



NEW ZEALAND FIBROUS PLASTER ASSOCIATION

# **Fibre-reinforced gypsum products MANUFACTURING CODE OF PRACTICE Australia & New Zealand**

This Code of Practice proposes performance requirements for fibre-reinforced gypsum products for use in buildings as lining material or as mouldings and decorative forms. Methods of manufacture are included but other methods may also be used. A number of test methods are given in appendices.

## ***PREFACE***

This Code of Practice was prepared by New Zealand Fibrous Plaster Association and is derived from well-established industry practices and obsolete Standards including AS 2590—1983, *Glass fibre reinforced gypsum plaster*, AS 2185—1978, *Fibrous plaster products*, and NZS 4221:1972, *Fibrous plaster sheet*.

The objective of this Code of Practice is to provide manufacturers and purchasers of fibre-reinforced gypsum products with performance requirements for such products for use as lining material for walls, ceilings and partitions and as mouldings and architectural forms.

The first Standards dealing with sisal hemp reinforced were issued in 1931. This Code of Practice encompasses all types of fibre-reinforced gypsum products.

The terms 'normative' and 'informative' have been used in this Code of Practice to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of this Code of Practice, whereas an 'informative' appendix is only for information and guidance.

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# **Fibre-reinforced gypsum products**

## **Manufacturing Code of Practice for Australia & New Zealand**

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### **1. SCOPE**

This Code of Practice specifies requirements for fibre-reinforced gypsum products intended for use in buildings as a lining material for walls, ceilings and partitions and as mouldings and architectural forms.

NOTE: Alternative methods for demonstrating compliance with this Code of Practice are given in Appendix A.

### **2. PURPOSE AND CONTEXT OF USE**

#### ***2.1. Function***

Fibre-reinforced gypsum is formed into sheets for lining the interior of buildings and moulded into decorative shapes for use inside buildings.

#### ***2.2. Action***

Fibre-reinforced gypsum products are subjected to normally existing conditions inside buildings including stresses due to movement in the frame to which they are attached, surface decoration (e.g. painting), bumps and scratches and to conditions as a result of handling, storage and construction including bending, stacking, vibration and moisture penetration.

### **3. REFERENCED DOCUMENTS**

The following documents are referred to in this Code of Practice:

#### **AS**

2592 Gypsum plaster for building purposes

#### **AS/NZS**

2589 Gypsum linings-Application and Finishing

### **4. OTHER MATERIALS OR METHODS**

Provided that the requirements of Clause 6 are met, this Code of Practice shall not be interpreted so as to prevent the use of materials or methods of manufacture not specifically referred to herein.

### **5. DEFINITIONS**

For the purpose of this Code of Practice, the following definitions apply: <sup>^</sup>

#### ***5.1. Edge***

The side of a sheet formed against the screed used to control sheet thickness.

#### ***5.2. Fibre-reinforced gypsum product***

A composition of gypsum plaster, water, fibre and, if required, other reinforcement forming a rigid body, one surface of which is smooth and suitable for decoration.

#### ***5.3. Mouldings***

Cast formed fibre-reinforced gypsum products in shapes other than flat sheeting.

## 6. PERFORMANCE OBJECTIVES

Fibre-reinforced gypsum products shall satisfy the following objectives:

- (a) *Materials* Products shall be made from gypsum plaster with fibre reinforcing suitable for use with gypsum.
- (b) *Hardness* Products shall have appropriate surface hardness to ensure satisfactory service life and to ensure that they do not suffer undue damage during handling and installation.
- (c) *Strength* Products shall be of sufficient thickness and have sufficient reinforcement to ensure that they do not suffer undue damage during handling and installation and to ensure satisfactory service life.
- (d) *Surface finish* Products shall have one surface (or side) that is smooth, even and suitable for decoration or as otherwise specified.
- (e) *Shape* Products shall be clean and true to shape with sharp and unbroken arrises and sheets shall be free from warping that cannot be straightened without cracking.
- (f) *Suitability for fixing* Products shall have sufficient strength and bearing surface to ensure that fixing methods as outlined in AS/NZS 2589 are sufficient for installation and accommodate in-service stresses.

## 7. PERFORMANCE REQUIREMENTS

### 7.1. General

When tested in accordance with the methods contained in this Code of Practice, products shall comply with the requirements of Clauses 7.2 to 7.7.

