

Water Industry Specification

SPECIFICATION FOR POLYPROPYLENE ENCAPSULATED STEPS FOR USE IN MANHOLES AND ACCESS CHAMBERS

FOREWORD

This specification has been prepared by the Water Research Centre under the direction of the Sewers and Water Mains Committee in consultation with the Water Industry to define the properties of polypropylene encapsulated steps for use in manholes and access chambers. The steps may be cast or fixed into precast concrete chamber rings during their manufacture or fitted into existing precast concrete or brick chambers with the aid of a suitable epoxy resin. The fixing method may include the use of inserts for particular applications.

The step consists of metal reinforcement which provides the mechanical strength, completely encapsulated with at least 3mm of polypropylene. The plastic cover provides corrosion protection to the metal reinforcement and adds to the rigidity of the step. In addition it provides a nominally flat surface on which to stand in reasonable comfort and gives a comfortable hand hold.

Steps should only be installed in chambers that are in good condition and show no structural degradation.

Compliance with this specification does not itself confer immunity from legal obligations.

The specification does not purport to include all the necessary provisions of a contract. Users of this specification are responsible for its correct application.

Where reference is made to a British Standard, WIS or other specification, this shall be understood to refer equally to any other equivalent specification.

Purchasers are reminded that this specification requires that the manufacturer shall operate a quality system relating to the manufacture of steps to this specification in compliance with BS5750: Part 2 (EN29002), which ensures that products claiming to comply with this specification consistently meet the required level of quality. Enquiries regarding the availability of NACCB or equivalent accredited third party certification should be addressed to an appropriate third party certification body or to WRC Swindon.

This specification calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

It has been assumed in the drafting of this specification that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Information contained in this specification is given in good faith but neither the Foundation for Water Research nor the Water Research Centre can accept any responsibility for actions taken as a result.

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1. SCOPE

This document specifies the requirements for polypropylene encapsulated steps for use in man entry chambers. The requirements include quality assurance, dimensions, materials, appearance, type and quality control tests and marking.

2. QUALITY ASSURANCE

Manufacturers shall operate a quality system relating to this specification in compliance with BS5750: Part 2 (EN29002).

3. MATERIALS

3.1 Plastics

The plastics used in the manufacture of step rungs shall be polypropylene complying with the requirements of BS5139 Type AC-M-A, i.e. thermally stabilised propylene copolymer for moulding.

NOTE If the steps are to be installed, or stored, where they will be subjected to prolonged exposure to direct sunlight it may be necessary to protect them from the degradation effects of ultraviolet light. This may be achieved by the use of suitable pigments and/or stabilisers. Advice should be sought from the step manufacturer.

3.2 Metal reinforcement

The metal reinforcement shall meet the relevant requirements given in Table 1.

3.3 Effect of non-metallic products on water quality

When used under the conditions for which they are designated, non-metallic products in contact with or likely to come into contact with potable water shall comply with the requirements of BS6920: Part 1: 1988.

NOTE 1 Non-metallic products for installation and use in the United Kingdom which are verified and listed under the UK Water Fittings Byelaws Scheme are deemed to satisfy the requirements of this clause. Details of the Scheme are obtainable from the Water Research Centre Byelaws Advisory Service, 660 Ajax Avenue, Slough SL1 4BG.

Non-metallic products approved by the Department of the Environment Committee on Chemicals and Materials of Construction for use in Public Water Supply and Swimming Pools are considered free from adverse health effects for the purposes of compliance with this clause.

NOTE 2 A list of approved chemicals and materials and details of the approvals scheme is available from the Secretary of the Committee at the Department of the Environment, Water Division, Romney House, 43 Marsham Street, London SW1P 3PY.

4. DESIGN

4.1 General

The dimensions of the steps shall comply with those shown in either Figures 1 or 2.

All surfaces of the reinforcement shall be encapsulated with at least 3mm of polypropylene at any point except for those reinforced with stainless steel having tails that are specifically designed to be uncoated. The steps shall be free of any sharp projections or edges likely to cause injury.

