INTERNATIONAL STANDARD

ISO 9353

First edition
1991-05-15

Glass-reinforced plastics — Preparation of plates with unidirectional reinforcements by bag moulding

Plastiques renforcés au verre textile — Préparation des plaques d'essai à renfort unidirectionnel par moulage au sac

Reference number
ISO 9353:1991(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

International Standard ISO 9353 was prepared by Technical Committee ISO/TC 61, *Plastics*.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Glass-reinforced plastics — Preparation of plates with unidirectional reinforcements by bag moulding

1 Scope

This International Standard describes the preparation of test plates made of unidirectionally orientated glass fibre or fabric and thermosetting resins by laying up and curing.

The orientation of the reinforcement in each layer and the lay-up method shall be as given in the appropriate specification.

These resins cure with or without loss of reaction products; in either case, their properties are not significantly altered. The resins can be processed at an elevated pressure agreed between the interested parties. The purpose of this International Standard is to standardize the preparation of the plates from which test specimens are subsequently machined. Standard specimens prepared in this manner may be used either for evaluating the components, i.e. the glass reinforcement, finishes, resins, catalysts, curing agents, etc., or for quality control of the finished products.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 1172:1975, *Textile glass reinforced plastics — Determination of loss on ignition.*

3 Principle

Plates are prepared by one of the following methods:

3.1 Method A

The glass reinforcement, impregnated with liquid resin containing a suitable catalyst or curing agent, is moulded under conditions of temperature and pressure appropriate for the resin and curing system.

3.2 Method B

The glass reinforcement, impregnated with resin partially cured to the B-stage (prepreg) but capable of further curing, is moulded at a temperature higher than room temperature and at a pressure appropriate for the resin and curing system.

4 Apparatus and auxiliary equipment

4.1 Apparatus

4.1.1 Hydraulic or mechanical press, with the following characteristics:

a) temperature-measurement and control device capable of maintaining the curing temperature within the specified limits;

b) means of applying a moulding force with an accuracy of ±5 % over the period of time required for the curing of the resin.

4.1.2 Autoclave, of any dry-heat type, with the following characteristics:

a) temperature-measurement and control device as specified in 4.1.1 a);

b) heat-up speed of at least 3 °C/min;

c) ability to maintain the required pressure with an accuracy of ± 1 % over the period of time required for curing of the resin;

d) vacuum pump capable of applying a vacuum of at least 0,08 MPa;

e) compressed-air supply capable of applying a pressure of 0,7 MPa with an accuracy of ± 5 %.

4.2 Auxiliary equipment

4.2.1 Metal lay-up plate, measuring 500 mm × 500 mm × 5 mm.

4.2.2 Metal cover (pressure) plate, measuring 300 mm × 300 mm × 5 mm.

4.2.3 Rubber pressure-retaining rings, resistant to a temperature at least 20 °C higher than the actual curing temperature.

4.2.4 Release membrane, resistant to a temperature at least 20 °C higher than the actual curing temperature, such as a poly(vinyl fluoride) (PVF) or polytetrafluoroethylene (PTFE) film or PTFE-coated fabric.

4.2.5 Perforated release membrane, resistant to a temperature at least 20 °C higher than the actual curing temperature, such as a PVF or PTFE film or PTFE-coated fabric.

4.2.6 Pressure blanket, resistant to a temperature at least 20 °C higher than the actual curing temperature, such as a PTFE or PTFE-coated fabric.

4.2.7 Breather material, such as aluminium gauze or glass fabric.

4.2.8 Material for absorbing excess resin, such as glass fabric.

4.2.9 Cork dams or **metal edge-spacer bars**, 300 mm long and 15 mm wide, their thickness depending on the thickness of the plate to be produced.

4.2.10 Sealing tape, resistant to a temperature at least 20 °C higher than the actual curing temperature.

5 Procedure

The materials used for preparing the test plates, including the materials from which the test plates are made, shall be conditioned for at least 2 h at one of the standard atmospheres specified in ISO 291.

5.1 Method A

5.1.1 The glass-fibre roving shall be dried at 80 °C for a period of 1 h, except in the case of sized or finished rovings requiring a lower temperature. After drying, the roving shall be cooled to 23 °C and conditioned for 6 h at one of the standard atmospheres specified in ISO 291, then impregnated with the resin containing a suitable catalyst or curing agent.

5.1.2 The impregnation of the roving may be carried out using any technique to obtain a homogeneous tape or sheet of parallel-orientated impregnated rovings.