### 7.2. Materials

#### 7.2.1. Gypsum plaster

The base gypsum plaster used in manufacture of fibre-reinforced gypsum products shall comply with AS 2592.

#### 7.2.2. Reinforcing fibre

Reinforcing fibre shall consist of coated glass fibre, sisal hemp or some other appropriate material specifically designed and graded for use with gypsum plaster. The fibre shall be free from dirt and other substances in quantities likely to adversely affect the serviceability of the finished product.

The following amounts of glass fibre are deemed to comply with this Clause:

- (a) 255 g/m<sup>2</sup> for 8 mm thick sheets.
- (b) 345 g/m<sup>2</sup> for 12.5 mm thick sheets.

#### 7.2.3. Other reinforcement

Other suitable reinforcement includes timber laths, hessian scrim or other appropriate material suitable for use with gypsum plaster

#### 7.2.4. Release agents

Oils and greases used as release agents during the manufacturing process shall leave the plaster surface of the product clean, unstained and suitable for decoration.

#### 7.2.5. Water

Water used for mixing plaster shall be clean and fresh without colour and suitable for drinking.

### 7.3. Thickness

When measured in accordance with Paragraph B2 of Appendix B, the thickness of sheets shall be within  $\pm 1$  mm of the nominal stated thickness. No sheet shall have a measured thickness less than 8mm.

### 7.4. Surface hardness

When tested in accordance with Paragraph B3 of Appendix B, the diameter of any impression caused by the test ball in the tested surface shall not exceed 5mm.

### 7.5. Bearing surfaces

Products shall have bearing surfaces that provide for easy installation. Mouldings shall have a bearing surface not less than 19mm wide on all edges that are in contact with wall, ceiling or similar surfaces.

### 7.6. Moisture content

When tested in accordance with Paragraph 4 of Appendix B, the moisture content shall not exceed 5 percent at the time of supply.

### 7.7. Nail pull resistance

When tested in accordance with Appendix C, fibre-reinforced gypsum products shall have minimum nail pull resistance appropriate to its intended use as per Table 1.

NOTE: The nail pull test is used to ensure that fibre-reinforced products have sufficient strength and flexibility to resist fastener pull through due to in-service loads and actions.

**TABLE 1 MINIMUM NAIL PULL RESISTANCE**

<b>Walls</b>	<b>(studs max. 600 mm centres)</b>	<b>Ceilings (joists/furring max. 600 mm centres)</b>
	<b>270 N</b>	<b>300 N</b>

NOTE: The nail pull resistance requirement is based on the ability of the fastener to withstand a differential pressure of 0.5 kPa, with a suitable safety margin.

### 7.8. Sheets only

#### 7.8.1. Transverse bending test

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When tested in accordance with Appendix D at a force of 150 N, the specimen shall not break and the deflection shall not exceed 15 mm. If the deflection is less than 6 mm, the force shall be increased until failure occurs. The deflection before failure shall then be not less than 6 mm.

NOTE: The bending strength test is used to ensure the sheets have sufficient strength to withstand bending during installation and due to in-service loads and actions.

#### 7.8.2. Bond strength

When tested in accordance with Appendix E, the bond strength in tension shall be not less than 250 N after 24 h drying and of the scrimming shall not be less than 110 N after 48 h drying.

NOTE: The bond strength test is to ensure sufficient strength between the back of the product and the material to which it is attached.

## 8. MANUFACTURE

### 8.1. Sheets

Fibre-reinforced gypsum sheets shall be manufactured by one of the following methods:

(a) *One-gauge method*

- (i) A sufficient quantity of gauged plaster shall be poured to an even thickness over the surface of a casting bench and the requisite amount of fibre reinforcement shall be distributed evenly over the gauged plaster surface.
- (ii) The fibre reinforcement shall be pressed and rolled down until it is thoroughly incorporated and evenly dispersed in the plaster gauge.
- (iii) The sheet shall be ruled off to an even thickness.

(b) *Two-gauge method*

- (i) A face gauge of unreinforced plaster of even consistency shall be spread to cover the entire surface of the bench to a thickness of approximately 1 mm and shall be allowed to set partially.
- (ii) Before the set of the face gauge has advanced to the stage where effective bonding of the two gauges is jeopardised, the required amount of fibre reinforcing shall be evenly distributed over the gauged plaster surface and shall be thoroughly incorporated and evenly dispersed in the plaster gauge.