Table 1 – Acceptable materials for metal reinforcement

| Material | Solid | | Tubular | |
|-----------------|-------------|--------|--------------|--------|
| | BS | grade | BS | grade |
| Mild steel | 4360 | 43A | 1387 | — |
| | — | — | 6323: Part 2 | HFW2 |
| Stainless steel | 970: Part 1 | 316S31 | 6323: Part 8 | LW17KM |
| Aluminium | 1474 | 6082 | 1474 | 6082 |
| | — | — | 1471 | 6082 |

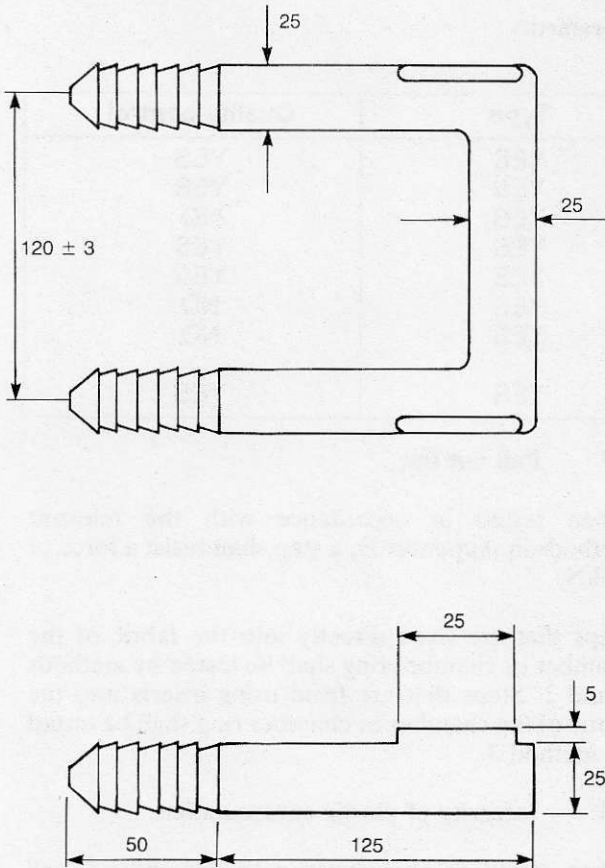


Figure 1 – Minimum dimensions of single step

4.2 Treads

The tread area of each step shall be nominally flat with a raised pattern of at least 2mm height to enhance the slip-resistance of the surface.

The upstands at the ends of the tread to act as boot stops shall be at least 5mm high and 25mm long for single steps and at least 20mm high and 25mm long for double steps as shown in Figures 1 and 2.

4.3 Inserts

Where inserts are provided, they shall be manufactured from the same material as the plastic encapsulation of the step and shall comply with the relevant requirements of this specification.

5. WORKMANSHIP

The steps shall be free from visible defects, except that minor imperfections due to the injection ports on the mould shall be acceptable provided that the minimum thickness and integrity of the cover are maintained. The injection ports shall not be on the top surface of the step.

