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Abbey Wood
Bristol
BS34 8JH

OBSOLESCENCE NOTICE

All DTD specifications were declared obsolescent from 1st April 1999. All DTD 900 series approvals also lapsed at that time. The standards will no longer be updated but will be retained as obsolescent documents to provide for the servicing of existing equipment.

Further Guidance

The aim in declaring the specifications obsolescent is to recognise that the documents are not being updated and thus should be used with care by both purchaser and supplier. For example, a specification could contain valid technical information but may also contain type approval clauses that contradict procurement policy and/or use materials that do not comply with environmental legislation. The obsolescent specification can still be used as a basis for a purchase provided that the supplier and purchaser agree suitable changes to the specification within the purchase order/contract.
For the DTD 900 system, each specification has provided an MoD approved material and process. For these items, the declaration of obsolescence will constitute the termination of both the extant MoD approval and the continuing MoD assessment that had underpinned those approvals. Again, the technical content of the document remains valid and can be used by both purchaser and supplier as a basis for a contract but an acceptable (to the parties) approval/assessment procedure would be required.

PROCUREMENT EXECUTIVE
MINISTRY OF DEFENCE

D.T.D. 5634
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Aerospace Material Specification

STRETCHED OR PRESSED ACRYLIC SHEET OF SUPERIOR ENVIRONMENTAL RESISTANCE, FOR AIRCRAFT GLAZING

Note 1. This specification is one of a series issued by the Procurement Executive, Ministry of Defence, either to meet a limited requirement not covered by an existing British Standard (Aerospace Series) or to serve as a basis for inspection of material, the properties and uses of which are not sufficiently established to warrant submission to the British Standards Institution for standardization.

Note 2. The tests employed in this specification are chosen for their reproducibility and ability to control the properties of the material. They are not intended to be simulated service tests which, because of variability of test conditions, may be unsatisfactory for control purposes.

Note 3. This specification calls for the use of substances and/or test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the supplier or the user from statutory obligations related to health and safety at any stage of manufacture or use.

1 SCOPE

This specification controls the supply of stretched or pressed acrylic material for transparent aircraft glazing prepared from as-cast sheets. The sheet shall be stretched or pressed, polished and formed by procedures that produce a material having the properties specified herein.

2 RELATED DOCUMENTS

2.1 Spectacle lens material. British Standard 3062: 1970.

2.2 Test methods for transparent materials for aircraft glazing:
European Standard pr EN 2155.

2.3 Thinners for cellulose nitrate paints and dopes DEF-STAN 80-38/1.

3 MATERIAL

The stretched or pressed sheets shall be fabricated by a specified process, from as-cast sheets of stable cross-linked polymer or co-polymer, consisting essentially of methyl methacrylate which shall contain no plasticiser, shall be suitable for biaxial extension and meet the requirements of Annex A of this specification.

4 CLASSIFICATION

The material shall be designated in four classes according to the optical deviation and distortion characteristics. The optical deviation is determined according to the method given in pr EN 2155-7 and optical distortion according to that given in pr EN 2155-8.

Class 0a The optical deviation shall not be greater than 1.5 minutes (0.00043 radians). The optical distortion, when the sheet is measured at an optical incidence of 60°, shall be such that the slope does not exceed 1 in 17.

Class 0b The optical deviation shall not be greater than 3.0 minutes (0.00087 radians). The optical distortion when the sheet is measured at an optical incidence of 60°, shall be such that the slope does not exceed 1 in 17.

Class 0c The optical deviation shall not be greater than 6.0 minutes (0.00175 radians). The optical deviation when the sheet is measured at an optical incidence of 45°, shall be such that the slope does not exceed 1 in 12.

Class 0d The optical deviation shall not be greater than 10 minutes (0.00291 radians). The optical distortion when the sheet is measured at normal optical incidence, shall be such that the slope does not exceed 1 in 12.

5 DENSITY

The mass density of the material as determined by the method given in pr EN 2155-1 shall be within the range 1.180 to 1.190 Mg/m^3.

6 OPTICAL DEFECTS

6.1 The major surfaces of the sheets shall have a high polish and be free from scratches and grazes.

6.2 When examined as in pr EN 2155-6 for defects the sheets in 0a and 0b classifications (clause 4) shall satisfy the following clauses:

6.2.1 there shall be no crazing or voids;

6.2.2 sheets shall not contain defects larger than those defined in pr EN 2155-6;

6.2.3 sheets containing major and minor defects as defined in pr EN 2155-6 shall be acceptable providing:

i an area enclosed by a circle of radius 150 mm with each major defect as centre contains no other major defect and not more than three minor defects;

ii an area enclosed by a circle of radius 150 mm and centre at any point on the sheet which does not contain a major defect, contains no more than five minor defects;

iii in an area enclosed by a circle of radius 150 mm and centre at any part on the sheet, the total area of sub-minor defects is less than 2 mm^2 (sub minor defects are defined as fibres, foreign matter and surface faults smaller than minor defects).

6.2.4 Un-cut sheets having, within 100 mm of the edges, defects which are larger than those defined in pr EN 2155-6 shall be considered as acceptable.

6.3 Sheets in classification 0c or 0d of clause 3 shall be examined for defects as in pr EN 2155-6 to a standard agreed between manufacturer and purchaser.

7 OPTICAL PROPERTIES

7.1 Colour

The sheets, when viewed through the pressed/stretched surface, shall meet the colour requirements of clause 3 of 2.1. The average absorptivity shall be determined for each of the following spectral bands:

400 nm - 500 nm
500 nm - 580 nm
580 nm - 700 nm

The limits of colouration shall be such that:

i in the band 500-580 nm the average absorptivity does not exceed 0.1 per cent per mm;

ii the difference in average absorptivity between any two of the above spectral bands does not exceed 0.08 per cent per mm.