(c) *Other methods*

Other methods of manufacture may be used provided that product performance is equal to or better than that given by the methods above.

### 8.2. Mouldings

*Mouldings* shall be manufactured as follows:

(a) *One-gauge method*

- (i) A sufficient quantity of plaster shall be poured into the mould, ensuring penetration into all angles of the mould, and the requisite amount of fibre reinforcement shall be distributed evenly over the plaster surface.
- (ii) The fibre reinforcement shall be pressed and rolled down until it is thoroughly incorporated and evenly dispersed in the plaster gauge.
- (iii) The fixing edges shall be ruled off clean and straight.

(b) *Two gauge method*

- (i) A face gauge of plaster shall be thoroughly brushed or worked into angles of the mould and spread evenly over all faces. The plaster shall then be allowed to partially set.
- (ii) The body gauge shall be poured over the face gauge and reinforced with the appropriate combination of fibre and other suitable reinforcement.
- (iii) The fixing edges shall be ruled off clean and straight.

(c) *Other methods*

Other methods may be used provided product performance is equal to or better than that given by the methods above.



# APPENDIX A - MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS CODE OF PRACTICE

(Informative)

## ***A1 Scope***

This Appendix sets out the following different means by which compliance with this Code of Practice can be demonstrated by the manufacturer or supplier:

- a) Evaluation by means of statistical sampling
- b) The use of a product certification scheme.
- c) Assurance using the acceptability of the suppliers quality management system
- d) Other such means proposed by the manufacturer or suppliers and acceptable to the customer.

## ***A2 Statistical sampling***

Statistical sampling is a procedure which enables decisions to be made about the quality of batches of items after inspecting or testing only a portion those items. This procedure will only be valid if the sampling plan has been determined on a statistical basis and the following requirements are met:

- (a) The sample must be drawn randomly from a population of product of known history. The history must enable verification that the product was made from known materials at essentially the same time by essentially the same processes and under essentially the same system of control.
- (b) For each different situation, a suitable sampling plan needs to be defined. A sampling plan for one manufacturer of given capability and product throughput may not be relevant to another manufacturer producing the same items.

In order for statistical sampling to be meaningful to the customer, the manufacturer or supplier needs to demonstrate how the above conditions have been satisfied. Sampling and the establishment of a sampling plan should be carried out in accordance with AS 1199, guidance to which is given in AS1399.

## ***A3 Product certification***

The purpose of product certification is to provide independent assurance of the claim by the manufacturer that products comply with the stated Code of Practice.

The certification scheme should meet the criteria described in SAAHB 18.28 (SNAZ HB 18.28) in that, as well as full type testing from independently sampled production and subsequent verification of conformance, it requires the manufacturer to maintain effective quality planning to control production.

The certification scheme serves to indicate that the products consistently conform to the requirements of the Code of Practice.

## ***A4 Suppliers quality management system***

Where the manufacturer or supplier can demonstrate an audited and registered quality management system complying with the requirements of the appropriate or stipulated Australian or international Code of Practice for a supplier's quality system or systems, this may provide the necessary confidence that the specified requirements will be met. The quality assurance requirements need to be agreed between the customer and supplier and should include a quality or inspection and test plan to ensure product conformity.

Guidance in determining the appropriate quality management system is given in AS/NZS ISO 9000.

## ***A5 Other means of assessment***

If the above methods are considered inappropriate, determination of compliance with the requirements of this Code of Practice may be assessed by being based on the results of testing coupled with the manufacturer's guarantee of product conformance.

Irrespective of acceptable quality levels (AQLs) or test frequencies, the responsibility remains with the manufacturer or supplier to supply products that conform to the *requirements* of the Code of Practice.

## APPENDIX B - METHODS OF TEST

(Normative)

### ***B1 Scope***

This Appendix sets out methods of test to determine the sheet thickness, surface hardness and moisture content of fibre-reinforced gypsum products.

### ***B2 Thickness measurements***

Measure the thickness at 5 points on the sheet using a dial micrometer with an accuracy of 0.2 mm, at a position not less than 25 mm from a cut edge or 100 mm from a moulded edge. Report the average and the range of the 5 readings.