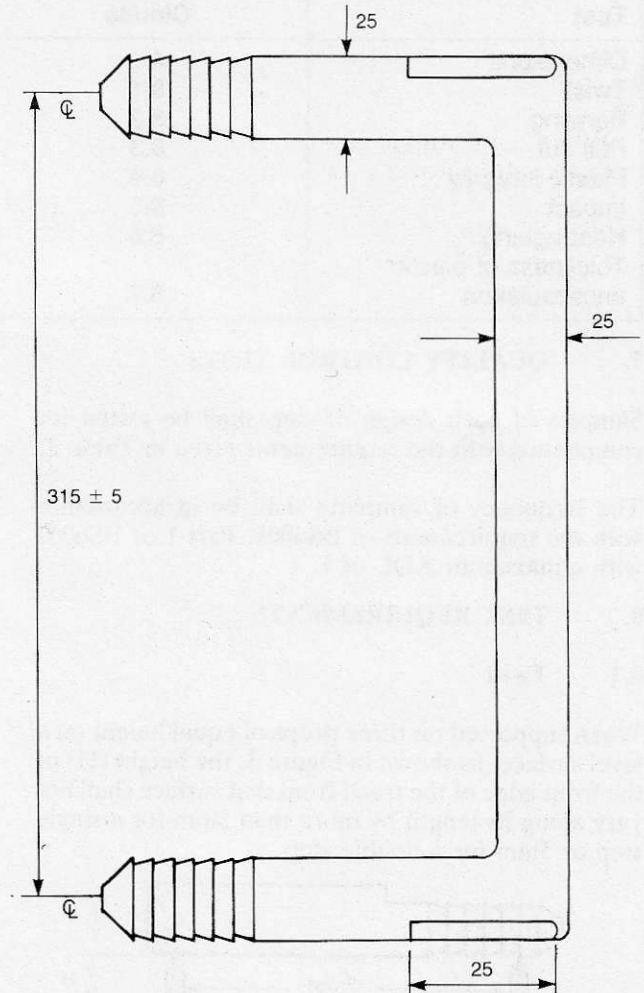


Figure 2 – Minimum dimensions of double step

6. TYPE TESTS

The steps shall meet the test requirements specified in Table 2.

These tests shall be carried out initially and repeated annually or when any significant changes are made to the design, the manufacturing method or to the materials.

Table 2 – Type requirements

| Test | Clause | Type | Quality control |
|------------------------------------|--------|------|-----------------|
| Dimensions | 4 | YES | YES |
| Twist | 8.1 | YES | YES |
| Bending | 8.2 | YES | NO |
| Pull out | 8.3 | YES | YES |
| Plastic integrity | 8.4 | YES | YES |
| Impact | 8.5 | YES | NO |
| Heat ageing | 8.6 | YES | NO |
| Thickness of plastic encapsulation | 8.7 | YES | YES |

7. QUALITY CONTROL TESTS

Samples of each design of step shall be tested for compliance with the requirements given in Table 2.

The frequency of sampling shall be in accordance with the requirements of BS6001: Part 1 or BS6002 with a maximum AQL of 1.

8. TEST REQUIREMENTS

8.1 Twist

When supported on three props of equal height on a level surface, as shown in Figure 3, the height (H) of the front edge of the tread from that surface shall not vary along its length by more than 3mm for a single step or 5mm for a double step.

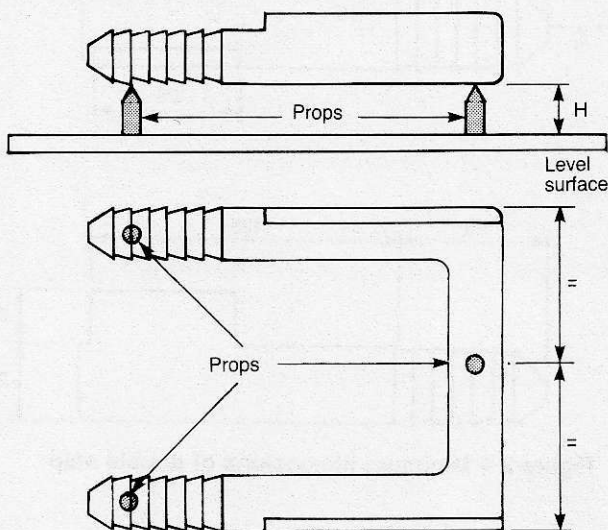


Figure 3 – Test for twist

8.2 Bending

When tested in accordance with Appendix A a step shall support a load of 2.5kN with no visible damage to the plastic cover. The average deflection determined in accordance with Appendix A shall not exceed 5mm and after removal of the load, the residual deflection shall not exceed 1mm. The graphical plots of load against deflection shall exhibit essentially a straight line relationship, i.e. the loading is within the elastic range of the metal reinforcement.

8.3 Pull out test

When tested in accordance with the relevant methods in Appendix B, a step shall resist a force of 7.5kN.

Steps that are fixed directly into the fabric of the chamber or chamber ring shall be tested by methods 1 and 2. Steps that are fixed using inserts into the fabric of the chamber or chamber ring shall be tested by method 3.

8.4 Integrity of plastic encapsulation

When tested in accordance with Appendix C, all plastic encapsulated parts of a step shall have an electrical resistance greater than 2M ohm.

8.5 Impact test

When tested in accordance with Appendix D a step shall absorb an impact of 20kg from a height of 1 metre without visible sign of fracture.

8.6 Heat ageing

All steps shall show no visual cracking, particularly of weld lines or at injection points when tested in accordance with Appendix E.

8.7 Thickness of plastic encapsulation

There shall be a minimum thickness of plastic encapsulation of 3mm over the reinforcement when tested in accordance with Appendix F.