7.2 Refractive index

The refractive index when determined by the method given in pr EN 2155-3 shall be in the range 1.480 to 1.500.

7.3 Ultra-violet light transmittance

The ultra-violet transmittance at any wavelength in the range 290-330 nm when determined by the method given in pr EN 2155-4 shall not exceed the values shown in Figure 1.

7.4 Visible light transmittance

The visible light transmittance of the sheets shall be such that when determined by the method described in pr EN 2155-5, the value shall not be less than:

91% for sheet less than 2.5 mm thick
90% for sheet between 2.5 mm and 8 mm in thickness
89% for sheet between 8 mm and 12 mm in thickness
88% for sheet between 12 mm and 20 mm in thickness
85% for sheet between 20 mm and 50 mm in thickness

7.5 Optical deviation

The optical deviation when determined as in pr EN 2155-7 shall not exceed the values given in clause 4.

7.6 Optical distortion

The optical distortion when determined as in pr EN 2155-8 and under the viewing angle specified in clause 4 shall not exceed the values given in clause 4. For discontinuities, “d” as defined in the test method shall not exceed 0.5 mm.

7.7 Haze

Haze when determined as described in Appendix 1 shall not exceed 3%.

8 RESISTANCE TO NATURAL WEATHERING

8.1 The method of exposure and associated testing shall be as given in pr EN 2155-11.

8.2 Specimens will be exposed for a period of 6 months under the hot humid conditions at the Joint Tropical Testing and Research Establishment (JTTRE), Queensland, Australia; arrangements for this exposure may be made through the JTTRE Liaison Officer, PERME, Waltham Abbey, Essex EN9 1BP.

8.3 Corresponding sets of control specimens shall be stored in the dark at 23°C ± 2°C, 50% RH ± 5% RH both at JTTRE and in the UK.

8.4 Edge sealing of the exposed and control specimens is permitted providing a solvent-free sealant is used.

8.5 After natural weathering the material shall conform to the following requirements:

8.5.1 Appearance - specimen shall not exhibit any waviness, "water marks" or geometrical distortion, see Appendix B of pr EN 2155-11.

8.5.2 Biological attack - no signs of biological attack or organic growth shall be exhibited, see Appendix C of pr EN 2155-11.

8.5.3 Dimensional stability - material shall not exhibit more than 0.2% change, see Appendix D of pr EN 2155-11.

8.5.4 Ultra-violet light transmission at 290 nm to 330 nm - shall not exceed the values shown in Fig 1.

8.5.5 Visible light transmittance (pr EN 2155-5) shall not be less than the following values:

Actual Material Thickness (t) mm	Visible Light Transmittance per cent
less than 2.5	89
2.5 < t < 8	88
8 < t < 12	87
t ⩾ 12	85

8.5.6 Haze as determined by method given in Appendix 1 - shall not exceed 4%.

8.5.7 Tensile strength - when tested as in pr EN 2155-17, this shall not be less than 70 MPa.

8.5.8 Charpy impact resistance - when tested in accordance with pr EN 2155-18, this shall not be less than 30 kJ/m^2.

8.5.9 Craze resistance - when tested in accordance with the method given in Appendix 3 the material shall meet the requirements of clause 11.1 of this specification.

8.5.10 Retention of strength after crazing - when tested in accordance with the method given in Appendix 4, the material shall meet the requirements of clause 11.2 of this specification.

8.5.11 Crack propagation resistance (pr EN 2155-21) - the toughness factor measured at 23°C ± 2°C shall not be less than 90% of the value determined prior to exposure.

9 THERMAL PROPERTIES

9.1 Coefficient of Linear Thermal Expansion

The coefficient of linear thermal expansion as determined by the method given in pr EN 2155-12 shall not exceed a value of 7 x $10^{-5}/^{o}C$.

10 MECHANICAL PROPERTIES

10.1 Tensile Strength

When tested as in pr EN 2155-17, the tensile strength of the material (at maximum load recorded) shall not be less than 70 MPa. For the purposes of this material specification the clauses in pr EN 2155-17 referring to elongation at break and modulus of elasticity may be disregarded.

10.2 Charpy impact test

When tested in accordance with pr EN 2155-18 the impact strength shall not be less than 30 kJ/m^2.

11 SUSCEPTIBILITY TO SOLVENT GRAZING

11.1 Resistance to crazing

When tested in accordance with the method given in Appendix 3 using both isopropyl alcohol and thinners for cellulose nitrate paints and dopes (clause 2.3), in separate tests involving five specimens for each solvent, under an outer fibre stress of 20.8 MPa the specimens shall show no visible signs of crazing, cracking or other degradation.

11.2 Retention of strength after crazing

When tested in accordance with the method given in Appendix 4 under an outer fibre stress of 20.8 MPa, no specimen shall fail.

12 RESISTANCE TO CRACK PROPAGATION

12.1 At standard test conditions, 23°C ± 2°C, 50% RH ± 5% RH.

When tested in accordance with pr EN 2155-21 the average toughness 'K' value shall not be less than 2.9 $MN/m^{3/2}$. No determination shall be less than 2.5 $MN/m^{3/2}$.

12.2 At low temperature (-18°C ± 2°C)

When tested in accordance with pr EN 2155-21 the average toughness 'K' value at this temperature shall not be less than 1.3 $MN/m^{3/2}$.

No determination shall be less than 1.2 $MN/m^{3/2}$.

13 THERMAL RELAXATION

When tested in accordance with pr EN 2155-22 (UK proposal) the temperature of onset of relaxation shall not be less than 123.0°C.

14 DEGREE OF STRETCH

When tested in accordance with pr EN 2155-23 (UK proposal) the degree of stretch shall not be less than 65%.