The resin content of the impregnated-roving tape or sheet shall not be in excess of 45 % (*m*/*m*).

5.1.3 The number of layers of impregnated-roving tape or sheet required to produce the final cured thickness of plate (see 5.1.5) shall be laid up on the metal lay-up plate (4.2.1).

5.1.4 Unless otherwise specified, not more than 50 % of the resin gel time at the impregnation temperature shall elapse before the curing process is started.

5.1.5 The assembly on the metal lay-up plate (4.2.1) shall be ready for curing as shown in figure 1 or figure 2. The number of layers of absorption material (4.2.8) required for excess-resin absorption depends on the resin content required for the cured plate. The plate thickness and resin content are also a function of pressure, temperature and other factors, depending upon the properties of the glass-fibre roving and of the resin system. Before making the plates, it will therefore be necessary to determine by experiment the number of layers of resin-impregnated roving tape or sheet required, the number of absorption layers required for excess-resin absorption, and the pressure necessary to obtain cured plates of the required thickness and resin content.

5.1.6 The temperature, pressure and time of curing shall be agreed upon by the interested parties, depending on the type of resin, catalyst or curing agent. During the curing cycle, the temperature shall be maintained within the tolerances shown in figure 3, as indicated by the temperature-measurement device [4.1.1 a)]. The temperature at any point on the active surface of the plate being moulded shall not differ by more than ± 2 °C from the value indicated by the temperature-measurement device.

5.1.7 On completion of the curing process, and cooling to room temperature, if necessary, in such a way that any deformation, damage, etc., is avoided, the test plate shall be removed from the press or autoclave, discarding all used auxiliary materials.

5.1.8 Unless otherwise agreed, the plates shall be used without further treatment. If not specified in the relevant standard, the type, size and orientation of the glass reinforcement shall be agreed upon by the interested parties. The margins of the plate shall be discarded up to at least 15 mm from its edges.

5.2 Method B

5.2.1 The required materials shall be conditioned at one of the standard atmospheres specified in ISO 291. If the materials have been stored at a temperature lower than 23 °C, they shall be put in an air-tight bag (to prevent moisture pick-up) until they reach 23 °C. Then the required amount shall be conditioned for 2 h.

After conditioning, the material required for the preparation of the test plates shall be cured within 6 h after conditioning, unless otherwise specified.

5.2.2 The roving tape or sheet preimpregnated with resin partially cured to the B-stage shall be cut into rectangles having the dimensions required to produce a 300 mm × 300 mm laminated plate.

5.2.3 Prepare a lay-up of the preimpregnated material to produce a cured test plate as described in 5.1.3 to 5.1.8.

5.3 Determination of plate dimensions

5.3.1 Measure the lengths of the four sides of the plate four times to an accuracy of 0,5 mm, after having trimmed at least 15 mm from its edges (see 5.1.8). Calculate the arithmetic mean of the four measurements, rounded to the nearest 1 mm.

5.3.2 Measure the thickness to an accuracy of 0,05 mm at each of the four corners, but not closer than 25 mm to the edges, and in the centre. Calculate the arithmetic mean of the five measurements, rounded to the nearest 0,1 mm.

5.3.3 Weigh the plate to an accuracy of 0,1 g. Record the mass to the nearest 1 g.

5.3.4 From each corner, take one test specimen measuring 25 mm × 25 mm. For each test specimen, determine the glass-fibre content by mass as specified in ISO 1172. Calculate the average content, rounded to the nearest 0,1 % (m/m) and record this value as well as the maximum and minimum values.

6 Test report

The test report shall include the following particulars:

a) a reference to this International Standard and to the method used (A or B);

b) a description of the materials used in the preparation of the plate (nature and type of resin, catalyst, curing agent or other additives, including the amounts used, as well as the nature and type of glass-fibre roving, nature of finish, etc.);

c) a complete description of the orientation of the reinforcement layers with respect to each other through the thickness of the plate;

d) a description of the apparatus (type of press, autoclave and mould, method of checking temperatures and pressures, etc.);