9. MARKING

Each step shall be clearly and permanently marked with the following identification in a manner which is visible after installation:

- the number of this specification, i.e. WIS No. 4-33-01. (The use of this mark is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of this specification and the claim is his sole responsibility).
- the manufacturer's identification;
- the batch identification code;
- the reinforcement code as per Table 3.

Table 3 – Reinforcement material code

| Material | Solid | Tubular |
|-----------------|-------|---------|
| Mild steel | MSS | MST |
| Stainless steel | SSS | SST |
| Aluminium | ALS | ALT |

10. REFERENCES

This specification makes reference to the latest edition (except where otherwise stated) of the following publications, including all addenda and revisions which should also be consulted.

- BS12 Specification for Portland cements.
- BS887 Specification for precision vernier calipers.
- BS970 Specification for wrought steels for mechanical and allied engineering purposes. Part 1 General inspection and test procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.
- BS1387 Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS21 pipe threads.
- BS1471 Specification for wrought aluminium and aluminium alloys for general engineering purposes – drawn tube.
- BS1474 Specification for wrought aluminium and aluminium alloys for general engineering purposes – bars, extruded round tubes and sections.
- BS1610 Materials testing machines and force verification equipment. Part 1 Specification for the grading of the forces applied by materials testing machines.
- BS4360 Specification for weldable structural steels.
- BS4550 Methods of testing cement. Part 5 Standard sand for concrete cubes.
- BS5139 Classification for polypropylene plastics Materials for moulding and extrusion.
- BS5750 Quality systems (EN 29002) Part 2 Specification for production and installation.
- BS6001 Sampling procedures for inspection by attributes. Part 1 Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.

- BS6002 Specification for sampling procedures and charts for inspection by variables for percent defective.
- BS6323 Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 2 Specific requirements for hot finished welded steel tubes. Part 8 Specific requirements for longitudinally welded stainless steel tubes.
- BS6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Part 1 Specification.

APPENDIX A – BENDING TESTS

A.1 APPARATUS

A.1.1 A mild steel block 70mm in diameter, faced with rubber of at least 60 IRHD hardness.

A.1.2 A device that complies with the accuracy requirement for grade 2.0 testing machines given in BS1610: Part 1: 1985, capable of applying a load of at least 3.2kN.

A.1.3 A clamping device for securely holding the tails of a step. Alternatively, the step may be fitted in accordance with the step manufacturers instructions in a suitably restrained mortar block.

A.1.4 A device suitable for measuring deflection with an accuracy of $\pm 0.05\text{mm}$ and a maximum travel of 10mm.

A.2 PROCEDURE

A.2.1 The tails of the test sample shall be clamped firmly so as to leave the design projection acting as a cantilever.

The load shall be applied centrally and normal to the tread as shown in Figure 4 at the rate of 2.5kN per minute in approximately 0.5kN increments.

All readings of the deflection shall be recorded with an accuracy of $\pm 0.1\text{mm}$ at the centre of the tread.

A.2.2 Apply the initial load of 2.5kN and hold for 1 minute. Remove the load and record the reading on the deflection gauge to establish the datum point after 1 minute.

A.2.3 Apply the bending load and record the deflection from the datum point at each 0.5kN increment up to 2.5kN. Maintain the load for 1 minute.

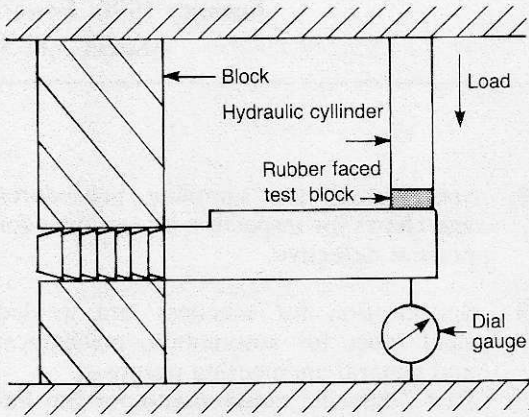


Figure 4 – Test for bending

A.2.4 Remove load, after 1 minute repeat A.2.3.

A.2.5 Remove the load and record the residual deflection after 1 minute.

A.2.6 Plot a graph of the two load cycles and record the average deflection at 2.5kN.