15 DIMENSIONS

15.1 The sheet size and thickness shall be as specified in the contract or order.

15.2 The thickness of a sheet at any point shall not differ from the nominal thickness by more than plus or minus the value given in Figure 2 for the particular size range.

16 TYPE APPROVAL

Before any particular manufacturer's materials are supplied as complying with this specification, the manufacturer shall obtain type approval for each sheet thickness available.
Application for approval shall be submitted to the Director of Materials Quality Assurance, Building E 135/1, Royal Arsenal East, London SE18 6TD together with:

i evidence that the materials comply with all the requirements specified herein;

ii samples of the material at least 600 mm square for which approval is sought;

iii details of composition to be supplied in confidence to the Director, Materials Quality Assurance;

iv recommended forming and fabrication instructions;

v details of sheet thicknesses and maximum sizes available.

17 FORMULATION CHANGES

Any proposed change whatsoever by the manufacturer in the formulation and/or the production process shall be notified to the Design Authority through the Aeronautical Quality Assurance Directorate, Harefield House, Harefield, Uxbridge, Middx UB9 6BB. If significant, the material shall be designated a new product which shall require specific and separate approval. The changed material, if approved, shall be given a new name or trade symbol.

18 SAMPLING AND INSPECTION IN CONTINUOUS PRODUCTION

18.1 Each sheet shall be subject to the acceptance tests detailed in clause 19.1.

18.2 From every five sheets produced from any one precursor material, one sheet shall be selected at random and subjected to the tests detailed in clause 19.2. This sheet shall be selected in such a manner that the whole range of production thicknesses shall be examined over a suitable time interval.

18.3 At a frequency of 1 in 100 (± 10%) for each precursor material, one sheet shall be selected at random for testing as detailed in clause 19.3.

18.4 At the discretion of the MOD Quality Assurance Authority named in the contract any sheet of material may be tested to the full requirements of this specification.

NOTE Continuous production is defined as normal day-today stretch or press operation without change of conditions, or plant breakdown necessitating recalibration of any process-monitoring equipment. The sampling sequence shall recommence on resumption of normal production.

19 ACCEPTANCE TESTS

Any manufacturer's material granted type approval under this specification shall be subject to the following acceptance tests:

19.1 Each Sheet:

Clause 7.5 Optical deviation
Clause 7.6 Optical distortion
Clause 6.1 Surface finish
Clause 6.2 Optical defects
Clause 15 Dimensions

19.2 One Sheet in Five (see clause 18.2):

Clause 7.4 Visible light transmittance
Clause 7.7 Haze
Clause 12.1 Resistance to crack propagation - at standard test conditions
Clause 14 Degree of stretch
Clause 13 Thermal relaxation

19.3 One Sheet in 100 (see clause 18.3):

Clause 7.3 Ultra-violet light transmittance
Clause 11.1 Resistance to crazing

19.4 In the event of test specimens failing any test, then another set of specimens for that test shall be produced from the same sheet and re-tested. Should these fail, the sheet is rejected and each of the remaining sheets in that set of five sheets shall be re-tested.

20 STORAGE QUALITIES

Sheets stored under the conditions recommended by the manufacturer shall fully meet the requirements of this specification for a period of 5 years, from the date of dispatch. Sheets stored for more than 5 years shall be tested for compliance with the acceptance tests of clause 19 of this specification, and if they pass, shall have unrestricted life for a further 5 years.

21 PROTECTION AND PACKAGING

21.1 Individual sheets shall be protected on both major surfaces by a masking system approved by the Head of Materials Department, RAE, and which can be readily removed without injury to the surfaces. The masking must protect the surfaces from damage during delivery, storage, normal handling and cutting operations.

21.2 The packaging shall be suitable for maintaining the material in its original condition and the sheets shall be supported to avoid damage.

22 MARKING

Each sheet shall be clearly marked on the protective backing with:

22.1 This specification number.

22.2 The name or trade symbol of the manufacturer as designated in the approval.

22.3 The manufacturer's batch number or reference and date of manufacture.

22.4 The sheet thickness and grade of material.

22.5 The name or trade symbol of the manufacturer of the precursor material, and the specification to which it conforms.

NOTE: The markings called for in clauses 22.1 and 22.2 shall be spaced at intervals of not less than 600 mm over the surface protective masking.

ANNEX A

As-cast, modified acrylic sheet suitable for biaxial extension

A1 Scope

The properties of this material shall meet the requirements of the foregoing specification except as stated in the following clauses.

A3 MATERIAL

The sheets shall be made from a stable, cross-linked polymer or co-polymer consisting essentially of methyl methacrylate, shall contain no plasticiser and shall be suitable for biaxial extension.

NOTE: Clauses 4 to 7 do not apply.

A8 RESISTANCE TO NATURAL WEATHERING

The properties of the as-cast material shall be such that the requirements of paragraph 8 are met by the qualified product of the biaxial extension process.

A9 THERMAL PROPERTIES

A9.1 Coefficient of Linear Thermal Expansion

The coefficient of linear thermal expansion as determined by the method given in pr EN 2155-12 shall not exceed a value of 1×10^{-4}/°C.

A9.2 Deformation Temperature Under Load

The deformation temperature under load as determined by the method given in pr EN 2155-13 shall not be less than 100°C.

A9.3 1/10 Vicat softening temperature

The softening point of the sheet as determined by the method given in pr EN 2155-14 shall not be less than 105°C.

A9.4 Thermal stability

The procedure described in pr EN 2155-15 shall be followed except that the oven temperature shall be 180°C ± 5°C and the specimens shall be maintained at this temperature for 2 hours. After cooling there shall be no evidence of blisters nor other surface imperfections; changes in ultra-violet light transmittance, visible light transmittance and optical defects, shall be insignificant.

A10 MECHANICAL PROPERTIES

A10.1 Tensile strength

When tested as described in pr EN 2155-17 no individual value for tensile strength shall be less than 62 MPa.