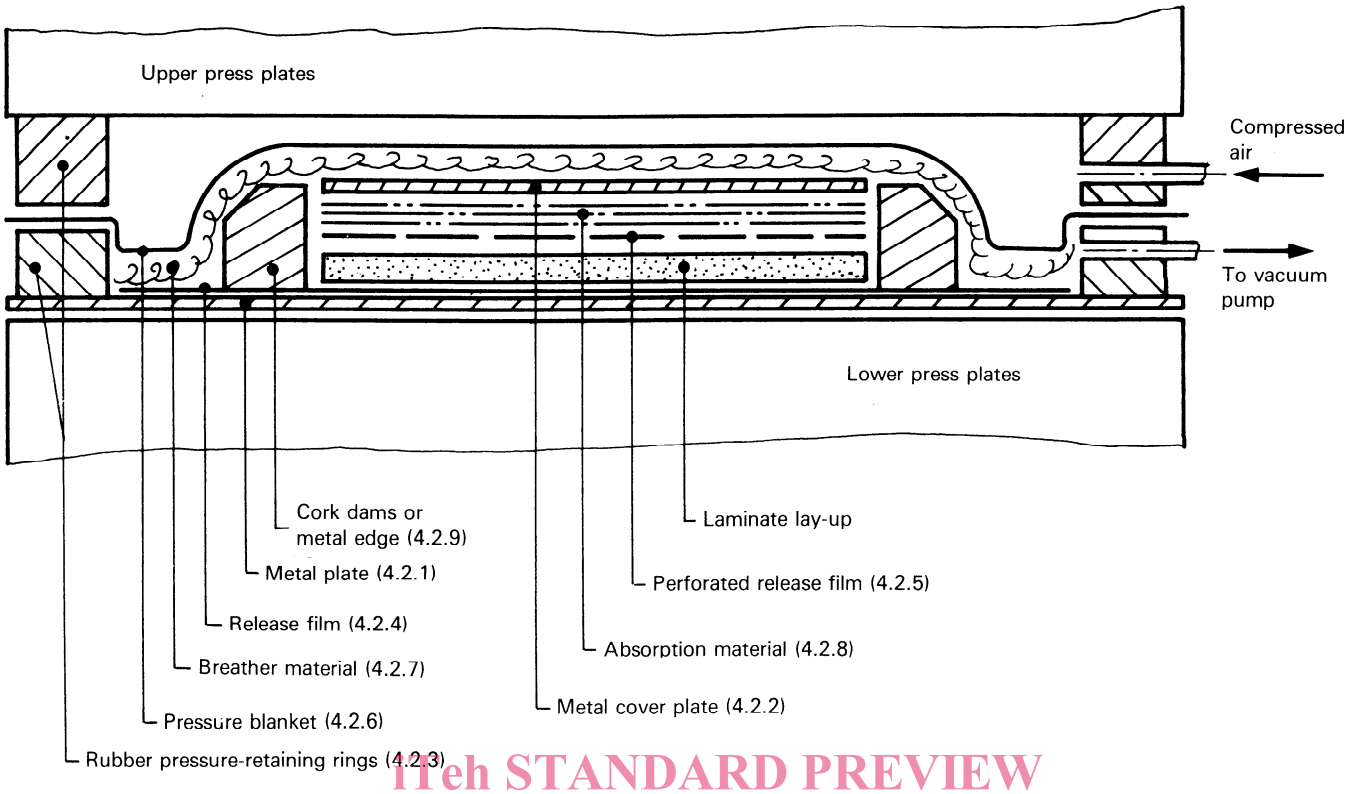
e) the conditioning atmosphere selected from ISO 291;

f) the working conditions (moulding pressure, temperature, curing time, cooling to room temperature, etc.);

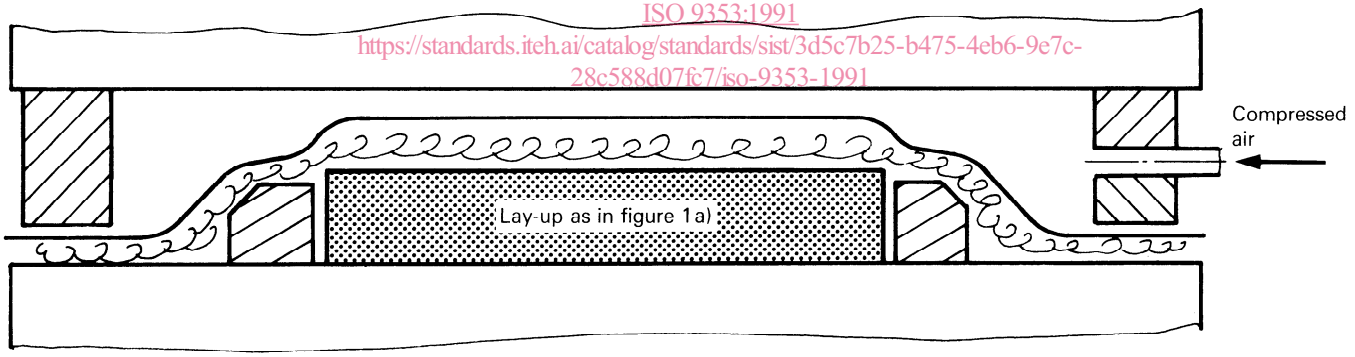
g) the dimensions and mass of the plate, and its glass-fibre content expressed as a percentage by mass;

h) any operating conditions not specified in this International Standard, as well as incidents that may have affected the properties of the plate;