A.3 TEST REPORT

The report shall include the following information:

- (a) Identification of the test sample (manufacturer, batch, reinforcement and size).
- (b) Method of holding the tails (clamped or cast in mortar block).
- (c) Initial deflection to give the datum point and the deflection at each 0.5kN increment of load and at the final load for two test cycles.
- (d) The residual deflection and the average deflection at 2.5kN load.
- (e) The graph of the two load cycles.
- (f) The date of the test.

APPENDIX B – PULL OUT TEST

METHOD 1

B.1 APPARATUS

B.1.1 A device that complies with the accuracy requirement for grade 2.0 testing machines given in BS1610: Part 1: 1985, capable of applying a force of at least 20kN.

B.1.2 Mould to produce mortar test blocks with minimum dimensions of either 100mm × 100mm × 250mm long for single step of 100mm × 100mm × 500mm long for double step.

B.2 PROCEDURE

B.2.1 Cast step into a mortar block and allow to cure for at least 10 days before testing. The mortar mix shall be a 3:1 ratio by weight of the Leighton Buzzard sand fraction A complying with BS4550: Part 5 to OPC standard blend cement complying with BS12. Free water:cement ratio 0.40.

NOTE Tails longer than 100mm are permitted to protrude from the bottom of the mortar block or may be cut off.

B.2.2 Apply the force between the centre of the front tread of the step and mortar block. This force shall be applied in an elapsed time of between 30 and 60 seconds, without shock, up to 7.5kN and sustained for 1 minute.

NOTE If failure occurs by a fracture of the block or by a shear cone this does not constitute failure of the step and a re-test is necessary.

METHOD 2

B.3 APPARATUS

B.3.1 As specified in clause B.1 plus drill and masonry drill bit of the size recommended by the manufacturer.

B.4 PROCEDURE

B.4.1 Cast mortar block and allow to cure for at least 10 days before testing. Drill two fixing holes in the test block at centres and depth recommended by the manufacturer.

Coat the tails with a suitable epoxy resin. Fit tails into the drilled holes and allow the resin to cure for at least 1 day before testing.

NOTE See CIRIA Report 69 Effective use of epoxy and polyester resins in civil engineering structures, published by Construction Industry Research and Information Association.

Test as specified in clause B.2.

METHOD 3

B.5 APPARATUS

B.5.1 As specified in clause B.1.

B.6 PROCEDURE

B.6.1 Cast the plastic inserts into a mortar block and allow to cure for at least 10 days before testing. Push the tails of the step into the inserts. Test as specified in clause B.2.2.

B.7 TEST REPORT

The report shall include the following information:

- Identification of the test sample (manufacturer, batch, reinforcement and size).
- The method of fixing tails in the mortar block (cast, epoxy resin, inserts).
- The load at failure.
- The date of the test.

APPENDIX C – INTEGRITY OF PLASTIC ENCAPSULATION TEST**C.1 APPARATUS**

C.1.1 An insulation resistance meter or equivalent instrument capable of measuring insulation resistance with a range of 0 – 200Mohm having a nominal open circuit voltage of 500 volts d.c.

C.1.2 A drill plus bit capable of drilling a hole of at least 3mm diameter through the polypropylene to expose the metal reinforcement.

C.1.3 A vessel of sufficient size to enable half of the step to be immersed in salt/detergent solution.

C.2 PROCEDURE

C.2.1 Drill the polypropylene encapsulation to expose the metal reinforcement on a convenient face at the mid-point of the cross-member of the step.

C.2.2 Immerse half of the step in the test solution to within 10mm of the exposed metal for a minimum of 30 min. A typical arrangement is shown in Figure 5.

C.2.3 Connect one electrode from the insulation resistance meter to the exposed metal and immerse the other electrode from the meter in the test solution. Record the reading on the meter.

C.2.4 Remove the step from the solution and wipe off any solution from the surface of the step. Immerse the other half of the step to within 10mm of the exposed metal for a minimum of 30 min and repeat C.2.3.

NOTE For steps with uncoated tails, do not drill the plastic encapsulation but connect the electrode from the meter to one of the exposed metal tails. Immerse the step to within 10mm of the exposed metal tails and proceed as for C.2.3. Do not immerse the metal tails in the salt solution.