NOTE: Clause 10.2 does not apply to the as-cast material.

A11 SUSCEPTIBILITY TO SOLVENT CRAZING

A11.1 Resistance to solvent crazing

The as-cast material shall meet the requirements of clause 11.1 except that the outer fibre stress shall be 13.8 MPa.

NOTE: Clause 11.2 does not apply to the as-cast material.
Clauses 12, 13 and 14 do not apply to the as-cast material.

A15 DIMENSIONS

A15.1 The sheet size and thickness shall be as specified in the contract or order.

A15.2 The thickness of any sheet at any point shall not differ from the nominal thickness by more than the tolerance agreed between the manufacturer and the user.

A16 TYPE APPROVAL

The manufacturer of biaxially extended sheet is required to demonstrate type approval for the as-cast material covered by this annex, as a condition of DEF STANs 05-24 and 05-21.

NOTE: Paragraph 18 does not apply to the as-cast material.

A19 ACCEPTANCE TESTS

Any manufacturer's material granted type approval under this annex shall be subject to the following acceptance tests:

A19.1 Each sheet

Clause 15 Dimensions

A19.2 One sheet from each batch

Clause 7.1 Colour
Clause 7.3 UV transmittance

A19.3 At not less frequently than three monthly intervals, one sheet from a further batch selected at random:

Clause A9.3 l/10 Vicat softening temperature
A9.4 Thermal stability
A10.1 Tensile strength
A11.1 Resistance to solvent crazing

NOTE: The term "batch" signifies casting mix.

A20 PROTECTION AND PACKAGING

A20.1 Individual sheets shall be protected on both major surfaces by a masking system approved by the Head of Materials Department, RAE, and which can be readily removed without injury to the surfaces. The masking must protect the surfaces from damage during delivery, storage, normal handling and cutting operations.

A20.2 The container shall be suitable for maintaining the material in its original condition and the sheets shall be supported to avoid damage.

A21 MARKING

Each sheet shall be clearly marked on the protective backing with:

A21.1 "Acrylic sheet precursor for stretching (or pressing) to DTD 5634".

A21.2 The name or trade symbol of the manufacturer as designated in the approval.

A21.3 The manufacturer's batch number or reference.

A21.4 The sheet thickness.

NOTE: The markings called for in clauses A21.1 and A21.2 shall be spaced at intervals of at least 600 mm over the surface protective backing.

APPENDIX 1

Determination of haze

1 SCOPE AND FIELD OF APPLICATION

This standard specifies the determination of haze of planar sections of transparent plastics employing a defined light source and a photometer with a spectral response corrected to approximate that of photopic vision.

2 DEFINITION

Haze is defined as the scatter of light from an accumulation of tiny particles within the material, or from very small defects on the surface. This can lead to an obscuration of the view through the material or the spreading of an image beyond its proper limits.

3 APPARATUS

The apparatus, as shown in Figure 3, consists of a stabilised light source with associated system to produce a collimated beam, a specimen holder and photometer mounted on a convenient optical bench such that the specimen may be moved on the optical axis of the system between light source and photometer.

3.1 Light Source

3.1.1 The light source shall be a gas-filled tungsten filament lamp of photometric quality, operating at a colour temperature of 2855 ± 100K. The power supply to this lamp should be stabilised to ensure short-term constant light output.

3.1.2 The light source is combined with an optical system to produce a parallel light beam of area at least 1 cm^2 and of approximately circular cross-section.

3.2 Integrating Sphere Photometer

3.2.1 The integrating sphere may be of any diameter exceeding 150 mm so long as the total port area does not exceed 2 per cent of the internal reflecting area of the sphere. The axis of the irradiating beam shall pass through the centre of the entrance port and the centre of the integrating sphere. The photocell shall be positioned on the sphere 90° from the entrance port.

3.22 The irradiating light beam shall not be vignetted at the entrance port of the integrating sphere.

3.2.3 Reflecting surfaces - the surfaces of the interior of the integrating sphere and baffles shall be of substantially equal reflectance, matt, and highly reflecting throughout the visible wavelength region. A highly reflecting matt sphere paint should be used.

3.3 Photocell

3.3.1 The radiant flux within the sphere shall be measured by a photo-electric cell, the output measurements of which shall be proportional within ± 0.5 per cent to the incident flux over the range of intensity used. Spectral conditions for source and receiver must be constant throughout the test of each specimen. The design of measuring instrument shall be such that there shall be a zero reading when the sphere is dark.

3.3.2 The spectral response of the photocell shall be corrected to approximate that of photopic vision.

3.4 The specimen shall be mounted normal to the beam.

4 TEST SPECIMENS

4.1 Preparation. Specimens should be cut from sheets. The surfaces of the test specimens shall be substantially flat and parallel. Both surfaces shall be washed with clean water, then rinsed with distilled water and allowed to dry.

4.2 Dimensions. The test specimens shall be substantially larger than the entrance port of the integrating sphere. The thickness of the specimens shall be measured in three places to an accuracy of 0.2 mm.

5 PROCEDURE

5.1 The apparatus shall be set up and allowed sufficient time to reach thermal equilibrium before measurements are made.

5.2 A reading (b) is made with the specimen placed between the collimator and integrating sphere and at a distance equal to the diameter of the sphere from the entrace port thereof.

5.3 A further reading (c) is made with the specimen in contact with the entrance port of the integrating sphere where both incident and scattered light are received within the sphere. The relative positions of light source, collimator and sphere are not altered during the sequence of measurements.