### ***B3 Surface hardness test***

The surface hardness test shall be carried out at three points on the surface of an undamaged sample as follows:

- (a) Using a suitable apparatus gently apply a force of 150 N to the surface of the sheet through a 10 mm diameter steel ball. Allow it to remain in position for 5 min.
- (b) Remove the force and ball and measure the diameter of each impression of the ball on the surface.

### ***B4 Moisture content***

Determination of moisture content shall be carried out on test specimens as follows:

- a) For sheets, the specimens shall be 450 mm x 300 mm
- b) For mouldings, the specimens shall as far as possible be of a similar mass as those for sheets.
- c) Perform the following procedure:
  - (i) Weigh the specimen to an accuracy of 0.1 % as received.
  - (ii) Dry in a well ventilated oven at a temperature of  $45^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for 12 hours then allow to cool in air for approximately 2 hours.
  - (iii) Weigh the specimen on a weighing device accurate to 0.1%.
  - (iv) Dry again for approximately 2 hours and recool. Repeat this process until the specimen assumes constant weight to within 0.5%.

The difference between the initial and final weight shall be divided by the final weight and multiplied by 100 to give the moisture content of each specimen as a percentage of its oven dry weight and reported. For a number of specimens from the same sheet the average shall be reported.

# APPENDIX C - A NAIL PULL RESISTANCE TEST FOR SHEETS

(Normative)

## C1 Scope

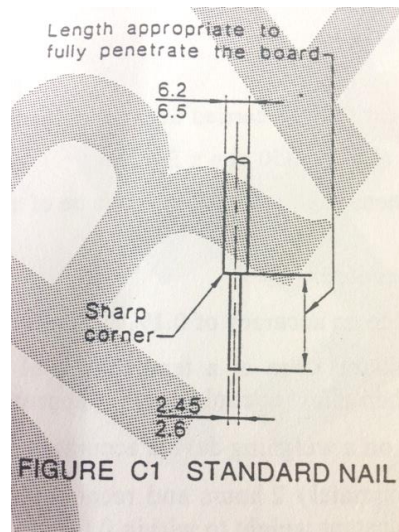
This Appendix sets out the method for determining the nail pull resistance of fibre reinforced gypsum plaster sheets for applications that require mechanical fixings.

The test determines the ability of the sheet to resist nail pull-through by evaluating the load required to push a standard nail head through the sheet.

## C2 Apparatus

The following apparatus is required:

- A calibrated universal testing machine in accordance with AS2193, with a minimum capacity of 1 kN and capable of a strain rate of 25 mm/min.
- A 'standard' test nail which has a shank diameter between 2.45 mm and 2.60 mm and a head diameter between 6.2 mm and 6.5 mm. See Fig C1.
- Specimen support plate with a  $75 \pm 2$  mm diameter hole.
- A standard 2.75 mm twist drill.



## C3 Test specimen, sample preparation and conditioning

Cut six specimens  $150 \pm 10$  mm x  $150 \pm 10$  mm.

Drill a pilot hole through the thickness in the center of each test specimen, perpendicular to the face.

Store the test specimens for a minimum of 2 h., at  $23 \pm 2^\circ\text{C}$  and  $50 \pm 5\%$  relative humidity.

## C4 Test procedure

The test procedure shall be as follows:

- Centre each specimen face up on the base plate and manually lower the cross head until the shank of the test nail is located in the pilot hole.
- Set the universal machine cross head speed at 25 mm/min and test.
- Record the maximum load for all six specimens.
- Calculate and record the average of the loads given in Step (c).

## C5 Test report

The following shall be reported:

- Identification of sample received.

- b) Name of laboratory or authority which performed the test.
- c) Test Date(s)
- d) The average load in newton's on the test nail.
- e) Any observations, in relation to either the test sample or performance of the test, which may assist in correct interpretation of test results.
- f) Reference to this Australian/New Zealand Standard i.e. AS/NZS 2590.