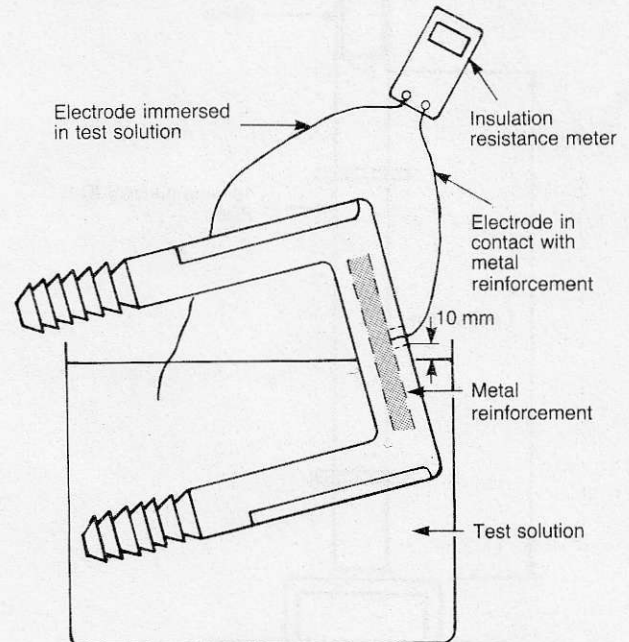


Figure 5 – Typical arrangement for testing the integrity of the plastic encapsulation

C.3 TEST REPORT

The report shall include the following information:

- Identification of the test sample (manufacturer, batch, reinforcement and size).
- The two meter readings for each step.
- The date of the test.

APPENDIX D – IMPACT TEST**D.1 APPARATUS**

D.1.1 An impact rig as shown in Figure 6 or equivalent.

D.2 PROCEDURE

D.2.1 Fit step in a mortar block as described in the relevant method in Appendix B.

D.2.2 Locate block so that step faces vertically upwards.

D.2.3 Drop a striker of mass 20 ± 0.1 kg from a height of 1 metre on the centre of the step.

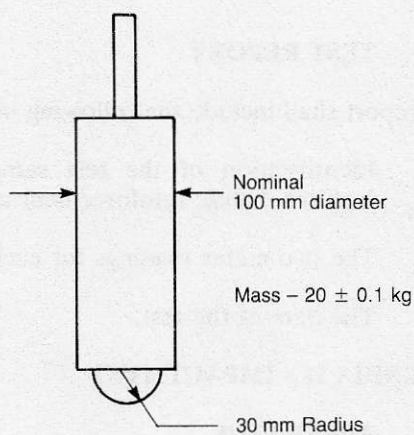
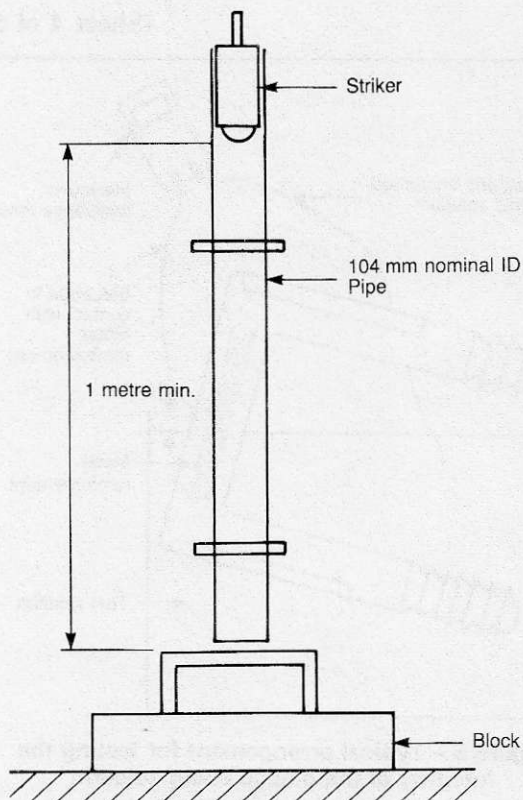


Figure 6 – Suitable impact rig and striker

D.3 TEST REPORT

The report shall include the following information:

- Identification of the test sample (manufacturer, batch, reinforcement and size).
- The visual assessment of condition of sample after testing.
- The date of the test.

APPENDIX E – HEAT AGEING TEST

E.1 APPARATUS

E.1.1 Hot air oven, or alternatively a bath containing polyethylene glycol, glycerol or a mineral oil free from aromatic hydrocarbons that is capable of automatically maintaining an average temperature of $155 \pm 2^\circ\text{C}$.