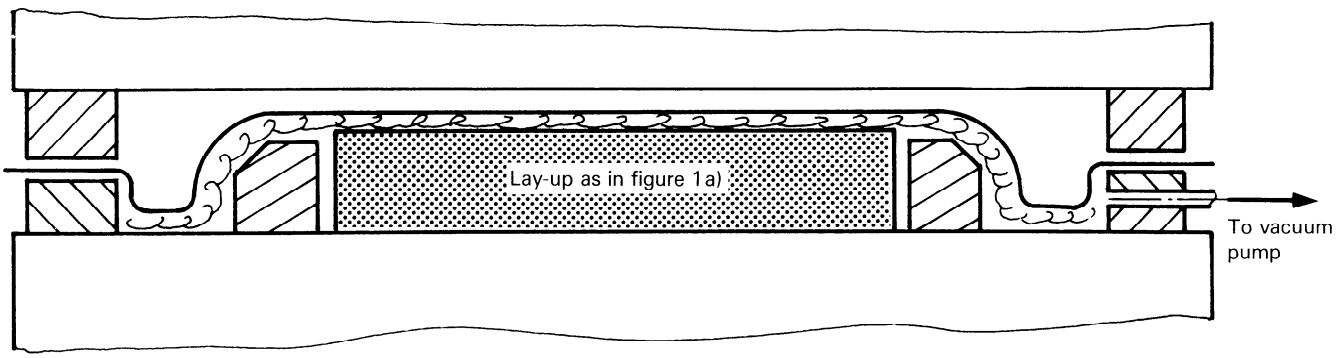
i) the date of preparation of the plate.