## APPENDIX D - BENDING STRENGTH TEST FOR SHEETS

(Normative)

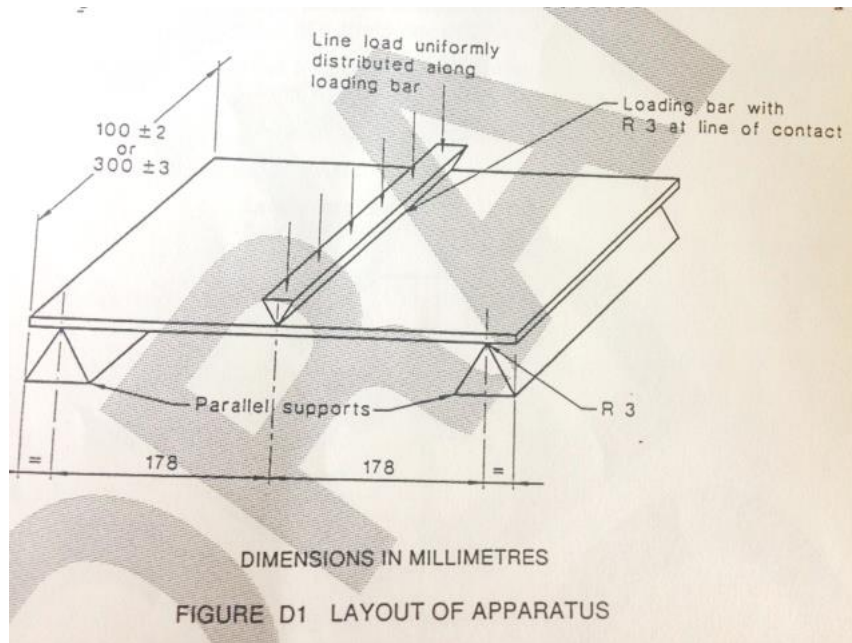
### D1 Scope

This Appendix sets out the method for determining the bending strength of fibre-reinforced gypsum plaster sheets.

### D2 Apparatus

The following apparatus is required:

- A calibrated universal testing machine in accordance with AS2193, with a minimum capacity of 1 kN and capable of a strain rate 25 mm/min.
- Test rig as shown in Figure D 1.



### D3 Test specimens

Eight test specimens  $300 \pm 3$  mm by  $400 \pm 10$  mm, (see Note for alternative specimen dimension), shall be cut from each sheet so that no part of the test specimen is nearer than 100 mm to the edge of the sheet.

Four specimens shall have their long dimension parallel to one edge of the sheet and the other four parallel to the other edge of the sheet and shall be marked when cut to indicate their orientation.

NOTE: Laboratory evaluation has verified that samples of  $100 \pm 2$  mm may be satisfactorily substituted for the specified 300 mm dimension. In this case the reported result should be derived from the actual result multiplied by a factor of three.

### D4 Conditioning

The test specimens shall be stored at  $23 \pm 2^\circ\text{C}$  and  $50 \pm 5\%$  relative humidity for a minimum of 12 hours.

### D5 Test procedure

The procedure shall be as follows:

- Place the specimen on two parallel supports at least 300 mm in length and spaced at  $356 \pm 0.4$  mm centres (see Figure D1). The support edges shall be straight and horizontal and have a radius of 3 mm.
- Test two of the four specimens taken from one orientation 'face up' and the remaining two 'face-down'.

- (c) Test two of the four specimens taken from the other orientation 'face-up' and the remaining two 'face-down'.
- (d) Apply a vertical force uniformly across the full width of the specimen along a line parallel to and mid-way between the supports. The member applying the load shall be straight and horizontal and have a radius of 3 mm along the line of application.
- (e) Apply the test force at a uniform rate of travel of 25 mm/mm until failure.
- (f) Record the failure force to the nearest % N for each pair of specimens.

### ***D6 Test report***

The following shall be reported:

- a) Identification of sample received.
- b) Name of laboratory or authority which performed the test.
- c) Test Date(s)
- d) The average breaking forces for the specimens for each test condition for each direction of test.
- e) Any observations, in relation to either the test sample or performance of the test, which may assist in correct interpretation of test results.
- f) Reference to this Australian/New Zealand Standard i.e. AS/NZS 2590.

# APPENDIX E - BOND TENSION STRENGTH TEST FOR SHEETS

(Normative)

## E1 Scope

This Appendix sets out the method for determining the bond strength in tension of fibre-reinforced gypsum plaster sheets when using adhesive or scrimming.

## E2 Principle

A test assembly is loaded in tension, producing a tensile force on the fixing material. The value of the load at failure enables the bond strength in tension of the fixing material to the sheet to be determined.