5.4 The procedure shall be repeated for each of two additional specimens.

6 EXPRESSION OF RESULTS

The per cent haze is calculated from:

$$\text{Per cent haze} = \frac{100\,(c-b)}{c}$$

7 TEST REPORT

The test report should include:

7.1 Individual values and average value of per cent haze for these three specimens.

7.2 Average value of thickness of these three specimens.

APPENDIX 2

Method for the determination of freedom from visual distortion

A screen with alternate and adjacent black and white bands of width 13 mm shall be mounted with the lines vertical. It shall be of such a size that it is able to form a complete background for the largest sheet to be inspected. The screen shall be evenly and brightly illuminated.

The sheet to be inspected shall be held in a vertical plane at a convenient height by a support set at an angle of 60° to the screen, and one edge of the sheet shall be in contact with one edge of the screen.

The screen shall be observed through the sheet and examined for any distortion of the bands.

The sheet shall then be rotated in a vertical plane through 90° and the screen again examined for distortion. For the inspection of very large thick sheets it may be convenient to rotate the screen in a vertical plane through 90°, or to provide an additional vertical screen with horizontal bands rather than rotating the sheet itself.

APPENDIX 3

Determination of resistance to crazing

1 SCOPE AND FIELD OF APPLICATION

This method specifies the resistance of transparent sheet to the effect of a solvent environment while set up as a cantilever beam with a load applied at the free end.

2 DEFINITIONS

For the purposes of this method the craze resistance is defined as the appearance or otherwise of crazing (cracks) when a solvent (isopropyl alcohol or thinners for cellulose nitrate paints and dopes) is applied under controlled conditions for a period of 30 minutes to the surface of a specimen experiencing a fibre stress as stated in the material specification. The test is carried out at a temperature of 23 ± 2°C.

3 APPARATUS AND MATERIALS

3.1 A suitable cantilever loading arrangement shall be set up as in Figure 4 the fixed support and fulcrum being horizontal and parallel with radiused contact faces.

3.2 Suitabe weights may be hung from the loading point to induce the required fibre stress.

3.3 A supply of isopropyl alcohol of analytical reagent grade and of thinners for cellulose nitrate paints and dopes meeting the requirements of DEF STAN 80-38/1 are required.

4 TEST SPECIMENS

4.1 The sheet material shall have a high polish and be free from scratches and grazes.

4.2 Five specimens shall be cut of dimensions 175 x 25 ± 1 mm x 6 ± 0.5 mm. The cut edges shall be machined smooth, polished and be free from chipping. Material thicker than 6 mm shall be machined on one face only to 6 mm thickness and the non-machined face shall be tested.

NOTE: No method has been developed yet for specimens thinner than 6 mm: for such material, a test method shall be agreed between supplier and customer.

4.3 A hole 6 mm diameter shall be drilled with centre 15 mm from one end and on the centre line of the specimen to facilitate loading (see Figure 4).

5 CONDITIONING

5.1 The specimens shall be preconditioned at 23 ± 2°C, 50 ± 5% relative humidity for at least 48 hours prior to testing under the same conditions.

5.2 The apparatus and solvent (in a suitably stoppered container) shall be similarly preconditioned.

6 PROCEDURE

6.1 For unstretched material the test specimens shall be freely suspended in an air circulating oven and maintained at a temperature of 155 ± 2°C for a period of 30 minutes. After allowing to cool to room temperature under draught free conditions the specimens are annealed in an air circulating oven to the

manufacturers instructions, then allowed to cool to room temperature under draught free conditions. After annealing and cooling the width and thickness shall be measured at the position of the fulcrum with an accuracy of ± 0.02 mm.

6.2 For stretched material the test specimens shall be freely suspended in an air circulating oven and maintained at a temperature of 75 ± 2°C for a period of 16 hours and then allowed to cool under draught free conditions. Prior to testing the width and thickness shall be measured at the position of the fulcrum with an accuracy of ± 0.02 mm.

6.3 The specimens shall be set up as cantilever beams and loaded with the specified outer fibre stress which may be calculated from the formula

$$\text{Loading (newtons)} = \frac{s\ BA^2}{6L}$$

where

s = outer stress in MPa

B = width measured in mm

A = thickness measured in mm

L = length from the fulcrum point to the load application point to the nearest 0.1 mm.

6.4 After application of the load for 10 minutes and while still under load the solvent shall be applied to each specimen by means of a 20 mm square filter paper patch placed with one edge adjacent to the fulcrum as shown in Figure 4 and kept wet with the solvent.

6.5 The patch shall be removed after 30 minutes and the specimen examined for evidence of crazing.

7 EXPRESSION OF RESULTS

The appearance or otherwise of crazing after 30 minutes shall be noted.

8 TEST REPORT

The test report shall include the appearance or otherwise of crazing at the outer fibre stress level for each solvent employed.

APPENDIX 4

Determination of retention of strength after crazing (stretched or pressed acrylic)

1 SCOPE AND FIELD OF APPLICATION

This method examines the ability of a material to maintain its strength over an arbitrary period under load, after the application of a solvent which is known to induce crazing in such materials.

2 DEFINITIONS

For the purposes of this method, retention of strength after crazing is defined as the tendency of the specimen to lose strength over a period of 24 hours at 35 ± 3°C because of the possible inception of crazing at the commencement of this period. The application of acetone under controlled conditions is utilised to induce crazing, and the specimen is loaded to develop the outer fibre stress as stated in the material specification.

3 APPARATUS AND MATERIAL

3.1 A suitable cantilever loading arrangement shall be set up as in Fig 5, the fixed support and fulcrum being horizontal and parallel with radiused contact faces.

3.2 Suitable weights may be hung from the loading point to induce the required fibre stress.

3.3 A supply of acetone of analytical reagent grade is required.

4 TEST SPECIMENS

4.1 The specimen shall consist of a strip of the material 25 mm wide and 175 mm long cut from sheet. Material thicker than 6.0 mm shall be machined on one face to 6.0 mm and this shall be face B (see Fig 5) during test. The edges of the strip shall have a polished finish and be free from chipping.