a) Overpressure and vacuum method



b) Overpressure method



c) Vacuum method

Figure 1 — Schematic example of a curing press

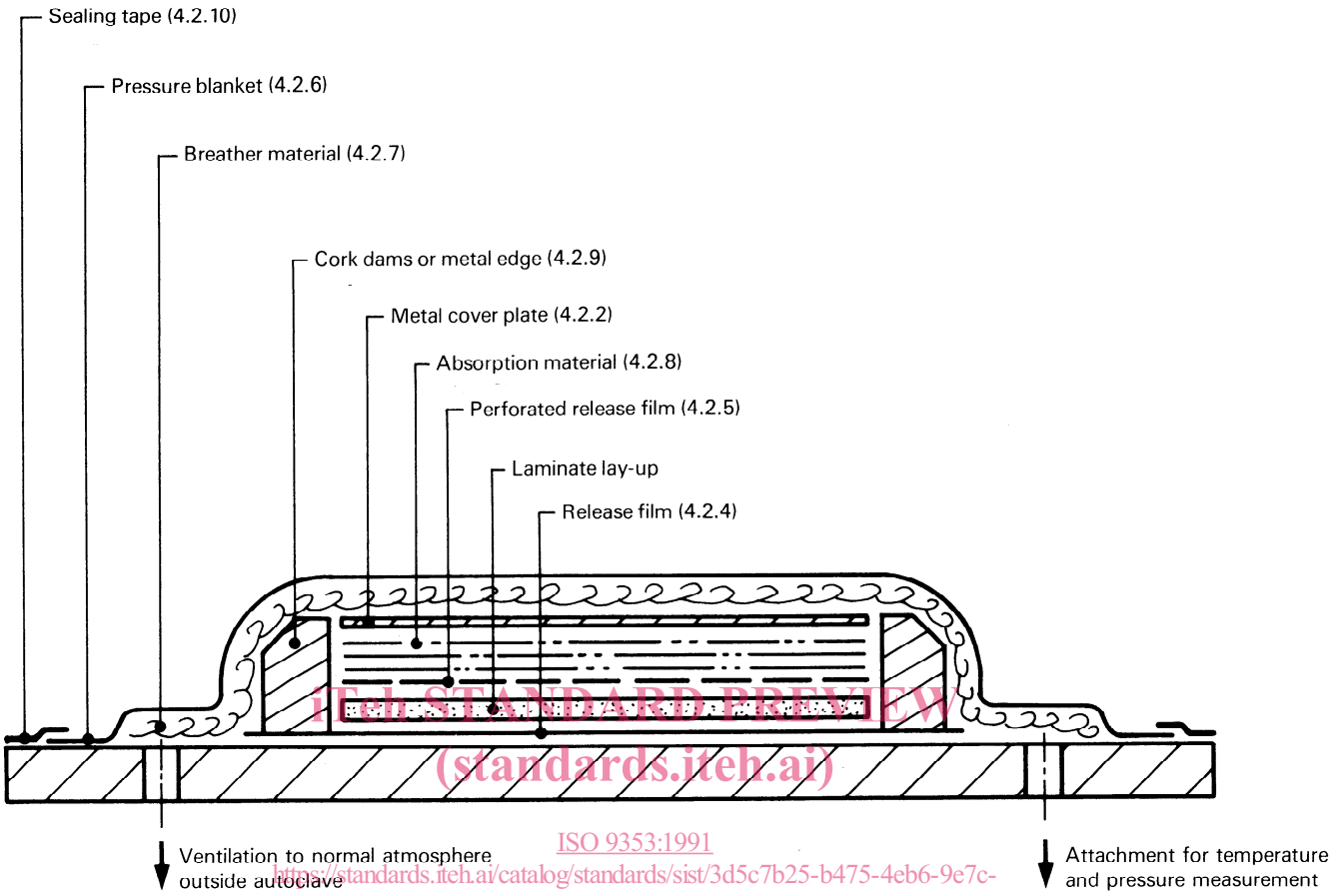


Figure 2 — Schematic example of autoclave curing

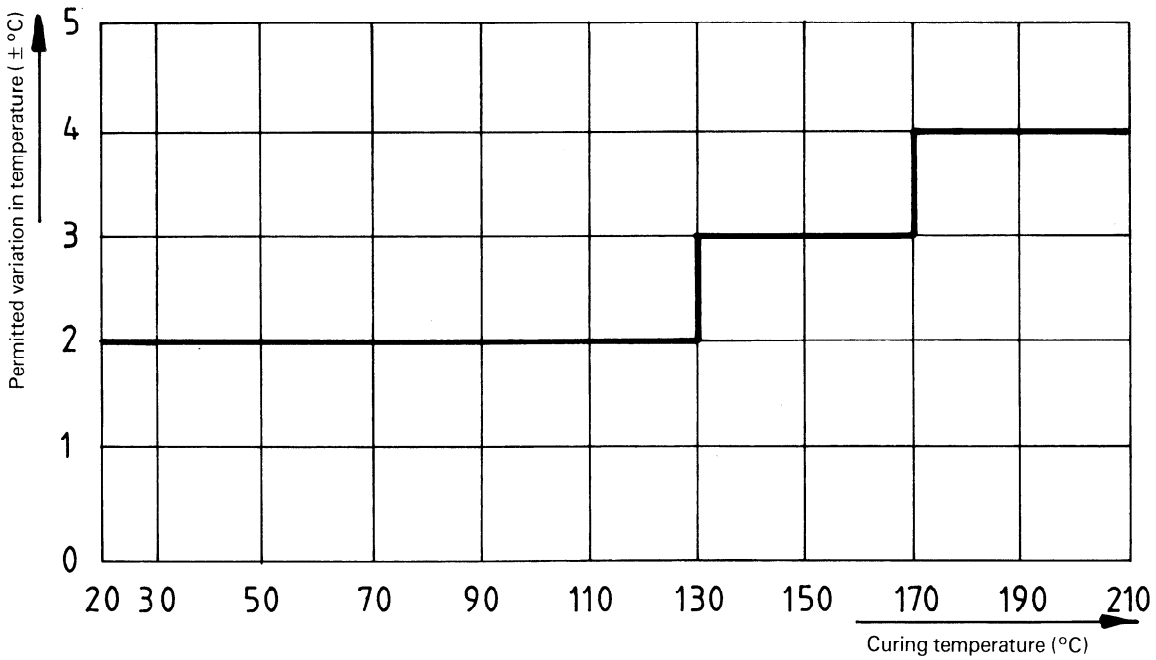


Figure 3 — Permissible variation of curing temperature (see 5.1.6)

This page intentionally left blank