## E3 Apparatus

The following apparatus is required:

1. Square ended spatula.
2. One block of metal,  $50 \pm 1$  mm x  $50 \pm 1$  mm x 5 mm (minimum) high.
3. Three pieces of fibre reinforced gypsum plaster sheet, of minimum size 70 x 70 mm taken from the same sheet but not within 100mm of an edge.
4. One 10 mm eye bolt or other suitable means of attachment
5. Two 1 mm nominal external diameter metal spacers (wire), approximately 70 mm long.
6. Calibrated tensile testing machine complying with the requirements of AS 2193.
7. Suitable weight having a mass of 7 kg.
8. Mastic adhesive in accordance with AS2753
9. Gypsum plaster as specified by the manufacturer as suitable for scrimming.
10. Fibre reinforcing for scrimming.
11. 200 mm long, 3 mm diameter steel rod.
12. 50 x 50 x 25 mm long mould (holes on opposite sides).

## E4 Preparation of assemblies

### E4.1 Adhesive method

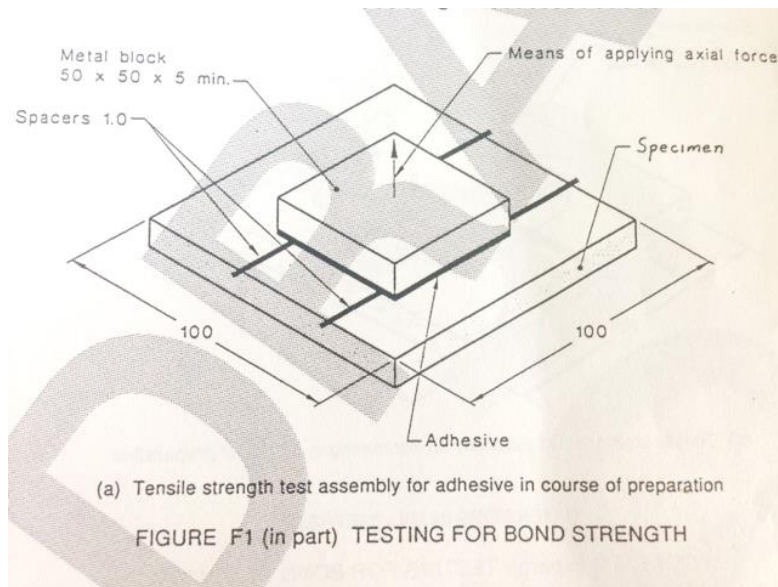
Prepare three test assemblies as follows:

- a) Condition the specimens of fibre-reinforced gypsum sheet at a temperature of  $23 \pm 2^{\circ}\text{C}$  and  $50 \pm 5$  % relative humidity and the metal block and adhesive at a temperature  $23 \pm 2^{\circ}\text{C}$  for a minimum of 24 h immediately preceding the preparation of test assemblies.
- b) Locate means of attachment centrally in the face of the block opposite to the face selected for bonding. Ensure that when the load is applied it is applied axially to the test block.
- c) Using the spatula, apply the adhesive under test to one side of the block to a wet thickness of approximately 2 mm.
- d) Immediately press the adhesive coated face of the block centrally and square onto the back of the specimen until the adhesive just starts to squeeze out.
- e) Insert the two spacers into the assembly as shown in Figure E 1.
- f) Immediately compress the assembly under the weight of the 7 kg mass. Immediately remove the weight. Pull out the spacers, taking care not to disturb the block alignment.
- g) Using a square cut, remove excess adhesive with the spatula.
- h) Condition the test assembly at a temperature of  $23 \pm 2^{\circ}\text{C}$  and  $50 \pm 5$  % relative humidity for 24 h.