4.2 A hole 6 mm in diameter shall be drilled with centre 15 mm from one end and on the centre line of the strip to facilitate loading (see Fig 5).

4.3 The protective masking shall be removed and the specimen washed in clean water at 30° to 40°C, rinsed with distilled water and allowed to dry.

5 CONDITIONING

5.1 After heat treatment and annealing the specimens shall be conditioned at a temperature of 35 ± 3°C for a period of 24 hours immediately prior to testing under the same conditions.

5.2 The apparatus shall also be conditioned at a temperature of 35 ± 3°C for a period of 24 hours immediately prior to the test.

6 PROCEDURE

6.1 The test specimens shall be freely suspended in an air circulating oven and maintained at a temperature of 75° ± 2°C for a period of 16 hours and then allowed to cool to room temperature under draught-free conditions.

6.2 Prior to testing, the width and thickness of the specimen shall be measured at the position of the fulcrum with an accuracy of ± 0.02 mm.

6.3 The specimen shall be supported as shown in Fig 5 and loaded with weights suspended from the hole. The loading applied shall be calculated from the formula:

$$\text{Loading (newtons)} = \frac{s\ BA^2}{6L}$$

where: s = required outer fibre stress in MPa.

B = width of the specimen at fulcrum in millimetres.

A = thickness of the specimen at fulcrum in millimetres.

L = distance from fulcrum to loading point in millimetres to the nearest 0.1mm.

6.4 Acetone at 35 ± 3°C shall be liberally applied to face A (see Fig 5) for 5 minutes continuously with a soft brush, care being taken to ensure that the acetone-wetted area extends to the position above the fulcrum. The specimen shall then be left undisturbed for 24 hours.

6.5 Ten specimens from one sheet shall be tested.

7 TEST REPORT

The failure or otherwise of any specimens shall be reported.

Approved for issue,

D K Thomas

Head of Materials Department,
Royal Aircraft Establishment,
Farnborough.

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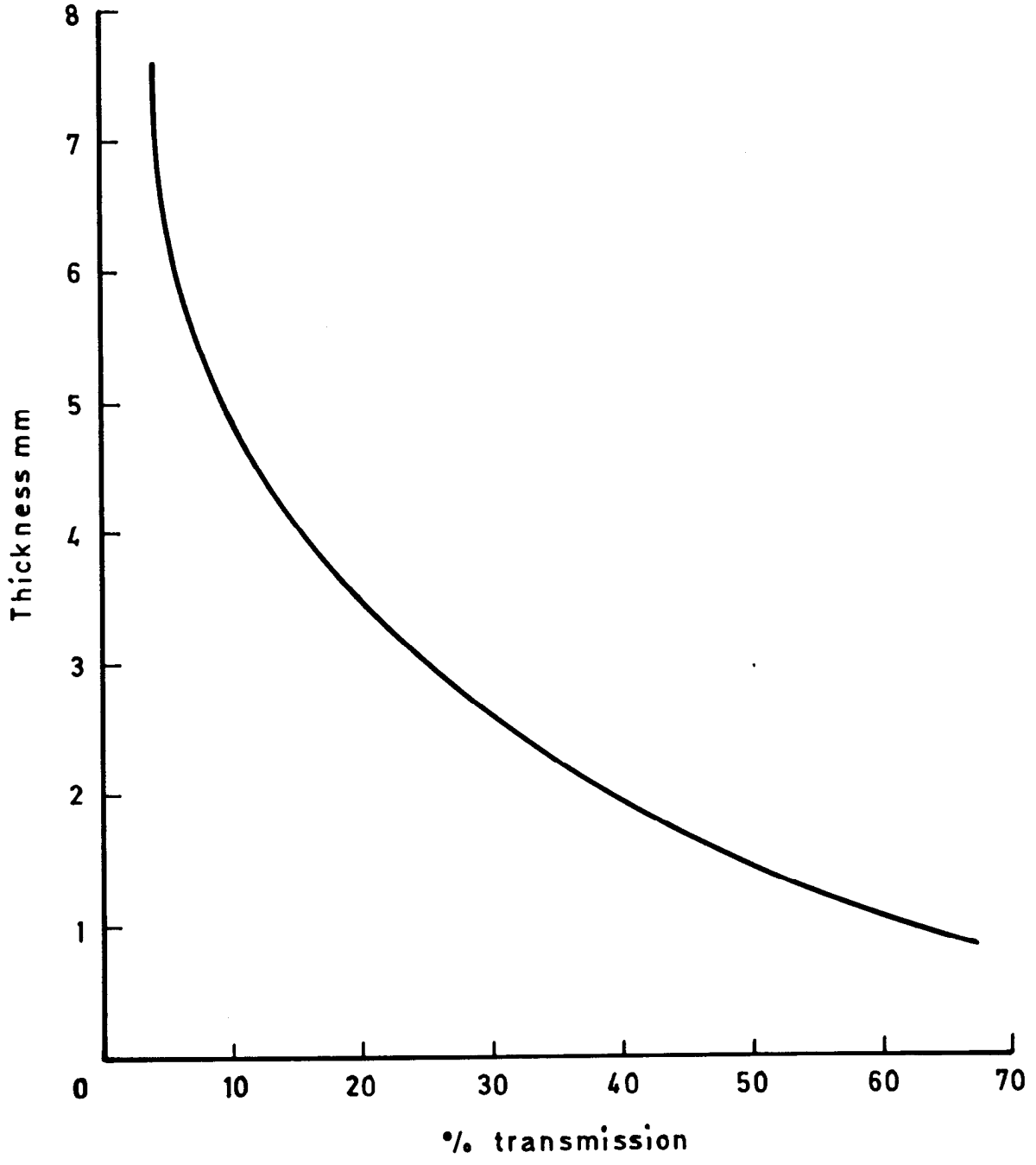