E.1.2 System for supporting test step in the oven or oil bath that does not cause local hot spots.

E.2 PROCEDURE

E.2.1 Suspend the test step in the hot air oven or oil bath previously raised to $155 \pm 2^\circ\text{C}$ so that it is not in contact with any part of the oven or bath.

E.2.2 Allow the temperature of the oven or bath to stabilise at $155 \pm 2^\circ\text{C}$.

E.2.3 Leave the test step in the oven or bath at $155 \pm 2^\circ\text{C}$ for at least 3 hours.

E.2.4 Remove the step from the oven or bath taking care not to damage the hot sample.

E.2.5 Allow the test step to cool naturally in air and visually examine for defects.

E.3 TEST REPORT

The report shall include the following information:

- Identification of the test sample (manufacturer, batch, reinforcement and size).
- The visual assessment of condition of sample after testing.
- The date of the test.

APPENDIX F – DETERMINATION OF THE THICKNESS OF THE PLASTIC ENCAPSULATION

F.1 APPARATUS

F.1.1 Vernier calipers complying with BS887.

F.1.2 Suitable saw for cutting step.

F.2 PROCEDURE

F.2.1 Cut the step perpendicularly at the five points shown in Figure 7.

F.2.2 Measure the thickness of the plastic using the vernier calipers to an accuracy of $\pm 0.1\text{mm}$ at each point.

F.2.3 Record the minimum thickness at each point to an accuracy of $\pm 0.1\text{mm}$.

F.3 TEST REPORT

The report shall include the following information:

- (a) Identification of the test sample (manufacturer, batch, reinforcement and size).
- (b) The minimum thickness of the plastic at each point.
- (c) The date of the test.

APPENDIX G – INFORMATION TO BE GIVEN BY THE PURCHASER IN HIS ENQUIRY AND ORDER

The following information should be given by the purchaser in his enquiry and order:

- (a) Type of step.
- (b) Length and type of tail where applicable.
- (c) Reinforcement material.
- (d) Whether UV resistance is required.
- (e) Whether to be in contact with potable water.

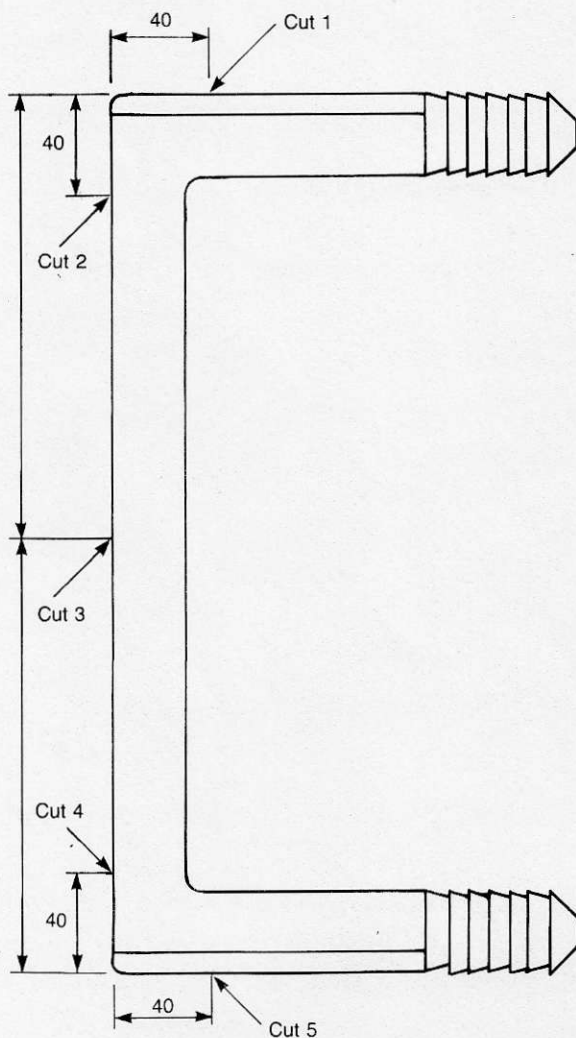


Figure 7 – Cutting positions on step to determine thickness of plastic encapsulation