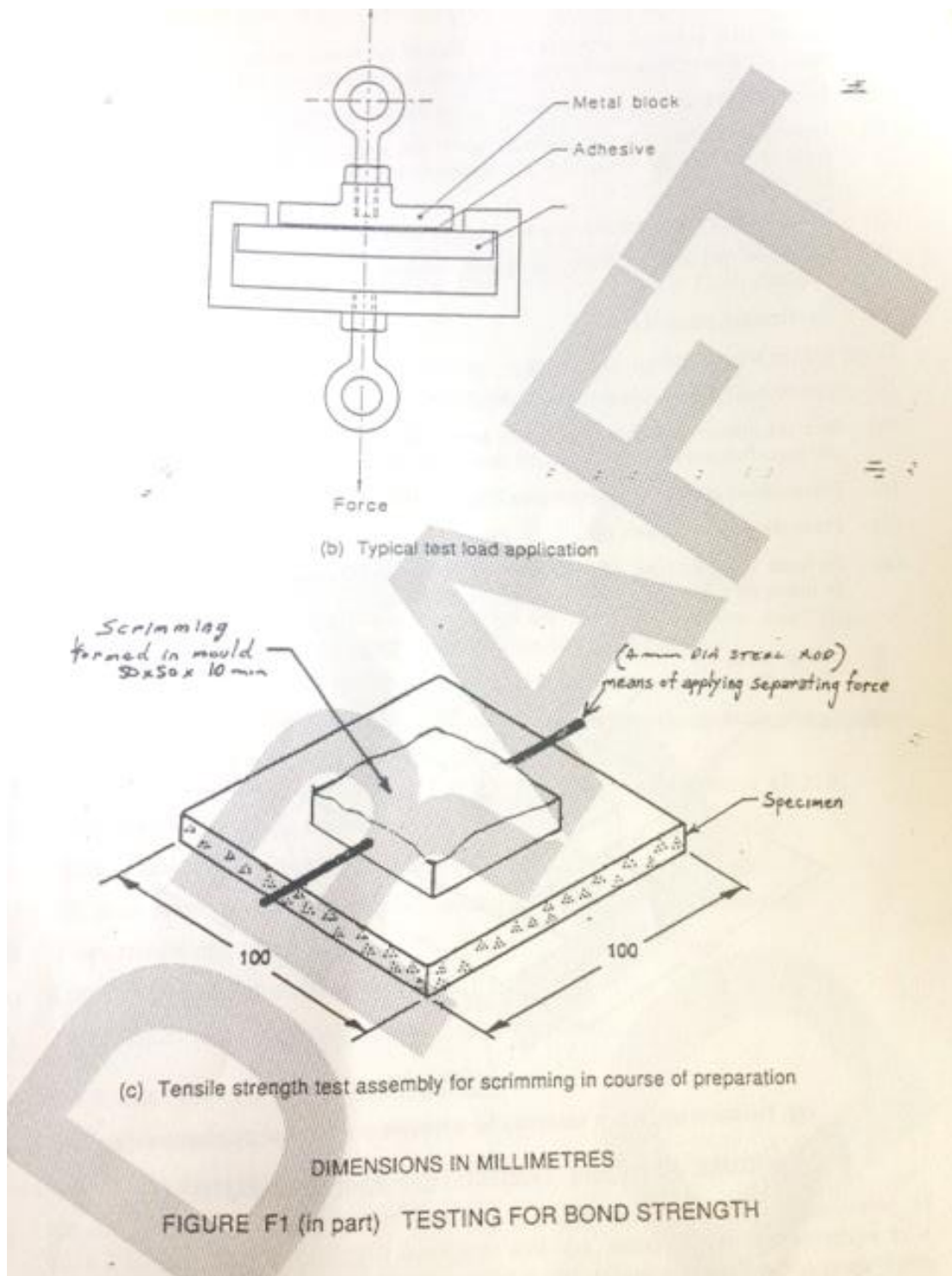
## E4.2 Scrimming method

Prepare three test assemblies as follows:

- a) Condition the specimen as described in step E4.1 a).
- b) Mix the plaster and fibre reinforcing intended to be used for scrimming according to the manufacturer's instructions sufficient to fill the mould.
- c) Place mould on back of sample (see Figure E 1 c)).
- d) Place mixture and insert rod.
- e) Perform steps E4.1 e), f), g) and h) and condition the assembly for a further 24 hours for a total of 48 hours conditioning.







### E5 Test procedure

Test the three assemblies as follows:

- Load the assembly in tension in the testing machine at a rate of jaw separation of 50 mm/min.
- Record the tensile force at failure, in newton's.
- Calculate the average of the forces for the three assemblies.

### E6 Test report

The following shall be reported:

- Identification of sample received.
- Name of laboratory or authority which performed the test.

- c) Test Date(s)
- d) The average breaking force in newton's as calculated in Paragraph E 5 c).
- e) Any observations, in relation to either the test sample or performance of the test, which may assist in correct interpretation of test results.
- f) Reference to this Code of Practice.