Note For thickness greater than 7mm the transmission is approximately 4%

Fig 1 Maximum permissible ultra-violet transmission in the range 290-330 nanometres

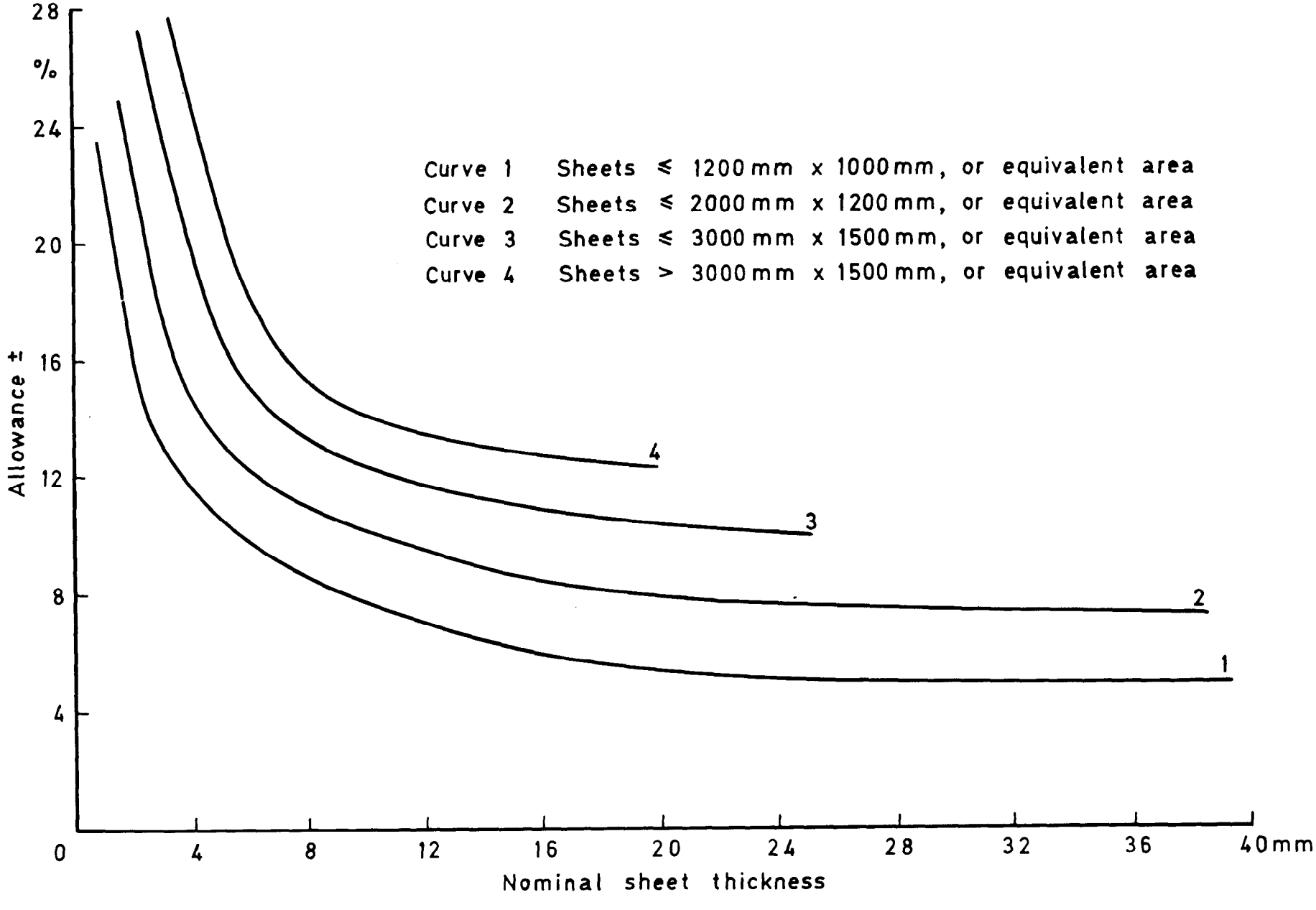


Fig 2 Thickness tolerances on sheet material

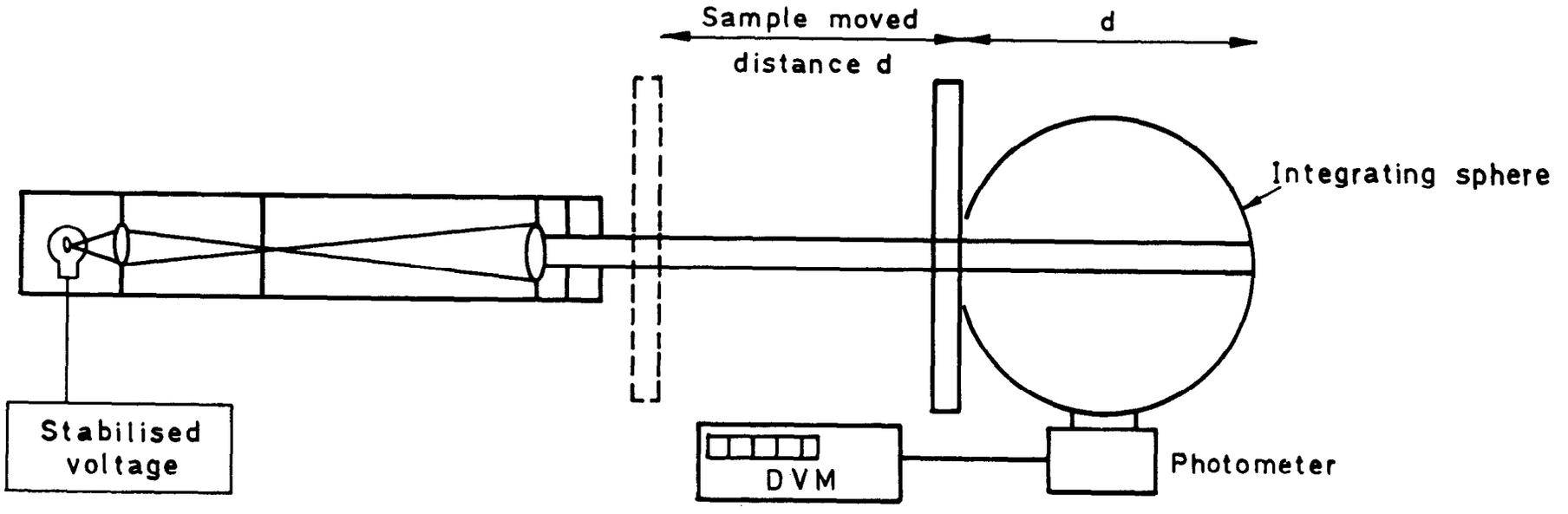
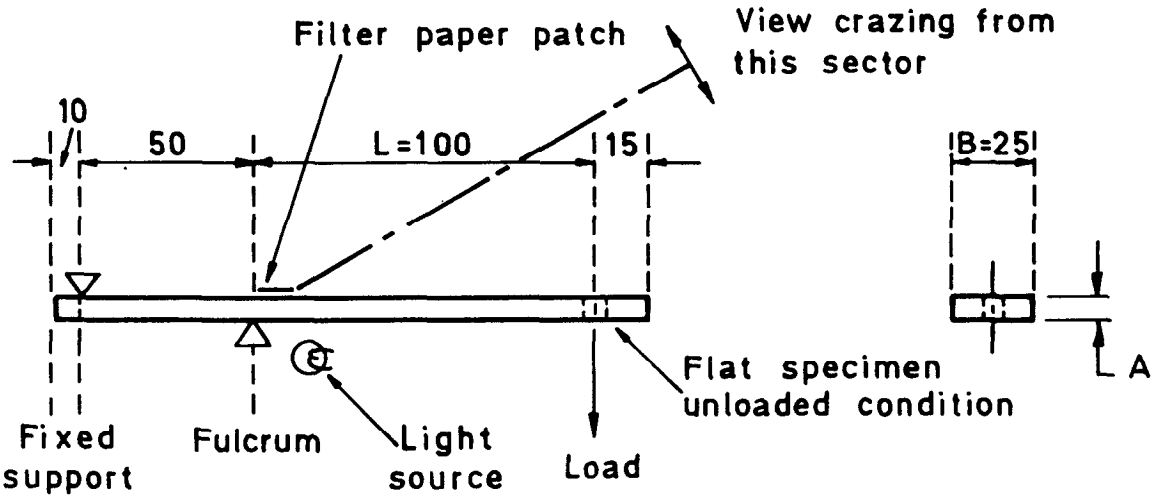
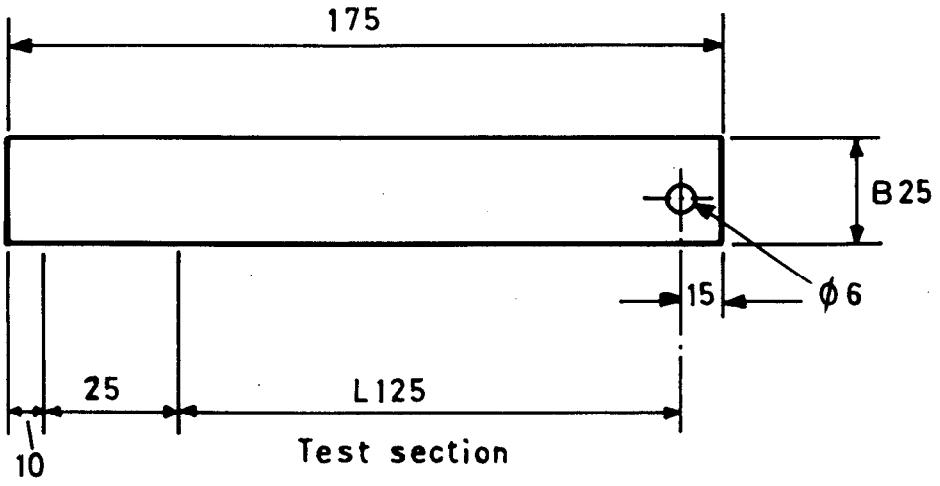


