make sure the fog deposits are not disturbed and are exposed to only artificial light.
- 9.18** After the conditioning period, reweigh the foil disks containing the fog residue and record the data on the data sheet (Appendix B).

10. Calculations

The weight of the fog residue is determined by the difference in weight between the aluminum foil disk before and after testing. It is important to note the post-conditioning time when reporting a gravimetric fog result.

11. Data Report

The Data Report for the Gravimetric Method is shown in Appendix B. All results, comments, etc., are to be entered on this form. A copy of this report is to be included with each sample being submitted for approval, or as agreed upon by the contractual parties.

12. Notes

12.1 Marginal Indicia

The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE TEXTILES AND FLEXIBLE PLASTICS COMMITTEE