Fig 3 Measurement of haze

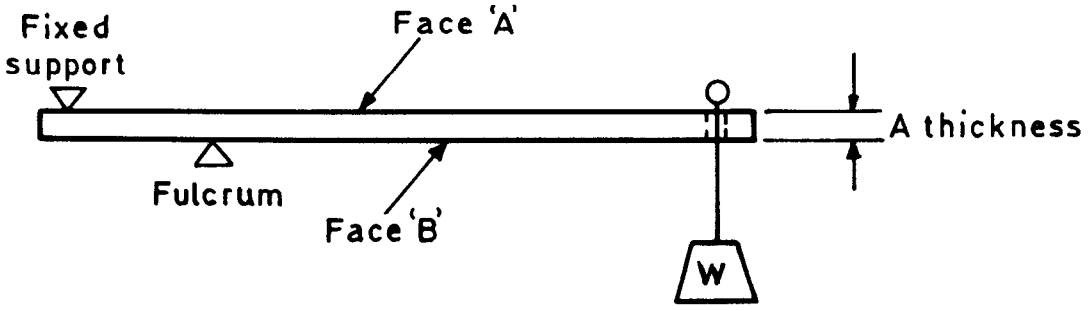


Measurements in millimetres

Fig 4 Test specimen and loading condition for resistance to crazing test



Test specimen



Loading geometry

Dimensions in millimetres

Fig 5 Test specimen and loading geometry for retention of strength after crazing test

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